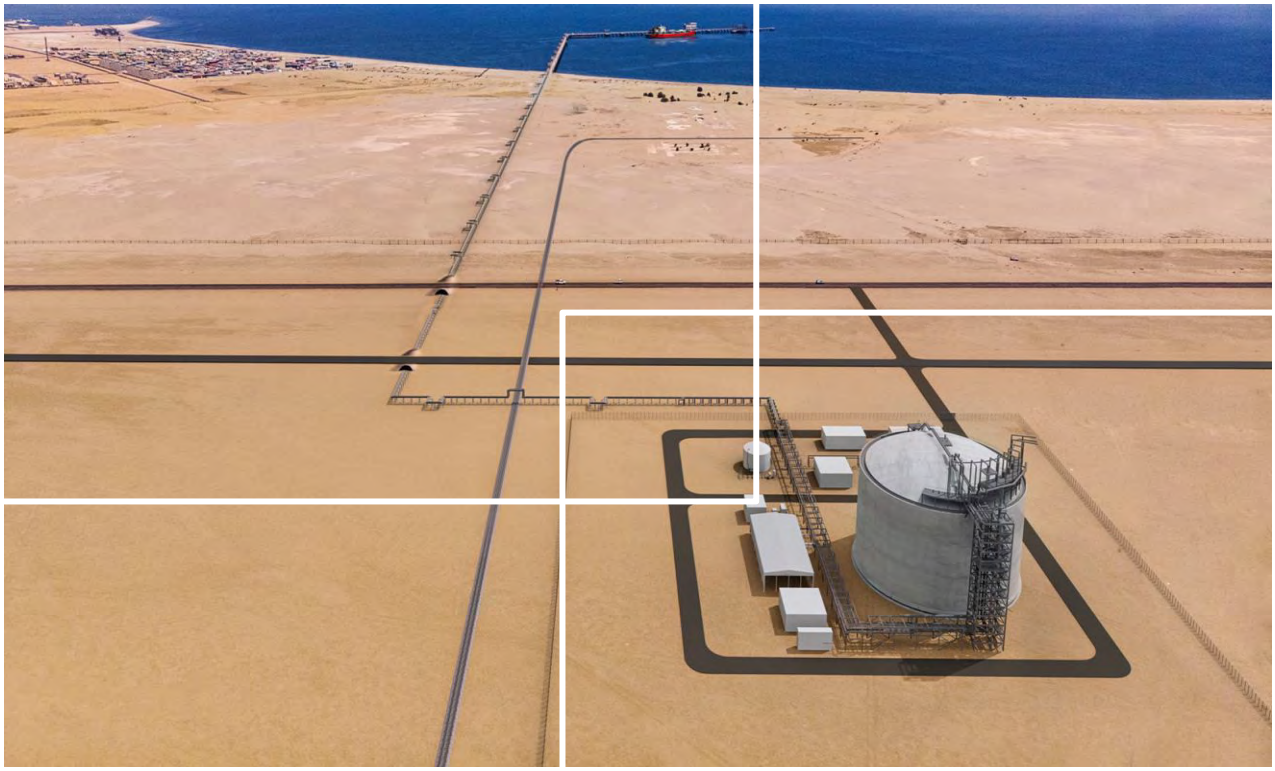


Submitted to: CMB.TECH Namibia (Pty) Ltd
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REPORT:

DRAFT ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT OF THE CONSTRUCTION OF AN AMMONIA TERMINAL AT THE WALVIS BAY PORT AREA, ERONGO REGION, NAMIBIA

PROJECT NUMBER: ECC-145-453-REP-33-D

REPORT VERSION: REV 01

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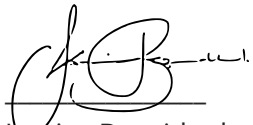
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EXECUTIVE SUMMARY

Environmental Compliance Consultancy (Pty) Ltd (ECC) has been appointed as the environmental assessment practitioner (EAP) to conduct an environmental and social impact assessment (ESIA) by CMB.TECH Namibia (Pty) Ltd (hereinafter referred to as the Proponent or CMB.TECH). CMB.TECH, in partnership with Ohlthaver & List (O&L) Group, forms the joint venture Cleanergy Solutions Namibia (Pty) Ltd. Cleanergy Solutions Namibia is currently constructing a hydrogen production and refuelling plant in Walvis Bay. CMB.TECH, a Belgium company specialising in the design, construction and operations of large marine and industrial modes of transportation that utilise hydrogen and ammonia.

As part of the bigger intended hydrogen and ammonia infrastructure development and operation, the proposed project involves the construction of the Ammonia Terminal at the Walvis Bay port area, in the Erongo Region, Namibia. The proposed site can be accessed via the B2 road between Swakopmund and Walvis Bay and is aligned to the overall port development masterplan.

In terms of the Namibian Environmental Management Act, 2007 and its regulations, the Ministry of Mines and Energy (MME) is the competent authority for the proposed Project. The proposed project trigger listed activities in terms of the Act, and as such, requires an environmental clearance certificate.

SCREENING PHASE

The first step in the ESIA process is to register the Project with the Department of Environmental Affairs (DEA)/Ministry of Environment, Forestry and Tourism (MEFT) (completed) followed by a screening exercise to determine which listed activities under the Environmental Management Act, No. 7 of 2007 and associated regulations are triggered, and if significant impacts may arise from the Project. The location, scale, and duration of Project activities will be considered against the receiving environment.

The screening phase determined that the most likely potential environmental and social impacts could include:

- Noise impacts
- Air quality, including dust emissions
- Visual impacts affecting the sense of place
- Traffic impacts off-site
- Economic and socio-economic impacts, e.g., employment opportunities, contribute to green fuel economy and reduction of greenhouse gas emissions

SCOPING PHASE

The objective of the scoping phase was to obtain a thorough understanding of the biophysical and socioeconomic environment in which the Project is located, often using baseline and specialist studies. It also provided an opportunity for the public to have input into the scope of the assessment. The technical inputs combined with the inputs from the I&APs led to the development of the Terms of Reference (ToR) for the assessment phase. A desktop and literature research and specialists' input were considered during the preparation of the scoping report.

TERMS OF REFERENCE

The ToR within the scoping report was proposed for the assessment phase and covered the following:

Socio-economic assessment

A socio-economic study was conducted in-house to assess the impact of the project on the current socio-economic state of the locals and impacts on a regional and national scale.

Visual assessment

The assessment was conducted in-house and include a study of the visual impact and its effects on the local tourist businesses and residential areas. The assessment also considers the landscape impacts.

Health and Safety assessment

The objective was to assess potential health and safety impacts associated with the construction and operation of the Ammonia Terminal project. The assessment identified hazards, evaluated risks. The study was conducted by Antea Group, an independent Netherlands company.

Climate change assessment

A climate change assessment was commissioned to assess the emission baseline of the biophysical environment and formulate recommendations for the management or mitigation of any potential impacts that the Project may contribute to climate change.

Air quality

The assessment which included a study of the legal requirements pertaining to air quality applicable to international legal guidelines, limits and dust control regulations.

Noise quality

The objective was to assess the potential noise impacts of the proposed project on surrounding sensitive receptors, including residents, businesses, and the tourism sector.

Traffic assessment

A traffic assessment was commissioned to assess the implications relevant to the project regarding additional vehicles on the current B2 road.

Biodiversity assessment

The objective of the biodiversity assessment was to assess the bio-physical (vertebrate fauna & flora) issues relevant to the project and assess the significance of development and environmental impact that the project may have on the vertebrate fauna and flora at the proposed site including general comment. A visit to the proposed project area (applicable portions only) was conducted to assess the development site. Sensitive areas and species were identified within the Walvis Bay port area.

Heritage assessment

A heritage assessment was conducted to comply with the Namibian national legislature, including the National Heritage Act, 2004 (Act No 27 of 2004) and the National Heritage Regulations (if applicable), Government Notice (GN) 3490 of 2005.

Additionally, the scoping report defines the impact methodology for the impact assessment phase of the ESIA, this is included in chapter 6 of this report. The evaluation and identification of the environmental and social impacts require the assessment of the Project characteristics against the baseline characteristics, ensuring that all potentially significant impacts are identified and assessed.

The draft scoping report and draft environmental management plan (EMP) was provided to the public for review for more than three months (10 June 2024 to 16 September 2024), which included further public engagements between 8 July and 10 July 2024 in Walvis Bay, Swakopmund, and Arandis. The submission of the final scoping report to the competent authority, including MME and MEFT was on 17 September 2024. All I&AP comments were captured and responded to by providing an explanation or further information in the response table, which was attached as an addendum report to the final scoping report which was submitted to the competent authority on 17 September 2024.

The next stage of the ESIA process was to conduct the impact assessment. This is the draft impact assessment report and has been made available for public review for a period of 14 days in terms of Section 32(1) of the Environmental Management Act (EMA) No.7 of 2007. The final ESIA report and appendices will be prepared and submitted formally to the MME and the MEFT as part of the application for an environmental clearance certificate for the Project. The phases of the ESIA are provided in Figure 1.

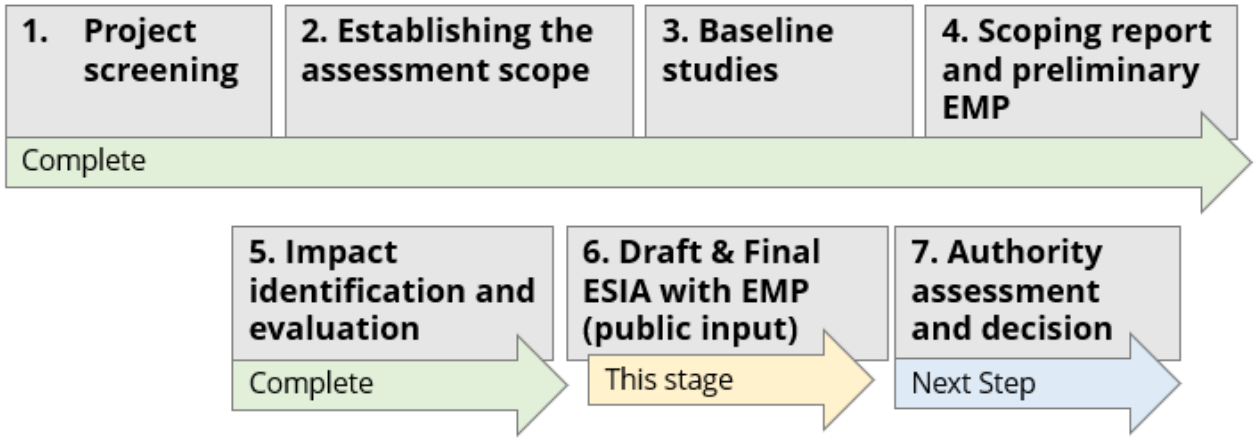


Figure 1 – Simplified phases of the Ammonia Terminal Project ESIA process

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ABBREVIATIONS AND TERMS

Abbreviation and terms	Description
%	percentage
~	approximately
µg	microgram
˚C	degrees celsius
AA	Aqueous Ammonia
ADT	average daily traffic
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
AIDS	Acquired immune deficiency syndrome
AQO	air quality objectives
AQSR	Air quality sensitive receptors
Bevi	Besluit externe veiligheid inrichtingen (Public Safety (Establishments) Decree)
BID	background information document
BOG	boiled off gas
Brzo	Besluit risico's zware ongevallen (Dutch Major Accidents (Risks) Decree)
BWh	represents a hot desert climate
$CaSO_4.H2O$	gypsum
CH_3	methyl group
CIA	cumulative impact assessment
Cleanergy Solutions	Cleanergy Solutions Namibia (Pty) Ltd
CO	Carbon monoxide
CO_2	Carbon dioxide
COVID-19	coronavirus disease 2019
dBA	decibels A
DEA	Directorate of Environmental Affairs
EAP	environmental assessment practitioner
ECC	Environmental Compliance Consultancy (Pty) Ltd
EEZ	Exclusive Economic Zone
EIA	Environmental impact assessment
EMA	Environmental Management Act No.7 of 2007
EMP	environmental management plan
ENE	east-northeast
ESD	emergency shut down
ESIA	environmental and social impact assessment
ESMP	environmental and social management plan
GDP	gross domestic product
GHG	Greenhouse gases
GIS	Geographic Information System
GN	government notice

Abbreviation and terms	Description
H_2	hydrogen
HAZOP	Hazard and Operability Study
HC	hydrocarbon
HIV	human immunodeficiency virus
I&APs	interested and affected parties
IA	instrument air
IBA	Important Bird Area
IFC	International Finance Corporation
IUCN	International Union for Conservation of Nature
kg/h	Kilogram per hour
km	kilometre
km^2	squared kilometre
km/h	kilometre per hour
kWh/a	kilowatt-hours per annum
$kWh/m^2/day$	kilowatt-hours per square metre per day
L_{Aeq}	Equivalent Continuous Sound Pressure Level
Ltd	limited
m	metre
m^3	cubic metre
m^3/day	cubic metre per day
MAT	mean annual temperature
MAWLR	Ministry of Agriculture, Water and Land Reform
MEFT	Ministry of Environment, Forestry and Tourism
MFMR	Ministry of Fisheries and Marine Resources
$mg/m^2/day$	Milligram per square metre per day
mm	millimetre
MME	Ministry of Mines and Energy
MoHSS	Ministry of Health and Social Services
MURD	Ministry of Urban and Rural Development
mt	metric tonnes
N/A	not applicable
N_2	nitrogen
NAAQS	National Ambient Air Quality Standards
NaCl	halite
Namport	Namibian Ports Authority
NCCSAP	National Policy Climate Change Strategy and Action Plan
NDC	Nationally Determined Contributions
NDP5	fifth National Development Plan
NGU	Nitrogen Generation Unit
NH_3	ammonia
NHC	National Heritage Council
No.	number

Abbreviation and terms	Description
No_x	oxides of nitrogen
No_2	nitrogen dioxide
NSR	noise sensitive receptor
O&L	Ohlthaver & List Group
OHS	occupational health and safety
Pb	lead
PHC	primary healthcare
PM	particulate matter
ppm	parts per million
psi	pounds per square inch
Pty	proprietary
QGIS	Quantum Geographic Information System
QRA	quantitative risk assessment
Reg	registration
RH	relative humidity
SA	South Africa
SADC	Southern African Development Community
SEMP	strategic environmental management plan
SANS	South African National Standard
So_2	sulphur dioxide
SoW	scope of work
SW	southwest
T	tonnes
TB	tuberculosis
tph	total petroleum hydrocarbons
tCO2e	tonnes of carbon dioxide equivalent
ToR	terms of reference
UN	United Nations
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Conventions to Combat Desertification
UNCLOS	Unites Nations Law of the Sea Convention
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization
WWF	World Wildlife Fund for Nature

1 INTRODUCTION

1.1 COMPANY BACKGROUND

Environmental Compliance Consultancy (Pty) Ltd (ECC) has been appointed as the environmental assessment practitioner (EAP) to conduct an environmental and social impact assessment (ESIA) by CMB.TECH Namibia (Pty) Ltd (hereinafter referred to as the Proponent or CMB.TECH).

CMB.TECH, in partnership with Ohlthaver & List (O&L) Group, forms the joint venture Cleanergy Solutions Namibia (Pty) Ltd. Cleanergy Solutions Namibia is currently constructing a hydrogen production and refuelling plant in Walvis Bay. CMB.TECH, a Belgium company specialising in the design, construction and operations of large marine and industrial modes of transportation that utilise hydrogen and ammonia. It forms an integral part of Compagnie Maritime Belge which is a family-owned shipping group, founded in 1895.

CMB.TECH in intent on becoming a driving force in the growth of the Namibia's hydrogen economy, while contributing to the global shift for industrial decarbonisation. The organisation is in the process of finalising the construction of the first hydrogen production plant in Namibia together with its joint venture partner O&L, with first production intended for the beginning of 2025.

As part of the bigger intended hydrogen and ammonia infrastructure development and operation, which CMB.TECH is actively pursuing, the Proposed construction of the Ammonia Terminal will occur at the Walvis Bay port area, in the Erongo Region, Namibia as shown in Figure 2. The proposed site can be accessed via the B2 road between Swakopmund and Walvis Bay and is aligned to the overall port development masterplan.

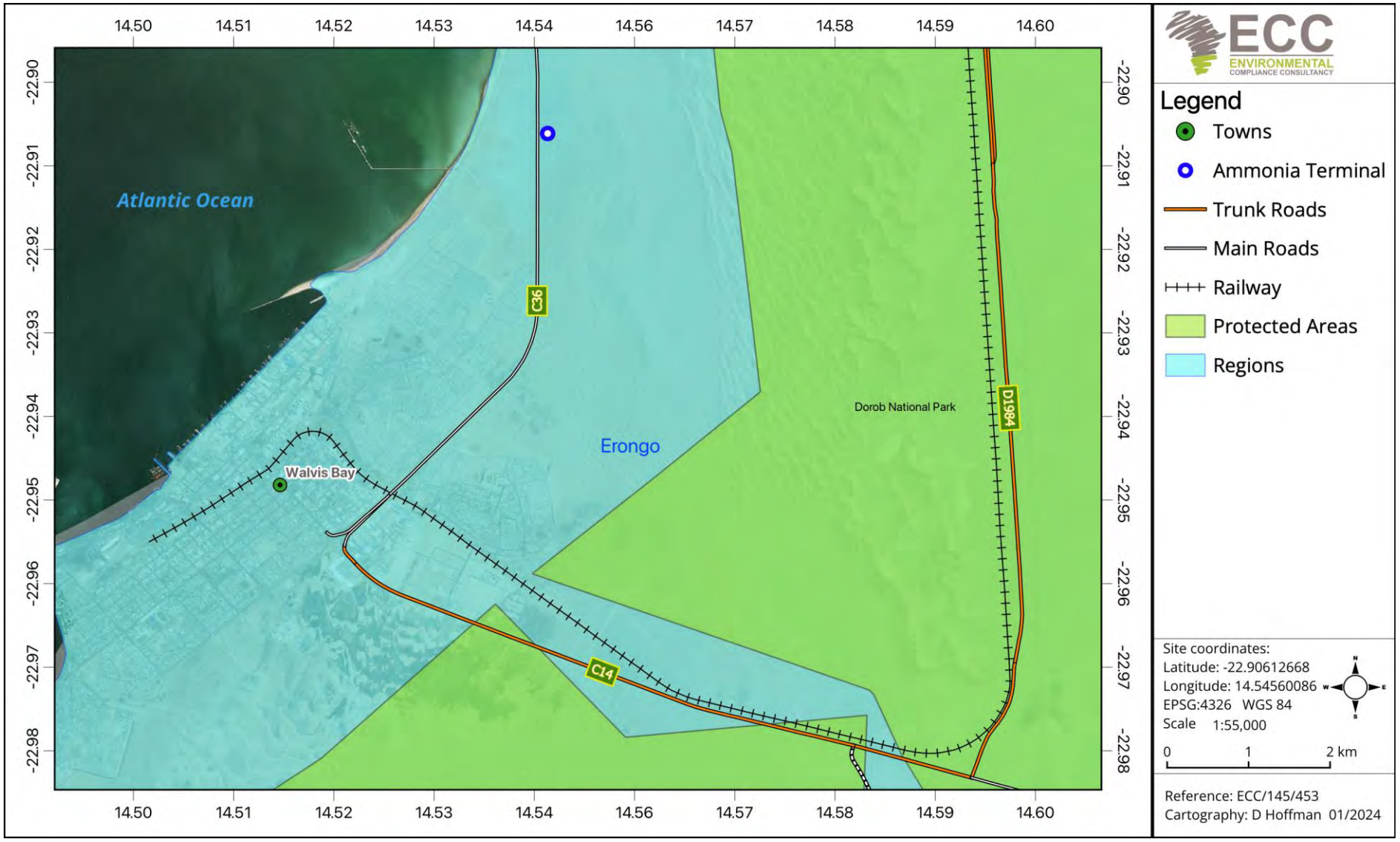


Figure 2 – Locality map of the project

1.2 PURPOSE OF THE SCOPING REPORT

An environmental and social impact assessment (ESIA) has commenced in compliance with the requirements of the Environmental Management Act, No. 7 of 2007, and its regulations. This report presents the findings of the scoping study phase that forms part of the larger ESIA process.

The scoping report summarises the prescribed ESIA process to be followed, provides information on the baseline biophysical and socio-economic environments, project description and details, outlines the terms of reference for the assessment phase, and presents an environmental and social management plan (ESMP), which is provided as Appendix A.

The scoping report and appendices has been submitted to the public for review and input. The revised scoping report with public is submitted to the Ministry of Mines and Energy (MME) as the competent authority for the Project and Namport and the Ministry of Environment, Forestry and Tourism (MEFT) - Directorate of Environmental Affairs (DEA) for a record of decision.

1.3 THE PROPONENT OF THE PROPOSED PROJECT

CMB.TECH Namibia (Pty) Ltd is the Proponent for the proposed Project. CMB.TRCH/Cleanergy Solutions Namibia have an option agreement from Namport which enables them to lease a portion of land in the North Port.

The Proponents' details are provided in Table 1.

Table 1 – Proponent's details

Company representative	Contact details
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1.4 ENVIRONMENTAL AND SOCIAL ASSESSMENT PRACTITIONER

Environmental Compliance Consultancy (Pty) Ltd (ECC) (Reg. No. 2022/0593) has prepared this final scoping report and the ESMP on behalf of the Proponent and in line with the relevant national regulations and international best practice.

This report has been authored by employees of ECC, who have no material interest in the outcome of this report, nor do any of the ECC team have any interest that could be reasonably regarded as being capable of affecting their independence in the preparation of this report. ECC is independent from the Proponent and has no vested or financial interest in the project, except for fair remuneration for professional fees rendered based upon agreed commercial rates. Payment of these fees is in no way contingent on the results of this report, the assessment, or a record of decision issued by the Government. No member or employee of ECC is, or is intending to be, a director, officer, or any other direct employee of CMB.TECH Namibia (Pty) Ltd. No member or employee of ECC has, or has had, any shareholding in CMB.TECH Namibia (Pty) Ltd.

All compliance and regulatory requirements regarding this report should be forwarded by email or posted to the address as set out in Table 2.

Table 2 - EAP details

EAP	Contact details
Environmental Compliance Consultancy (Pty) Ltd	P O Box 91193, Klein Windhoek, Namibia Tel: +264 81 669 7608 Email: info@eccenvironmental.com

1.5 ENVIRONMENTAL REQUIREMENTS

The Environmental Management Act, 2007, and its regulations, stipulates that an environmental clearance certificate is required before undertaking any of the listed activities that are identified in the Act and its regulations. Potential listed activities triggered by the Project are provided in Table 3.

Table 3 – Activities potentially triggered by the Project
Source: Environmental Management Act, 2007, and its 2012 regulations.

Listed activity	As defined by the regulations of Act	Relevance to the project
Energy generation, transmission, and storage activities	(1.a) The construction of facilities for the generation of electricity; (1.b) The construction of facilities for the transmission and supply of electricity.	– An emergency diesel generator is included to provide enough power to one boiled off gas (BOG) compressor and at least one fire water pump in case of power shortage.
Water Resource Developments	(8.6) Construction of industrial and domestic wastewater treatment plants and related pipeline systems.	– All the effluents generated by the Ammonia Terminal facilities will be handled by the wastewater system/unit. – Wastewater permit will be obtained.
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. (9.2) Any process of 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 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. (9.5) Construction of filling stations or any other facility for the underground and aboveground storage of dangerous goods, including petrol, diesel, liquid, petroleum, gas or paraffin.	– Liquid ammonia will be stored in an ammonia storage tank with a size of 40000 tonne storage capacity.

2 APPROACH TO THE ASSESSMENT

2.1 PURPOSE AND SCOPE OF THE ASSESSMENT

The aim of this assessment is to determine which impacts are likely to be significant; to scope the available data and identify any gaps that need to be filled; to determine the spatial and temporal scope; and to identify the assessment methodology.

The scope of the assessment was determined by undertaking a preliminary assessment of the proposed Project against the receiving environment, obtained through a desktop review and available site-specific literature.

2.2 THE ASSESSMENT PROCESS

The ESIA methodology applied to this assessment is compliant with Namibia's EMA 2007 which is applicable to all projects including marine areas located within Namibia's Territorial Waters and Exclusive Economic Zone (EEZ) (Territorial Sea and Exclusive Economic Zone of Namibia Act 3 of 1990). The EISA methodology has been developed using the International Finance Corporation (IFC) standards and models performance Standard 1: 'Assessment and management of environmental and social risks and impacts' (International Finance Corporation, 2012 and 2017) as a guideline, as well as Namibian Draft Procedures and Guidance for EIA and EMP (Republic of Namibia 2008); international and national best practice guidelines and combined relevant ESIA experience from the core project team.

This assessment is a formal process whereby the potential positive and negative effects that the Project may have on the biophysical, social and economic environments are identified, assessed and reported, so that the significance of potential impacts can be taken into account when considering a record of decision for the proposed Project. Final mitigation measures and recommendations are based on the cumulative experience of the consulting team and the client, taking into consideration the potential environmental and social impacts. The process followed, through the assessment, is illustrated in 3 and is detailed further in the following sections.

2.3 SCREENING OF THE PROJECT

The first step in the ESIA process is to register the Project with the DEA/MEFT (completed) and followed by undertake a screening exercise to determine whether it is considered a listed activity under the Environmental Management Act, No. 7 of 2007 and associated regulations, and if significant impacts may arise from the Project. The location, scale, and duration of Project activities will be considered against the receiving environment. The assessment process is shown in Figure 3.

1. Project screening

Complete

The first stages in the ESIA process are to undertake a screening exercise to determine whether the Project triggers listed activities under the Environmental Management Act, 2007, and its regulations. The screening phase of the Project is a preliminary analysis, in order to determine ways in which the Project might interact with the biophysical, social, and economic environments.

Stakeholder engagement:
- Registration of the project
- Preparation of the BID

2. Establishing the assessment scope

Complete

Where an ESIA is required, the second stage is to scope the assessment. The main aim of this stage is to determine which impacts are likely to be significant; to scope the available data and any gaps that need to be filled; to determine the spatial and temporal scope; and to identify the assessment methodology.

The scope of this assessment was determined through undertaking a preliminary assessment of the proposed Project against the receiving environment. Feedback from consultation with the public and the Proponent informs this process. The following environmental and social topics were scoped into the assessment, as there was the potential for significant impacts to occur. Impacts that are identified as potentially significant during the screening and scoping phase are taken forward for further assessment in the ESIA process. These are:

SOCIOECONOMIC ENVIRONMENT
- Employment
- Community health, safety and security on site and off site
- Positive socioeconomic impact – green energy
- Visual impacts on sense of place

BIOPHYSICAL ENVIRONMENT
- Noise and air quality, including dust emissions
- Road traffic
- Heritage and culture
- Biodiversity
- Climate change
- Flood plains

3. Baseline studies

Complete

A robust baseline is required to provide a reference point against which any future changes associated with a Project can be assessed, and to allow suitable mitigation and monitoring to be identified.

The region and general areas have been studied for various projects and assessments. This literature was available to be referenced. The Project site-specific area has been studied as part of the ESIA process, and the following has been conducted as part of this assessment:
- Field surveys
- Desktop studies
- Consultation with stakeholders
- Specialist field visits, and ongoing studies

The environmental and social baselines are provided in this scoping study.

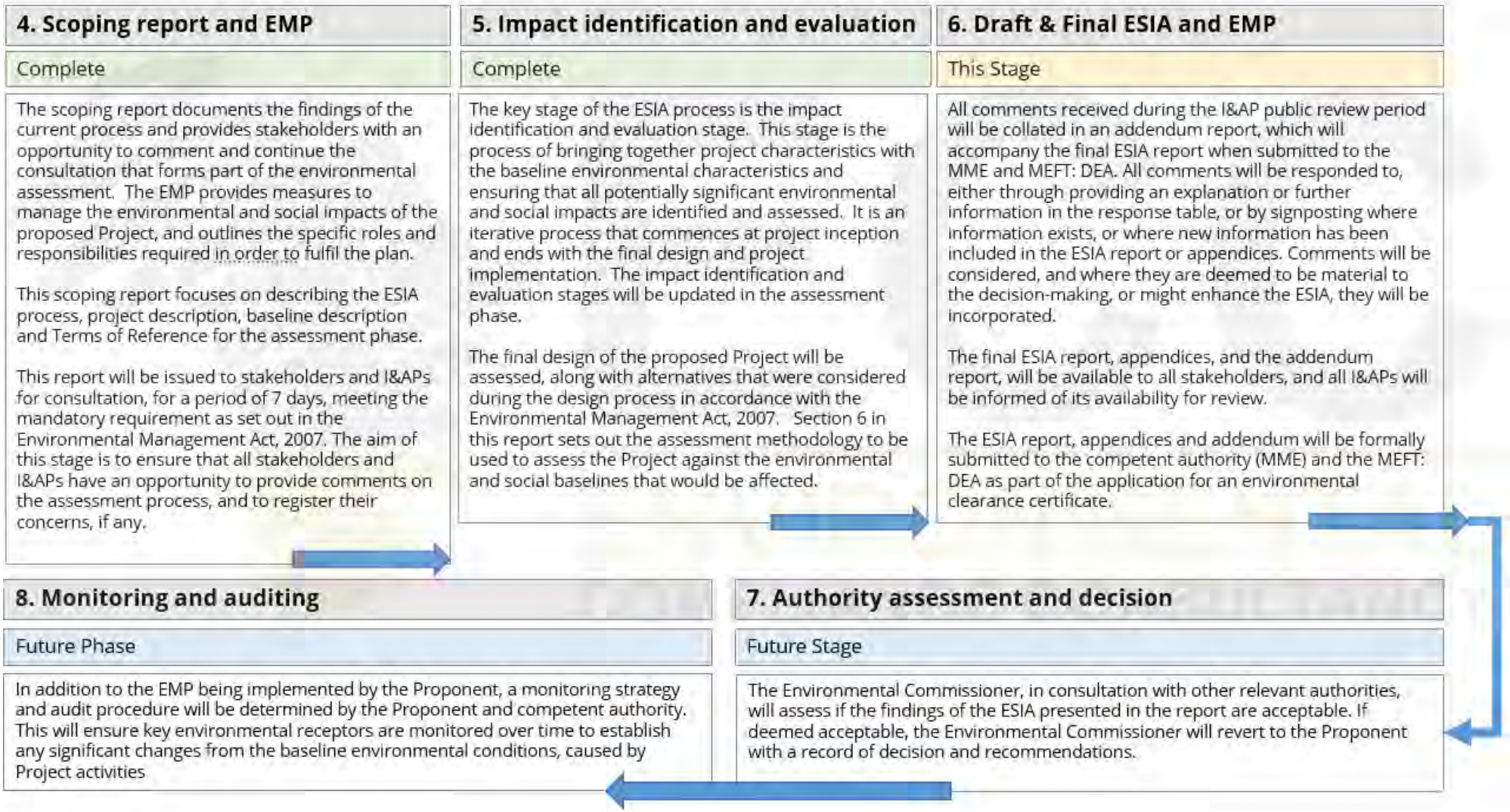


Figure 3 – ESIA process and stages complete

2.4 STUDY AREA

This ESIA study area has been defined according to the geographic scope of the receiving environment and potential impacts that could arise because of the Project. The receiving environment is a summary term for the biophysical and socioeconomic environment that is described in the baseline chapter. The study area is presented in Figure 4.

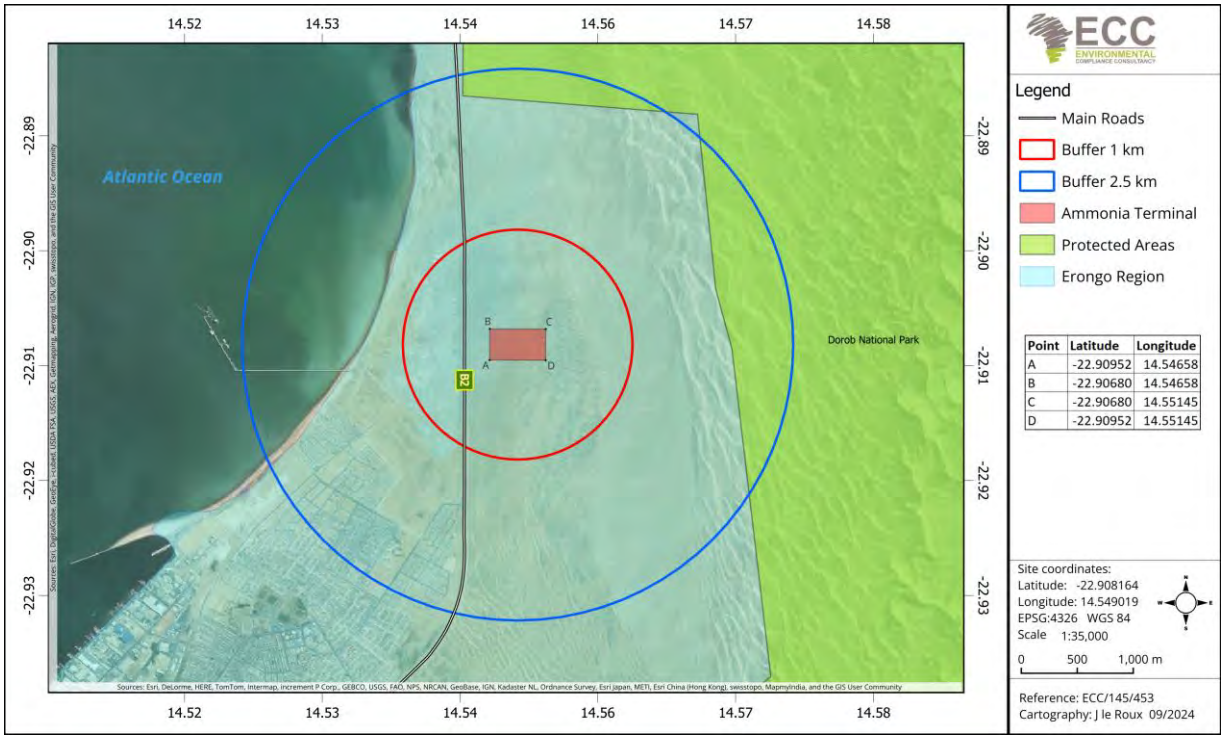


Figure 4 – Project study area

2.5 PUBLIC CONSULTATION

Public participation and consultation are a requirement as stipulated in the Environmental Impact Assessment Regulations (Regulations 21 and 23) of the EMA, No.7 of 2007 for a project undertaking a listed activity and of which an environmental clearance certificate is sought. Consultation is a compulsory and critical component of the assessment process for achieving transparent decision-making and can provide many benefits. Consultation is ongoing during the ESIA process.

The objectives of the public participation and consultation process are to:

- Determine the relevant government, regional, and local regulating authorities.
- Provide information on the Project to the public and competent authorities, introducing the overall project concept and planning in the form of a background information document (BID).
- Listen to and understand community issues, record concerns and questions.
- Explain the process of the ESIA and the timeframes involved and establish a platform for ongoing consultation.

Public consultation for the Project commenced on 04 March 2024 when stakeholder letters were distributed to focus groups and identified key stakeholders and interested and affected parties (I&APs). In terms of Section 22 of the Environmental Management Act, No. 7 of 2007 and its regulations, to register I&APs, a public meeting is not a requirement during the public consultation process for all projects. However, the EAP, along with the proponent, considered it pertinent to arrange public meetings at the Walvis Bay Town Hall on 12 of March 2024, Swakopmund Tamariskia Town Hall on 13 of March 2024 and Arandis Town Hall on the 14th of March 2024. These towns were chosen based on the current scope of influence of the project. The EAP will maintain a high level of engagement throughout the ESIA process as more public and stakeholder engagement meetings will be scheduled during the impact assessment phase.

Matters raised by registered I&APs in relevant stakeholder consultations and the public meetings in Walvis Bay, Swakopmund and Arandis are considered typical for the nature, location and scale of project, and these are summarised as follows:

- Potential safety hazards, safety measures and emergency preparedness plans.
- Possible risks of ammonia in relation to the ocean, biotic and abiotic environments.
- Potential impacts of water usage on the water availability for locals.
- Potential visual impacts on surrounding residents and tourism.
- Impacts on National Protected Areas
- Lack of national standards and local regulations to guide project operations.
- Potential local, regional and national socioeconomic benefits.

The Project adverts and public meetings invitations were placed in local newspapers on 29 February and 07 March 2024. The notice and adverts (refer to the public consultation document provided in Appendix B) were placed in the following local newspapers:

- The Republikein;
- The Namibian Sun; and
- Allgemeine Zeitung.

2.5.1 IDENTIFICATION OF KEY STAKEHOLERS AND INTERESTED AND AFFECTED PARTIES

A stakeholder mapping exercise was undertaken to identify individuals or groups of stakeholders and the method by which they will be engaged during the ESIA process.

Stakeholders were approached through direct communication (letters and phone calls), the national press, or directly by email. A summarised list of stakeholders for this project is given below:

- Neighboring businesses;
- affected and surrounding conservancies;
- The general public with an interest in the Project;

- Ministry of Environment, Forestry, and Tourism (MEFT);
- Ministry of Mines and Energy (MME);
- Ministry of Agriculture, Water and Land Reform (MAWLR);
- Ministry of Urban and Rural Development (MURD);
- Ministry of Industrialisation and Trade;
- Ministry of Defense and Veteran Affairs;
- NAMCOR;
- Namport;
- NACSO;
- Erongo Regional Council;
- Walvis Bay Town Council; and
- Walvis Bay Municipality

The records of the public consultation process in the form of a summary report are provided in Appendix B and includes a list of interested and affected parties (I&APs'), evidence of consultation, including notes of public meetings, advertisements in national newspapers, and a summary of the comments or questions raised by the public. An addendum report was compiled (Appendix C) with additional interested and affected parties (I&APs) inputs during the public review period.

3 REVIEW OF THE LEGAL ENVIRONMENT

This chapter outlines the regulatory framework applicable to the proposed Project. As stated in Section 1, an environmental clearance certificate is required for any listed activity in the Government Notice No. 29 of 2012 of the EMA. The proposed Project is within Namibia's maritime zones and bounded by environmental protected areas (i.e. Dorob National Park and Namib-Naukluft Park). Therefore, a comprehensive scoping and impact assessment is undertaken to assess the significance of potential impacts that may be triggered by the project and recommend feasible and practical mitigation, management and monitoring systems for adoption during the different phases of the project.

International best practises, engineering codes and standards will be adopted into the various architectural designs and structural elements of the project to ensure the safety, reliability and performance of engineered systems.

A thorough review of relevant legislation has been conducted for the Project. Table 4 identifies relevant legal requirements specific to the Project. Table 5 provides the national policies and plan. Table 6 specifies permits relevant for the Project. Table 7 identifies the international policies and plans relevant to the Project.

3.1 NATIONAL REGULATORY FRAMEWORK

Table 4 - Details of the regulatory framework as it applies to the proposed Project

National regulatory regime	Summary	Applicability to the Project
Constitution of the Republic of Namibia (1990)	The constitution defines the country's position in relation to sustainable development and environmental management. The constitution refers that the state shall actively promote and maintain the welfare of the people by adopting policies aimed at the following: "Maintenance of ecosystems, essential ecological processes and biological diversity of Namibia, and the utilisation of living, natural resources on a sustainable basis for the benefit of all Namibians, both present, and future." Article 100 stipulates that "Land, water and natural resources below and above the surface of the land and in the continental shelf and within the territorial waters and the exclusive economic zone of Namibia shall belong to the State if they are not otherwise lawfully owned". This defines the Government position in requiring licences for activities within these operational areas and facilitate control over them.	The proposed Project will ensure the sustainable use of the environment, and has aligned its corporate mission, vision, and objectives with the Constitution of the Republic of Namibia (1990). The Proponent is also obligated to ensure its activities do not in any way interfere with any basic human rights as described under the constitution. The government is the ultimate accountable institution for ensuring that policies are put in place to protect natural resources for the benefit of all. This is achieved through the three branches: executive, judiciary and legislative.

National regulatory regime	Summary	Applicability to the Project
Territorial Sea and Exclusive Economic Zone Act No.3 of 1990	To determine and define the territorial sea, internal waters, exclusive economic zone and continental shelf of Namibia and activities associated herewith. The continental shelf is defined as State land and the Exclusive Economic Zone (EEZ) extends to 200 nautical miles (~370.4 km offshore).	The Project falls within the Namibian Exclusive Economic Zone (EEZ). The Namibian coast is governed as a national asset for the benefit of current and future generations. The Proponent is committed to conduct its operations to standards that complement long-term national policies on the conservation and management of coastal environments. The Project will commit to boost coastal economics, social development opportunities, coastal ecosystems and processes that maintain them.
Environmental Management Act, 2007 (Act No. 7 of 2007) and its regulations (2012), including the Environmental Impact Assessment Regulation, 2007 (No. 30 of 2011)	The Act aims to promote sustainable management of the environment and the use of natural resources. The Act requires certain activities to obtain an environmental clearance certificate prior to Project development. The Act states that an EIA should be undertaken and submitted as part of the environmental clearance certificate application process. The MEFT is responsible for the protection and management of Namibia's natural environment. The Department of Environmental Affairs (DEA), under the	This environmental scoping report documents the findings of the scoping phase of the environmental assessment to be undertaken for the proposed Project. The process has been undertaken in line with the requirements under the Act, its regulations, and international standards such as IFC.

National regulatory regime	Summary	Applicability to the Project
	MEFT, is responsible for the administration of the ESIA process.	
The Regional Councils Act (No. 22 of 1992)	This Act sets out the conditions under which Regional Councils must be elected and administer each delineated region. From a land use and project planning point of view, their duties include, as described in section 28 "to undertake the planning of the development of the region for which it has been established with a view to physical, social, and economic characteristics, urbanisation patterns, natural resources, economic development potential, infrastructure, land utilisation pattern and sensitivity of the natural environment. The main objective of this Act is to initiate, supervise, manage, and evaluate development.	The proposed project area falls under the mandate and municipal development plans of the Erongo Regional Council. Therefore, the Erongo Regional Council along with other governing bodies in the region will be consulted throughout the ESIA process.
The Namibian Ports Authority Act, 1994 (Act 2 of 1994)	The Act provides for the establishment of the Namibian Ports Authority to undertake the management and control of ports and lighthouses in Namibia, and the provisions of facilities and services related thereto. The Act gives provisions for licence to undertake activities in any port (including entry to a port).	During Project construction and mobilisation, any delivery ship or vessel(s) entering Namport waters will comply with all nautical safety requirements and will obtain relevant permission or licences, where required.
Soil Conservation Act, No. 76 of 1969	This Act makes provision for the prevention and control of soil erosion, and for the protection, improvement, and conservation of soil and vegetation.	The construction phase of the project will entail minimal disturbances to soils structure, soil horizons of the desert environment.

National regulatory regime	Summary	Applicability to the Project
Hazardous Substances Ordinance, No. 14 of 1974	This Ordinance provides for the control of toxic substances and can be applied in conjunction with the Atmospheric Pollution Prevention Ordinance, No. 11 of 1976. This applies to the manufacture, sale, use, disposal, and dumping of hazardous substances, as well as their import and export.	The planned Project will involve an emergency diesel generator consisting of a diesel storage tank. In addition, ammonia is a combustible fuel. The Proponent shall guarantee safe handling, transfer, storage, and disposal protocols are developed, implemented and audited throughout the construction and operation phase of the Ammonia Terminal. Leakage detection systems will be in place and inspections will be conducted to timely address any leakages. Monitoring frequencies are outlined in the ESMP. The Proponent is obliged to ensure a licence to operate as a Group I hazardous substance supplier is in place prior to the project commencement.
National Heritage Act 27 of 2004	The act provides for the protection and conservation of places and objects of heritage significance and the registration of such places and objects. It also makes provision for archaeological "impact assessments".	A heritage impact assessment will be conducted during the full ESIA process. The heritage impact assessments will include mitigation measures should archaeological artifacts be encountered during Project construction or operation.
Labour Act (No. 6 of 1992)	The Ministry of Labour, Industrial Relations and Employment is aimed at ensuring harmonious labour relations through promoting social justice, occupational health and safety and enhanced labour market services for the benefit of all Namibians. This ministry insures	The proponent should ensure the safety and welfare of employees throughout the project development framework.

National regulatory regime	Summary	Applicability to the Project
	effective implementation of the Labour Act No. 6 of 1992.	
Water Resources Management Act No.11 of 2013	The Act provide for the regulation and monitoring of water services and provide for incidental matters.	The Proponent is to acquire water required for the Project through a local water service provider (i.e. Walvis Bay Municipality). Walvis Bay Municipality is the custodian for water supply to end consumers in the region.

3.2 NATIONAL POLICIES AND PLANS

Table 5 - National policies and plans applicable to the Ammonia Terminal Project

Policy or plan	Description	Relevance to the Ammonia Terminal Project
Vision 2030	Vision 2030 sets out the nation's development targets and strategies to achieve its long-term national objectives. Vision 2030 states that the overall goal is to improve the quality of life of the Namibian people aligned with the developed world.	The proposed Ammonia Terminal Project supports Namibia's long-term development goals. The national development goals are aimed at achieving a statutory prosperous and industrialised nation, developed by Namibia's own natural and human resources. The project will further build on the achieving the goals through continued employment creation and ongoing contributions to gross domestic product (GDP).
Fifth National Development Plan (NDP5)	The NDP5 is the fifth in a series of seven five-year national development plans that outline the objectives and aspirations of Namibia's long-term vision.	The planned Ammonia Terminal Project will complement efforts towards achieving the set targets through creating of employment opportunities, where and when required.

Policy or plan	Description	Relevance to the Ammonia Terminal Project
	The NDP5 pillars are economic progression, social transformation, environmental sustainability, and good governance.	
The Harambee Prosperity Plan ii (2021 – 2025)	Second Pillar: Economic advancement – ensuring increasing productivity of priority key sectors and the development of additional engines of growth, such as new employment opportunities.	The proposed Project meet government efforts in addressing high unemployment rate through the generation of employment within the regional and national landscape.
Namibia's Green Plan, 1992	Namibian has developed a 12-point plan for integrated sustainable environmental management to ensure a safe and healthy environment and to maintain a viable economy. Clause 2 (f) makes specific mention to guidelines related to sustainable development.	The Proponent is in full cognisance of the clauses under the Green Plan to ensure that best industrial practises are implemented to sustain the country's renewable resources, secure a safe and healthy environment and a prosperous economy for present and future generations.
Draft Gas Bill, 2001	The draft gas bill aims to promote the establishment of a gas transportation and distribution network in Namibia for the purpose of domestic supply and for export; to establish a framework of licensing of the gas industry and a national gas regulator to monitor the performance of licence conditions and promote reliability of services; to ensure safety, efficiency and environmental responsibility in the transportation and distribution of natural gas; to facilitate investment in pipeline infrastructure by private, public, municipal and mixed owned enterprises. The draft bill also aims to promote a competitive market in gas in the long term,	Although not enacted, the Proponent will take note of the draft bill requirements regarding the safe handling and storage of ammonia gas.

Policy or plan	Description	Relevance to the Ammonia Terminal Project
	and to stimulate cross-border trade in gas between Namibia and its neighbours.	
Pollution Control and Waste Management Bill (draft), 1999	This draft Act aims to promote sustainable development by regulating the discharge of pollutants into the air, land and sea. Additionally, to ensure Namibia has an integrated waste management approach and complies with international legislation.	The Proponent to take note of the draft bill requirements and ensure conditions are adhered to with regards to containment of pollutants.
The Green Paper for the Coastal Policy of Namibia	The Green Paper provides an outline of the key findings of a long-term study on the conservation and management of the Namibian coast. It sets out the coastal policy and the vision for the coast, as well as principals, goals and objectives for coastal governance. It also presents the options for institutional and legal arrangements towards implementing the emerging Namibia Coastal Policy options for coastal governance in Namibia.	The principles of Integrated Coastal Zone Management will be used as guideline during the ESIA and will have to be considered and included where applicable in the ESMP.
The National Policy on Coastal Management for Namibia	The National Policy on Coastal Management for Namibia aims to provide a framework to strengthen governance of Namibia's coastal areas to realise long-term national goals defined in Vision 2030 and specific targets of the National Development Plans, namely: sustainable economic growth, employment creation and reduced inequalities in income. Overall, the policy aims to ensure that our coastal resources are protected, used and developed for increases livelihood security and sustainable economic development for all Namibians.	The Proponent shall be guided by the strategic recruitment plan to ensure fair recruitment of local people for various tasks as the Project evolves.

3.3 RELEVANT PERMITS AND LICENCES

Table 6 - Relevant permits and licences required for the project

Permit/Licence	Act/Regulation	Related activities requiring permits	Relevant Authority
Environmental clearance certificate	Environmental Management Act, No. 7 of 2007	Required for all listed activities as stipulated in the EMA Regulations of 2012.	Ministry of Environment, Forestry and Tourism
Written approval for the development of private property on municipal land	The Standard Building Regulations and amendment, 1995	Required for the development of bulk infrastructure within Walvis Bay municipal land.	Municipality of Walvis Bay
A licence required to operate as a supplier of Group I hazardous substances	Hazardous Substances Ordinance No.14 of 1974	Required for the Proponent to supply of Group I hazardous substances.	The National Radiation Protection Authority under the Ministry of Health and Social Services.
Wastewater discharge licence[1]	A permit is issued under Section 72 of the Water Resources Management Act, Act No. 11 of 2013, Water Resource Management Regulations of 2023.	Required for the demineralised water discharged to the evaporation pond contained within the Project site.	Ministry of Agriculture, Water and Land Reform (MAWLR)

3.4 INTERNATIONAL CONVENTIONS

Table 7 - International policies and plans applicable to the Ammonia Terminal Project

Policy or plan	Description	Relevance to the Ammonia Terminal Project
United Nations Law of the Sea Convention (UNCLOS), 1982	The UNCLOS provides an international legal framework to govern the seas and oceans of the world. Namibia as the	This is achieved though the EMA Act. The manufacturing, storage, handling or processing

[1] Effluents will be not discharged into the environment as the pond will operate as a closed-circuit system.

Policy or plan	Description	Relevance to the Ammonia Terminal Project
	designated State is required to administer exploitation, protection and preservation of the marine environment and natural resources on the Namibian Continental Shelf and Exclusive Economic Zone.	of hazardous substances is a listed activity under the EMA Act and requires an environmental clearance certificate. An environmental impact assessment study is conducted in this regard, and mitigation management measures will be provided in the ESMP. It is not envisaged that any hazardous waste will be generated or will be required to be disposed of or moved across Namibian border.
The International Finance Corporation Standards (IFC), 2012	Through eight (8) Performance Standards, the standards draw a framework and strategic commitments for Proponents to promote sustainable development through integrated environmental and social risks assessments, and setting standards and management techniques to avoid, minimise and where residual impacts remain, to compensate/offset for risks and impacts to workers and affected communities. Performance Standard 3 recognises that consumption of finite resources, threats to air, water, land and projected atmospheric concentrations of greenhouse gases (GHG) threatens the public health and welfare of current and future generations at the local, regional and global level.	The potential impacts to be triggered by the proposed project are assessed thoroughly as part of the ESIA and management mitigation measures to guide standards of operation are provided in the ESMP. The Proponent is committed to engage in international best practises to ensure seamless operations within the Namibian environment.

Policy or plan	Description	Relevance to the Ammonia Terminal Project
Paris Agreement, 2015	The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by maintaining a global temperature rise well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase further by 1.5°C above pre- industrial levels. Namibia is a non-Annex 1 Party to the Paris Agreement, ratified in 2016. The government is actively engaged in addressing climate change and works in collaboration with international organisations and partners to boost the nation's capacity to meet its climate-related objectives.	Namibia's approach to climate change regulation is closely aligned with commitments of the sustainable development goals (SDGs).
The United Nation Convention for the Protection of the Ozone Layer, 1985	The overarching objective of the convention is to protect human health and the environment against adverse effects resulting from modification of the ozone layer. Parties commit to cooperate in research concerning substances and processes that modify the ozone layer on human health and environmental effects of such modifications, and on alternative substances and technologies and systematic observations. Currently Namibia isn't signatory to the convention, however best practises are key parameters towards the country's effort in meeting its climate-related objectives.	Namibia is a net carbon sink. However, commitments are drawn to achieve national climate change objectives through sustainable development goals (SDGs) programs.

Policy or plan	Description	Relevance to the Ammonia Terminal Project
United Nations Framework Convention on Climate Change (UNFCCC), 1992	The objective of the convention is to reduce and stabilize greenhouse gases at an atmosphere level to reduce impacts on climate systems, to allow ecosystems time to adapt to these changes, reduce food shortages and promote economies to develop in sustainable manners. Namibia ratified the UNFCCC in 1995 and thus is obligated to prepare and submit national communications, biennial update reports and NDCs (a climate action plan to cut emissions and adapt to climate impacts).	Namibia developed the National Policy Climate Change Strategy and Action Plan (NCCSAP) to facilitate and enhance energy efficiency and promote sustainable low carbon development and sustainable energy through technology and innovations. This is relevant to the project as the innovative scope of work proposed builds on an emerging green hydrogen industry in the country.
The Stockholm Declaration on the Human Environment, Stockholm 1972	Namibia has adopted the declaration in 1996 with the following Principle 3 and 21 most relevant to the proposed Ammonia Terminal Project. Principle 3 states that the earth has capacity to produce, maintain, restore and improve vital renewable resources, wherever practicable. Principle 21 states Namibia has the right to explore her own resources but to ensure that there is effective policies and controls in place to regulate these activities as to not cause detrimental harm to the environment.	Namibia has adopted various measures in place in support of other emerging green hydrogen pilot and large-scale projects. Across southern Africa, Namibia is one of the countries with abundance renewable energy resources and has potential to be a leading force for transition towards a green economy.

4 PROJECT DESCRIPTION

4.1 NEED FOR THE PROJECT

Global economies are still largely reliant on carbon-based fossil fuels, but with the ever-present risk of climate change looming on the horizon, industries and governments are fully embracing a drive for economic decarbonisation. Within the Namibian context, Namibia can still be considered a net-carbon sink, but all aspects of life in the country are vulnerable to the short, medium and long-term impacts of climate change. According to WWF (2023), climate change is experienced through severe droughts and floods, which pose significant risks to Namibia's already arid environment. It is anticipated that climate change will disrupt annual rainfall patterns, alter seasonality, exacerbate water scarcity and threaten food security.

Namibia offers favourable solar and wind energy for the production of sustainable energy. Eco-friendly and/or sustainable energy provides an opportunity for new career paths, creates new jobs through operational green energy demonstration and production plants and contributes to the economy whilst reducing the strong reliance on non-renewable sources e.g., coal (Constellation, 2024). Green hydrogen is produced by splitting water through the process of electrolysis, powered by renewable energy which does not generate carbon dioxide as a by-product. Green hydrogen can be converted to green ammonia, as ammonia has a higher energy density, lower transportation costs and has less technical challenges (Amelang, 2023). Green ammonia is considered a key energy carrier in the global decarbonization effort and could contribute significantly to Namibia's Vision 2030 targets of reducing greenhouse emissions by 91% (Acciona, 2020).

Additionally, the Project will provide indicators to the relevant stakeholders on what is required from a governance perspective and guide the formulation of national policies, guidelines, standards and legislation geared toward sustainable practices.

The Proponent proposes that initially the Project as a whole, will be a pilot project to scope the development, skills, competence, and standards of the Namibian market as there is an opportunity for growth and development within the country.

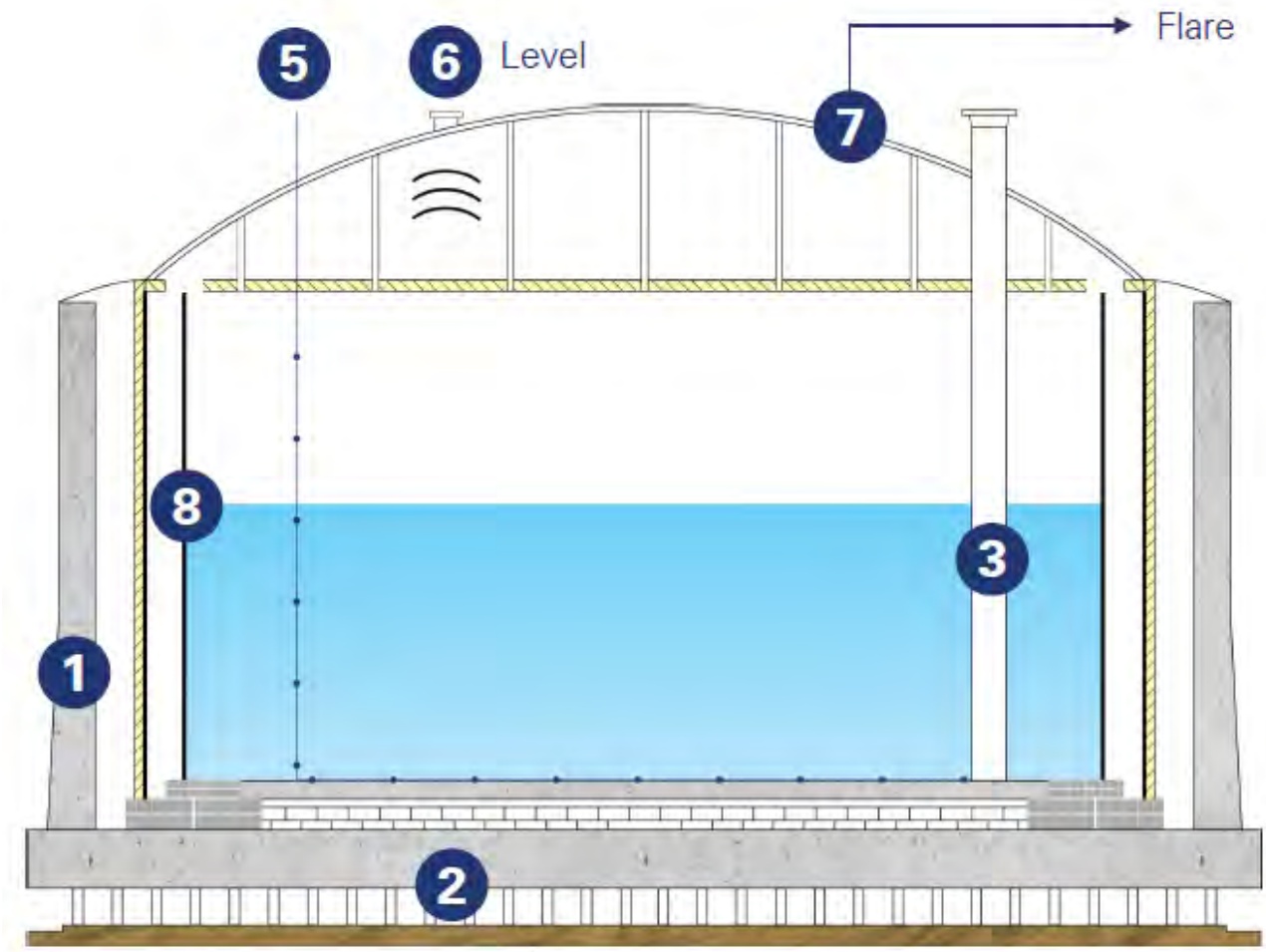
During the Ammonia Terminal operations, it is proposed that the liquid ammonia be transported from an ammonia production plant via the ammonia pipeline to the terminal for storage and future exporting purposes via the Jetty at the Walvis Bay North port. The proponent is also exploring the potential import of ammonia during the first five (5) years of operation. The Ammonia Terminal is therefore an important component in the development of the green ammonia industry within Namibia.

