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.TECH**

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REPORT:

FINAL ESIA REPORT FOR THE CONSTRUCTION AND OPERATION OF AN AMMONIA PIPELINE FROM ARANDIS VIA FARM 58 TO WALVIS BAY NORTH PORT AREA, ERONGO REGION, NAMIBIA

PROJECT NUMBER: ECC-145-480-REP-47-D

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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. The Ohlthaver & List (O&L) Group is the largest privately owned consortium in Namibia, with an operational track record spanning over a century and covering a diverse number of industries. CMB.TECH, a Belgium company, is a diversified and future-proof maritime group, leading the way in decarbonisation. Their focus lies in large-scale marine and industrial applications powered by hydrogen and ammonia.

As part of the bigger intended hydrogen and ammonia infrastructure development and operation, which CMB.TECH is actively pursuing, the proposed construction of an ammonia pipeline is envisioned and will be constructed from Arandis via Farm 58 to the Walvis Bay port area, in the Erongo Region, Namibia

In terms of the Namibian Environmental Management Act, 2007 and its regulations, the Ministry of Industries, Mines and Energy (MIME) 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 and Forestry (DEAF)/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 was 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
- Heritage impacts
- Biodiversity impacts
- Traffic impacts
- Surface and groundwater impacts
- 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 Pipeline Project. The assessment included high risk, sensitive receptors, risk evaluation and mitigations and strategies. The study was conducted by CMB.TECH and a further study will be conducted by an independent party.

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, surrounding 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 Main Road, 1984 and C28 roads.

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 environmental significance the project may have on the vertebrate fauna and flora at the Proposed pipeline route and alternatives identified.

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 and social management plan (ESMP) was provided to the public for review for almost three months (03 July 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 MIME and MEFT was on 20 September 2024.

Additional adverts were published on the 5th and 6th of June 2025, and a stakeholder letter was released on 11 June 2025 to inform the public about the proposed change by the Proponent from a hydrogen pipeline between Arandis and Farm 58 (Walvis Bay) to extending the ammonia pipeline from the Walvis Bay north port to Arandis.

The next stage of the ESIA process was to conduct the impact assessment. The draft impact assessment report was 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. All I&AP comments were captured during the review period of the assessment phase and responded to by providing further information in the response table, which is attached as an addendum report (Appendix L) to this final ESIA. The final ESIA report and appendices is submitted formally to the MIME and the MEFT for a record of decision. The phases of the ESIA are provided in Figure 1.

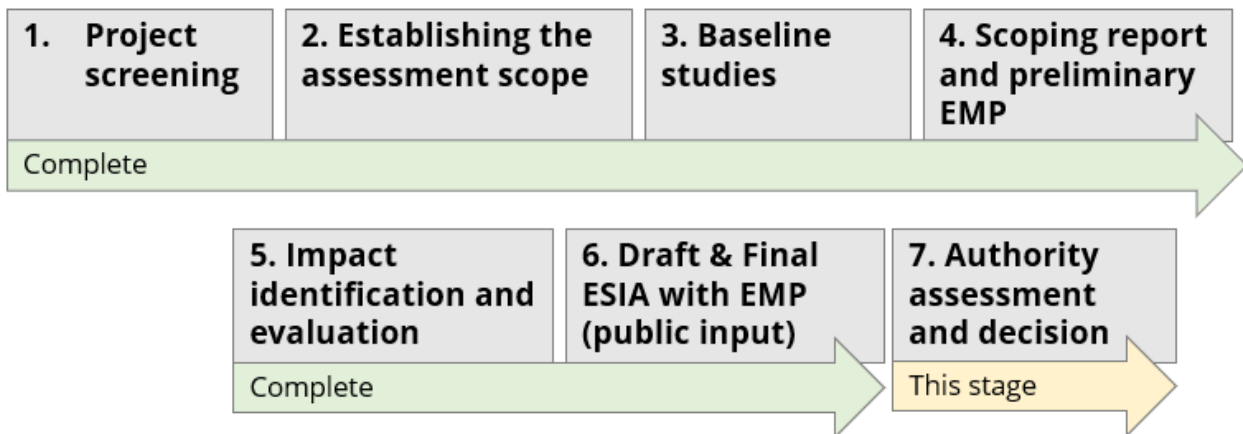


Figure 1 – Simplified phases of the Ammonia Pipeline Project ESIA process

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ABBREVIATIONS AND TERMS

Abbreviation and terms	Description
%	percentage
~	approximately
µg	microgram
°C	degrees celsius
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
ASME	American Society of Mechanical Engineers
BID	background information document
BWh	represents a hot desert climate
CaSO ₄ .2H ₂ O	gypsum
CIA	cumulative impact assessment
Cleanergy Solutions	Cleanergy Solutions Namibia (Pty) Ltd
CMB.TECH	CMB.TECH Namibia (Pty) Ltd
CO	Carbon monoxide
CO ₂	Carbon dioxide
COVID-19	coronavirus disease 2019
dBA	decibels A
DEAF	Directorate of Environmental Affairs and Forestry
DMA	Directorate of Marine Affairs
DWNP	Directorate of Wildlife and National Parks
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
ENVID	Environmental Hazard Identification
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
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GN	government notice

Abbreviation and terms	Description
H ₂	hydrogen
HASP	Health and Safety Plan
HAZID	Hazard Identification
HAZOP	Hazard and Operability Study
HC	hydrocarbon
HIV	human immunodeficiency virus
I&APs	interested and affected parties
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
kV	kilovolt
kWh/a	kilowatt-hours per annum
kWh/m ² /day	kilowatt-hours per square metre per day
L _{Aeq}	Equivalent Continuous Sound Pressure Level
LOPA	layer of protection analysis
Ltd	limited
m	metre
m ³	cubic metre
m ³ /day	cubic metre per day
MAFWLR	Ministry of Agriculture, Fisheries, Water and Land Reform
mamsl	metres above mean sea level
MEFT	Ministry of Environment, Forestry and Tourism
mg/m ² /day	Milligram per square metre per day
MIME	Ministry of Industries, Mines and Energy
mm	millimetre
MoDVA	Ministry of Defense and Veteran Affairs
MoHSS	Ministry of Health and Social Services
Ms/m	millisiemens per meter
mt	metric tonnes
MURD	Ministry of Urban and Rural Development
MWT	Ministry of Works and Transport
N/A	not applicable
N ₂	nitrogen
NAAQS	National Ambient Air Quality Standards
NaCl	halite
NAMCOR	National Petroleum Corporation of Namibia
NamPort	Namibian Ports Authority
NCCSAP	National Policy Climate Change Strategy and Action Plan

Abbreviation and terms	Description
NDC	Nationally Determined Contributions
NDP5	fifth National Development Plan
NGU	Nitrogen Generation Unit
NH ₃	ammonia
NHC	National Heritage Council
NIMT	Namibian Institute of Mining & Technology
No.	number
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
RoD	Record of decision
SA	South Africa
SADC	Southern African Development Community
SEMP	strategic environmental management plan
SANS	South African National Standard
SDG	sustainable development goals
SO ₂	sulphur dioxide
SOP	standard operating procedures
SoW	scope of work
SW	southwest
T	tonnes
TB	tuberculosis
tph	total petroleum hydrocarbons
tCO ₂ e	tonnes of carbon dioxide equivalent
ToR	terms of reference
TSP	total suspended particles
UN	United Nations
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Conventions to Combat Desertification
UNCLOS	United Nations Law of the Sea Convention

Abbreviation and terms	Description
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization
WWI	World War 1
WWF	World Wildlife Fund for Nature

1 INTRODUCTION

1.1 COMPANY BACKGROUND

Environmental Compliance Consultancy (Pty) Ltd (ECC) has been engaged by CMB.TECH Namibia (Pty) Ltd (hereinafter referred to as the Proponent or CMB.TECH) as the environmental assessment practitioner (EAP) to conduct an environmental and social impact assessment (ESIA) and develop an environmental and social management plan (ESMP) for the proposed construction of an ammonia pipeline from Arandis via Farm 58 to the Walvis Bay port area, Erongo Region, Namibia.

CMB.TECH, in partnership with Ohlthaver & List (O&L) Group, forms the joint venture Cleanergy Solutions Namibia (Pty) Ltd (hereinafter referred to as Cleanergy Solutions). The Ohlthaver & List (O&L) Group is the largest privately owned consortium in Namibia, with an operational track record spanning over a century and covering a diverse number of industries. CMB.TECH, a Belgium company, is a diversified and future-proof maritime group, leading the way in decarbonisation. Their focus lies in large-scale marine and industrial applications powered by hydrogen and ammonia. CMB.TECH is listed on Euronext Brussels and the NYSE.

CMB.TECH is intent on becoming a driving force in the growth of the Namibia's hydrogen economy, while contributing to the global shift for industrial decarbonisation. Cleanergy Solutions Namibia began receiving key components for its electrolyser in mid-2024. The company has aimed to commission the plant by the first quarter of 2025, with full commissioning expected by mid-2025 (Mining & Energy, 2024).

As part of the bigger intended hydrogen and ammonia infrastructure development and operation, which CMB.TECH is actively pursuing, the proposed construction of an ammonia pipeline is envisioned and will be constructed from Arandis via Farm 58 to the Walvis Bay port area, in the Erongo Region, Namibia (refer to Figure 2). The proposed pipeline can be accessed via the D1984 road and the B2 road between Arandis and Walvis Bay.



Figure 2 - Locality map of the project

1.2 PURPOSE OF THE REPORT

An environmental and social impact assessment (ESIA) has commenced in compliance with the requirements of the Environmental Management Act, No. 7 of 2007 (EMA), and its 2012 regulations. This report aims to present the findings of the larger ESIA process. In addition to describing the prescribed ESIA process, the report describes the baseline biophysical and socioeconomic environments, a Project description, findings from the assessment phase, and presents an environmental and social management plan (ESMP).

Public participation is a critical aspect of the ESIA process. The scoping report and appendices was made available to the public for review and comment, allowing stakeholders to provide valuable input. The revised scoping report with public input is submitted to the Ministry of Industries, Mines and Energy (MIME) as the competent authority for the Project, and the Ministry of Environment, Forestry and Tourism (MEFT) - Directorate of Environmental Affairs (DEA) for review. The draft ESIA and ESMP were issued for public and government review for a period of 14 days. The final ESIA and ESMP has been submitted to the Government for review and issuance of the Record of Decision (RoD).

1.3 THE PROPONENT OF THE PROPOSED PROJECT

CMB.TECH Namibia (Pty) Ltd is the Proponent for the proposed Project. A servitude will need to be registered for the pipeline once all the necessary approvals has been granted, and the route finalised.

The Proponents' details are provided in Table 1.

Table 1 – Proponent's details

Company representative	Contact details
Ms Liesbeth Verhaert Manager H ₂ & NH ₃ production	CMB.TECH Namibia (Pty) Ltd: No.1 Charles Cathral Street P O Box 81588, Olympia, Windhoek, Namibia Liesbeth.verhaert@cmb.tech +32 479 56 15 06

1.4 ENVIRONMENTAL AND SOCIAL ASSESSMENT PRACTITIONER

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

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.	– Power supply may be required for basic needs of temporary facilities during the project such as office space, toilets and changing. – Power supply will be supplied from a local diesel generator.
Waste management, treatment, handling and disposal activities	(2.3) The import, processing, use and recycling, temporary storage, transit or export of waste.	– During construction, waste may be produced and temporarily stored on-site. – General construction waste will be produced and will be handled and disposed of appropriately. – A waste management plan will be developed and followed on-site.
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.	– The ammonia pipeline will transport ~800 metric tonnes of green ammonia per day to the ammonia terminal. – There will be constant monitoring with a fibre optic cable of possible leakages points, pressure switches and vibrations (external digging). These systems will be monitored from Arandis to the Ammonia Terminal and the to the existing jetty in Walvis Bay. – Ammonia, when in large amounts, is deemed hazardous. Therefore, the relevant permits relating to the handling of ammonia will be

Listed activity	As defined by the regulations of Act	Relevance to the project
		acquired from the National Radiation Protection Authority, under the Ministry of Health and Social Services (MoHSS).
Infrastructure	10.1 (a) The construction of oil, water, gas and petrochemical and other bulk supply pipelines	– The ~112 km ammonia pipeline will be constructed between Arandis and Walvis Bay port area.

2 APPROACH TO THE ASSESSMENT

2.1 PURPOSE AND SCOPE OF THE ASSESSMENT

This assessment aims 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 detailed assessment methodology.

The scope of the assessment was determined by undertaking a preliminary assessment of the proposed Project against the receiving environment. The initial assessment findings were that the proposed Project may be associated with visual impacts, potential disturbance to faunal habitats, potential removal of flora species likely to be encountered within the pipeline corridor, potential disturbance to objects of heritage significance and health and safety concerns to the workforce/receiving environment should there be leakages from the pipeline.

The public consultation process commenced in March 2024, and public meetings were held in Walvis Bay, Swakopmund and Arandis. Informal public engagements were held in Walvis Bay, Swakopmund and Arandis in July 2024. Inputs raised by I&APs and key stakeholders within the region were considered in determining the scope of the assessment.

2.2 THE ASSESSMENT PROCESS

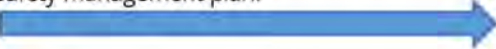
The ESIA methodology applied to this assessment is compliant with Namibia's EMA 2007 which is applicable to all projects including marine areas located within Namibia's Territorial Waters and Exclusive Economic Zone (EEZ) (Territorial Sea and Exclusive Economic Zone of Namibia Act 3 of 1990). The ESIA methodology has been developed using the International Finance Corporation (IFC) standards and models Performance Standard (PS) 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 practise 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 Figure 3 and is detailed further in the following sections.

2.3 SCREENING OF THE PROJECT

The first stages in the ESIA process are to register the Project with the DEA/MEFT (completed) and 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 screening phase determined that the project would likely trigger or associated with impacts such as visual impacts, traffic impacts (likely during the construction phase), potential contamination or pollution of surface and groundwater resources, noise impacts (during construction), dust generation, impacts on faunal habitats and pristine flora species of the desert environment, health and safety to the occupational workforce and socioeconomic environment. These are significant impacts and trigger listed activities of the EMA and thus a full ESIA study is required.

1. Project screening	2. Establishing the assessment scope	3. Baseline studies
Complete	Complete	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, 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 	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 and off site - Positive socio-economic impacts – green energy - Visual impacts on sense of place BIOPHYSICAL ENVIRONMENT - Noise and air quality, including dust emission - Road traffic - Heritage and culture - Biodiversity - Climate change - Flood plains The following topics were scoped out of the ESIA, and they are therefore not discussed further in this report. - An assessment of safety impacts or risks associated with developing the mine are not included within the scope of this assessment and will be addressed by the Proponent in a site-specific safety management plan. 	A robust baseline is required, in order 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 area 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, monitoring, and ongoing studies The environmental and social baselines are provided in the scoping study. 

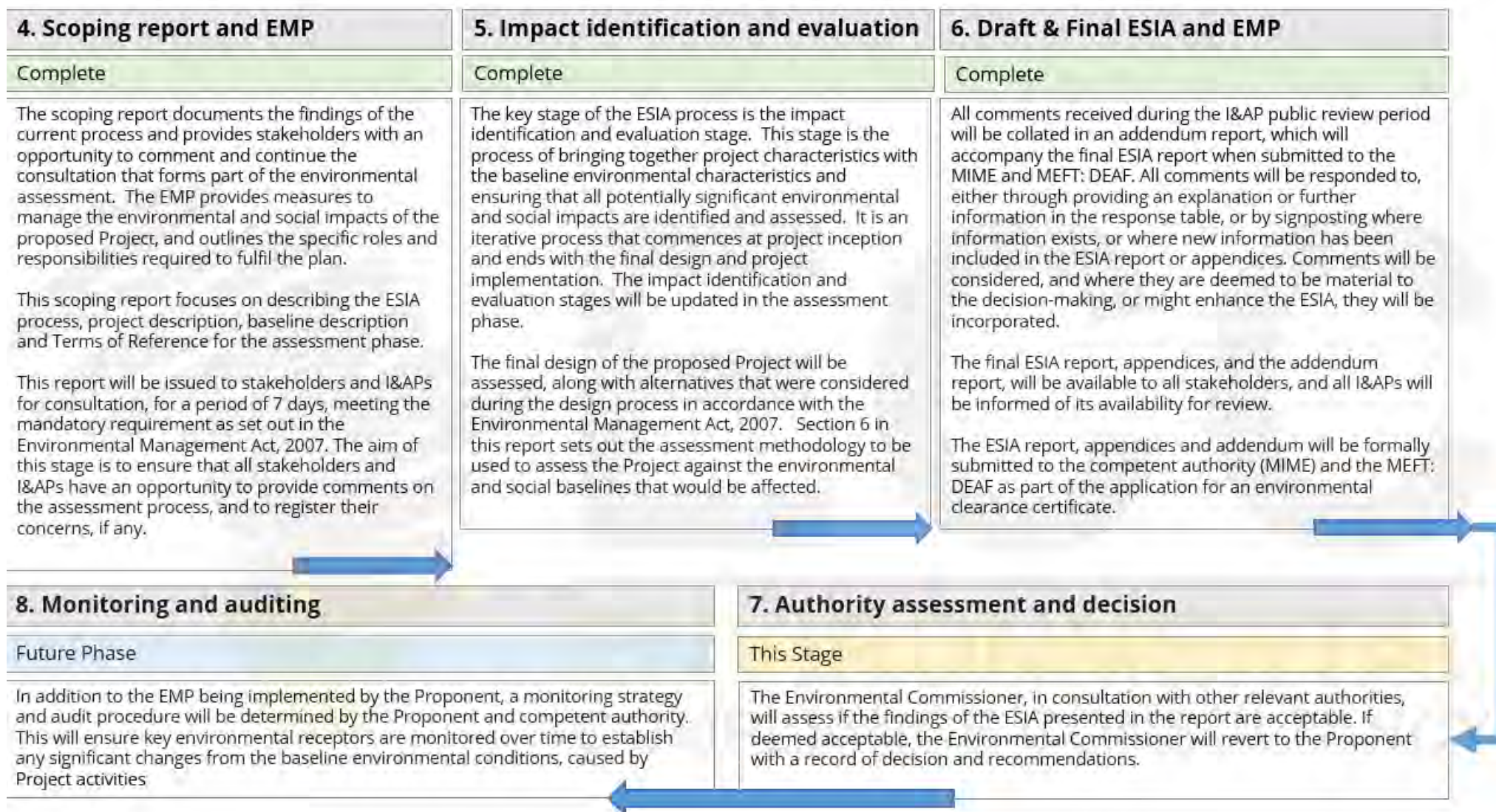


Figure 3 – ESIA process and stages complete

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 geographical boundaries of the study area span from areas under communal supervision of the locals to exclusive and pristine environments that are under government supervision and management. Additionally, the pristine desert environment, ecological features, community locations, and other corridors of development were guiding tools employed in determining the study area boundaries. This will aid in sourcing out direct, indirect and cumulative impacts likely to be triggered by the project.

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 a compulsory and critical component of the assessment process for achieving transparent decision-making and can provide a better public perception and reception on the Project. Consultation is ongoing during the ESIA process.

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

- Identify and engage the relevant government, regional, and local regulating authorities (key stakeholders) to gain insights and increase support- leading to better Project outcomes;
- Provide Project information to the public and competent authorities, introducing the overall project concept and planning in the form of a background information document (BID);
- Capture community issues, record concerns and questions for inclusion in the ESIA study; and
- To explain the ESIA process, 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 potentially interested and affected parties (IAPs). Public meetings were deemed necessary by the EAP and the Proponent in order to broaden the scope of the impact assessment. Public meetings were held in Walvis Bay, Swakopmund and Arandis from the 12th - 14th of March 2024. Additional informal engagements were held in Walvis Bay, Swakopmund and Arandis from 8-10 July 2024. These towns were chosen based on the current scope of influence of the Project. The EAP will maintain a high level of engagement with key stakeholders and the general public throughout the ESIA process.

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. The concerns raised relevant to the proposed ammonia pipeline project are:

- Potential safety hazards, safety measures and emergency preparedness plans.
- Possible risks of ammonia in relation to the ocean, biotic and abiotic environments.
- Potential risk of ammonia leakages on the biophysical environment.
- Impacts on sensitive and national protected areas.
- Potential risks associated with pipeline material, design and proximity to other pipelines.
- Lack of national legislation, standards and local regulations to guide various elements of the Project.
- Potential local, regional and national socioeconomic benefits.

The Project adverts and public meetings invitations were placed in local newspapers on the 29th of February and 07th March 2024.

Additional adverts were published on the 5th and 6th of June 2025, and a stakeholder letter was released to inform the public about the proposed change by the Proponent from a hydrogen pipeline between Arandis and Farm 58 (Walvis Bay) to extending the ammonia pipeline from the Walvis Bay north port to Arandis. 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 (i.e. letters and phone calls), indirectly through the national press, and directly by email. A summarised list of stakeholders for this project is given below:

- | | |
|--|---|
| – Neighbouring businesses; | – Ministry of Industries, Mines and |
| – Affected and surrounding conservancies | Energy (MIME); |
| – The general public with an interest in the Project; | – Ministry of Urban and Rural Development (MURD) |
| – Ministry of Environment, Forestry, and Tourism (MEFT); | – Ministry of Agriculture, Fisheries, Water and Land Reform (MAFWLR); |
| | – Ministry of Industrialisation and Trade; |

- Ministry of Defense and Veteran Affairs (MoDVA);
- Walvis Bay International Airport
- National Planning Commission (NPC);
- NAMCOR
- NamPort;
- NACSO;
- Namib-Nauklüft Park
- Dörob National Park;
- #Gaingu Conservancy;
- Erongo Regional Council;
- Walvis Bay Town Council;
- Walvis Bay Municipality;
- Swakopmund Town Council;
- Swakopmund Municipality
- Arandis Town Council
- TransNamib;
- Sand Miners Association
- Savanna Marble CC

The records of the public consultation process in the form of a summary report are provided in Appendix B and include 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. This document and associated appendices were provided to I&APs' between 12-26 August 2025. All comments were captured and responded to in the addendum report (Appendix L).

3 REVIEW OF THE LEGAL ENVIRONMENT

This chapter outlines the regulatory framework applicable to the proposed Project. As stated in chapter 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. Dörob National Park and Namib-Nauklüft 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 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 provide opportunities for streamlined operations that would warrant safety, reliability and performance of engineered systems.