4.2 PROJECT PHASES – CONSTRUCTION PHASE

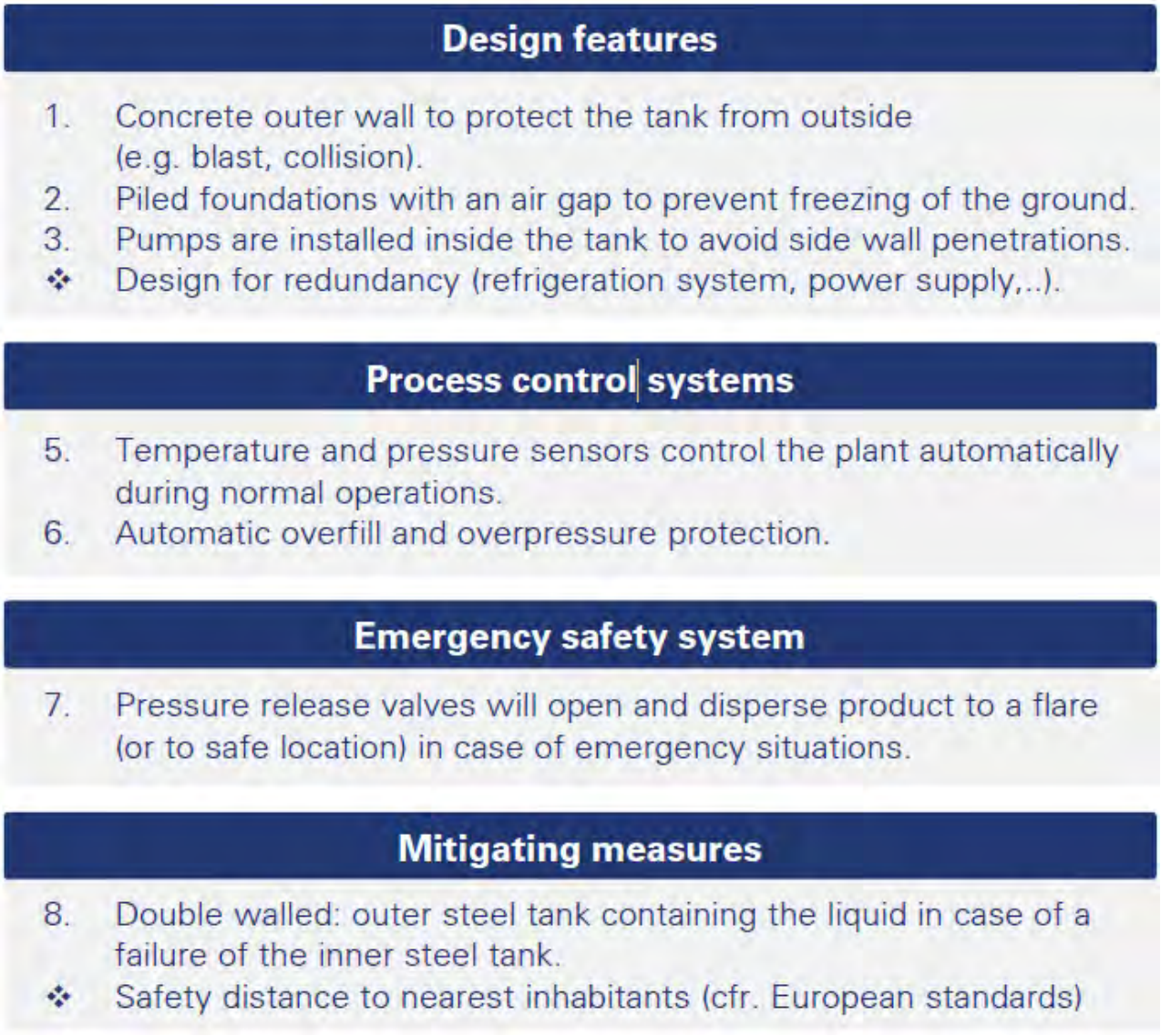
The proposed construction phase will include low-impact and non-intrusive activities. During the construction, the following sections will be incorporated in the Ammonia Terminal:

- The installation of a double wall full containment ammonia storage tank of 40 000 metric tonnes (mt) capacity and the export facilities associated.
- A Nitrogen Generation Unit (NGU) to produce the nitrogen required for the utilities.
- An instrument Air Unit to produce air required for the Nitrogen Generation Unit.
- Fire water and potable water tanks and pumps.
- An emergency diesel generator.
- A wastewater system.
- Refrigeration unit.
- Flare unit.
- Scrubber & Aqueous Ammonia (AA) storage.

The ammonia storage is a full containment double wall steel/concrete tank fixed roof of 40000 mt where ammonia is stored in its liquid form at atmospheric pressure of -32˚C. Figure 5 shows the terminal design with numbered labels and descriptions.



(a)



(b)

Figure 5 - Ammonia terminal design (a); Descriptions to the labelled components of the Ammonia Terminal structure (b), (Source: Cleanergy Solutions)

4.2.1 OPERATIONAL PHASE

During the operational phase, liquid ammonia will be transported from the ammonia plant to the Ammonia Terminal for storage, where it will be prepared for loading onto the vessel and exported. The Proponent will also investigate the possibility of importing ammonia during the first five (5) years of operation, with the potential to extend this practice in subsequent years. Figure 6 shows a representation of the overall block flow diagram of the Ammonia Terminal.

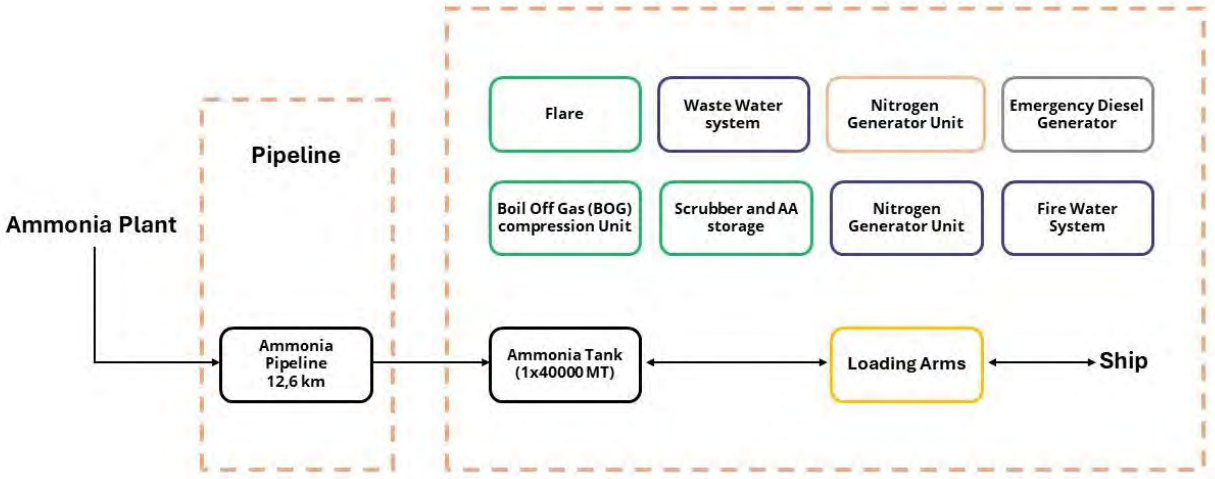


Figure 6 - Block Flow diagram of the Ammonia Terminal

4.2.2 EQUIPMENT AND MATERIAL

An instrument air package is provided for the Ammonia Terminal to provide plant air to the Nitrogen Generation Unit (NGU) and instrument air to the other users. Instrument air (IA) will be mainly used for analysers, actuators of control valves and emergency valves. This package includes air compressors with filters, compressors and interstage aftercoolers, compressed and instrument air receivers, and air dryer package. Table 8 details all equipment and material to be used for the Ammonia Terminal.

Table 8 - Details of equipment and materials to be used for the Ammonia Terminal

Equipment Description	Type	Material	Required capacity	Unit	Insulation status (Yes, No, N/A)	Estimated weight (kg)
Tank Area						
Storage Tank	Full Containment	Tank shell	40 000 MT	Tonnes	Yes	74 624 883
Transfer Pumps	Centrifugal Pump, Submerged	Stainless Steel, 304 L	886 465	m^3/hr kW	N/A	16 610
Cooldown Pump	Centrifugal Pump, Submerged	Stainless Steel, 304 L	108 40	m^3/hr kW	N/A	6 000
Transport Type						
MLA Drain Vessel	Horizontal Vessel	Low Temperature Carbon Steel	18	m^3	No	15 000
Marine Loading Arms	Marine un/loading arm with no vapour return	Low Temperature Carbon Steel	800/ 2660 unloading/loading	m^3/hr	N/A	250 kN vertical 39 kN horizontal
Refrigeration Area						
Refrigeration Compressor LP Stage	Twin Screw (Oil Flooded)	Low Temperature Carbon Steel	2240	kg/hr	N/A	10 300
Refrigeration Compressor HP Stage	Twin Screw (Oil Flooded)	Low Temperature Carbon Steel	3670	kg/hr	N/A	10 300
Refrigeration NH_3 Pumps	Centrifugal Pump	Low Temperature Carbon Steel	72	m^3/hr	N/A	1 000
Refrigeration K.O. Drum	Horizontal Vessel	Low Temperature Carbon Steel	20	m^3	Yes	17 000
Refrigeration Economizer	Horizontal Vessel	Low Temperature Carbon Steel	40	m^3	Yes	26 000

Equipment Description	Type	Material	Required capacity	Unit	Insulation status (Yes, No, N/A)	Estimated weight (kg)
Refrigeration Liquid Receiver	Horizontal Vessel	Low Temperature Carbon Steel	20	m^3	Yes	17 000
Condensers	Air Cooler	Low Temperature Carbon Steel	150	kW	N/A	-
Vacuum Breaker Heater	Air Cooler	Low Temperature Carbon Steel	100	-	N/A	-
Scrubber Unit						
Aqueous Ammonia Scrubber	Horizontal Vessel with Vertical tower	Stainless Steel, 304 L	5	m^3	N/A	10 000
Aqueous NH_3 Pumps	Centrifugal Pump	Stainless Steel, 304 L	5	m^3	N/A	600
Aqueous NH_3 Scrubber Heat Exchanger	Plate heat exchanger	Stainless Steel, 304 L	20	kW	N/A	500
Flare Unit						
Flare K.O. vessel	Horizontal Vessel	Low Temperature Carbon Steel	7.5	m^3	N/A	6 000
Flare stack	Self-supporting	A516 gr. 70N	29100	Kg/h	N/A	2 100
Flare tip	Open Pipe Fuel assisted	Stainless Steel, SS310			N/A	1 402
Fuel Storage Tank to Flare	Horizontal Vessel	Stainless Steel, SS316 L	67.7	m^3	N/A	29 000
Nitrogen Unit						
I.A. Buffer Vessel	Vertical Vessel	Carbon Steel	3	m^3	N/A	750
N_2 Buffer Vessel	Vertical Vessel	Carbon Steel	10	m^3	N/A	2 500
Air Buffer Vessel	Vertical Vessel	Carbon Steel	3	m^3	N/A	750

Equipment Description	Type	Material	Required capacity	Unit	Insulation status (Yes, No, N/A)	Estimated weight (kg)
Dryers	Chiller	Carbon Steel	350	m^3/hr	N/A	300
Absorption Columns	-	Carbon Steel	69.6	m^3/hr	N/A	860
Air Compressor	Screw Compressor	Carbon Steel	250	Nm^3/hr	N/A	2 804
Intake Air Filter	-	Carbon Steel	576	m^3/hr	N/A	7
Discharge Particle Air Filter	-	Carbon Steel	576	m^3/hr	N/A	7
Water Utilities Unit						
Firewater Storage Tank	Vertical Vessel	Carbon Steel + SS316 internal cladding	2400	m^3	N/A	2 500 000
Drinking Water Storage Tank	Vertical Vessel	Linear Low-Density Polyethylene	10	m^3	N/A	
Jockey Pump	Centrifugal Pump	Cast iron	10	m^3/hr	N/A	
Firewater Pump	Centrifugal Pump	Cast iron	681.3	m^3/hr	N/A	
Jockey Pump	Centrifugal Pump	Cast iron	10	m^3/hr	N/A	
Firewater Pump	Centrifugal Pump	Cast iron	681.3	m^3/hr	N/A	
Potable Water Pump	Centrifugal Pump	Stainless Steel, SS316	85-20	m^3/hr	N/A	
Drinking Water Pump	Centrifugal Pump	Stainless Steel, SS316 L/304 L	2	m^3/hr	N/A	
Denim Water Package	-	Stainless Steel, SS316	4	m^3/hr	N/A	
Denim Water Filtration Unit	Reverse Osmosis	Stainless Steel, SS316	4	m^3/hr	N/A	

Equipment Description	Type	Material	Required capacity	Unit	Insulation status (Yes, No, N/A)	Estimated weight (kg)
Denim Water Pump	Centrifugal Pump	Stainless Steel, SS316	4	m^3/hr	N/A	
Denim Water Storage Vessel	Vertical Vessel	HDPE black-coated	10	m^3	N/A	
Emergency Diesel Generator						
Diesel Storage Tank	Storage Tank	Carbon Steel	26000 L	-	N/A	
Emergency Power Generator Unit	Diesel Generator	Carbon Steel	1	MW	N/A	
Diesel Pump	Centrifugal Pump	Carbon Steel	3	m^3/hr	N/A	
Sewage System						
Effluent Lift Pump	Centrifugal Pump	Carbon Steel	40	m^3/hr	N/A	
Rain Water Collection Vessel	Underground Pit	Concrete	200	m^3	N/A	
Spill Tank	Underground Pit	Concrete	50	m^3	N/A	

4.2.3 POWER SUPPLY

During the construction phase and normal operation, power will be supplied to all electrical consumers from the grid. It is estimated that during operations, annual power consumption will be approximately 15 000 000 KWh/a, based on a continuous ammonia supply from the ammonia plant and eight (8) ship loading per year. In the event of an emergency where grid power is unavailable, an emergency diesel generator will provide backup power. In the event of power loss, the terminal will undergo immediate emergency shut down (ESD). The refrigeration system power supply will be switched from the grid to the installed emergency diesel generator to continue cooling the storage tank but at a lesser capacity since the main vapor generation input lines will be shutdown. The emergency diesel generator consists of a diesel storage tank and diesel pumps.

4.2.4 WATER SUPPLY

During construction and operations of the Ammonia Terminal, approximately 20 m^3/day potable water will be required and will be sourced from the Walvis Bay Municipality.

4.2.5 WORKERS AND ACCOMODATION

The Project will create job opportunities during both the construction and operational phases. It is anticipated that most employees will likely reside in Walvis Bay and Swakopmund, thus not requiring on-site accommodation. During the construction phase, approximately 700 workers are expected to be employed, depending on the scope and timing of simultaneous activities. Similarly, approximately 100 workers employees are anticipated to be employed during the operational phase.

4.2.6 WASTE MANAGEMENT

The varying waste categories expected to be produced by the Project are general household waste, plastics and hazardous waste. All household or non-hazardous waste if applicable will be disposed of at the local landfill site and the hazardous waste will be disposed at the disposal site in Walvis Bay.

4.2.7 WASTEWATER EFFLUENT

All the effluents generated by the Ammonia Terminal facilities will be handled and contained within an evaporation pond. Effluents will be not discharged into the environment as the pond will operate as a closed-circuit system.

Rain/storm water will be collected in the first flush pit where oil leakages are controlled. If any oil leakage occurs, the oily water pumps will transfer the oily contaminated water to the de-oiling package for oily content removal. The treated water will then be sent to an observation basin along with rain/storm water from the rest of the site before being channelled to the evaporation pond.

In case water in the observation basin is off spec, it will be handled with caution. If there is ammonia contamination in the rain/storm water, then water will be trucked to a facility where it can be treated.

4.2.8 DECOMMISSIONING AND REHABILITATION STAGE

At the decommissioning stage, the tank may be repurposed for use as a liquefied petroleum gas (LPG) storage tank. The EMP developed for the proposed Project sets out auditable management and rehabilitation actions for the Proponent to ensure careful and sustainable management measures are implemented. The Proponent will have to implement rehabilitation measures at the Project decommissioning stage as outlined in the ESMP.

4.3 ALTERNATIVES CONSIDERED

In terms of the Environmental Management Act, No. 7 of 2007 and its regulations, alternatives considered should be analysed and presented in the ESIA reports. This requirement ensures that during the design evolution and decision-making process, potential environmental impacts, costs, and technical feasibility have been considered, which leads to the best option(s) being identified.

Potential alternatives range from alternative methodologies to technologies of construction. These will be considered throughout the duration of the impact assessment as more information becomes available and options are weighed.

4.3.1 NO-GO ALTERNATIVES

If the Project does not proceed, Namibia will lose the socio-economic and environmental benefits tied to the green hydrogen initiative. The country has a unique opportunity to become a leader in the emerging green energy sector and a global exporter of green ammonia, which could attract significant foreign investment. The green hydrogen vision leads to the creation of career paths, create employment opportunities, contribute to the economy by reducing energy dependence and provide solutions to pressing environmental challenges. According to the Nationally Determined Contribution (NDC) registry, Namibia has set bold goals to reduce greenhouse gas emissions by 2030 and pursuing green energy projects will strategically allow Namibia to reach milestones.

5 ENVIRONMENTAL AND SOCIAL BASELINE

5.1 BASELINE DATA COLLECTION

This section sets out the findings of the initial desktop study, which included a review of existing literature, spatial data and publicly available reports pertaining to the receiving biophysical and socio-economic environments of the project area. The desktop study is an important part of the scoping component, as it identifies any knowledge gaps that require additional information prior to the assessment phase. As part of this study, the baseline environmental and social conditions are defined, with inputs from specialist studies commissioned as part of the broader environmental impact assessment.

5.2 DESKTOP AND FIELD SURVEYS

ECC completed the initial desktop baseline studies for the Project in July 2024. Further desktop and field-based baseline studies were completed in September 2024, which enhanced the the Project's dataset.

5.3 SPECIALIST STUDIES

The specialist studies shown in Table 9 were commissioned and completed, to determine the baseline state of the environment.

Table 9 - Specialist studies that were completed for the ESIA

Study Area	Purpose	Specialist name
Biodiversity and dune morphology	– Biodiversity and habitat – Identification of species of concern and sensitive areas – Impacts of construction and operational activities on habitats and biodiversity (if any)	– Peter Cunningham
Hydrogeology and surface water	– Water supply – Surface drainage analysis – Potential groundwater contamination – Soil analysis	– Luke Towers (ECC)
Air quality	– Provide emission standards and dust suppression requirements – Assess prevailing wind directions and possible effects of dust emissions on the process and/or personnel – Model potential air quality impacts	– Renee von Gruenewaldt

Study Area	Purpose	Specialist name
Noise	– Identification of possible receptors, and assess levels of noise to which they may be exposed during construction and operations	– Renee von Gruenewaldt
Traffic	– The traffic study assessed the potential traffic impacts and loading on routes associated with the activities – The study assessed the capacity of infrastructure and safety aspects of the entry road	– Albie Smith
Heritage and culture	– A heritage assessment is required, to comply with Namibian national legislature	– Dr Alma Nankela
Visual and sense of place	– Assessing the potential visual impacts (viewshed) of the proposed Project on the receiving environment	– Johan Le Roux (ECC)
Health and safety	– The memo has been referenced in this assessment as it presents a thorough risk assessment conducted based on CMB.TECH design and Dutch standards. This has been applied to the project due to the similarities in the scope of work.	– Antea Group
Climate change	– identify impacts, to assist the Project in adhering to set climate change goals and national emission reduction targets – Provide recommendations to manage and mitigate potential impacts related to climate change	– David Jarrett

5.4 LAND USE

The proposed Ammonia Terminal will be situated within the Walvis Bay north port area. The port of Walvis Bay is centrally the coast of Namibia and provides access to principal global shipping routes. The Walvis Bay port is the largest commercial port in Namibia and serves as

a logistics for many Namibian industries, and thus has many different facilities providing support to the various industries which depends on the services offered such as a container terminal, privately operated bulk cargo terminal and tugboats, syncrolifts and access general service and maintenance, food, water and fuel. The Walvis Bay port is a highly urbanised, disturbed and is continuously expanding with the north port especially earmarked for further development, according to the Walvis Bay Town Masterplan (Walvis Bay Municipality, 2024).

The proposed site is within declared and zoned municipal land neighboured by the Dörob National Park. The Dörob National Park was proclaimed in 2010 and covers the central Namib desert. It is bordered to the north by the Ugab River and the Skeleton Coast Park. The Omaruru River bisects it, while the Swakop River is situated to the south of its boundary. The nearest human receptors to the proposed Ammonia Terminal are the Walvis Bay residential areas approximately 3 km to the south of the site and the Afrodite Beach beach-front development which lies approximately 5 km north of the Project site.

Figure 7 shows the various land use distribution in and around the proposed Ammonia Terminal.

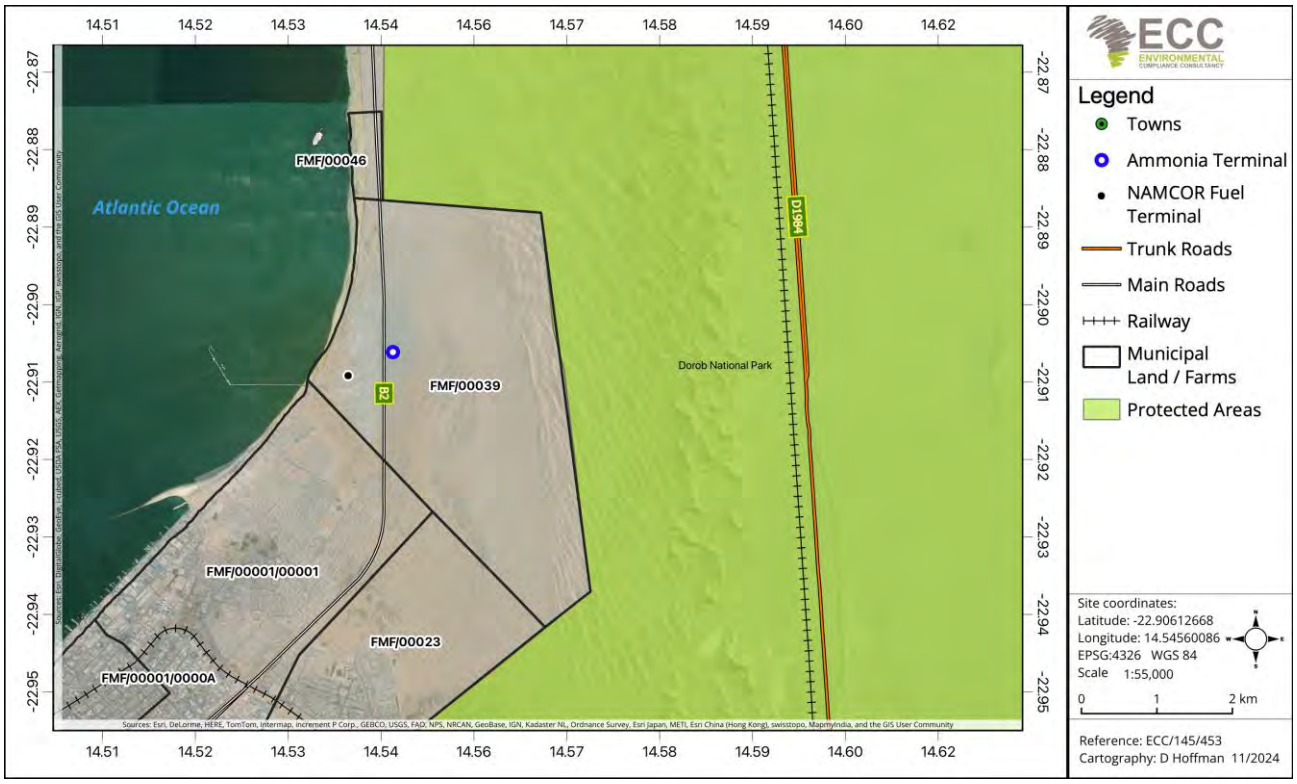


Figure 7 – Location of the proposed ammonia terminal in proportion to residential, municipal and conservation areas

5.5 CLIMATE

Climate and weather data from meteoblue (2024) along with desktop QGIS data for the site has been used to provide the climate data for the Project area. The Walvis Bay area and

proposed terminal site falls under the Köppen climate classification BWh. This denotes a mid-latitude desert climate. Given this climatological condition, the area experiences primarily arid conditions, with minimal fluctuations in temperatures and rainfall distributed sporadically throughout the year. Most of the ~80 900 km^2 of the Namib is hyper-arid, characterised by low humidity and high evaporation rates, high temperatures, low rainfall (15–100 mm) and strong winds (Wassenaar, et al., 2013).

5.5.1 TEMPERATURE

The Mean Annual Temperature (MAT) of the Project area summer months are characterised by warm temperatures with an average maximum temperature of 29˚C and average minimum temperature of 15˚C (Figure 8). The warmest months are generally between November and May while winter months, with minimum temperatures reaching 8 ˚C, span from June to September.

5.5.2 WIND

During the winter months, the coastal towns (i.e. Walvis Bay and Swakopmund) experience intermitted blasts of strong, hot air that are referred to as east winds or bergwind conditions. This weather event, descend over the great escarpment, pick up and carry sand particles towards the coast, over and into the Atlantic Ocean (Atlas of Namibia Team, 2022). Generally, the proposed site area experiences wind speeds of up to 38 km/h, with predominant wind directions emanating from the southwest (SW) and east-northeast (ENE) as shown in Figure 9.

5.6 RAINFALL AND EVAPORATION

The area is located within the Desert biome that is predominated by erratic rainfall patterns and receives on average annual rainfall <20 mm. The surface and hydrogeology impact assessment undertaken for the hydrogen pilot plant at Farm 58 (located in the vicinity of the current site) reported rainfall records over more than 50 years with an average annual rainfall of 13 mm (Namib Hydrosearch, 2022). Potential evaporation is between 1680 and 1820 mm per year (Mendelsohn, Jarvis, Roberts, & Robertson, 2002).

5.7 SOLAR RADIATION AND HUMIDITY

The average annual solar radiation is between 5.4 to 5.6 kWh/m^2/day which is low due to the frequent cloud and fog cover experienced along the coast. Fog defines much of the Namib Desert's climate (Atlas of Namibia Team, 2022). The approximate number of days that this area receives fog are more than 125 days per annum, the most compared to inland and eastern areas of Namibia (Mendelsohn, Jarvis, Roberts, & Robertson, 2002). The majority of summer days are partly cloudy, whereas in winter there are more sunny days (Figure 10). The months with the highest humidity, have humidity of approximately more than 90% relative humidity (RH) and the driest months have a humidity between 40 and 50% RH.

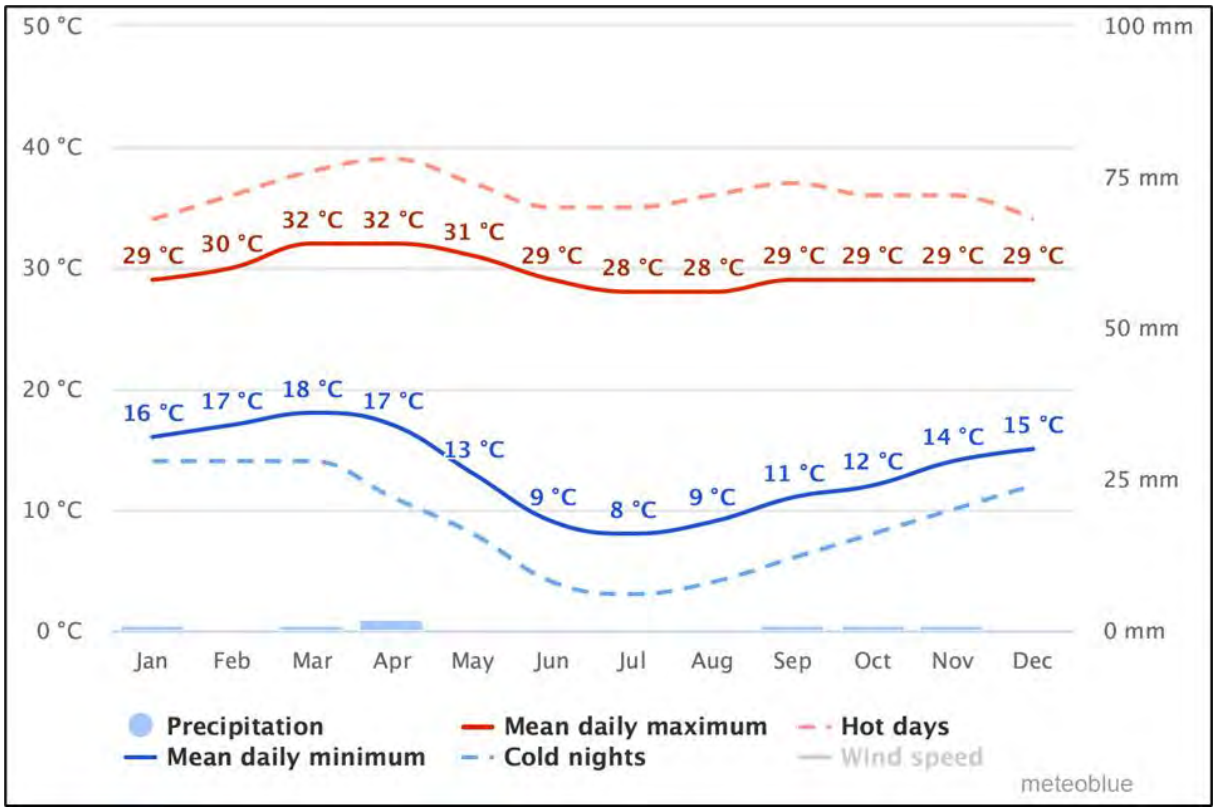


Figure 8 - Average temperature and precipitation (Meteoblue, 2024)

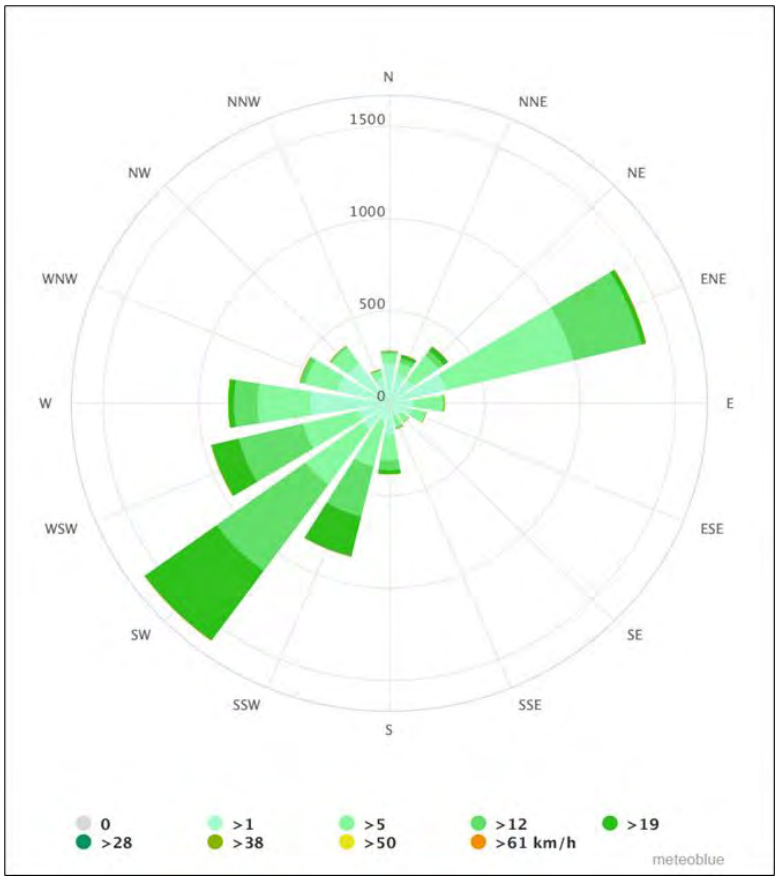


Figure 9 - Average wind speed and direction in the Project area (Meteoblue, 2024)

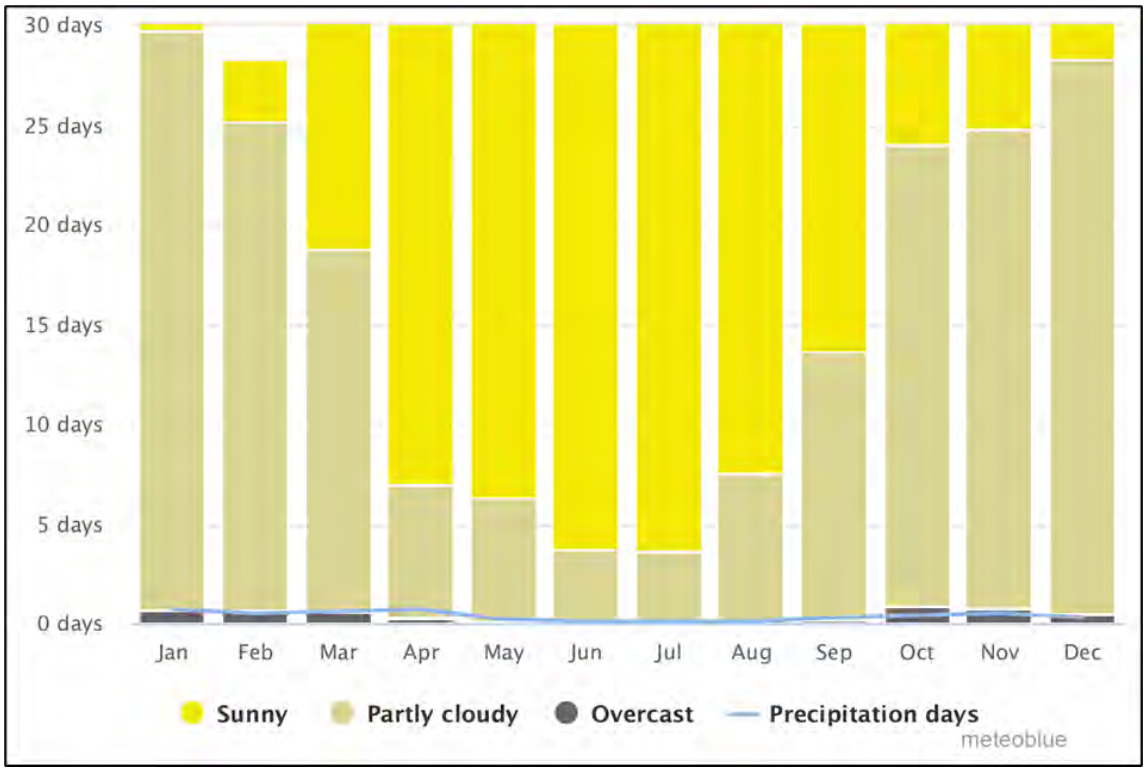


Figure 10 - Annual cloud cover and precipitation days (Meteoblue, 2024)

5.8 AIR QUALITY

Airshed Planning Professionals (Pty) Ltd was engaged by ECC to undertake an air quality impact assessment for the proposed Project in May 2024 (Appendix E). The main objective of the investigation was to quantify the potential air quality impacts resulting from the Project activities on the surrounding environment and human health.

The scope of work (SoW) included the review of technical information and legislation relevant to air quality in a Namibia context. A baseline assessment was undertaken to gain an understanding of the receiving environment, taking into account existing sources of air pollution and the status of air quality within the region, as well as sensitive receptors in the form of human settlements (Figure 11). Following the baseline assessment, the AERMOD dispersion model was used to simulate the expected impacts from Project emission sources, with the simulated ground level concentrations and dust fall rates screened against the applicable air quality objectives (AQOs) to determine the significance of the proposed Ammonia Terminal project on the receiving environment (Airshed Planning Professionals, 2024).

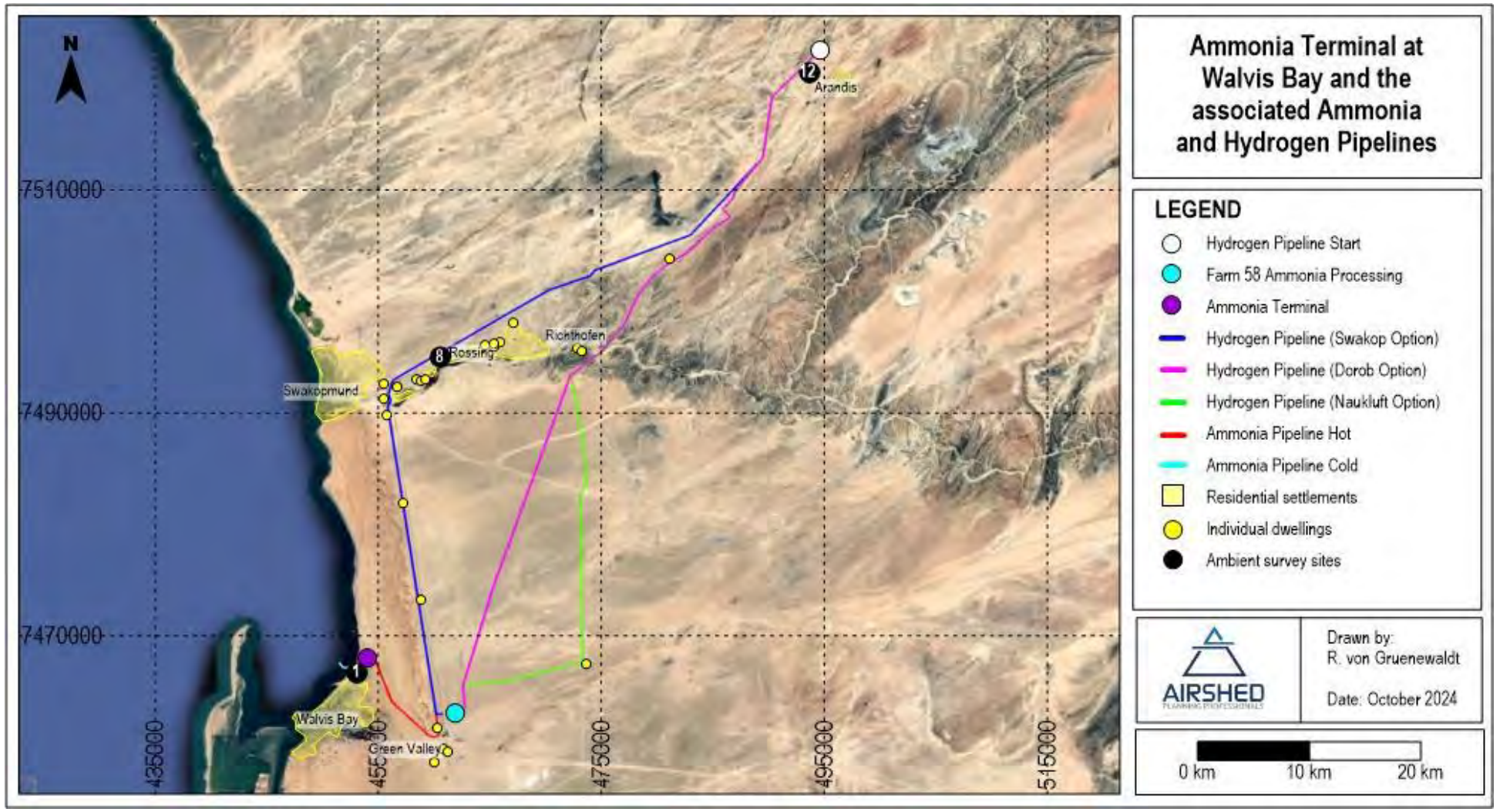


Figure 11 - Identified AQSR in the vicinity of the Project (Airshed, 2024)

5.8.1 SENSITIVE RECEPTORS AND ATMOSPHERIC DISPERSION

The potential air quality sensitive receptors (AQSR) were identified as residents approximately 3 km from the Project site. According to the air quality assessment report, meteorological conditions control the dispersion, transformation and eventual removal of pollutants from the atmosphere. Dispersion comprises a vertical component, which is defined by the stability of the atmosphere and the depth of the surface-mixing layer, while horizontal dispersion is a result of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution as a result of plume 'stretching'. Figure 12 shows that at the North port area of Walvis Bay, representative of the Project site, daytime wind is predominantly directed from the west and southwest with south-southwest winds predominating at night.

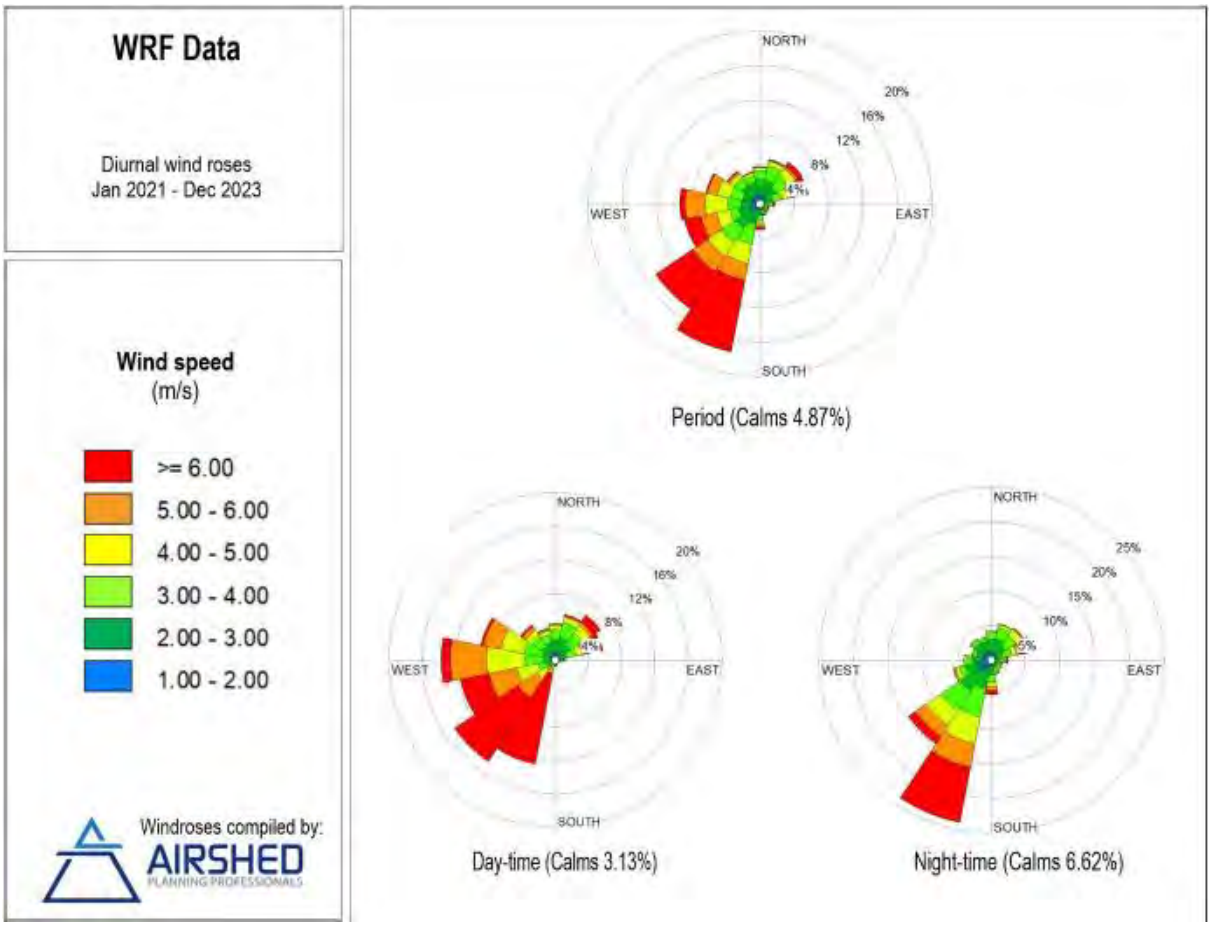


Figure 12 - Period, day - and night-time wind roses based on modelled WRF data (Airshed, 2024)

Assessment of the atmospheric stability showed that during the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface. Night times are characterised by weak vertical mixing and predominance of a stable layer (Figure 13). For low level releases, the highest ground level concentrations would occur during weak wind speeds and stable (night-time) atmospheric conditions (Airshed Planning Professionals , 2024).

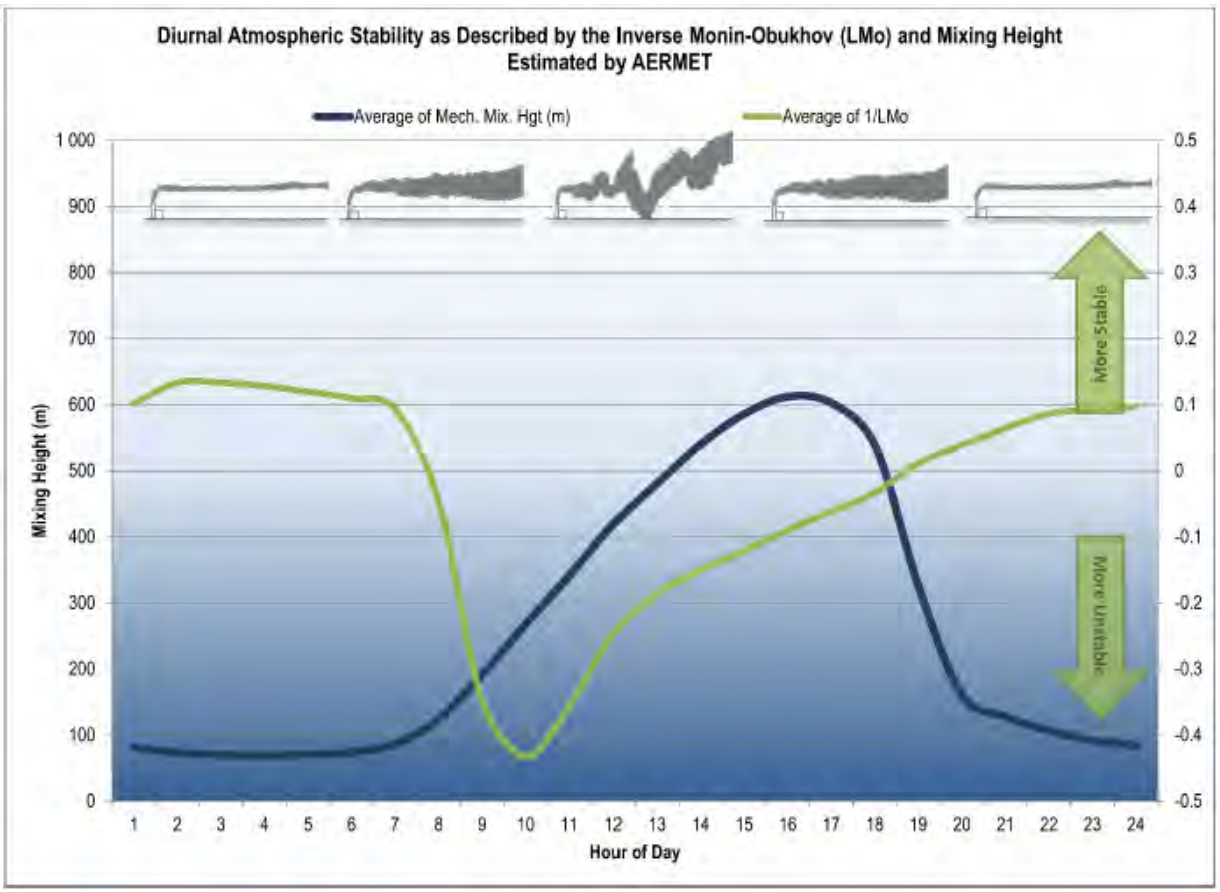


Figure 13 - The diurnal atmospheric stability for the site for the site (north of Walvis Bay) as estimated with AERMET (Airshed, 2024)

5.8.2 CURRENT AMBIENT AIR QUALITY

During the field survey, three sites were selected (Site 1, Site 8 and Site 12) to measure particulate matter of 10 and 2.5 microns in size (PM_{10} and $PM_{2.5}$) (Figure 11). The measured daily PM_{10} concentrations ranged between 24.4 µg/m³ and 27.1 µg/m³ and the daily $PM_{2.5}$ concentrations ranged between 3.2 µg/m³ and 5.6 µg/m³ (Table 10). Site 1 is of interest to the proposed Project as it is most representative of the Project site.

Table 10 - The daily average PM_{10} and $PM_{2.5}$ for the 2024 survey

Survey site	PM_{10} (µg/m³)	$PM_{2.5}$ (µg/m³)	Start measurement	End measurement
Site 1	25.5	5.2	25/07/2024 09:36	26/07/2024 01:00
Site 8	24.4	3.2	24/07/2024 09:14	24/07/2024 23:57
Site 12	27.1	5.6	23/07/2024 08:32	23/07/2024 23:58

5.8.3 EXISTING IMPACTS TO AIR QUALITY WITHIN THE STUDY AREA

Sources identified as possibly impacting air quality in the region include, but are not limited to:

- Vehicle tailpipe emissions from national and main roads;
- Emissions from fishing and shipping operations;
- Fugitive emissions from the Anixas Power Station operation;
- Fugitive emissions from mining operations; and
- Various miscellaneous fugitive dust sources (wind erosion of open areas, vehicles-entrainment of dust along paved and unpaved roads).

5.8.3.1 Vehicle tailpipe emissions

Air pollutions from vehicles may be classified as primary and secondary pollutants (Airshed Planning Professionals, 2024). Primary pollutants are those emitted directed from a source into the atmosphere, whereas the origin of secondary pollutants lie within the interactions between the primary emissions in the atmosphere (Envira, 2022). The significant primary pollutants emitted by vehicles include carbon dioxide (CO_2), CO, hydrocarbons (HCs), sulphur dioxide (SO_2), oxides of nitrogen (NO_x), particulates and lead (Pb). Secondary pollutants include nitrogen dioxide (NO_2), photochemical oxidants (e.g., ozone – O_3), HCs, sulphur acid, sulphates, nitric acid, and nitrate aerosols (Airshed Planning Professionals, 2024). Vehicle tailpipe emissions are localised sources and unlikely to impact far-field receptors.

5.8.3.2 Mining operations in the region

Fugitive dust sources associated with mining activities include drilling and blasting operations, materials handling activities, vehicle-entrainment by haul vehicles and wind-blown dust from stockpiles. Mining operations represent potentially the most significant sources of fugitive dust emissions ($PM_{2.5}$, PM_{10} and total suspended particles with small amounts of NO_x, CO, SO_2, CH_3, and CO_2 being released during blasting operations and from mine trucks. There are no mining activities in the immediate vicinity of the project, but mining activities are located further (more than 20 km) to the north-northeast and northeast of the site (Airshed Planning Professionals, 2024).

5.8.3.3 Fugitive dust sources

Fugitive dust emissions may occur as a result of vehicle entrained dust from local paved and unpaved roads, and wind erosion from open areas. The extent of particulate emissions from the main roads will depend on the number of vehicles using the roads and the silt loading on the roadways and prevalent wind conditions. The quantity of wind-blown dust is similarly a function of the wind speed, the extent of exposed areas and the moisture and silt content of such areas.

5.9 CLIMATE CHANGE

Climate change refers to long-term shifts in temperature, weather patterns and atmospheric conditions on earth. While climate fluctuates over time, climate change is induced with significant shifts in climate patterns that are primarily driven by human activities, particularly the burning of fossil fuels (coal, oil and natural gas), deforestation and industrial processes, which increase the concentration of greenhouse gases (GHGs) in the atmosphere.

Namibia is a signatory to various United Nations (UN) conventions and protocols such as the United Nations Framework Convention on Climate Change (UNFCCC), the United Nations Convention on Biological Diversity (UNCBD) and the United Nations Conventions to Combat Desertification (UNCCD). As such, Namibia has several key obligations aimed at addressing climate change, promoting sustainable development and contributing to global efforts to limit global warming. As a non-Annex 1 Party to the Paris Agreement, Namibia is required to submit national inventory reports on anthropogenic greenhouse gas emissions. This regulatory framework supports the country's commitments to addressing climate change. Furthermore, businesses are working to reduce their carbon footprint by incorporating renewable energy sources into their operations, setting emission reduction targets and implementing carbon pricing and trading mechanisms.

In mid- 2024, ECC contracted RDJ Consulting Services to conduct a predictive carbon footprint analysis for activities and operations associated with the Ammonia Terminal. The climate change impact assessment study primarily focused on evaluating and modelling the projected greenhouse gas emissions associated with the Ammonia Terminal operations. The goal was to gain a deeper understanding of the terminal's vulnerability to climate change, assess the potential environmental risks, and identify actionable opportunities for reducing emissions. Additionally, the forecasting of future emission scenarios provides valuable insights that facilitate the redesign of critical Project area for improved efficiency and reduced environmental impacts. The specialist report is provided in Appendix F.

5.9.1 CLIMATIC CONDITIONS OF WALVIS BAY

Namibia is naturally an arid country and has several biodiversity hotspots and rainfall 250 mm – 600 mm per year, with mean temperatures between 16- 22 °C (RDJ, 2024). As an arid country, Namibia depends heavily on its groundwater resources. This brings with it challenges such as high rainfall variability that makes recharge into aquifers also variable, so groundwater reserves in many places are not reliable.

According to RDJ (2024), the mean yearly temperature trends for Walvis Bay shows that the temperature is rising (Figure 14), suggesting an increasing impact of climate change in the area. A similar trend in rainfall patterns is also observed (Figure 15). These rainfall patterns are often followed by extended periods of drought.

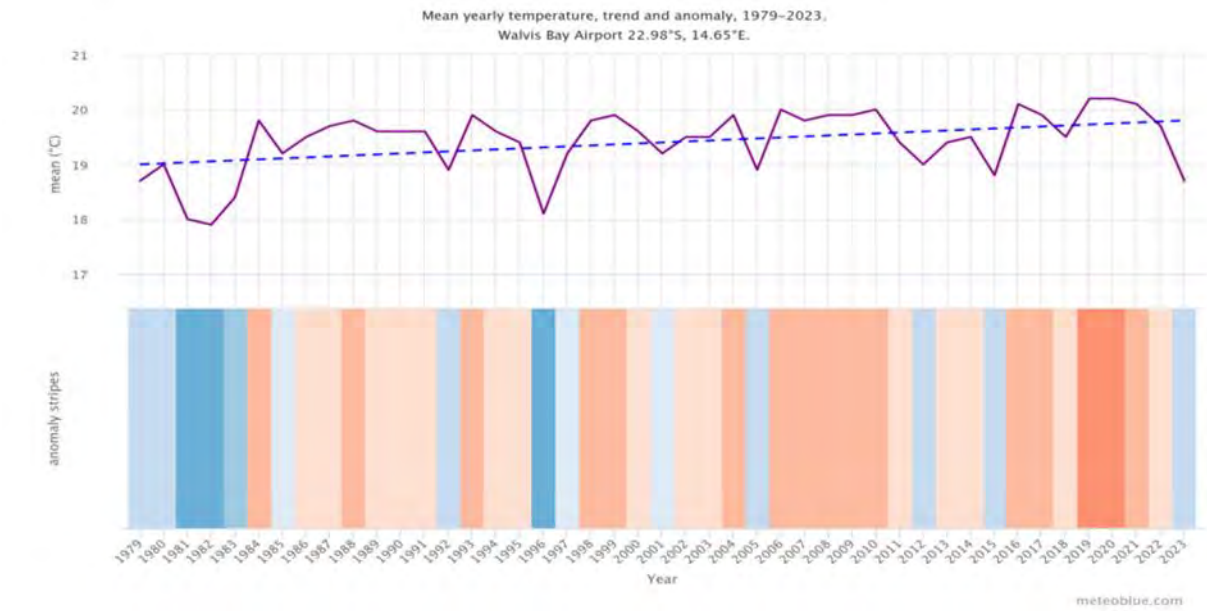


Figure 14 - Mean annual temperature for the Walvis Bay area (Source: RDJ, 2024)

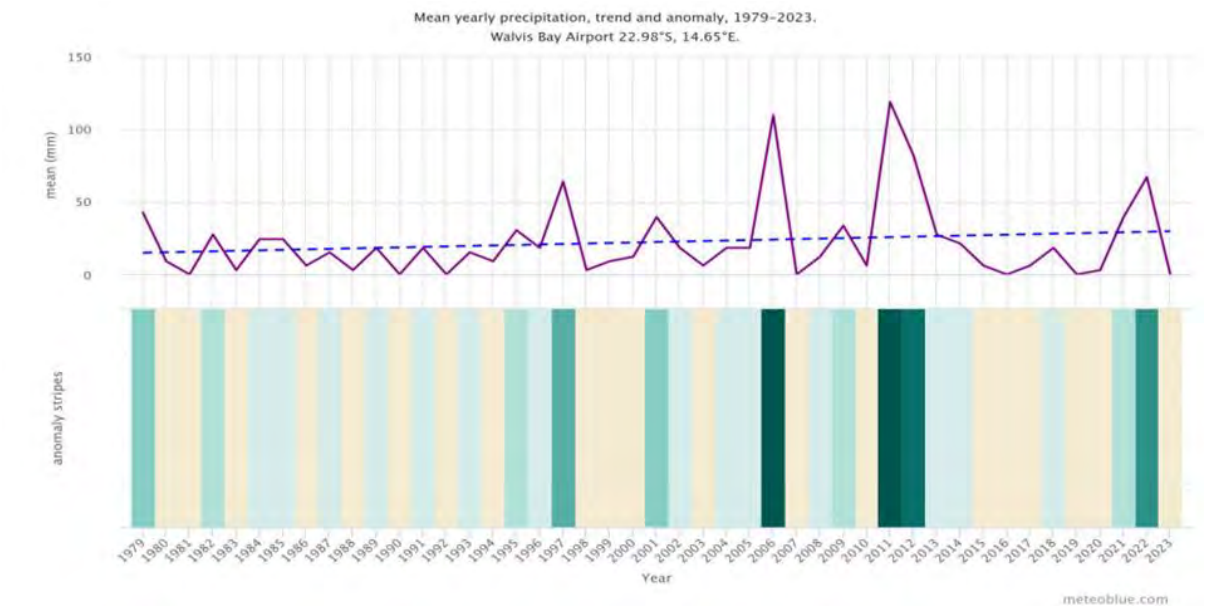


Figure 15 - Mean annual precipitation for the Walvis Bay area (Source: RDJ, 2024)

Climate change is generally associated with impacts such as temperature fluctuations, altered rainfall patterns, increased flooding and prolonged periods of drought. As a result, industrial entities adopt decarbonization strategies into their operations to ensure sustainable practices, optimise energy use and effectively manage water resources.

Although Namibia is a net carbon sink in comparison to other global carbon and GHG emitters, it is important that the Project adopt and promote the transition to a low-emission future. The impacts related to the Project's vulnerability to climate change are discussed in chapter 7 and best environmental practises are provided in the ESMP.

5.10 TOPOGRAPHY AND SOILS

Regionally the topography of the Project area decreases gradually from the escarpment in the east to the coast in the west. The local site topography is relatively flat occurring at approximately 10 metres above mean sea level (Figure 16).