A thorough review of relevant legislation has been conducted for the proposed Project. Table 4 identifies relevant legal requirements specific to the Project. Table 5 provides the national policies and plans. Table 6 specifies permits relevant for the Project. Table 7 identifies the international policies and plans relevant to the Project. International codes and standards that will be applied in the design of various project elements are provided in Table 8.

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 of government: Executive, Judiciary and Legislative.

National regulatory regime	Summary	Applicability to the Project
Territorial Sea and Exclusive Economic Zone Act No.3 of 1990	The Act defines and determines 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 in line with 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	The environmental scoping report documents the findings of the scoping phase of the environmental assessment undertaken for the proposed Project. The current phase undertaken is the environmental and social impact assessment. 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
	Department of Environmental Affairs, under the MEFT, is responsible for the administration of the EIA 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 ammonia pipeline will be constructed adjacent to the Walvis Bay municipal townland masterplan area, through Farm 58, Namib-Naukluft area to Arandis. The Municipality of Walvis Bay and the Erongo Regional Council office are mandated to uphold and authorise any developmental works in the town and the overall Erongo Region. These are key stakeholders and will be engaged at various levels during 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).	Construction materials may not be available in the local market. Should there be any delivery ship or vessel(s) entering NamPort waters during the construction phase of project and mobilisation, it will be required that all nautical safety requirements are complied with, and all relevant permissions or licences are acquired.
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
Water Resource Management Regulations of 2023, Water Resources Management Act, Act No. 11 of 2013	This Act provides for the control, conservation and use of water for domestic, agricultural, urban, and industrial purposes; and to make provision for the control of certain activities on or in water. The Department of Water Affairs, within the Ministry of Agriculture, Fisheries, Water and Land Reform (MAFWLR), is the custodian responsible for the administration of the Act.	The Proponent is to acquire water required for the construction phase through a local water service provider (i.e. Walvis Bay Municipality). All waste generated, particularly during the construction phase will be handled appropriately by means of the wastewater system and disposed of at the waste disposal site. Measures to prevent potential surface and groundwater pollution are contained in the ESMP.
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.	Approximately 800 metric tonnes of ammonia will be transported daily from Arandis to the ammonia terminal at the Walvis Bay port area. The Proponent is obligated to ensure that safe handling, transfer, storage, and disposal protocols are developed, implemented and audited throughout the construction and operation phase of the ammonia pipeline. Leakage detection systems will be in place and inspections will be conducted routinely to timely address any leakages. Monitoring frequencies are outlined in the ESMP.

National regulatory regime	Summary	Applicability to the Project
		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 has been conducted during the full ESIA process. The heritage impact assessment will include mitigation measures should heritage objects or artifacts be encountered during Project construction, operation and decommission.
Labour Act (No. 6 of 1992) repealed on 21 December 2007 by the Labour Act, 2007 (Act No. 11 of 2007)	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 effective implementation of the Labour Act No. 6 of 1992. According to Labour Act, 2007 (Act No. 11 of 2007), Chapter 4 of the legislation, a legal duty is imposed on employers to provide and maintain a working environment that is safe, healthy, and without risk to the well-being of employees and other persons affected by work activities.	The Proponent will implement the necessary measures to ensure the safety and welfare of employees throughout the Project development phases by developing an occupational health and safety plans, emergency response and contingency plan and standard operating procedures (SOPs).

3.2 NATIONAL POLICIES AND PLANS

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

Policy or plan	Description	Applicability to the 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 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 NDP5 pillars are economic progression, social transformation, environmental sustainability, and good governance.	The proposed Project will complement efforts towards achieving the set targets through creating of employment opportunities, where and when required. The design of different Project's elements will ensure that triggered significant impacts towards the biophysical and social environment are reduced to the greatest extent feasible.
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	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

Policy or plan	Description	Applicability to the Project
	economy. Clause 2 (f) makes specific mention to guidelines related to sustainable development.	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, and to stimulate cross-border trade in gas between Namibia and its neighbours.	Although not enacted, the Proponent will take note of the draft bill requirements regarding the safe transport and handling of ammonia gas. The bill promotes the emergence of a green economy through the gas energy industry.
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. Pollution control protocols and monitoring frequencies will be developed for the Project.
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	The principles of Integrated Coastal Zone Management will be used as guidance in the ESIA and will be considered and included where applicable in the ESMP.

Policy or plan	Description	Applicability to the Project
	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.	
A blueprint for Namibia's green industrialisation	Namibia plans to develop an integrated renewable energy ecosystem encompassing energy generation, storage, "green molecule" manufacturing (including ammonia), port infrastructure development and upscaling, and supporting industries. These supporting industries include renewable hydrogen derivatives (ammonia, synthetic fuel & green iron/steel), mineral refinery (rare earth refinery and lithium refinery), and renewable energy hardware (solar panels, wind turbines and electrolyzers). With the overall aim of becoming a renewable energy and green manufacturing powerhouse, targeting markets on the continent and beyond, Namibia has sights on supplying overseas markets in Europe and Asia, where the bulk of renewable hydrogen and ammonia demand is largely expected to be met through imports.	Namibia offers an ideal location to enable CMB.TECH to supply ammonia to vessels operating worldwide, ensuring a reliable and sustainable fuel source. This aligns with global efforts to decarbonise the maritime industry and meet environmental targets.
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-	The Proponent shall be guided by the strategic recruitment plan to ensure fair recruitment of competent locals as the Project requires.

Policy or plan	Description	Applicability to the Project
	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.	

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
Park entry permit to enter the Dörob National Park and the Namib-Nauklüft Park	Nature Conservation Ordinance (No. 4 of 1975)	Required to enter the Dörob National Park and Namib-Nauklüft Park for project geotechnical investigations and other related activities.	Ministry of Environment, Forestry and Tourism (MEFT): Directorate of Wildlife and National Parks (DWNP)
Written approval for the development on 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

Permit/Licence	Act/Regulation	Related activities requiring permits	Relevant Authority
Servitude licence	Roads Authority Act, 1999 (Act No. 17 of 1999) Local Authorities Act, 1992 (Act No. 23 of 1992)	Required in order to use a specific portion of land for the purpose of laying and maintaining a pipeline	Ministry of Works and Transport (MWT)
Road access and crossing permits	Roads Authority Act, 1999 (Act No. 17 of 1999)	Required to cross public roads or infrastructure	Ministry of Works and Transport (MWT)
Letter of no objection for the construction an ammonia pipeline within a national park	A procedural requirement of the MEFT to guide the record of decision (RoD) process.	Required of any industrial infrastructure to be developed within the Dörob National Park and Namib-Nauklüft Park.	Management Committee of the national parks
Letter of consent from the #Gaingu conservancy	Nature Conservation Ordinance, 1975 Environmental Management Act (Act No. 7 of 2007) (EMA), with EIA Regulations (2012)	written consent or consent letter is required from the landowner or legal custodian - the conservancy committee or traditional authority, ensuring local rights are honoured.	#Gaingu conservancy
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 (MoHSS)
Application for licence to remove riparian species, fill or excavate riparian zone or erect structural development within riparian zone	Water Resources Management Act, No. 11 of 2013	Required due to the crossing of the pipeline over the Swakop River	Ministry of Agriculture, Fisheries, Water and Land Reform (MAFWLR)

Permit/Licence	Act/Regulation	Related activities requiring permits	Relevant Authority
Licence to discharge effluent	Water Act No.11 of 2013	Required for water disposal activities.	Ministry of Agriculture, Fisheries, Water and Land Reform (MAFWLR)
Occupational Health and Safety (OHS) compliance	Labour Act, 2007 (Act No. 11 of 2007) and related Occupational Health and Safety Regulations.	The establishment of a Health and Safety Plan (HASP) and emergency response plans to ensure compliance to occupational health and safety.	Ministry of Health and Social Services (MoHSS)

3.4 INTERNATIONAL CONVENTIONS

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

Policy or plan	Description	Applicability to the 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 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.	This is achieved through the EMA Act. The manufacturing, storage, handling or processing 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 borders.

Policy or plan	Description	Applicability to the Project
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 essentially guide standards of operation. These are provided in the ESMP. The Proponent is committed to adopt where applicable, international best practises to ensure economic growth efforts are aligned to Namibia's conservation and environmental management systems.
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 drawn to commitments made through the sustainable development goals (SDGs) programs, particularly at community level.

Policy or plan	Description	Applicability to the Project
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 at present. However, continued commitments are drawn to achieve national climate change objectives through sustainable development goals (SDGs) programs.
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).	Although Namibia is classified as a net carbon sink country at present, the country 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/ammonia 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 Pipeline Project. Principle 3 states that the earth has capacity to produce, maintain, restore and improve	Namibia has shown support to newly developed green hydrogen pilot projects. Across southern Africa, Namibia is one of the countries with abundance renewable energy resources and

Policy or plan	Description	Applicability to the Project
	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.	has potential to lead the transition into green economy.

3.5 INTERNATIONAL CODES AND STANDARDS

Table 8 - Relevant international codes and standards applicable to the Project

International standard/code	Description	Relevance to the Project
IEC 60079 Hazardous Area Classification Standard	The IEC 60079 series is a compilation of standards that cover all permitted protection techniques for equipment in potentially hazardous areas. It is maintained by the International Electrotechnical Commission (IEC) and has been generally adopted worldwide.	The Project involves the transportation of ammonia. Ammonia is much less flammable than hydrogen, however at certain concentrations and temperatures it could cause an explosion. The Proponent will ensure apparatus to be used in the construction of various project elements that meet these standards.
IEC 61508 Functional Safety of electrical, electronic and programmable electronic (E/E/PE) safety-related systems	This standard allows for the development of a uniform technical approach that can be applied to all safety systems in electronics and related software. The standard requires analysis of the potential risks or hazards of a given system or device. It provides categories to determine the level of likelihood of a potential hazard and the consequences should it occur.	Similarly, the Proponent is committed to ensuring that advanced electronics and software's are in place to timely detect potential hazards and launch the necessary remediations.

International standard/code	Description	Relevance to the Project
IEC 61511 Functional safety - Safety instrumented systems for the process industry sector	The standard provides the benchmark for the management of functional safety in the process industries. It defines the safety lifecycle and describes how functional safety should be managed throughout that lifecycle. It also defines requirements for management processes (plan, assess, verify, monitor and audit) and for the competence of people and organisations engaged in functional safety. An important management process is Functional Safety Assessment (FSA) which is used to make a judgement as to the functional safety and safety integrity achieved by the safety instrumented system.	The standards allow for periodic monitoring of functional systems for malfunctions. This allows for streamlined and efficient operations of various system units.
AS 1940 Storage and Handling of Flammable liquids and combustible liquids	Australian Standard 1940 (Storage and Handling of Flammable and Combustible Liquids) was formally updated in August 2017. This change is important, because the standard forms an important reference for the State and Territory fuel storage legislation. AS 1940-2017 provides requirements for the planning, design, construction, and safe operation of all installations in which flammable or combustible liquids are stored or handled.	Ammonia may be flammable and under certain concentrations and temperatures; therefore, these standards and the associated handling guidelines are applicable and would be integrated in different departments of the project as required.
American Society of Mechanical Engineers (ASME)		

International standard/code	Description	Relevance to the Project
ASME B31.3 Process Piping (1922)	American Society of Mechanical Engineers (ASME) B31.3 contains requirements for piping typically found in petroleum refineries; chemical, pharmaceutical, textile, paper, semiconductor, and cryogenic plants; and related processing plants and terminals. It covers materials and components, design, fabrication, assembly, erection, examination, inspection, and testing of piping. This Code applies to piping for all fluids including: • raw, intermediate, and finished chemicals; • petroleum products; • gas, steam, air and water; • fluidized solids; • refrigerants; and • cryogenic fluids.	The piping specifications as may be deemed appropriate for the local desert environment would be considered. This specification allows to corrosion resistance etc.
South African Bureau of Standards		
SANS 10260-2	The South Africa National Standards (SANS) deals use of verified equipment for industrial distribution of hydrogen.	The standards allow for the use of verified, best available technologies. This ensures streamlined, efficient and modernized operations.

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, industries and governments are embracing a drive for economic decarbonisation. While Namibia can still be considered a net-carbon sink, 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. Within Namibia, these impacts threaten ecological resources, ecosystems functions and economic and social sustainability and development. Climate change is expected to affect the annual rainfall patterns and seasonality, likely adding to water scarcity and threatening 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 practises.

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 Pipeline Project, the Proponent proposes that the liquid ammonia be transported from the ammonia production plant in Arandis via the ammonia pipeline to the ammonia terminal at Walvis Bay North Port for storage and the existing jetty for future exporting purposes. The ammonia pipeline and other associated components builds on a significant emerging green ammonia industry in Namibia.

4.2 PROJECT PHASES – CONSTRUCTION PHASE

4.2.1 CONSTRUCTION OF STAGING AREAS AND STORAGE YARDS

Staging areas and storage yards will be strategically located along the planned right-of-way (ROW) and cleared of vegetation (if required). These areas are used to stockpile the pipes, store fuel tanks, sandbags, silt fencing, stakes, and equipment parts. They will also provide parking for construction equipment and employee vehicles.

4.2.2 RIGHT OF WAY CLEARING

Once the site has been established, the ROW will be cleared of vegetation and obstacles. Sensitive, rare and important vegetation may be removed and relocated to a suitable environment.

4.2.3 TRENCH EXCAVATION

The trench for the pipeline will be excavated in segments where the pipeline will be buried. If hard rock is encountered, these sections will be blasted, or jackhammers will be used to excavate the trench. When construction is done in the vicinity of existing water pipelines, powerlines and other services, chemical injections may be used as an alternative. Sandbags will be placed within the trench to support the pipe during installation.

4.2.4 PIPE TRANSPORT, STRINGING AND ASSEMBLY

After trench excavation, 12 metre pipe segments will be transported from the staging area to the ROW. Pipes will be laid either above ground beside the trench or within the trench, supported by sandbags in steep terrain. The final placement will be determined through the ESIA process. Pipe sections will be bent using a pipe bending tool to allow the pipeline to follow the planned route and the terrain. Pipe sections will be welded together, potentially sandblasted, and the weld joints coated to prevent corrosion. For added protection against corrosion, cathodic protection will be applied. Cathodic protection wire must be foreseen in the same trench of the pipeline. X-ray inspection will be used to ensure the quality of each weld joint. Finally, connected pipe lengths of pipe will be carefully lowered into the trench.

4.2.5 OBSTACLES: ROADS AND STREAMS

The pipeline's route crosses existing roads, highways, streams, rivers and wetlands. Pipelines will be constructed underneath these obstacles using techniques like boring for shallow depth, open-cut excavation or using horizontal directional drilling (HDD) for deeper placement. Each obstacle requires a unique construction method and order of operations to minimise negative impacts.

4.2.6 TESTING AND RESTORATION

After the pipe installation and inspection, the trench is carefully backfilled. Pipeline integrity will be verified using hydrostatic testing before Project completion. This process involves pumping water through the pipeline at a pressure exceeding the maximum operational level. If the pipeline remains intact, it is deemed operational. Following testing, the ROW will be seeded, fertilized, and marked with above-ground markers. An additional safeguard measure is to tape along the pipeline route positioned 300 mm above the pipeline. This to indicate the approach of an underground line while excavating a trench in future situations. Warning signs for above-ground pipelines will be installed, particularly at crossing points, to raise awareness about the presence of pipelines in the vicinity.

4.2.7 SUPPORTING INFRASTRUCTURE

Supporting infrastructure will be required and constructed during the ammonia pipeline project. Valve stations will be built above the pipeline allowing operators to shut off sections of the pipeline due to either maintenance or emergency response to a potential leakage of incident. A fiber optic cable will be following along the pipe route (secured to the pipe) to ensure the monitoring of all parameters such as temperature, pressure and vibrations. Pipe leak detection systems will be installed for the ammonia pipeline to ensure early identification and prompt responses.

To ensure pipeline integrity, welds must be x-rayed and the pipe hydrotested. This process involves pumping in clean water, pressured above the expected maximum average operating pressure (MAOP). Then, all water is removed, and pipeline intervention gadgets (pigs) may be inserted into the pipe to clean it out. Pigs are devices used to inspect and remove dirt and other construction debris while pipelines are being assembled. When the pigs eventually exit the far end of the pipe, the line will be filled with dry air. However, the pigging system is optional and cleaning the line is not necessary in the case of the ammonia pipeline. Air compressors pump up the air, and the air is run through a drier. The air will be sampled and tested for moisture content. When those parameters get low enough, the complete pipeline is filled with nitrogen to absorb more of the remaining moisture. The pipeline is then deemed fit to transport ammonia.

Valve stations will be placed at regular pipeline sections. Additionally, pig sender/receiver will be incorporated at the beginning and end of the pipelines for security purposes for potential above ground installations.

4.2.8 EQUIPMENT AND MATERIALS

The equipment listed below will be used during the construction phase though this list is comprehensive at the time of writing, operational requirements may result in the introduction of additional equipment and materials during construction):

- Trenchers
- Skid steer loaders

- Rock grinders
- Backhoe loaders
- Dozers
- Excavators
- Articulated trucks
- Trackhoe with Jackhammer
- Weld Decks
- Pipelayers
- Directional drilling equipment
- Welding stations
- Transportation trucks
- Truck to load and transport pipes to designated locations

The ammonia pipeline will consist of approximately 8-inch carbon steel pipe with a 75 mm insulation layer (above ground pipeline). The underground pipeline will be painted to prevent corrosion. Table 9 provides the specifications and design details of the ammonia pipeline.

Table 9 - Ammonia Pipeline design specifications

Parameter	Unit	Ammonia pipeline
Transported fluid	-	Ammonia
Design pressure	barg	Preliminarily 60
Design/operating temperature	°C	5
Material	-	Carbon steel
Line pipe type	-	SMLS
Material grade	-	API 5L X60
Specified minimum yield	MPa	415
Insulation layer (above ground pipeline)	mm	75
Corrosion allowance	mm	1.0

4.2.9 POWER SUPPLY

Power supply may be provided by a local electricity distributor for the Erongo Region. Power supply will be used for temporary facilities during the Project such as office space, toilets and changing areas during the construction phase.

4.3 OPERATIONAL PHASE

During the operational phase, liquid ammonia with a mass flow between 20 to 60 ton/h will be transported ~112 km from the proposed ammonia production plant on Arandis to the ammonia terminal near the Walvis Bay north port area for storage. Trained personnel will continuously monitor operations and ensure safety procedures are followed.

There will be constant monitoring with a fibre optic cable of possible leakages points, pressure switches and vibrations (external digging). These systems will be monitored from Farm 58. Infield surveys will also be conducted on a regular basis and/or when required.

4.3.1 WATER SUPPLY

Water for construction and operational needs (worker facilities) may be sourced from the local municipality/town council, however no such agreements have been made as of yet. The Project's water requirements are not anticipated to impact local water supply.

4.3.2 WORKERS AND ACCOMODATION

Approximately 30 to 100 semi-skilled workers will be hired during the construction of the ammonia pipeline, with two security guards on night duty. Employees will likely reside in Arandis, Walvis Bay, or Swakopmund; no on-site accommodation is planned.

4.3.3 WASTE MANAGEMENT

A waste management plan will be developed and overseen by the engineering, procurement and construction (EPC) contractor. Temporary waste bins will be available on-site varying in waste categories such as general household waste, plastic, steel, concrete and hazardous waste. The waste management plan will include:

- On-site waste separation and collection (general waste, plastic, steel, concrete, hazardous waste).
- Proper waste disposal procedures.
- Regular toolbox talks to keep workers informed about waste management requirements.
- Mitigation measures will be further detailed in the environmental and social management plan (ESMP).

4.4 DECOMMISSIONING PHASE

The ESMP will outline auditable decommissioning and rehabilitation procedures and 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.

4.5 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 EIA report. 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 that have been identified during the ESIA process so far is whether the pipeline should be designed to be placed above or below ground. It has been proposed that the ammonia pipeline be constructed underground wherever feasible. In areas between Arandis and Walvis Bay where geological conditions make underground installation impractical, the pipeline will be routed above ground. Additionally, different pipeline routing options have been considered between Farm 58 and Arandis. Taking into consideration distance from sensitive receptors and input from biodiversity and heritage assessments, the Namib-Nauklüft route will be used for the ammonia pipeline between Farm 58 and Arandis.

4.5.1 NO-GO ALTERNATIVES

Should the Project not occur, the socio-economic and environmental benefits associated with the green hydrogen/ammonia initiative in Namibia will be lost. Namibia has the opportunity to be a leader in the emerging green energy markets and be an international exporter of green ammonia, which may be a vital source of foreign investment. The green hydrogen vision leads to the creation of career paths, employment, contribution to the economy in terms of reducing energy reliance and income generation and provides a solution to present environmental concerns. 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 locally will strategically allow Namibia to reach milestones.

5 ENVIRONMENTAL AND SOCIAL BASELINE

5.1 BASELINE DATA COLLECTION

This section describes the findings of the Project scoping phase desktop study and specialist studies conducted for the assessment phase of this assessment report. The desktop study, which is a requirement of the scoping phase, 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. Specialist studies utilised for this assessment report are defined further in section 5.3.

5.2 DESKTOP AND FIELD SURVEYS

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

5.3 SPECIALIST STUDIES

The specialist studies shown in Table 10 were commissioned and completed, to determine the baseline state of the environment.

Table 10 - Specialist studies that were completed for the ESIA

Study Area	Purpose	Specialist and date of report
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; and – Model potential air quality impacts.	– Renee von Gruenewaldt Airshed Planning Professionals (Pty) Ltd (Airshed) – October 2024
Traffic	– Potential traffic impacts and loading on routes associated with the Project activities; and	– Albie Smith Zutari Namibia (Pty) Ltd – September 2024

Study Area	Purpose	Specialist and date of report
	– The capacity of pipeline infrastructure and safety aspects of the entry road.	
Noise	– Identification of possible sensitive receptors; and – Assess levels of noise to which they may be exposed during construction and potential maintenance.	– Renee von Gruenewaldt Airshed Planning Professionals (Pty) Ltd (Airshed) – October 2024
Heritage and culture	– A heritage assessment is required, to comply with Namibian national legislature.	– Dr. Alma Nankela RCHeritage Services CC – August 2025
Health and safety	– Identify high risk factors; – Identify sensitive receptors including workforce; – Mitigation measures and strategies; and – Upcoming documents to support occupational health and safety and public health and safety.	– Pieter Van Driessche (CMB.TECH) and Jasper Van Hassel (CMB.TECH) – July 2025
Hydrogeology and surface water	– Water supply; – Surface drainage analysis; – Potential groundwater contamination; and – Potential soil contamination.	– Luke Towers Environmental Compliance Consultancy (Pty) Ltd – July 2025
Biodiversity and dune morphology	– Biodiversity and habitat; – Identification of species of concern and sensitive areas; and – Impacts of construction and maintenance activities on habitats and biodiversity (if any).	– Dr. Peter Cunningham Environment and Wildlife Consulting Namibia – June 2025
Climate change	– Identify impacts, to assist the Project in adhering to set climate change goals and	– David Jarrett RDJ Consulting – November 2025

Study Area	Purpose	Specialist and date of report
	national emission reduction targets; and – Provide recommendations to manage and mitigate potential impacts related to climate change.	