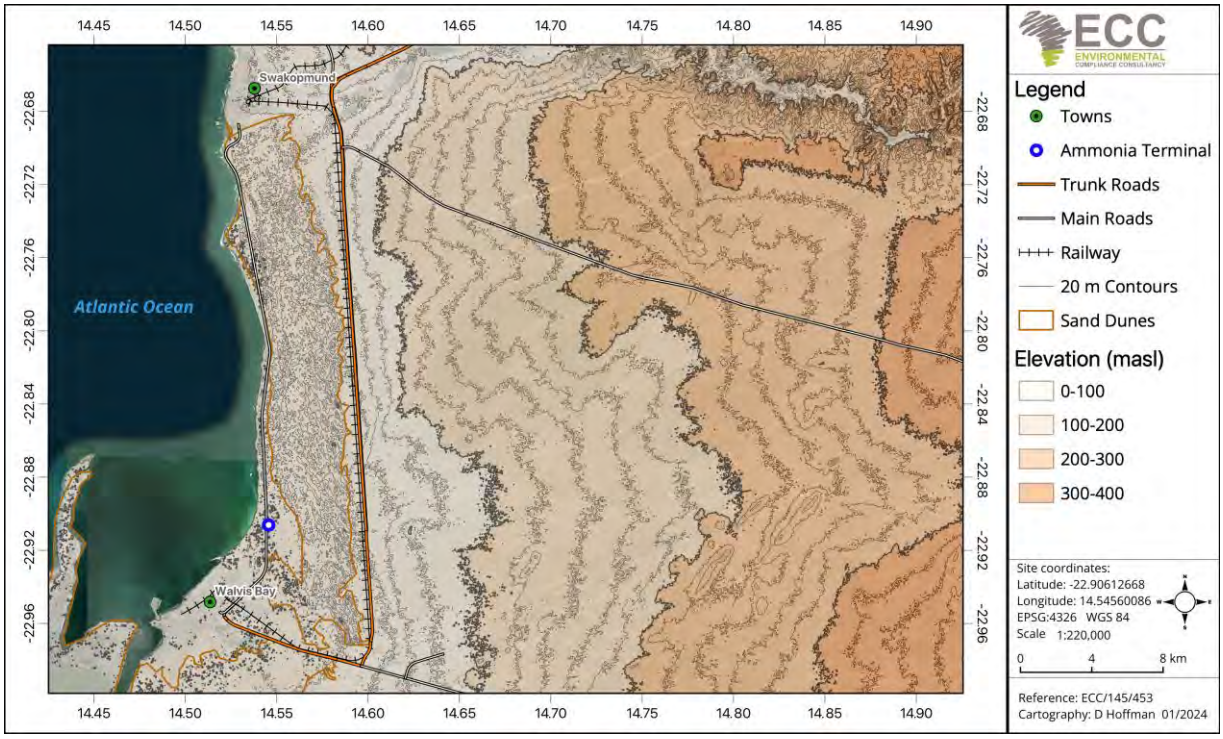


Figure 16 - Elevation of the Project area

According to the 1:1 000 000 scale Namibian Soil Map of 2021 (Coetzee, 2021), the dominant soil type in the Project area is identified as Sodic Gleyic Petrosalic Solonchak (Figure 17). Sodic soils refer to a high concentration of sodium ions absorbed at cation exchange sites and are often characterised as soils with poor drainage properties, and poor soil-air associations preventing root growth, plant production and promoting soil erosion (Levy & Shainberg, 2005). The "gleyic" component indicates that the soil has undergone waterlogging, which is characterized by reduced oxygen availability in the soil. This waterlogging leads to the reduction of iron compounds and the formation of iron and manganese compounds that impart a blue, gray, or greenish color to the soil. Gleyic soils typically develop in areas where water is stagnated, and they are often found in depressions or low-lying areas where the groundwater table is near or at the surface. Petrosalic refers to the presence of a hard, cemented layer or horizon of salts, often sodium salts (like sodium chloride), that forms below the soil surface. These petrosalic layers are often referred to as "salts," and they can be impervious or hard, preventing root penetration and water movement. This horizon is generally found at a certain depth, which can vary, but its presence typically marks the boundary where salts have accumulated and solidified. Solonchak soils are highly saline with a high concentration of soluble salts. This type of soil is largely restricted to the arid to semi-arid climatic zones and coastal regions. The organic content in dry soil is biologically and

chemically less stable and in arid areas tends to decrease very quickly, leading to poor soil quality (Dilnashin, et al., 2020).

Sodic Gleyic Petrosalic Solonchak soils are a complex combination of saline, sodic, and waterlogged conditions, with a hard, salt-encrusted horizon. They are typically found in regions with poor drainage and high evaporation, where the combination of high sodium levels, waterlogging, and salinity makes them difficult to manage for agriculture. Effective reclamation requires careful soil management, including leaching, gypsum application, and drainage improvements.

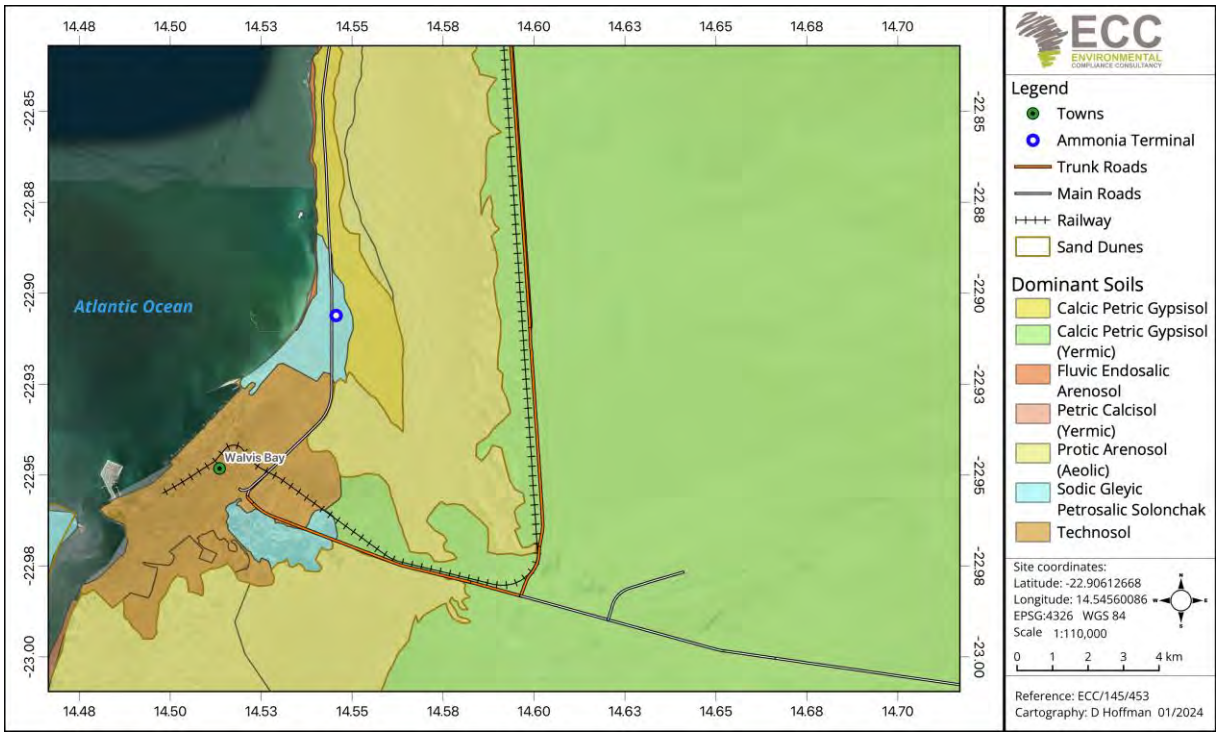


Figure 17 - Dominant soils of the Project area

5.11 HYDROLOGY AND DRAINAGE

Existing data on the hydrology of the coastal areas of Namibia is scarce with the exception of the larger ephemeral rivers. West flowing ephemeral rivers that originate inland, east of the Escarpment, have their headwaters in areas of higher rainfall. These include large rivers such as the Swakop and Kuiseb. Within the coastal plains, smaller west flowing ephemeral streams are present but rarely flow. The large rivers are important water sources for the dry coastal areas either as surface water or as recharge source to alluvial aquifers. Significant seasonal flows occur in intervals of 3 to 5 years. The Kuiseb River alluvial aquifers supply Walvis Bay (Rooibank and Dorop aquifers). Occasional flooding in Walvis Bay (e.g. in 2021) occurred due to flow in the Kuiseb River in response to higher rainfall in inland areas (Khomas Hochland). The Swakop River flow is dammed upstream (Swakoppoort Dam) and in exceptional rainfall seasons overflow occurs that reach the coastline. The Kuiseb and Swakop Rivers are 32 km to

the north and 20 km south of the site respectively and do not have any direct impact on the Project site.

In contrast to the larger ephemeral rivers, locally dry rivers channels have much smaller catchments with extents limited to the arid or hyper arid parts of the Namib Desert and are not connected to the larger river catchments. These channels also flow due west over the coastal gravel plains and are seen to terminate in the coastal dune belt between Walvis Bay and Swakopmund. The channels are ill defined with eroded banks and are partly covered by aeolian sand. High runoff due to rainfall can result due to low vegetation cover and exposed rocky surfaces and result in short but rapid flows in the ephemeral streams or as sheet flow where channels are not well defined. No observable channels transect the proposed Project locations, and surface flows emanating from the east are likely to be disrupted and partially diverted by the B2 road, railway line and dunes to the east.

5.12 GEOLOGICAL SETTING

The regional geology of the area comprises rocks of the Damara Supergroup, predominantly calc-silicate and quarzitic rocks of the Nosib Group (Etusis and Khan Formations) and intrusive Salem Granites of similar age, overlain by Quaternary aeolian sands of the Namib Group (Sossus Formation) and undifferentiated surficial Quaternary deposits of sand, gravel, gypcrete and calcrete (Figure 18). Locally the site occurs on the northward migrating dune belt of the Sossus Formation. A summary of the lithostratigraphy of the project area is provided in Table 11.

Table 11 - Lithostratigraphy of the Project area

Supergroup	Group	Formation	Lithological Description
Damara	Nosib	Khan	Greyish green calc-silicate rock, minor metaconglomerate, mica schist and amphibolite.
		Etusis	Pink feldspathic quartzite and meta-arkose, metaconglomerate, local gneiss, mica schist and marble
Intrusive syn-tectonic rocks	Salem Granites		Pink to grey, foliated porphyritic to non-porphyritic, coarse grained monzogranite and granodiorite

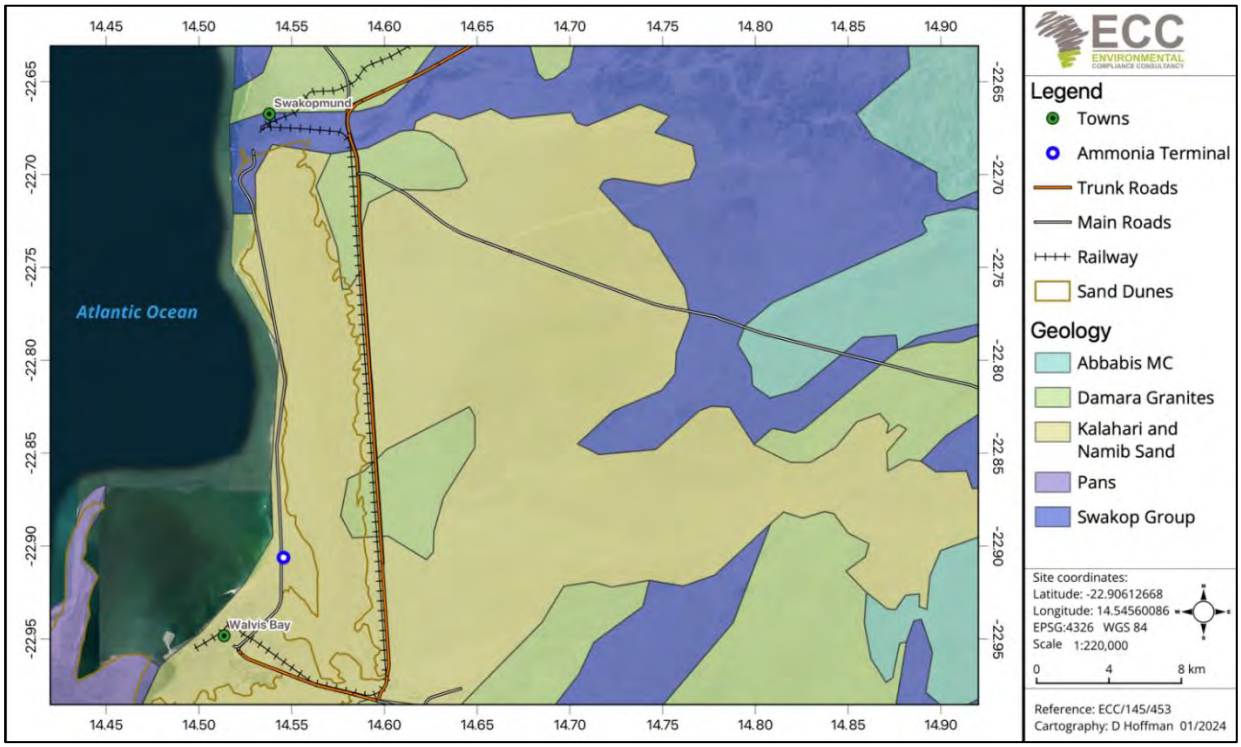


Figure 18 - Geological map of the Project area

5.13 HYDROGEOLOGY

The Project area occurs in the broader Erongo groundwater basin. Regionally, groundwater flows in a westward direction originating in the inland hard rock areas with discharge to the coastal sediments. According to the 1:1000 000 hydrogeological map of Namibia, the aquifers in the Project area are generally of very low potential, and mostly saline to hyper-saline (Figure 19). This is a result of low groundwater flow rates and high residence time due to low hydraulic conductivity and gentle hydraulic gradient. Local groundwater recharge is also negligible under the hyper-arid conditions of the Namib Desert. Where the westward topographic gradient is steeper or impervious bedrock is present, springs emanate from the sediments. The long residence time results in evaporation / evapotranspiration of the groundwater which concentrate soluble salts causing the groundwater to become brackish to saline. Mineral dissolution is another process of increasing salinity. Gypcrete (consisting of gypsum, $CaSO_4.H_2O$) and halite (NaCl) that have accumulated in the coastal sediments over time are dissolved by groundwater (and occasional surface flow) adding to the salinity of the groundwater. The groundwater is therefore not potable and unusable by humans or local fauna, although Namib Hydrosearch (2022) notes some local use from within the Project area for road construction.

Towards the south, the alluvial Kuiseb River aquifers are found, from which the Rooibank and Dorob Water Supply Schemes supply potable water to the Walvis Bay Municipality. The Kuiseb River Aquifers are known productive primary alluvial aquifers that are recharged by seasonal river flow in response to rainfall in the inland elevated areas (Khomas Hochland). These

alluvial aquifers are limited to the Kuiseb River course and delta and not present in the Project area (Namib Hydrosearch, 2022).

The nature of the sediments underlying the proposed Project site support the presence of a shallow, saline to brine groundwater table likely impacted by seawater intrusion and concentration of salts by evaporation. The hydrogeological conditions require consideration during construction as the groundwater table may be intersected during establishment of foundations. Dewatering may prove ineffective in the long term due to the proximity of the sea (continuous source of ingress). Brine ingress is also known to contribute to the deterioration of reinforced concrete and metals. It may be that the brines in the subsurface are of economic potential that may be diminished by potential chemical or hydrocarbon spills. Appropriate impermeable surfaces, bunding and drainage is required.

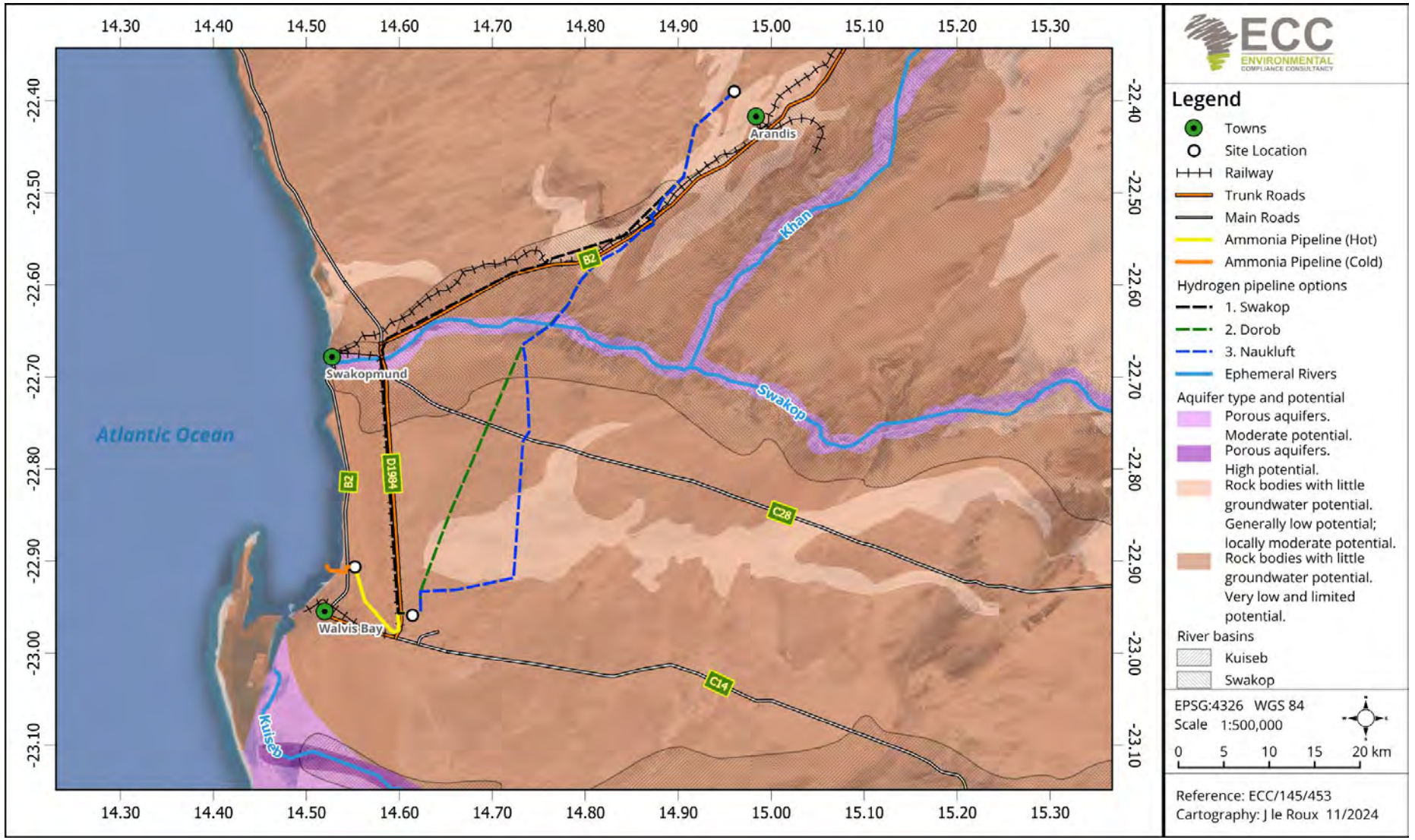


Figure 19 - Hydrology and hydrogeology map of the Project area

5.14 BIODIVERSITY BASELINE

Namibia has diverse wildlife and flora, it has been reported that 16% of the total plant species that occur in Namibia are endemic to the country (Craven & Vorster, 2006). The proposed Project area is located within the Southern Desert area (Figure 20) of the Namib Desert. The Namib Desert is a landscape located in southwestern Africa, which is considered the oldest desert on Earth, with its sands believed to be around 5 million years old. The Namib Desert has unique endemic biodiversity and scenic landscapes, with a major section contained in the Namib Naukluft Park and the adjacent Dörob National Park, together forming a major tourist attraction site in Namibia (Wassenaar, et al., 2013). According to Peter Cunningham (2024) the general Swakopmund/Walvis Bay area, is regarded as "relatively low" in overall (all terrestrial species) diversity, however terrestrial endemism in the area on the other hand is "moderate to high".

5.14.1 GENERAL BIOME CHARACTERISTICS AND FLORA

Despite the extreme and unfavourable climatic conditions in the Southern Desert area (Figure 20), the Namib Desert's biotic communities are extraordinarily appealing and unique (Wassenaar, et al., 2013). The dominant vegetation structure in the Southern Desert is grassland and dwarf shrublands. The plant diversity is characterised as extremely low with less than 50 species. Plant endemism is viewed as "medium" – with between 1-15 endemics expected from the general area (Cunningham, 2024). Tree cover is extremely low, and the dominant vegetation are *Brownanthus arenosus* and *Othonna cylindrica*. *Brownanthus arenosus* is characterised as a succulent subshrub adapted to the dry conditions of the desert and the drier sections of the shrubland biome in Namibia and South Africa. *Othonna cylindrica*, similarly to *Brownanthus arenosus*, is a succulent subshrub with bright yellow flowers and near-endemic to Namibia.

The floristic group refers to the geographical distribution of seemingly unrelated vegetation species overlap in such a way that suggests that they have an origin in common – similar evolutionary history (Atlas of Namibia Team, 2022). The floristic group of the proposed area is the Welwitschia Desert where up to 200 species are co-inhabitants.

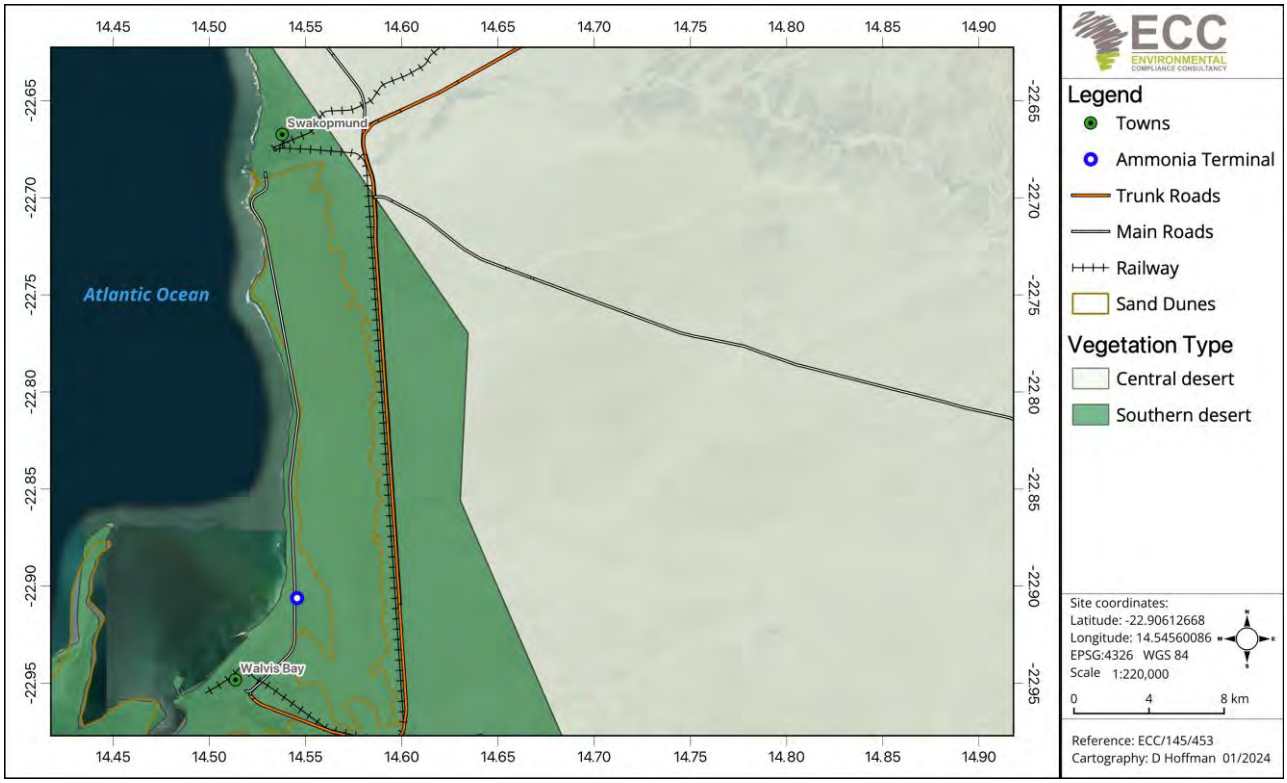


Figure 20 – Vegetation cover in the general Project area

A comprehensive biodiversity and dune study was conducted by Peter Cunningham end of April and May 2024 in the Project area (Appendix G).

5.14.1.1 Larger trees and shrubs

Only one (1) species of larger tree/shrub species were identified in the Project area - *Salsola* spp. on patches of dune hummocks (Figure 21). It is noted that none of the important larger tree/shrub species in the general larger area is exclusively associated with the Project site.

5.14.1.2 Grasses

Stipagrostis sabulicola (tough dune grass) occurs on the dunes while the inter-dune flats (streets) are covered with *Stipagrostis gonatostachys* after rains. The eastern inland sections – pro-Namib – are dominated by *Stipagrostis obtusa* and *S. ciliata* after rains. During the assessment no grass species were identified within the Project area. It was observed that the general area was very dry, accounting for the low number and abundance of grasses observed throughout.

5.14.1.3 Sensitive/important vegetation and habitats

Salsola spp. dune hummocks

Important areas include a patch of *Salsola* spp. dune hummocks immediately east of the proposed site located on a barren salt pan. These vegetated hummocks have a high diversity of vertebrate (and invertebrate) fauna and serve as foraging area for carnivores (e.g., black-backed

jackal, brown hyena, etc.) and ungulates (e.g., gemsbok, springbok, etc.). Figure 21 shows the *Salsola* spp. dune hummocks on the eastern boundary of the Project site.



Figure 21 -The *salsola* spp. dune hummocks on the eastern boundary of the Ammonia Terminal site

5.14.2 FAUNA

The overall terrestrial diversity of the proposed Project area is low in comparison to the central and northeastern parts of the country. The overall bird diversity is moderate with approximately 141 to 170 species. The Walvis Bay area tends to be a hotspot for bird life, as birds are attracted to the species richness and abundance because of the nutrients brought by the highly productive upwelling system of the Benguela Current (BirdLife International, 2024). The diverse and unique bird life presents a huge attraction for tourists and bird enthusiasts with approximately 100 000 birds, e.g., flamingos and pelicans. The reptile diversity is described as low (41-50 species), with lizards making up majority of the reptile species with approximately 24 to 27 species and local snakes – 10 to 14.

Amphibian patterns are closely related to average rainfall due to the breeding habits in water and the reliance on moist habitats during the frog lifecycle. Due to the low average rainfall in the region, amphibians are quite scarce with 1-3 species. The overall mammal diversity is low with 16 to 30 species of which half is endemic.

5.14.2.1 Avifauna

The Walvis Bay and Sandwich Harbour wetlands, including the lagoon, salt pans and bird sanctuary are classified as Ramsar sites (i.e., Namibia is signatory to the Ramsar Convention protecting important wetland sites) as well as globally Important Birding Area (IBA's) (Cunningham, 2024). Additionally, Walvis Bay is an important feeding grounds for a variety for aquatic species such as Palaearctic migrants and flamingo's moving between the coast and the Etosha Pans.

Approximately 14 species of birds are endemic or near endemic to Namibia with most endemics occurring in the savannah biome (30%). Bird diversity in the general Project area is estimated at 111-170 species and 2-4 species being endemic, which is low quite low. High bird endemism is concentrated from the Naukluft Mountains northwards along the escarpment to the Kunene River (Mendelsohn, Jarvis, Roberts, & Robertson, 2002). The most important endemic birds known/expected to occur in the general area are Gray's lark, dune lark and Herero chat. In the general area two (2) species of birds are listed as critically endangered (great crested grebe, Cape gannet), seven (7) species as endangered (Cape cormorant, bank cormorant, black stork, white-backed vulture, martial eagle, tawny eagle, Ludwig's bustard), six (6) species as vulnerable (great white pelican, greater flamingo, lesser flamingo, secretarybird, lappet-faced vulture, Hartlaub's gull) and eight (8) species as near threatened (black-necked grebe, crowned cormorant, Verreaux's eagle, peregrine falcon, kori bustard, African black oystercatcher, chestnut-banded plover, Damara tern).

A total of 11 species of birds were observed in the larger Project area during field assessments over the past 14 years. However, none of the bird species expected and/or observed/confirmed during the rapid assessment are exclusively associated with the Project area.

5.14.2.2 Reptiles

Approximately 261 species of reptiles are known to occur in Namibia thus supporting approximately 30% of the continent's species diversity. At least 22% or 55 species of Namibian lizards are classified as endemic. The Namib-Naukluft Park has an estimated 100 species in total and the neighbouring Skeleton Coast National Park has at least 77 species of reptiles. No data exists for the Dorob National Park (Cunningham, 2024).

It was reported that reptiles are "disappearing at an alarming rate" from the central Namib Desert, within the Dörob National Park dunes between Swakopmund and Walvis Bay (The Namibian, 2021). The biggest threat has been identified as poaching due to the high prices on the international black market. At least 63 species of reptiles are expected to occur in the general area with 38 species (60.3%) being endemic. There are approximately 19 snakes (two (2) thread snakes), one (1) quill snouted and 16 typical snakes) of which nine (9) species (47.4%) are endemic, one (1) tortoise, one (1) terrapin, 19 lizards of which 11 species classified as endemic (57.9% endemic), one (1) plated lizard, one (1) monitor, tow (2) agamas, one (1)

chameleon and 17 geckos of which 15 species classified as endemic (i.e., 88.2% endemic). Geckos expected and/or known to occur in the general area have the highest occurrence of endemics (88.2%) of all the reptiles in this area. Three important coastal and dune and/or *Salsola* hummock associated species are *Bitis peringueyi* (Péringuey's Adder), *Typhlosaurus braini* (Brains's Blind Legless Skink) and *Pachydactylus rangei* (Web-footed gecko). Overall, low densities in the marginal habitats (i.e., coastal salt pan habitat in the Project area and sparsely vegetated gypsum/gravel plains in the Farm 58 area are low biodiversity areas (Figure 22). Although 34 species were confirmed from baseline studies dating back to 2007, no reptiles were encountered during the field survey carried out in April/May 2024.

5.14.2.3 Amphibians

In recent decades it has been observed that more than 70% of the world's amphibian species are in decline, with 32% of the world's nearly 6600 amphibian species threatened with extinction and 43% experiencing declines (Hayes, Falso, Gallipeau, & Stice, 2010). There are approximately 65 recorded species, six (6) of which are endemic to Namibia. Most amphibians require water to breed and are therefore associated with the permanent water bodies, mainly in northeast Namibia (Cunningham, 2024). Therefore, desert areas are marginal habitat for amphibians. Approximately seven (7) species of amphibians can occur in the general area, of which three (3) are endemic and none are specifically associated with the Project area.

There are no water bodies within the vicinity of the Project site. No amphibians were observed during the rapid site assessment. The presents harsh conditions to amphibians, with very little rainfall generally occurring in the area (<20mm annual average) and being highly variable (>100% coefficient of variation).

5.14.2.4 Mammals

Namibia has a rich wildlife with approximately 250 mammal species including small mammals. Currently 14 mammal species are considered endemic to Namibia of which 11 species are rodents and small carnivores of which very little is known. Endemic mammals are broadly associated with the escarpment belt the Namib from higher elevations to the east (Mendelsohn, Jarvis, Roberts, & Robertson, 2002). Low diversity has been confirmed in large herbivore in the general area with oryx and springbok having the highest density of the larger species. Average diversity and abundance have been confirmed in large carnivorous mammals.

The most important species from the general area are the Namibian wing-gland bat (*Cistugo seabrai*) listed as endemic and rare; Littledale's whistling rat (*Protomys littledalei namibensis*); brown hyena (*Parahyaena brunnea*) and leopard (*Parthera pardus*) listed as near threatened and vulnerable (population trends decreasing), respectively (IUCN, 2022). None of the unique/important mammal species are exclusively associated with the proposed Project area.

During the field assessment seven (7) species (four (4) of which are small mammals) were identified in the larger general area, with a total of 28 identified from studies conducted since

2010. These species include suricate, dassie rat, ground squirrel, round-eared elephant-shrew, Namaqua rock mouse, four-striped grass mouse and Setzer's hairy-footed gerbil. Large mammals known to pass through occasionally include cheetah, kudu, leopard, warthog, etc. The low small mammal "capture success" rates of between 4.4-8.06% are indicative of the general marginal habitat, low rodent densities, and overall dry conditions. According to Cunningham (2024) rodents are typically "boom-and-bust" species with higher densities expected during the rainy season with an increase in grass cover and available food.

5.14.2.5 Sensitive/important vegetation and habitats

The coastal strip between Walvis Bay and Swakopmund

This coastal strip is an Important Bird Area (IBA) (90km²) and is listed as a biodiversity "Red Flag" area with a high density of waders along the beach areas as well as breeding sites for Damara tern (*Sterna balaenarum*) (Cunningham, 2024). The Damara tern is currently classified as Near Threatened/near endemic in Namibia; however, the risk of catastrophic extinction is relatively low because most of the colonies and suitable breeding habitat are reasonably healthy and stable.

Although Damara tern potentially could breed on the salt pan (Ammonia Terminal site) and the sandy/gravel gypsum plains (Farm 58 area), this has not yet been recorded and neither are these areas the quiet undisturbed habitat the birds prefer (i.e., not expected to breed in the Project area). Currently the three major threats to the Damara tern breeding colonies are off-road vehicles, an increase in coastal tourist densities and associated housing developments and lastly the increase in predatory jackal and gull densities.



Figure 22 - Highly disturbed and barren salt pan area of the proposed Project site

5.15 BUILT ENVIRONMENT BASELINE

5.15.1 TRAFFIC AND TRANSPORT

The traffic baseline study for the Project was conducted by Zutari Namibia (Pty) Ltd (herein referred to as "Zutari") to assess the expected affected routes around the Walvis Bay Port area; the present traffic operating and pavement conditions; and assess the impact of the proposed Ammonia Terminal traffic generation on the existing road network. The traffic baseline study was completed in September 2024 (Appendix H).

The Project site can only be accessed using the B2 Main Road. The B2 Main Road is designed and constructed for high traffic volumes. The section of road that is affected by the Project will only be the section of road between Swakopmund and Walvis Bay along the coast (Figure 23).



Figure 23 - Section of the B2 Main Road impacted by the Project (Zutari Namibia, 2024)

5.15.1.1 Access to the Project site

During the Ammonia Terminal Project, access from the B2 Main Road to the Project site will be required. A new intersection will have to be constructed to gain access to the B2 Main Road from the Ammonia Terminal. Sight distances to both sides of the road were investigated and found to be adequate. Zutari proposes an intersection, with a deceleration lane and a passing lane.

5.15.1.2 General characteristics and conditions of the road

Five (5) intersections were identified on the B2 Main Road during the traffic study (Figure 24) and location, condition and potential access to the Project site is captured in Table 12.

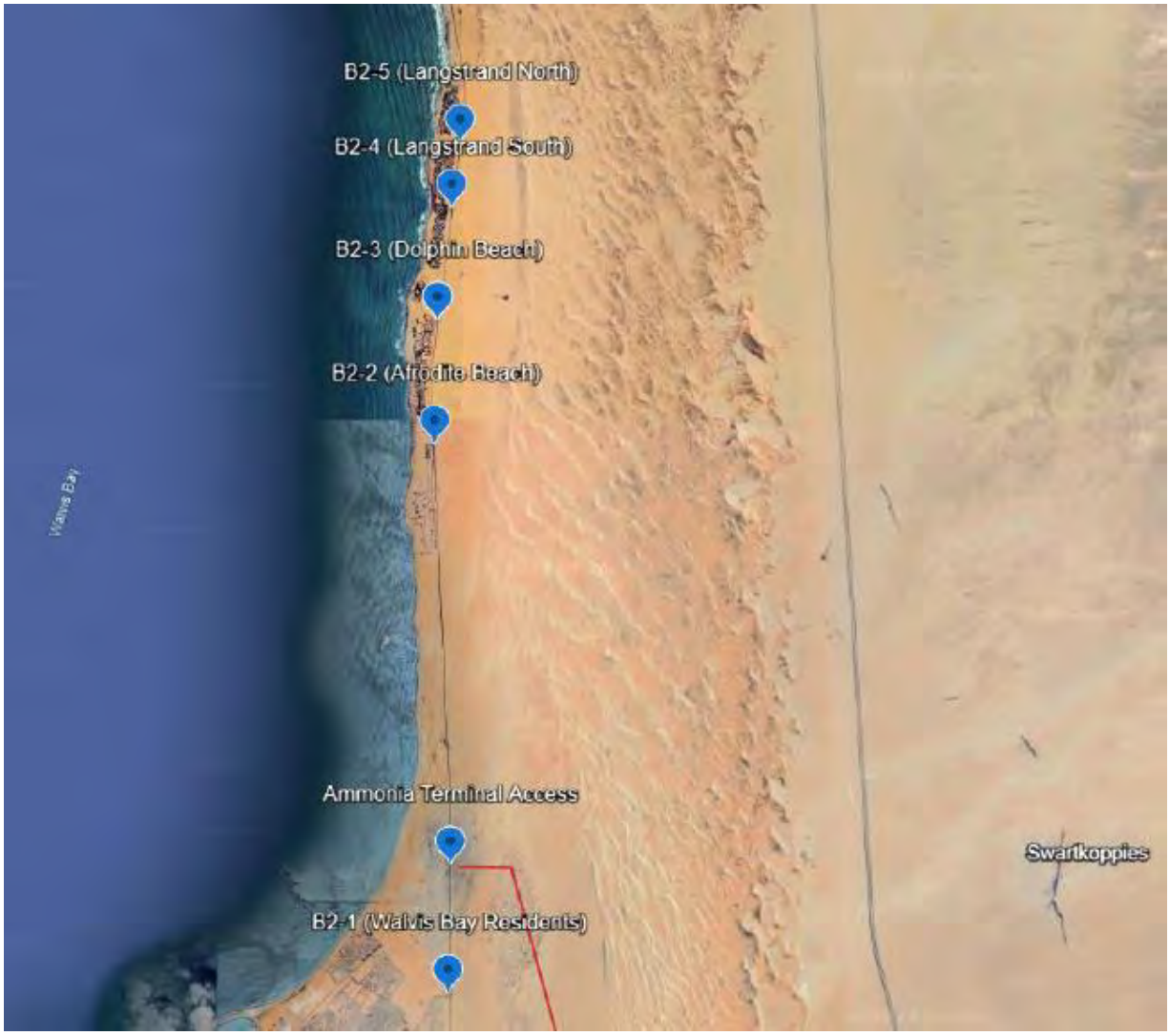


Figure 24 - Identified intersections along the B2 Main Road (Zutari Namibia, 2024)

Table 12 - Intersection details between Swakopmund and Walvis Bay (Zutari Namibia, 2024)

Intersection No.	Location	Size	Stakeholder	Condition	Adequate sight Distance	Potential Access to Terminal
B2-1	22°55'19"S 14°32'38"E	Major, West side	Walvis Bay Residents	Good	Yes	No
B2-2	22°51'16"S 14°32'32"E	Major, West side	Afrodite Beach Residents	Good	Yes	No
None	22°54'22"S 14°32'40"E	N/A	Ammonia Terminal Access	N/A	Yes	Yes
B2-3	22°50'21"S 14°32'34"E	Major, West side	Dolphin Beach Residents	Good	Yes	No
B2-4	22°49'31"S 14°32'40"E	Major, West side	Langstrand South Residents	Good	Yes	No
B2-5	22°49'02"S 14°32'44"E	Major, West side	Langstrand North Residents	Good	Yes	No

The B2 Main Road is a high traffic volume sealed bitumen surfaced road. Most of the road section is in a good condition with minor defects such as isolated edge breaks, minor rutting intersections, small potholes and small cracks. According to Zutari (2024) a team from the Roads Authority of Namibia Maintenance division was busy with edge break repairs and the team informed that pothole and crack repairs were scheduled within the next year.

5.15.1.3 Affected communities

During the traffic impact assessment, the affected communities along the proposed route of the Ammonia Terminal were identified as follows:

- Walvis Bay town residents;
- Motorists/commuters/tourists travelling on the B2 road;
- Swakopmund town residents;
- Afrodite Beach residents;
- Dolphin Beach residents; and
- Langstrand residents

5.15.1.4 Traffic data

Existing Traffic Data

Existing traffic data collected included available historic traffic data, moving traffic counts and estimated traffic data from the Roads Authority of Namibia. The data from the moving vehicle count between Swakopmund and Walvis Bay (B2 road) and on D 1984 has been converted to 24 hour counts by using the information from the permanent and ad hoc stations. Table 13 shows the average daily traffic (ADT) in the general area.

It was found that more heavy vehicles make use of the D1984 road, due to a restriction on heavy vehicles on the B2 road between Swakopmund and Walvis Bay established by Roads Authority (RA). The light vehicle between Swakopmund and Walvis Bay are generally residents commuting to their workplace. Small delivery vehicles also use the B2 road to deliver goods and services between Swakopmund and Walvis Bay.

Table 13 - Average daily traffic volumes on B2 and D 1984 between Swakopmund and Walvis Bay

Description	ADT Light	ADT Heavy	ADT Total
B2:			
Moving Traffic Count – Swakopmund to Walvis Bay	3 480	165	3 645
D1984:			
Moving Traffic Count	420	780	1 200

5.16 SOCIAL AND SOCIO-ECONOMIC BASELINE

The Erongo Region is located on the central western area of Namibia covering approximately 63 586 km^2 and comprises 7.7% of Namibia's total area. Cleanergy Solutions Namibia launched the construction of Africa's first green hydrogen plant, refueling station and hydrogen academy in Walvis Bay in 2023. Industries such as manufacturing, mining and agriculture are expected to shift to more sustainable practices and reduce the carbon footprint on a global scale (Shiwayu & Hartmann, 2023). The main goal of the Hydrogen Academy is to provide the skill and training related to the production and usage of hydrogen as fuel for heavy duty and mining equipment. This produces a whole new exciting field that explores new initiatives and provides new career and employment opportunities (Cleanegy Solutions Namibia, 2023).

5.16.1 POPULATION AND GROWTH RATE

In 1991, the Namibian population stood at 1.4 million people and the Erongo Region had a population of 55 470 (Iipumbu, 2024). The preliminary population and housing census of 2023 reported that Namibia's population after 32 years has doubled to 3 022 401 with Erongo Region making up 240 206 (Namibia Statistic Agency, 2023). The first main population increase in 1994 was noted due to the inclusion of Walvis Bay into Namibia from South Africa. The increase between 2001 and 2011 can be attributed to the increase in industrialisation in the coastal towns and mining activities. Currently Erongo Region is the fifth most populated region in the country with a population density of 3.8 persons per km^2 and the average household size of 3.1 persons per household which is below average of 3.8 (Namibia Statistic Agency, 2023). The proposed Project is situated approximately 3 km from the Walvis Bay town with a population of 52 058 as of 2024 (World Population Review, 2024).

The growth rate in the Erongo Region increased greatly in the past decades, with more males residing in the Erongo than females, with a difference of approximately 4 400. This is mainly attributed to job availability in the industrialised market at the coast, whereby traditionally certain skill sets were not associated to be 'female jobs'. Moreover, a high rate of urbanisation is experienced in the Erongo Region and is directed towards the Walvis Bay-Swakopmund area.

5.16.2 POVERTY AND UNEMPLOYMENT

The three industries in which most Namibian citizens are employed are:

- Agriculture, forestry and fishing;
- Accommodation and food services activities; and
- Wholesale and retail trade.

In 2018 it was reported that 53.4% of employed Namibians work in the private sector and 21.5% by the state (Namibia Statistics Agency, 2019). State-owned enterprises provide jobs for 7.6% of Namibians and private individuals - 16.6%. Wages and salaries were reported as the main income source of 47.4% of households in Namibia.

It has been reported that the overall unemployment rate is approximately 35%, with youth unemployment rate estimated at 50% (Shikololo, 2023). The highest education obtained by most of the country (approximately 32%) is Junior secondary level of secondary school (Namibia Statistics Agency, 2019).

The labour force survey stated that Erongo region has the lowest unemployment rate (approximately 21.9%) in the country (Namibia Statistics Agency, 2019). Furthermore, Erongo region's youth also have the lowest unemployment rate (25%), not including those studying at a tertiary level. The unemployment rate for Erongo region has dropped with 5% in 2011 (Namibian statisitc Agency, 2011).

5.16.3 ECONOMIC ENVIRONMENT

5.16.3.1 Infrastructure - Namport

The Namibian Ports Authority (also referred to as 'Namport' or the 'Authority') was established by the Namibian Ports Authority Act, No. 2 of 1994 (Namport, 2023). Namport manages Namibia's ports in Walvis Bay and Lüderitz. The Port Walvis Bay is Namibia's largest commercial port, receiving approximately 3,000 vessel calls each year and handling about 5 million tonnes of cargo. The Port of Walvis Bay handles container imports, exports and transshipments, as well as bulk and break-bulk of various commodities and serve a wide range of industries such as the petroleum, salt, mining and fishing industries (Namport, 2023). Both bulk and bagged salt are exported from the Port of Walvis Bay.

According to Namport's integrated annual report for the financial period from 1 April 2022 to 31 March 2023, Namport has recorded a revenue increase of approximately N$1.5 billion or 22%

compared to the N$1.2 billion increase recorded in 2022 (Endjala, 2024). The profit was set against a target of N$1.2 billion while the ports authority announced an operating profit of N$411 million compared to the 2022 financial year which recorded N$375 million (Endjala, 2024).

5.16.3.2 Fisheries

The central Namibian coast is characterised by its nutrient-rich cold Benguela Current and upwelling system in the Atlantic Ocean, which supports a highly productive fishing industry. More than 20 species of fish, lobsters and crabs are commercially harvested in these waters (Erongo Regional Council, 2015).

The fishing industry is the third largest economic sector contributing approximately 3.5% of GDP since 2007. It is administered by the Ministry of Fisheries and Marine Resources (MFMR) and is regarded as an important sector because (i) it is the fourth-largest foreign currency earner (as of 2012); (ii) it is a big employer, especially in the Erongo region, employing 25,000 people in 2012; and (iii) it has potential to contribute to the country's food security and livelihood diversification (Chiripanhura & Teweldemedhin, 2016). The value of fishing, onshore and offshore processing accounted for N$3,410 million in 2008 (Erongo Regional Council, 2015). The industry at Walvis Bay, and Lüderitz in the Karas Region, employs about 14,000 workers, of which about 43% work on vessels at sea while 57% are involved in onshore processing (Erongo Regional Council, 2015).

5.16.3.3 Tourism

The hospitality and tourism industry in Namibia contributed N$5.2 billion directly to the GDP, which is equivalent to 3.5% of the total GDP and is responsible for 44,700 of direct employment in the sector, including over 2,900 tourism-based jobs created in community conservation areas in 2018. (GIZ, 2022).

The Erongo Region recorded an occupancy rate of 59.36%, in the fourth quarter of 2022, compared to 50.01% in 2019, showing growth after the effects of the COVID pandemic (Nangolo, 2023). There are a wide range of tourist hot spots in the Erongo region, with Swakopmund and Walvis Bay being key attractions on a national and international scale. A variety of tourist attractions include Dune 7, Sandwich Harbour, Welwitschia Plains, Atlantic coastline and the Namib Desert, Cape Cross Seal Reserve, Dead Sea and the wider skeleton coastline (Nangolo, 2023). Furthermore, Walvis Bay's lagoon and wetlands are regarded as one of the most important coastal Wetlands in southern Africa due to its birdlife (Erongo Regional Council, 2022).

5.16.3.4 Energy and sustainable practices

Energy demand is continuously increasing and plays a vital role in all developed and developing countries. In Namibia there is heavy reliance on fossil fuels which accounts for ~63% of the total energy consumption (WWF Namibia, 2023).

Currently, Namibia is not an oil-producing country and at present does not possess the capacity to refine crude oil for petrol and fuel production (Institute for Public Policy Research, 2023). Fuels

are transported internationally, and lubricants are imported from South African refineries via the Walvis Bay harbour. However, Namibia is continuously encouraging efforts to find gas and oil reserves in an attempt to increase economic growth and lessen the reliance on imports (WWF Namibia, 2023). Exploration for oil and gas is underway under the control of the National Oil Company, NAMCOR. It has been reported that recent discoveries of large reserves of crude oil off the Namibian coast could potentially double the gross domestic product (GDP) by 2040 (Mathekga, 2022).

Green hydrogen is a potential fuel now introduced in Namibia by Cleanergy Solutions Namibia (Pty) Ltd, in which hydrogen molecules are separated from water with electrolysis powered by renewable energy. Green hydrogen has the potential to reduce the use of fossil fuels especially in the transport sector while mitigating climate change; reduce reliance on imported fuel and secure economic growth in Namibia (WWF Namibia, 2023).

Cleanergy Solutions launched the construction of Africa's first green hydrogen plant, refueling station and hydrogen academy in Walvis Bay in 2023. The main goal of the Hydrogen Academy is to provide the skill and training related to the production and usage of hydrogen as fuel for heavy duty and mining equipment. This produces a whole new exciting field that explores new initiatives and provides new career and employment opportunities (Cleanegy Solutions Namibia (Pty) Ltd, 2023).

5.16.4 PUBLIC HEALTH

The public health and safety section below has been informed by the quantitative risk assessment (Appendix I) carried out by Antea Group.

5.16.4.1 Public health

Namibia's health services are twofold: private (serving approximately 18% of the population with medical aid) and public (serving the remaining 82%) (Christians, 2020). Public health falls under the Ministry of Health and Social Services (MoHSS), which operates a four-tiered health system, consisting of primary healthcare (PHC) sites, district hospitals, intermediate hospitals and a referral hospital (Christians, 2020). Overcrowding is common at hospitals due to higher quality of care compared to rural clinics. (Namibia Ministry of Health and Social Services , 2017).

Walvis Bay currently has the highest rate of tuberculosis (TB) infections in Namibia. This was also the first town during the COVID-19 pandemic where cluster infections were occurring. This may be due to the international harbour, various trucking companies and overcrowding in townships, whereby airborne diseases travel faster. In 2015 it was reported that in the Erongo Region the HIV prevalence in women between ages of 15 and 49 was 14.6% and men between the same ages 10.4% (Namibia Ministry of Health and Social Services, 2015). The 2016 Ministry of Health Centennial Surveillance Survey confirmed Walvis Bay had a HIV/AIDS prevalence rate estimated at 17.6% and Swakopmund of 18.6%. The national prevalence rate average stands at 17.2%. Both

Swakopmund and Walvis Bay are above the national average; however, Walvis Bay has shown a noted decrease from previous surveys (29% in 2009) and Swakopmund has shown a significant increase from the 2015 survey (10.5%). National for urban areas, the age group 45-49 group had the highest prevalence rate, whereby in rural areas the age group 35-39 had the highest prevalence rate.

5.16.4.2 Ammonia hazard

Ammonia is a colourless gas with a pungent and suffocating odour. It liquefies easily under pressure, with a normal boiling point of -33°C. Although classified as a non-flammable gas, it will burn in 16–25% vapour concentrations in air when exposed to open flames.

It is incompatible with certain materials. It is corrosive to copper, brass, silver, zinc and galvanized steel. Contact with strong oxidizers can result in fires and explosions. It forms explosive products when in contact with calcium hypochlorite (household) bleaches, halogens, gold, mercury and silver. Heat is generated when ammonia dissolves in water. At high temperatures, ammonia emits hydrogen and nitrogen. Products of combustion include nitrogen and water, which are harmless to life and the environment.

When ammonia is toxic when inhaled or swallowed and can irritate or burn skin, eyes, the nose or the throat at levels as low as 35 ppm but normally at 100–125 ppm, through inhalation or direct contact. At 700 ppm it can cause serious and permanent injury with extreme rapidity (Riscom, 2024).

5.16.4.3 Diesel hazard

Diesel is a hydrocarbon mixture with variable composition, with a boiling-point ranging between 252°C and 371°C. It is a pale-yellow liquid with a petroleum odour. Due to the flash point of diesel between 38°C and 65°C, this material is not considered highly flammable but will readily ignite under suitable conditions (e.g. high pressures).

Diesel is stable under normal conditions. It will react with strong oxidising agents and nitrate compounds. Diesel is not considered a toxic material. Contact with vapours may result in slight irritation to nose, eyes and skin and may cause headache, dizziness, loss of consciousness or suffocation as well as lung irritation with coughing, gagging, dyspnoea, substernal distress and rapidly developing pulmonary oedema.

When diesel is mishandled or accidentally spilled into watercourses, it floats on the surface of the water and can cause significant environmental hazards, particularly in the case of large spills (Riscom, 2024). It is therefore important that best practices are enhanced pertaining to the handling of diesel and any other hydrocarbons throughout the Project life cycle.

5.16.4.4 Legal framework used in QRA

The quantitative risks assessment (QRA) presented in Appendix I has been carried out according to Dutch legislation and has been referenced in this assessment. The following points applies:

- In the Netherlands, facilities with large quantities of hazardous substances fall under the Dutch implementation of the Seveso-directive - Brzo (Besluit risico's zware ongevallen) act. With respect to external safety the decree Bevi (Besluit externe veiligheid inrichtingen) is applicable. Bevi imposes requirements with respect to the individual risk contours
- Within the 10-6/year individual risk contour no vulnerable objects (houses, hospitals, schools etc.) are allowed (norm value)
- Vulnerable objects include:
    - Houses, houseboats and caravans;
    - Buildings intended for the residence, whether or not for part of the day, of minors, elderly, sick or disabled persons, such as hospitals, retirement homes, nursing homes, schools or buildings or parts thereof intended for day care for minors;
    - Buildings in which large numbers of people are usually present during a large part of the day, which in any case include office buildings and hotels with a gross floor area of more than 1500 m^2 per object, or complexes in which more than 5 shops are located and of which the combined gross floor area is more than 1000 m^2 and shops with a total gross floor area of more than 2000 m^2 per shop, insofar as those complexes or shops contain a supermarket, hypermarket or department store is located; and
    - camping and other recreational areas intended for the stay of more than 50 people for several consecutive days.
- Within the 10-6/year individual risk contour preferably no limited vulnerable objects are allowed (target value)
    - This includes all that does not fall in the above categories for instance industrial objects.

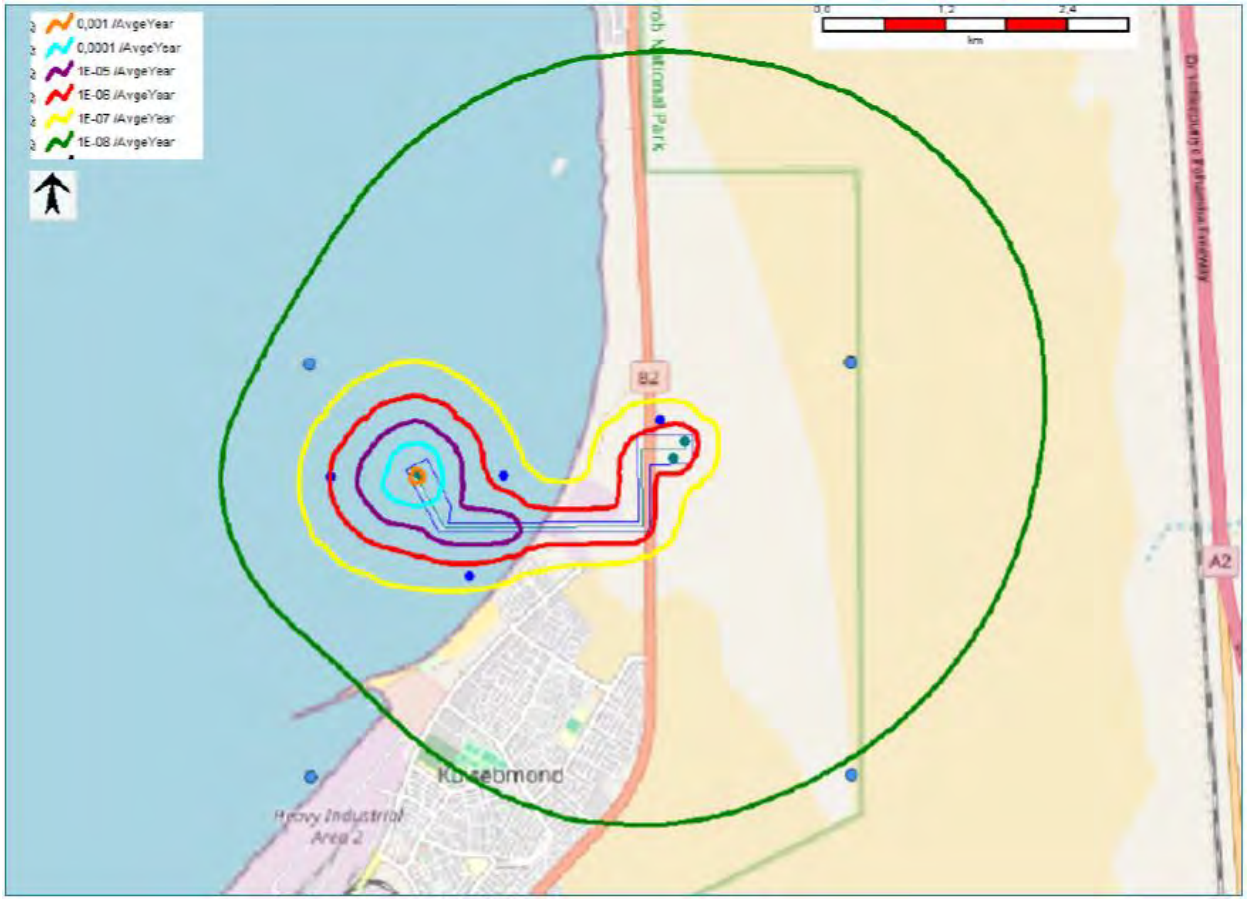
5.16.4.5 Safety of the full containment tank

The ammonia storage tank used in the project has one roof system but consists out of three containment systems. The first one (inner part) being the primary container, the second one is the double steel wall. The roof spans the inner and outer steel tank wall. The outer wall is concrete and would function as a tertiary containment system, but this system is primarily designed as a blast wall and not as a tertiary containment system, although it would function as one.

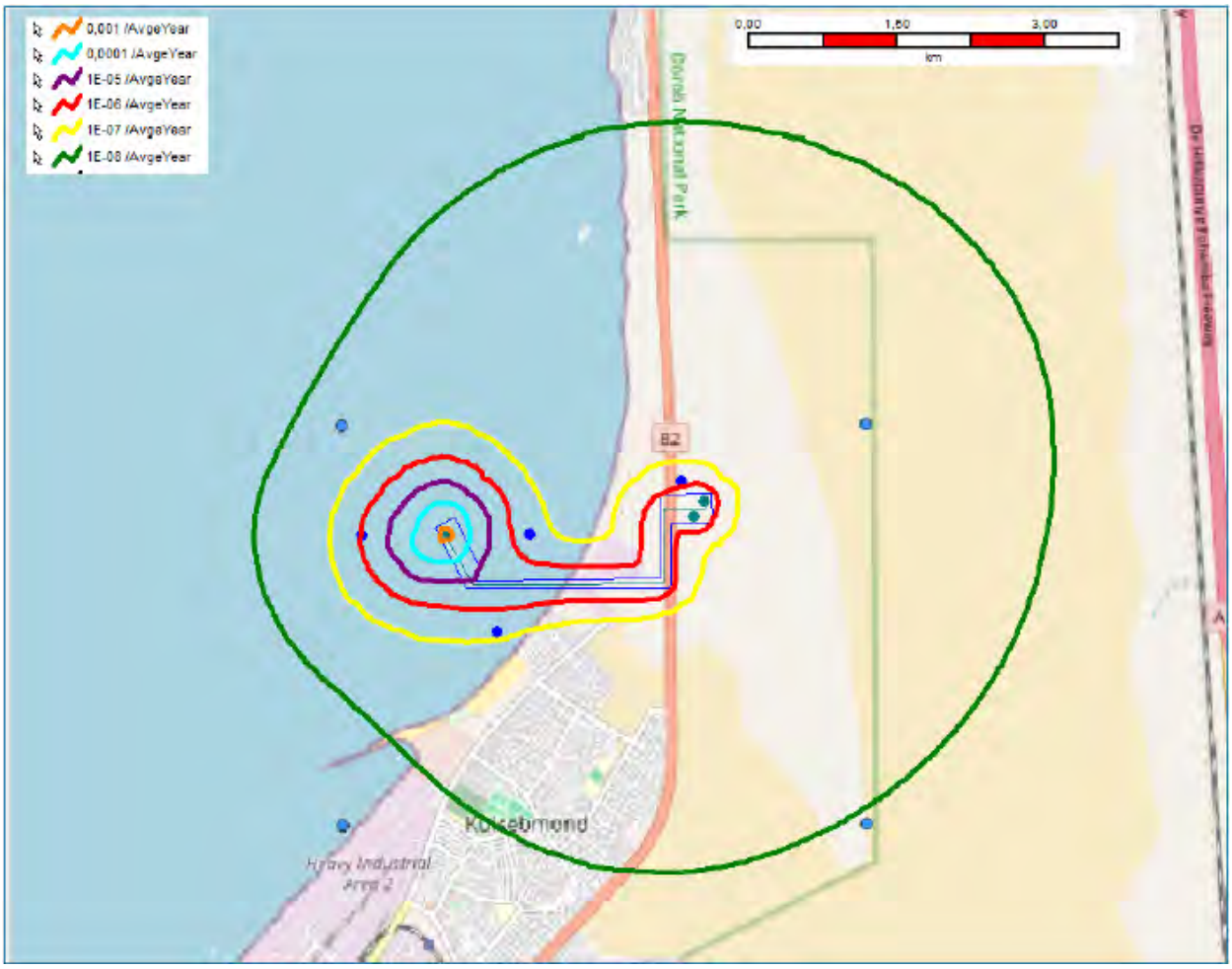
The applied scenarios for a full containment tank and corresponding frequencies for failure are presented in Appendix I.

5.16.4.6 QRA calculated risk and findings

The calculated risk used was a 10-6/yr contour to evaluate the external safety of the Project. It was found the 10-6/yr contour extends outside the current fencing of the facility. No houses or buildings are situated within this contour. It was concluded that the current Project plans and designs in relation to the nearest residential community is deemed acceptable (Figure 25).



(a)



(b)

Figure 25 - Risk contours of Ammonia Terminal and operations during the first 5 years (a); Risk contours of Ammonia Terminal with export after the initial 5 years (b)

5.17 CULTURAL HERITAGE

It has been reported that the Erongo Region is characterised by major archaeological landscapes, however a large portion of the region is archaeologically undocumented. Researchers have found that the Namib Sand Sea forming part of the Namib desert between Lüderitz and Walvis Bay revealed evidence of a small freshwater lake and human settlement during the African Middle Stone Age, between 20 000 and 300 000 years ago (Stratford & Stone, 2024). This discovery sheds light on the importance of the southern African desert landscapes to the story of human history.

The heritage impact assessment for this proposed Project was conducted and compiled by RCheritage Services cc in August 2024 (Appendix J). The archaeological survey followed a basic two-phase process of evaluation: the desk study, followed by an assessment based on the field survey. The proposed Project location is in proximity to the soft barren salt encrusted extinct mid-Holocene tidal lagoon and adjacent to endemic shrubs like Hummock dune species, i.e.,

Sasola spp. The extinct mid-Holocene tidal lagoon assisted in informing the reconstruction of the Holocene paleoenvironmental evolution of the paleo-lagoons along the Namibian coast and macrotidal estuarine systems (RCHeritage Services, 2024). During the assessment no animals, their footprints, or their skeletal faunal remains were observed due to arid conditions, extreme noise from vehicles on the B2 road, off-road vehicles, urbanisation and population increase (RCHeritage Services, 2024).

Archaeological remains along the coast are often represented by groups of shell-middens, accumulations of marine and terrestrial (wild and domestic) vertebrates remains, pottery, beads, human footprints, and various artefacts, including human remains buried under silt deposits, with some exposed by natural erosion corresponding to the flood deposits. Extensive shell midden accumulations provide valuable archaeological evidence related to the coastal conditions of Namibia (RCHeritage Services, 2024).

The field survey and assessment have located two heritage features in proximity to the proposed Project site. The first site showed evidence of shell midden and fragmented *Donax serra* (white mussel) (Figure 26) located at least 43.31 m from the proposed Project site. The second site is rather a potential historic site with an isolated heap of discarded debris from rusted and corrugated metal materials located 278.17 m away (Figure 27).



Figure 26 - Shellmidden and fragmented Donax serra referred to as "Site 01"



Figure 27 - Isolated heap of discarded debris from rusted and corrugated metal materials referred to as "Site 02"

Additionally, there are three sites in proximity to the Ammonia Terminal, identified through the QRS assessment, namely: the gypsum encrustation on the pan surface (QRS 206/194) located approximately 412.62 m from the proposed Ammonia Terminal; the surface scatter of *Donax serra* fragments (QRS 206/195) located at about 574.69 m from the proposed Ammonia Terminal; and the surface scatter of *Donax serra* fragments (QRS 206/196) located at about 23.96 m. All QRS heritage features and the two sites discovered during the site visit are shown in Figure 28.

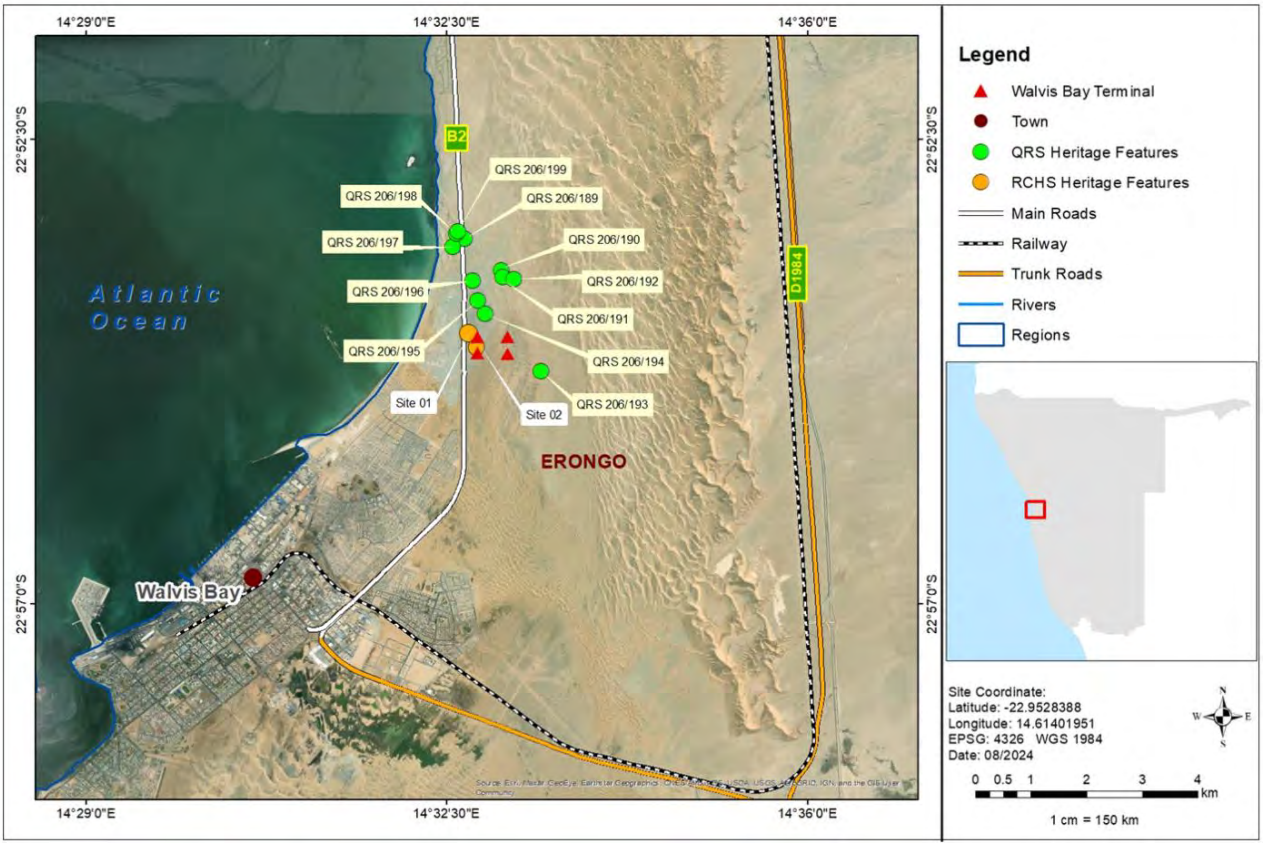


Figure 28 Consolidated map of all heritage features in the vicinity of the proposed Project

5.18 VISUAL – SENSE OF PLACE

The following visual receptors were identified during the visual impact study:

- The Walvis Bay residents
- The North Port tenants (industrial businesses)
- The Walvis Bay Airport
- Motorists/commuters/tourists travelling on the B2 road between Swakopmund and Walvis Bay
- Tourist activities on the Dune Belt

The closest suburbs to the Ammonia Terminal are Narraville, Kuisebmund and the Afrodite Beach development. Other North Port businesses are NAMCOR and Namport which are within the direct vicinity of the proposed Project. Furthermore, the North Port is set aside for future developments which would increase the businesses surrounding the proposed Project. This will potentially influence the visual impact of the Project, by reducing visibility of the Project to the potential receptors. The proposed Project may be spotted from several areas on the Walvis Bay Airport runway, however this receptor is identified as negligible, as the airport will not be visibly affected by the presence of the Ammonia Terminal, and it will not reduce the visibility of aircrafts.

The Coastal Dune Belt is considered a scenic drive, known for the road separating the ocean from the desert. This stretch from Walvis Bay to Swakopmund is renowned and generally visited by locals and tourists either for the natural scenic beauty or in search of activities such as climbing the Dune 7 and participating in other off-road activities. Development near the dunes may be subjectively upsetting to locals and visiting tourists, affecting their sense of place.

Visual impacts towards receptors in the local area, road users and tourists are further discussed and assessed in detail in Chapter 7. The viewshed map (Figure 29) shows the potential receptors within a 10 km radius.

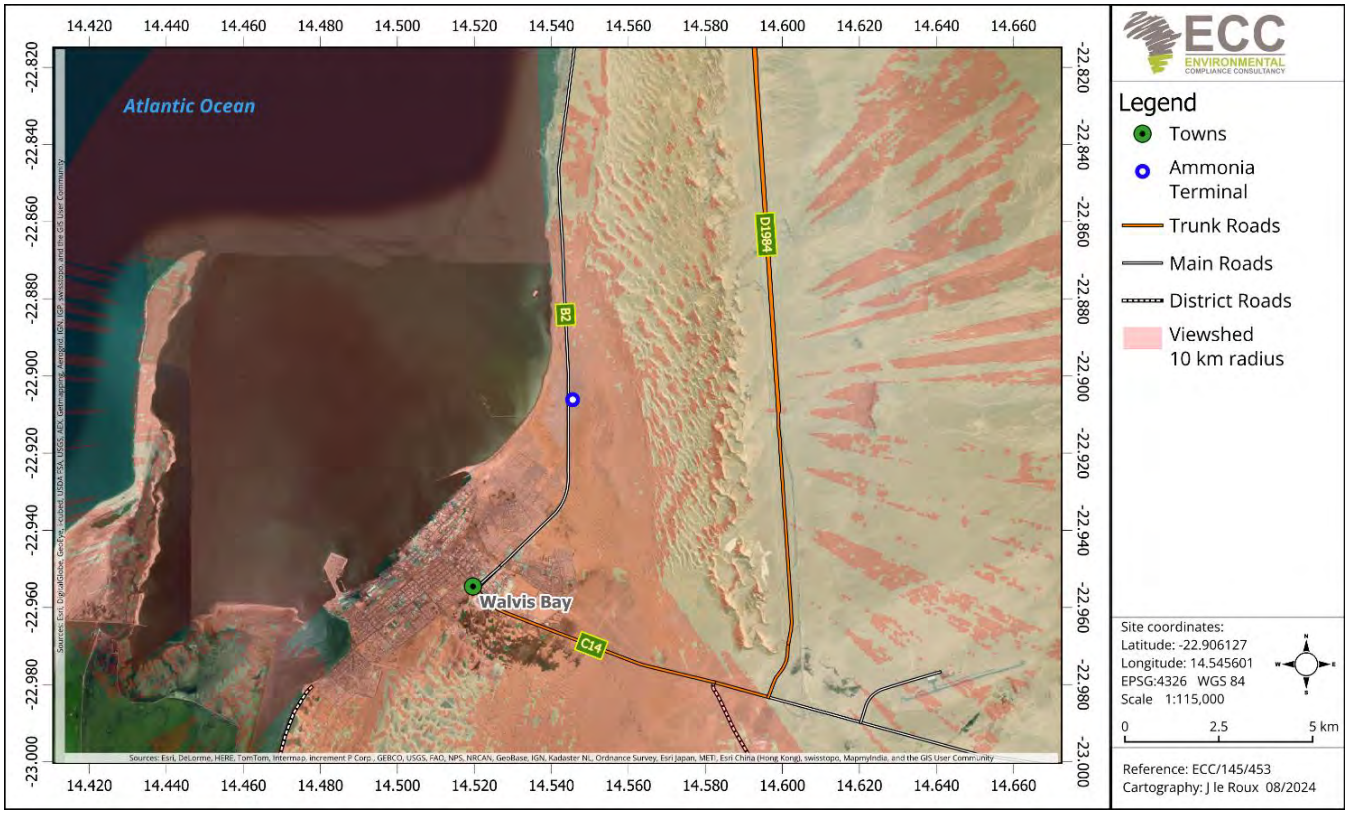


Figure 29 - Viewshed map

5.19 NOISE

(Airshed Planning Professionals, 2024) was engaged by ECC to undertake an environmental noise impact assessment (Appendix K) for the proposed Ammonia Terminal project. The main objective of the noise specialist study was to determine the significance of impacts on the acoustic environment and potential noise sensitive receptors (NSRs) given noise generated by activities proposed as part of the project.

The IFC General Environmental Health and Safety Guidelines on noise address impacts of noise beyond the property boundary of the facility under consideration and provides noise level guidelines (Table 14).

Table 14 - IFC noise level guidelines

Area	One-hour L_{Aeq} (dBA) 07:00 to 22:00	One-hour L_{Aeq} (dBA) 22:00 to 07:00
Industrial receptors	70	70
Residential, institutional and educational	55	45

5.19.1 NOISE SENSITIVE RECEPTORS

Potential noise sensitive receptors within the study area include the residential area of Walvis Bay and the Afrodite beach community.

5.19.2 NOISE SURVEY AND RESULTS

The survey sites were selected after careful consideration of future activities, accessibility, potential noise sensitive receptors, and safety restrictions. A total of 12 survey sites were selected. The location of the noise survey sites is provided in (Figure 30). Survey results for the campaign undertaken from the 23 to 26 July 2024 are presented in Figure 31 showing day-time results and Figure 32 showing night-time results. A full summary of the noise measurement conducted can be found in the noise impact assessment (Appendix K).

The survey site in proximity to the Project was Site 1 (near Walvis Bay). The noise levels at Site 1 were within the IFC noise guidelines for day- and night-time conditions.

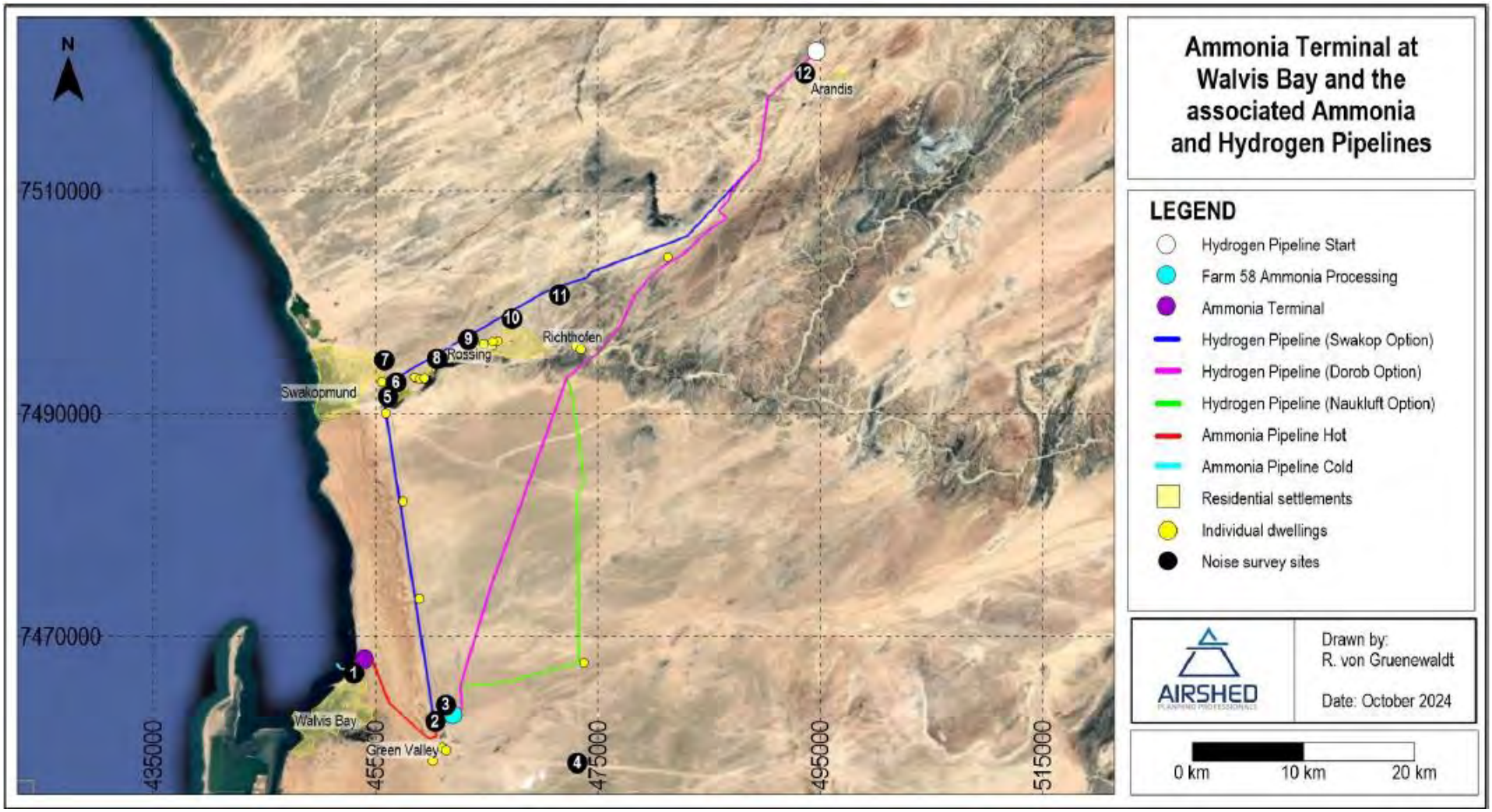


Figure 30 - Sensitive receptors within the study area and baseline noise survey sites

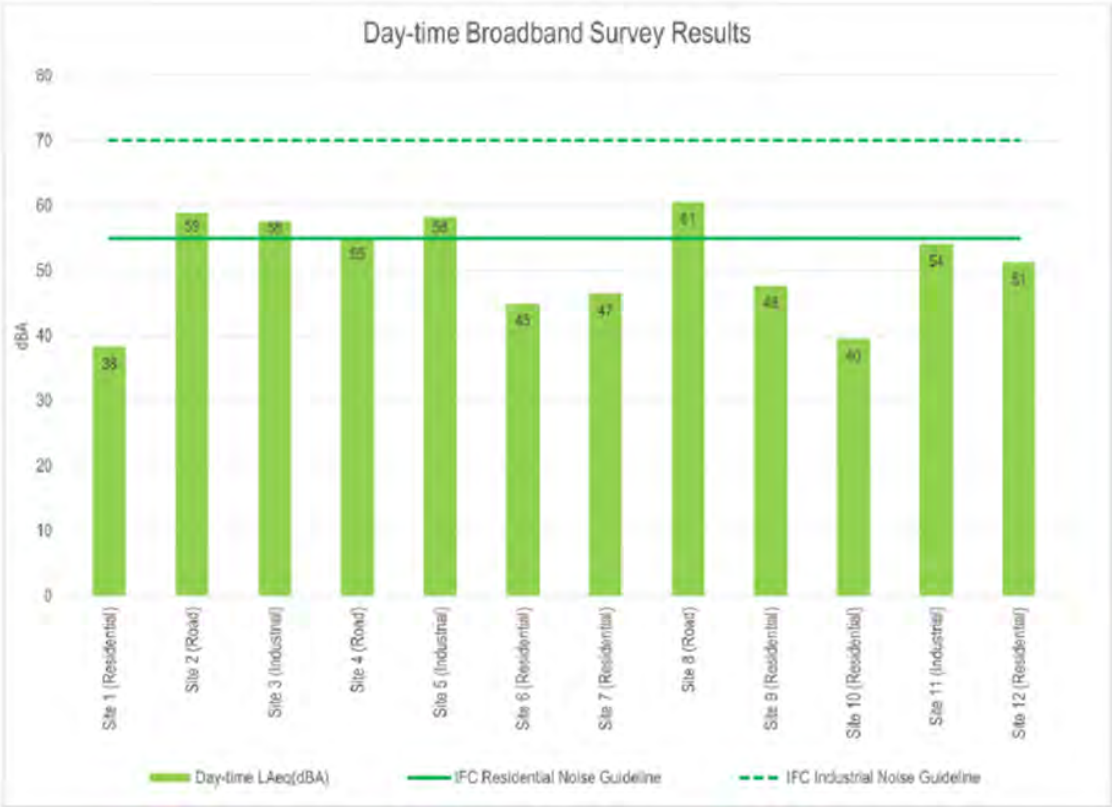


Figure 31 - Day-time broadband survey results (Airshed, 2024)

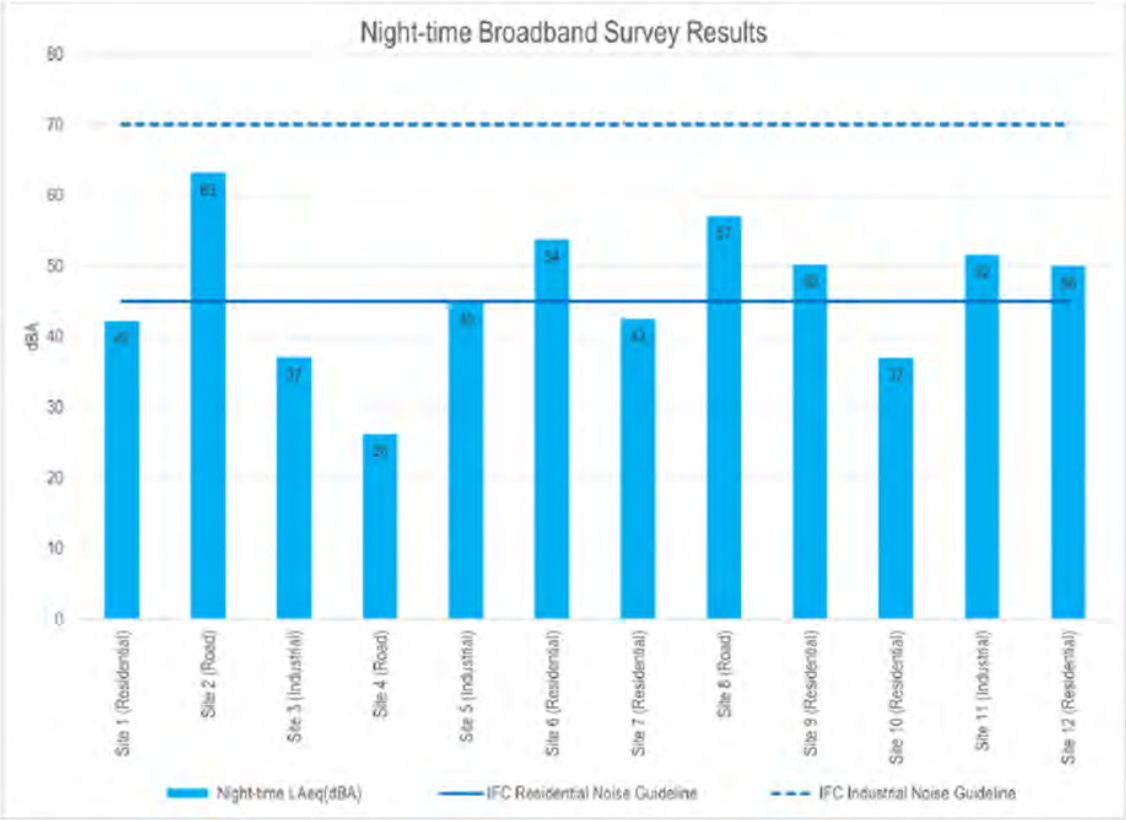


Figure 32 - Night-time broadband survey results (Airshed, 2024)

6 IMPACT IDENTIFICATION AND EVALUATION METHODOLOGY

6.1 INTRODUCTION

Chapter 2 provides an overview of the approach used in this ESIA process, and details each of the steps undertaken to date. Prediction and evaluation of impacts is a key step in the ESIA process. This chapter outlines the methods that will be followed, to identify and evaluate the impacts arising from the proposed Project. The findings of the assessment will be presented in the full assessment report.

This chapter provides comprehensive details of the following:

- The assessment guidance that will be used to assess impacts.
- The limitations, uncertainties, and assumptions regarding the assessment methodology.
- How impacts will be identified and evaluated, and how the level of significance will be derived.
- How mitigation will be applied in the assessment, and how additional mitigation will be identified.
- The cumulative impact assessment (CIA) method that will be used.

This assessment will aim to determine which impacts are likely to be significant; to scope the available data and identify any gaps that need to be filled; to determine the spatial and temporal scope; and to identify the assessment methodology.

The scope of the assessment was determined by undertaking a preliminary assessment of the proposed Project against the receiving environment, and was obtained through a desktop review, available site-specific literature, monitoring data, and site reports, as set out in this scoping report.

6.2 ASSESSMENT GUIDANCE

The following principal documents will be used to inform the assessment method:

- International Finance Corporation standards and models, in particular performance standard 1: 'Assessment and management of environmental and social risks and impacts' (International Finance Corporation, 2012 and 2017).
- International Finance Corporation Cumulative Impact Assessment (CIA) and Management Good Practice Handbook (International Finance Corporation, 2013).
- Namibian Draft Procedures and Guidance for EIA and EMP (Republic of Namibia, 2008).

6.3 LIMITATIONS, UNCERTAINTIES AND ASSUMPTIONS

Table 15 below shows the potential limitations, uncertainties and assumptions associated with the proposed Project.

Table 15 - Limitations, uncertainties and assumptions

Topic	Limitation/uncertainty/assumption
Environmental and Social Baseline Data	– Data gaps in specific environmental and social indicators. – Spatial and temporal variability of baseline data. – Accuracy and reliability of existing data sources.
Green Hydrogen Industry and Regulations	– Lack of established regulatory frameworks. – Uncertainties in market demand and project viability. – Evolving technologies and best practices for green hydrogen/ammonia.
Climate Change	– Potential impacts of climate change on Project infrastructure and operations (e.g. extreme weather events, sea level rise). – Uncertainty in climate projections and their influence on long-term assessments.

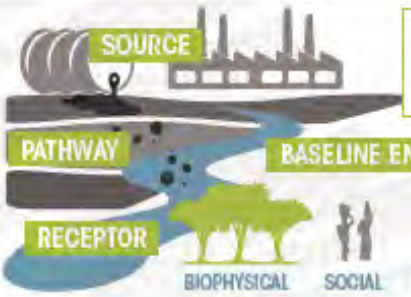
6.4 ASSESSMENT METHODOLOGY

The ESIA methodology applied to this assessment has been developed by ECC using the International Finance Corporation (IFC) standards and models, in particular performance standard 1: 'Assessment and management of environmental and social risks and impacts' (International Finance Corporation, 2017); Namibian Draft Procedures and Guidance for EIA and EMP (Republic of Namibia, 2008); international and national best practice; and over 25 years of combined ESIA experience. The methodology is set out in Figure 33.

The evaluation and identification of the environmental and social impacts require the assessment of the Project characteristics against the baseline characteristics, ensuring that all potentially significant impacts are identified and assessed.

The significance of an impact is determined by taking into consideration the combination of the sensitivity and importance/value of environmental and social receptors that may be affected by the proposed Project, the nature and characteristics of the impact, and the magnitude of any potential change. The magnitude of change (the impact) is the identifiable changes to the existing environment that may be negligible, low, minor, moderate, high, or very high; temporary/short-term, long-term or permanent; and either beneficial or adverse.

ECC IMPACT PREDICATION AND EVALUATION METHODOLOGY



ECC ESIA METHOD

- Predication and evaluation of impacts is a key step in the EIA process.
- The methods ECC follows to identify and evaluate the impacts arising from projects is outline in this diagram.

THE FOLLOWING PRINCIPLES ARE USED BY ECC FOR ASSESSMENTS

- International Finance Corporation standards and models, in particular Performance Standard 1, 'Assessment and management of environmental and social risks and impacts' (International Finance Corporation, 2017) (International Finance Corporation, 2012);
- International Finance Corporation CIA and Management Good Practice Handbook (International Finance Corporation, 2013) and,
- Namibian Draft Procedures and Guidance for EIA and EMP (Republic of Namibia, 2008).

DETERMINE THE SIGNIFICANCE OF AN IMPACT

SENSITIVITY AND VALUE OF A RECEPTOR

The sensitivity and value of a receptor is determined by identifying how sensitive and vulnerable a receptor is to change, and the importance of a receptor (internationally, nationally, locally)

NATURE AND CHARACTERISTICS OF THE IMPACT

The nature and characteristics of the impact is determined through consideration of the frequency, duration, reversibility and probability of the impact occurring.

MAGNITUDE OF CHANGE

The magnitude of change measures the scale or extent of the change from the baseline condition, irrespective of the value. The magnitude of change may alter over time, therefore temporal variation is considered (short-term, medium-term, long-term; reversible, irreversible environmental assessment methodology.

ECC – NATURE OF IMPACT

BENEFICIAL (POSITIVE)
An impact that is considered to represent an improvement on the baseline or introduces a positive change.

ADVERSE (NEGATIVE)
An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.

REVERSIBILITY

REVERSIBLE
Impacts are reversible and recoverable in the future

PARTLY REVERSIBLE
Some parts of the impact can be reversed while others remain

IRREVERSIBLE
Impacts which are not reversible and are permanent

DURATION

TEMPORARY
Transient; a period of less than 1 year

SHORT TERM
Impacts that are likely to last for the duration of the activity causing the impact and are recoverable (1-5 years)

MEDIUM TERM
Impacts that are likely to continue after the activity causing the impact and are recoverable (5-15 years)

LONG TERM
Impacts that are likely to last far beyond the end of the activity causing the damage (greater than 15 years with impact ceasing after decommissioning of the project)

PERMANENT

SCALE OF CHANGE - EXTENT / GEOGRAPHIC SCALE

ON-SITE
Impacts that are limited to the boundaries of the proposed project site

LOCAL
Impacts that occur in the local area of influence, including around the proposed site and within the wider community

REGIONAL
Impacts that affect a receptor that is regionally important by virtue of scale, designation, quality or rarity.

NATIONAL
Impacts that affect a receptor that is nationally important by virtue of scale, designation, quality or rarity.

INTERNATIONAL
Impacts that affect a receptor that is nationally important by virtue of scale, designation, quality or rarity.

ECC – TYPE OF IMPACT

DIRECT
Impacts causing an impact through direct interaction between a planned project activity and the receiving environment/ receptors.

INDIRECT
Impacts that result from other activities that are encouraged to happen as a result / consequence of the Project. Associated with the project and may occur at a later time or wider area

CUMULATIVE
Impacts that arise as a result of an impact and effect from the project interacting with those from another activity to create an additional impact and effect

MAGNITUDE OF CHANGE

VERY HIGH / UNKNOWN	Loss of resource, significantly affecting the long term quality and integrity of a resource; irreparable damage or loss of key characteristics, features or elements; or the magnitude is too great to quantify as it is unknown.
HIGH / MAJOR	Loss of resource, and quality and integrity of resource; severe damage to key characteristics, features or elements; or Large scale or major improvement of resources quality; extensive restoration or enhancement; major improvement of attribute quality.
MODERATE	Loss of resource, but not adversely affecting its integrity; partial loss of/damage to key characteristics, features or elements; or Benefit to, or addition of, key characteristics, features or elements; improvements of attribute quality.
LOW / MINOR	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (or maybe more) key characteristic, feature or element; or Minor benefit to, or addition of, one (or maybe more) key characteristic, feature or element; some beneficial effect on attribute quality or a reduced risk of a negative effect occurring.
NONE / NEGLIGIBLE	Very minor loss or detrimental alteration to one (or maybe more) characteristic, feature or element; or Very minor benefit to, or positive addition of, one (or maybe more) characteristic, feature or element.

PROBABILITY

IMPROBABLY (RARE)
The event may occur in exceptional circumstances yet, rarely occurs in the industry. The event could occur once every 100 years

LOW PROBABILITY (UNLIKELY)
The event has happened elsewhere yet, is unlikely to occur. The event could occur once every 10 years

MEDIUM PROBABILITY (POSSIBLE)
The event could occur under some circumstances. The event could occur once every 5 years.

HIGH PROBABILITY (LIKELY)
The event is expected to occur. The event could occur twice per year

DEFINITE (ALMOST CERTAIN)
The event will occur. The event could occur once per month

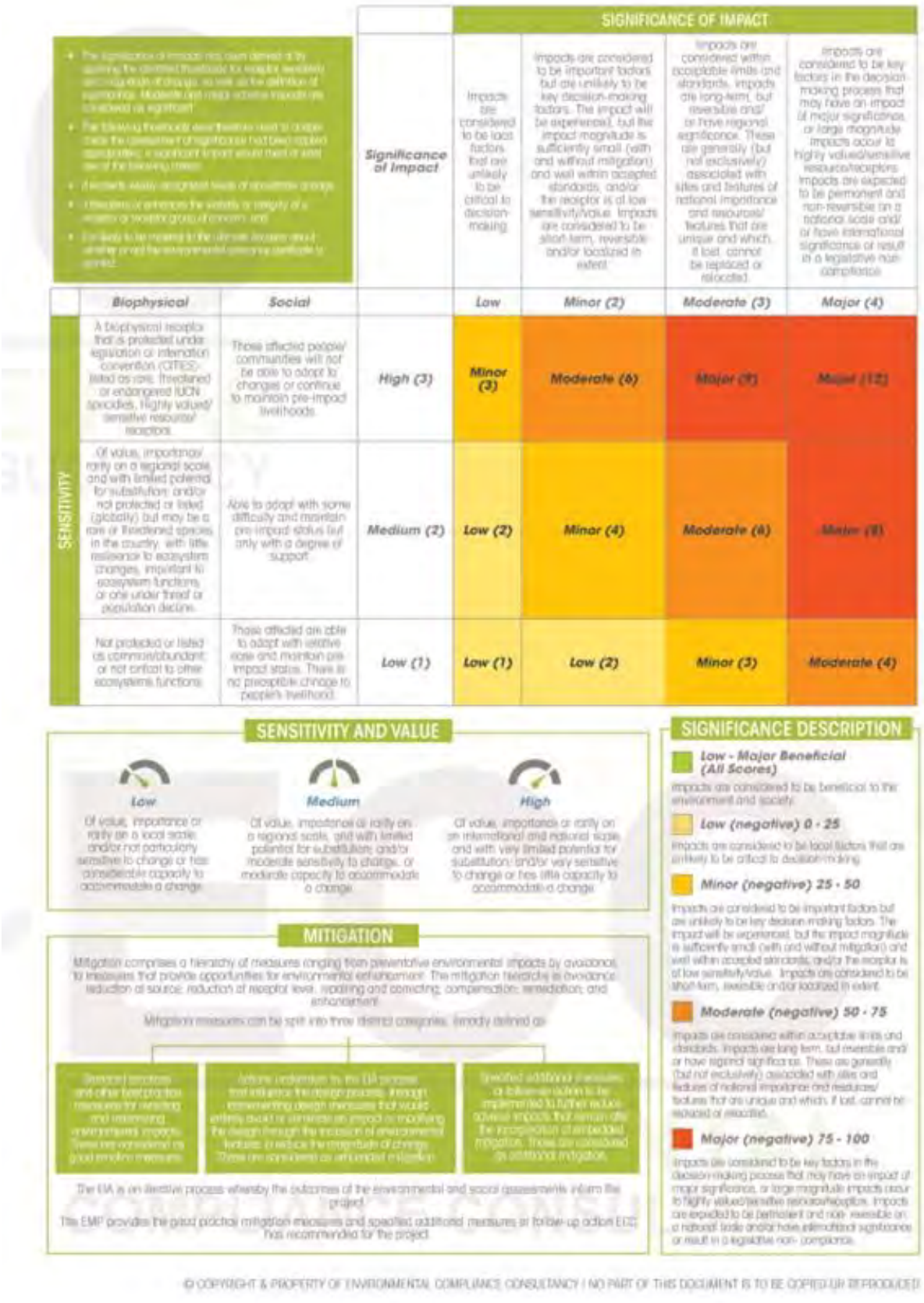


Figure 33 - ECC ESIA methodology based on IFC standards

6.5 CUMULATIVE IMPACTS

6.5.1 CUMULATIVE IMPACT ASSESSMENT METHOD

Cumulative impacts may arise as a result of other Project activities, or due to the combination of two or more projects in the Project area. A cumulative impact assessment (CIA) will be undertaken by applying the IFC CIA Good Practice Handbook (International Finance Corporation, 2013), which recommends that a rapid CIA is undertaken.

A rapid CIA takes into consideration the challenges associated with a good CIA process, which include a lack of basic baseline data, uncertainty associated with anticipated development, limited government capacity, and the absence of strategic regional, sectoral, or integrated resource planning schemes.

The following five-step rapid CIA process will be followed:
Step 1: Scoping – Determine spatial and temporal boundaries
Step 2: Scoping – Identify valued environmental and social receptors and identify reasonably foreseeable developments
Step 3: Determine the present condition of valued environmental and social receptors (The baseline)
Step 4: Evaluate the significance of the cumulative impacts
Step 5: Identify mitigation measures to avoid or reduce cumulative impacts

The following information will be applied to the assessment in line with the above steps and IFC guidance:

- The spatial and temporal boundaries of the CIA are the extent of the Project boundaries and the duration of the construction and operation phases of the proposed Project.
- Valued environmental and social receptors that may be affected.
- A review of existing and reasonable, anticipated and/or planned developments has been undertaken, which is based on the information presented in chapter 4.
- The predicted future conditions of sensitive and common environmental and social receptors have been taken into consideration in the assessment.
- The assessment findings will be presented in the assessment report and will have the CIA applied in combination with professional judgment and published environmental assessment reports.
- A review of mitigation and monitoring measures will be undertaken, with any additional ones identified.

6.6 MITIGATION

Impacts that are identified throughout the ESIA process will be subjected to a process of impact mitigation, which is inherent in all aspects of the ESIA system. Embedded mitigation and good practice mitigation will be considered in the assessment. Additional mitigation measures will be

identified when the significance of an impact requires it and causes the impact to be further reduced.

The principal of impact mitigation comprises a hierarchy of measures ranging from preventative environmental impacts by avoidance, to measures that provide opportunities for environmental enhancement and will be applied to all impacts associated with the proposed Ammonia Terminal Project. The mitigation hierarchy is avoidance; reduction at source; reduction at receptor level; repairing and correcting; compensation; remediation; and enhancement. The environmental and social management plan (ESMP) for the Project provides good practice measures of the impact mitigation and specifies additional measures or follow-up action where required. The ESMP is appended to this report (Appendix A– ESMP). On completion of the impact assessment, the mitigation measures from the impact assessment and recommendations from the specialist studies are then incorporated into the Final ESMP, which forms an appendix of the Final ESIA (Appendix A – ESMP).

Mitigation measures can be split into three distinct categories, broadly defined as:

- Actions undertaken by the ESIA process that influence the design process, through implementing design measures that would entirely avoid or eliminate an impact, or, modifying the design through the inclusion of environmental features to reduce the magnitude of change. These are considered embedded mitigation;
- Standard practices or other best practice measures for avoiding and minimising environmental impacts. These are considered good practice measures;
- Specified additional measures or follow up actions to be implemented, to further reduce adverse impacts that remain after the incorporation of embedded mitigation. These are considered additional mitigation measures.

Where additional mitigation is identified, a final assessment of the significance of impacts (residual impacts) will be carried out, taking into consideration the additional mitigation.

The ESIA is an iterative process whereby the outcomes of the environmental assessments inform the environmental management of the proposed Ammonia Terminal Project through the ESMP.

The ESMP in Appendix A provides an outline of the good practice measures and specified additional measures or follow-up actions to be undertaken. The project ESMP will be finalised on completion of the impact assessment process and included in the final ESIA report.

7 IMPACT ASSESSMENT FINDINGS & MITIGATIONS

This impact assessment was completed taking into consideration the input received from stakeholders during the public participation phase. Specialist studies that had previously been conducted were reviewed and reassessed based on the input from the public participation phase. As part of the final impact assessment, a final environmental and social management plan (ESMP) was produced to manage residual impacts that cannot be mitigated through the project evolution process.

This chapter presents the findings of the ESIA for the proposed project as per the ESIA process, scope and methodology set out in Chapters 2 and 6. The aim of this ESIA report is to focus on the significant impacts that may arise because of the proposed project. This chapter therefore only considers the significant impacts and or those that may have specific interest to the community and stakeholders. A summary of impacts that are not considered significant is discussed in 7.1.

The list of high level and likely impacts that are considered significant or of interest to the community and stakeholders are as follows:

- Socio-economic: employment and employee occupational health and safety
- Socio-economic: community health and safety
- Socio-economic: traffic
- Socio-economic: tourism
- Socio-economic: heritage
- Socio-economic: visual
- Environment: biodiversity (fauna), air quality and noise impacts.

For each potential significant or sensitive impact, a summary is provided which includes the activity that would cause an impact; the potential impacts; embedded or best practice mitigation (stated where required / available); the sensitivity of receptor that would be impacted; the severity, duration, and probability of impacts; the significance of impacts before mitigation and after mitigation measures are applied.

7.1 IMPACTS NOT CONSIDERED SIGNIFICANT

As a result of an iterative project evolution process, mitigation has been incorporated and embedded into the project plan, thereby designing out potential environmental and social impacts or reducing the potential impact so that it is not significant. The ESMP provides best practice measures, management and monitoring for identified impacts. Impacts that have been assessed as not being significant are summarised in Table 16 and are not discussed further, unless otherwise indicated.

Table 16 - Non-significant impacts

Environmental or Social topic	Potential impact	Rational
Social environment		
Light disturbance	Light disturbance on Walvis Bay, Afrodite Beach and Dolphin Beach	The Project site will be located within the North Port, with existing industrial infrastructure already present. The light emitted by the Ammonia Terminal will not have a significant impact on Walvis Bay residents. Based on the viewshed map, the residents of Afrodite and Dolphin Beach are approximately 5 - 7 km from the Project area.
Land use	Land may no longer be used for other purposes such as agriculture	The area is highly arid and has very limited groundwater potential making the area not productive for agricultural purposes. Therefore, the construction of the Ammonia Terminal would not have a significant impact on land use.
Human Rights	The effects that the Ammonia Terminal Project may have on the human rights of the local community	Residents will not be expected to relocate or change their way of living to accommodate the Project. The development and operations of the Project will not violate human rights of local communities.
Biophysical environment		
Soils	The impact on soil quality and potential soil erosion	The soil in the Proposed site is characterised as poor soil due to its low water and air association, high salinity and cemented nature. The Project is would not have a significant impact on soil.
Terrestrial flora	Potential loss to terrestrial flora and impact on the existing plant biodiversity due to the Project	The land is highly barren with no flora available on the Project site, therefore the Project is unlikely to have a significant impact on the overall plant biodiversity of the area.

Environmental or Social topic	Potential impact	Rational
Sea water/salt water	Potential impact of toxic ammonia on the nearby seawater	The scrubber outlet will release less than 25 ppm of ammonia, in emergency cases, ammonia will be burned (99th percentile). Furthermore, ammonia is lighter than air - any small traces of ammonia released at a 45 m height will not impact the sea/salt water.
Surface and groundwater quality	Potential contamination and impact on the quality of surface or groundwater	There are no nearby rivers, with the closest river being approximately 20 km from the Project site. The groundwater in the Project area is generally of very low potential, and mostly saline to hyper-saline. The nearest moderately porous aquifer and major Kuiseb aquifer is approximately 12 km and 22 km from the proposed Project.

7.2 SOCIO-ECONOMIC ENVIRONMENT: ECONOMIC

Impacts associated with the construction, operations and decommissioning of the proposed Ammonia Terminal Project have been identified and have undergone the assessment process to derive the significance value of each impact. The impacts are categorised into tow broad categories namely economic and social influences and assessed separately. Economic impacts include issues such as employment, changes in economic activity such as tourism and increased local expenditure and skills development. The significant economic impacts before mitigation are summarised in Figure 34 for illustrative purposes. Details related to each specific impact is discussed further in this section.

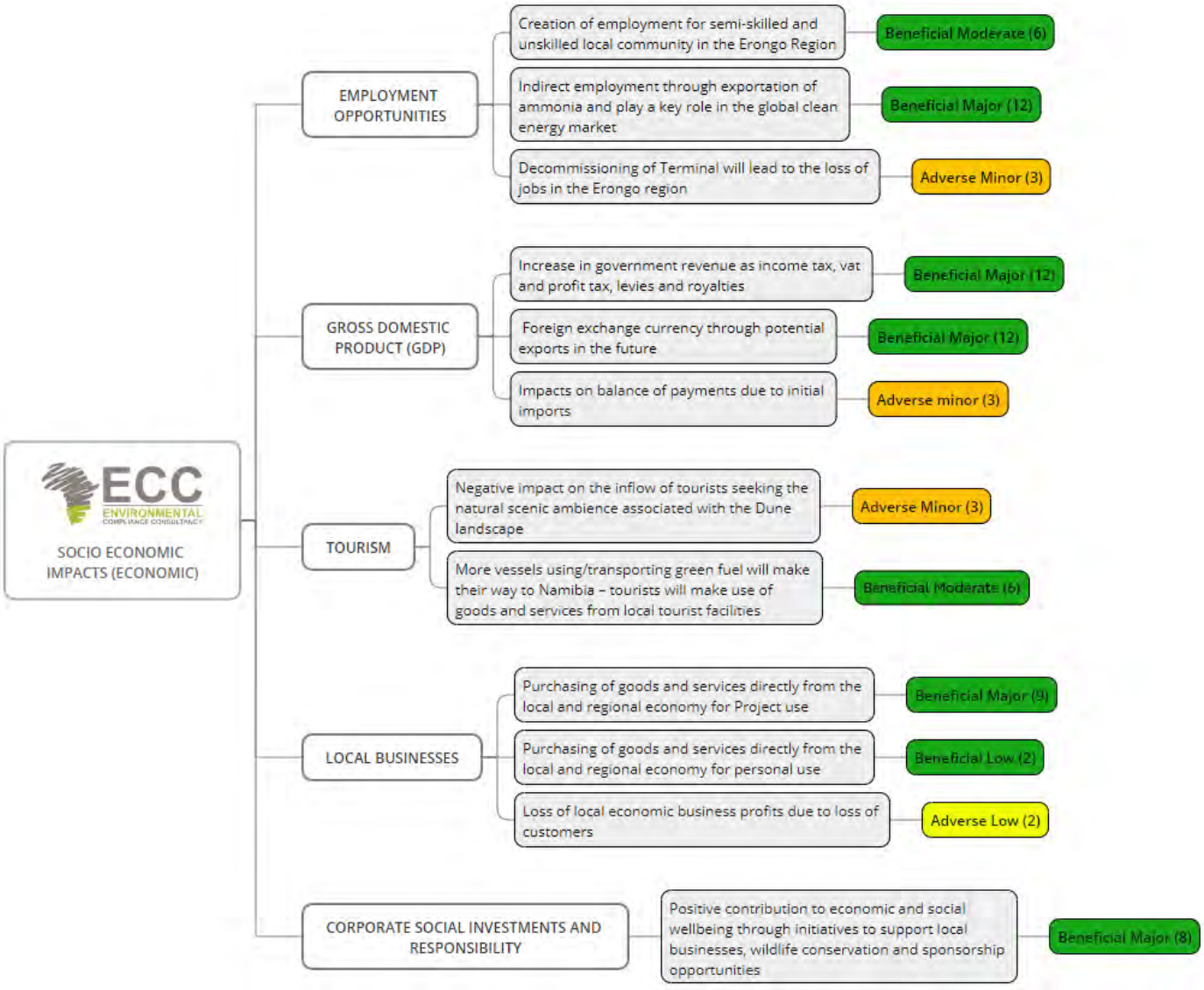


Figure 34 - Socio-economic impacts

7.2.1 EMPLOYMENT OPPORTUNITIES

In Namibia, it has been reported that to date, the green hydrogen sector has generated temporary employment opportunities for more than 400 individuals. Among ongoing green hydrogen projects in Namibia, the Cleanergy Solutions Demonstration Plant including a public refueling station, a dual fuel workshop and a H_2 Academy was initiated at the end of 2021 (CMB.TECH, 2024). The green hydrogen industry especially presents an opportunity for young unemployed Namibians.

7.2.1.1 Direct employment of semi-skilled and unskilled locals during the Project

During the construction phase of the Project, approximately 700 temporary positions for semi-skilled and unskilled labourers could be generated, which benefits the local and regional community. It is expected that local labour will be employed for basic construction of the double wall full containment ammonia storage tank and associated facilities, as set out in chapter 4 of this report. The impact is beneficial, direct and partly reversible due to the short term of the

construction activities (less than 5 years). The possibility is definite, as workers will be required for the Project to be initiated. The magnitude of change is minor due to added temporary positions and improvements to members of the larger Erongo Region. The sensitivity is expected to be medium due to the regional scale of the impact. The overall significance of the impact is beneficial moderate.

7.2.1.2 Indirect employment

The Ammonia Terminal Project, encompassing construction, operations and decommissioning phases, is anticipated to create indirect employment opportunities for third parties throughout the Project. Collaborating with potential service providers and short-term contractors will generate opportunities for indirect employment across the Erongo Region and potentially at a national scale.

During the Project construction it is envisioned that contractors, subcontractors, general workers etc. would be required, and additionally various compliance and quality inspections and planned and ad hoc maintenance will be required during operations. Certain services and expertise will be outsourced from various businesses, which will in turn generate employment for these jobs and skills development which will benefit other organisations as well. In addition, local or national suppliers may be used for non-specialised equipment and machinery required for the Project, while imported specialist supplies are highly likely.

The nature of the impact is beneficial, indirect and irreversible for the duration of operations. The impact will be long-term due to the duration of the Project operations. The impact is likely. The magnitude of change is major due to the vast opportunities this could provide to other Namibian businesses. The sensitivity is expected to be high due to the national scale. The overall significance of this impact is beneficial major.

7.2.1.3 Employment during the decommissioning and closure phase

The decommissioning and closure of the Project is not foreseen to occur within the next 50 years, however a decommissioning phase has been included in the impact assessment. It is, however, recommended that an Impact Assessment for Terminal Decommissioning be initiated (similar to what is required in mining operations) in order to ensure that all negative impacts can be minimised as far as reasonably practicable. Part of the decommissioning process will include downsizing of the workforce. The loss of employment is considered sensitive to the affected individuals and communities. The significance of this impact is deemed minor as not many workers (approximately 100 workers) will be required during the operational phase of the Project and employees may easily find other jobs within the growing green hydrogen industry in Namibia.

The impact is expected to be permanent due to the decommission of the Project; employees' positions are likely to be permanently terminated. This is a precautionary rating, based on the worst-case scenario. However, if a similar project is brought to the area as a replacement this provides an opportunity for employees with experience in the field. The impact on the local and

regional economy is also considered of minor significance, with a sensitivity rating of medium. The overall significance of the impact is minor. Table 17 below outlines the employment impacts of the Project.

Table 17 - Summary of employment impacts

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction of Project	Community	Creation of employment for semi-skilled and unskilled local community in the Erongo Region	Beneficial Direct Reversible Short term Regional Definite	Medium	Minor	Beneficial Moderate (6)
Operations of Project		Indirect employment through exportation of ammonia and play a key role in the global clean energy market	Beneficial Indirect Partly Irreversible Long term National Likely	High	Major	Beneficial Major (12)
Decommissioning and closure		Decommissioning of Terminal will lead to the loss of jobs in the Erongo region	Adverse Direct Reversible Permanent Regional Likely	Medium	Minor	Minor (3)

7.2.2 IMPACTS TO GROSS DOMESTIC PRODUCT (GDP)

The government collects revenues predominantly for two purposes: 1) to finance the goods and services they provide to the Namibian citizens and businesses; 2) to fulfill their redistributive role (Organisation for Economic Co-operation and Development, 2023). Revenue for the Namibian government consists of income tax, profit tax, value added tax, duties and levies, royalties (when required) and other taxes, contributing 27.17% to Namibian GDP as of 2022. Namibia's substantial solar, wind and biomass resources are a comparative national advantage that can be leveraged for long-term socio-economic benefit (Uanguta, 2024).

Revenues and profits are likely to enhance the economy, sustainably develop the essential energy sector and positively impact the Namibian gross domestic product (GDP). Table 18 shows the impacts on gross domestic product (GDP).

7.2.2.1 Impacts on revenue for the government

All companies operating in Namibia are required to fulfil their tax obligations to the government. In the same way, the Proponent will contribute to the country's GDP and therefore the probability of this impact is definite.

Furthermore, the impact will be beneficial, direct, irreversible and over a long term due to the foreseen duration of the Project (more than 50 years). The magnitude of change is major due to the major improvement and contribution to diversification of the national economy. The sensitivity of the impact is high due to the national benefit of the Project and the certainty of the benefit to the national GDP. The significance of the impact is beneficial major.

7.2.2.2 Impacts of foreign exchange currency through potential exports

The green hydrogen complex offers enormous prospects for foreign exchange earnings and economic growth. The most immediate opportunities lie within the exporting of products produced, as the localised costs of electricity will be low, and ammonia production is likely to be internationally competitive (Altenburg & Kantel, 2024). Namibia, providing a conducive social and biophysical environment, has the potential to become a leading exporter in the green hydrogen industry.

The impact is beneficial, direct, irreversible and will likely be over a long-term. The impact is likely due to international interest in the Project. The magnitude of change is major as foreign exchange earnings will undoubtedly enhance socio-economic development within Namibia over the long-term. The sensitivity of the impact is high due to the benefit at a national scale and potentially beyond. The overall significance of the impact is beneficial major.

7.2.2.3 Impacts on balance of payments due to initial imports

The balance of payments refers to the records of all transactions between a country and the rest of the world. During the Project, initial imports may be required which in turn could impact the balance between import and exports of the country. The impact is adverse and would directly result in an outflow of foreign currency. The impact is partly reversible as imports will most probably occur during construction, hence a short -term impact is anticipated. The impact is expected to occur (medium probability), as there may always be a potential need for minor imports during the Project.

The impact magnitude of change is minor as imports are expected to be only during the initial stages of the Project. The sensitivity is low as the small-scale initial imports are not expected to be long-term and thus no detrimental impacts on the Namibian economy is expected. The initial investments on imports would likely enhance local production as the Project advances and will stimulate economic growth, more exports and increased export revenues. Overall, the

significance of the impact is expected to be minor during the initial stage of the Project and will be positive in the long-term.

Table 18 - Impact assessment for gross domestic product (GDP)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Operations of Project	National and local government/ GDP	Increase in government revenue as income tax, vat and profit tax, levies and royalties	Beneficial Direct Irreversible Long term National Definite	High	Moderate	Beneficial Major (12)
		Foreign exchange currency through potential exports in the future	Beneficial Direct Irreversible Long term National Likely	High	Major	Beneficial Major (12)
		Impacts on balance of payments due to initial imports	Adverse Direct Partly reversible Short term National Possible	Low	Minor	Minor (3)

7.2.3 IMPACTS TO TOURISM

The Erongo Region, specifically the coastal towns - Walvis Bay and Swakopmund as well as communities such as Langstrand are a tourist hotspot for numerous reasons including the pristine and scenic beauty of the Namib desert, the rich historic infrastructure, unique marine and plant life. The dune belt area between Swakopmund and Walvis Bay provides an array of tourist activities such as sand boarding and off-road quad bike trips. Additionally, residential communities such as Long Beach, Dolphin Beach and Afrodite Beach provide ocean side accommodation for tourists.

The impacts of on tourism is shown in Table 19.

7.2.3.1 Negative impact on tourism

The Ammonia Terminal construction and operations occurring in the Walvis Bay port area is approximately 3 km outside of Walvis Bay and 5 km away from the nearest beach residents/accommodation. It is widely reported that tourists generally appreciate the scenic beauty and natural landscape of the world's most ancient desert. Continuous industrialisation and urbanisation along the Namibian coast may negatively impact Namibia's tourism industry.

This impact will be adverse, direct, partly reversible and over a long-term due to the duration of the Project (more than 50 years) during construction and operations. The probability of the impact is possible, as this impact is subjective and may vary from person to person.

The sensitivity of the impact is low due to the local scale of the impact, and the magnitude of change is moderate due to the contribution of tourism in Namibia, as the fastest growing sector and driver to reduce rural poverty (GIZ, 2020). The overall significance of the impact is minor. Mitigation measures are related to visual impacts and are outlined in the ESMP.

7.2.3.2 Positive Impact on tourism

During the Project, more vessels using/transporting green fuel will make their way to Namibia. This provides the opportunity for more tourists to visit the coastal towns, purchasing goods and participating in tourist activities, contributing to the livelihood of the local community. The impact is beneficial, direct and partly reversible as this would be affected by decommissioning of the Project. The impact is possible should cruise liners convert to ammonia.

The sensitivity of the impact is medium due to the regional benefit of the impact and the magnitude of change is moderate because of the potential growth this may provide the tourism industry. The significance of the impact is beneficial moderate.

Table 19 - Impacts on tourism

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction and operations of the Project	Local Tourism	Negative impact on the inflow of tourists seeking the natural scenic ambience associated with the Dune landscape	Adverse Direct Partly reversible Long term Local Possible	Low	Moderate	Minor (3)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Operations of the Project	Local Economy	More vessels using/transporting green fuel will make their way to Namibia – tourists will make use of goods and services from local tourist facilities	Beneficial Direct Partly Reversible Long term Regional Possible	Medium	Moderate	Beneficial Moderate (6)

7.2.4 IMPACTS TO LOCAL BUSINESES

The proposed Project will rely on local wholesalers and businesses for non-specialised essential goods and services. Additionally, the potential influx of workers into the community will indirectly benefit these businesses through increased sales and demand for their products and services. The impacts on local business are detailed in Table 20.

7.2.4.1 Direct impacts – local purchasing of goods and services for the Project

During construction and operations, the proposed Project is likely to purchase non-specialized goods and services from local or Namibian businesses depending on construction and operational needs. This may be beneficial for the Proponent in terms of cost and local small to large businesses in terms of business opportunity and generation of income.

The impact will be beneficial, direct and irreversible. The proposed Project may extend to a national scale if goods or services are not available locally and need to be sourced from other regions in Namibia. The impact will be likely, due to the convenience presented to the Proponent to build strong relationships with local suppliers. Additionally, the green hydrogen sector may create a gap in the local market, creating new business opportunities. The significant contribution to local procurement provides long-term benefits for the Erongo Region and Namibia as a whole.

The sensitivity of the impact is expected to be high due to its local, regional and national contribution. The magnitude of change will be major due to the extent and improvement to the community and country. The overall significance of the impact is beneficial major.

7.2.4.2 Indirect impacts – local purchasing of goods and services related to the Project

During the Project there is potential for relocation of very few employees within the Erongo Region, contributing to local economy by supporting local businesses through purchases and making use of local accommodation. The impact is indirect, reversible and over long term due to

the duration of the Project. It is highly likely that locals will choose to support nearby businesses for their household needs. The sensitivity of this impact is expected to be medium because of the regional scale and the magnitude of change will be moderate because of the added support to local and regional businesses. The overall significance of the impact is beneficial low.

7.2.4.3 Impacts of the decommissioning phase on local businesses

Should the Ammonia Terminal Project be decommissioned, and enter the closure phase, this may lead to the loss of employment, leading to potential relocation and less purchases from local business suppliers; hence less direct and indirect support towards local businesses. The impacts are expected to be adverse, direct, permanent and reversible due to possible extension of the Project or similar projects brought to the area. The impact is possible but not foreseen within 50 years of the Project lifecycle.

The sensitivity of this impact is expected to be low due to the local scale and the magnitude of change will be negligible due to the minor loss towards a selected number of people or businesses. The overall significance of the impact is low.

Table 20 - Impacts of direct and indirect spending on local businesses

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction and operations of the Project	Local and National Economy	Purchasing of goods and services directly from the local and regional economy for Project use	Beneficial Direct Irreversible Short term National Likely	High	Minor	Beneficial Major (9)
	Local Economy	Purchasing of goods and services directly from the local and regional economy for personal use	Beneficial Indirect Reversible Long term Regional Likely	Low	Negligible	Beneficial Low (2)
Decommissioning phase		Loss of local economic business profits due to loss of customers	Adverse Direct Reversible Permanent Regional Possible	Low	Negligible	Low (2)

7.2.5 CORPORATE SOCIAL INVESTMENTS AND RESPONSIBILITY

The Proponent is encouraged to develop corporate social responsibility (CSR) initiatives or programmes to enhance the economic and social well-being of Namibians. Future opportunities may include wildlife conservation and potential sponsorship opportunities. Namibia has emerged as a global model for integrating communities, conservation, and tourism through its communal conservancy program, as a result of a constitution that safeguards wildlife and laws that empower local communities. Private sectors are encouraged to form partnerships with conservancies, or alternatively provide financial support to conservancies (Jaro Consultancy, n.d.). The impact would be beneficial, partly reversible and over a medium term as this may be developed at a later stage in the Project. The potential impact is likely as the Proponent is exploring partnerships to continually support the economic growth in Namibia.