5.4 SOCIAL AND SOCIO-ECONOMIC BASELINE

The proposed Project is located on the outskirts, northeast of Walvis Bay to ~5 km north of Arandis in the Erongo Region. The pipeline will be traversing through the #Gaingu Communal Conservancy, the Dorob and Namib-Naukluft National Park and in the jurisdictions of Swakopmund and Walvis Bay municipal lands. The Erongo Region is situated in the central western area of Namibia and covers a land area of ~63586 km², which makes up 7.7% of Namibia's total area. Walvis Bay has an active micro economic model, with 81% of the total population active in the Walvis Bay Urban Constituency. The general Walvis Bay Rural Constituency has an area of ~9134 km² (Erongo Regional Council, 2022).

Walvis Bay, being a port city, fits in as an integral part of Namibia's vision to become a logistics hub for the Southern Africa Development Community (SADC) region. The Namibian Ports Authority (also referred to as 'NamPort' is amongst the largest employers in Walvis Bay Urban Constituency and therefore a main driver for growth and development (Erongo Regional Council, 2022). Namibian waters are highly productive with a rich and unique diversity of marine and coastal species. Namibia's fishing industry is among the top export earners of foreign currency (Erongo Regional Council, 2015). The tourism industry also plays a vital role in the economy of the Walvis Bay and Swakopmund area. Along the central coast, Swakopmund (a resort town) and Walvis Bay, offer an oasis where the sea meets the desert (Namibia Tourism Board, 2024).

Walvis Bay has the potential for future sustainable development and growth. Industries such as manufacturing, mining and agriculture are expected to shift to more sustainable practises and reduce the carbon footprint on a global scale (Shiwayu & Hartmann, 2023).

Mining in Namibia, just like in other countries, has led to the establishment of towns i.e. Oranjemund, Arandis and others (National Planning Commission, 2021). Arandis is situated near the Rössing Uranium Mine, one of the largest open-pit uranium mines in the world, since 1976. Additionally, Arandis is home to the Namibian Institute of Mining and Technology (NIMT), a vocational training institution that offers courses in mining,

manufacturing and engineering (Namibian Institute of Mining & Technology (NIMT), 2025). Arandis is increasingly exploring green industries as part of its economic diversification such as green charcoal production and solar powered operations (Hartman, 2023).

5.4.1 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 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 km² and the average household size of 3.1 persons per household, which is below average of 3.8 (Namibia Statistic Agency, 2023).

The growth rate in the Erongo increased greatly in the past decades, with more males residing in the Erongo than females, with a difference of ~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 and Swakopmund area.

The Arandis population recorded in 2011 was ~10 200, of which females were 5 300 and males – 4 900 and the population density 0.8 (Erongo Regional Council, 2015). In 2023, Arandis had a population of 13 542 with an annual growth of ~2.5% (Namibia Statistics Agency, 2024). This is mainly due to Husab Mine moving into full scale operations and housing incentives to stay in Arandis from Swakop Uranium.

5.4.2 POVERTY AND UNEMPLOYMENT

According to the 2023 Labour Force Report from the Namibia Statistics Agency, the industries in which most Namibian citizens are employed are agriculture, forestry and fishing; wholesale and retail trade; and manufacturing administration and support services (Namibia Statistics Agency, 2025). 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 ~35%, with youth unemployment rate estimated at 50% (Shikololo, 2023). The highest education obtained by

most of the country (~32%) is Junior secondary level of secondary school (Namibia Statistics Agency, 2019).

The Labour Force Survey conducted in 2019 stated that Erongo region has the lowest unemployment rate (~21.9%) in the country (Namibia Statistics Agency, 2019). Approximately 80% of Walvis Bay Urban constituency residents' main source of income is derived through monthly salaries and weekly wages, and other earnings gained through non-farming businesses (at 9% and cash remittance at 5%).

5.4.3 ECONOMIC ENVIRONMENT

5.4.3.1 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 Walvis Bay Port is Namibia's largest commercial port and receives ~3 000 vessel calls yearly and handles 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 serves 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 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).

5.4.3.2 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 ~3.5% of GDP since 2007. It is administered by the Ministry of Agriculture, Fisheries, Water and Land Reform (MAFWLR) 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 – employed ~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 ǀKaras

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).

5.4.3.3 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 significant recovery post the COVID-19 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 and Walvis Bay Lagoon (proclaimed Ramsar sites), Welwitschia Plains, Atlantic coastline and the Namib Desert, Cape Cross Seal Reserve, Dead Sea and the wider skeleton coastline (Nangolo, 2023). Furthermore, the Walvis Bay's Lagoon and the Sandwich Harbour are two of the five designated Ramsar sites in Namibia and provide pristine environments for various birdlife populations (Erongo Regional Council, 2022).

5.4.3.4 Energy and sustainable practises

Energy demand is continuously increasing and plays a vital role in the economies of all developed and developing countries. From a local perspective, fossil fuels are heavily relied on and accounts for ~63% of the total national 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 for transformation and progression into the gas industry to increase economic growth and lessen reliance on imports (WWF Namibia, 2023). Oil and gas exploration in Namibia are currently underway and are mandated by the National Petroleum Corporation (NAMCOR). Recent discoveries of large crude oil reserves off the Namibian coast have been reported and could potentially double the gross domestic product (GDP) by 2040 (Mathekga, 2022).

Green hydrogen is an emerging fuel industry in Namibia. Green hydrogen includes the separation of hydrogen molecules from water through the electrolysis process powered entirely by (solar or wind) renewable energy sources. Green hydrogen has the potential to reduce dependence on fossil fuels especially in the transport sector while mitigating climate change; reduce reliance on fuels through imports and secure a market and economic growth for Namibia (WWF Namibia, 2023).

Cleanergy Solutions Namibia launched the construction of a green hydrogen plant, refueling station and hydrogen academy in Walvis Bay in 2023. The main goal of the hydrogen academy is to provide the skills and training related to the production and usage of hydrogen as fuel for heavy duty and mining equipment. This provides a new exciting field locals to learn and develop new skills sets for career paths within the green economy industry (Cleanegy Solutions Namibia (Pty) Ltd, 2023). Additionally, the Hylron Oshivela Green Hydrogen Plant, located near Arandis officially opened on 14 April 2025, with the facility representing a pioneering effort in zero-emission industrialisation in Southern Africa (Kariko, 2025)

5.4.3.5 Mining

Arandis is often referred to the “Uranium Capital of the World” due to the largest open-pit uranium mine in the world located ~15 km from it (Schneider, 2014). Arandis was established as a home for Rössing Uranium Mine employees in the late 1970’s. At the end of 2022, Rössing Uranium had a workforce of ~901 with 98% of the workforce being Namibians. Between 2006 and 2010, Rössing has contributed over N\$2.6 billion to government revenue in taxes, which represents about 8% of Namibia’s total tax on income and profits annually (Rossing Uranium Limited, 2011).

Husab Mine is the third biggest uranium mine in the world and is situated 22 km south of Arandis. During 2022, Husab Mine contributed N\$3.2 billion into the local economy through local procurement, taxes and royalties, employee salaries and benefits, as well as social investments (Namibia Economist, 2023). The mine employs ~1 700 permanent employees and over 500 contractors, making it the largest employer in the Namibian mining industry, and one of the biggest employers in the country (Chamber of Mines of Namibia, 2020)

5.4.4 HEALTH AND SAFETY BASELINE

5.4.4.1 General public health

Namibia’s health services are twofold: private (serving ~18% of the population with medical aid) and public (serving the remaining 82%) (Christians, 2020). Public health falls under the mandate of 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). Health care facilities in the Project area include the Swakopmund District Hospital, Mondesa Clinic, Tamariskia Clinic (Swakopmund), Arandis Clinic (Arandis), Walvis Bay District Hospital, Walvis Bay Clinic, Kuisebmund Clinic and Narraville Clinic (Walvis Bay).

Despite relatively good health infrastructure, 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 can be seen as contributions from 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 Human Immunodeficiency Virus/ Acquired Immunodeficiency Syndrome (HIV/AIDS) 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 at 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%). 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.

Best practises should be employed during construction and operational activities to prioritise the safety and health of the occupational workforce and sensitive receptors. This includes measures such as water spraying during construction to control dust, covering trucks, scheduling noisy activities to minimise disturbance, using quieter equipment and providing information to workers and communities on Project related safety, hygiene, the spread of communicable diseases, exposure to hazardous materials due to pipe leaks or accidents and disease prevention.

5.4.4.2 Ammonia characteristics and health hazard

Anhydrous ammonia is a colourless gas characterised by a sharp, suffocating odour. It readily liquefies under pressure and has a boiling point of -33°C . Although it is classified as non-flammable, it can ignite in air when present at concentrations between 16% and 25%, particularly when exposed to open flames.

Ammonia is chemically reactive and incompatible with various substances. It is corrosive to metals such as copper, brass, silver, zinc and galvanized steel. Contact with strong oxidising agents can trigger fire or explosion. Hazardous reactions may also occur when ammonia interacts with calcium hypochlorite (commonly found in household bleach), halogens, gold, mercury, or silver. Dissolution in water is exothermic, releasing heat, and at elevated temperatures, ammonia decomposes into hydrogen and nitrogen gases. Its combustion products, nitrogen and water, are non-toxic and environmentally benign.

Ammonia poses significant health hazards and is toxic if inhaled or ingested and may cause irritation or burns to the skin, eyes, nose and throat at concentrations as low as 35 parts per million (ppm) (Riscom, 2024). Ammonia is classified by the National Institute for Occupational Safety and Health (NIOSH) as Immediately Dangerous to Life or Health (IDLH) at concentrations of 300 ppm. This threshold signifies that exposure at or above this level

can cause death, irreversible health effects, or impair an individual's ability to escape from a hazardous environment (NIOSH, 2023).

5.4.4.3 Diesel fuel health hazard

Diesel is a hydrocarbon mixture with variable compositions, 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 impacts, particularly in the case of large spills (Riscom, 2024).

5.4.4.4 Ammonia pipeline safety controls and preventative measures

The Proponent is committed to adhering to international codes and best practises and will implement comprehensive preventative steps and measures to ensure the long-term safety and integrity of the ammonia pipeline as per Appendix D. Table 11 describe measures taken during the engineering and construction phase of the Project.

Table 11 - Safety control and preventative measures taken prior to Project operations

Measure/activity	Description
Mechanical design according to American Society of Mechanical Engineers (ASME)B31.4	The American Society of Mechanical engineers have developed design codes for pipelines that are suitable for oil and gas applications. Using these standards will ensure a proper design of the pipeline installation.
Hazard identification (HAZID) review	A HAZID review is a qualitative risk analysis technique used to identify potential hazards and threats in a process. It is typically conducted in a workshop setting and aims to alert management to any threats and hazards as early as possible. The identified hazards are classified based on their probability of occurrence and the severity of their consequences.
Environmental hazard identification (ENVID) review	An ENVID focuses on identifying environmental aspects that arise from the interaction between a facility and its surroundings. The goal is to plan

Measure/activity	Description
	for, avoid, or mitigate potential environmental impacts.
Quantitative risk assessment (QRA) by an independent third party	A QRA is a structured process used to identify, analyse, and quantify risks in numerical terms. It determines the probability of hazardous events occurring and their potential consequences. Additionally, the QRA will define safety distances from sensitive receptors.
HAZOP / layer of protection analysis (LOPA) by an independent third party	A HAZOP review is a structured and systematic examination of a complex system, typically a process facility, to identify potential hazards and operability issues that could affect safety and efficiency.
Material selection review	A systematic process used to identify the most suitable materials for a specific application, considering various factors such as mechanical properties, cost, availability and environmental impact.

Additional preventative measures are outlined below:

- The ASME B31.3 and ASME B31.8 describes test and inspection requirements that will allow to check the quality of the construction and validate if the installation is constructed in a safe way (e.g. non-destructive testing, post weld heat treatment);
- Ensure that corrosive air can't harm the core material of the pipeline. Suitable coating (marine coating) will be applicable, the use of correct insulation which will maintain safe operation conditions on one hand and will protect the core pipe by creating a barrier; and
- Correct approach for pipeline sections that are underground and above ground with have specific health and safety applications, i.e., the buried pipeline will have proper coating and cathodic protection, and above ground pipelines will be fenced off and indications of no trespassing.

5.5 AIR QUALITY

Airshed Planning Professionals (Pty) Ltd (Airshed) 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 assessment was to quantify the potential air quality impacts resulting from the pipeline construction activities on the surrounding environment and human health and identify sensitive receptors.

Modelled meteorological data for a three-year period (2021 to 2023) was used to determine the dispersion potential of the site, which influences the dispersal and removal of air pollution. To determine the potential impacts from the pipeline construction, an emissions inventory had to be established accounting for all sources of air pollution associated with the construction activities. Emissions were based on the process description and equipment list provided. The American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) 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 pipeline construction on the receiving environment.

5.5.1 SENSITIVE RECEPTORS

The potential air quality sensitive receptors (AQSR) within the study area include Walvis Bay residential areas (i.e., Naraville, Green Valley, formerly known as Farm 37), nearby accommodation (Gut Richthofen and Moon Landscape self-catering) and Arandis.

5.5.2 CURRENT AMBIENT AIR QUALITY

Three survey sites were selected (i.e. Site 1, Site 8 and Site 12) to record PM₁₀ and PM_{2.5} grab samples (Figure 5). The measured PM data is provided in Table 12. The measured daily PM₁₀ 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. It should be noted that the measured concentrations were only over a single day (less than 24 hours, day and night concentrations) and only provide an indication of concentration levels in the area.

Table 12 - Measured daily average PM10 and PM2.5 for the 2024 survey

Survey site	PM ₁₀ (µg/m ³)	PM _{2.5} (µg/m ³)	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	23/27/2024 23:58

5.5.3 EXSITING IMPACTS TO AIR QUALITY WITHIN THE STUDY AREA

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

- Vehicle tailpipe emissions from national and main roads;
- Fugitive emissions from surrounding mining operations; and,
- Various miscellaneous fugitive dust sources (wind erosion of open areas, vehicle-entrainment of dust along paved and unpaved roads).

5.5.3.1 *Vehicle tailpipe emissions*

Primary pollutants from vehicles, those emitted directly into the atmosphere, include carbon dioxide (CO₂), carbon monoxide (CO), hydrocarbons (HCs), sulphur dioxide (SO₂), oxides of nitrogen (NO_x), particulates and lead (Pb). Secondary pollutants, pollutants from vehicles formed in the atmosphere due to chemical reactions, include nitrogen dioxide (NO₂), photochemical oxidants (e.g., ozone), hydrocarbon gas HCs, sulphur acid, sulphates, nitric acid, nitric acid and nitrate aerosols. Vehicle tailpipe emissions are localised sources and unlikely to impact far-field (Airshed Planning Professionals, 2024).

5.5.3.2 *Nearby mining operations in the region*

Fugitive dust sources associated with mining activities include drilling and blasting operations, material handling activities, vehicle-entrainment by mining fleet and wind-blown dust from stockpiles. Mining operations represent potentially the most significant sources of fugitive dust emissions (PM_{2.5}, PM₁₀ and TSP) with small amounts of NO_x, CO, SO₂, methane, and CO₂ being released during blasting operations and from mine trucks (Airshed Planning Professionals, 2024). Fugitive dust emissions due to on-site operations are typically only of concern within 3 km of the mine boundary, depending on the location of the mine boundary and extent of the mining operations.

5.5.3.3 *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, particularly disturbed 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. The extent, nature and duration of agricultural activities and the moisture and silt content of soils are required to be known in order to quantify fugitive emissions from this source. 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.

5.6 VISUAL – SENSE OF PLACE

The ammonia pipeline is anticipated to be mostly below ground and only above ground in areas where the geological characteristics are not suitable for a below ground pipeline. In areas where the pipeline is above ground, visual intrusion will be more pronounced in otherwise pristine or undeveloped landscapes, potentially disrupting scenic views and altering the natural character of the affected area. Hence visual impact is for the most part negligible as the pipeline will predominantly align with existing infrastructure, namely the NamWater pipeline between Arandis and Swakopmund and the 220 kV transmission line within the Namib-Naukluft between Walvis Bay and Arandis.

Walvis Bay is Namibia's foremost deep-water port and a multifaceted economic engine for both the country and the wider Southern African region (Namibia Today, 2025). The

Namibia Ports Authority (NamPort) plans to expand to accommodate the evolving needs of industries and international trade (New Era, 2023). The North Port is set aside for future developments, which would increase the surrounding businesses and industrialisation. Farm 58 has been re-zoned for heavy industrial use and is favourably positioned to support export-oriented businesses, given its proximity to the Port of Walvis Bay. Additionally, designated land within the area has been allocated for utility corridors. The section of the Namib-Naukluft National Park traversed by the pipeline is largely uninhabited, with limited access to accommodation. The nearest facilities are Gut Richthofen (~1.5 km from pipeline) and Moon Landscape self-catering (~1.7 km from pipeline).

5.7 NOISE

Airshed Planning Professionals (Airshed) conducted the environmental noise impact assessment (Appendix F) for the Project. 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 activities proposed for the Project. Operational activities were not included in the specialist report as it was considered not significant. However, maintenance and sporadic repairs were assessed under chapter 7.

The IFC General Environmental Health and Safety Guidelines on ambient noise address impacts of noise beyond the property boundary of the facility under consideration and provides noise level guidelines (Table 13). It is further important to note that the IFC noise level guidelines for residential, institutional and educational receptors correspond with the SANS 10103 guidelines for urban districts.

Table 13 - 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

5.7.1 NOISE SENSITIVE RECEPTORS

Potential noise sensitive receptors within the study area include individual homesteads and residential areas (i.e., Walvis Bay, Swakopmund, Rössing and Arandis).

5.7.2 NOISE SURVEY AND RESULTS

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 for the campaign undertaken from the 23 to 26 July 2024 are presented in Figure 4 showing day-time results and Figure 5 showing night-time results. The IFC residential noise guideline was exceeded at Site 6, Site 9 and Site 12 during night-time conditions.

A full summary of the noise measurement conducted can be found in the noise impact assessment (Appendix F).

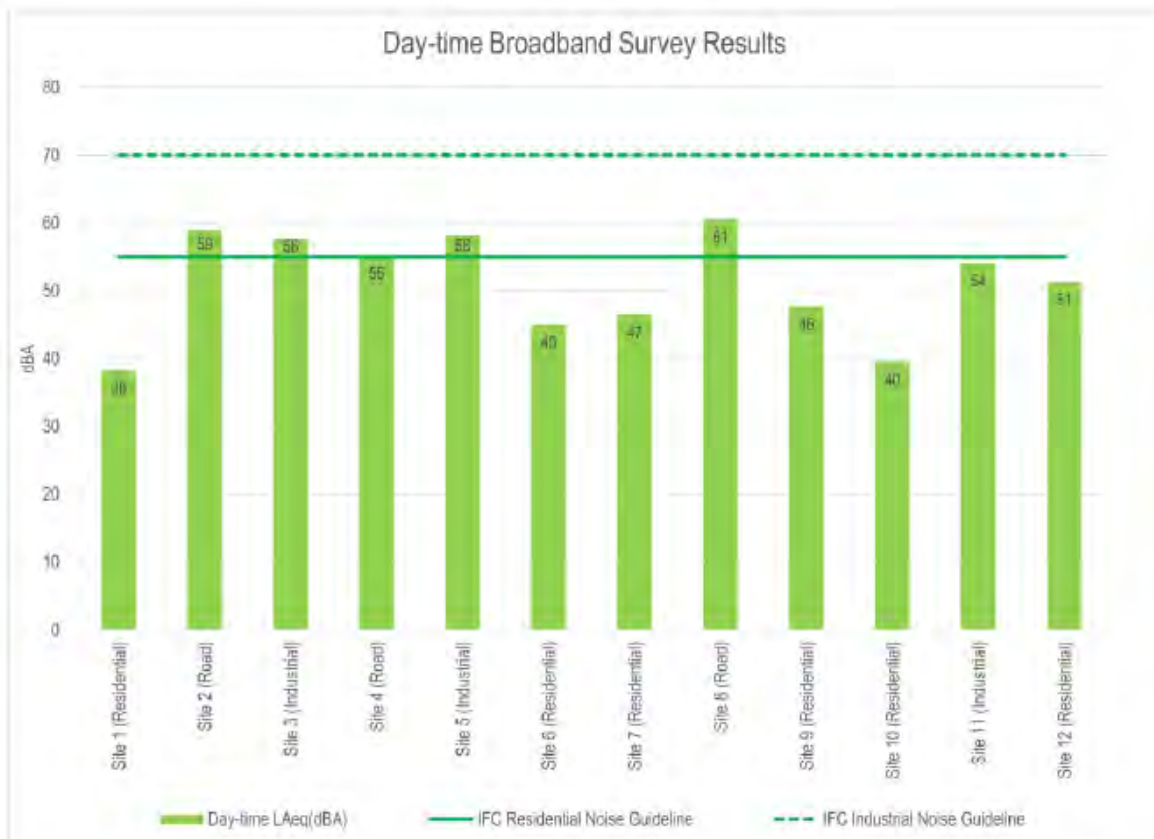


Figure 4 - Day-time broadband survey results (Airshed, 2024)

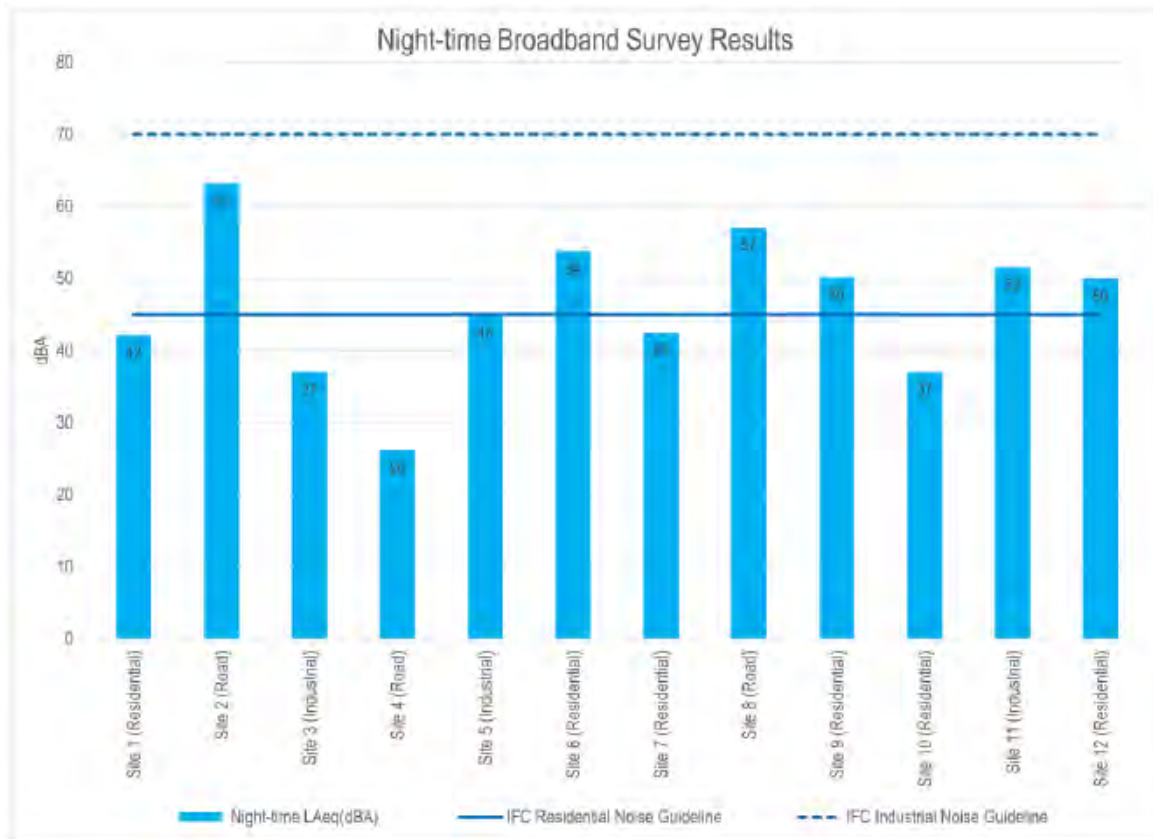


Figure 5 - Night-time broadband survey results (Airshed, 2024)

5.8 CULTURAL HERITAGE

Extensive archaeological, palaeo-environmental and heritage surveys conducted along Namibia's coastal region, particularly in the vicinity of the proposed ammonia terminal and have uncovered a rich and well-preserved record of human activity spanning from the Late Pleistocene to the early colonial period ((Detroit & Nankela, 2014; Kinahan, 2014; Morse *et al.*, 2013; Nankela, 2017, 2022). Findings include shell middens, pottery, beads, animal and human skeletal remains, footprints and artefacts, some exposed by natural erosion from past flooding events. Notably, Kinahan (2014) identified molluscan fauna dating back over 40 000 years, alongside shell middens and pottery from the 7th century *Anno Domini* (AD), reflecting human presence linked to climatic and coastal shifts during the Holocene.

Evidence of early trade between local communities and seafaring traders around Walvis Bay, dating to the 17th – 19th centuries is seen in material remains such as bottles, tins, clothing and building remnants. Similarly, historical artefacts in the High Dune Belt, including beads, bullet casings, and copper wires, are linked to colonial trade and military training activities by South African forces in the 1960s.

Surveys by the Namib Desert Archaeological Survey, in conjunction with environmental compliance requirements, have documented widespread archaeological evidence of nomadic pastoralist and hunter-gatherer activities. Sites dating from the Late Pleistocene and Holocene are typically found in isolated granite outcrops, hill saddles, and near lithic material sources. A unique aspect of Namib Desert subsistence was the harvesting of wild grass seeds, particularly *Stipagrostis*, dug from harvester ant caches. This activity, especially important during periods of low rainfall, is ethnographically linked to Khoekhoegowab-speaking pastoralists over the last 500 years. Seeds were processed into porridge or fermented into beer with wild honey. Despite poor preservation at many sites, this practise reflects early food security strategies that supported population resilience during ecological stress (Kinahan, 2005, 2020; Kinahan *et al.*, 2010).

Additionally, colonial-era remains, including farm buildings, WWI battlefields (e.g., Trekkopje, Husab), railway lines and regimental insignia, mark early 20th century activity tied to European merchants and military campaigns, particularly the 1915 Allied-German conflict.

Overall, the region holds significant archaeological and historical value, capturing diverse human adaptations to the arid environment over tens of thousands of years. The archaeological heritage survey was undertaken by Dr. Nankela in mid-2024 and aimed to identify and document archaeological sites, artifacts and other heritage resources in the immediate Project area. The area of interest stretches 100 m to either side of the pipeline, although heritage resources outside this corridor were also recorded. The field survey identified twenty-two (22) heritage features in the vicinity of the ~112 km ammonia

proposed route, ~5 km outside of Arandis (hot) to the ammonia terminal area (cold). Figure 6 and Figure 7 shows an overview of the heritage resources identified in the Project area.

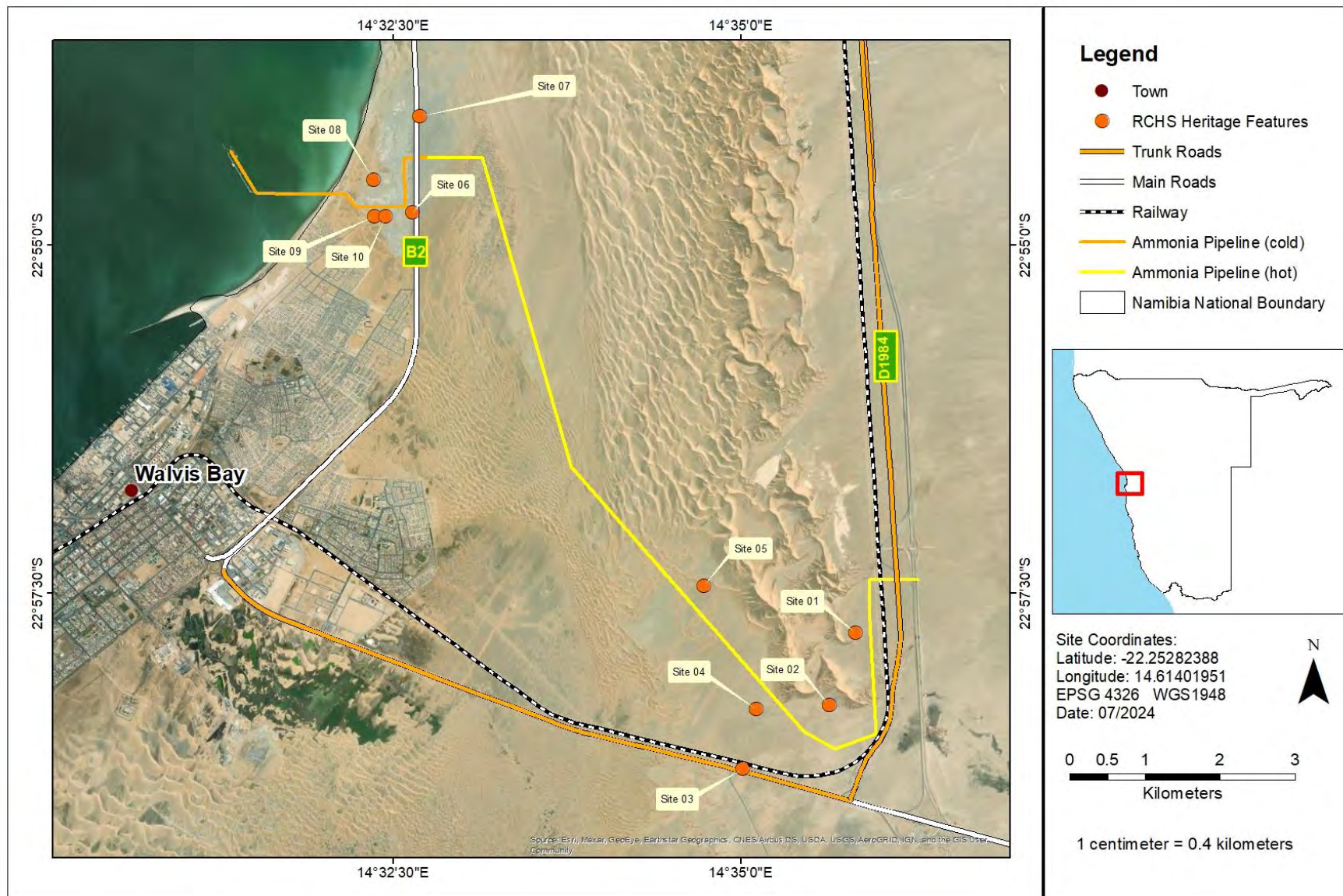


Figure 6 - Distribution of heritage resources located along the pipeline route between Farm 58 and the Existing jetty in the Walvis Bay North Port area

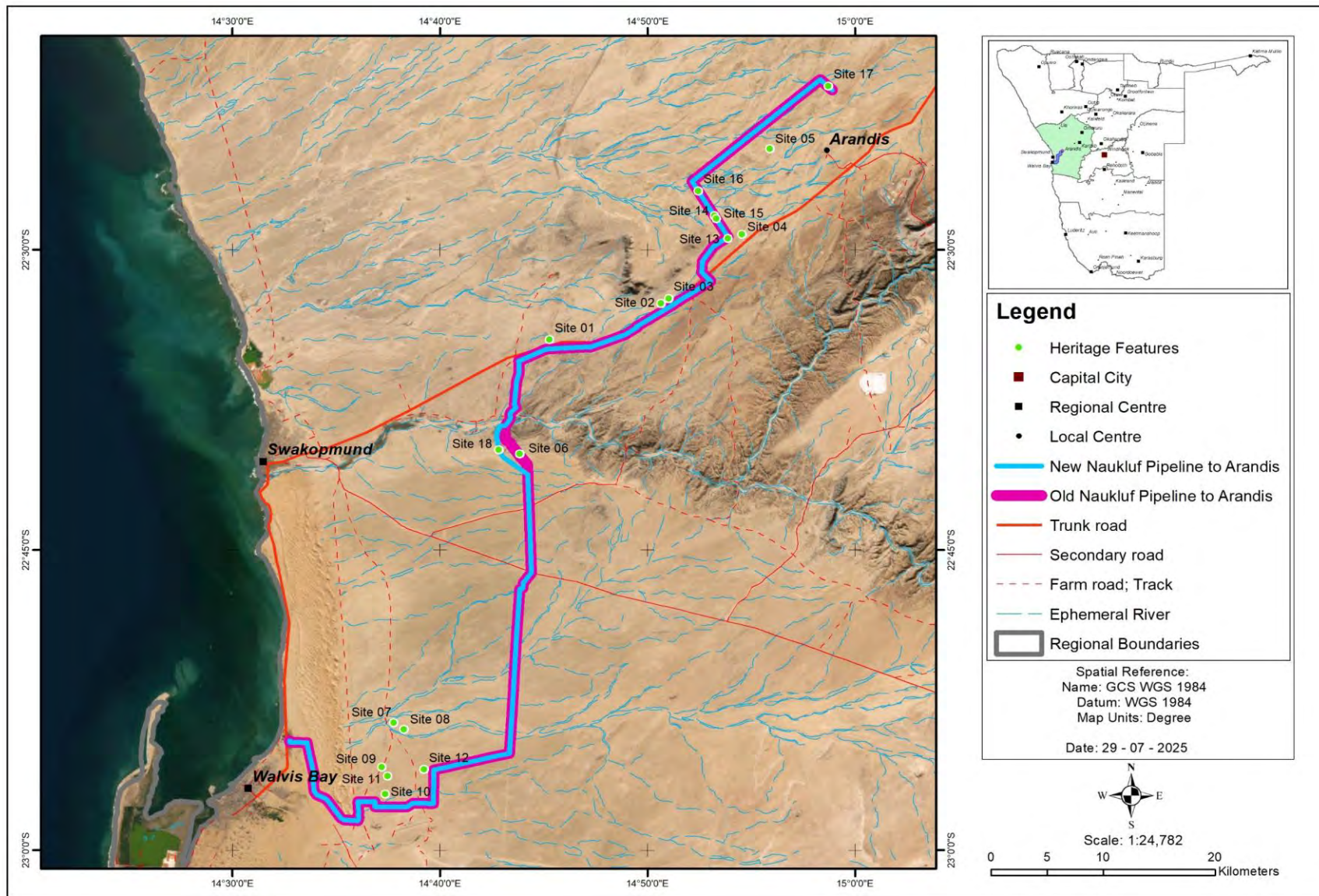


Figure 7 - Distribution of heritage resources located along the pipeline route between Farm 58 and Arandis

5.8.1 HISTORICAL RESOURCES (RUSTED METAL DEBRIS) IDENTIFIED NEAR DUNE 7

Five (5) potential historic sites in the High Dune Belt area were identified by Nankela 2024 (Appendix G), comprising of an isolated heap of discarded debris of broken bottles, rusted canned beef cans, unidentified corrugated materials, buried and surface corrugated asbestos structures with fishing nets and baskets. This likely belonged to “bokkop soldiers” who participated in military training exercises, fishing and trading activities with indigenous traders between the 17th and 19th centuries. These sites are situated between 180 and 200 metres from the proposed ammonia pipeline and their significance in terms of the Heritage Act No. 27 of 2004 is considered very low (RCHeritage Services CC, 2024).

5.8.2 THE TWO-WAYSIDE MONUMENTS

The field survey also identified two (2) wayside crosses (with no human remains), likely honouring victims of the road accidents between Walvis Bay and Swakopmund (Figure 8). While these crosses are regarded as sacred features, they are not considered significant under the National Heritage Act No. 27 of 2004.



Figure 8 - Wayside crosses belonging to the road accident victims along the Walvis Bay/Swakopmund B2 road (Source: RCHS, 2024)

5.8.3 THE WAYSIDE MONUMENT (MAXUILILI G.I. NATHANIEL)

The study also recorded a wayside monument, dedicated to Maxuilili G.I. Nathaniel, a veteran of Namibia’s struggle for independence, who died at the site on 23 June 1999 (Figure 9). This monument is located approximately 800 m from the proposed ammonia pipeline route (hot) and is considered sacred under the National Heritage Act No. 27 of 2004. His remains were re-buried at the declared Heroes Acre in Windhoek.



Figure 9 - Nathaniel Maxuilili monument along the C14/M36 road behind Dune 7 in Walvis Bay (Source: RCHS, 2024)

5.8.4 WORLD WAR I REGIMENTAL INSIGNIA CREATED IN 1915 BY THE SECOND DURBAN LIGHT INFANTRY AND THE KIMBERLEY REGIMENTS

Field surveys have identified several historically significant features within the Namib Desert, particularly related to its historical use as a station along the former narrow-gauge railway between Swakopmund and Karibib. These features are notably concentrated around key World War I battlefields at Reit, Pforte, Trekkopje and Jakalswaters (Kinahan and Stejskal, 2011). One prominent example is a regimental insignia constructed from stone by the Durban Light Infantry and Kimberley Regiments (Second Battalions) during the April – May 1915 campaign. This feature, located on Farm 58, was declared a national monument in 1915 (Figure 10).



Figure 10 - Above and below is the World War I regimental insignia on a hill saddle declared as national monument site in 1915 (Source: RCHS, 2024)

5.8.5 REGIMENTAL INSIGNIA BADGE, A THISTLE-SHAPED "BUTTON" EIGHT FEET IN DIAMETER "BUTTON" EIGHT FEET IN DIAMETER, MADE FROM BROWN AND WHITE STONE AND GRAVEL LOCATED ON A HILL SADDLE OVERLOOKING RÖSSING MOUNTAIN

The regimental insignia was constructed during the World War I campaign (circa April – May 1915) by the Second Battalion of the Kimberley Regiment and the Durban Light Infantry (Figure 11). Its historical importance is associated with a broader network of World War I heritage features found throughout the Namib Desert.



Figure 11 - Shows the WWI second regimental badge in the imposing Rössing Mountain laid out in stones by the Kimberly Battalion Regiment and Durban Light Infantry (Source: RCHS, 2024)

5.8.6 LATE PLEISTOCENE MIDDLE STONE AGE ARTEFACT MADE OF YELLOWISH-BROWN CERT, WHICH IS A KEY PART OF LOCAL STONE ARTEFACT ASSEMBLAGES FOUND ON GRAVEL PLAINS

The Late Pleistocene Middle Stone Age artefacts identified at this site, primarily composed of chert, appear to be in their primary depositional context. This enhances the site's research value, as the artefacts represent a significant component of local stone tool assemblages commonly found on the gravel plains of the Namib Desert, particularly within hydrothermal vein quartz and crystalline quartz geological settings (Figure 12).



Figure 12 - Left image is the location of the site where the MSA chert tool has been record. Right image is some of the actual tools at the site (Source: RCHS, 2024)

5.8.7 STONE FEATURES ON A DOLERITE RIDGE, WHICH MAY LIKELY CONTAIN IMPORTANT MATERIAL EVIDENCE OF DESERT SUBSISTENCE STRATEGIES OR A BURIAL CAIRN

A cluster of at least four well-preserved stone features, likely disturbed cairns, has been identified along the crest of a dolerite ridge (Figure 13). These features are located approximately 6.41 metres from the proposed ammonia pipeline route towards Arandis, placing them within a potentially impacted zone. Given their proximity, the site is considered vulnerable to disturbance from construction activities.





Figure 13 - A series of stone cairn features on a dolerite ridge along the proposed pipeline (Source: RCHS, 2024)

5.8.8 ISOLATED SEED-DIGGING SITE IN A DISTURBED SETTING ALONG A SMALL TRIBUTARY IN THE GRAVEL PLAIN

The isolated seed-digging site is likely associated with short-term occupations by small hunter-gatherer groups who extracted wild grass seeds from underground caches created by harvester ants (*Messor* spp.). Located near a river course, the site shows signs of slight erosion, which diminishes its overall scientific value. Consequently, it has been assigned a significance rating of 2 under the National Heritage Act (Act No. 27 of 2004), with a vulnerability rating of 2 out of 5 (vulnerability ratings used by the specialist here are explained in the heritage report in Appendix G).

5.8.9 CLUSTER OF DIGGING SITES ALONG THE PROPOSED AMMONIA PIPELINE

A cluster of at least four seed digging sites (Figure 14), located at GPS coordinates Lat: 22°56'6.10"S and Long: 14°37'21.37"E, have been identified within the proposed ammonia pipeline corridor on the calcite gravel plain. The site measures approximately 1 to 2 meters in diameter and is believed to reflect short-term occupation by small hunter-gatherer groups who harvested wild grass seeds from underground caches created by harvester ants (*Messor* spp.) in nearby river courses and tributaries. The site is well preserved, dispersed within 5 to 10 meters of each other, and are clearly identifiable through satellite imagery. Associated artefacts include a superficially rusted small drum, likely in secondary deposition. The site holds moderate significance under the National Heritage Act (Act No. 27 of 2004), with a significance rating of 3 but are highly vulnerable due to their direct location within the pipeline path.



Figure 14 - A cluster of seed-digging sites along the proposed ammonia pipeline (RCHS, 2024)

5.8.10 SUPERFICIAL SHELL MIDDEN ACCUMULATIONS OF SKELETAL REMAINS OF MARINE AND TERRESTRIAL VERTEBRATES

Two (2) superficial shell-midden, accumulations containing skeletal remains of marine and terrestrial vertebrates (Figure 15) were identified at the extinct mouth of the Tumas Rivers and tidal lagoon, dating to approximately 1 600 years. While the typology of these shell middens is unknown, the remains are linked to more recent human activities associated with the construction of the coastal railway and coastal defence installation at Rand Rifles (Nankela, 2024). These sites are significant under the Heritage Act No. 27 of 2004 and as a result have been flagged as “no go zone”. A significant portion of the gravel plain has been disturbed by ongoing infrastructure development and recreational activities, including quad biking and off-road driving around the Dune 7 area and the development of utility service infrastructure (installation of water pipelines, overhead powerline grid and renewable energy facilities).



Figure 15 - Superficial shell midden accumulations of skeletal remains of marine and terrestrial vertebrates near the extinct mid-Holocene tidal lagoon (Source: RCHS, 2024)

5.8.11 ARCHAEOLOGICAL OR PALEONTOLOGICAL REMAINS (INCLUDING POSSIBLE BURIED REMAINS, MILITARY EXPLOSIVES) BURIED OR PRESERVED UNDER SHALLOW SEDIMENTARY DEPOSITS IN THE PROJECT AREA

The field survey conducted mainly identified surface archaeological features within the immediate Project area. There is potential that buried sub-surface archaeological,

paleontological or historic resources within the Project footprint may be discovered during site preparation, construction and maintenance activities or exposed by natural, gradual aeolian erosions over time. No major earthworks are anticipated; however, this does not preclude the possibility of discovering military explosives, particularly in the Dune 7 area, which served as a military training ground for the South African Defence Force in the 1960s. Heritage resources and potential disturbances could result from employees' lack of awareness. It is crucial to exercise caution in the Project area, particularly in the unlikely event that military explosives are discovered.

5.8.12 STONE FEATURES NEAR THE PROPOSED PIPELINE

During the second phase of field surveys conducted, a group of gathered stone features on the eastern side of a dolerite ridge was observed (Figure 16). These features measure 90 cm x 1.2 m while overlooking the railway line and flat plains. The site is not vulnerable to the proposed final pipeline route to Arandis, as it's located approximately 112 m from it. Additionally, the stones are not of heritage value.



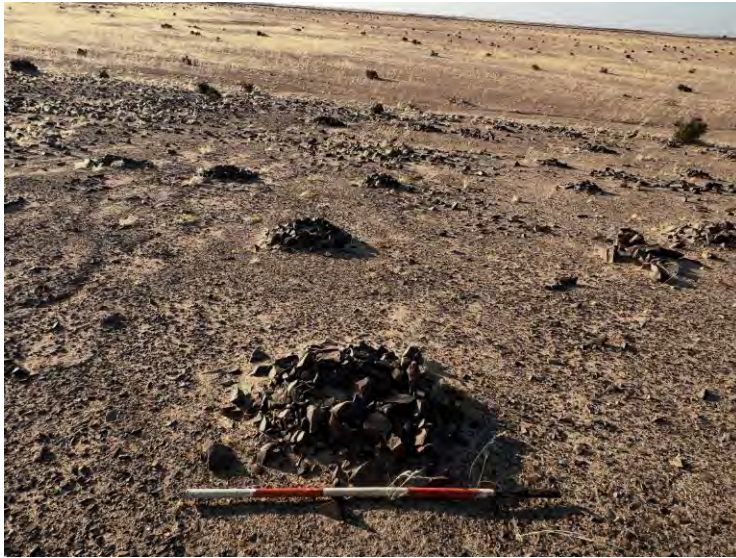


Figure 16 - Stones that were likely gathered, collected and crushed as ballast stones for railway line in the foreground of the top image

5.8.13 BURIAL CAIRNS LOCATED ALONG THE FINAL PROPOSED ROUTE

Potential burial cairns were observed in four (4) different sites (Figure 17).