The sensitivity of the impact is considered medium due to the regional impact; however, it has a potential to have a much wider impact. The magnitude of change is considered high, given the economic vulnerability of the receptors (Table 21). The overall significance of the impact is considered beneficial major.

Table 21 - Impact assessment for corporate social responsibility

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Corporate social responsibility	Community	Positive contribution to economic and social wellbeing through initiatives to support wildlife conservation and sponsorship opportunities	Beneficial Indirect Partly Reversible Medium term Regional Likely	Medium	Major	Beneficial Major (8)

7.3 SOCIO-ECONOMIC ENVIRONMENT: SOCIAL

Social impacts include the consequences to local populations in terms people's lives, comfort, occupational hazards in the workplace and interactions. The possible significant social impacts that have special interest to the community and stakeholders, before mitigation measures are applied, have been summarised in the following section. It is important to note that a comprehensive HAZOP (Hazard and Operability Study) will be conducted by the proponent before the construction of the plant. This study will form part of the project's Health and Safety Management Plan. As such, this section is not intended to duplicate or replace the purpose and scope of a dedicated Health and Safety Management Plan.

7.3.1 AIR QUALITY

An air quality impact assessment was carried out by Airshed Planning Professionals (Pty) Ltd (Airshed), and a report was generated in early November 2024 (Appendix E). The methodology followed by the specialist was to establish an emissions inventory to account for all sources of air pollution associated with the construction, operations, commissioning and decommissioning activities of the Project. Emissions were based on the process description and equipment list provided by the Proponent. The AERMOD (American Meteorological Society/Environmental Protection Agency Regulatory Model) dispersion model was used to simulate the expected impacts from these emission sources, with the simulated ground level concentrations and dust fall rates screened against the applicable air quality objectives (AQOs) to determine the

significance of the proposed Project on the receiving environment (Airshed Planning Professionals, 2024). The impacts ratings are provided in provided in Table 22. The impacts before mitigation measures are presented in Figure 35, for illustrative purposes only. The potential impacts are discussed further in the sections below.

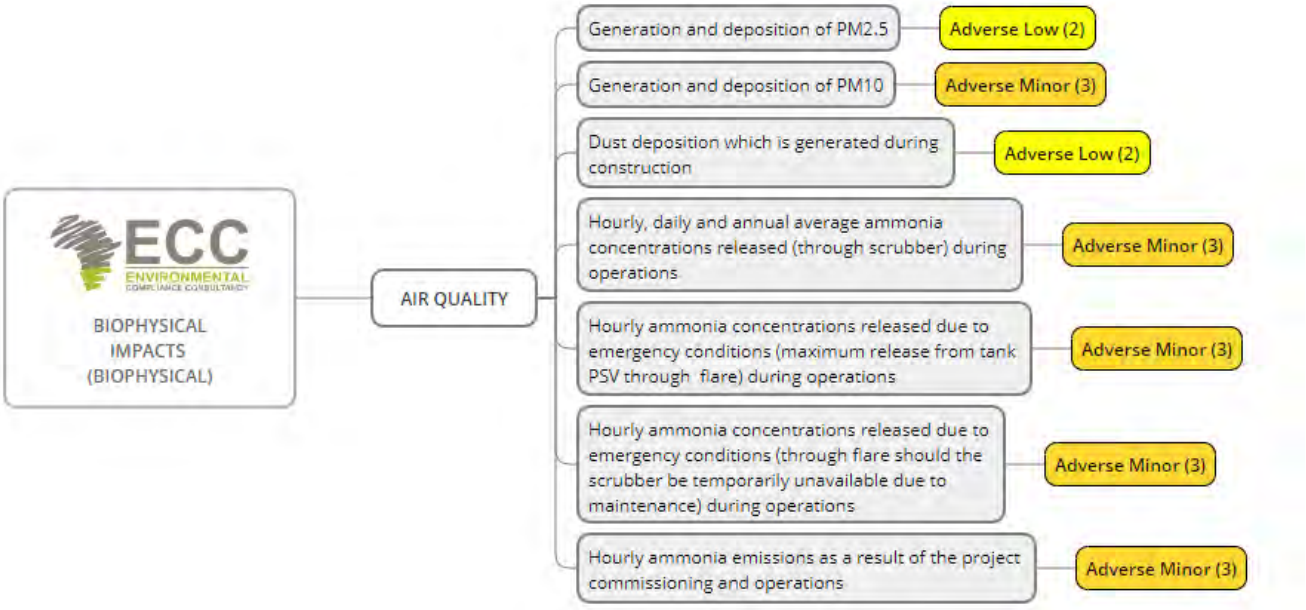


Figure 35 - Air quality impacts

In the absence of guidelines on ambient air concentrations in Namibia, reference is made to the air quality objectives (AQO). These objectives are based on the World Health Organisation IT-3 (WHO interim target which are regarded feasible limits for the arid environment of Namibia and are also in line with the South African (SA) National Ambient Air Quality Standards (NAAQS). The WHO IT daily average target is 37.5 µg/m³ for $PM_{2.5}$, which is not to be exceeded more than four (4) times per year while the annual average target for $PM_{2.5}$ is 15 µg/m³ (Airshed, 2024). The PM_{10} daily average threshold is set at 75 µg/m³ which should not be exceeded more than four (4) times per year while the annual average is set at 40 µg/m³. The threshold for residential dust fallout is set at 600 mg/m^2/day. This threshold is not to be exceeded more than three (3) times per year or two (2) consecutive months.

The evaluation criteria are based on human exposure to specific criteria pollutants. Air quality sensitive receptors (AQSRs)were identified where the public is likely to be unwillingly exposed. Potential air AQSRs within the Project area and close to the Project areas include the residential area of Walvis Bay, Afrodite beach and motorists travelling between Walvis Bay and Swakopmund on the B2 road. Figure 36 presents an overview of these sensitive receptors.

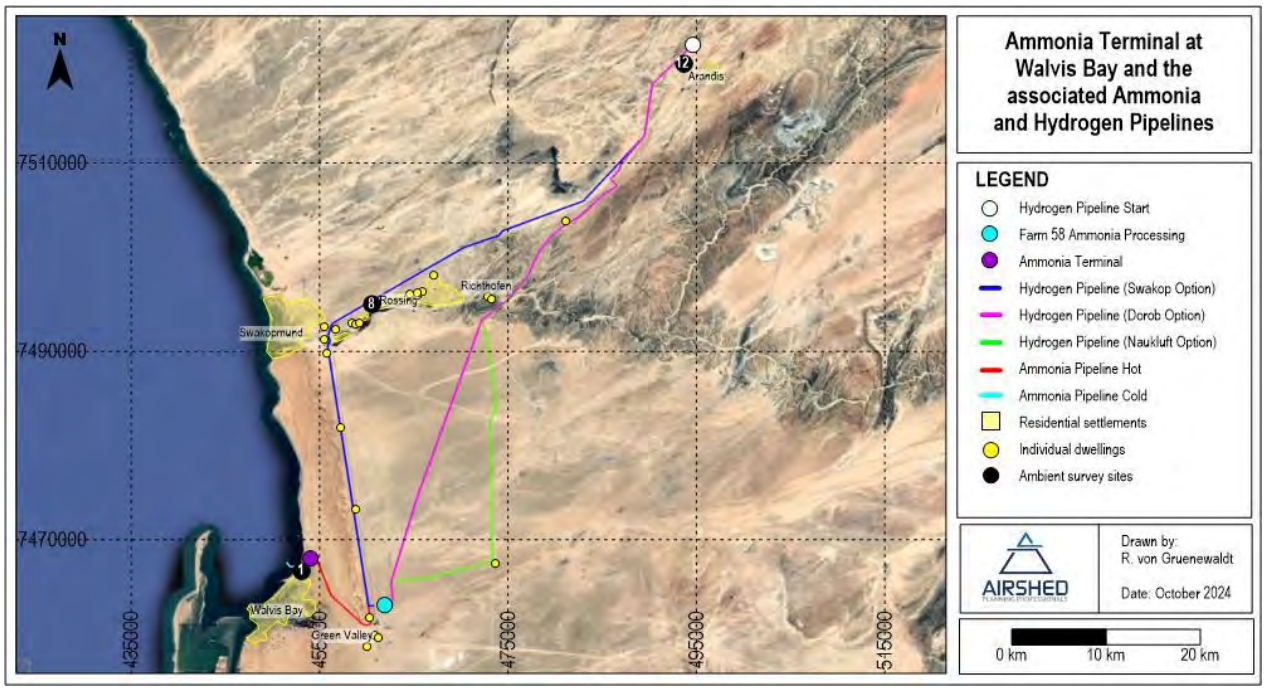


Figure 36 - Identified AQSRs within the Project area

7.3.1.1 Generation of particulate matter 2.5 ($PM_{2.5}$) during construction activities

During the construction of the proposed Project, particulate matter 2.5 ($PM_{2.5}$) will be generated. Particles are defined by their diameter for air quality regulatory purposes and fine particulate matter is defined as particles that are 2.5 microns or less in diameter ($PM_{2.5}$) (California Air Resource Board, 2024). Emissions from combustion of gasoline, oil, diesel fuel or wood produce much of the $PM_{2.5}$ pollution found in outdoor air, as well as a significant proportion of PM_{10}.

According to the air quality assessment findings (Appendix E), the modelled daily and annual $PM_{2.5}$ ground level concentrations due to Project construction activities will be within the AQO at all potential sensitive receptors within the study area (Walvis Bay residential area). The modelled daily and annual $PM_{2.5}$ ground level concentrations, before mitigation measures are in Figure 37 and Figure 38, respectively.

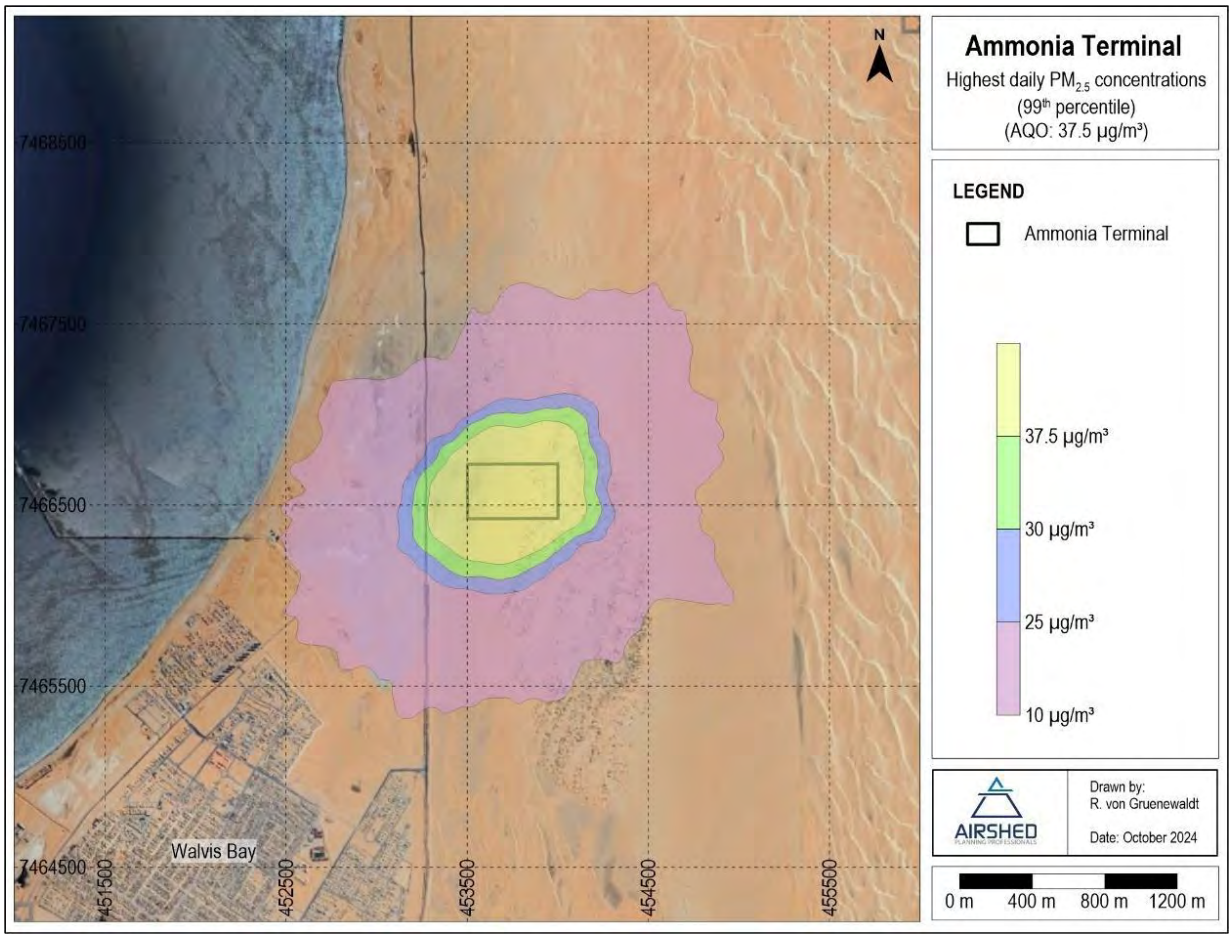


Figure 37 - Simulate daily (99th percentile) $PM_{2.5}$ ground level due to Project construction activities

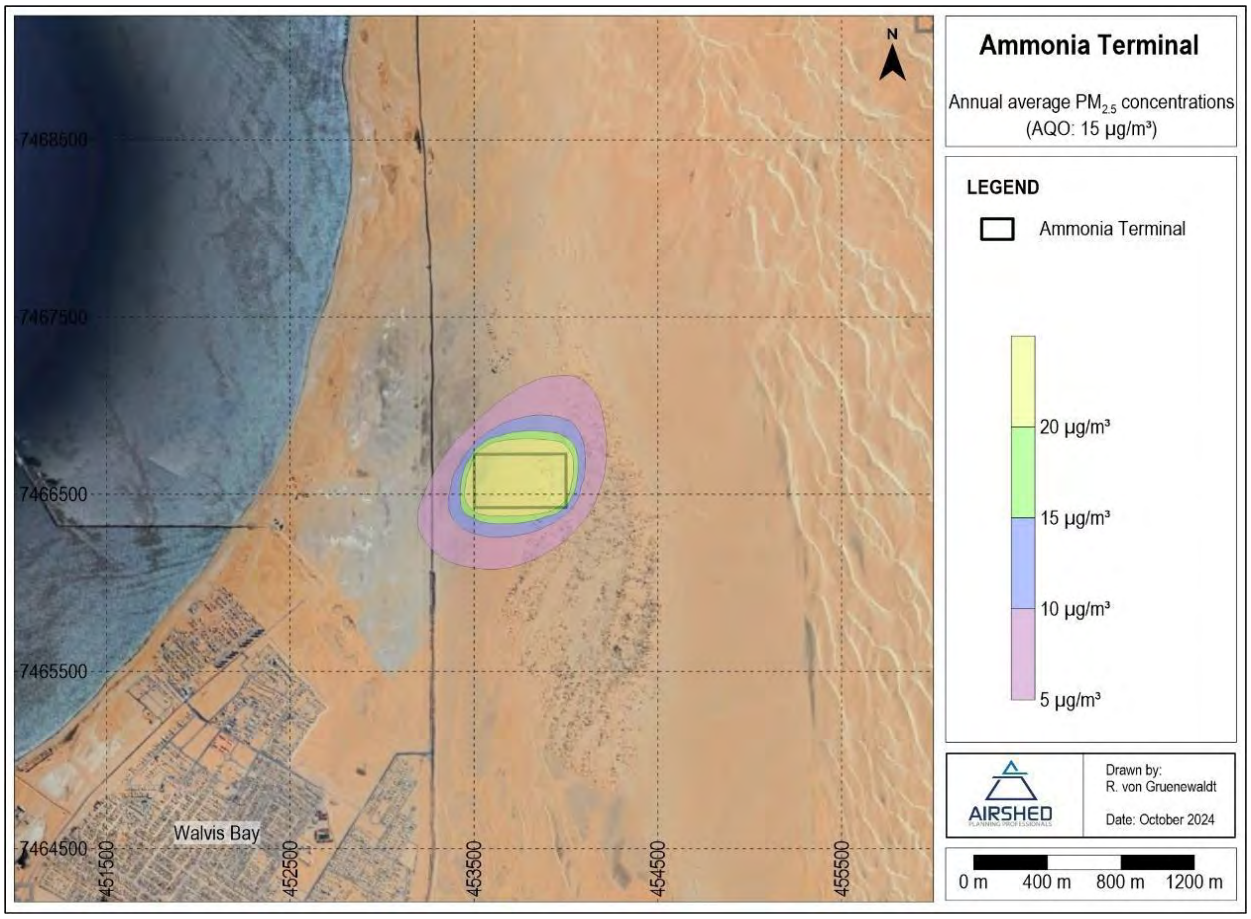


Figure 38 - Simulate annual average $PM_{2.5}$ ground level concentrations due to Project activities

The simulated $PM_{2.5}$ ground level concentrations are expected to be more centered around the Project site, as expected, and would disperse in different directions depending on the prevailing meteorological conditions. The nature of impact is adverse, directly affecting receptors, reversible and temporary due to the specific activities carried out during construction activities. Fine particles will likely be emitted during the construction phase.

The sensitivity of the impact is rated low due to the localized nature of the impact. The magnitude of change before mitigation is minor as the model indicates that the Walvis Bay residents and motorists travelling on the B2 road may be exposed to daily $PM._{25}$ ground level concentrations of 10 µg/m^3 and 25 µg/m^3 (Figure 37). This ground level concentrations are below the $PM_{2.5}$ daily concentration limit, set at 37.5 µg/m^3. Annual average $PM_{2.5}$ are expected to be centred around the Project site and motorists travelling on the B2 road may only be subject to $PM_{2.5}$ ground level concentrations of about 5 µg/m^3 (this is below the 15 µg/m^3 annual threshold) (Figure 38). As a result, the significance of the impact is low. The mitigation measures are provided in the ESMP.

7.3.1.2 Dust generation (PM_{10}) during construction activities

Particulate matter 10 (PM_{10}) is defined as particles with a diameter of 10 microns or less which can be inhaled into the lungs and induce adverse health effects (California Air Resource Board, 2024). PM_{10} also includes dust from construction sites, landfills and agriculture, wildfires and

brush/waste burning, industrial sources, wind-blown dust from open lands, pollen and fragments of bacteria (California Air Resource Board, 2024).

According to the air quality assessment report (Appendix E), the annual PM_{10} ground level concentrations due to Project construction activities are within the AQO at all potential sensitive receptors within the study area. The PM_{10} daily ground level concentrations, however, exceed the AQO up to ~1.5 km from Walvis Bay to the southwest of the Project site (Airshed Planning Professionals, 2024).

The daily and annual average PM_{10} ground level concentrations due to Project construction phase, before mitigation, are shown in Figure 39 and Figure 40, respectively.

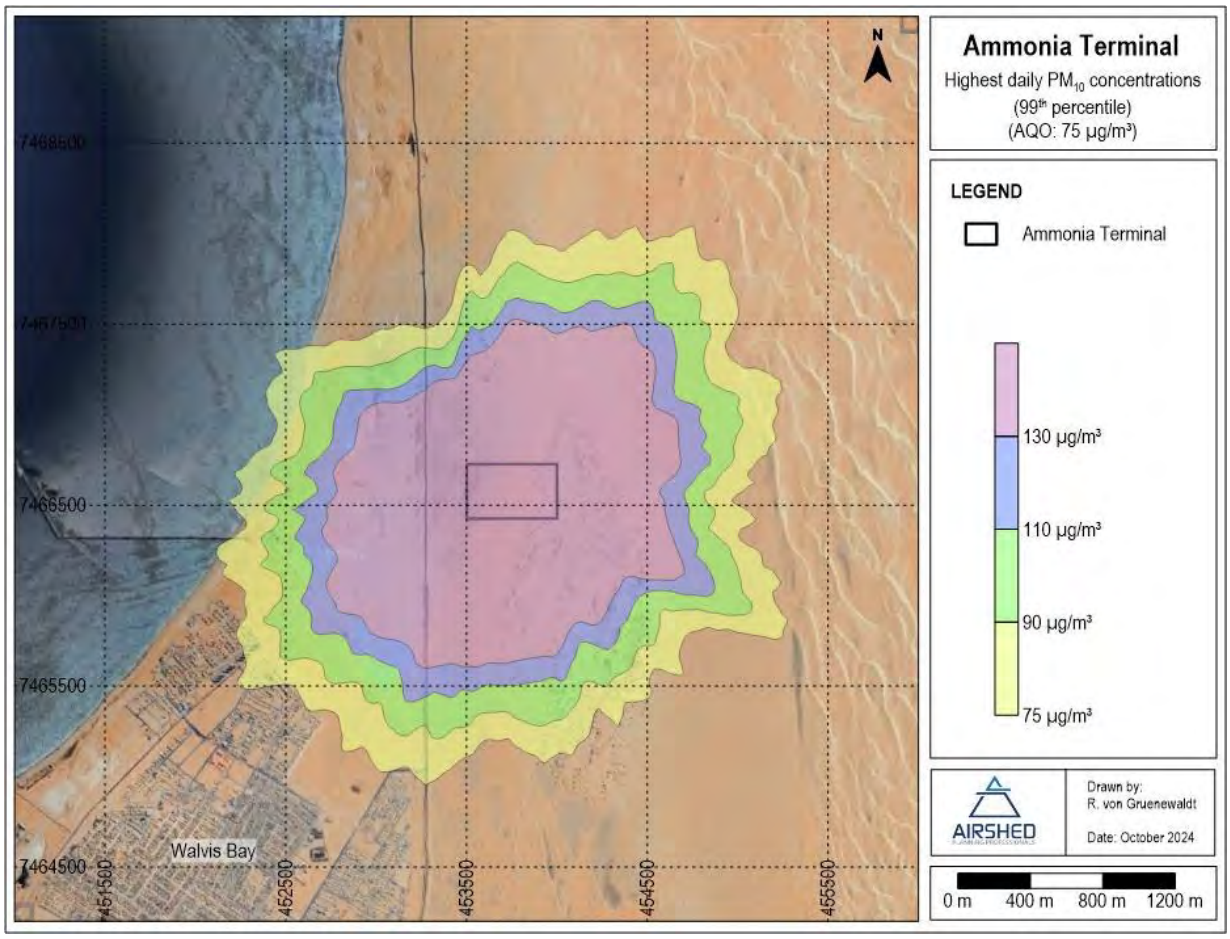


Figure 39 - Simulate daily (99th percentile) PM_{10} ground level concentrations due to Project construction activities

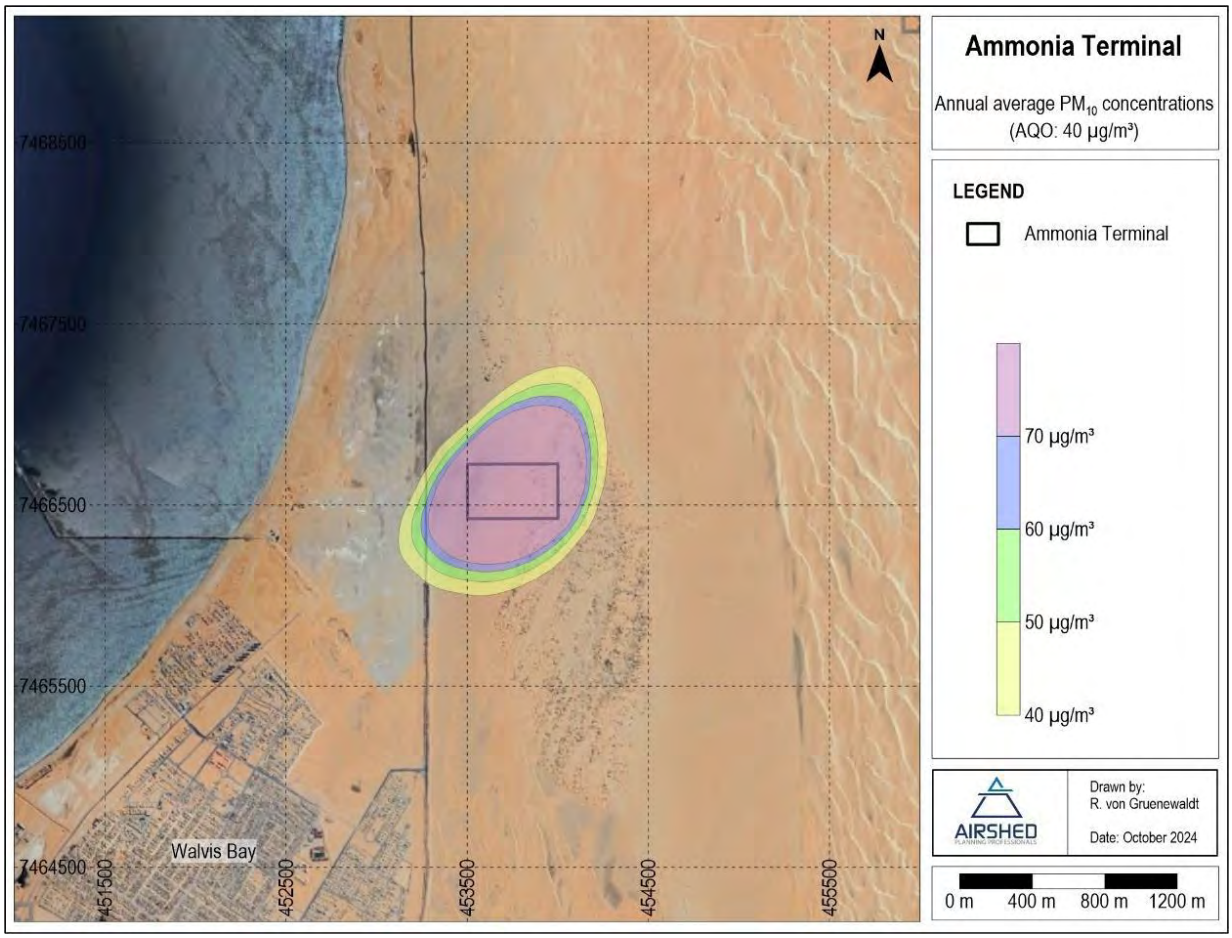


Figure 40 - Simulate annual average PM_{10} ground level concentrations due to Project construction activities

The impact is adverse, directly affecting receptors (motorists travelling on the B2 road and Walvis Bay residents), reversible and temporary due to the specific activities carried out during construction activities. The duration of construction activities is also drawn into perspective. The generation of PM_{10} is likely as these commonly are produced at construction sites.

The sensitivity of the impact is low due to the local scale of the impact and the magnitude of change before mitigation is moderate due to PM_{10} daily ground level concentrations exceeding the AQO, as Walvis Bay residents living ~ 3 km southwest of the Project area will be exposed to 75 µg/m^3 (Figure 39).The overall significance of the impact is adverse minor. Mitigation measures are described in the ESMP and will reduce the impact on the community exposed.

7.3.1.3 Dust fallout and deposition during construction activities

During construction activities, dust will be generated. Construction activities involve excavation of the dune surface or sub-surface, this exposes dry, loose sand to wind, increasing the likelihood of dust storms. The air quality assessment (Appendix E) reported that the maximum daily dust fallout is expected to be within the AQO for residential areas (600 mg/m²/day) at all sensitive receptors within the study area (Figure 41), before mitigation.

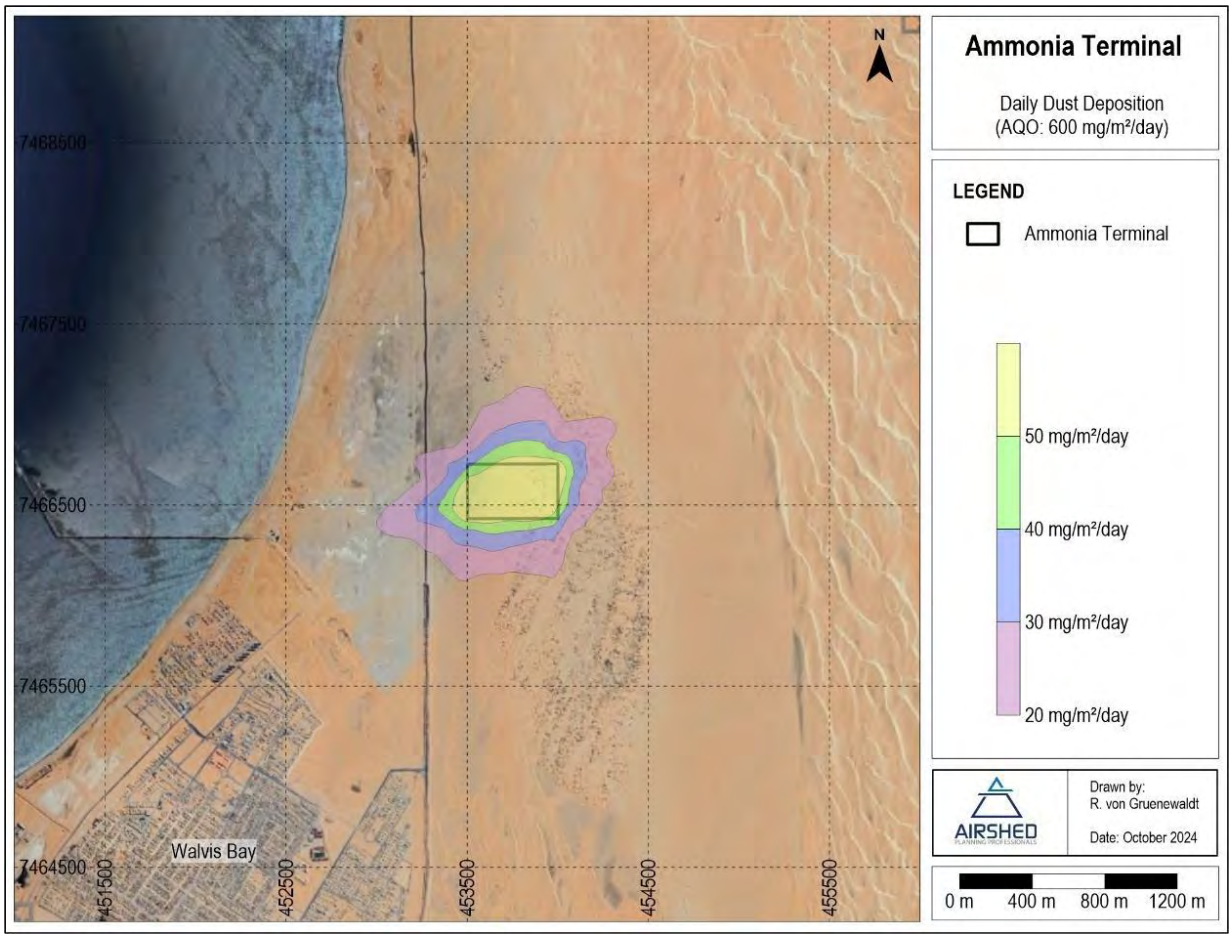


Figure 41 - Simulate highest daily dust deposition due to Project construction activities

The impact is adverse, directly affecting receptors, reversible after construction activities and temporary due to the duration of construction activities. The proposed Project site is within the dune belt approximately 3 km from Walvis Bay, thus the generation of dust is likely.

The sensitivity of the impact is low due to the local scale of the impact and the magnitude of change before mitigation is negligible because the daily dust deposition beyond the Project site is 40 mg/m^2/day, which is well below the AQO criteria for residential areas (600 mg/m^2/day). Due to the low dust fallout concentrations, it may be expected that the dust generated may not necessarily disrupt traffic flow on the B2 road. Overall, the significance of the impact is rated low. The mitigation measures are provided in the ESMP.

7.3.1.4 Hourly, daily and annual average ammonia concentrations released (through scrubber) during operations

In the refrigeration unit, inerts accumulate in the liquid receiver as they are non-condensable at these conditions. To remove the inerts, the gas phase of the liquid receiver is purged continuously toward the scrubber unit. To recover as much ammonia as possible, it is first sent through the purged ammonia recovery system of the refrigeration unit. The composition, condition and flowrate of the purge to the scrubber may vary depending on the vendor of the refrigeration unit and the amount of inerts added. The expected composition of the purge gas

sent to the scrubber is assumed to be 95% of nitrogen (N_2) and 5% ammonia (NH_3) and the assumed flowrate is 1000 kg/h (Proton Ventures, 2014).

The scrubber will absorb the ammonia traces remaining in the purge using demi water (demineralised water). The scrubber has been designed to release gases with a concentration of less than 25 ppm of ammonia (Proton Ventures, 2014).

The air quality assessment carried out for the Project reported that the simulated NH_3 ground level concentrations released through the scrubber due to continuous operations are well within the AQO at all off site sensitive receptors.

The highest hourly, daily and annual average ammonia concentrations released (through scrubber) during operations are shown in Figure 42, Figure 43 and Figure 44, respectively.

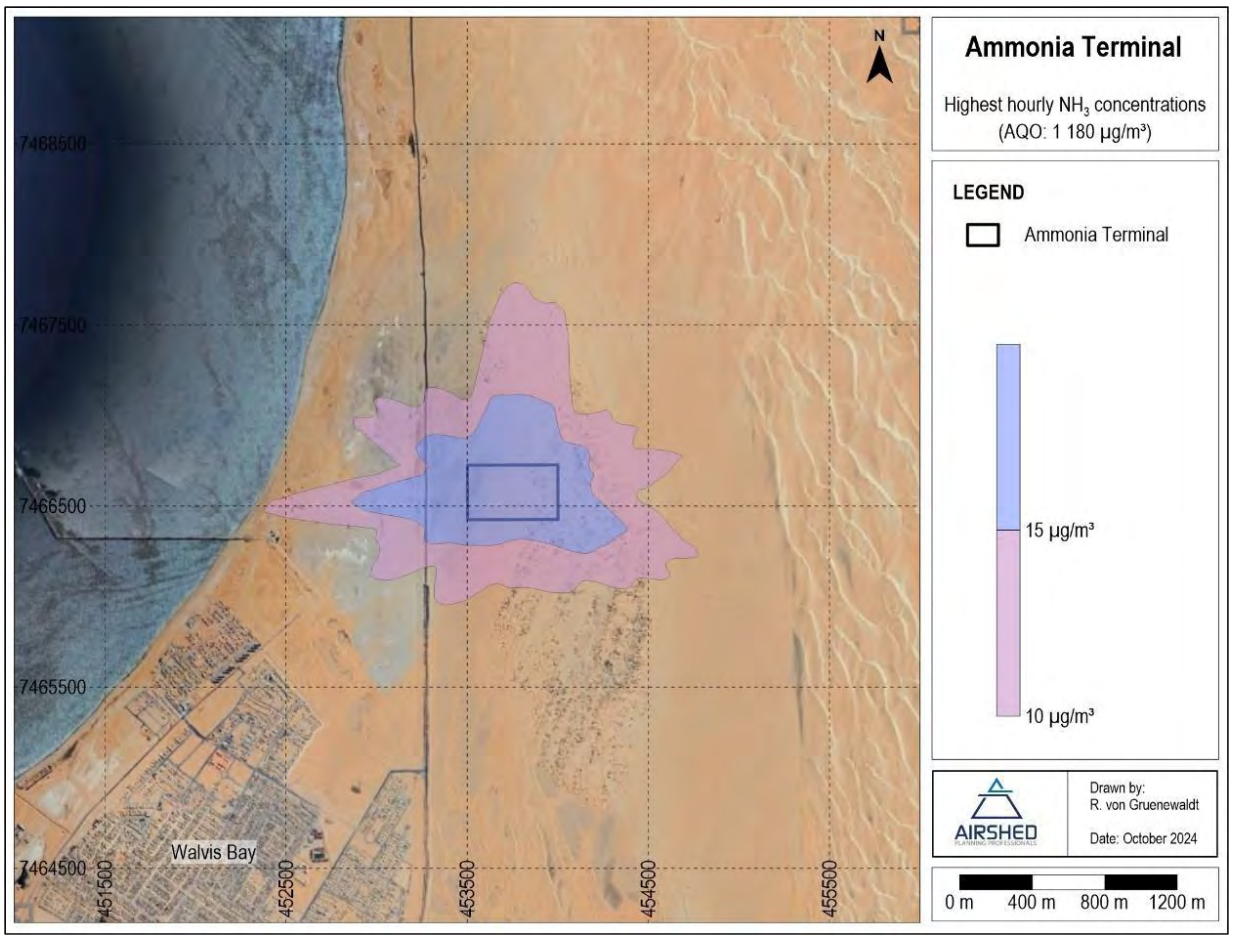


Figure 42 - Simulate highest hourly NH_3 ground level concentrations due to normal Project operations

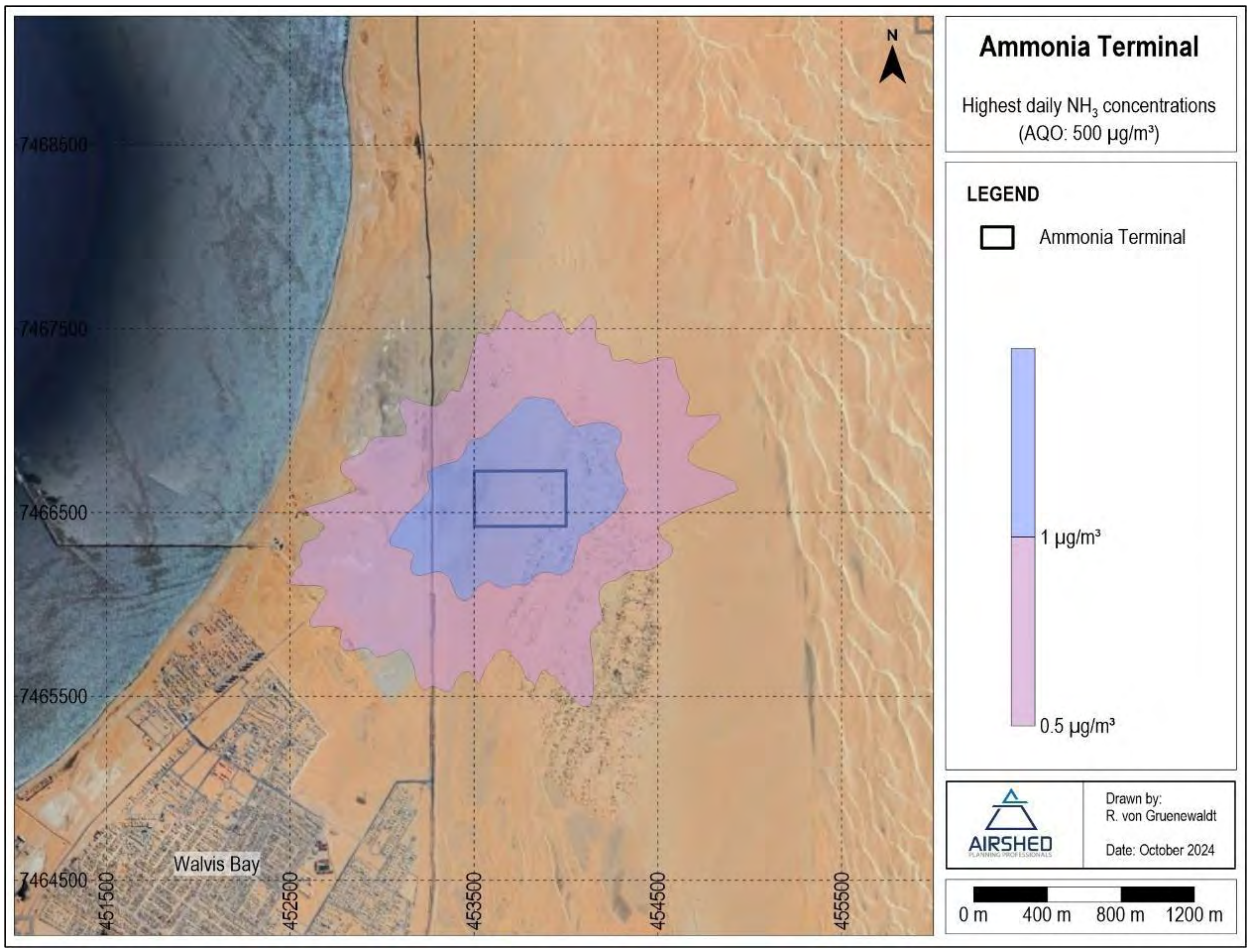


Figure 43 - Simulate highest daily NH_3 ground level concentrations due to normal project operations

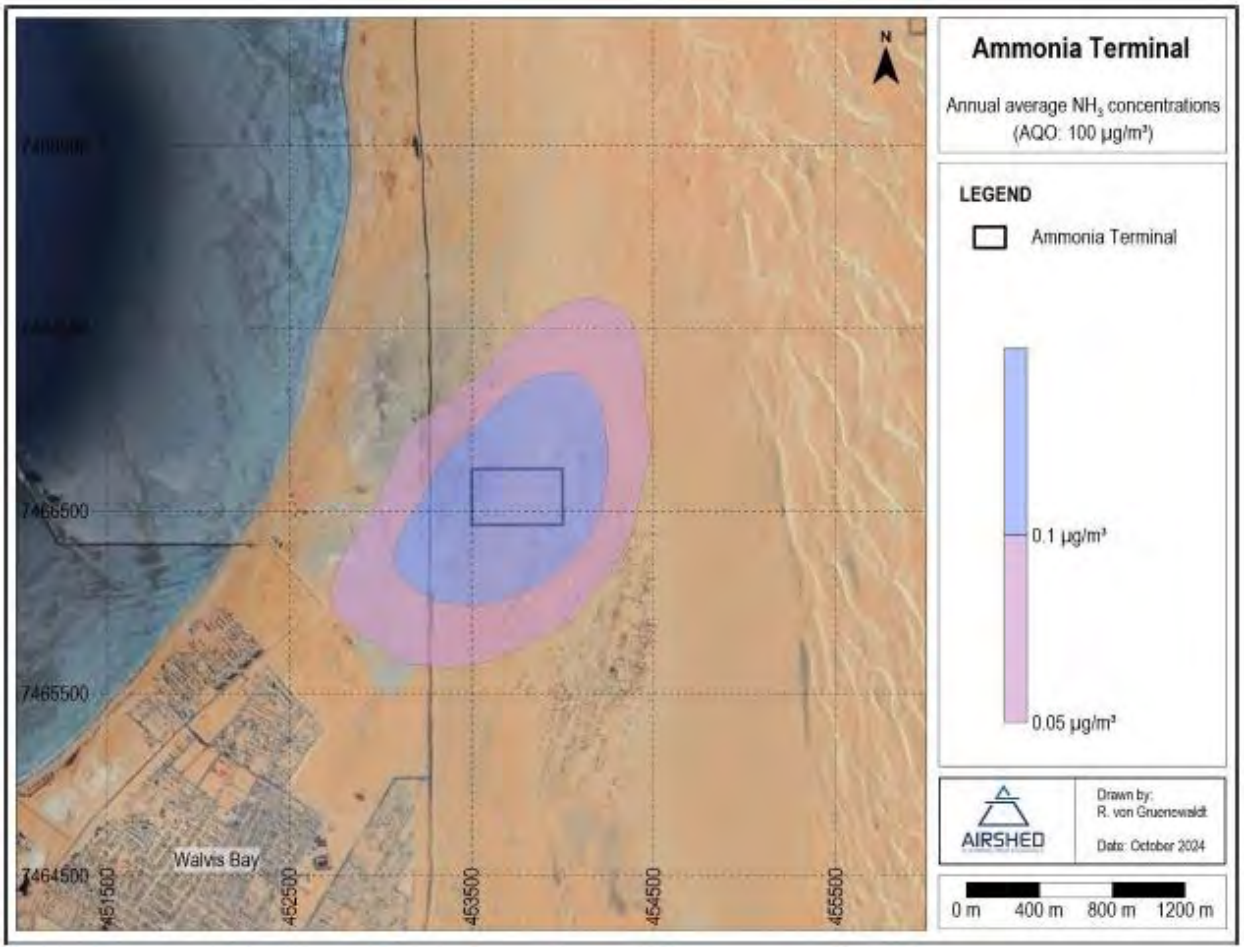


Figure 44 - Simulate annual average NH3 ground level concentrations due to normal Project operations

The impact is adverse, directly affects potential sensitive receptors and irreversible due to health implications that may be caused. The impact will be expected to be over the long term due to the duration of operations (~50 years). Very small ammonia concentrations will be released during operations.

The sensitivity of the impact is low due to the local scale and the magnitude of change before mitigation is minor, as the ammonia concentration released are well below the AQO criteria as shown by the hourly, daily and average annual simulations above.

The overall significance of the impact is moderate. Mitigation measures adopted by the Proponent include abiding by the international codes and standards as well as the SA NAAQS. Additionally, ammonia traces will be absorbed by the scrubber with demi water to lower the ammonia concentration of less than 25 ppm. More mitigation measures are further discussed in the Project ESMP.

7.3.1.5 Hourly ammonia concentrations released due to emergency conditions (maximum release from tank pressure safety valves through flare) during operations

During operations, emergency situations should be considered, by which the maximum release of emissions from tank pressure safety valves occur using the flare. If the burning efficiency of flare is assumed of 99%, then 1% of the release ammonia is liberated to the atmosphere. In this case, 291 kg/h of ammonia is not burned (Proton Ventures, 2014). During the air quality assessment (Appendix E), emergency situations were modelled at hourly averaging periods only, as these events are not likely to extend over a day at a time. Figure 45 shows that the simulated NH_3 ground level concentrations due to emergency Project conditions during operations are well within the AQO at all off site sensitive receptors and within the site boundaries.

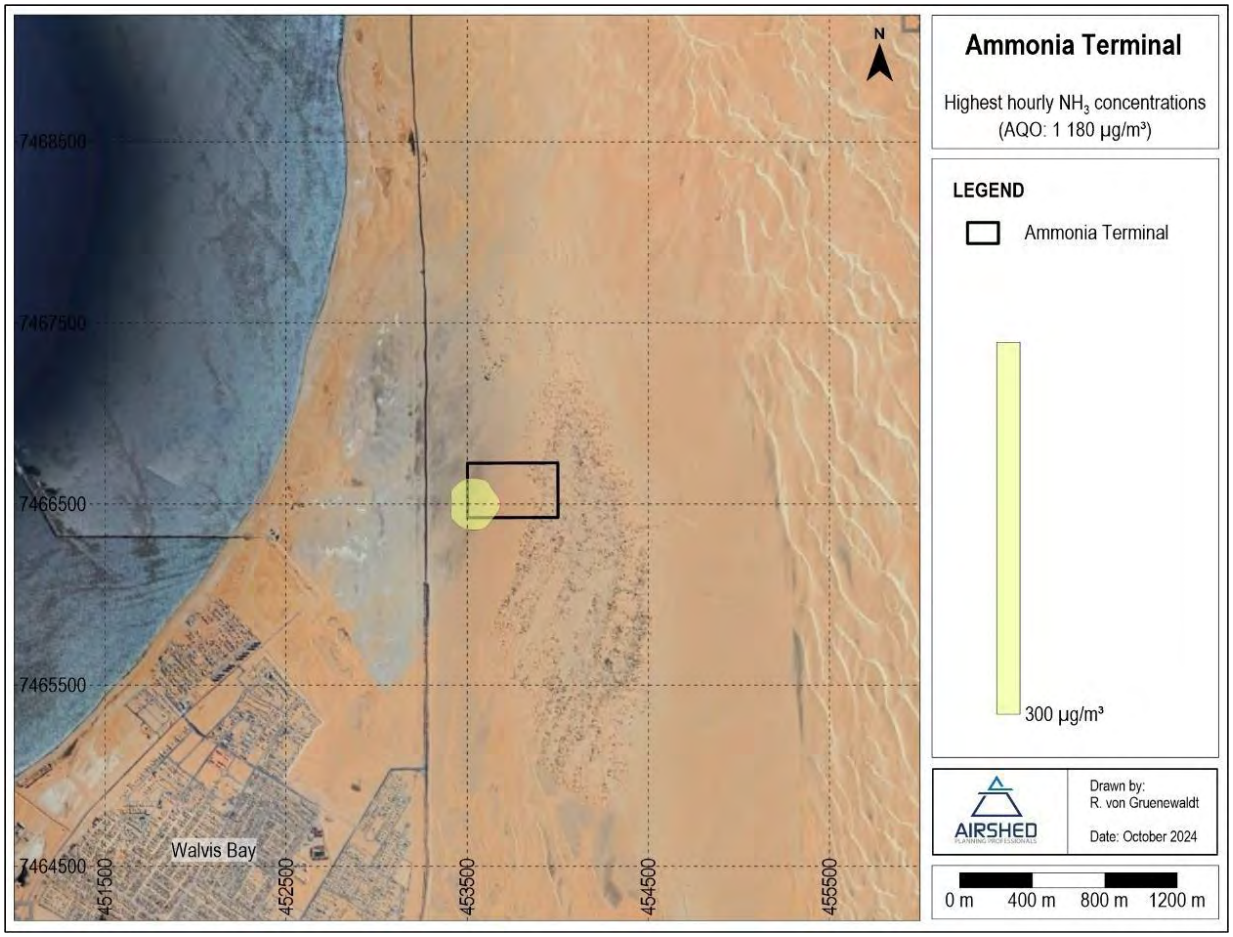


Figure 45 - Simulate highest hourly NH_3 ground level concentrations due to emergency conditions (maximum release from the tank PSVs)

The impact is adverse, and based on the model, employees will be directly affected, however the broader community will not be impacted. The impact is irreversible as there is a risk that the impact may potentially result in occupational health related complications. Emergency situations are expected to occur sporadically and temporarily, therefore the duration of impact temporal. Emergency events should be expected as they pose significant risks. Therefore, the probability of emergency events occurring is rated “possible”.

The sensitivity of the impact is low due to the local scale of the impact and the magnitude of change before mitigation is negligible. The highest hourly NH_3 ground level concentrations due to emergency conditions such as maximum release from tank pressure safety valves using a flare is 300 µg/m^3, which is well below the AQO 1180 µg/m^3 criteria. The overall significance of the impact is rated adverse minor as employees are the most likely to be impacted. The mitigation measures are detailed in the ESMP.

7.3.1.6 Hourly ammonia concentrations released due to emergency conditions (through flare, should the scrubber be temporarily unavailable due to maintenance) during operations

Emergency conditions whereby the scrubber is temporarily unavailable due to potential normal maintenance, the use of the flare is assessed. If the burning efficiency of the flare is assumed of 99%, then 1% of the release ammonia is liberated to the atmosphere. In this case, a flowrate of 1000 kg/h of purge, 95% N_2 and 5% NH_3, is sent to the flare. As result of burning just 99% of the ammonia, this would result in 0.5 kg/h of NH_3 being released during the shutdown of the scrubber unit and during the purging of the reference system (Proton Ventures, 2014). During the air quality assessment (Appendix E), emergency conditions were modelled at hourly averaging periods only, as these events are not likely to extend over a day at a time. The assessment findings were that the simulated NH_3 ground level concentrations due to emergency Project operations are well within the AQO at all off site sensitive receptors (Figure 46). However, the employees are the most vulnerable receptors.

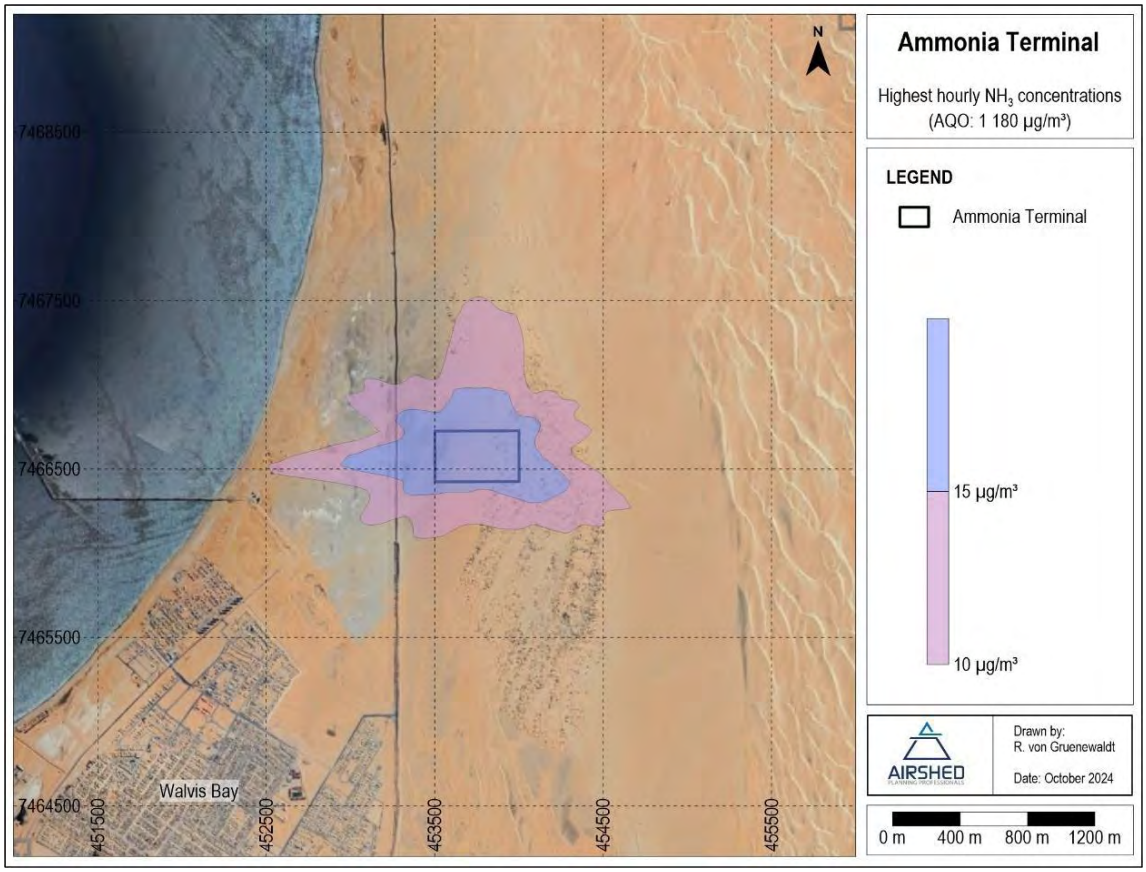


Figure 46 - Simulate highest hourly NH_3 ground level concentrations due to emergency conditions

The impact is adverse, directly affecting employees and no surrounding communities are likely to be impacted. The impact is irreversible as it may result in employees experiencing health complications. The scrubber may be unavailable on a temporary basis. It should be assumed that the potential use of the flare instead of the scrubber is only during short-term emergency events.

The sensitivity of the impact is low due to the local scale and the magnitude of change before mitigation is minor. The highest hourly NH_3 concentrations through the flare is 10 - 15 µg/m^3 while the scrubber is out of commission, which is well below the AQO 1180 µg/m^3 criteria. The overall significance of the impact is minor. The mitigation measures are provided in the ESMP.

7.3.1.7 Hourly and daily ammonia emissions as a result of Project commissioning

During start-up, commissioning and decommissioning, it is expected that the flare unit will be operating continuously. The expected maximum flowrate during commissioning is about 2000 kg/h. Composition of the stream changes along the commissioning process, ranging from 0-90% of NH_3 and the rest as N_2.

Considering a 1% ammonia not being burned after flaring continuously, in the worst-case scenario assumed of 90% NH_3 in a flowrate of 2000 kg/h, would result in 18 kg/h for the duration of the commissioning process.

The assessment findings were that the simulated NH_3 ground level concentrations due to commissioning of Project operations are well within the AQO at all off site sensitive receptors (Figure 47 and Figure 48). However, the workforce is the most vulnerable.

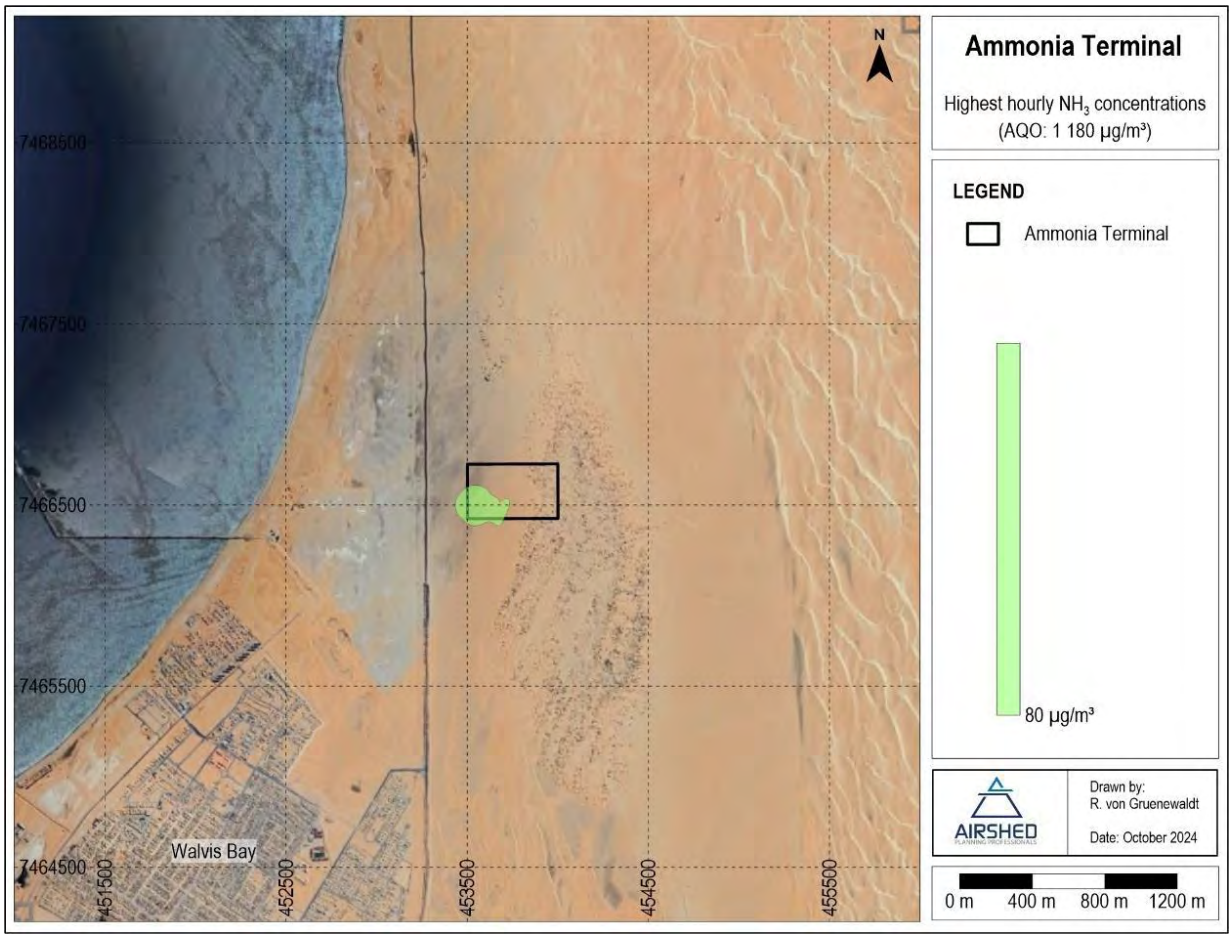


Figure 47 - Simulate highest hourly NH_3 ground level concentrations due to Project commissioning activities

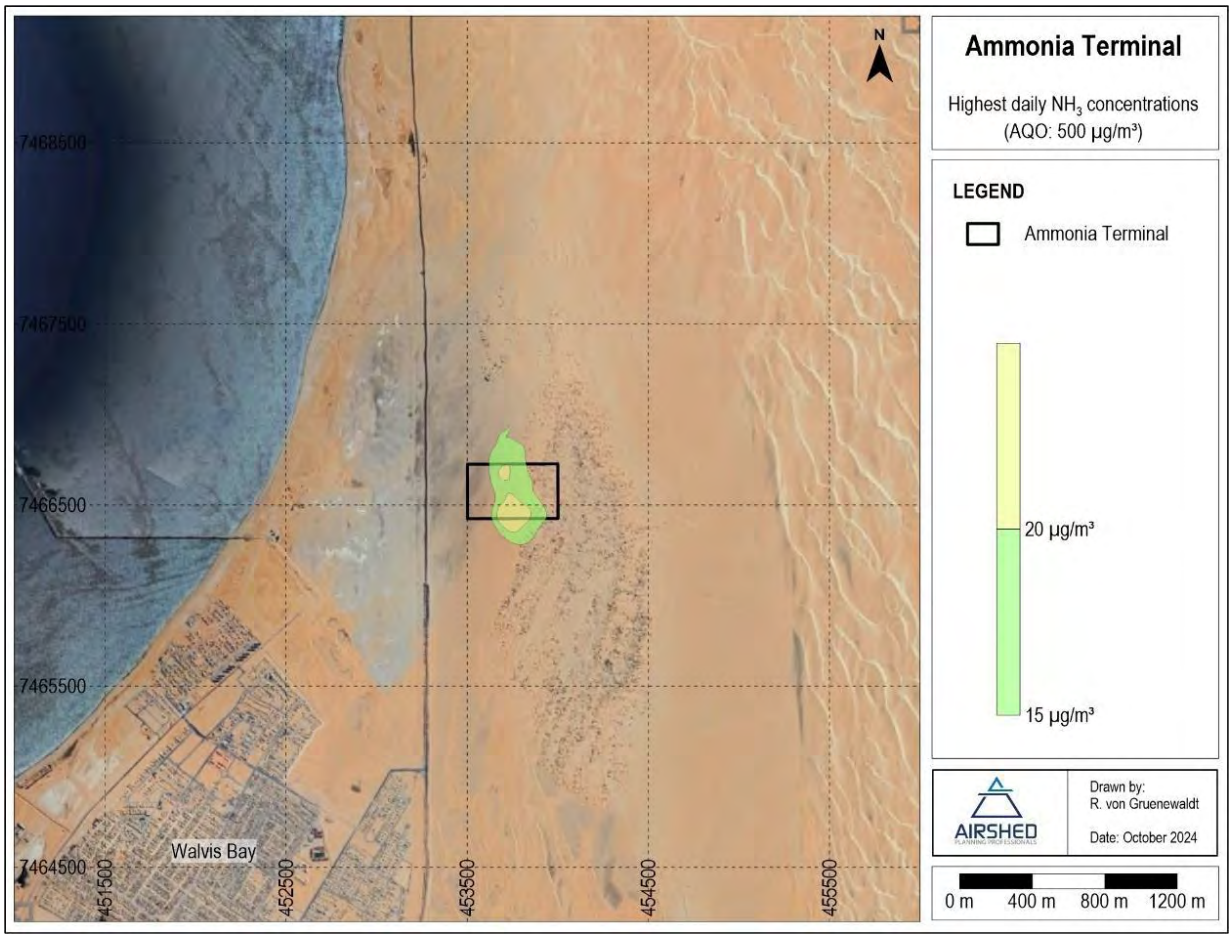


Figure 48 -Simulate highest daily NH3 ground level concentrations due to project commissioning activities

The impact is adverse, direct, irreversible due to potential health risks to employees. As per the modelled NH_3 ground level concentrations, no neighbouring communities would be affected. The commissioning phase of the Project was modelled for hourly and daily averaging periods, as the duration of commissioning was not specified and it was assumed that this event could extend from an hour to a couple of days, hence temporarily (Airshed Planning Professionals (Pty) Ltd, 2024). The conditions and use of flare during commission of operations are likely.

The sensitivity of the impact is rated low as no neighbouring communities will be impacted. The magnitude of change is rated low as the highest hourly and daily NH_3 concentrations through the flare range between 10 - 15 µg/m^3, which is well below the AQO 1180 µg/m^3 criteria and will likely be contained within the Project area. The overall significance of the impact is rated adverse minor. The mitigation measures are provided in the ESMP.

Table 22 - Air quality impacts

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction phase	Air quality	Generation and deposition of $PM_{2.5}$	Adverse Direct Reversible Temporary Local Likely	Low	Minor	Low (2)
		Generation and deposition of PM_{10}	Adverse Direct Reversible Temporary Local Likely	Low	Moderate	Minor (3)
		Dust deposition which is generated during construction	Adverse Direct Reversible Temporary Local Likely	Low	Negligible	Low (2)
Operational phase		Hourly, daily and annual average ammonia concentrations released (through scrubber) during operations	Adverse Direct irreversible Long term Local Definite	Low	Negligible	Minor (3)
		Hourly ammonia concentrations released due to emergency conditions (maximum release from tank PSV	Adverse Direct Irreversible Temporary Local Likely	Low	Minor	Minor (3)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		through flare) during operations				
		Hourly ammonia concentrations released due to emergency conditions (through flare should the scrubber be temporarily unavailable due to maintenance) during operations	Adverse Direct Irreversible Temporary Local Likely	Low	Minor	Minor (3)
Commissioning and decommissioning		Hourly ammonia emissions as a result of the project commissioning and operations	Adverse Direct Irreversible Temporary Local Likely	Low	Minor	Minor (3)

7.3.2 TRAFFIC IMPACTS

The impacts of added traffic due to the Ammonia Terminal activities on the Walvis Bay-Swakopmund commuters, nearby communities, motorists and tourists are illustrated in Figure 49.

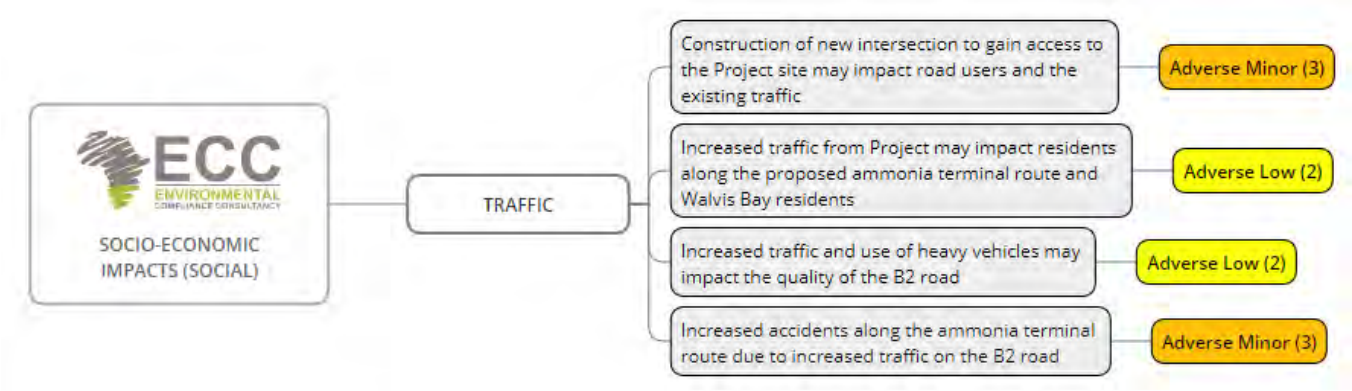


Figure 49 - Traffic impacts

7.3.2.1 Impacts of the construction of an access road to the proposed Project site

During the construction and operations of the Ammonia terminal, an access road from the B2 road to the proposed Project will have to be constructed. During a traffic impact assessment conducted by Zutari Namibia (Pty) Ltd (Appendix H), a potential access was identified and assessed as shown on Figure 50. The traffic study proposed an intersection, with a deceleration lane and a passing lane. However, due to new developments at the Walvis Bay north port, new sub-roads will be created. This will be considered by local authorities in future engagements.



Figure 50 - Potential access road position from the B2 road to the Ammonia Terminal

The impact is adverse, directly impacting receptors in the vicinity, reversible and temporary due to the duration of the construction of an access road. The development of the intersection will be definite as there is currently no access to the proposed Project site, which includes a deceleration line and a passing lane to allow passing cars to proceed while moving aside to access the terminal.

The sensitivity of the impact is low due to the local scale of the impact and the magnitude of change is minor as it is not foreseen to have a large impact socially or towards the environment. The overall significance of the impact is minor. Mitigation measures are described in the ESMP.

7.3.2.2 Increased traffic impact on Walvis Bay and other nearby residential areas

The proposed Project may generate increased traffic during the life cycle of the Project. The impact is adverse, directly affecting road users, reversible and over the long term due to the foreseen life cycle of the proposed Project (more than 50 years). The impact is possible, and the B2 road has high volumes of commuting traffic currently.

Additional Traffic Data

Taking into consideration the materials transported during construction, monitoring of activities, number of employees and daily removal of waste; the additional traffic during the Ammonia Terminal Project is calculated, as shown in Table 23.

Table 23 - Average daily traffic expected during the construction and operations of the Project

Description	ADT Light	ADT Heavy	ADT Total
B2:			
Vehicles added during the construction phase	5	3	8
Vehicles added during the operational phase	5	2	7

The sensitivity of the impact as it affects local. The magnitude of change is minor as the impact will cause some congestion on the B2 especially during construction. The overall significance of the impact is low. Mitigation measures are described in the ESMP.

7.3.2.3 Potential negative impact on the quality of the road

The increased traffic on the road and use of heavy vehicles for the proposed Project may negatively affect the quality of the B2 main road. The impact is adverse, cumulative due to the added impact of the weight of the large vehicle and frequent use of the road for Project needs. The impact is reversible and over the long term due to the period of time the road is used for the Project (more than 50 years). The impact is unlikely as the road already has high volumes of traffic and it is frequently upgraded and improved and currently in good condition for road users.

The sensitivity of the impact is low due to the local scale of the impact and the magnitude of change is negligible due to the very low or minor impact. The overall significance of the impact is low. Mitigation measures are described in the ESMP.

7.3.2.4 Increased potential accidents on the B2 road

The increased traffic on the B2 main road may result in added risk of potential accidents on the road. The impact is adverse, directly affecting all road users, irreversible as serious injuries may be sustained, or lives may be lost (Table 24). The impact may be possible and over a long period due to the life span of the Project (more than 50 years).

The sensitivity of the impact is low due to the local scale of the impact and the magnitude of change is major due to the potential serious injuries or death that may result from road accidents. The overall significance of the impact is minor. Mitigation measures are described in the ESMP.

Table 24 - Traffic impacts

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction phase	Community, motorists, tourists	Construction of new intersection to gain access to the Project site may impact road users and the existing traffic	Adverse Direct Reversible Temporary Local Definite	Low	Minor	Minor (3)
Construction and operations		Increased traffic from Project may impact residents along the proposed Ammonia Terminal route and Walvis Bay residents	Adverse Direct Reversible Long term Local Possible	Low	Negligible	Low (2)
		Increased traffic and use of heavy vehicles may impact	Adverse Cumulative Reversible Long term Local	Low	Negligible	Low (2)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		the quality of the B2 road	Unlikely			
		Increased accidents along the Ammonia Terminal route due to increased traffic on the B2 road	Adverse Direct Irreversible Long term Local Possible	Low	Major	Minor (3)

7.3.3 VISUAL IMPACTS

The detailed visual and sense of place impacts of the Ammonia Terminal activities on the Walvis Bay-Swakopmund community, road users and tourists are illustrated in Figure 51 and shown in Table 25.

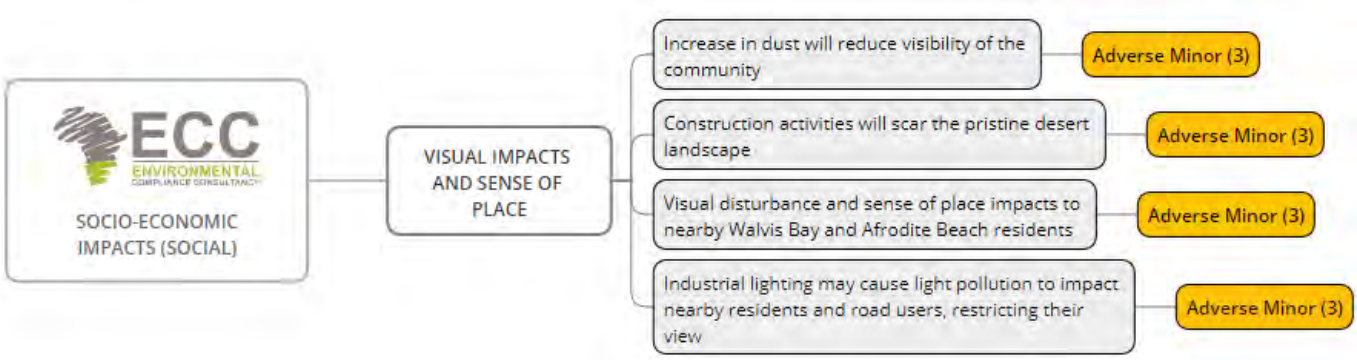


Figure 51 - Visual and sense place impacts

7.3.3.1 Increase in dust during construction may have visual impacts

During the construction of the Ammonia Terminal Project, the emission of dust will occur. Research on dust emissions, PM_{10} and $PM_{2.5}$ sources and impacts on receptors from the strategic environmental management plan (SEMP) Project conducted for the Erongo Region has indicated that dust concentrations are generally higher at coastal monitoring stations than at the stations located further inland, often exceeding the daily World Health Organization (WHO) guideline value(s) (Liebenberg-Enslin, von Oertzen, & Mwananawa, 2020). The impact is adverse, directly interacting with receptors, reversible and over a short period due to the duration of the construction activities (approximately 2 years). The proposed site of the Project within the dune belt outside of Walvis Bay makes dust generation definite.

The sensitivity of the impact is low due to the local scale of the impact and the magnitude of change before mitigation is minor due to low impact to the overall receiving environment and vicinity from sensitive receptors (i.e. public, residential areas etc.). The overall significance of the impact is minor. Mitigation measures are indicated in the ESMP.

7.3.3.2 Scarring of the pristine desert landscape may have visual impacts

The Ammonia Terminal construction activities involve removal of potential topsoil to provide a suitable foundation for the terminal and associated infrastructure. The development of the Project will change the natural desert landscape. The impact is adverse, directly impacting receptors in the vicinity, reversible and over a short period due to the duration of the construction activities. The development of the infrastructure will definitely change the landscape as any construction activity will disturb a vacant and pristine area. However, the Project location is not frequented by tourists or the public at large.

The sensitivity of the impact is low due to the local scale of the impact and the magnitude of change before mitigation is minor due to the low level of severity to the overall environment. The overall significance of the impact is minor. Mitigation measures are indicated in the ESMP.

7.3.3.3 Industrial lighting may restrict the view on nearby residents and road users

During the Ammonia Terminal construction and operations industrial lighting used may be problematic for B2 road users (causing night blindness) and causing light pollution for residential areas near the terminal and associated infrastructure. The impact is adverse, directly impacting receptors in the vicinity, reversible and over a long term due to the duration of the Project (more than 50 years). The industrial lighting may be distracting and in severe cases may restrict the view of B2 road users, making the impact likely.

The sensitivity of the impact is low due to the local scale of the impact and the magnitude of change is minor due to the low impact to the road users and nearby residents. The overall significance of the impact is minor. Mitigation measures are indicated in the ESMP.

Table 25 - Visual and sense of place impacts

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction phase	Community	Increase in dust will reduce visibility	Adverse Direct Reversible Short term Local Definite	Low	Minor	Minor (3)
		Construction activities will scar the pristine	Adverse Direct Partly reversible	Low	Minor	Minor (3)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		desert landscape	Short term Local Definite			
Construction and operations		Visual disturbance and sense of place impacts to nearby Walvis Bay residents	Adverse Direct Partly reversible Long term Local Possible	Low	Moderate	Minor (3)
	Community, motorists, tourists	Industrial lighting may cause light pollution to impact nearby residents and road users, restricting their view	Adverse Direct Reversible Long term Local Likely	Low	Minor	Minor (3)

7.3.4 NOISE IMPACTS

A noise impact assessment was carried out by Airshed (Section 5.19) (Appendix K). The main objective of the noise specialist study was to determine the significance of impacts on the acoustic environment and noise sensitive receptors (NSRs), given noise generated by construction, operational and commissioning activities proposed for the Project. In the assessment of sampled and simulated noise levels, reference was made to the International Finance Corporation (IFC) noise level guidelines for residential, institutional and educational receptors (55 dBA during the day and 45 dBA during the night), since these are applicable to nearby NSRs. Annoyance was assessed according to the South African National Standard (SANS) 10103 (2008) scale.

The detailed noise impacts of Ammonia Terminal activities on the Walvis Bay community and other sensitive receptors are shown in Table 26. The impacts from this assessment are presented in Figure 52 for illustrative purposes only, before mitigation. The potential impacts are discussed further in the sections below.

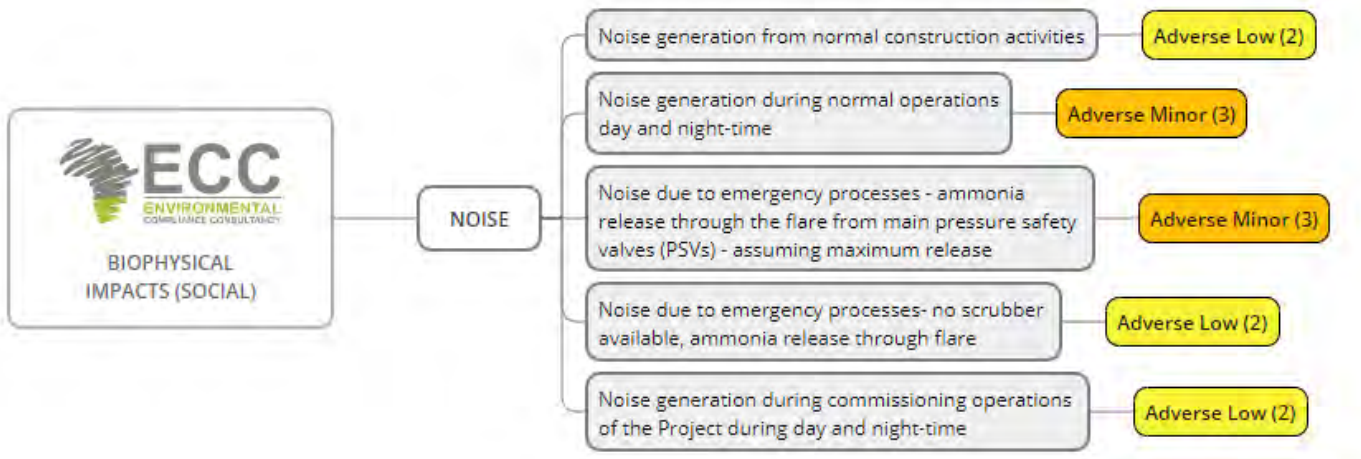


Figure 52 - Noise impacts

7.3.4.1 Construction noise generation

During normal construction activities noise will be generated due to the use of construction equipment and machinery. The nature of the impact is adverse and directly affects the NSR. The impact is reversible and will impact NSR's for a short period of time (less than 5 years). Noise generated is likely and will be limited to the Project site (on-site).

The magnitude of the impact is minor, as the nearest receptors are ~3 km away from the Project site and it is not expected to be detrimental to the Walvis Bay community. The sensitivity rating is low as the activities will occur on-site only. The overall significance of the impact is low. Mitigation measures are outlined in the ESMP.

7.3.4.2 Operational noise generation during day and night-time

During the Ammonia Terminal Project, normal noise due to the components associated with the Ammonia Terminal such as the scrubber, nitrogen (N_2) and instrument air (IA) generation units are assessed in terms of noise. The noise impact assessment concluded that there are no exceedances of the IFC noise guideline for residential areas and is not expected to have an impact on nearest sensitive receptors during the day and night-time as shown in Figure 53 and Figure 54, respectively.

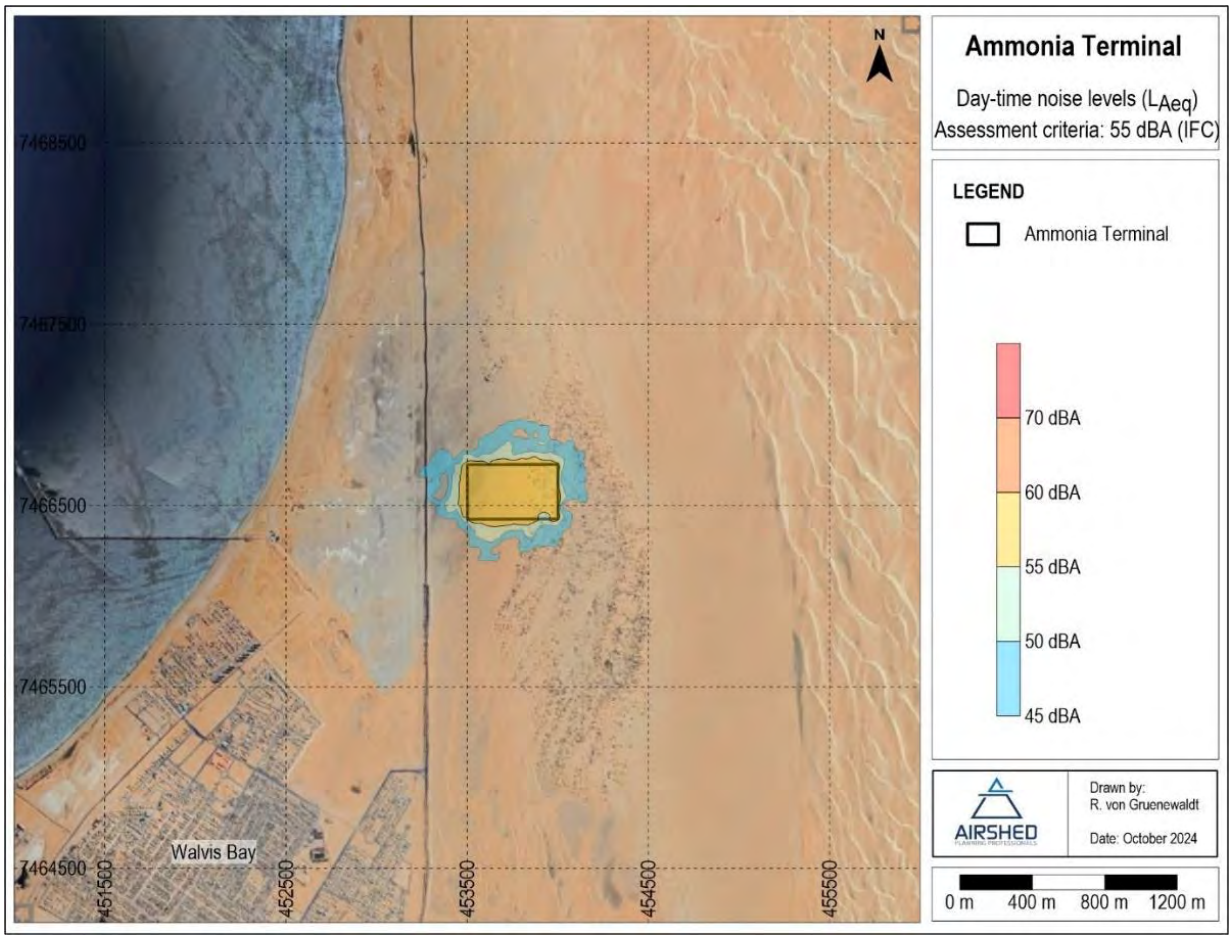


Figure 53 - Simulated day-time noise levels due to normal Project operation only

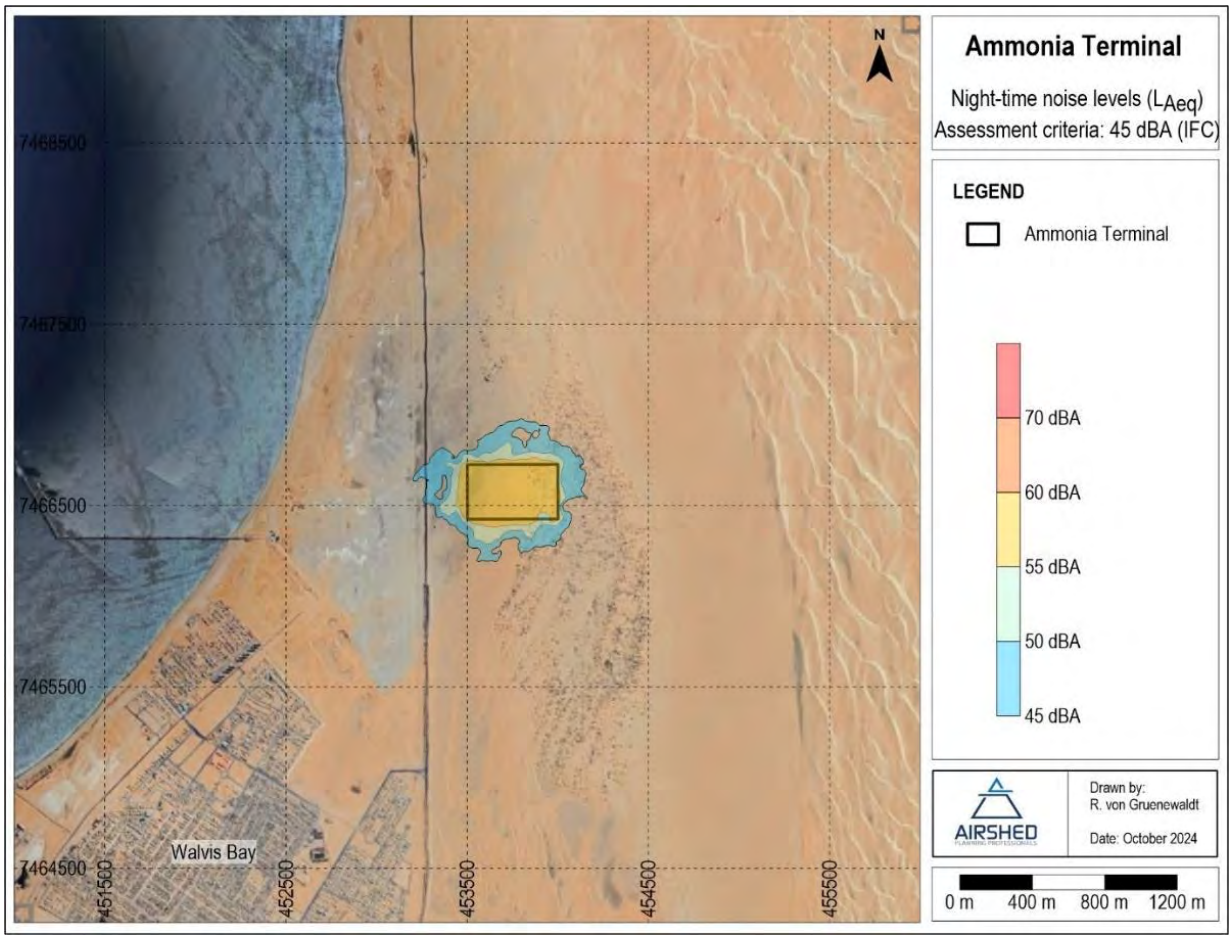


Figure 54 - Simulated night-time noise levels due to normal Project operations only

The impact is impact is adverse, directly affecting receptors and reversible due to potential Project decommissioning. The impact will occur over long term, during normal operations (~50 years). The impact is likely as slight noise is to be expected from normal operations.

The sensitivity of the impact is low due to noise slightly extending past the Project site. The magnitude of change before mitigation is minor, as sensitive receptors will not be affected and no community reaction is expected with generated noise well below IFC noise guidelines (23.1 dBA and 24.7 dBA) during the day and night, respectively. The overall significance of the impact is minor. Mitigation measures are detailed in the ESMP.

7.3.4.3 Noise due to emergency processes – ammonia released through the flare from main pressure safety valves (PSVs) – assuming maximum release

The worst-case scenario of flaring would be due to a sudden change in the ambient pressure. A sudden drop in ambient pressure can shift the main storage tank pressure dangerously close to the maximum designed overpressure with the environment. To rapidly relieve this pressure, the tank is equipped with a series of 4 PSVs ("T" orifice) with a total rated capacity of 29.1 tph. This amount is such that neither the reference system, nor the scrubber, is able to cope with and thus this stream is directed toward the flare for combustion, assisted with propane (Proton Ventures, 2014).

The noise impact assessment (Appendix G) found that there were no exceedances of the IFC noise guideline for residential areas during the day (Figure 55); however, the night-time noise levels (53.2 dBA) exceeded the IFC noise guideline (45 dBA) for residential areas (Figure 56).

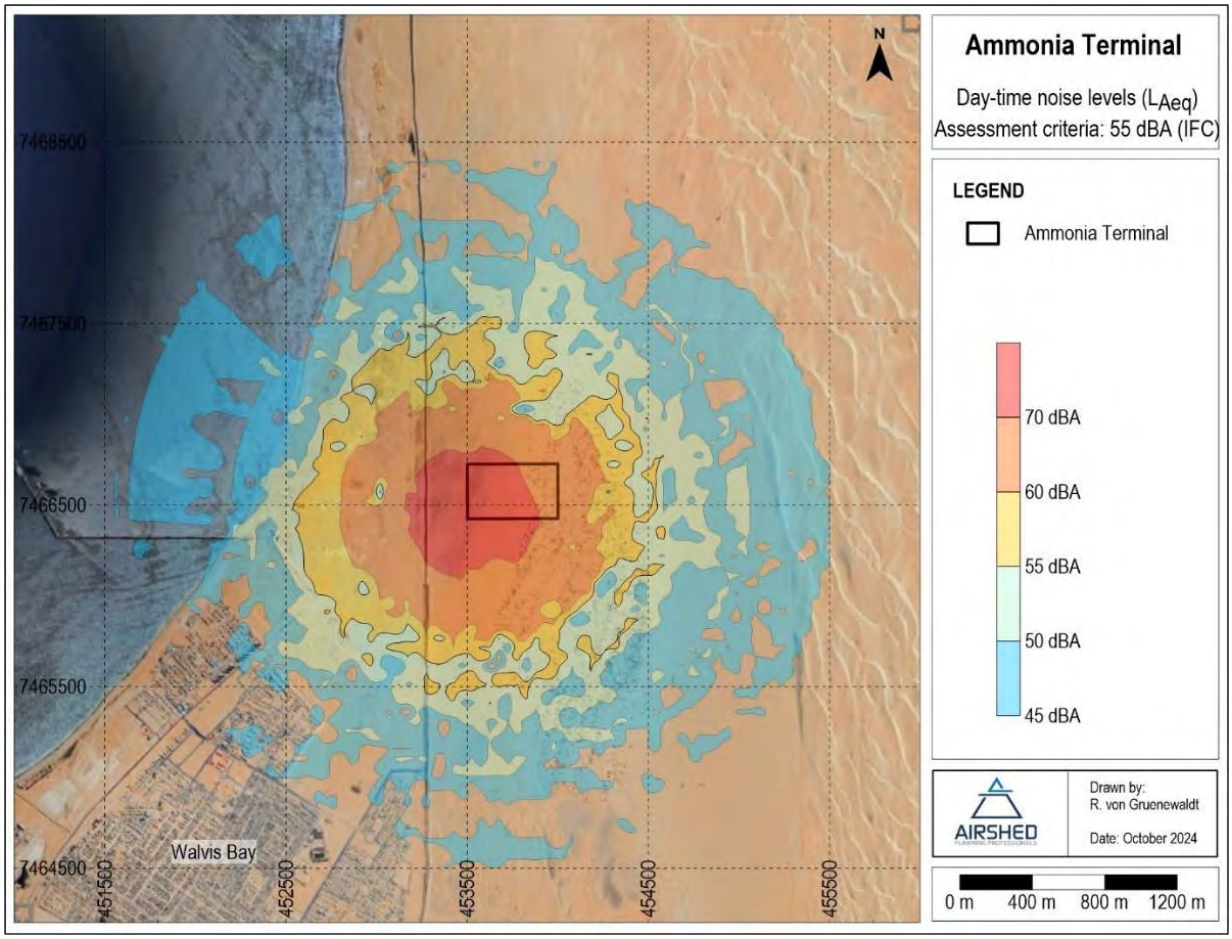


Figure 55 - Simulated day-time noise levels due to Project emergency process (assuming 1 hr tank PSVs maximum release through the flare)

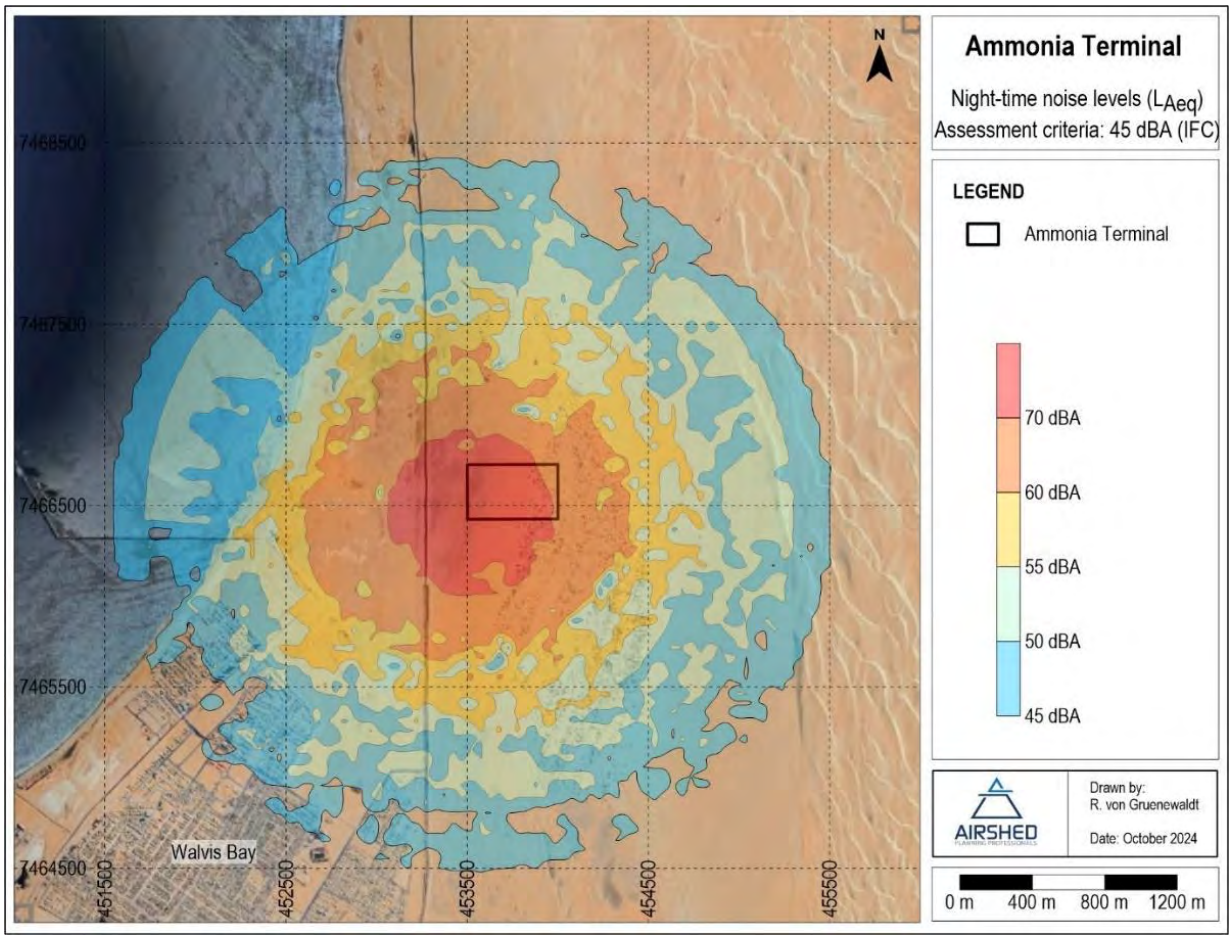


Figure 56 - Simulated night-time noise levels due to Project emergency process (assuming 1 hr tank PVSs maximum release through the flare)

The impact is adverse, direct and reversible. The impact will be temporary, and it is assumed that tank PSVs maximum release through the flare will be an hour. Due to the worst-case scenario, response to emergency situations should be planned and expected, therefore the impact is likely.

The sensitivity of the impact is low due to the local impact. The magnitude of change before mitigation is moderate as temporary and short-lived noise levels at night-time may result in community reaction with widespread complaints. The overall significance of the impact is minor. Mitigation measures are described in the ESMP.

7.3.4.4 Noise due to emergency processes – no scrubber available, ammonia release through flare

During operations, the scrubber may not be operating or may be under maintenance, the purge with same flowrate (of 1000 kg/h) and composition is sent to the flare. The noise impact assessment reported that there are no exceedances of the IFC noise guideline for residential areas during the day and night-time as shown in Figure 57 and Figure 58, respectively.

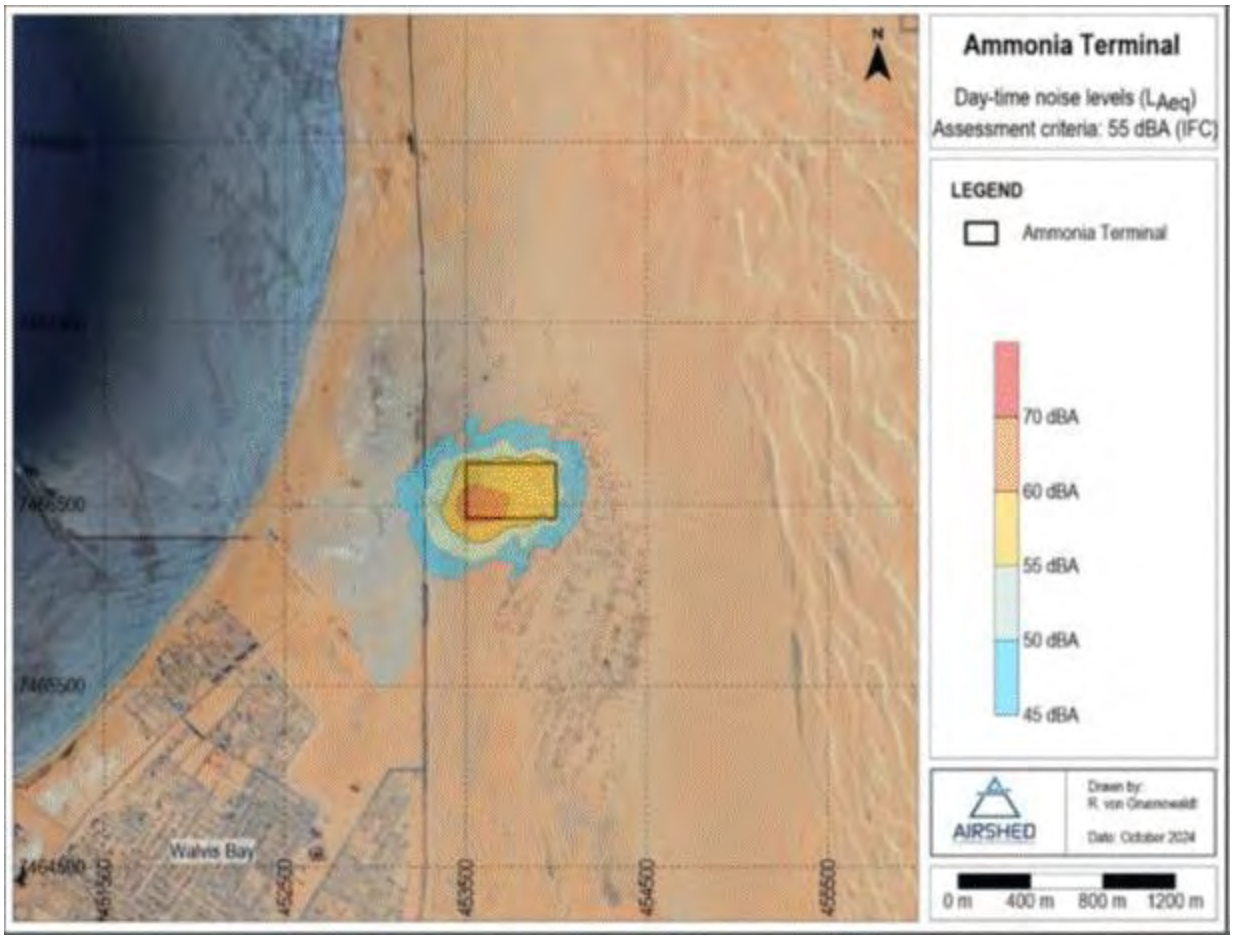


Figure 57 - Simulated day-time noise levels due to Project emergency process (assuming 1 hr scrubber emission release through the flare)

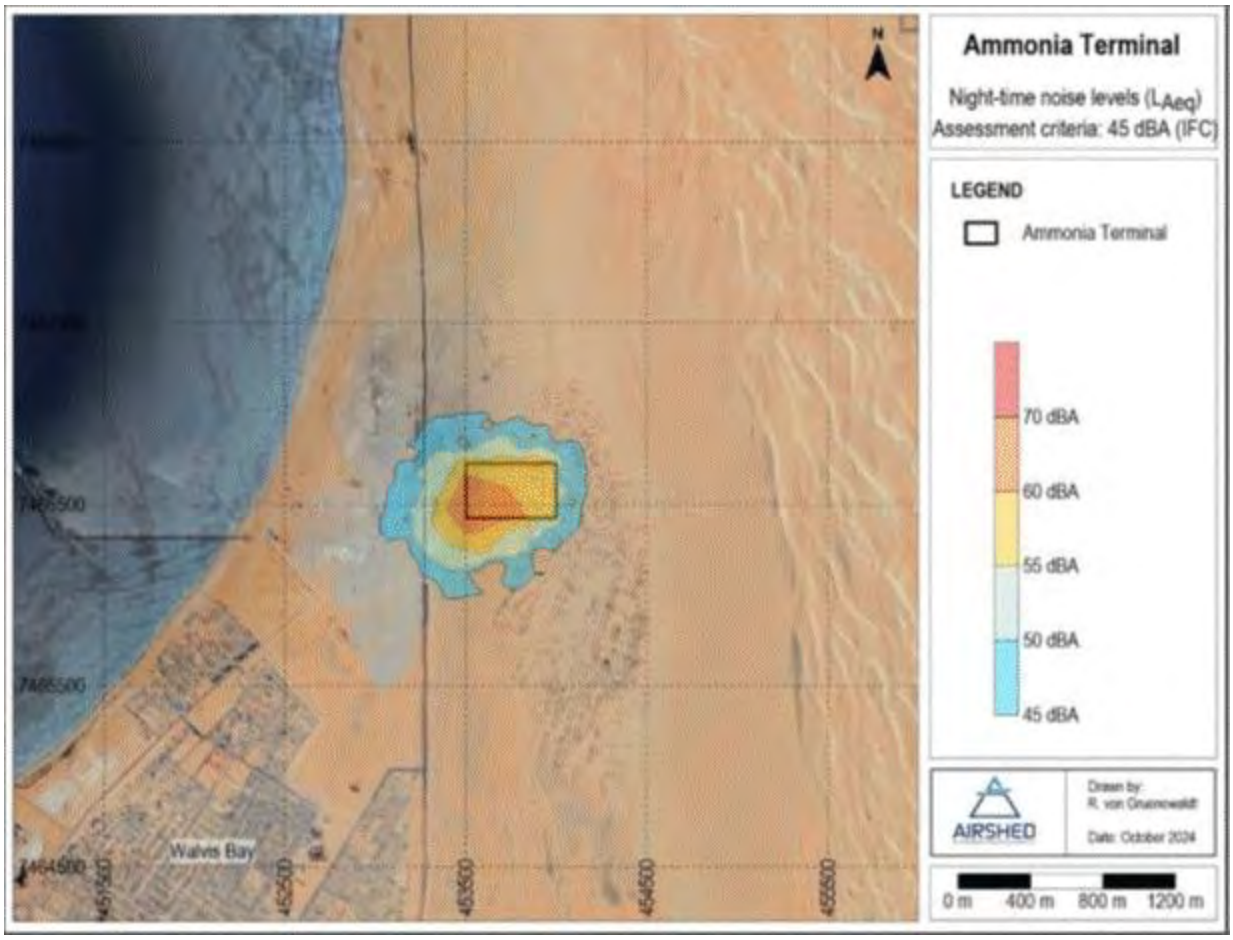


Figure 58 - Simulated night-time noise levels due to Project emergency process (assuming 1 hr scrubber emission release through the flare)

The impact is adverse, direct and reversible as the noise will not have lasting effects. The impact will be temporary, as it is assumed that throughput released through the flare is estimated at an hour. Emergency situations, such as the unavailability of the scrubber should be expected, therefore the impact is likely.

The sensitivity of the impact is low due to the local impact. The magnitude of change before mitigation is minor because no community reaction is expected with generated noise below IFC noise guidelines (25.9 dBA and 29.6 dBA) during the day and night respectively. The overall significance of the impact is low. Mitigation measures are described in the ESMP.

7.3.4.5 Noise generation during commissioning operations of the Project during day and night-time

During start-up, commissioning and decommissioning it is expected that the flare unit will be operating continuously. The expected maximum flowrate during commissioning is about 2000 kg/h (Proton Ventures, 2014). The noise assessment findings showed that there are no exceedances of the IFC noise guideline for residential areas during the day and night-time as shown in Figure 59 and Figure 60, respectively.

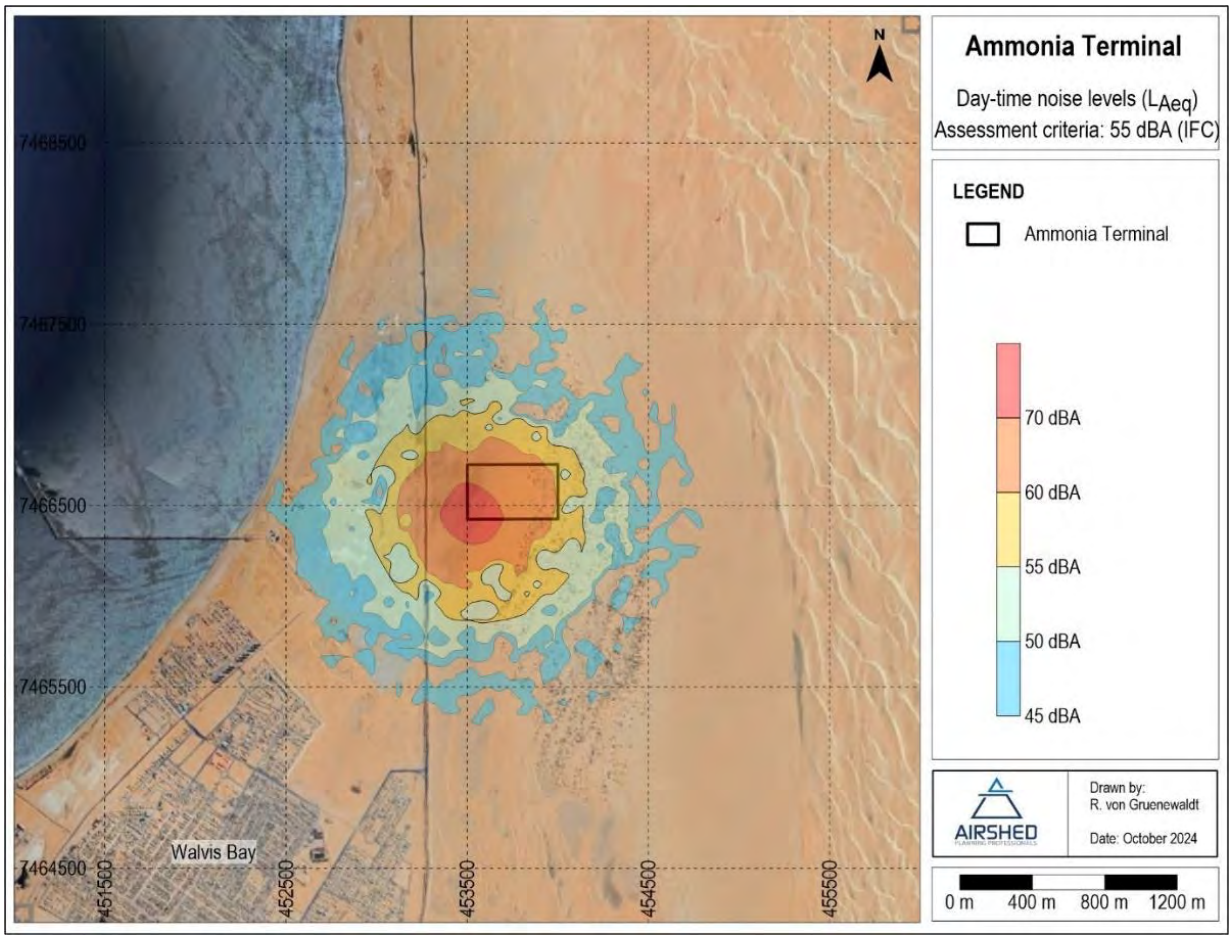


Figure 59 - Simulated day-time noise levels due to Project during commissioning operations only

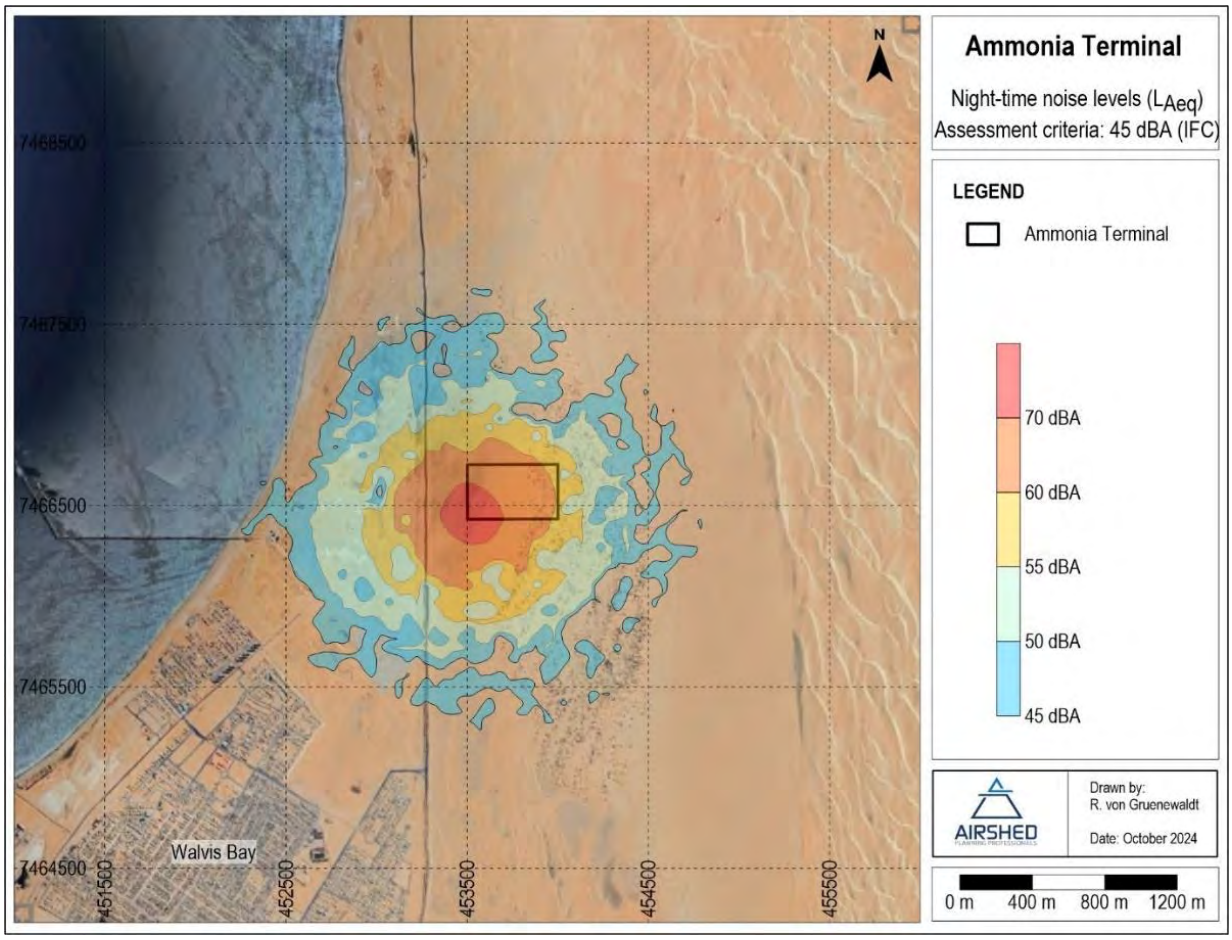


Figure 60 - Simulated night-time noise levels due to Project during commissioning operations only

The impact is adverse, direct and reversible as the impacts are recoverable should the Project cease. The impact will be temporary during Project commissioning only. The impact is rated as likely, as this impact is expected during the Project commissioning phase.

The sensitivity of the impact is low due to the local scale of noise released. The magnitude of change before mitigation is minor because no community reaction is expected with noise levels below IFC noise guidelines (40.4 dBA and 41.7 dBA) during the day and night, respectively. The overall significance of the impact is minor. Mitigation measures are detailed in the ESMP.

Table 26 - Noise impacts

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction phase	Noise	Noise generation from normal construction activities	Adverse Direct Reversible Short term On-site Likely	Low	Minor	Low (2)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Operational phase		Noise generation during normal operations day and night-time	Adverse Direct Reversible Long-term On-site Likely	Low	Minor	Minor (3)
		Noise due to emergency processes - ammonia release through the flare from main pressure safety valves (PSVs) - assuming maximum release	Adverse Direct Reversible Temporary Local Likely	Low	Moderate	Minor (3)
		Noise due to emergency processes- no scrubber available, ammonia release through flare	Adverse Direct Reversible Long term Local Likely	Low	Minor	Low (2)
Project commissioning		Noise generation during commissioning operations of the	Adverse Direct Reversible Temporary Local scale Likely	Low	Minor	Low (2)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		Project during day and night-time				

7.3.5 HERITAGE IMPACTS

Due to the significance of cultural objects and features, various domestic laws are in place and several international treaties and conventions have been ratified, aimed and ensuring adequate protection of and respect for these resources. Despite this legislative and regulatory protection, heritage resources are still facing numerous threats the most significant of which has been identified by the National Heritage Council as the following (National Heritage Council of Namibia, 2024).:

- Expansion of anthropogenic activities, especially uncontrolled infrastructure developments in urban and rural areas;
- New transportation infrastructure (roads, railways and port facilities), utilities or service infrastructure (installation of water, telephone and renewable energy facilities);
- Pollution, physical resource extraction (large- and small-scale mining and quarrying) and deliberate destruction (vandalism, graffiti and theft); and
- Change in use (of all above).

Heritage impact assessments identify potential disturbance and/or destruction to structures, features and artifacts in the Project area, with cultural heritage significance as a result of the Project construction, operations and decommissioning activities.

The archaeological survey for the Project followed a basic two-phase process of evaluation: the first a desk study, followed by an assessment based on the field survey.

A field survey was undertaken by the heritage specialist, RCHeritage Services cc in August 2024 (Appendix J). The impacts from this assessment are presented in Figure 61 for illustrative purposes only, before mitigation. The potential impacts are discussed further in the sections below.

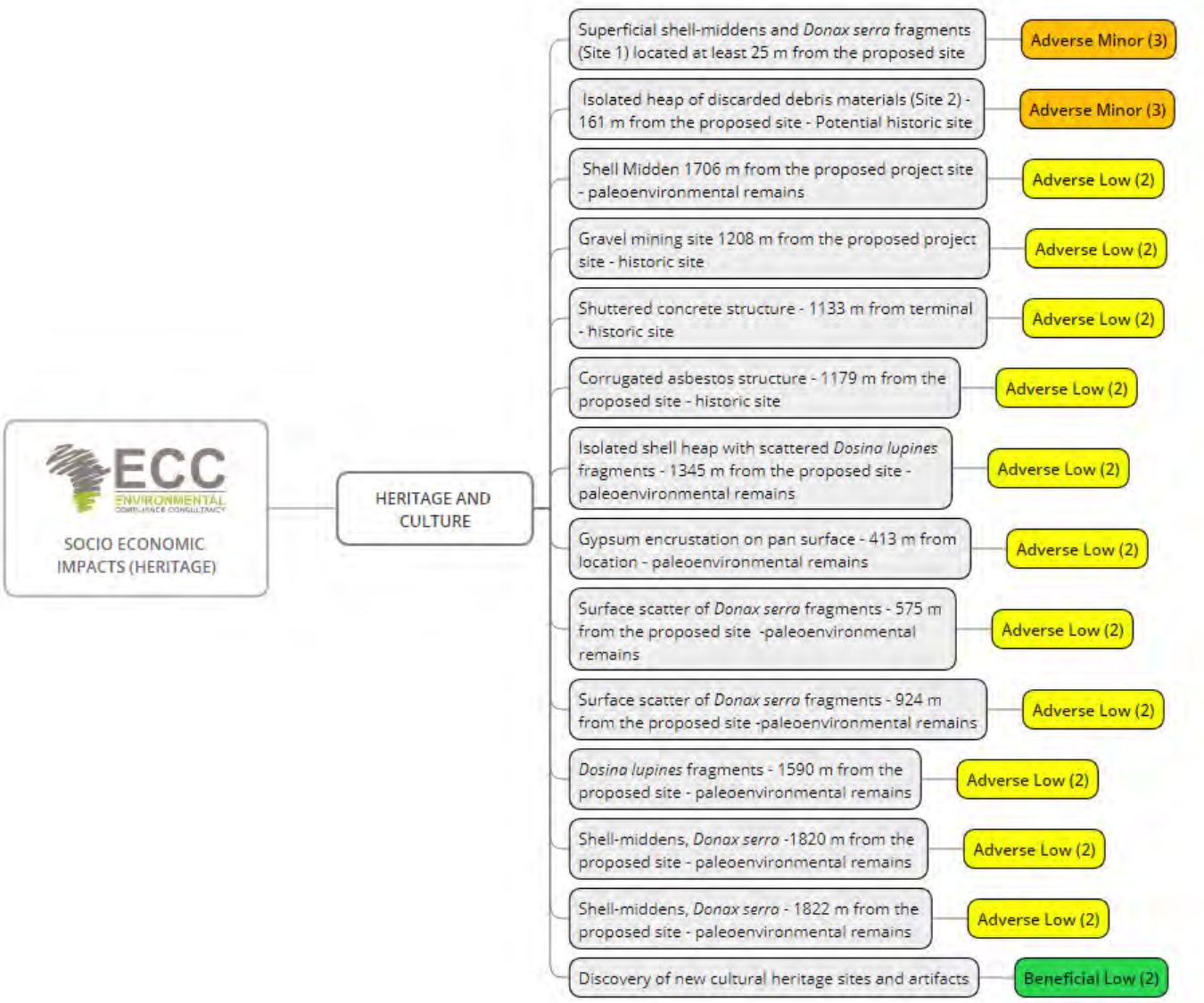


Figure 61 - Heritage impacts

During the desktop study, eight (8) sensitive archaeopaleontological features (shell middens) along the extinct mid-Holocene tidal lagoon were identified and three (3) historic sites. During the field survey, it was confirmed that two (2) heritage features were within the Project footprint (Figure 62).