- Site 1 (Site 14 on map): burial cairns were identified featured structures composed of loose diabase fragments arranged in roughly circular patterns, with diameters ranging from 1.2 to 1.6 meters;
- Site 2 (Site 15 on map): contained cairns of similar morphology, constructed from medium-sized loose diabase stones, also arranged in roughly circular formations, with diameters between 1.4 and 1.7 meters;
- Site 3 (Site 16 on map): recorded during this field campaign and differed from the previous ones by the use of small, loose quartzite fragments arranged in a near-perfect circular form, measuring between 1.3 and 1.5 meters in diameter;
- Site 4 (Site 17 on map): burial cairn was also documented during this campaign. It consisted of diabase fragments arranged in a roughly elliptical shape, with dimensions ranging from 0.8 to 1.6 meters in diameter.



Figure 17 - A potential burial cairn and associated tool at site 14

5.8.14 ROCK ENGRAVING SITE AMONG ONE OF THE SMALL TRIBUTARIES ON THE SOUTH SIDE OF THE SWAKOP RIVER CROSSING

A rock engraving site was identified on the diabase ridge, in the vicinity of the Richthofen in Naukluft National Park. The engravings are housed on an upright panel facing up but with little patina, making it difficult to see for an untrained eye as shown Figure 18. All the figures are quite large in morphology, measuring between 20 cm x 1.4 m, and have been executed in light pecking and abrasion.



Figure 18 - Above image shows the engraved fish on a poor surface and the bottom image show a poorly visible linear figure

5.9 BUILT ENVIRONMENT BASELINE

5.9.1 TRAFFIC AND TRANSPORT

The traffic baseline study for the Project was conducted by Zutari Namibia (Pty) Ltd (herein referred to as “Zutari”) (Appendix H), presenting road access infrastructure and traffic conditions along the proposed ammonia pipeline route. The proposed route is planned to traverse from a proposed ammonia production plant in Arandis, past the proposed ammonia plant at Farm 58 in the Walvis Bay district, to the proposed ammonia terminal at North Port, Walvis Bay. The baseline assessment covers existing road conditions, planned intersection upgrades, sight distance compliance, and traffic volume analysis.

5.9.1.1 Stakeholder access and connectivity

The road network within the study area comprises of the B2, C28 and D1984 roads and provides essential access to a wide range of stakeholders and land uses, including:

- Residential homesteads near Walvis Bay, Swakopmund and Arandis;
- Mining operations: Trekkopje Mine, Rössing Mine, and Husab Mine;
- NamWater pump stations supply water and pipelines to the mines;
- Tourist destinations, including Goanikontes Oasis and scenic viewpoints;
- Agricultural plots and farmsteads near Swakopmund;
- Dorob National Park; and
- Goanikontes Oasis is accessed via the B2 and C28 roads.

5.9.1.2 Alternative access routes from the ammonia production plant in Arandis to the ammonia plant on Farm 58

Route from ammonia production plant to B2 main road intersection

The intersection providing access from Arandis to the B2 is a high-traffic (Figure 19), bitumen-surfaced junction designed to accommodate vehicle volumes from Rössing Uranium Mine, Trekkopje Uranium Mine and the town of Arandis (Figure 20). Sight distances at the intersection are adequate, with no safety concerns identified. The layout supports heavy vehicle turning movements and the road surface is in good condition. As such, no upgrades to the existing infrastructure are deemed necessary.



Figure 19 -Potential route of the proposed ammonia pipeline from the proposed ammonia production plant to the B2 road (Source: Zutari, 2024)





Figure 20 - Access from main road (B2) to Arandis (Source: Zutari, 2024)

Gravel road from the ammonia production plant through the Trekkopje mine road towards the B2 main road

Access from the proposed ammonia production plant to the B2 road can be facilitated via the existing Trekkopje gravel road, which currently supports heavy vehicle movements associated with Trekkopje Mine operations. The route transitions from gravel to a bitumen-surfaced intersection at the B2, which is designed to accommodate high traffic volumes, including heavy vehicles (Figure 21).

Sight distances at the intersection are adequate and no safety concerns have been identified. The existing road surface is in good condition, and no upgrades are deemed necessary. Subject to approval, a portion of Trekkopje Mine's access road beyond its main gate may be utilised to link the plant to the B2 Road. However, a short new access road and intersection will need to be constructed to complete the connection from the production plant.





Figure 21 - Access from the proposed ammonia production plant, through (gravel road) through Trekkopje site access road (Source: Zutari, 2024)

5.9.1.3 Inventory and condition of the intersections

A total of 15 intersections were identified (Figure 22):

- 12 along the B2 road;
- 2 along the C28 road; and
- 1 along the D1984 road.



Figure 22 - Identified intersections along B2 and C28 roads (Source: Zutari, 2024)

Major intersections

Major intersections include B2-3, B2-10, B2-11, B2-12. These intersections provide primary access to high-volume areas such as the mines, Swakopmund residential zones and the Walvis Bay Harbour. All were found to be in excellent condition, with no structural defects observed. They are designed to support heavy vehicle movement and are capable of accommodating the projected increase in traffic associated with the proposed ammonia pipeline Project.

Minor intersections

Minor intersections include B2-1, B2-2, B2-4, B2-5, B2-6, B2-7, B2-8 and B2-9. These intersections serve local stakeholders such as farmsteads and tourist destinations. These were generally in good to fair condition, with minor surface defects including edge breaks, potholes and rutting noted in selected locations. While usage of these intersections is currently low, a few may be suitable for use during the construction and operational phases of the project.

5.9.1.4 Slight distance and safety consideration

Sight distance assessments were conducted at all existing access points and intersections. The majority were found to have ample sight distance in both directions, ensuring safe vehicle operations and adequate stopping distances. However, the Goanikontes Oasis intersection on the B2 road was identified as a potential safety concern due to limited sight distance in both directions. This could reduce driver reaction time and increase the risk of accidents in the event of an unexpected obstruction.

5.9.1.5 *Potential access points for pipeline construction*

Three existing intersections were identified as suitable access points for the ammonia pipeline north of the B2 main road. These include:

- B2-5 – Railway Access
- B2-7 – Namib Lead and Zinc
- B2-9 – Swakopmund Quarry

Each of these intersections is equipped with existing railway crossings and has sufficient sight distance in both directions, making them safe and practical for use during the construction and operational phases. The presence of existing railway infrastructure also offers a cost advantage.

A gravel road could be constructed to connect these access points directly to the ammonia pipeline route. Leveraging the existing infrastructure will minimise the need for additional crossings and reduce overall development costs

5.9.1.6 *Road conditions and ongoing maintenance*

B2 Road (Swakopmund – Arandis Section)

The 60 km sealed bitumen section between Swakopmund and Arandis is a high-traffic corridor and is generally in a good condition. Isolated minor defects were observed, including:

- Visual edge breaks;
- Rutting near intersections;
- Small potholes; and
- Surface cracks.

Regular maintenance is evident, with a Roads Authority of Namibia team observed performing edge break repairs during the site investigation. The team indicated that pothole and crack repairs are scheduled for completion within the next year (Figure 23). While long-term plans to widen the B2 Road are in place, budget constraints may delay implementation.



Figure 23 - Photos taken on section of the B12 Road (cracks and potholes) (Source: Zutari, 2024)

D1987 – C28 Connection (13 km segment)

This section consists of the following (Figure 24 and Figure 25):

- 8 km of salt gravel road; and
- 5 km of low volume sealed surfaced road.

The sealed section was upgraded by the Roads Authority to accommodate increased traffic from the Langer-Heinrich Mine, which uses the C28 corridor. Overall, the road is in good condition, though the salt-gravel portion exhibits the following minor defects:

- Small potholes; and
- Damaged wearing course.

Additional maintenance is required on the gravel section to maintain safe and efficient access. There are also ongoing discussions within the Roads Authority regarding the potential upgrading of the initial 8 km of gravel road to better accommodate mining related traffic.

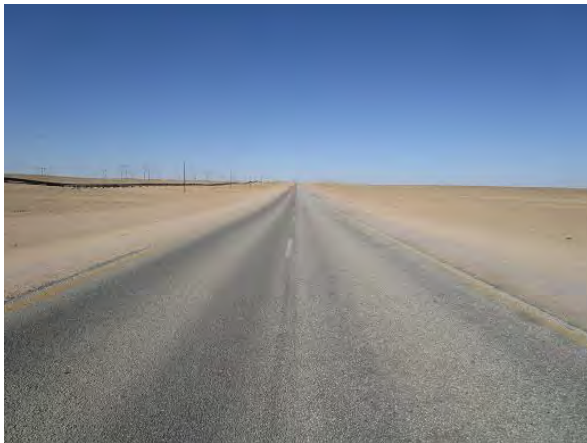


Figure 24 - Photos taken on a section of the C28 Road (Source: Zutari, 2024)



Figure 25 - An intersection-section of the D1987 road (Source: Zutari, 2024)

5.9.1.7 *Terrain conditions, sight distance and proximity to existing infrastructure at possible road crossings for the pipeline*

The proposed ammonia pipeline will intersect several existing roads and infrastructure corridors between Swakopmund and Arandis, including the B2 and C28 roads. These crossings vary in terrain conditions, sight distance and proximity to existing infrastructure such as water pipelines, powerlines, fibre optic cables and railway lines. In many locations, the road elevation is lower than the surrounding natural ground level, such as the Swakopmund – Arandis crossing shown in Figure 26, which may make trenching beneath the road technically challenging and, in some cases, infeasible without significant earthworks.



Figure 26 - B2 Main Road crossing between Swakopmund and Arandis (Source: Zutari, 2024)

While no alternative crossing structures, such as culverts or bridges, exist at most sites, the relatively flat surrounding landscape allows flexibility in realigning the pipeline to more suitable crossing points. Most of the proposed crossing locations; Swakopmund – Arandis, Swakopmund intersection shown in Figure 27, Swakopmund River bridge, Green Hydrogen Demonstration Plant (GHDP) shown in Figure 28, Dorob Pipeline Route shown in Figure 29 and the Naukluft Pipeline Route shown in Figure 30, provide adequate sight distance in both directions, supporting safe access during the construction and operational phases. However, locations such as the Naukluft route shown in and the Goanikontes Oasis intersection pose potential safety risks due to limited visibility and blind crests. Where feasible, it is recommended that existing infrastructure such as the Swakopmund River bridge and constructed railway crossings, be used to minimise traffic disruption, reduce construction costs and ensure compliance with road safety standards.



Figure 27 - B2 Main Road crossing at Swakopmund intersection (Source: Zutari, 2024)



Figure 28 - D1987 road crossing at the Green Hydrogen Demonstration Plant (Source: Zutari, 2024)



Figure 29 - C28 road crossing, Dorob ammonia pipeline route option (Source: Zutari, 2024)



Figure 30 - C28 Road crossing, Naukluft ammonia route option (Source: Zutari, 2024)

5.9.1.8 *Alternative routes from the proposed ammonia pipeline from the ammonia plant on Farm 58, Walvis Bay district to the Ammonia Terminal at the North Port, Walvis Bay*

The D1984 and B2 roads offer the most viable entry routes for construction and operational logistics, with supporting infrastructure already in place or planned for enhancement for the proposed ammonia pipeline coming from the ammonia plant on Farm 58, (Figure 31).

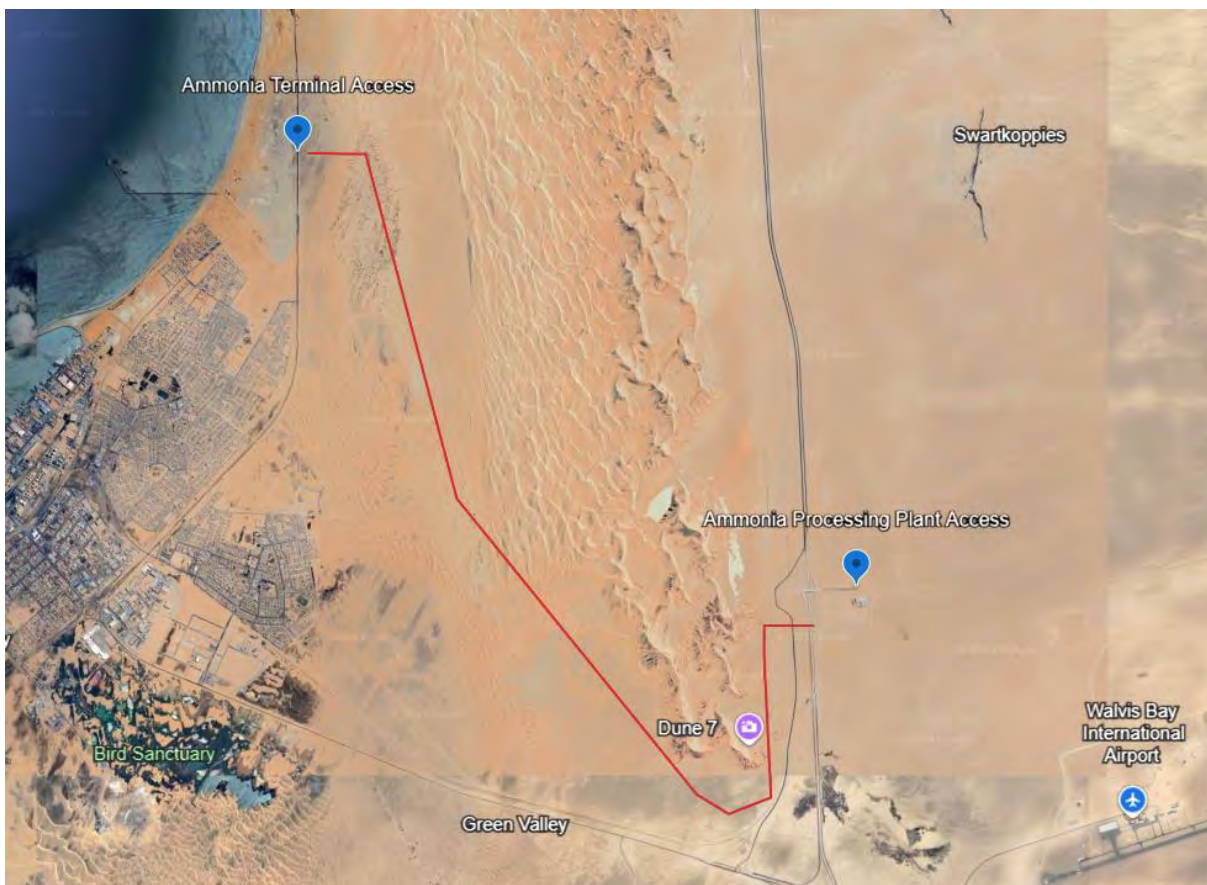


Figure 31 - Potential access from B2 main road and D1984 road

Primary access route via D1984

The D1984 road serves as the most direct access route from the Green Hydrogen Demonstration Plant (GHDP) (Farm 58) to the ammonia terminal for the ammonia pipeline to pass. This road connects seamlessly with Walvis Bay Harbour and features a newly constructed bridge and several major intersections designed to accommodate high traffic volumes (Figure 32). Sight distance assessments confirm that visibility at key junctions is sufficient to ensure the safe movement of heavy vehicles and construction traffic. The road surface is in excellent condition due to recent upgrades, and the vertical and horizontal alignments meet design standards for the required operating speeds.

Notably, the D1984 has been upgraded to a dual carriageway to accommodate anticipated traffic growth from the port and industrial developments. Approximately 65% of the average daily traffic (ADT) on this road consists of heavy vehicles, confirming its suitability for freight and industrial access.



Figure 32 - Access from D1984 road to the GHDP (Source: Zutari, 2024)

5.9.1.9 *Alternative access via M36 road from the ammonia plant on Farm 58 to the ammonia terminal (B2 main road) at the Walvis Bay North Port*

An alternative route is available via the B2 main road, a 35 km sealed bitumen road between Swakopmund and Walvis Bay (Figure 33). This road experiences high traffic volumes and provides access to residential areas such as Long Beach, Dolphin Beach, and Afrodite Beach. It remains in good condition, with only minor surface defects observed (e.g., isolated edge breaks, minor rutting, small potholes, and surface cracks).

To accommodate safe access from the ammonia terminal, a new intersection would have to be constructed along the B2. However, sight distance evaluations at the current proposed location confirm compliance with safety standards. Given current traffic volumes and conditions, no additional upgrades beyond the new intersection are deemed necessary.

Although the B2 includes multiple major intersections, which are used heavily by residential traffic, these intersections are not suitable for providing construction access to the ammonia pipeline during development phases due to traffic volumes constraints and safety considerations.



Figure 33 - Potential access from B2 main road to the ammonia terminal (Source: Zutari, 2024)

Field observations and assessments revealed the following surface defects along the B2 main Road, shown in Figure 34:

- Isolated edge breaks;
- Minor rutting near intersections;
- Small potholes; and
- Surface cracking.

These defects are minor and do not impact the operational integrity of the road. Intersections along the B2 are generally in good condition, though not suitable for construction access due to congestion and traffic safety constraints.



Figure 34 - Photos taken on a section of the B2 road (cracks and potholes) (Source: Zutari, 2024)

5.9.1.10 Traffic volumes and composition

Traffic data was obtained from the Roads Authority of Namibia and supplemented by moving traffic counts. Permanent and estimated traffic data points are shown in Table 14. RA Station 021 – B2 Main Road (Swakopmund to Arandis, 364 days, 2023)

- RA Station 253 – B2 Main road (302 days, 2023)
- Estimated Traffic – D1991 Road at B2 intersection (based on 2021 data)

Table 14 - Average daily traffic volumes per link

Description	ADT Light	ADT Heavy	ADT Total
B2 Road			
RA Station 21 (2023) Swakopmund to Arandis	2 339	951	3 290
RA Station 253 (2023) – Arandis to Usakos	1 766	1 766	1 766
Moving Traffic Count – Swakopmund to Walvis Bay	3 480	3 480	3 480
D1991			
Estimated Traffic B2 Intersection (2021)	38	38	38
D1984			
Moving Traffic Count	420	420	420

The following ADT breakdown by heavy vehicle percentage is presented in Table 15.

Table 15 - ADT breakdown by heavy vehicles percentage

Road Section	Heavy vehicle % ADT
B2: Swakopmund to Arandis	29%

B2: Arandis to Usakos	32%
B2: Swakopmund to Walvis Bay	4.5%
D1991 at B2 Intersection (estimated)	48%
D1984: Swakopmund to Walvis Bay	65%

The D1984 road experiences significantly higher heavy vehicle volumes than the B2 between Swakopmund and Walvis Bay (Figure 35). This is attributed to a restriction on heavy vehicles imposed by the Roads Authority on the B2 segment, diverting freight traffic to the D1984 corridor.



Figure 35 - Photo taken on a section of the D1984 road (Source: Zutari, 2024)

5.9.1.11 Safety and sight distance compliance

All existing and proposed intersections and access points were reviewed to assess compliance with minimum sight distance standards. The evaluation confirmed that stopping distances at the design speed are adequate, providing sufficient reaction time for drivers to detect and avoid potential obstacles. Sight distances in both directions at all access points were found to be acceptable for safe vehicle movement, including heavy construction traffic.

5.9.1.12 Traffic and transport baseline summary

Based on the road condition, sight distance analysis and traffic data, the D1984 road is recommended as the primary access route for the proposed ammonia pipeline route. It offers superior road conditions, higher heavy vehicle capacity, and fewer conflicts with residential and commuter traffic. The B2 road can serve as a secondary route, with minor intersection enhancements required to accommodate safe access. Overall, the existing road infrastructure is adequate to support the proposed development with minimal additional upgrades.

5.10 LAND USE

The proposed ammonia pipeline will be located between Arandis and the Walvis Bay north port area, defined by Namibia Ports Authority (NamPort), to connect the ammonia production

plant to the ammonia terminal for storage. The Port of Walvis Bay is located along the central western coast of Namibia with access to principal shipping routes. The Walvis Bay port consists of different facilities such as a container terminal, privately operated bulk cargo terminal and tugboats. The area is a highly disturbed and is continuously expanding with the north port earmarked for further development, according to the Walvis Bay Town Masterplan (Walvis Bay Municipality, 2024). The ammonia pipeline will be constructed from the ammonia production plant and its associated solar plant situated along Trekoppje road, outside of Arandis. However, the proposed ammonia plant does not fall within the scope of this ESIA process and will be conducted separately.

The proposed pipeline route transverses the Dörob National Park and the Namib-Nauklüft National Park. The Dörob National Park was proclaimed in 2010 and covers the central Namib desert to protect the fragile coastal and desert ecosystems. 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 Namib-Nauklüft National Park is an ecologically protected area and was proclaimed in August 1979 to conserve part of the Namib Desert. In 1979, the Park was identified as the largest protected area in Namibia, with an area of 49 800 km² (info namibia, 2025). The Park includes the Namib Desert, Nauklüft Mountains, Sandwich Harbour, Sossusvlei, Dead Vlei and Sesriem.

Figure 36 provides a visual representation of the proposed green ammonia pipeline route in proportion to surrounding local and national conservation areas.

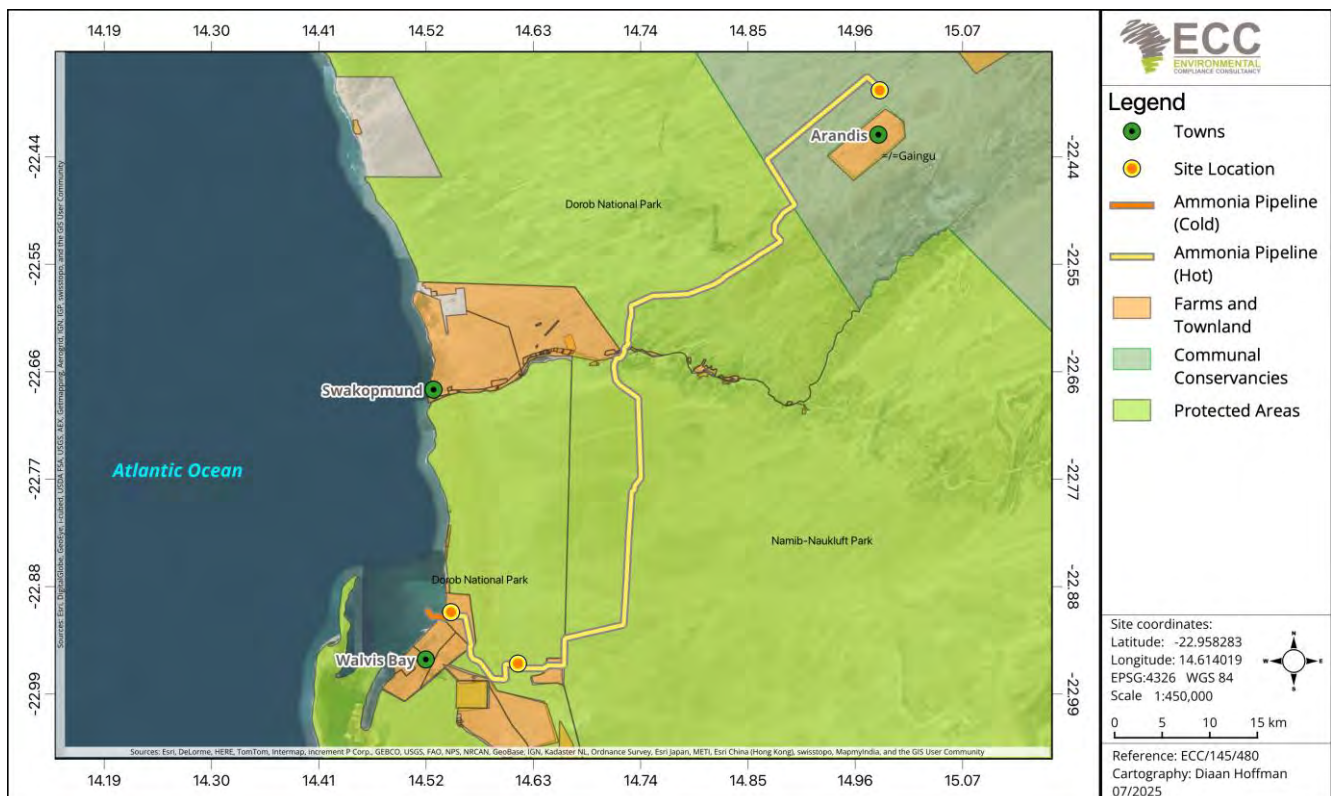


Figure 36 - Stakeholder map of the surrounding local and national conservations areas

5.11 CLIMATE

Climate and weather data from Meteoblue (2024), along with desktop QGIS data for the Erongo Region, was used for climate data for the Project area due to the vast length of the ammonia pipeline. The proposed Project site falls under the Köppen climate classification BWh coastal (cold desert climate) and inland (hot desert or semi-arid climate). Given this climatological condition, the area experiences primarily arid to semi-arid conditions, with minimal fluctuations in temperatures and rainfall distributed sporadically throughout the year. Most of the ~80 900 km² 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).

5.11.1 TEMPERATURE

In the Erongo Region, summer months (December to February) are characterised by warm temperatures with an average maximum temperature of 30°C and average minimum temperature of 17°C (Figure 37). The warmest months are generally between October and March while the coldest months with minimum temperatures reaching 11°C span from June to August. The overall annual temperatures are stable and steady.

5.11.2 WIND

During the winter months, the coastal towns (i.e. Swakopmund, Henties Bay and Walvis Bay) experience fiery blasts of strong, hot air that are referred to as east winds. These strong winds from the eastern direction descend over the great escarpment, get picked up and carried with sand particles towards to coast and over and into the Atlantic Ocean (Atlas of Namibia Team, 2022). Wind speed in Arandis tend to be higher during colder months, i.e. June to August. The average wind speeds in the general Erongo Region are between 10 - 20 km/h, with dominant east-northeast winds (ENE), followed closely by southwest (SW) (Figure 38).

5.12 RAINFALL AND EVAPORATION

The area is located within the Desert biome that is predominated by erratic rainfall patterns and receives on average annual rainfall of <20 mm. The surface and hydrogeology impact assessment undertaken for the hydrogen pilot plant at Farm 58 (located in the vicinity of a section of the ammonia pipeline) 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 1960 mm per year (Mendelsohn, Jarvis, Roberts, & Robertson, 2002).

5.13 SOLAR RADIATION AND HUMIDITY

The annual average solar radiation is between 5.4 to 5.8 kWh/m²/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 equates to more than 125 days, the highest number compared to the inland and eastern regions of Namibia (Mendelsohn, Jarvis, Roberts, & Robertson, 2002). The majority

of days in the summer months are partly cloudy, whereas in winter, there are more sunny days, as shown in Figure 39. The months with the highest humidity, have relative humidity (RH) of >80%, while the driest months have a humidity between 30 and 50% RH.

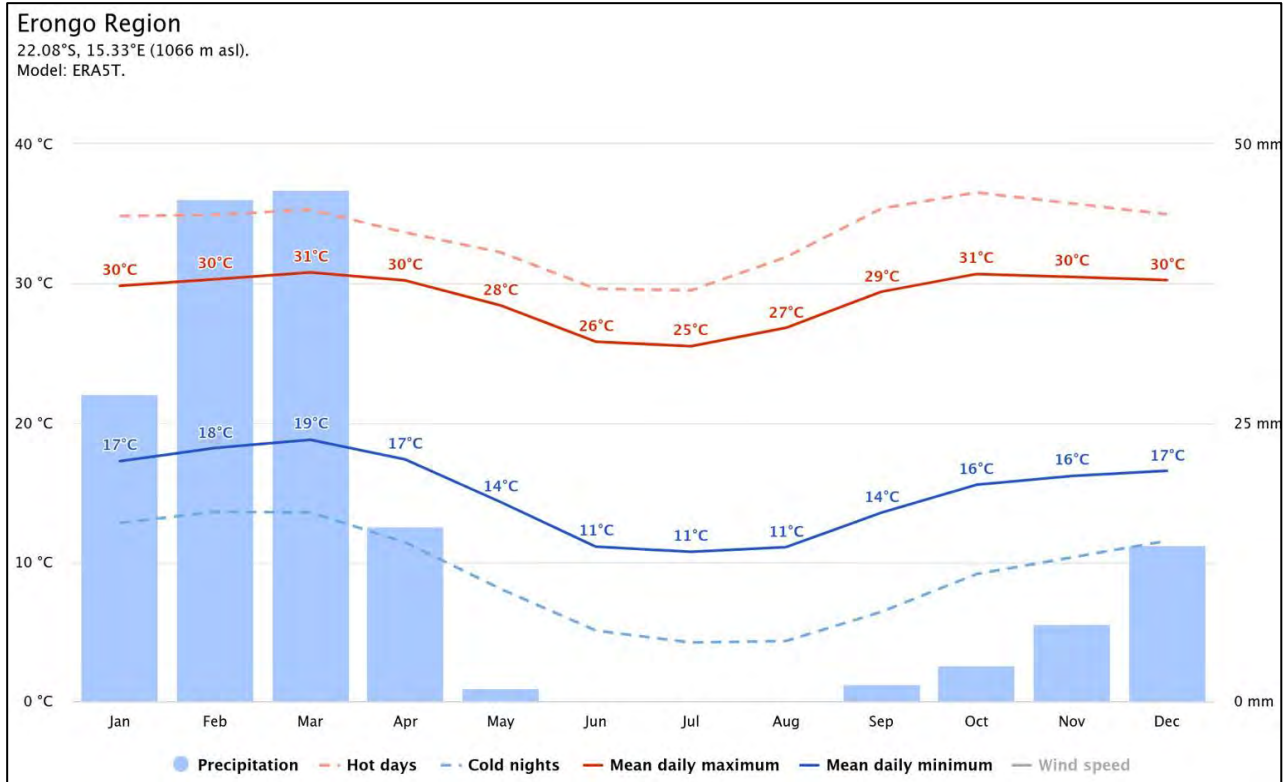


Figure 37 – Annual average temperature and precipitation in the Erongo Region (Meteobblue, 2024)

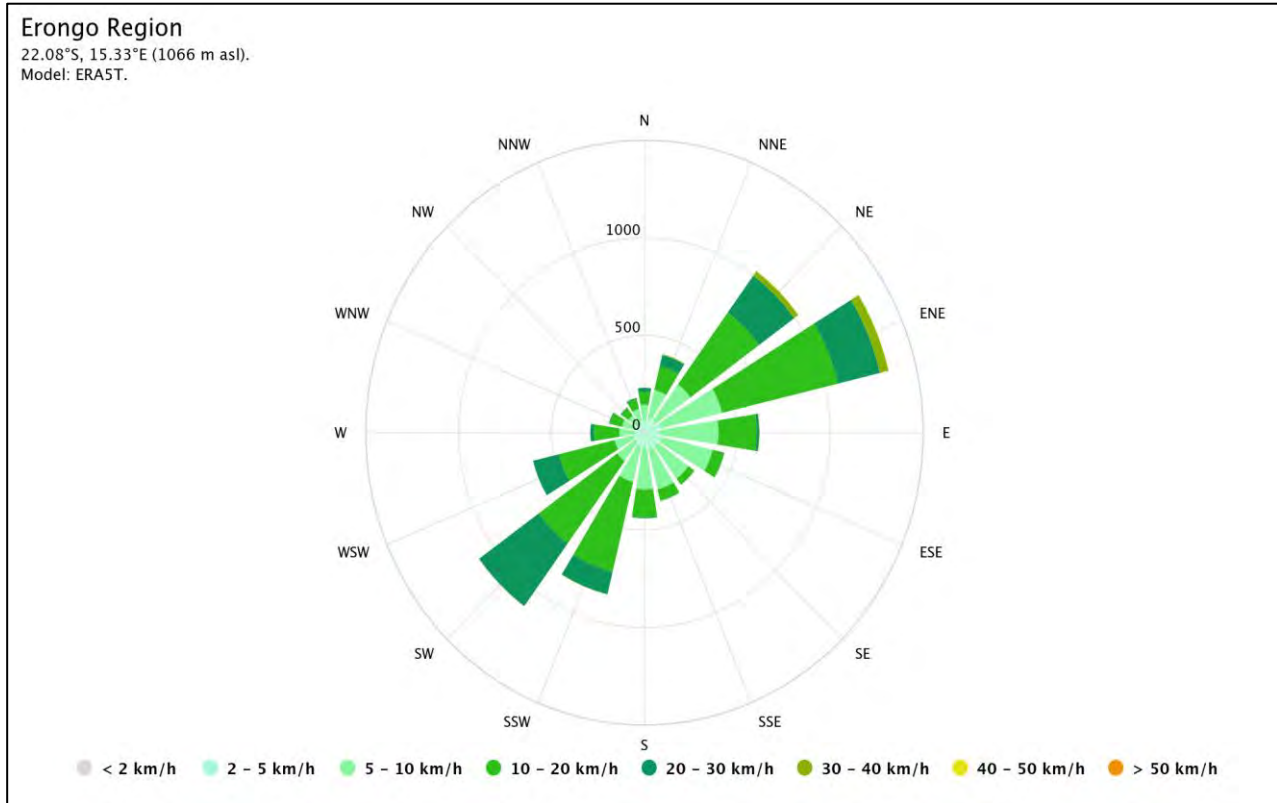


Figure 38 - Annual average wind speed and direction in the Erongo Region (Meteoblue, 2024)

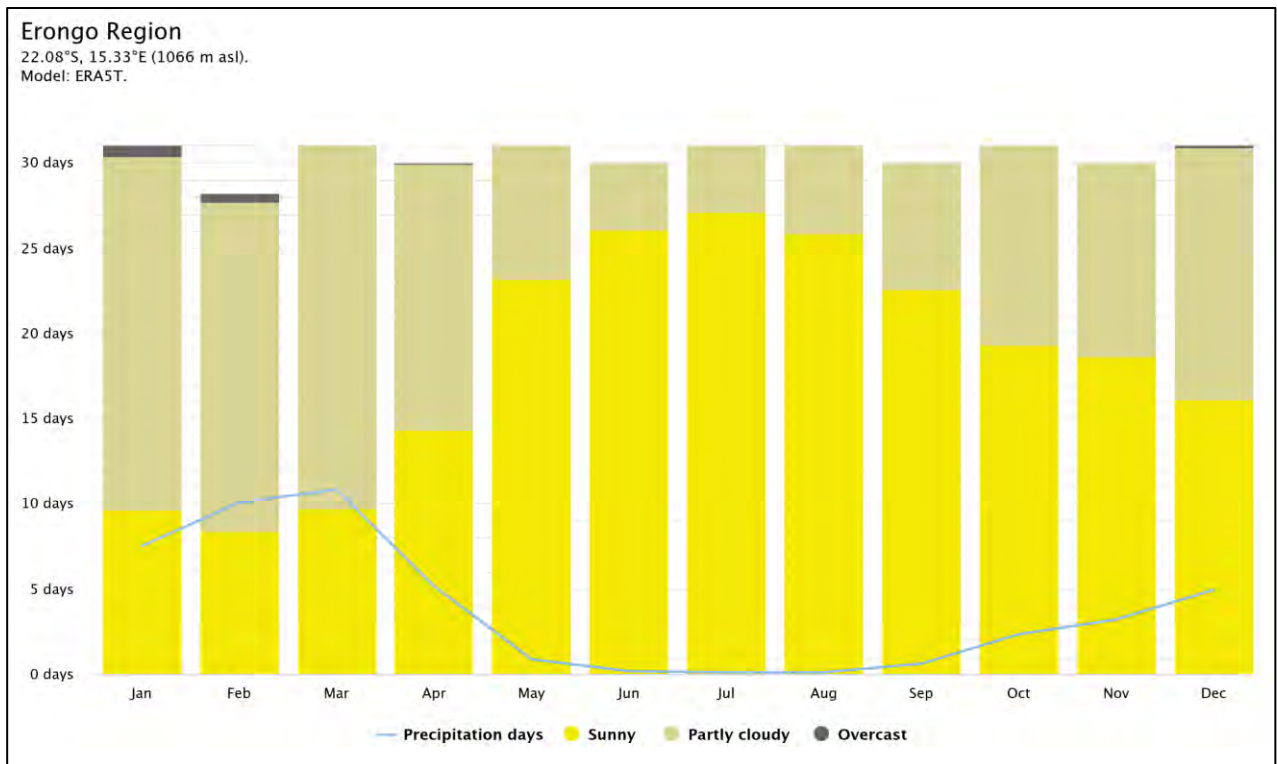


Figure 39 - Annual cloud cover in the Erongo Region (Meteoblue, 2024)

5.14 CLIMATE CHANGE

A climate change impact assessment was conducted by RDJ consulting, with a revised report provided in November 2025. This section is based on the climate change assessment report (Appendix I).

Carbon accounting refers to the systematic process of measuring, calculating, analysing, and reporting an organization's greenhouse gas (GHG) emissions in a way that ensures compliance with relevant environmental regulations, supports sustainability goals, and provides transparency to stakeholders. The primary goal of carbon accounting is to quantify the GHG emissions produced by both private and public organizations. By doing so, it enables these entities to determine the volume of carbon emissions generated across their operations. In addition to quantifying emissions, carbon accounting identifies specific operational areas responsible for generating those emissions, thus allowing for more targeted mitigation strategies (RDJ Consulting, 2025).

The Methodology of the climate change assessment report is based on GHG Protocol. Emission factors and calculation approaches come from various databases and national sources. The GHG Protocol provides standards and guidance for companies to voluntarily calculate and report on their GHG emissions. A specific Global Warming Potential (GWP) is applied to GHGs other than CO₂ to account for their higher warming effect, and the result is known as carbon dioxide equivalent (CO₂e). A GWP is a measure of how much energy the emissions of 1 tonne of a gas will absorb over a given period, relative to the emissions of 1 tonne of CO₂.

The Equator Principles require an alternative analysis to be conducted when there is an “expectation” that CO₂e emissions will exceed 100,000 tonnes of CO₂e per annum during any stage of the Project. This will include both Scope 1 and Scope 2. The IFC started their Performance Standards in 2006 and have since updated so that projects with “significant emissions” that are expected to or currently produce more than 100,000 tonnes of CO₂-equivalent annually, the client will quantify direct emissions from the facilities owned or controlled within the physical project boundary, as well as indirect emissions associated with the off-site production of energy used by the project. However, PS3 states that Clients should “consider alternatives and implement technically and financially feasible and cost-effective options to reduce Project-related GHG emissions during the design and operation of the Project” and for Projects that are expected to produce more than 25,000 tonnes of CO₂-equivalent annually, the Client to quantify “direct emissions from the facilities as well as indirect emissions associated with the off-site production of energy used by the project” (Ramboll, 2023).

Calculated emissions for the Walvis Bay area are estimated at 56 222 tCO₂e. The combined emissions for scope 1, 2 and 3 are estimated at 193.8 tCO₂e (~194 tCO₂e) in year one.

5.15 TOPOGRAPHY AND SOILS

From the inlet of the pipeline near Arandis, the first ~40 km of the pipeline follows an elevation profile decrease from ~590 metres above mean sea level (mamsl) in a south-westerly direction to the crossing of the Swakop River and its flood plain (~140 – 120 mamsl). After crossing the river (~1.2 km traversing the river), the pipeline continues southward with decreasing elevation to Farm 58 and the port at ~70 mamsl and ~5 mamsl, respectively (Figure 40).

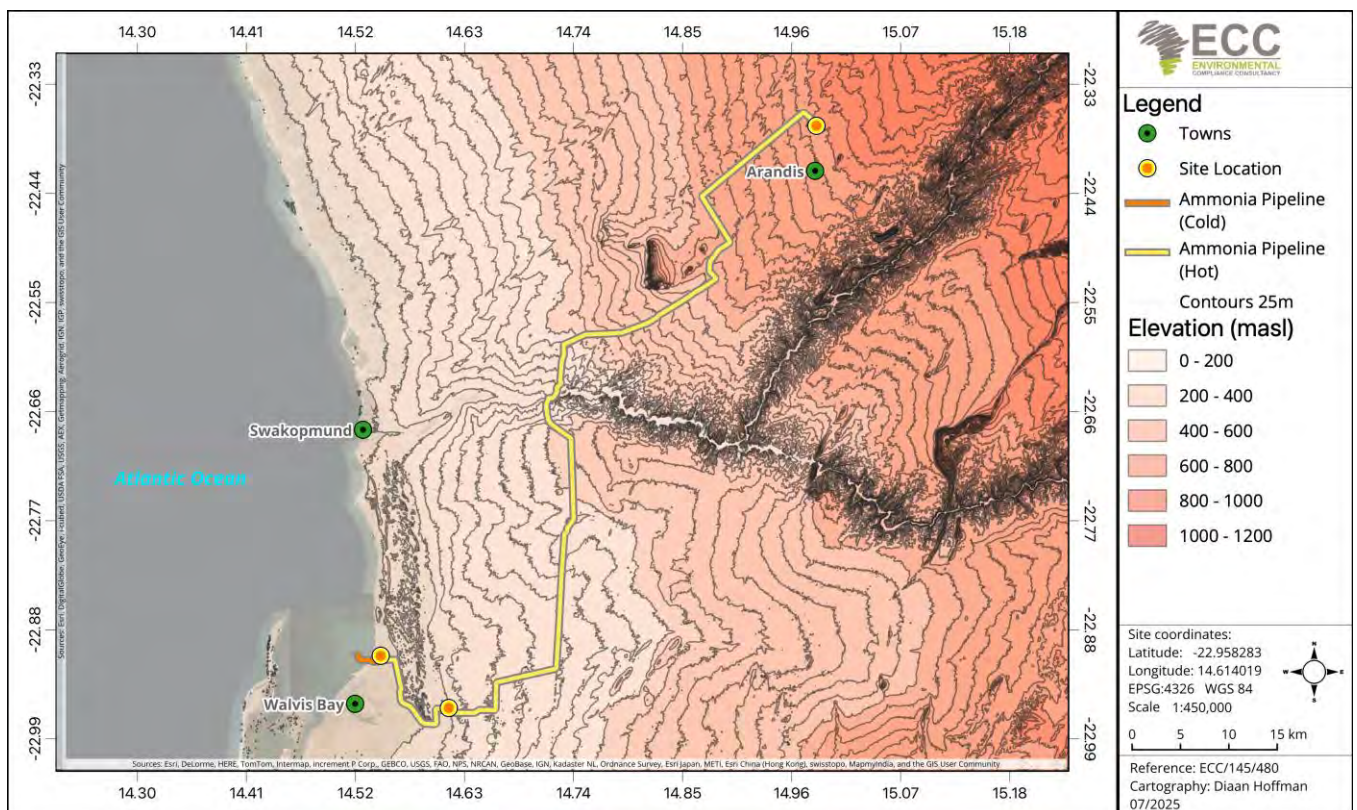


Figure 40 - Topographic map of the area for the proposed ammonia pipeline

The pipeline route traverses the Namib Desert land division, which is widely covered by unconsolidated colluvial material (i.e. calcrete, gypsum). The predominant soil type is classified as Petric Gypsisols (Figure 41). Aeolian gypsiferous deposits are widespread in the region, particularly near Walvis Bay. Petric Gypsisols are a subgroup of Gypsisols, characterised by a dense, hardened gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) accumulation near or at the surface, forming an alkaline petrogypsic horizon. These soils are associated with arid and semi-arid environments, where evaporation exceeds precipitation, allowing for the concentration and precipitation of gypsum in the soil profile. The soils are typically strongly cemented, thus restricting water infiltration, retention and root growth. This is supported by the large unvegetated areas observed in the region. Soil suitability for agricultural use is very limited due to the poor fertility and hardpan nature of the soils. There are however some

agricultural operations located in the Swakop River's dry bed and floodplain, ~10 km downstream of the pipeline crossing (Towers, 2025).