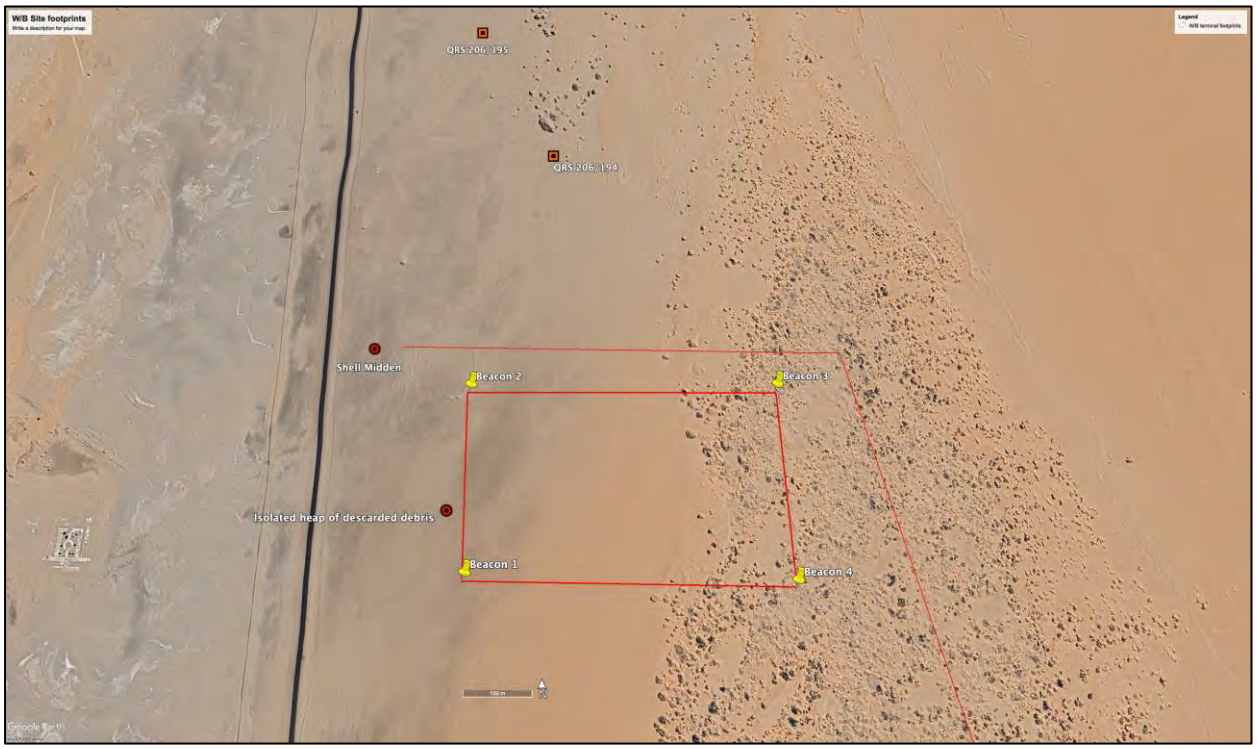


Figure 62 - The two (2) sites discovered during the site survey and its location in relation to the Project footprint (RCHeritage Services, 2024)

7.3.5.1 Project activities may impact on superficial shell middens and molluscan remains

Superficial shell middens accumulations fragmented *Donax serra* (White mussel) were encountered over a large area of approximately 15 m in a disturbed tidal flat of the extinct mid-Holocene tidal lagoon and 43.31 m away from the Project location. These findings represent the tidal flood extent of a terminal Pleistocene lagoon (RCHeritage Services, 2024). It has been reported that shell middens are potential traces of human occupation in the Namib Desert (Kinahan, 2012).

The Proponent is not expected to access these areas during the construction and operation of the Ammonia Terminal. The nature of the impact is adverse, indirect and irreversible due to the permanent loss or damage to the remains. The probability of the impact is likely due to the proximity of the remains to the Project. The magnitude of change is negligible, as it was reported that the shell middens and *Donax serra* fragments are secondary depositions. Furthermore, the findings have no significant scientific value due to the severe disturbance in the area from the construction of B2 tar road and associated activities. The sensitivity of the receptor is low due to the local scale of the impact. The overall significance is minor. No mitigation measures are required according to the heritage study (Appendix J).

7.3.5.2 Project activities may impact potential prehistoric remains identified

It is assumed that an isolated heap of discarded debris from rusted and unidentified corrugated metal materials identified could potentially be a historic site, with evidence of a temporary settlement post. The potential historical site is located ~161 m from the proposed Project site.

It was noted that no other similar or associated materials were observed in the immediate surrounding area of the site.

It is expected that construction and operations of the Project will indirectly disturb or destroy the potential historic site. The nature of the impact is adverse, indirect and irreversible due to the permanent loss or damage to the area. The probability of the impact is likely due to the proximity to the proposed Project. The magnitude of change is negligible, due to poor state of conservation and it has not been established whether the discarded debris from rusted and corrugated metal materials is from a recent or historical period. The sensitivity of receptor is low due to the local scale of the impact. The overall significance is minor. No mitigation measures are required according to the heritage study (Appendix J).

7.3.5.3 Construction activities may impact the previously identified sites of archaeological interest in proximity to the footprint of the Project

The construction activities may possibly disturb or destroy previously identified sites that are 950 m within the Project footprint. Three were identified as following: (1) gypsum encrustation on the pan surface (*QRS 206/194)* located 412.62 m from the proposed Ammonia Terminal; (2) the surface scatter of *Donax serra* fragments (*QRS 206/195*) located ~574.69 m from the proposed Ammonia Terminal; and (3) the surface scatter of *Donax serra* fragments (*QRS 206/196*) located ~923.96 m from the proposed Ammonia Terminal.

The nature of the impact is adverse, indirect and irreversible due to the potential permanent loss or damage to the findings. The probability of the impact is possible as the locations of the potential archaeological sites are between 400 m and 950 m from the Proposed site. The magnitude of change is minor, due the sites being previously identified and not during the site survey. The sensitivity of receptor is low due to the local scale of the impact. The overall significance is low. According to the heritage study, these sites should be treated as no-go zones as they lack detailed information from their previous project. The mitigation measures are outlined in the ESMP.

7.3.5.4 Construction activities may disturb previously identified sites more than 1000 m away but still within the vicinity of the Project

During construction and operations of the Project, previously identified sites more than 1000 m away may be disturbed, however the probability is unlikely. Such sites include potential historic sites and paleoenvironmental remains.

The nature of the impact is adverse, indirect and irreversible due to the potential permanent loss or damage to the potential sites. The magnitude of change is minor, as these are potential archaeological sites, however these it is unidentified as such. The sensitivity of receptor is low due to the local scale of the impact. The overall significance is low. No mitigation measures are required according to the heritage study (Appendix J).

7.3.5.5 Project activities may lead to potential new cultural heritage sites, objects and artifacts

During construction and operations, discovery of new cultural heritage sites, objects and artifacts may occur within the general Project site. In cases where heritage sites are discovered, the 'chance find procedure' will be used as implemented in the ESMP. The nature of the impact is beneficial, direct and irreversible. The probability of the impact is possible, as many regions of the Namib Desert are yet to be studied. Should any major discoveries be made, this may be substantial for the Namib desert area and cultural tourism. There are still a lot of unknowns about both the Namib desert and surrounding rivers. Therefore, the magnitude of change is moderate, and the sensitivity of receptor will be low due to the local cultural benefit associated with this impact. The significance of the impact is beneficial low. The mitigation measures are outlined in the ESMP.

Table 27 - Heritage impacts prior to mitigation measures

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction and operations	Cultural heritage	Superficial shell-middens and *Donax serra* fragments (Site 1) located at least 25 m from the proposed footprint of the site	Adverse Indirect Irreversible Permanent On-site Likely	Low	Negligible	Minor (3)
		Isolated heap of discarded debris materials (Site 2) - 161 m from terminal-potential historic site	Adverse Indirect Irreversible Permanent On-site Likely	Low	Negligible	Minor (3)
		Shell Midden 1706 m from terminal location - paleoenviron	Adverse Indirect Irreversible Permanent Regional Unlikely	Low	Minor	Low (2)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		mental remains				
		Gravel mining site 1208 m from terminal - historic site	Adverse Indirect Irreversible Permanent On-site Unlikely	Low	Negligible	Low (2)
		Shuttered concrete structure - 1133 m from terminal - historic site	Adverse Indirect Irreversible Permanent On-site Unlikely	Low	Negligible	Low (2)
		Corrugated asbestos structure - 1179 m from location - historic site	Adverse Indirect Irreversible Permanent On-site Unlikely	Low	Negligible	Low (2)
		Isolated shell heap with scattered *Dosina lupines* fragments - 1345 m from location - paleoenvironmental remains	Adverse Indirect Irreversible Permanent Regional Unlikely	Low	Minor	Low (2)
		Gypsum encrustation on pan surface - 413 m from	Adverse Indirect Irreversible Permanent On-site	Low	Minor	Low (2)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		location - paleoenvironmental remains	Possible			
		Surface scatter of *Donax serra* fragments - 575 m from the terminal - paleoenvironmental remains	Adverse Indirect Irreversible Permanent On-site Possible	Low	Minor	Low (2)
		Surface scatter of *Donax serra* fragments - 924 m from the terminal - paleoenvironmental remains	Adverse Indirect Irreversible Permanent On-site Possible	Low	Minor	Low (2)
		Dosina lupines fragments - 1590 m from terminal- paleoenvironmental remains	Adverse Indirect Irreversible Permanent On-site Unlikely	Low	Minor	Low (2)
		Shell-middens, *Donax serra* - 1820 m from terminal - paleoenvironmental remains	Adverse Indirect Irreversible Permanent Regional Unlikely	Low	Minor	Low (2)
		Shell-middens,	Adverse Indirect	Low	Minor	Low (2)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		Donax serra - 1822 m from terminal - paleoenvironmental remains	Irreversible Permanent Regional Unlikely			
Ammonia Terminal Project activities		Discovery of new cultural heritage sites and artifacts	Beneficial Indirect Irreversible Permanent On-site Possible	Low	Moderate	Beneficial Low (2)

7.3.6 SOCIAL/COMMUNITY IMPACTS

The significant social/community impacts before mitigation are summarised in Figure 63 for illustrative purposes. Details related to each specific impact are discussed further in this section and the impact ratings are shown in Table 28.



Figure 63 - Social/community impacts

7.3.6.1 Impacts on the skills and development of employees

Skills development is widely recognised as a critical aspect of Namibia's socio-economic development. Green hydrogen as part of the green economy is fairly new to Namibia and it has been documented that new and emerging green jobs mostly require higher-level qualifications and managerial skills (International Labour Organisation). Additionally, green hydrogen Projects provide on the job training for future green jobs, an increasingly popular industry.

The impact is beneficial, directly affecting local communities. The impact is irreversible and permanent due to the valuable skills and training offered. Furthermore, Cleanergy Solutions is currently developing a green hydrogen academy at Farm 58, aiming at upskilling and training future employees. Training includes the production and usage of hydrogen as fuel for heavy duty equipment like trucks, locomotives and mining equipment, as well as gensets which further diversifies Namibia's power mix (Cleanergy Solutions Namibia , 2023).

The sensitivity of the impact is low due to the local scale of the impact and the magnitude of change is moderate due to the significant opportunity in developing the skills of employees. The overall significance of the impact is beneficial moderate.

7.3.6.2 Increase in employment will positively impact the livelihood of locals

According to Namibia's Vision 2030, the goal is to reduce the unemployment rate to 5% by 2030 (United Nations Development Programme, 2024). The proposed Project will give preference to locals as it pertains to semi-skilled and unskilled jobs. Employment of locals will enhance the quality of life of the Walvis Bay – Swakopmund community. It has been reported that the unemployment rate in Erongo region has an unemployment rate of approximately 21.9% (Namibia Statistics Agency, 2019).

The impact is directly beneficially to receptors. The impact is reversible as the status of employees can change for a variety of reasons. Employment will be provided over a long period of time, due to the span of the Project (more than 50 years). The probability of the impact is definite as employment will allow income to the household contributing to everyday expenses.

The sensitivity of the impact is low due to the local scale of the impact and the magnitude of change is moderate due to the improvement to people's lives. The overall significance of the impact is beneficial moderate.

7.3.6.3 Influx of workers to the Erongo Region, specifically Walvis Bay, due to green hydrogen job seekers, may lead to further negative impacts

Walvis Bay Namibian Port Authority, known as the gateway port for trade between landlocked countries and the rest of the world and industrial development opportunities such as the proposed Project, could cause more people to relocate to Walvis Bay seeking jobs, potentially increasing crime rates. Additionally, influx of workers may increase the spread of illnesses.

The impact is adverse, cumulative due to added impacts as relocation occurs and unemployment increases. The impact is partly reversible and over a medium period of time due to the potential return of job seekers to their original places of living. The probability of the impact is possible.

The sensitivity of the impact is low due to the local scale of the impact and the magnitude of change is moderate due to potential significant criminal activities, spread of illness and increased unemployment. The overall significance of the impact is minor. Mitigation measures are described in the ESMP

7.3.6.4 Ammonia inhalation from potential leaks or releases could affect the health of surrounding communities

A quantitative risk assessment (QRA) was carried out by Antea Group in 2024 (Appendix I). The main objective was to quantify the risk of the Project at worst case scenario with relation to the nearest community.

During the Ammonia Terminal operations, an emergency scenario could potentially cause the release of airborne toxic vapours, fires and explosions due to a system failure or malfunction that could impact the local residents, the nearest being ~ 3 km away (Walvis Bay residents). The impact is adverse and affects the community directly. The impact is rated irreversible as it could be fatal. The impact is considered permanent. The impact is rated as unlikely as the design of the ammonia tank to prepare for identified worst-case scenarios should be acknowledged.

The magnitude of impact is very high/unknown, as this could lead to serious changes and fatalities in the worst-case scenario. It should be noted that, in the Quantitative Risk Assessment carried out by Antea Group for the Project in 2024, the 10-6/yr contour is used to evaluate the external safety situation. This contour does not include any vulnerable objects (housing, office buildings and care facilities e.g. schools, hospitals etc.) and is therefore considered acceptable from a health and safety perspective. The sensitivity of impact is rated as high due to the potential impacts on community lives. The significance of impact is adverse major prior to mitigation measures. Mitigation measures are outlined under 7.3.7.4 and the ESMP. The significance of the impact after mitigation is moderate.

7.3.6.5 Increased housing demand impacts

The north port area is continuously expanding with new initiatives and opportunities, bringing more businesses to Walvis Bay. The proposed Project and other north port projects will cause job seekers to relocate to Walvis Bay and the demand for housing will increase. The impact is adverse, cumulative due to the added jobs that are yet to come in the area, irreversible and long-term due to the duration of the Project. The demand for more housing is possible as more jobs will be created in the north port and more relocations will be possible (Table 28).

The sensitivity of the impact is low due to the local scale of the impact and the magnitude of change is minor as it is not foreseen to have a large impact socially. The overall significance of the impact is minor. Mitigation measures are described in the ESMP.

Table 28 - Impacts on the community

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Ammonia Terminal Project constructio	Community	Increase in skills and development of locals	Beneficial Direct Irreversible Permanent	Low	Moderate	Beneficial Moderate (4)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
n and operations		providing opportunities for future projects, perhaps in the green hydrogen industry	Local Definite			
		Increase in employment of locals provide improved livelihoods	Adverse Direct Reversible Long term Local Definite	Low	Moderate	Beneficial Moderate (4)
		Potential increase in crime due to influx of workers	Adverse Direct Irreversible Long term Local Possible	Low	Moderate	Minor (3)
		Influx of job seekers due to the promise of the green hydrogen industry may result in increased unemployment, crime and illnesses	Adverse Cumulative Partly reversible Medium term Local Possible	Low	Moderate	Minor (3)
		Long term impacts of potential ammonia inhalation on the health of surrounding residents	Adverse Direct Irreversible Long term Local Unlikely	High	Very High	Moderate (6)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		Increased demand for housing available in Walvis Bay	Adverse Cumulative Irreversible Long term Local Possible	Low	Minor	Minor (3)

7.3.7 OCCUPATIONAL HEALTH AND SAFETY IMPACTS

Occupational health and safety (OHS) refers to the practice that deals with the safety, welfare, and social well-being of workers. Providing a safe working environment for staff members is a legal responsibility vested upon employers (Professional Evaluation and Certification Board, 2024). Employers are required by law to ensure that their workplaces are safe, healthy and free from hazards that could cause harm to workers. This section provides the potential occupational health and safety risks associated with the activities of the Ammonia Terminal. The occupational health and safety impacts are assessed in Table 29. The occupational health and safety impacts that may arise because of the project before mitigation and in cases of a high rating, after mitigation are presented in Figure 64, for illustrative purposes only.

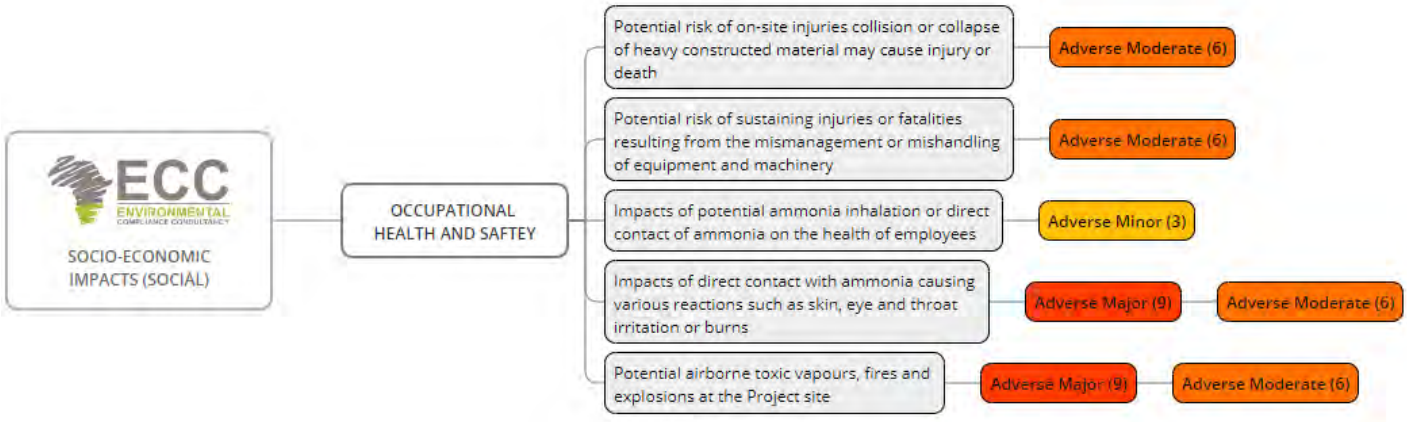


Figure 64 - Occupational health and safety impacts or risks

7.3.7.1 Workplace safety: Potential risk of on-site injuries leading to short-term impairment, permanent disabilities of fatalities

Construction work often involves complex tasks with heavy machinery, power tools, and hazardous materials, all of which require specific knowledge and experience to operate safely. The fast-paced and high-pressure environment creates a significant risk for injuries, particularly when workers are operating heavy machinery, using power tools or working in close proximity to each other. Injuries sustained in these scenarios could range from minor injuries, such as cuts, bruises, or sprains to severe injuries, including fractures, dislocations, or traumatic head injuries. In the worst-case scenario, fatalities could occur as a result of machinery accidents, falls or collisions with heavy equipment.

The nature of impact is adverse and will directly affect workers on site. The duration of the impact is short term as construction activities are anticipated to be completed within 6 to 12 months. Injuries sustained are irreversible as they could be serious and may lead to death, therefore the impact is rated irreversible. It is expected that contractor workers will be hired through a tendering process, which implies that they possess the required skills and are expertise in the industry. As a result, injuries are more likely to occur do to accidents rather than a result of incompetency or practical inexperience. Therefore, probability of impact occurring is therefore rated medium (possible). The magnitude of impact is rated high due to varying degrees of injury severity that can occur, ranging from minor injuries to potentially life-threatening incidents. Overtime, the magnitude of impact may be lessened to moderate as personnel get accustomed to operations. The sensitivity of impact is rated as medium as injuries could lead to permanent disabilities, which limit workers future employment opportunities and their ability to perform tasks within the industry. Overall, the significance of impact, before mitigation measures is rated adverse moderate. The impact ratings are provided in Table 29.

7.3.7.2 Potential risk of sustaining injuries or fatalities resulting from the mismanagement or mishandling of equipment and machinery during the operational phase

The operational phase involves the use of various equipment and machinery, which, if mismanaged or mishandled, pose significant risks to the safety and well-being of workers. During this phase, the risk of accidents and injuries increases significantly. These risks likely arise from improper operation, inadequate maintenance, or failure to follow safety protocols. This can result in accidents ranging from minor injuries to serious or fatal incidents.

It is expected that the Proponent will develop a comprehensive set of criteria to ensure that high-risk environments are staffed with qualified and skilled workers to fulfill safety, regulatory and operational requirements. Injuries in the workplace are likely due to personnel interacting with equipment and machinery, therefore, the impact is considered both adverse direct and on-site. Considering the anticipated 50-year lifecycle of the Project, the duration of the impact is assessed as long-term. Although personnel will consistently adhere to safety precautions, the probability of event is rated medium (possible) as industrial workspaces are typically regarded as high-risk environments. The magnitude of the impact is rated as high, as injuries may range from minor to severe, including potentially life-threatening incidents. The sensitivity of the impact is rated medium, as injuries could impair workers' ability to perform their duties or affect their future employability. Overall, the significance of impact is expected to be adverse moderate, before mitigation measures. The impact ratings are provided in Table 29.

The Proponent is expected to abide to the following occupational health and safety measures, which are also outlined in the ESMP:

- Incorporate occupational health and safety requirements into the bidding and tendering process to ensure contractors meet safety standards;
- Comply with the safety and health requirements as outlined in the Labour Act No. 6 of 1992 and ISO 45001 standards for occupational health and safety management;

- Develop and implement standard operating procedures (SOPs) for all work areas;
- Provide on-site safety inductions to all employees, with specific focus on mobile equipment and on-site traffic safety;
- Conduct regular site inspections to monitor compliance with safety standards, document any non-conformances and identify the corrective actions required; and
- Document injury statistics, track corrective actions and record lessons learnt to improve safety practices on-site.

7.3.7.3 Impacts of potential ammonia inhalation of ammonia on the health of employees

Employees working on-site may be exposed to ammonia (NH_3) emissions as a result of opening equipment, pipe elements or in case of a potential leak and emissions of vapour in an emergency situation. This could impact their respiratory system. The impact is adverse and affects receptors directly. The impact is rated irreversible due to potential chronic illnesses or severe irritations. The impact could have permanent effects. The impact is rated as possible. It should be noted that the highest hourly concentration on-site is 15 µg/m^3 during normal operations, which is significantly less than 1 180 µg/m^3, the chronic inhalation screening criteria for ammonia.

The magnitude of impact is rated moderate because although the ammonia emissions may cause respiratory diseases and severe irritations, there are occupational health and safety measures in place. The sensitivity of impact is rated as low, because the impact on employees is on-site. The significance of impact is adverse minor.

7.3.7.4 Impacts of direct contact with ammonia causing various reactions such as skin, eye and throat irritation or burns

In an emergency, worst case scenarios are assessed due to the acute toxicity of gaseous ammonia. In a case where an employee is exposed to a large amount of toxic gaseous ammonia, this may lead to various reactions such as skin burns, irritation, eye injuries, frostbite, serious injuries and potential fatalities. The impact is adverse and affects employees directly. The impact is rated irreversible as it could be fatal. The impact is considered permanent. The impact is rated possible to assess the worst-case scenario. The storage tank used in this project has one roof system but consists of three containment systems. The first one (inner part) being the primary container, the second one is the double steel wall. The roof spans the inner and outer steel tank wall. The second double steel wall is designed to collect both the liquid and the vapour in the event of a failure of the primary container and can withstand all possible stresses, such as explosions (static compression stress of 0.3 bar for 300 m), fragments and cold thermal stress. The outer roof is supported by the second containment housing and can withstand stresses, such as explosions.

The magnitude of impact is very high/unknown due to the danger it poses to the health and safety of employees. The sensitivity of impact is rated as high due to potential fatalities of employees should the worst-case scenario occur. The significance of impact is adverse major prior to mitigation measures.

Mitigation measures include:

- An emergency plan, in association with the local authority, should be incorporated into on-site safety inductions for all employees;
- Applicable legal and international best practice for hydrogen piping, ammonia storage and associated equipment in the terminal transportation, storage and guidelines, or equivalent international recognised codes of good design and practice, must be incorporated in the designs.
- Develop and implement standard operating procedures (SOPs) for all work areas; and
- The incorporation of IEC 61508/61511 (Safety Instrumented Systems) codes as per the quantitative risk assessment (Appendix I).

Further mitigation measures are described in the ESMP. The significance of impact is adverse moderate after mitigation.

7.3.7.5 Potential airborne toxic vapours, fires and explosions at the Project site

In an emergency, worst case scenarios are assessed, considering that gaseous ammonia can be acutely toxic. Airborne toxic vapours, fires and explosions occurring due to system malfunctions could result in fatalities on-site. The impact is adverse and affects employees directly. The impact is rated irreversible as it could be fatal. The impact is considered permanent. The impact is rated as possible, due to potential worst-case scenario, however redundant designs and measures are in place such as the double walled storage tank, should system failures occur.

The magnitude of impact is very high/unknown as lives could be in serious danger, in the worst-case scenario. The sensitivity of impact is rated as high due to potential fatalities of employees should the worst-case scenario occur. The significance of impact is adverse major prior to mitigation measures. Mitigation measures are outlined in 7.3.7.4 and the ESMP. The significance of the impact after mitigation is moderate.

Table 29 - Potential employee occupational health and safety impacts or risks

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction phase	Employee Occupational Health and Safety	Potential risk of on-site injuries collision or collapse of heavy constructed material may cause injury or death	Adverse Direct Irreversible Short-term On-site Medium Possible	Medium	High	Moderate (6)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Operational phase		Potential risk of sustaining injuries or fatalities resulting from the mismanagement or mishandling of equipment and machinery	Adverse Direct Irreversible Long term On-site Possible	Medium	High	Moderate (6)
		Long term impacts of potential ammonia inhalation or direct contact on the health of employees	Adverse Direct Irreversible Permanent On-site Possible	Low	Moderate	Minor (3)
		Impacts of direct contact with ammonia causing various reactions such as skin, eye and throat irritation or burns	Adverse Direct Irreversible Permanent On-site Possible	High	Very high/Unknown	Major (9)
		Potential airborne toxic vapours,	Adverse Direct Irreversible Permanent	High	Very high/Unknown	Major (9)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
		fires and explosions at the Project site	On-site Possible			

7.4 BIOPHYSICAL ENVIRONMENT

7.4.1 CLIMATE CHANGE AND GHG EMISSIONS

Climate change stands as one of the most urgent global challenges today, posing significant impacts on the manufacturing, shipping, agricultural and energy production industries, extreme weather events, shifting precipitation patterns and temperature variations can disrupt operations, leading to supply chain interruptions, higher operational costs, and heightened risks to worker health and safety (Allen et al., 2018).

Environmental, social and governance (ESG) factors have become increasingly prominent in the corporate world, especially within the rapidly growing green hydrogen sector. Regulatory requirements have elevated ESG to a key focus at the board level, pushing companies to embed these principles into their strategic frameworks.

According to Equator Principles, projects that are expected to produce more than 100 000 tons of CO_2 equivalent (tCO_2e) annually, will be required to quantify and report on direct (Scope 1) emissions, this included emissions from the facilities owned or controlled within the physical project boundary, as well as indirect (Scope 2) emissions associated with the off-site production of energy used by the Project (Equator Principles, 2020).

The Project is dedicated to advancing the green energy transition by focusing on the production and utilisation of green hydrogen and ammonia as sustainable alternatives to fossil fuels. Therefore, a study conducted by a climate change specialist (RDJ Consulting) (Appendix H) was commissioned to assess potential carbon emissions generated by the project and evaluate their contribution to climate change. The study also examines potential mitigation and adaptation strategies to reduce the project's emissions and enhance resilience to the anticipated impacts of climate change. The significant climate change impacts before mitigation are summarised in Figure 65, for illustrative purposes only.

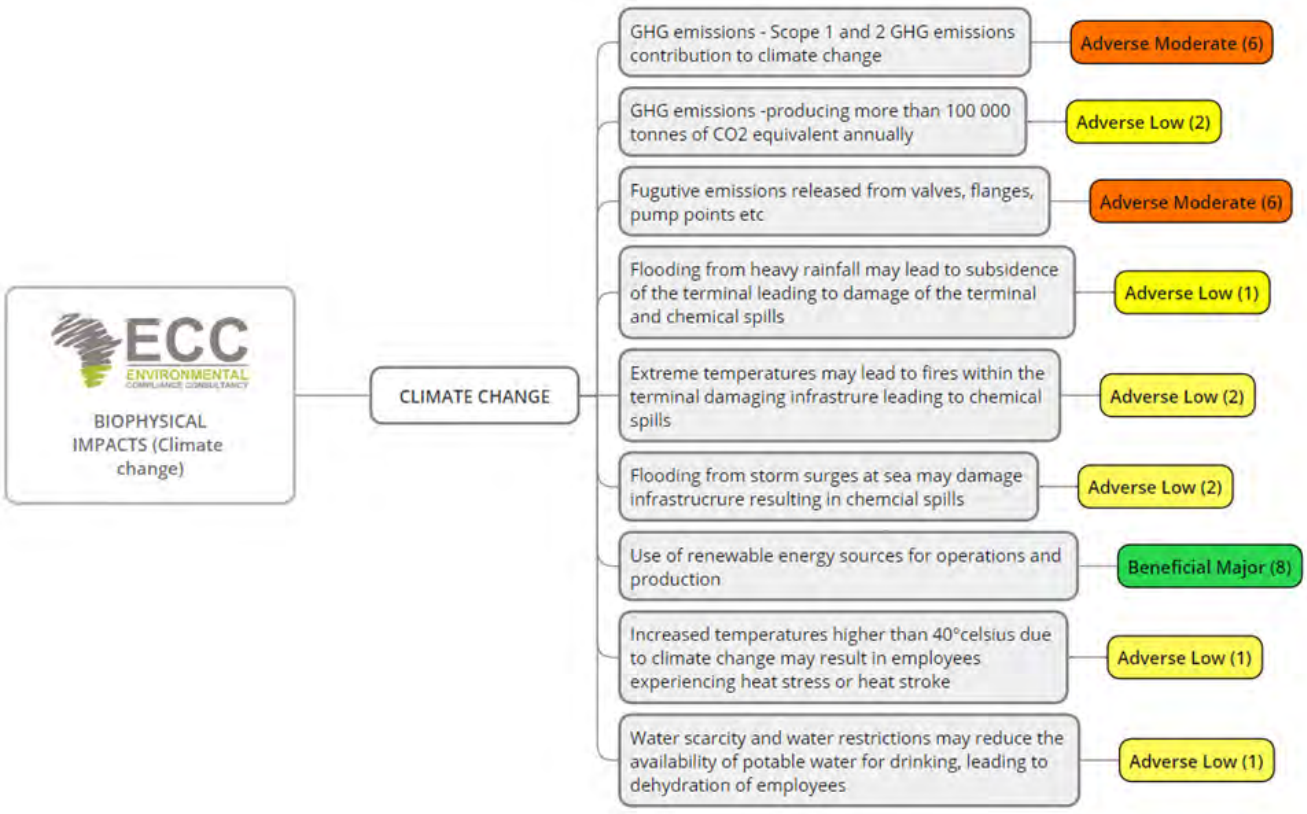


Figure 65 - Climate change impacts

7.4.1.1 Scope 1 and 2 greenhouse gas (GHG) emissions from the Project contributing to climate change

To ensure the lowest possible carbon emissions for the Project, the Proponent has developed innovative zero emissions technologies and infrastructure for renewable fuel generation, storage and distribution. The Project supports industries in adopting cleaner energy solutions to reduce carbon emissions, with a specific focus on creating a local offset for products produced. The potential scope 1 and 2 emissions that will be produced by the Project have been calculated. Scope 1 emissions will arise directly from operations and maintenance of infrastructure and energy use (Figure 66). The scope 1 emissions for the Project were calculated to be 2.45 tCO_2e, of which 77% of those emissions came from vehicle use in any reporting year modelled (RDJ Consulting Service CC, 2024).

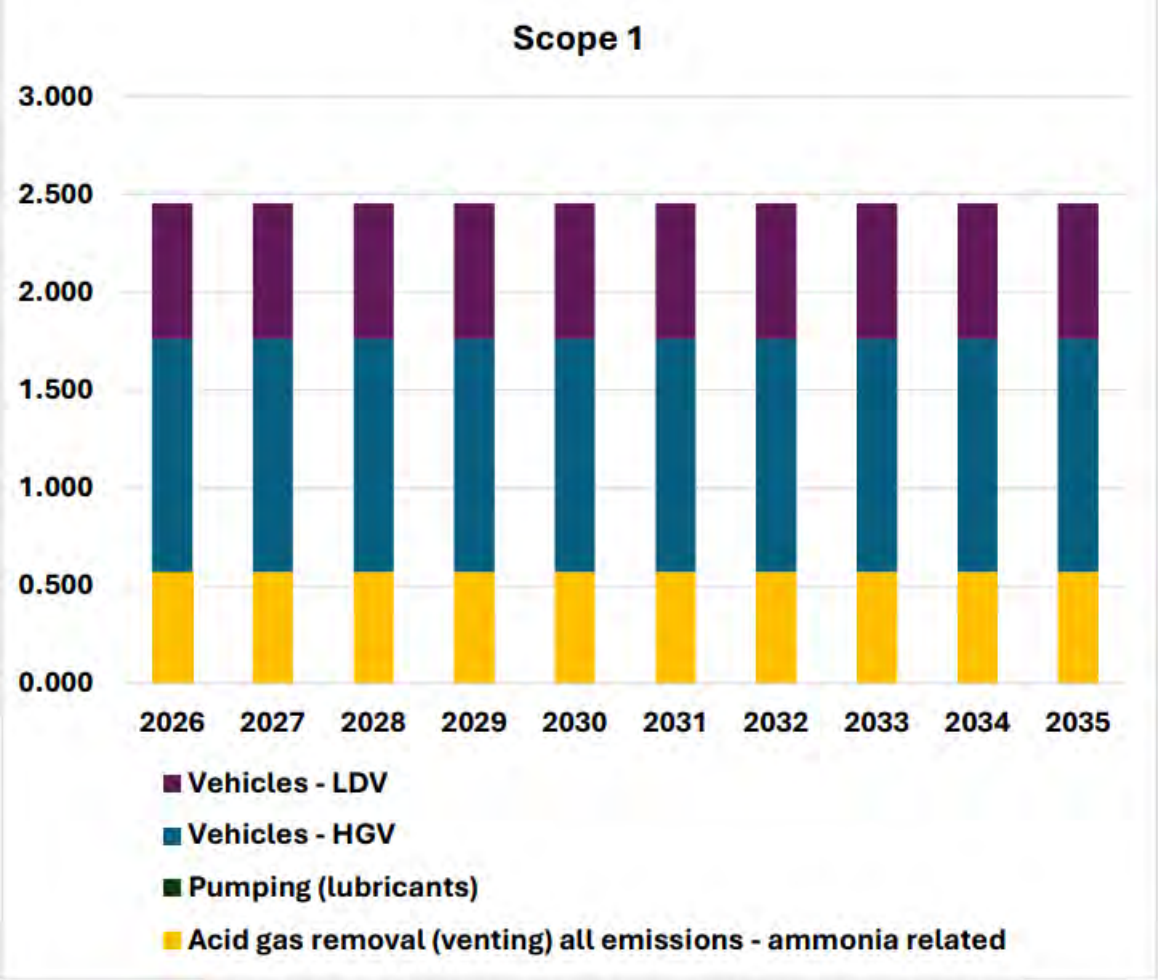


Figure 66 - Scope 1 emissions for the life of the Project

The scope 2 emissions for the Project were calculated to be 5 325 tCO_2e (Figure 67), mainly from the generation of purchased electricity, steam, heating and cooling. Although the organisation does not directly own the facilities responsible for these emissions, it drives the energy demand behind them. As part of their overarching sustainability and environmental management strategies, organisations increasingly bear the responsibility of addressing and accounting for their scope 2 emissions (RDJ Consulting Service CC, 2024).

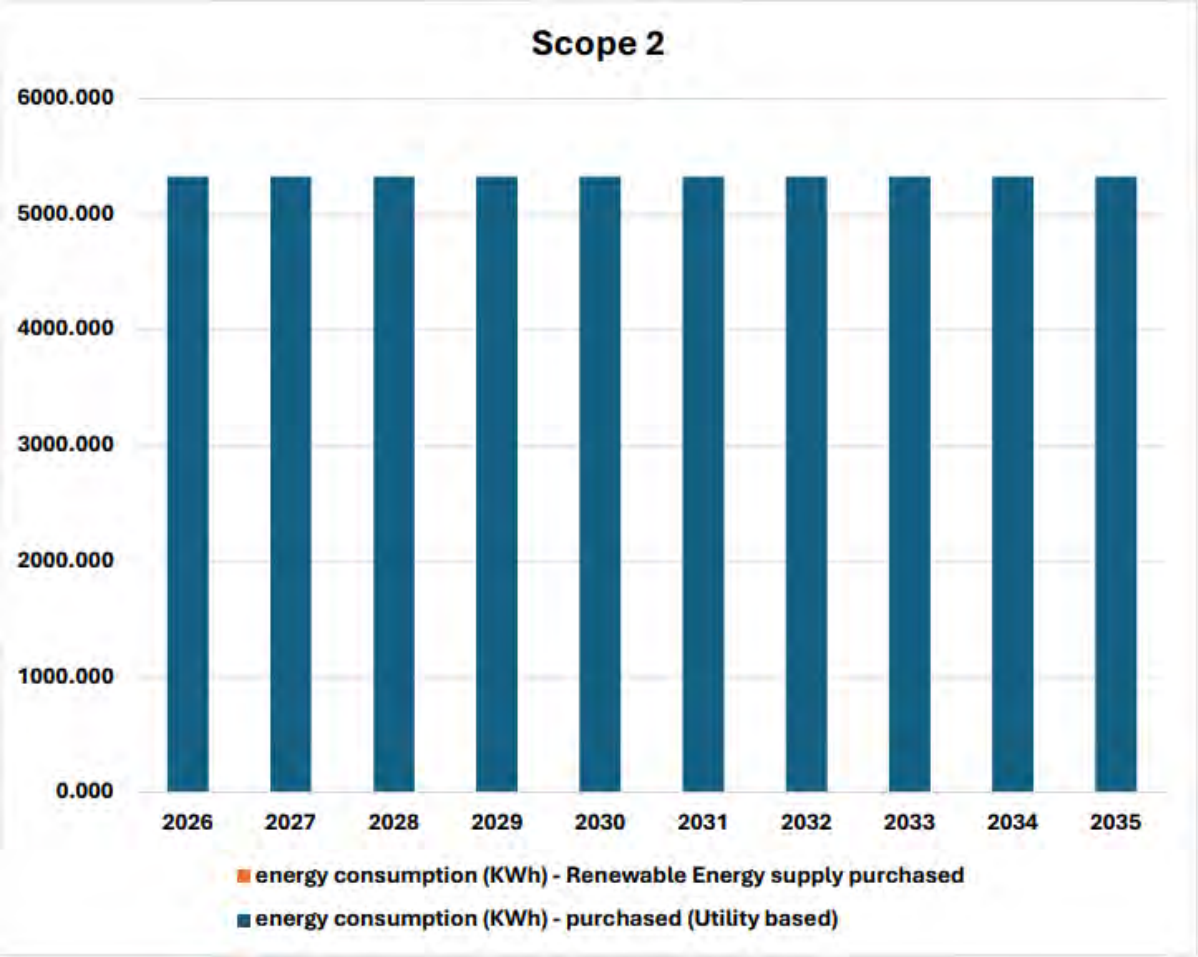


Figure 67 - Scope 2 emissions for life of the Project

The nature of this impact is adverse and direct, the impact is partly reversible, and the magnitude of change is negligible. The duration of the impact is long-term, and the scale of the impact is international. The probability of the impact however is likely, and the sensitivity of the impact is high. The significance of the impact has therefore been rated adverse moderate.
There are a few ways in which these impacts can be mitigated:

- Increase the use of renewable energy sources to reduce reliance on fossil fuels
- Reduce emissions by switching to lower-carbon fuels and electrifying operations where feasible.

7.4.1.2 Scope 1 and 2 GHG emissions exceeding 100 000 tCO_2e from the project contributing to climate change

The Equator Principles sets the threshold of 100 000 tons of CO_2 equivalent (tCO_2e) annually for projects requiring emissions reporting to focus on those with significant environmental impacts. This threshold targets high-emission projects that contribute substantially to greenhouse gas levels, aligning with global standards for evaluating large-scale operations. By requiring annual reporting, the Equator Principels enhances accountability and transparency, encouraging these projects to monitor and manage their emissions effectively (Equator Principles, 2020).

The projected scope 1 and 2 emissions from the project do not exceed the 100 000 tCO_2e threshold, therefore does not necessitate annual quantification and reporting in accordance with Equator Principles guidelines (RDJ Consulting Service CC, 2024). The nature of the impact is adverse and direct, the impact is reversible, and the magnitude of change is negligible. The duration of the impact is long term, and the scale of the impact is international. The probability of the impact is unlikely, and the sensitivity of the impact is high. Therefore, this impact has been rated adversely low. The mitigation measures for this impact are included in the ESMP.

7.4.1.3 Fugitive emissions from the Project contributing to climate change

Fugitive emissions refer to the unintended release of gases or vapors from various processes, typically during production, handling, or transportation, that are not captured or contained. These emissions occur outside of controlled or designed venting systems, and they are often difficult to measure and monitor. Fugitive emissions can result from a range of activities, such as leaks in equipment, pipelines, valves or seals (Rose, 2024).

During the life of the Project, fugitive emissions will be released, partly because of the molecular size of hydrogen molecules, its viscosity is lower compared to other gases and ammonia faces the same challenge. Emissions from certain components are expected to be so minimal that they do not require quantification. These components include tubing size lines (flexible lines with a diameter of 125 mm or smaller) and associated equipment, unless they are subject to monitoring under federal or state regulations. Additionally, non-piping fittings, such as swedge lock or ferrule fittings and streams where the operating pressure is at least 0.7 psi below ambient pressure, are also exempt from emission quantification (RDJ Consulting Service CC, 2024).

The nature of the impact is adverse and direct. The impact is partly reversible, and the magnitude of change is negligible. The duration of the impact is medium term and the and the scale of the impact is international. The probability of the impact is likely and the sensitivity of the impact is medium. Therefore, this impact has been rated adverse low. The mitigation measures for this impact are included in the ESMP.

7.4.2 CLIMATE CHANGE – IMPACTS CLIMATE CHANGE MAY HAVE ON PROJECT INFRASTRUCTURE

7.4.2.1 Extreme temperatures may result in the deterioration of project infrastructure leading resulting in leaks or fires

Climate change is expected to exacerbate conditions in the Namib Desert, leading to higher temperatures, more frequent and severe droughts, and increased water scarcity as shown in Figure 68.

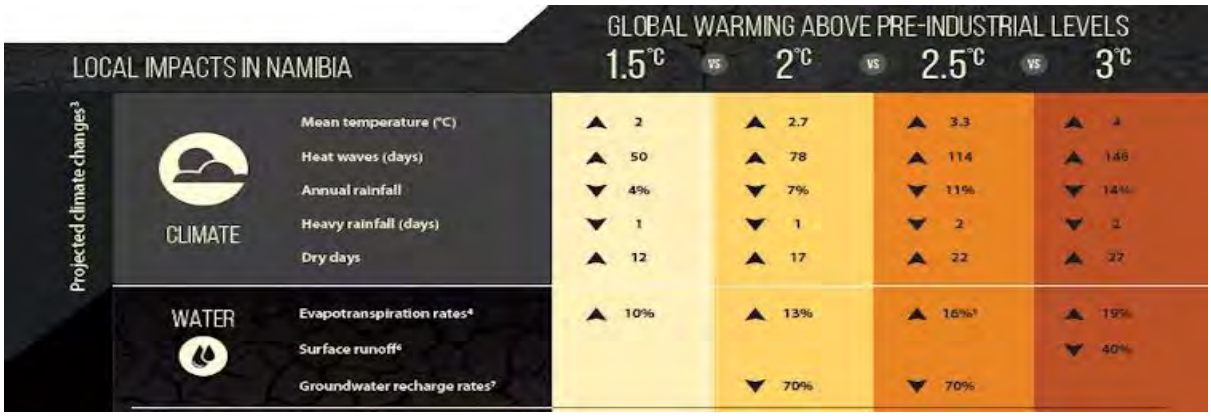


Figure 68 - What global warming of 1.5˚C and higher means for Namibia (New, 2018)

These changes will place additional strain on water resources essential for cooling within the terminal, potentially resulting in fires or explosions(RDJ Consulting Service CC, 2024). As per historical datasets, Walvis Bay has seen temperature anomaly excesses of 5°Celsius, thus making the known excess temperatures of 38°C. potentially being elevated to in excess of 44°C. and above. Maximum temperatures of 46°C. has been recorded for the area and with Climate Change trends, this will hover around the 50°C mark by 2050 if a business-as-usual approach is maintained. The challenge for the Ammonia Terminal operation will be to ensure tank and other equipment design can cope with the expected higher temperatures of up to 50°C (Meteoblue, 2024). Furthermore, higher temperatures could cause pressure to build up inside the storage tanks, potentially leading to ruptures or seal failures, resulting in the release of ammonia gas. In the event of a fire or explosion triggered by extreme heat, storage systems could be damaged, leading to a larger release of ammonia.

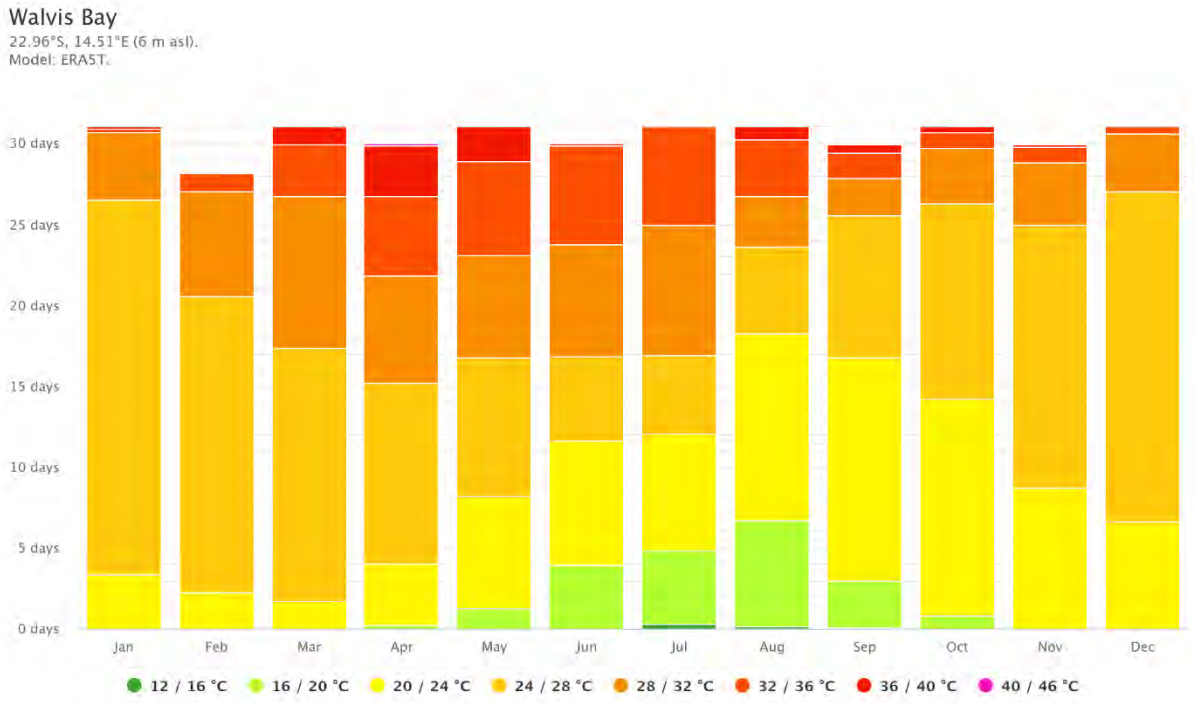


Figure 69 - Maximum temperatures (Walvis Bay)

Therefore, this impact is adverse and direct. The impact is partly reversible, and the magnitude of change is high. The duration of the impact is medium term, and the scale of the impact is local. The probability of the impact occurring is possible and the sensitivity of the impact is low. Therefore, this impact has been rated adverse low. The mitigation measures for this impact are included in the ESMP.

7.4.2.2 Storm surges and flooding may result in flooding of the terminal resulting in release of ammonia gas

Storm surges are temporary increases in sea level caused by strong winds, and low atmospheric pressure. These surges push water toward the shore, leading to coastal flooding, erosion, and damage to nearby infrastructure. Climate change is making storm surges and flooding more likely and more. As global temperatures rise, melting ice and thermal expansion cause sea levels to increase, giving storm surges a higher baseline to reach, resulting in severe flooding. Additionally, warmer ocean temperatures provide more energy for storms, making them stronger and more capable of generating larger surges (RDJ Consulting Service CC, 2024). As noted by (Josefsson J et al., 2012), climate change will have an impact on the Walvis Bay area. Although the Port is an exception due in part to the Pelican Point sand spit which provides protection from storm surge, climate change is anticipated to enhance the erosion rate of Pelican Point and so monitoring of the condition of Pelican Point is essential to safeguarding the terminal. Extreme winds during these times may also cause damage to Project infrastructure, especially during the month of July when winds can reach up to 50 km/h.

Given the above-mentioned damage to infrastructure could potentially lead to the release of ammonia gas. As depicted in Figure 37, Figure 38 and Figure 39 (Section 7.3.1), the hourly, daily, and annual concentrations of ammonia released do not currently reach the adjacent Atlantic Ocean. Additionally, the ammonia is lighter than air and any small traces of ammonia released at a 45 m height will not impact the ocean. The nature of this impact is adverse and direct. The impact is partly reversible, and the magnitude of change is high. The duration of the impact is medium term, and the scale of the impact is local. The probability of the impact occurring is unlikely and the sensitivity of the impact is low. Therefore, this impact has been rated adverse low. The mitigation measures for this impact are included in the ESMP.

7.4.2.3 Use of renewable energy for construction and operations will reduce the amount of carbon emissions emitted from the Project

The combustion of fossil fuels, such as coal, oil, and natural gas, releases carbon dioxide (CO_2) and other greenhouse gases into the atmosphere, which trap heat and contribute to global temperature rise. This process has disrupted weather patterns, driving climate change worldwide (Masson-Delmotte et al., 2018).

The Ammonia Terminal is a “clean” energy supporting activity that provides a pathway for society to transition away from fossil fuels. Thus, the operations of the Project will adopt low-carbon and zero-emission technologies, including renewable energy sources, to power its operations where possible.

While the Project's emissions will be negligible, by utilising clean energy options like wind, solar or hydrogen, the Project will significantly reduce or eliminate greenhouse gas emissions, thereby lowering its carbon footprint. This approach will help mitigate global warming and alleviate the harmful impacts of climate change.

The nature of this impact is beneficial and direct. The impact is reversible, and the magnitude of change is high. The duration of the impact is long term, the scale of the impact is international, the probability is definite, and the sensitivity of the impact is high. Therefore, this impact has been rated beneficial major.

7.4.3 CLIMATE CHANGE – IMPACT ON HEALTH AND SAFETY OF EMPLOYEES DUE TO INCREASED TEMPERATURES AND DECREASED POTABLE WATER

7.4.3.1 Increased temperatures higher than 40°Celsius due to climate change may result in employees experiencing heat stress or heat stroke

As detailed in section 7.4.2.1 Walvis Bay may see an increase in temperatures up to 45°C. High temperatures can harm employees' health, productivity, and safety by causing heat stress, which includes dehydration, heat exhaustion, heatstroke, and impaired cognitive function. This reduces efficiency, increases accident risks, and leads to absenteeism. The nature of this impact has been rated adverse and direct. However, this impact is reversible, and the magnitude of change is minor. The duration of the impact is temporary, and the extent of the impact is onsite. The probability of the impact occurring is possible and the sensitivity of the impact is low. Therefore, the significance of this impact has been rated low.

7.4.3.2 Water scarcity and water restrictions may reduce the availability of potable water for drinking, leading to dehydration of employees

Also as stated in section 7.4.2.1, increased temperatures due to climate change may result in higher levels of evaporation, reduced rainfall and longer periods of drought across the country. This will put stress on the region's potable water supply, resulting in further national water restrictions. This, coupled with high temperatures, may lead to dehydration and lack of available potable drinking water for employees. Dehydration affects employees by causing fatigue, headaches, reduced focus, and increased risk of heat-related illnesses, impairing productivity and workplace safety. It can lead to errors and accidents. The nature of this impact has been rated adverse and direct. However, this impact is reversible, and the magnitude of change is minor. The duration of the impact is temporary, and the extent of the impact is onsite. The probability of the impact occurring is possible and the sensitivity of the impact is low. Therefore, the significance of this impact has been rated low.

Table 30 - GHG emissions and impact of climate change

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction and operations	Climate change	GHG emissions - Scope 1 and 2 GHG emissions contribution to climate change	Adverse Direct Partly reversible Long-term International Likely	High	Negligible	Moderate (6)
	Climate change	GHG emissions - producing more than 25 000 tons of CO2 equivalent annually	Adverse Direct Reversible Long-term International Unlikely	high	Negligible	Low (2)
Operations	Climate change	Fugitive emissions released from valves, flanges, pump points etc.	Adverse Direct Partly Reversible Medium Term International Likely	Medium	Negligible	Minor (4)
	Biodiversity	Extreme temperatures may lead to fires within the terminal damaging infrastructure leading to the release of ammonia gas	Adverse Direct Partly reversible Medium term Local Possible	Low	High	Low (1)
	Biodiversity	Flooding from storm surges at sea may damage infrastructure resulting in the release of ammonia gas	Adverse Direct Partly reversible Medium term Local Possible	Low	High	Low (1)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
	Climate Change	Use of renewable energy sources for operations	Beneficial Direct Reversible Long term International Definite	High	High	Beneficial Major
	Operational health and safety	Increased temperatures higher than 40°celsius due to climate change may result in employees experiencing heat stress or heat stroke.	Adverse Direct Reversible Temporary Onsite Possible	Low	Minor	Low (1)
	Operational health and safety	Water scarcity and water restrictions may reduce the availability of potable water for drinking, leading to dehydration of employees.	Adverse Direct Reversible Temporary Onsite Possible	Low	Minor	Low (1)

7.4.4 SOIL IMPACTS

The specific impacts on soil, before mitigation, are presented in Figure 70 for illustrative purposes only. Impacts are discussed in detail in the sections thereafter.

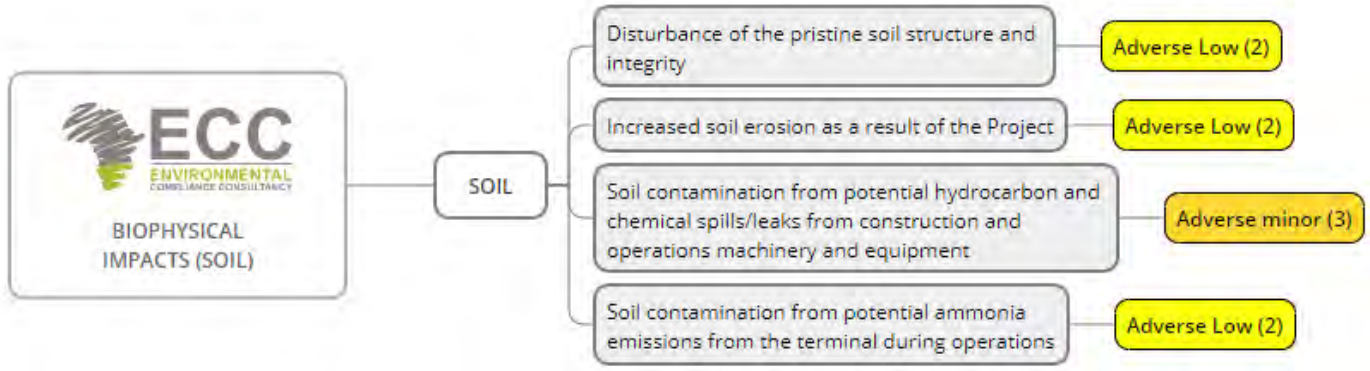


Figure 70 - Soil impacts

7.4.4.1 Impact on soil structure and integrity during the construction phase

During construction (earthwork and civils) activities, the soil structure and integrity may be drastically disturbed. The status of the soil quality is viewed as semi-disturbed. This area has not been developed and no agricultural activities occur in the area, however it is prone to recreational off-road driving. Grading in construction refers to the removal of soil or filling from one area to another to achieve a specific elevation. The impact is adverse, direct and partly reversible due to potential soil rehabilitation to be applied. The construction activities will take place over a short time (less than 5 years). The impact is likely as mixing and removal of soil (disturbance) forms part of the construction process (Table 31).

The soil type in this area is dominated and characterised by Sodic Gleyic Petrosalic Solonchak. Sodic soils are characterised as poor soil-water and soil-air association which generally impacts root growth, plant production and would result in an increase in soil erosion. Therefore, the magnitude of the change is negligible. The sensitivity rating will be low, as disturbance will only occur on-site. The overall significance of the impact is low. Mitigation measures are indicated in the ESMP.

7.4.4.2 Increased soil erosion as a result of the Project

It has been reported that increased soil erosion occurs when construction equipment removes vegetation, which provides root system that holds dirt in place and prevents soil erosion (Superior Groundcover Incorporated, 2020). The impact is adverse, direct and partly reversible due to potential measures taken during rehabilitation practices during and at the end of construction, which occurs over a short period of time (less than 5 years). The impact is possible. Although removal of vegetation is not likely because of the lack of flora in the Project area, the vehicle movement, stormwater drainage system and other construction activities may lead to increased soil erosion.

The magnitude of change is minor, as the area is already prone to wind erosion, due to lack of vegetation to stabilise the fine-grained sand. The impact will only affect the Project site making the sensitivity rating low. The overall significance of the impact is low. Mitigation measures are described in the ESMP.

7.4.4.3 Soil contamination from potential hydrocarbon and chemical spills and leaks from construction and operational machinery and equipment

During the Project, defective machinery or equipment may cause leaks of harmful or dangerous substances (hydrocarbons and chemicals). These spillages can range in volume and degree of impact (e.g. 1 litre vs 200 litre) and need to be cleaned up, removed and/or treated *in situ.* The impact is adverse, direct and partly reversible due to potential soil rehabilitation to be applied. A long-term plan will include a detailed rehabilitation plan during the decommissioning phase. The Project will take place over a long period (50 years). The impact may be likely due to the use of accidental faulty equipment or machinery or due to accidental spillages.

The magnitude of change is minor due to slight deterioration of the already poor and unproductive soil quality. The sensitivity of the impact will be low due to the potential impact will be centered in and around the Project site. The overall significance of the impact is minor. Mitigation measures are indicated in the ESMP.

7.4.4.4 Soil contamination from potential ammonia emissions from the storage tank during operations

Soil acidification decreases plant nutrients, acidification may degrade favourable bacteria and other soil organisms, and the ammonia may be present at toxic level (Department of Energy, Environment and Climate Action, 2024). The operational phase involves the storage of 50 000 to 60 000 T of ammonia, which is considered highly toxic. When ammonia is released, it forms gas/vapour and therefore no soil pollution is expected. The potential impact is adverse, direct and reversible due to the rehabilitation measures during decommissioning phase. However, it should be noted that the impact is very unlikely as ammonia escapes in vapour form which will be carried downwind.

The magnitude of change is negligible as the soil will not be impacted. The sensitivity of the impact is low because the target area will be limited to the Project site. The overall significance of the impact is low. Mitigation measures are described in the ESMP.

Table 31 - Impacts on soil

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction phase	Soil	Disturbance of the pristine soil structure and integrity	Adverse Direct Partly reversible Short term On-site Likely	Low	Negligible	Low (2)
		Increased soil erosion as a	Adverse Direct	Low	Minor	Low (2)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		result of the Project	Partly reversible Short term On-site Possible			
Construction and operations		Soil contamination from potential hydrocarbon and chemical spills/leaks from machinery and equipment	Adverse Direct Partly reversible Long term On-site Likely	Low	Minor	Minor (3)
Operational phase		Soil contamination from potential ammonia emissions from the terminal during operations	Adverse Direct Reversible Long term On-site Unlikely	Low	Negligible	Low (1)

7.4.5 GROUNDWATER IMPACTS

The rock body over which the site falls contains very limited groundwater potential, yielding less than 0.5 m^3 of water per hour. It is therefore highly unlikely that groundwater is found in the Project area. The specific impacts on groundwater, before mitigation, are presented in Figure 71, for illustrative purposes only. Impacts are discussed in detail in the sections thereafter.