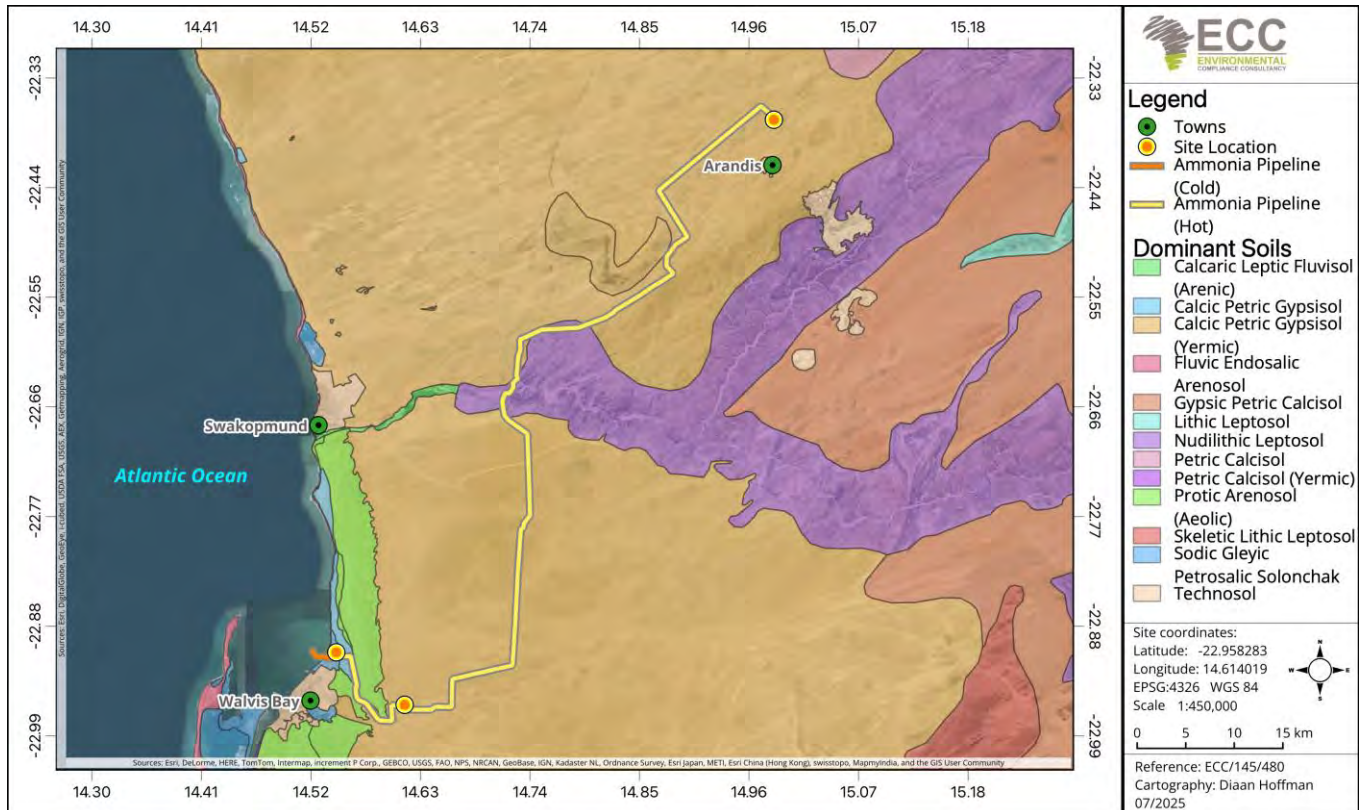


Figure 41 - Dominant soils of the Project area

5.16 HYDROLOGY AND DRAINAGE

A groundwater, soils and surface water impact assessment for the Ammonia Pipeline Project was prepared by Mr. Luke Towers in July 2025, to establish the current surface water and groundwater baseline and evaluate potential contamination impacts in the event of an ammonia leak or spill (Appendix J).

The initial ~15 km of pipeline does not occur in a defined river catchment, with the B2 road roughly aligning with the watershed for this section. The pipeline thereafter crosses into the Swakop River catchment, a short distance north of northern most exit of the D1991 road, as shown in Figure 42. The pipeline crosses the southern watershed near the southern end of the D1991 road, where it continues into an area without a defined catchment that is drained by the ephemeral Tumas River. The westward flowing Swakop River is ephemeral and seldom experiences flow in the southern reaches of the catchment where the pipeline crossing occurs (~20 km from the mouth to the Atlantic Ocean). However, this extent of the river is known to experience periodic flow associated with flash flooding every few years (flow experienced twice in the last ~6 years). The region east of the river crossing is a more incised and steeper sided valley as compared to the west, where it widens and the terrain flattens out into the dune field.

Run-off from rainfall in the areas north and south of the Swakop River catchment (including the area drained by the Tumas River) is expected to be limited and short lived; pooling in localised depressions and low points where evaporation and infiltration occur, especially when terminating into the dunes.

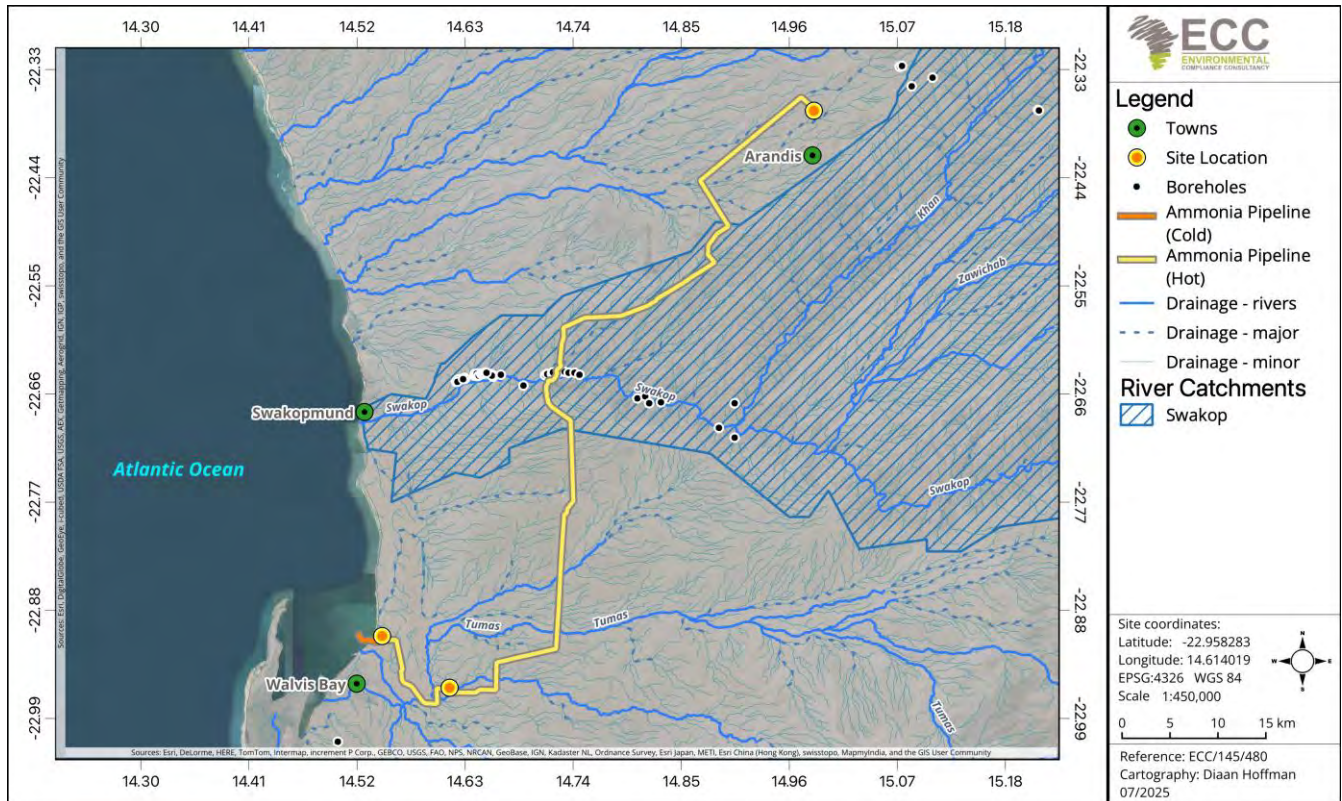


Figure 42 - Hydrology map of the ammonia pipeline project area presenting major ephemral rivers, major and minor drainages and catchment areas

5.17 GEOLOGICAL SETTING

The eastern segment of the pipeline (Arandis to D1991) is predominantly underlain by metasediments of the Damara Supergroup, Swakop Group and syntectonic Red Granites (Figure 43). Lithologies crossed variably include members of the Kuiseb, Karibib, Arandis and Chuos Formations, as well as the Red Granites. The greater portion of the pipeline north of the Swakop River is underlain by the Kuiseb Formation, comprising micaceous schist, minor calc silicates, arkosic quartzites and local marbles (and a portion over the Red Granites). South of the Swakop River and beneath the Quaternary cover, outcrop of the Nosib Group, Khan and Etusis formations as well as Salem Granites, are mapped on the 2214 Walvis Bay sheet. These lithologies vary in composition and are predominantly characterised by calc silicate rocks, mica schists, quartzite and metaconglomerate. The area directly around Walvis Bay comprises dune sands of the Namib Group, Sossus Formation.

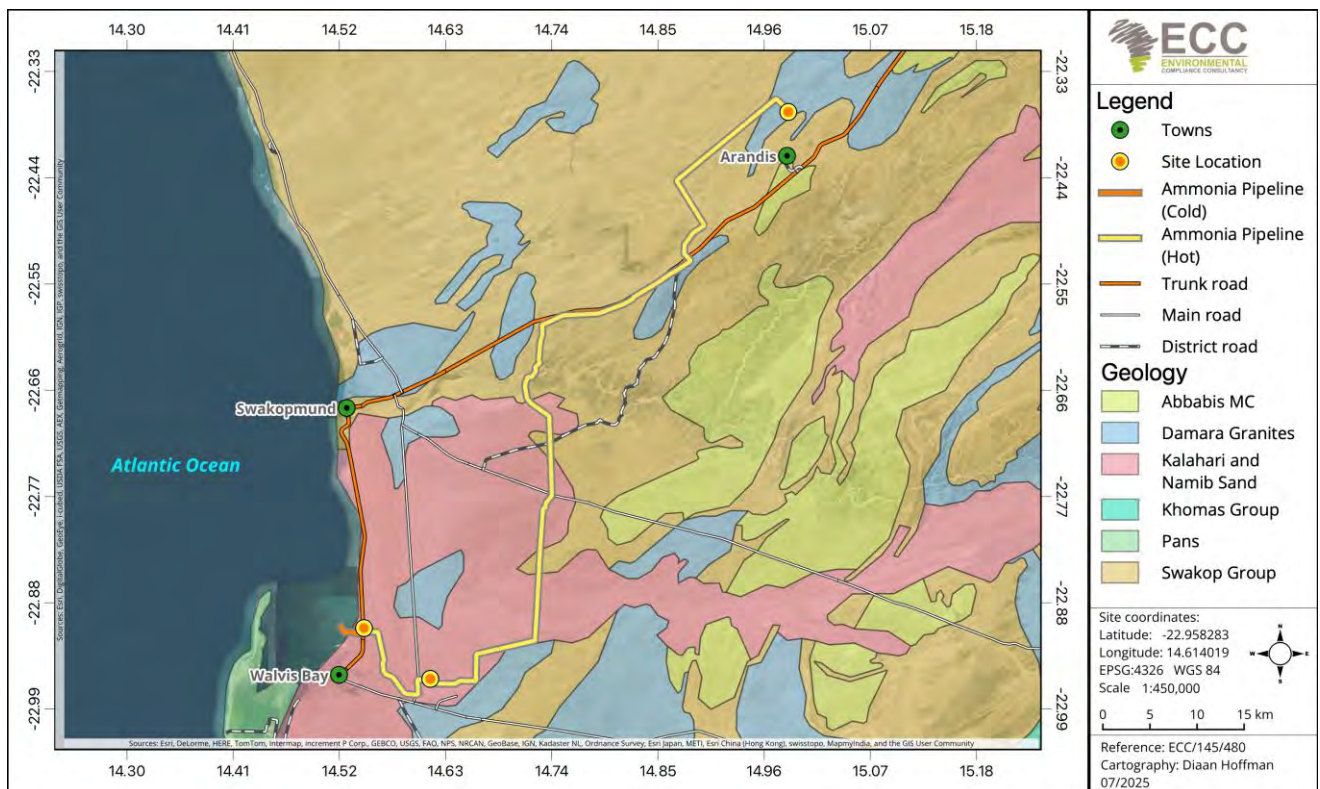


Figure 43 - Geology map of the Project area

5.18 HYDROGEOLOGY

The Namibian Hydrogeological map classifies the area as a region with little or no groundwater potential, as indicated in Figure 44. This is attributed to the predominant geology, as well as the low recharge and poor water quality encountered in the region. The metasediments occurring in the region typically have low groundwater potential and are classified as aquitards, however increased potential may be associated with faults and fractures. Although the schists of this Kuiseb aquitard are folded and faulted, they respond in a ductile manner to stress and therefore have poorly developed secondary porosity, making them less transmissive in terms of groundwater flow. This low transmissivity may be deemed advantageous, as it reduces the risk of groundwater contamination. Similar can be applied to the granites encountered. The alluvial sediments of the Swakop River are however, considered a porous aquifer.

Groundwater quality in the granites and schists is typically poor in this region due to rock-water interactions, low recharge rates, evaporation concentration and long residence times. This reduces the groundwater use potential of the region. Electrical conductivity (EC) values are expected to exceed 1000 mS/m as seen around Arandis.

When considering the porous aquifer associated with the Swakop River alluvium however, the groundwater quality may be improved as compared to the secondary fractured rocks in the region. This is evidenced by ~10 boreholes mapped on the national database occurring ~2 km downstream of the pipeline's river crossing, within the riverbed and >20 some 10 km further

downstream where conductivities are lower but still exceed ~400 mS/m, deeming the water unsuitable for human consumption without prior treatment, but in some instances still sufficient to use for agriculture or livestock watering (e.g. Swakop River plots and small holdings).

It is anticipated that the Quaternary sediments in the area east and north of Walvis Bay are thin with limited groundwater potential, albeit shallow water levels and with poor water quality.

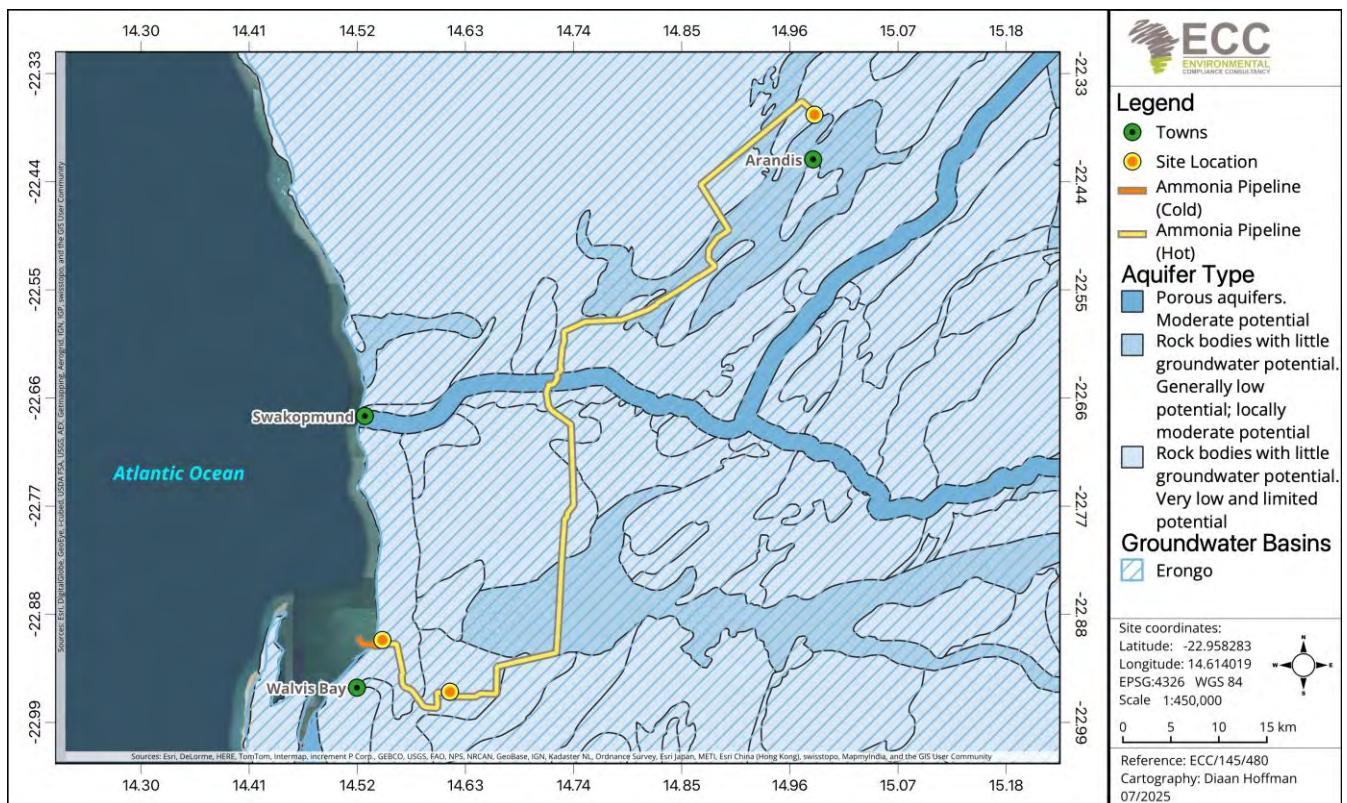


Figure 44 - Hydrogeology map of the Project area

5.19 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 and Central desert area (Figure 45), along the western coast of Namibia. The pipeline route will fall within 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 Nauklüft Park and the adjacent Dörob National Park, together forming a major tourist attraction site in Namibia (Wassenaar, et al., 2013). The environment surrounding the proposed Pipeline towards the eastern direction consist of vast open spaces, rocky terrain and limited vegetation.

A biophysical assessment focusing on the biodiversity of vertebrate fauna and flora within the ammonia pipeline Project area and its broader region was carried out by Dr. Peter Cunningham in 2024, with an update completed in July 2025 (Appendix K). According to Cunningham (2024) the general area is regarded as “relatively low” in all terrestrial species diversity, however terrestrial endemism in the area on the other hand is “moderate to high”.

5.19.1 GENERAL BIOME CHARACTERISTICS AND FLORA

Despite the arid and unfavourable climatic conditions of the Project route, the Namib Desert’s biotic communities are extraordinarily appealing and unique (Wassenaar, et al., 2013). The dominant structure around the site area is grassland and dwarf shrublands. The plant diversity is characterised as extremely low with less than 50 species. The plant endemism rate is low with ~2 to 9 species. Tree cover is extremely low, and the dominant vegetation observed 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 sub-shrub with bright yellow flowers and is classified as near-endemic to Namibia. The vegetation cover in the Project area is shown in Figure 45.

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 and thus a 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.

Three (3) vegetation types that were encountered for the pipeline route:

- Southern Namib;
- Central Namib; and
- Semi-desert and Savannah Transition Zone (Escarpment area)

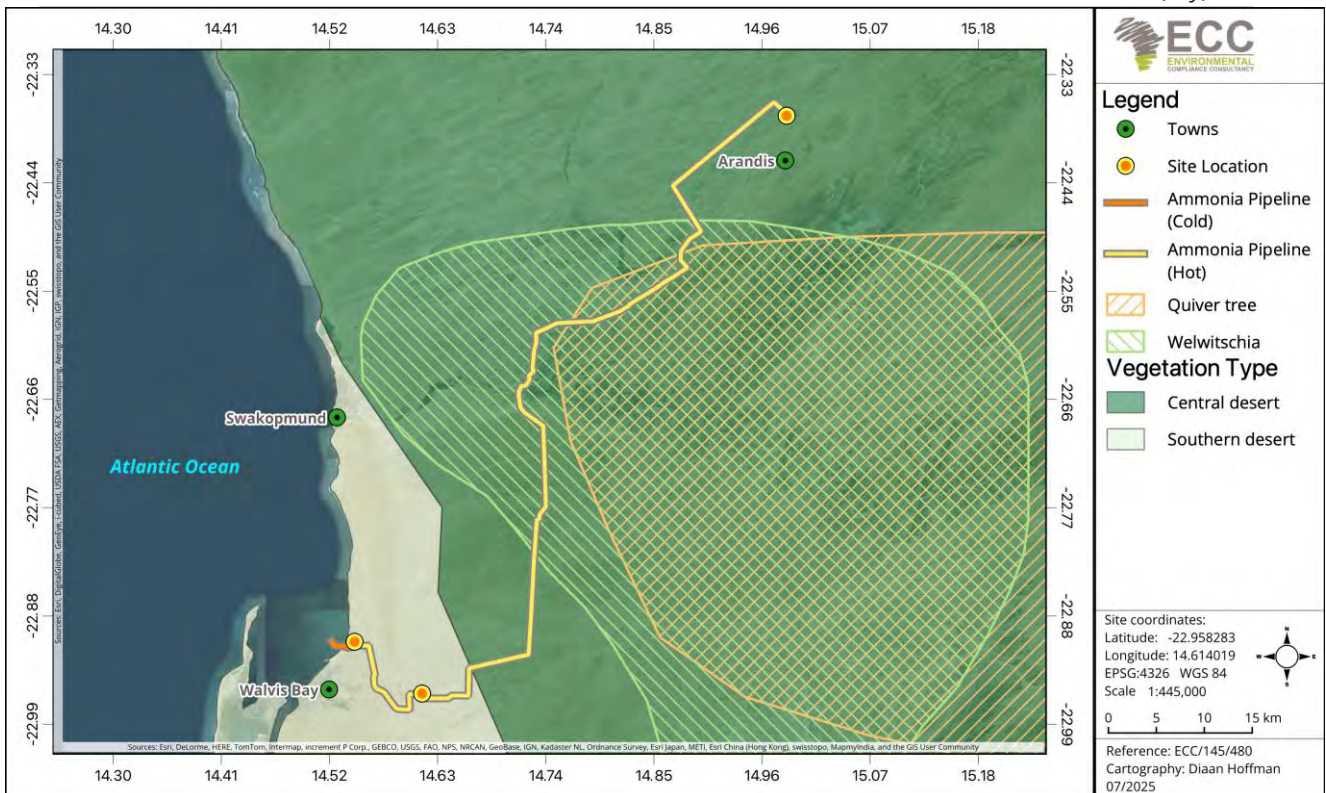


Figure 45 - Vegetation cover map of the Project area

5.19.1.1 Larger trees and shrubs

During the rapid assessment, a total of 22 species were identified with three (3) species classified as endemic (*Arthraerua leubnitziae*, *Commiphora saxicola*, *Zygophyllum stapffii*); 6 species are protected by the Forest Act No. 12 of 2001 (*Acacia erioloba*, *Commiphora saxicola*, *Euclea pseudebenus*, *Faidherbia albida*, *Tamarix usneoides*, *Welwitschia mirabilis*), 1 species protected under the Nature Conservation Ordinance No. 4 of 1975 (*Welwitschia mirabilis*) and 2 species listed as CITES Appendix 2 (*Euphorbia virosa*, *Welwitschia mirabilis*) from the Project area (Cunningham, 2024).