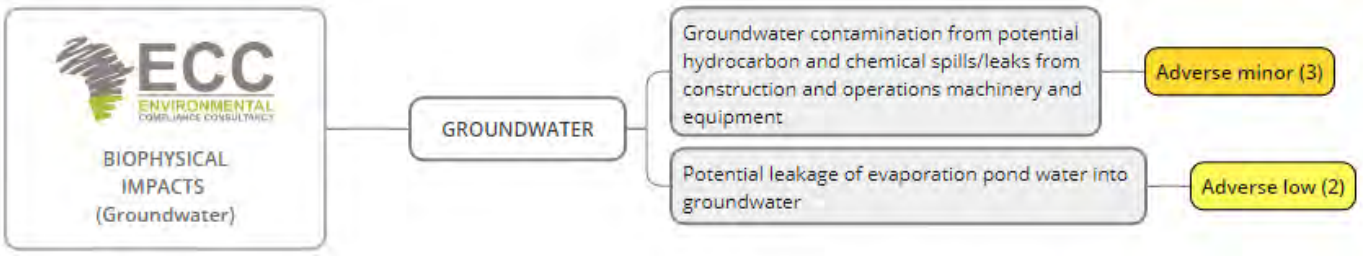


Figure 71 - Groundwater impacts

7.4.5.1 Groundwater contamination from potential hydrocarbon and chemical spills from machinery and equipment during the Project

Potential unforeseen leaks from damage or defective machinery/equipment or accidental spillages (hydrocarbons and chemicals) may occur during the Project and seep into the ground, however the nearest aquifer is the Kuiseb aquifer, which is approximately 10 km from the Project site and falls beneath Walvis Bay town. Additionally, the groundwater in the area is not potable. The impact is adverse, direct and irreversible (Table 32). The proposed Project will take place over a long period of time (50 years). The impact is likely due to accidental spills.

The magnitude of change is moderate due to the impact of groundwater contamination in the long term, however this depends on the amount of leakage, potential groundwater, albeit very low, time taken for cleanup and the physical properties of the soil, which is compact. The sensitivity of the impact will be low due to the fact that the impact is on-site. The overall significance of the impact is minor. Mitigation measures are indicated in the ESMP.

7.4.5.2 Potential leakage of evaporation pond water into groundwater

During the operational phase, an effluent system for potential stormwater will be developed. Should the stormwater contain traces of ammonia, the ammonia will be separated from clean rainwater and removed from the site by truck. The clean rainwater will be discharged into the evaporation pond, which has a capacity of 600m^3. Besides the unpotable groundwater, rainfall records collected over the past 11 years indicated that the maximum rainfall recorded was 9.8 mm per annum from 2011 to 2022 and therefore storm events (1:100-year flood event) from excessive rainfall are unlikely. The nature of the potential impact is adverse, affecting receptors directly and may have irreversible implications. The proposed Project will take place over a long period of time (50 years).

The magnitude of change is minor, as there is no potable groundwater in the area and the effluent system includes an oil separator, therefore clean water will be discharged to the evaporation pond. The sensitivity of the impact is low because the evaporation pond will be developed on the Project site. The overall significance of the impact is minor. Mitigation measures are described in the ESMP.

Table 32 - Impacts on groundwater

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction And operational phase	Groundwater	Groundwater contamination from potential hydrocarbon and chemical spills/leaks	Adverse Direct Irreversible Long term On-site Likely	Low	Moderate	Minor (3)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		from construction and operations machinery and equipment				
Operational phase		Potential leakage of evaporation pond water into groundwater	Adverse Direct Irreversible Long term On-site Unlikely	Low	Minor	Low (2)

7.4.6 SURFACE WATER IMPACTS

The nearest major ephemeral rivers are the Kuiseb and Swakop River, approximately 25 km and 27 km from the Proposed Project site, respectively. The sources of these rivers are in the Khomas area flowing westwards. The Atlantic Ocean is approximately 1 km from the proposed Ammonia Terminal site. However, the impact of the Ammonia Terminal on the sea water has been identified as not significant (section 7.1). The specific impacts on surface water, before mitigation, are presented in (Figure 72) for illustrative purposes only. Surface water impacts are discussed in detail in the sections thereafter.



Figure 72 - Impacts on surface water

7.4.6.1 Contamination (ammonia and oil) of stormwater runoff from potential excessive rainfall events

During the operational phase, stormwater runoff from excessive rainfall events may cause contamination from oil and gaseous ammonia traces during the Project. During construction, an effluent system will be developed which includes an oil separator and evaporation pond to which clean water will be discharged. The potential impact is adverse, direct and partly reversible due to contaminated water flowing to the oil separator and producing clean water, should it be maintained properly. The impact will be temporary, based on short rainfall events that may

occur. The impact is unlikely due to the rare events of storms and the development of an effluent system to mitigate contamination (Table 33).

The magnitude of change is minor as stormwater will be collected and treated through the effluent system. The impact is contained on-site. The overall significance of the impact is low. Mitigation measures are described in the ESMP.

Table 33 - Impacts on river, catchments and other fresh water sources

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Operational phase	fresh water	Contamination (ammonia and oil) of stormwater runoff from potential excessive rainfall events	Adverse Direct Partly reversible Temporary On-site Unlikely	Low	Moderate	Low (1)

7.4.7 BIODIVERSITY IMPACTS: FLORA

The general dune belt between Walvis Bay and Swakopmund is characterised as a major tourist attraction with various recreational activities such as dune climbing, sand surfing, quad bike riding and other off-road excursions. Therefore, recreational activities and residential development between Swakopmund and Walvis Bay are continuously expanding. The plains along the Central Namib are usually bare, although clumps of vygie *Mesumbryanthemum cryptanthum* and grasses such as *Sporobolus nebulosus*, *Stipagrostis namibensis*, S. *hermannii*, *S. hirtigluma* subsp. *hirtigluma*, etc. appear in clumps after localised rains. The proposed Ammonia Terminal location is in a barren saline pan area and consequently development impacts are not expected to be detrimental to flora as this is an extremely marginal environment for flora (Cunningham, 2024) (Appendix G).

During the construction phase, removal and land clearing activities will occur. During construction and operations, the possible introduction of invasive alien species may occur due to habitat change/modification, introduction of building sand from local rivers/quarries and the use of secondhand equipment, as well as potential illegal flora species collection on the proposed site. The specific impacts to flora in the Project area before mitigation during the construction and operation phases are presented in Figure 66, for illustrative purposes only. The potential Project impacts on flora diversity are discussed further in the sections below.

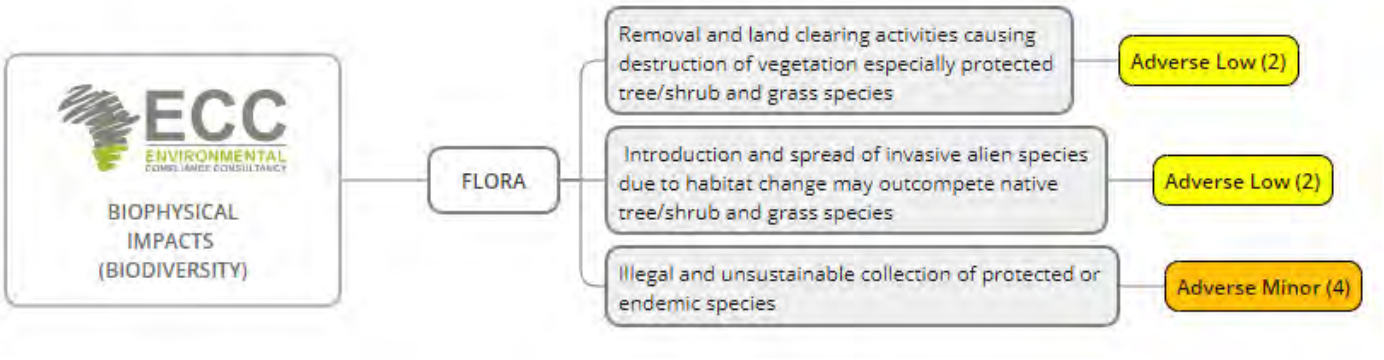


Figure 73 - Potential impacts on flora before mitigation

7.4.7.1 Removal of protected/sensitive flora (tree/shrubs and grass species)

The biodiversity specialist study conducted by Cunningham (2024), identified one large tree/shrub specie within the Ammonia Terminal location. During the rapid assessment, no grass species were observed at the proposed site. The removal of tree and shrub species is not likely to be detrimental due to the low species abundance of vegetation at the proposed site (Cunningham, 2024) . Furthermore, none of the Namibian protected, rare or endemic larger tree, shrub and grass species are exclusively associated with the Project area.

One sensitive habitat was identified within the Project vicinity, this area is known as the *Salsola* spp. dune hummocks. The vegetated hummocks have multiple microhabitats for vertebrate and invertebrate fauna and serve as a foraging area for large mammal, such as carnivores (black-backed jackal and brown hyena) and ungulates (gemsbok and springbok). This area should be avoided.

The impact of the removal of tree, shrub and grass species will be adverse, direct, partly reversible and will occur over a long term as the Project is expected to be operational for longer than 50 years, as shown in Table 1. The impact is concentrated on site only and is highly unlikely due to the lack of vegetation in the area. The magnitude of change is minor due to the minor loss of vegetation that is expected, and the sensitivity of the receptor is low because the impacted area is relatively small (on-site). The significance of the impact is low. Mitigation measures are indicated in the Project ESMP (Appendix A).

7.4.7.2 Potential introduction and spread of invasive alien species

During construction and operations, potential clearing of land may provide an opportunity for invasive alien species to colonise the bare sites and spread. The invasive alien species are one of the major threats to biodiversity as they are highly competitive, reducing the range of other native species. No invasive alien species were identified in the Ammonia Terminal proposed site.

The construction and operations of the Ammonia Terminal may have an adverse direct impact, that is partly reversible as vegetation will be removed and will occur long-term over the extent of the Project lifetime (50 years).

The magnitude of change is minor, due to the small measurable change to the ecological environment and the sensitivity will be low, due to the local scale of the impact. The overall significance of the impact is deemed low. Mitigation measures are discussed in the ESMP.

7.4.7.3 Illegal and unsustainable collection of protected species

During construction and operations, contractors and workers are employed, which increases the risk of potential illegal extraction of endemic/protected/rare vegetation species found on the proposed Ammonia Terminal location. In a recent report by Smit (2024), it is stated that *Adenia pechuelii* (elephants-foot), classified as endemic to the Namib Desert, currently appears to be one of the most-targeted flora species, with 326 elephant foot plants poached in 2023. According to the Forest Act 12 of 2001, elephants-foot is protected due to unsustainable harvesting for horticulture trade, additionally these plants have a slow growth rate, slow and/or episodic recruitment (Law.Africa Legislation Commons, 2017).

The impact is adversely irreversible due to loss of protected species and is likely to have long-term effects. However, the probability of the impact is highly unlikely as the proposed Project occupies a relatively small section, where the area has little to no vegetation currently.

The magnitude of change is minor due to the slight change the impact will have on the overall biophysical environment , and the sensitivity will be medium because of the regional scale of the impact. The overall significance of the impact is deemed minor. Mitigation measures are discussed in the ESMP.

Table 34 - Impacts on flora

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction phase	Trees, shrubs and grasses	Removal and land clearing activities causing destruction of vegetation especially protected tree/shrub species	Adverse Direct Partly reversible Long term On-site Unlikely	Low	Minor	Low (2)
Construction and operational phases of the Project	Trees and shrubs	Introduction and spread of invasive alien species due to habitat	Adverse Direct Partly reversible Long term Local	Low	Minor	Low (2)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
		change may outcompete native species	Possible			
	Grasses		Adverse Direct Partly reversible Long term Local Possible	Low	Minor	Low (2)
Employment, procurement of contractors, good and services	Trees and shrubs	Illegal and unsustainable collection of protected or endemic species	Adverse Direct Irreversible Permanent Regional Unlikely	Medium	Minor	Minor (4)

7.4.8 REPTILES

It is expected that approximately 63 reptile species are present in the general region of which more than half (38 species) is endemic. Namibia supports approximately 30% of Africa's reptile species diversity, with 22% of the lizards occurring in Namibia being endemic. Gecko's (17 species with 15 species being endemic) and lizards (19 species with 11 species being endemic) are the most important groups of reptiles expected from the general area followed by snakes (19 species with 9 species being endemic) (Cunningham, 2024). None of the unique/important species are exclusively associated with the proposed development area. The proposed development is in a barren saline pan area and consequently development impacts are not expected to be detrimental to reptiles as this is an extremely marginal environment for reptiles (Cunningham, 2024).

The specific impacts to reptiles in the Project area, before mitigation, are presented in Figure 74 for illustrative purposes only. The potential Project impacts on reptiles are discussed further in the sections below and in Table 35.

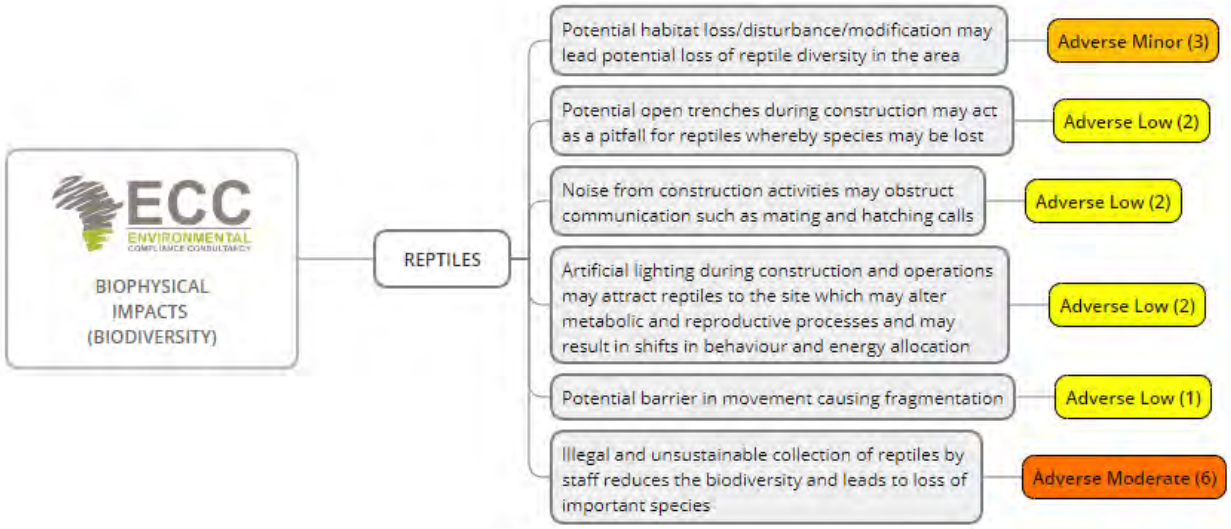


Figure 74 - Impacts on reptiles before mitigation

7.4.8.1 Impact of habitat destruction on reptiles

Vegetation removal during the construction phase may lead to the destruction, disturbance or modification of reptile habitats. Although no species were identified during the field assessment, species may often pass through the proposed area. The two species expected to occur in the area (*Stigmochelys pardalis* and *Varanus albigularis*) are classified as vulnerable and protected game although both, especially *S. pardalis*, probably only occasionally passes through the general area as a vagrant and not expected to occur permanently in the area due to the overall arid conditions. Additionally, three important coastal and dune and/or *Salsola* hummock associated species are *Bitis peringueyi* (Péringuey's Adder), *Typhlosaurus braini* (Brains's Blind Legless Skink) and *Pachydactylus rangei* (Web-footed gecko).

The nature of the impact is adversely direct, partly reversible and expected to occur over the long term due to the duration of the Project (50 years). The probability of the impact is possible, because although the proposed area is rather barren, reptiles may temporarily inhabit the area. The magnitude of change is moderate, due to the potential loss of important habitats for reptiles within the general dune area. The sensitivity of receptor is low because the impact will only impact reptiles on-site. The overall significance of the impact is deemed minor. Mitigation measures are further discussed in the ESMP.

7.4.8.2 Impacts of open trenches as pitfalls for reptiles

It is probable that some of the lizards, geckos and snakes in the general area may explore the open trenches during construction activities as a potential habitat or may fall in trenches which acts as traps. These areas are dangerous and may impact the survival of individuals.

The impact is adverse, direct and partly reversible. Open trenches are an activity part of the construction process; therefore, it is expected that the impact will be temporary. The impact is possible due to reptiles that may pass and roam in and around the Proposed site. The magnitude of change is minor due to the potential loss of protected or important individuals and the

sensitivity of the receptor is low because the impact will occur on-site. The overall significance of the impact is low. The mitigation measures are described in the ESMP.

7.4.8.3 Noise and vibration impact on reptiles

Noise from construction activities during the development of the Ammonia Terminal may cause stress in reptiles and impact their behaviour, obstructing communication such as mating and hatching calls. Species such as barking geckos (*Ptenopus*), common in arid areas in Namibia, are iconic for loud calls in the desert emitted by males to attract females to their burrows (Atlas of Namibia Team, 2022). Excessive noise may lead to confusion and potential injury of reptiles on the Project site. It has been reported that stress over time can lead to poorer health, faster aging, decreased reproduction, and greater susceptibility to diseases (American India Foundation, 2020).

The potential impact is determined as direct but temporary and deemed reversible following the construction phase. The impact is likely, as noise and vibrations are inevitable during construction of a Project. The magnitude of change is minor due to the measurable change caused to reptiles and the sensitivity will be low due to the impact occurring on-site. The overall significance of the impact is deemed low. Noise control measures are further discussed in the ESMP.

7.4.8.4 Artificial light impact on reptiles

Artificial lighting may attract reptiles to the proposed site, which may lead to increased competition among fauna species, especially among nocturnal reptiles. According to research scientists, predators use light to hunt, and the prey species use darkness to cover, therefore artificial light has the potential to disrupt habitats (DarkSky, 2024). It has been suggested that due to reptile's evolution with natural lighting cycles, alterations in diurnal and nocturnal light intensities may disrupt their physiology (Perry, Buchanan, Fisher, Salmon, & Wise, 2008).

The impact is adverse, direct, reversible and on-site. The magnitude of change is minor, due to the small measurable change brought by the impact. The sensitivity of the receptor is low due to the scale and extent of the impact. The overall significance of the impact is deemed low. Mitigation measures are described in the ESMP.

7.4.8.5 Movement barrier of reptiles may lead to fragmentation

The growth of infrastructure in the dune belt could hinder the movement of reptiles or restrict their ability to move freely because of the increased activity in the area. The impact is adverse, direct, reversible and over a long term due to the life span of the Project. The impact, however, is quite unlikely due to the small section of area used for development next to the already existing and busy B2 road. The magnitude of change is negligible as the impact will not be detrimental to the reptile population. The sensitivity is low, as this impact will occur on-site. The significance of the impact before mitigation is low.

7.4.8.6 Illegal and unsustainable collection of protected reptile species

During the construction phase, employees on a contract or permanent basis or associates may be involved in the illegal collection or smuggling of endemic/protected/rare reptile species found on site. It has been reported that chameleons, snakes, geckos and lizards from the dune belt between Swakopmund and Walvis Bay are less abundant, environmental authorities and tourist operators are suspecting that this may be due to a "reptile smuggling syndicate" *(The Namibian, 2011)*. Among the three important coastal and dune and/or Salsola hummock associated species, *Pachydactylus rangei* (Web-footed gecko), are often collected and smuggled to be kept or sold on the black market as exotic pets.

The nature of the impact is adverse, direct and irreversible due to permanent loss of reptile individuals, should the culprit not be identified. The probability of the impact is possible.

The magnitude of change is moderate, due to the potential loss of an endangered species and the potential changes it would cause in the natural ecosystem and processes such as food web relationships. The sensitivity of receptor is medium due to the regional extent as protected species are likely being targeted. The overall significance of the impact is considered moderate.

According to the specialist study (Appendix G), mitigation measures include discouraging poaching activities and collecting of veld foods e.g., local snakes and tortoises. It is imperative to educate/inform contractors and staff on protected species to avoid and the consequences of illegal collection of such species. Further mitigations are described in the ESMP.

Table 35 - Impacts on reptiles

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction and operational phase	Reptile	Potential habitat loss/disturbance/modification may lead potential loss of reptile diversity in the area	Adverse Direct Partly reversible Long term Local Possible	Low	Moderate	Minor (3)
Construction phase		Potential open trenches during construction may act as a pitfall for reptiles whereby	Adverse Direct Partly reversible Temporary Local Possible	Low	Minor	Low (2)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		species may be lost				
		Noise from construction activities may obstruct communication such as mating and hatching calls	Adverse Direct Reversible Temporary On-site Likely	Low	Minor	Low (2)
Power supply during construction and potentially during operations		Artificial lighting may attract reptiles to the site which may alter metabolic and reproductive processes and may result in shifts in behaviour and energy allocation	Adverse Direct Reversible Long term On-site Possible	Low	Minor	Low (2)
Construction and operational phase		Potential barrier in movement causing fragmentation	Adverse Direct Reversible Long term On-site Unlikely	Low	Negligible	Low (1)
Employment, Procurement of contractors, good and services for open pit mining		Illegal and unsustainable collection of reptiles by staff reduces the biodiversity and leads to loss of important species	Adverse Direct Irreversible Permanent Regional Possible	Medium	Moderate	Moderate (6)

7.4.9 AMPHIBIANS

Amphibians are declining worldwide as a result of anthropogenic activities and disturbances resulting in habitat destruction. Amphibians are strongly associated with the availability of surface water and the ephimeral drainage lines potentially serve as a seasonal habitat. The dry sandy coastal desert (Namib) and saline coastal areas are poor habitats for amphibians. Although the ephemeral Khan, Kuiseb and Swakop Rivers reach the sea in the Walvis Bay and Swakopmund areas, they seldom flow, with temporary freshwater pools being rare close to the coast (Cunningham, 2024). Overall, the saline coastal habitats are marginal for amphibians. None of the unique/important species are exclusively associated with the proposed development area. According to the biodiversity specialist study (Appendix X), the proposed development in a barren saline pan area is not expected to be detrimental to amphibians, as this is an extremely marginal environment for amphibians.

The endemic *Poyntonophrynus dombensis*, *Poyntonophrynus hoeschi* and *Phrynomantis annectens* are viewed as the most important, although they are not exclusively associated with the proposed development areas. The specific impacts to amphibians in the Project area before mitigation are presented in Figure 75 for illustrative purposes only. The potential Project impacts on amphibians are discussed further in the sections below and in Table 36.

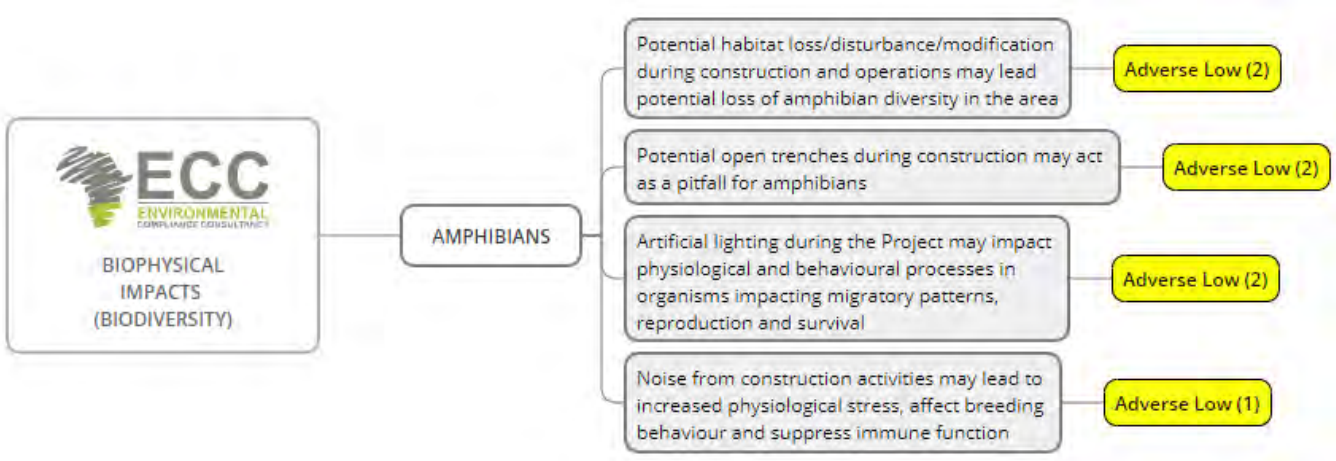


Figure 75 - Impacts on amphibians before mitigation

7.4.9.1 Impacts of sensitive habitat destruction on amphibians

During the construction of the Ammonia Terminal, potential habitats of sensitive amphibian may be destroyed, disturbed or modified. Approximately seven (7) species of amphibians can occur in suitable habitat in the general area, of these 3 species are endemic (*Poyntonophrynus dombensis*, *Poyntonophrynus hoeschi* and *Phrynomantis annectens*) – i.e., high level (42.9%) of amphibians of conservation value from the general area (Cunningham, 2024). During the field survey of the biodiversity specialist study, no amphibians were observed. Furthermore, no amphibians were observed at various other development sites throughout the general area dating back to 2007 (Cunningham, 2024).

The nature of the impact is adverse, direct, partly reversible and highly unlikely due to the dry conditions. The area is extremely marginal with very little rainfall generally occurring in the area (<50mm annual average) and being highly variable (>100% coefficient of variation) and sporadic of nature (Mendelsohn, Jarvis, Roberts, & Robertson, 2002). The magnitude of change is minor due to some measurable change or loss of sensitive habitats. The sensitivity of the receptor is low due to the local scale of the impact. The overall significance of the impact is low.

7.1.1.1 Impacts of open trenches as pitfalls for amphibians

Open trenches are often used in laying underground cables, pipelines and other structures, which function as pitfall traps. Amphibian species may become trapped within trenches during construction activities. These may pose a threat to amphibian individuals.

The impact is adverse, direct and partly reversible, however highly unlikely. The magnitude of change is minor due to the potential loss of protected or important individuals and the sensitivity of the receptor is low because the impact will occur on-site. The overall significance of the impact is low.

7.1.1.2 Artificial lighting impact on amphibians

Artificial lighting may impact nocturnal amphibians due to the impact on their biological rhythms, which are regulated by light. It has been reported that under artificial light conditions it is more difficult for frogs and toads to detect their prey and foraging rates are much lower impacting on survival.

The impact is adversely direct, reversible and may be experienced long-term, however the impact is highly unlikely due to the the saline coastal habitats that are marginal for amphibians. The magnitude of change is minor due to potential measurable change in amphibian individuals and the sensitivity is low due to the extent of the impact. The overall impact of light pollution on amphibians are low. Mitigation measures to artificial lighting are included in the ESMP.

7.1.1.3 Noise and vibration impact on amphibians

Noise from construction activities during the Project may cause increased physiological stress, change breeding behaviour, suppress immune function and colouration changes. These, however, may be a result of long-term exposure to noise. Due to the general dry and saline conditions in this area it is not likely that amphibians will be impacted by noise. The impact is adverse, direct, reversible and temporary as noise will only be produced in some activities during the construction phase. The magnitude of change is minor due to the minor changes this impact may inflict on amphibians and the sensitivity of receptor is low, due to the local extent of the noise produced. The overall significance of the impact is low. Mitigation measures set out in the ESMP regarding noise is applicable to amphibians.

Table 36 - Impacts on amphibians

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction and operation phase	Amphibians	Potential habitat loss/disturbance/modification may lead potential loss of amphibian diversity in the area	Adverse Direct Partly reversible Long term Local Unlikely	Low	Minor	Low (2)
Construction phase		Potential open trenches during construction may act as a pitfall for amphibians	Adverse Direct Partly reversible Long term Local Unlikely	Low	Minor	Low (2)
Power supply during construction and potentially during operations		Artificial lighting may impact physiological and behavioural processes in organisms impacting migratory patterns, reproduction and survival	Adverse Direct Reversible Long term Local Unlikely	Low	Minor	Low (2)
Construction phase		Noise may lead to increased physiological stress, affect breeding behaviour and suppress	Adverse Direct Reversible Temporary On-site Unlikely	Low	Minor	Low (1)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		immune function				

7.4.10 MAMMALS

According to Cunningham (2024), Appendix E, approximately 55 species of mammals are known and/or expected to occur in the general area of which 11 species (20%) are classified as endemic. At least 34.5% (19 species) of the mammalian fauna that occur or are expected to occur in general area are represented by rodents, of which 6 species (31.6%) are endemic. There are 13 species (23.6%) of bats, of which 1 species is listed as endemic and rare (7.7%) and carnivores with 11 species (20%), of which 1 specie (9.1%) is endemic and 5 species listed as vulnerable (45.5%).

The most important species from the general area are the Namibian wing-gland bat (*Cistugo seabrai*) listed as endemic and rare; Littledale's whistling rat (*Protomys littledalei namibensis*) – of which the subspecies "*namibensis*" is known to occur in the ephemeral river courses in the "Swakopmund area" Griffin (2003) – listed as endemic; brown hyena (*Parahyaena brunnea*) and leopard (*Parthera pardus*) listed as near threatened and vulnerable (population trends decreasing), respectively by the IUCN (2023).

None of the expected or unique/important mammal species are exclusively associated with the proposed developmental area and therefore are not expected to be detrimental to mammals in the general area (Cunningham, 2024). The specific impacts on mammals before mitigation measures are presented in Figure 75 for illustrative purposes only. Impacts are discussed in detail in the sections thereafter and in Table 37.

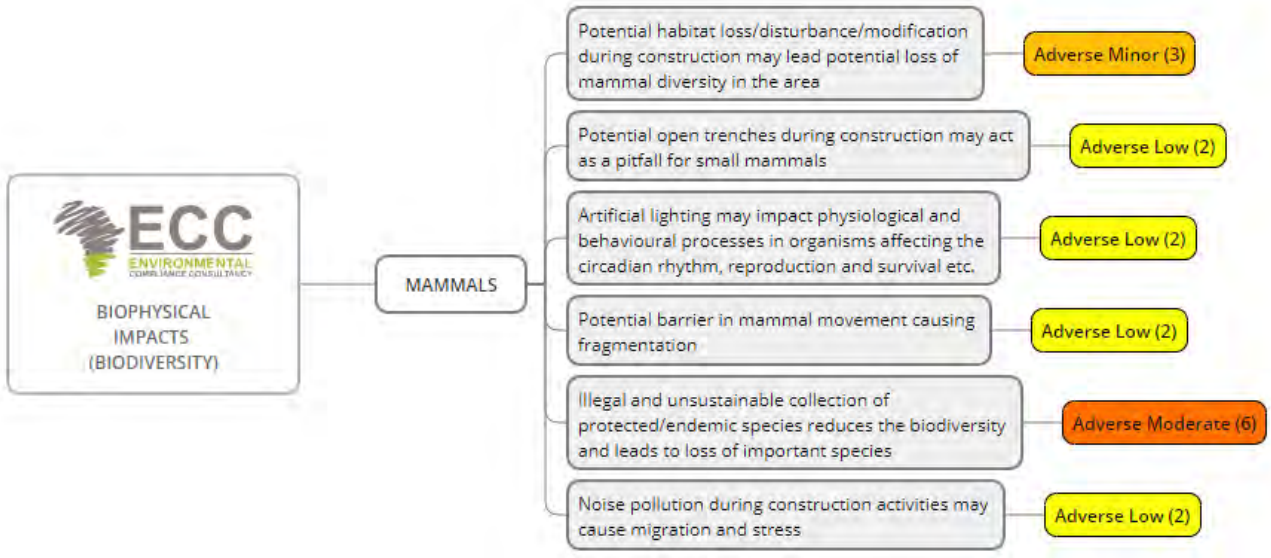


Figure 76 - Impacts on mammals before mitigation

7.4.10.1 Habitat destruction impact on mammal species

The destruction and/or modification of existing habitats reduces the area available for large animals to roam and inhabit, leading to the loss of habitat and increased likelihood of migration. Large mammals in the Project area are not expected to be exclusively impacted due to the expansion of tourist activities in the area. Therefore, the proposed development is in a barren saline pan area and consequently developmental impacts are not expected to be detrimental to mammals, as this is an extremely marginal environment for them. During a rapid site assessment of the larger general area including the ammonia pipeline and hydrogen pipeline Project areas (separate ESIA's), seven (7) species of mammals were confirmed from the various routes traversed. (Cunningham, 2024).

Seven small mammals' species were successfully trapped: *Proboscideus flavicaudatus* (round-eared elephant shrew), *Gerbillurus paeba* (hairy-footed gerbil), *Rhabdomys pumilio* (Four-striped Grass Mouse), *Tatera leucogaster* (bushveld gerbil), *Gerbillurus vallinus* (brush-tailed hairy-footed gerbil), and *Elephantulus intufi* (bushveld elephant-shrew) (Cunningham, 2024).

The Salsola dune hummock habitat, located on the eastern boundary of the proposed development area, are important for a variety of rodents (and carnivore foraging area – e.g., black-backed jackal, brown hyena) and should be avoided.

The nature of the impact is adversely direct, partly reversible and expected to occur over the long term due to the duration of the Project (50 years). The probability of the impact is possible, because although the proposed area is rather barren, small mammals could potentially inhabit the area. The magnitude of change is moderate due to the risk of potentially losing sensitive species populations and the sensitivity is low due to the local scale of the impact. The significance of the impact before mitigation is minor.

7.4.10.2 Impact of the open pit on mammals

Open trenches during the Project development are created for underground cables, pipelines and other structures, which function as pitfall traps. Small mammals may fall and become trapped in trenches during construction activities.

The impact is adverse, direct and partly reversible. Open trenches will occur for a limited time during the construction phase; therefore, it is expected that the impact will be temporary. The impact is possible due to mammals occurring in and around the Proposed site. The magnitude of change is minor due to the slight measurable change and potential loss of individual small mammal species and the sensitivity is low, as this impact will occur on-site. The significance of the impact before mitigation is low. Mitigations are discussed in the project ESMP.

7.4.10.3 Potential barrier to mammal movement

The expansion of developments along the dune belt impedes the movement of mammals or prevent them from moving freely due the amount of activity occurring in the area. The impact is adverse, direct and temporary due to the activity occurring during construction only. The

magnitude of change is minor due to the slight measurable change and potential loss of individual small mammal species and the sensitivity is low, as this impact will occur on-site. The significance of the impact before mitigation is low.

7.4.10.4 Artificial lighting impact on mammals

Artificial lighting may impact physiological and behavioural processes in organisms, affecting the circadian rhythm of small mammal should they experience this impact on a long-term basis. The artificial lights provide an indication that activity occurs in the area and are likely to deter large mammals. The impact is adverse, direct, reversible and may be experienced long-term. The impact is possible due small mammals that are seeking shelter within the area.

The magnitude of change is minor due to the measurable change caused to mammal individuals in the surrounding area and the sensitivity is low due to the extent of the impact. The significance of the impact before mitigation is low. Mitigation measures to artificial lighting are described in the ESMP.

7.4.10.5 Illegal and unsustainable collection of protected mammal species

During the Project lifetime, employed staff or potential associates may be involved in the illegal extraction or poaching of endemic/protected/rare mammal species found in the general development area.

Namibian protected mammal species expected to be found and confirmed from the current or previous studies in the Project area are as follows:

- *Macroscelides proboscideus flavicaudatus* (Round-eared Elephant-shrew) – Endemic
- *Protomys littledalei namibensis* (Littledale's Whistling Rat) – Endemic
- *Gerbillurus tytonis* (Dune Hairy-footed Gerbil) – Endemic
- *Gerbillurus vallinus* (Brush-tailed Hairy-footed Gerbil) – Endemic
- *Petromyscus collinus* (Pygmy Rock Mouse) – Endemic
- *Parahyaena (Hyaen*a) brunnea (Brown Hyena) – Insufficiently known; Vulnerable

The nature of the impact adverse, direct and permanent. The probability is possible as important mammals that roam around may be illegally collected.

The magnitude of change is moderate, because it involves a measurable impact directed towards sensitive species and potentially the surrounding natural ecosystem. The sensitivity of receptor is medium due to the regional extent. The significance of the impact before mitigation is moderate. Mitigation measures include discouraging poaching activities and collecting of veld foods. It is important to educate and inform contractors and staff on protected species to avoid and the consequences of illegal collection of such species. Further mitigations are described in the ESMP.

7.4.10.6 Noise impact on mammal species

Noise pollution is likely to deter large mammals. However, large mammals are more mobile and tend to pass through the general Project area often. Consistent long-term noise may result in stress and potentially interfere with breeding cycles of small mammals.

This impact is unlikely to be detrimental to mammals due to the short term of severe noise during construction activities. The nature of the impact is adverse, direct, reversible and on-site. The magnitude of change is minor due to the migration of large mammals, the sensitivity of the receptor will be low due to the local extent of the noise pollution. The overall significance of impact is low. Mitigation measures set out in the ESMP regarding noise is applicable to mammals.

Table 37 - Impacts on mammals

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction and operational phase	Mammals	Potential habitat loss/disturbance/modification may lead potential loss of mammal diversity in the area	Adverse Direct Partly reversible Long term Local Possible	Low	Moderate	Minor (3)
Construction phase		Potential open trenches during construction may act as a pitfall for small mammals	Adverse Direct Partly reversible Temporary On-site Possible	Low	Minor	Low (2)
Power supply		Artificial lighting may impact physiological and behavioural processes in organisms affecting the circadian rhythm, reproduction	Adverse Direct Reversible Long term Local Possible	Low	Minor	Low (2)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		and survival etc.				
Construction and operational phase		Potential barrier in movement causing fragmentation	Adverse Direct Partly reversible Temporary On-site Possible	Low	Minor	Low (2)
Employment, Procurement of contractors, good and services		Illegal and unsustainable collection of protected/endemic species reduces the biodiversity and leads to loss of important species	Adverse Direct Irreversible Permanent Regional Possible	Medium	Moderate	Moderate (6)
Construction phase		Noise pollution may cause migration and stress	Adverse Direct Reversible Temporary On-site Likely	Low	Minor	Low (2)

7.4.11 AVIAN

The Namib coast is important for 8 species and in terms of global populations it supports >90% of the world's chestnut-banded plovers (*Charadrius pallidus*); 31% of Cape teal (*Anas capensis*); and 26% of African black oystercatchers (*Haematopus moquini*). In terms of African endemic races, it supports: >90% of the lack-necked grebe (*Podiceps nigricollis gurneyi*); and 33% of the white-fronted plover (*Charadrius m. Marginatus*); and in terms of southern African sub-continental populations, it supports 31% of pied avocet (*Recurvirosta avocetta*), 13.7% of greater flamingo (*Phoenicopterus roseus*) and 10.3% of lesser flamingo (*Phoenicopterus minor*).

The proposed development is in a barren saline pan area and consequently development impacts are not expected to be detrimental to birds, as this is an extremely marginal environment for birds.

The biodiversity specialist report by Cunningham (2024) (Appendix G) indicated the following IUCN listed species that have been previously confirmed in the general Arandis-Walvis Bay Project area:

- Critically endangered: Cape Gannet (breeding endemic);
- Endangered: Cape Cormorant (breeding endemic), Martial Eagle, Ludwig's Bustard;
- Vulnerable: Great White Pelican, Greater Flamingo, Lappet-faced Vulture, Hartlaub's Gull;
- Near threatened: Black-necked Grebe, Crowned Cormorant, African Black Oystercatcher, Chestnut-banded Plover; and
- Endemic species: Rüppell's Korhaan, Rosy-faced Lovebird, Dune Lark, Gray's Lark,

The specific impacts on avifauna before mitigation are presented in Figure 77 for illustrative purposes only. Impacts are discussed in detail in the sections thereafter and in Table 38.

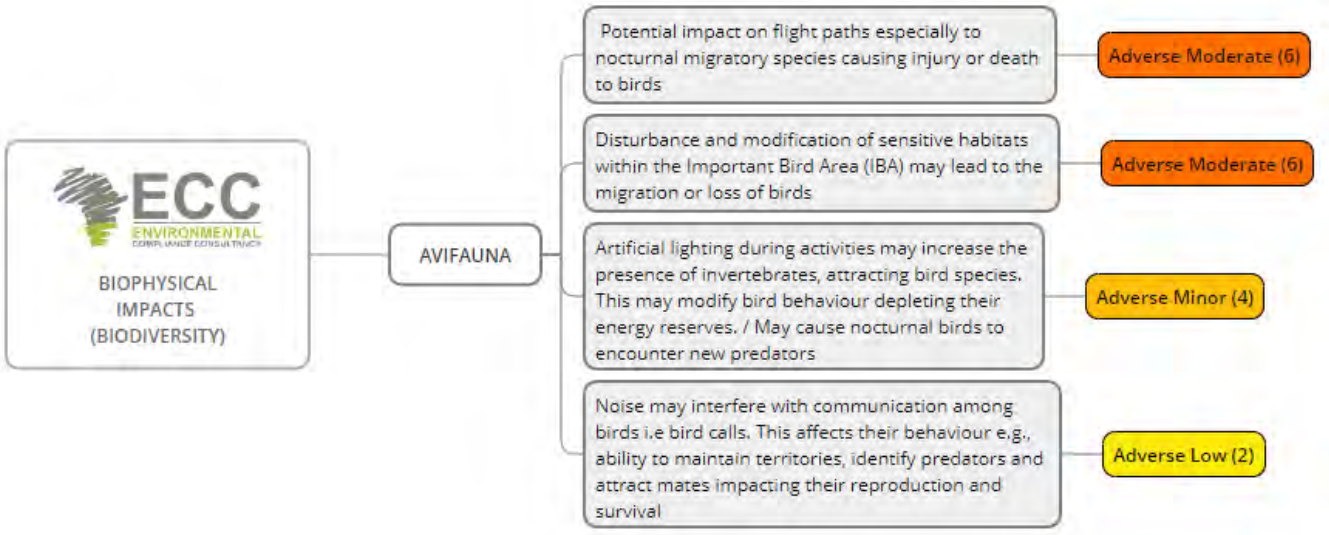


Figure 77 - Impacts on avifauna before mitigation

7.4.11.1 Potential avifauna flight path impact

There has been an increase in migrating bird collisions with artificial obstacles along their flight paths (Evans Ogdens, 1996). The entire coastline is classified as an IBA (Important Birding Area) known as the 30 km beach (national IBA status). This is especially important for migrant birds that are in search of foraging areas. The nature of the impact is adversely direct, partly reversible and occurring over a long-term period due to the duration of the Project. The impact is expected to be possible as the larger area consist of unique/endemic and protected migratory birds.

The entire coastline is known as an IBA (Important Birding Area), especially for Palearctic migrant species and birds moving between the various important coastal foraging sites. Although the actual saline pan development area is not viewed as an important bird foraging site, the infrastructures may potentially affect the flight paths of certain birds, especially nocturnal migratory species, and the Proponent should take cognisance of this and ensure that it is visible. The magnitude of change is moderate due the potential visibility impact and loss of migratory

birds within the IBA, and the sensitivity of receptor is medium due to the regional scale of the impact. The significance of the impact before mitigation is moderate.

7.4.11.2 Potential destruction of sensitive habitats of avifauna

During the specialist field study, a total of 11 species of birds were observed and/or confirmed during the rapid field assessment in the general region, while a total of 84 species have been confirmed from the general area from previous fieldwork by Peter Cunningham dating back to 2010.

The protected species identified in the general area is listed above. However, no birds were observed in the Ammonia Terminal project area during the assessment. The nature of the impact is adversely direct, partly reversible and may occur over a long-term period. The probability of the impact is possible due to the variety of birds found in the general area.

The Salsola dune hummock habitat, located on the eastern boundary of the proposed development area, are important for a variety of birds and should be avoided. The magnitude of change is moderate due the potential loss of avifaunal sensitive habitats and the sensitivity of receptor is medium due to the regional scale of the impact. The significance of the impact before mitigation is moderate.

7.4.11.3 Artificial lighting impact on avifauna species

It has been documented that lighting can attract large numbers of night-migrating birds from as far as 5 km away or cause confusion. Birds can become entrapped in these locations of bright lights, circling endlessly, depleting energy stores needed for migration, and even colliding with buildings and infrastructure (U.S. Fish & Wildlife Services, n.d.). Artificial lighting may increase the presence of invertebrates, which attract bird species in search for prey. However, light may make birds vulnerable and can alter the relationships between predators and prey and lead to the avoidance of essential habitats for their survival as a result of artificial lighting (U.S. Fish & Wildlife Services, n.d.).

The nature of the impact is adversely direct, reversible and over a long term for the duration of the Project (50 years). The magnitude of change is minor, due to the minor change this may cause bird species. The sensitivity of the receptor is medium, due to the regional impact this may have on migratory sensitive bird species. The overall significance of the impact before mitigation is minor. Mitigation management measures are further discussed in the Project ESMP.

7.4.11.4 Noise impact on avifauna species

Noise may interfere with communication among birds i.e., bird calls. This may affect their courtship and predator-prey relationships. It is unlikely that noise will be detrimental to the survival of bird species in the general area.

The nature of the impact is adverse, direct and reversible after the decommissioning phase. The magnitude of change is minor as noise impact will cause minor changes to avifaunal behaviour.

The sensitivity of the receptor is medium due to the regional extent of the impact as birds are migratory. The overall significance of impact is low. Mitigation measures are described in the Project ESMP.

Table 38 - Impacts on avifauna

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction and operational phase	Avifauna	Potential impact on flight paths especially to nocturnal migratory species causing injury or death to birds	Adverse Direct Partly reversible Long term Regional Possible	Medium	Moderate	Moderate (6)
		Disturbance and modification of sensitive habitats within the Important Bird Area (IBA) may lead to the migration or loss of birds	Adverse Direct Partly reversible Long term Regional Possible	Medium	Moderate	Moderate (6)
Power supply		Artificial lighting during activities may increase the presence of invertebrates, attracting bird species. This may modify bird behaviour depleting their energy reserves. / May cause nocturnal birds to encounter new predators	Adverse Direct Reversible Long Term Regional Possible	Medium	Minor	Minor (4)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction phase		Noise may interfere with communication among birds i.e bird calls. This affects their behaviour e.g., ability to maintain territories, identify predators and attract mates impacting their reproduction and survival	Adverse Direct Reversible Temporary On-site Likely	Low	Minor	Low (2)

7.5 FURTHER CONSIDERATION CUMULATIVE IMPACTS

The EIA regulations clearly state that cumulative impacts should be considered as part of the ESIA for a proposed project. Good practice requires that, as a minimum, cumulative impacts are assessed during the ESIA process. Cumulative impacts can arise when a single resource or receptor is affected by more than one impact from the proposed project.

Cumulative impacts may also arise because of the combination of two or more projects. A receptor could be impacted by similar types of impact from different developments, or a receptor. Cumulative impacts have a wide temporal and spatial scope and are not restricted to a local area nor need to happen at the same time. It is, therefore, crucial to identify a suitable study and assessment area, as well as a timeframe to assess. Cumulative impacts can also be vast and complicated; therefore, it is important to focus on the significant impacts.

- The six-step rapid CIA process has been followed:
- Step 1: Scoping - determine spatial and temporal boundaries.
- Step 2: Scoping - identify valued environmental and social receptors and identify reasonably foreseeable developments.
- Step 3: Determine the present condition of valued environmental and social receptors (the baseline)
- Step 4: Assessment of cumulative impacts and evaluation of the significance of the cumulative impacts
- Step 5: Identification of mitigation measures to avoid or reduce cumulative impacts.

The cumulative impacts that may arise because of the project before mitigation are presented in Figure 78, for illustrative purposes only and are outlined in Table 39 and Table 40.

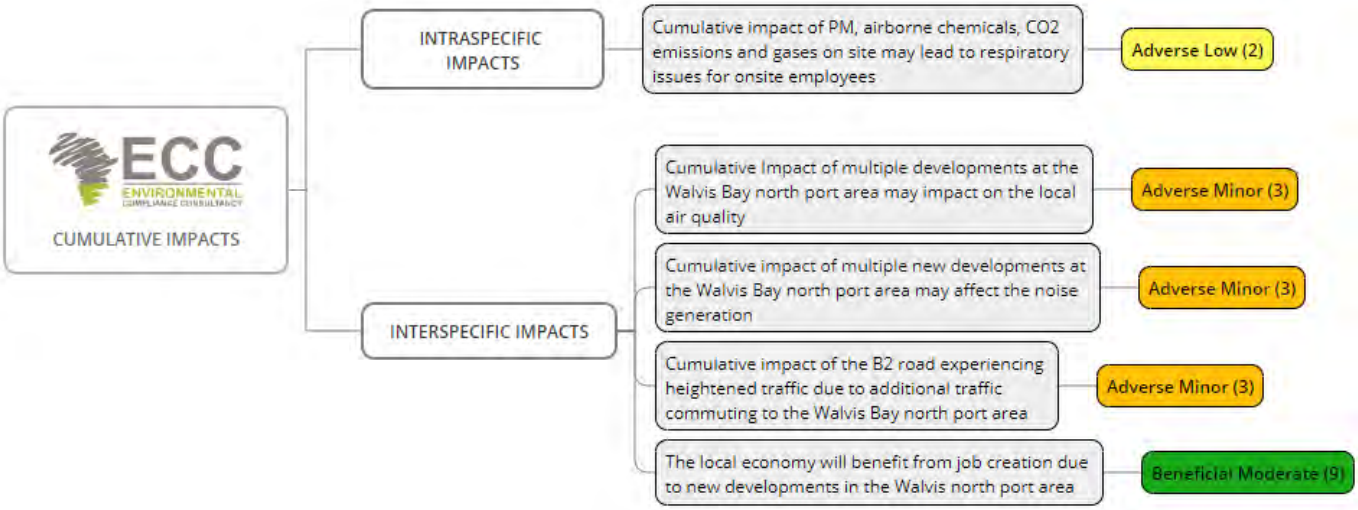


Figure 78 - Intraspecific and interspecific cumulative impacts

7.5.1 INTRASPECIFIC CUMULATIVE IMPACTS

7.5.1.1 Cumulative impact of PM, airborne chemicals, CO2 emissions and gases on site on employees

The use of different equipment, machinery and vehicles during the construction related activities may release fine particulate matter, airborne chemicals and CO_2 emissions and other gases. The impact on air quality may lead to potential respiratory issues for onsite employees. The nature of the impact is adverse and cumulative as a result of various sources contributing to air quality. The impact is reversible, and the duration of the impact is temporary, due to the related activities occurring during the construction phase only. The scale of this impact is on site and the magnitude of the impact is low. The probability of this impact occurring is likely and the sensitivity is low as occupational health and safety equipment and measures will be in place. However, it should be noted that the timeline and extent of other potential developments are unknown and therefore the assumption is made that other developments occur at the same time as a worst-case scenario view. Overall, the significance of the impact is low. Mitigation measures are included in Table 39.

7.5.2 INTERSPECIFIC CUMULATIVE IMPACTS

7.5.2.1 Cumulative impact of multiple developments at the Walvis Bay north port on the local air quality

The Project activities coupled with potential developments at the Walvis Bay north port area may generate airborne particulate matter (PM_{10} and $PM_{2.5}$), chemical gases and added CO_2 emissions from the added use of vehicles. These may have detrimental impacts on the air quality and respiratory health of nearby sensitive receptors. The nature of the impact is adverse and cumulative as a result of various sources contributing to air quality. The impact is reversible, and the duration of the impact is long term due to the prolonged cumulative impact. The magnitude

of the impact is low. The probability of this impact occurring is likely and the sensitivity is low as occupational health and safety equipment and measures will be in place. However, it should be noted that the timeline and extent of other potential developments are unknown and therefore the assumption is made that other developments occur at the same time as a worst-case scenario view. The significance of the impact is minor. Mitigation measures are included in Table 40.

7.1.1.1 Cumulative impact of multiple developments at the Walvis Bay north port on the noise generation

Use of Project equipment and machinery accompanied with noise generated from nearby projects within the Walvis Bay north port area could result in elevated noise pollution that may negatively impact sensitive noise receptors, i.e., the Walvis Bay community. The noise generated from multiple developments may be a nuisance to nearby Walvis Bay residents. The nature of the impact is adverse and cumulative as a result of various sources of noise in the Walvis Bay north port area. The impact is reversible, and the duration of the impact is long term due to the prolonged cumulative impact of multiple developments. The scale of this impact is on site and the magnitude of the impact is low as the simulated noise impact of the Project is below IFC noise guideline during normal project operations. The probability of this impact occurring is likely and the sensitivity is low due to the local scale. However, it should be noted that the timeline and extent of other potential developments are unknown and therefore the assumption is made that other developments occur at the same time as the Project for a worst-case scenario view. Overall, the significance of the impact is minor. Mitigation measures are included in Table 40.

7.1.1.2 Cumulative impact of the B2 road experiencing heightened traffic to the Walvis Bay north port area

Increased traffic during the Project alongside traffic generated by other new developments within the Walvis Bay north port area may lead to traffic congestion altering the flow of traffic on the B2 road. It is also expected that increased traffic on the road may cause degradation and damage as both heavy and light vehicles will be using the road, resulting in more frequent maintenance and repairs. The nature of this impact is adverse and cumulative, due to added traffic from neighboring developments and impacts on both traffic and the road quality. The impact is reversible, and the duration of the impact is long term due to the life cycle of the Project. The scale of this impact is local, and the magnitude of the impact is low. The probability of this impact occurring is likely as vehicles will be used by employees and for the transporting of goods and services. The sensitivity of this impact is rated low due to the local scale. However, it should be noted that the timeline and extent of other potential developments are unknown and therefore the assumption is made that other developments occur at the same time as the Project. The significance of the impact is minor. Mitigation measures are included in Table 40.

7.1.1.3 The local economy will benefit from job creation due to new developments in the Walvis Bay north port

The Walvis Bay north port area is currently being explored by new business ventures and opportunities that come with the vacant land and proximity to the Walvis Bay commercial port. The new potential developments can lead to a significant increase in local employment

opportunities, providing jobs for people with various skill sets and qualifications and increased spending. Additionally, local businesses may emerge to provide a variety of goods and services required by the new developments. The nature of this impact is beneficial, cumulative and party reversible. The duration of the impact is long term, due to the life cycle of the Project. The magnitude of the impact is high due to the major benefits. The probability of this impact occurring is likely and the sensitivity of this impact is medium due to the regional scale. Therefore, this impact has been rated beneficial major.

Table 39 - Intraspecific cumulative impacts of the Ammonia Terminal project

Receptor	Impacts	Significance of impact	Impact management
Air quality	**Activity:** Use of equipment, machinery and vehicles during construction phase. **Impact:** Increased fine particulate matter, airborne chemicals and CO_2 emissions and other gases.	**Low (2)**	– Dust suppression measures must be implemented. – Minimise air quality impacts during construction by limiting the speed of haul trucks; limiting unnecessary travelling of vehicles on untreated roads; and applying dust suppressants on regularly travelled, unpaved sections. – When haul trucks need to use public roads, the vehicles need to be cleaned of all mud and the material transported must be covered to minimise windblown dust. – The access roads to the Project site also needs to be kept clean to minimise carry-through of mud on to public roads. – Ensure that international air quality standards and best practices are adhered to. – Vehicles and machinery are to be regularly serviced according to the manufacturers' specifications and kept in good working order to minimise exhaust emissions. – Transition vehicle fleets from any potential diesel-powered to hybrid or electric powered vehicles, which have lower carbon emissions.

Table 40 - Interspecific cumulative impacts of the Ammonia Terminal project

Receptor	Impacts	Significance of impact	Impact management
Air quality	**Activity:** Construction activities coupled with the development of other Projects at the Walvis Bay North Port area. **Impact:** Increased fine particulate matter, airborne chemicals and CO2 emissions and other gases.	**Minor (3)**	– Dust suppression measures must be implemented. – Minimise air quality impacts during construction by limiting the speed of haul trucks; limiting unnecessary travelling of vehicles on untreated roads; and applying dust suppressants on regularly travelled, unpaved sections. – When haul trucks need to use public roads, the vehicles need to be cleaned of all mud and the material transported must be covered to minimise windblown dust. – The access roads to the Project site also needs to be kept clean to minimise carry-through of mud on to public roads. – Ensure that international air quality standards and best practices are adhered to. – Vehicles and machinery are to be regularly serviced according to the manufacturers' specifications and kept in good working order to minimise exhaust emissions. – Transition vehicle fleets from any potential diesel-powered to hybrid or electric powered vehicles, which have lower carbon emissions.
Noise	**Activity:** Project activities coupled with the development of other Projects at the Walvis Bay North Port area. **Impact:** Noise pollution.	**Minor (3)**	– Whenever possible, work hours for non-production heavy equipment should be restricted between dawn and dusk where the use of heavy equipment, power tools, and the movement of heavy vehicles is within 500 m from sensitive receptors. – All diesel-powered equipment and vehicles should be kept at a high level of maintenance. This should particularly include regular

Receptor	Impacts	Significance of impact	Impact management
			inspection and, if necessary, replacement of intake and exhaust silencers. Any change in the noise emission characteristics of equipment should serve as trigger for withdrawing it for maintenance. – Minimising noise levels to International Finance Corporation noise levels for residential areas (i.e. 55 dBA during the day and 45 dBA at night). – A noise complaints register must be kept.
Traffic (Road users and road quality)	**Activity:** Commuting of people and the transport of goods to and from the site coupled with the transport of people and goods to neighbouring sites. **Impact:** Increased traffic and heavy loads on the B2 may cause an increase in traffic congestion, resulting in longer travel times, fuel wastage and increased emissions. Additionally, the impact on the quality of roads and the necessity of for maintenance	**Minor (3)**	– Provide large visible road signage, indicating the presence of heavy vehicle traffic at least 500 m before, on either side of the site access road intersection along the road. – Implement a structured maintenance schedule to address wear and tear, including resurfacing, grading, and drainage improvements. – Continuous engagement among the developers at Walvis Bay North Port Area.
Employment, skills and the local economy	**Activity:** Job creation and investment in the local economy. **Impact:** Reducing unemployment, enhancing skills development through on-site training. and attracting investments. in a community spur the formation of new	**Beneficial Major (9)**	– Introduce focused training initiatives aimed at enhancing the skills of the local workforce. – Invest in community development projects, including, healthcare, and educational facilities, to enhance overall quality of life. – Preference to local suppliers for goods and services, thereby fostering the growth of indigenous businesses.

Receptor	Impacts	Significance of impact	Impact management
	businesses, cultivating an entrepreneurial environment and enhancing local economic diversity. The resulting growth in businesses and employment enlarges the local government's tax base, generating extra revenue for crucial public services like education, healthcare, and infrastructure. This contributes substantially to the comprehensive development of the Walvis Bay community. Moreover, the expansion of businesses involves investments in training programs, elevating the skills of the local workforce, boosting competitiveness, and attracting additional investments, ultimately fostering innovation.		– Collaborate with local and regional authorities to enhance infrastructure such as roads, power supply, and water facilities in support of the Walvis Bay North Port developments.

8 CONCLUSION

A complete and comprehensive Environmental and Social Impact Assessment (ESIA) has been undertaken for the Ammonia Terminal Project. All aspects have been considered in the impact assessment. These aspects have been thoroughly investigated against planned project activities. All contributions from the public participation have been considered and incorporated in the report for the decision making and impact assessment. All specialist input has been examined and the recommended mitigations have been included in the environmental and social management plan (ESMP).

The scoping phase of the ESIA described the receiving environment adequately. Alternatives were provided in terms of the construction methods, which were further assessed in the ESIA report with the aid of specialist studies. However, the ammonia capacity of the ammonia terminal may change as details are refined in which case an amendment to this assessment will be prepared.

Table 41 below summarises the impacts after mitigation. On a scale from 1 to 12, low to high, the beneficial (B) and negative (N) impact significance is stated. Some variation between the sub-sections of these aspects exists so the average significance is stated for some aspects.

Table 41 - Impacts after mitigation measures

Socioeconomic environment: economic		Socioeconomic environment: social		Biophysical environment	
Impacts on employment and job creation	B9	Impacts on air quality	N3	Impacts on soil and groundwater	N2
Impacts on national and local economy	B9	Visual impacts	N2	Impacts on surface water	N1
Project closure impacts	N3	Traffic impacts	N2	Biodiversity – Flora	N2
		Heritage and cultural impacts	N2	Biodiversity - amphibians	N2
		Noise impacts	N2	Biodiversity – Reptiles	N3
		Community health and safety impacts	N6	Biodiversity - mammals	N3
		Occupational health and safety impacts	N6	Biodiversity - Avifauna	N4

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APPENDIX A – ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

APPENDIX B – PUBLIC CONSULTATION DOCUMENT

APPENDIX C – SCOPING REPORT ADDENDUM REPORT

APPENDIX D – EAP CVS

APPENDIX E – AIR QUALITY IMPACT ASSESSMENT

APPENDIX F – CLIMATE CHANGE IMPACT ASSESSMENT

APPENDIX G – BIODIVERSITY IMPACT ASSESSMENT

APPENDIX H – TRAFFIC IMPACT ASSESSMENT

APPENDIX I – QUANTITATIVE RISK ASSESSMENT

APPENDIX J – HERITAGE IMPACT ASSESSMENT

APPENDIX K – NOISE IMPACT ASSESSMENT