5.19.1.2 Grasses

According to Peter Cunningham (2024), the grass in the Erongo Region area is characterised as follows:

- Southern Namib - *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 *Stipagrostis ciliata* after rain.
- Central Namib - the plains along the Central Namib are usually bare, although grasses such as *Sporobolus nebulosus*, *Stipagrostis namibensis*, *Stipagrostis hermannii*, *Stipagrostis hirtigluma* subsp. *hirtigluma*, etc. appear in clumps after localised rains.
- Semi-desert and Savannah Transition Zone (Escarpment area) - the general landscape is characterised by grasses which consists largely of *Stipagrostis* species, e.g., *S. uniplumis*.

During the rapid biodiversity assessment, no grass species were identified following the final proposed pipeline route.

5.19.1.3 *Sensitive/important vegetation and habitats*

1. Ephemeral drainage lines – i.e., Khan, Swakop & Tumas Rivers (and associated tributaries)

The various larger well vegetated ephemeral drainage lines throughout the Project area (i.e., Khan, Swakop & Tumas Rivers) which drains towards the coast, are virtual lifelines for most vertebrate fauna, especially ungulates, small mammals and birds that forage along these vegetated areas. The Swakop River (706 km²) is listed as a biodiversity Red Flag¹ area with important features such as linear oasis, riparian woodland, aquifer recharge, rich wildlife and bird flight paths (Figure 46).



Figure 46 - The Swakop River riparian habitat

¹ Biodiversity red flag indicates a high risk to critical biodiversity or ecologically irreplaceable areas.

2. Dune 7 Development (Farm 58 site)

Important areas include rocky ridges and small vegetated ephemeral drainage lines in the northern/northeastern parts of the site, which is located on a gypsum/sandy gravel plain (Figure 47). These sparsely vegetated, small ephemeral drainage lines and rocky ridges 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.). Unique reptiles such as Reticulated desert lizard and Namib Day Gecko are associated with these habitats, as well as species predating on them (e.g., various snake species).



Figure 47 - Rocky ridges at Farm 58 site

3. 30 km Coastline between Walvis Bay and Swakopmund

The 30 km coastal strip between Walvis Bay and Swakopmund is an Important Bird Area (IBA) (90 km²) 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*) (Figure 48). Although Damara tern potentially could breed on the salt pan (Ammonia Terminal and Ammonia Pipeline 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).



Figure 48 - The barren salt pan area between Swakopmund and Walvis Bay

4. Pipeline Route (including alternative sites)

Important areas that are intersected by the pipeline include the larger well vegetated ephemeral Tumas and Swakop Rivers, inselbergs, rocky ridges/outcrops/hills (especially with white geology favoured by the unique and range restricted *Pedioplanis husabensis*) and vegetated ephemeral drainage lines throughout the area (Figure 49). These areas have a high diversity of species, especially unique and/or protected species. The pipeline section along the the Namib-Nauklüft National Park and close to Arandis is constructed near dolerite ridges and rocky areas as shown in Figure 50 and Figure 51, respectively. The dolerite ridges and rocky habitats are known to support protected/endemic populations of *Aloe asperifolia* (kraal aloe) and *Commiphora saxicola* (rock corkwood) in the general Arandis area.



Figure 49 - Various pipeline routes assessed an associated well vegetated ephemeral Khan River (black dashed arrows); Tumas River (white dashed arrows) and Swakop River (blue dashed arrows); Welwitschia Flats (yellow dotted circle); larger inselbergs and rocky ridges (black dotted oblongs)



Figure 50 - Pipeline section that crosses the Swakop River (green solid line which is a change from previous dashed route) and associated open surface water and bird habitat (blue dotted oblong); dolerite ridges (black arrows) and rocky areas (white dotted oblongs)



Figure 51 - Arandis pipeline section change (new route being the solid blue line) and associated dolerite ridges (black arrows) and rocky areas (black dotted oblongs)

5.19.2 FAUNA

Namibia is internationally recognised for its rich and diverse wildlife. Thousands of species have been identified, each one plays a role in ecological processes that maintain the health, productivity, and beauty of the environment (Atlas of Namibia Team, 2022). Despite its arid conditions, the Namib Desert hosts a remarkably diverse and unique array of terrestrial species (Hofmeyr, 2024). Adaptations like fog collection, water conservation, heat avoidance, and moisture-dependent breeding have enabled animals to occupy ecological niches in this hyper-arid region.

5.19.2.1 Reptiles

The reptile diversity in the Project area is described as low (41 - 50 species), of which snakes make up 10 to 14 of the species and lizards making up majority of the reptile species with ~24 to 31 species. Reptile endemism is highest in western Namibia (~21 species) partly due to the higher diversity of restricted-range species along the escarpment. Thick-toed geckos (genus *Pachydactylus*) alone comprise 23 endemic species in Namibia, many concentrated in the Namib Desert (Atlas of Namibia Team, 2022).

The Namib-Nauklüft National 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 Dörob National Park. Approximately 63 species of reptiles are expected to occur in the Namib-Nauklüft and Dörob National Park(s) area, with 38 species being endemic, i.e., 60.3% endemic. The 63 species expected to occur in the general area consist of at least 19 snakes (2 thread snakes, 1 quill snouted and 16 typical snakes) of which 9 species (47.4%) are endemic, 1 tortoises, 1 terrapin, 19 lizards of which 11 species classified as endemic (57.9% endemic), 1 plated lizard, 1 monitor, 2 agamas, 1 chameleon and 17 geckos of which 15 species classified as endemic (i.e., 88.2% endemic).

Two species expected to occur in the Project area (*Stigmochelys pardalis* and *Varanus albigularis*) are classified as vulnerable and protected game although both, especially *S. pardalis*, most likely only passes through the general area occasionally as a vagrant and not expected to occur permanently in the area due to the overall arid conditions. *Pelomedusa subrufa* is only expected to occur in drainage lines in the area (e.g., Khan, Kuiseb, Swakop and Tumas Rivers and their tributaries) with suitable habitat, i.e., long lasting water holes.

5.19.2.2 Amphibians

Rainfall patterns strongly affect amphibian distribution, given their dependence on water for reproduction and moisture-rich habitats for survival. As a result of the low average rainfall in this area, frogs are quite scarce with 1 - 3 species. The area is underrepresented, with 3 toads and 1 species each for rain, rubber, sand and platanna known and/or expected to occur in the Project area. The dry sandy coastal desert (Namib) and saline coastal areas are poor habitat 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. The ephemeral Tumas River, located between the Kuiseb and Swakop Rivers, flows even more sporadically and is effectively blocked by the high dunes in the area (i.e., east of the dune belt area). Other water bodies in the area (except for leakages associated with various pipelines) are generally saline of nature and not suitable habitat for amphibians.

5.19.2.3 *Mammals*

Namibia has approximately 250 mammal species, representing about 75% of southern Africa's species richness, along with 14 species endemics to Namibia, many localised within the Namib Desert, its transition zones and escarpment areas. However, the overall mammal diversity in the general Project location is low compared to other sections in Namibia with 16 to 30 species (Mendelsohn, Jarvis, Roberts, & Robertson, 2002).

The overall diversity (1 - 2 species) and abundance of large herbivorous mammals is "low" in the general Project area, with oryx and springbok having the highest density of the larger species (Atlas of Namibia Team, 2022). The overall abundance and diversity of large carnivorous mammals is "average" (4 species) in the general area, with brown hyena having the highest density of the larger species (Atlas of Namibia Team, 2022). The overall mammal diversity in the general area is estimated at between 16 - 30 species, with 3 - 4 species being endemic to the area (Mendelsohn, Jarvis, Roberts, & Robertson, 2002). The species richness distribution of endemics is between 3 - 4 species in the general area, while the Namib-Nauklüft National Park has an estimated 80 species in total and the neighbouring Skeleton Coast National Park has at least 87 species of mammals.

At least 55 species of mammals are known and/or expected to occur in the Project area, of which 11 species (20%) are classified as endemic.

5.19.2.4 *Avifauna*

The overall bird diversity is moderate with ~141 to 170 species (residents and migratory birds) (Mendelsohn, Jarvis, Roberts, & Robertson, 2002). However, BirdLife International reports that the Walvis Bay Lagoon, a Ramsar-designated wetland in the Dörob National Park, hosts huge numbers of migratory shorebirds, some 250 000 birds in summer, including Greater and Lesser Flamingos, Chestnut-banded Plovers, Avocets, Stilts, Curlews, Sandpipers, and Kelp Gulls (BirdLife International, 2025).

Important bird areas in the Project area include the Walvis Bay wetland, which is considered the most important coastal wetland in southern Africa and one of the top three in Africa. The coastal wetlands support mainly Palaearctic migrants, often comprising up to 88% of the birds – e.g., up to 1% of the global Chestnut-banded Plover (approximately 2 000 individuals) are expected to occur in the Walvis Bay area. Between 70 000 and 100 000 birds in winter and up to 250 000 in spring are supported by the wetland. The Namib coast is especially 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 black-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 (*Recurvirostra avocetta*), 13.7% of greater flamingo (*Phoenicopterus roseus*) and 10.3% of lesser flamingo (*Phoenicopterus minor*).

Furthermore, up to 200 000 Holarctic shorebirds are supported seasonally along the Namibian coast, belonging largely to 12 annually occurring species, of which 5 species occur in numbers that form a significant proportion of the southern African flyway populations, e.g. curlew sandpiper (*Calidris ferruginea* 35%); sanderling (*C. alba* 32%); ruddy turnstone (*Arenaria interpres* 17.5%); grey plover (*Pluvialis squatarola* 7.8%) and red knot (*Calidris canutus* 1.6%).

Seven of the 14 Namibian endemic bird species (50% of all Namibian endemic species or 4% of the species expected to occur in the area) can or are likely to occur in the general area. The most important endemic birds known/expected to occur in the general area are Gray's lark, Dune lark and Herero chat. Gray's lark is one of the species with the most restricted range in Namibia. There are 2 species listed as critically endangered (Great crested grebe, Cape gannet), 7 species as endangered (Cape cormorant, bank cormorant, black stork, white-backed vulture, martial eagle, tawny eagle, Ludwig's bustard), 6 species as vulnerable (great white pelican, greater flamingo, lesser flamingo, secretary bird, lappet-faced vulture, Hartlaub's gull) and 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).

Bird species most likely to be adversely affected by the proposed Project development are the ground nesting species associated with gravel plains, such as the endemic Gray's lark and Rüppell's Korhaan (Figure 52), as well as larger raptors, especially the disturbance at breeding sites (i.e., lappet-faced vulture nesting sites mainly isolated with bigger *Acacia erioloba* trees). Aboveground pipeline infrastructures will act as a barrier to ostrich.



Figure 52 - The endemic Rüppell's Korhaan (*Eupodotis rueppellii*) observed in the Husab Mine area

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 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 Practise 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 16 below shows the potential limitations, uncertainties and assumptions associated with the proposed Project.

Table 16 - Limitations, uncertainties and assumptions

Topic	Limitation/uncertainty/assumption
Project Design and Technology	– Above-ground vs. below-ground pipeline construction – Pipeline materials and their environmental interactions – Ammonia production methods and their environmental footprints – Potential for leaks and safety measures
Environmental and Social Baseline Data	– Data gaps in specific environmental or social indicators – Spatial and temporal variability of baseline data – Accuracy and reliability of existing data sources
Green Hydrogen/Ammonia Industry and Regulations	– Lack of established regulatory frameworks (elaborate on specific gaps) – Uncertainties in market demand and project viability – Evolving technologies and best practises for green ammonia/hydrogen projects
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

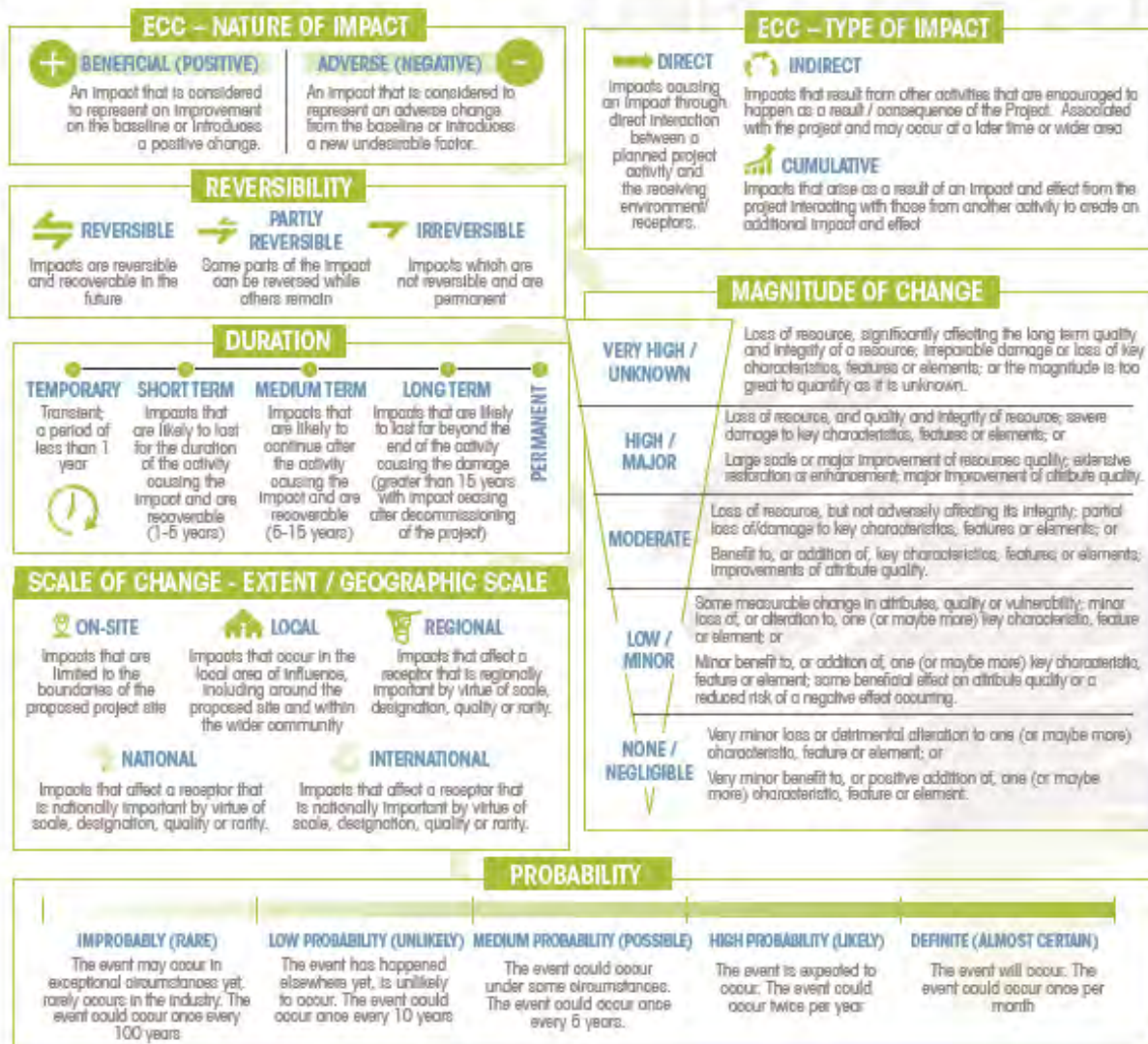
6.4 ASSESSMENT METHODOLOGY

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 practise; and over 25 years of combined ESIA experience. The methodology is set out in Figure 53.

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



			SIGNIFICANCE OF IMPACT				
				Low	Minor (2)	Moderate (3)	Major (4)
SIGNIFICANCE	- The significance of impacts may also be determined by assessing the identified thresholds for receptor sensitivity. Impacts exceeding the threshold of significance are considered as significant. - The following thresholds were further used to categorize the significance of impacts that have been accepted. A significant impact would mean that at least one of the following applies: - A receptor's ability to assimilate levels of impacts is exceeded. - A threshold of annoyance has been reached, or a receptor's acceptable level of concern is met. - Impacts are expected to be adverse to the receptor's ability to assimilate levels of impacts.	Significance of Impact Impacts are considered to be low factors that are unlikely to be critical to decision-making.	Impacts are considered to be important factors, but are unlikely to be key decision-making factors. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value. Impacts are considered to be short-term, reversible and/or localized in extent.	Impacts are considered within acceptable limits and standards. Impacts are long-term, but reversible and/or have regional significance. These are generally (but not exclusively) associated with sites and features of national importance and resources/features that are unique and which, if lost, cannot be replaced or relocated.	Impacts are considered to be key factors in the decision-making process that may have an impact of major significance, or large magnitude impacts occur to highly valued/sensitive resources/receptors. Impacts are expected to be permanent on national scale and/or have international significance or result in a legislative non-compliance.		
	Biophysical	Social					
	A biophysical receptor that is protected under legislation or international convention (CITES), listed as rare, threatened or endangered IUCN species, highly valued/sensitive resource/receptor. Of value, importance or rarity on a regional scale and with limited potential for substitution, and/or not protected or listed (globally) but may be a rare or threatened species in the country, with little resilience to ecosystem changes, important to ecosystem functions, or one under threat of population decline. Not protected or listed as common/abundant, or not critical to other ecosystem functions.	Those affected parties/communities will not be able to adapt to changes or continue to maintain pre-impact livelihoods. Able to adapt with some difficulty and maintain pre-impact status but only with a degree of support. Those affected are able to adapt with relative ease and maintain pre-impact status. There is no perceptible change to people's livelihood.	High (3) Medium (2) Low (1)	Minor (3) Low (2) Low (1)	Moderate (6) Minor (4) Low (2)	Major (9) Moderate (6) Minor (3)	Major (12) Minor (8) Moderate (4)
	SENSITIVITY AND VALUE						
Low Of value, importance or rarity on a local scale, and/or not particularly sensitive to change or has considerable capacity to accommodate a change.							
Medium Of value, importance or rarity on a regional scale, and with limited potential for substitution, and/or moderate sensitivity to change, or moderate capacity to accommodate a change.							
High Of value, importance or rarity on an international and national scale, and with very limited potential for substitution, and/or very sensitive to change or has little capacity to accommodate a change.							
MITIGATION Mitigation comprises a hierarchy of measures ranging from preventative environmental impacts by avoidance, to measures that provide opportunities for environmental enhancement. The mitigation hierarchy is avoidance, reduction of source, reduction of receptor level, and/or compensating, compensation, remediation, and enhancement. Mitigation measures can be split into three distinct categories, broadly defined as: Designated structures and other best practice measures for minimizing and reducing environmental impacts. These are considered as good practice measures. Active involvement by the EIA process and integration into design process. Through minimizing design measures that would either avoid or minimize impact or modifying the design through the inclusion of environmental features to reduce the magnitude of change. These are considered as an integral mitigation. Specified additional measures or follow-up action to be implemented to further reduce adverse impacts that remain after the implementation of an EIA. These are considered as additional mitigation. The EIA is an iterative process whereby the outcomes of the environmental and social assessments inform the project. The EMP provides the good practice mitigation measures and specified additional measures as follow-up action EDC has recommended for the project.							
SIGNIFICANCE DESCRIPTION Low - Major Beneficial (All Scores) Impacts are considered to be beneficial to the environment and society. Low (negative) 0 - 25 Impacts are considered to be low factors that are unlikely to be critical to decision-making. Minor (negative) 25 - 50 Impacts are considered to be important factors but are unlikely to be key decision-making factors. The impact will be experienced, but the impact magnitude is sufficiently small (with and without mitigation) and well within accepted standards, and/or the receptor is of low sensitivity/value. Impacts are considered to be short-term, reversible and/or localized in extent. Moderate (negative) 50 - 75 Impacts are considered within acceptable limits and standards. Impacts are long-term, but reversible and/or have regional significance. These are generally (but not exclusively) associated with sites and features of national importance and resources/features that are unique and which, if lost, cannot be replaced or relocated. Major (negative) 75 - 100 Impacts are considered to be key factors in the decision-making process that may have an impact of major significance, or large magnitude impacts occur to highly valued/sensitive resources/receptors. Impacts are expected to be permanent on national scale and/or have international significance or result in a legislative non-compliance.							

Figure 53 - 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 Practise 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 practise 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 Pipeline 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 practise 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 practises or other best practise measures for avoiding and minimising environmental impacts. These are considered good practise 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 Pipeline 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
- Social: community health and safety
- Social: air quality
- Social: traffic
- Social: heritage
- Social: visual
- Social: noise
- Environment: biodiversity
- Environment: soil, groundwater and surface water 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 practise 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 practise measures, management and monitoring for identified impacts. Impacts that have been assessed as not being significant are summarised in Table 17 and are not discussed further, unless otherwise indicated.

Table 17 - Non-significant impacts

Environmental or Social topic	Potential impact	Rational
Social environment		
Light disturbance	Light disturbance on Walvis Bay, Afrodite Beach, Dolphin Beach and Arandis	A portion of the Project site will be located in the vicinity of existing industrial infrastructure with plans of further industrial expansion. The light emitted during the construction of the pipeline from a cumulative point of view will not deter the nearest sensitive receptors which are ~300 m away from the nearest section of the pipeline between the north port area and Farm 58. The portion of the pipeline in the Namib-Naukluft Park and Arandis will be ≥ 5 km from sensitive receptors. Generally, night work is not allowed in National Parks.
Land/Corridor use	The land used for the pipeline may no longer be used for other purposes.	The pipeline corridor will follow existing infrastructure occupying a narrow section. The construction of the Ammonia pipeline would therefore not have a significant impact on land use.
Human rights	The effects that the Ammonia Pipeline 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		
Climate change (Appendix I)	The impact on carbon emissions	The ammonia pipeline is not expected to result in any significant direct emissions. Scope 1 emissions, estimated at 76.5 tonnes of carbon dioxide equivalent (tCO ₂ e), which are considered negligible. Vehicle emissions account for some 87% of

		all emissions, with operational vehicle use accounting for 72% of all Scope 1 emissions. No scope 2 emissions were identified for the pipeline's operations. Scope 3 (indirect) emissions account for 117.3 tCO₂e in Year 1 and 20.6 tCO₂e thereafter. Calculated emissions for the Walvis Bay area are estimated at 56 222 tCO₂e. The combined emissions for scope 1, 2 and 3 are estimated at 193.8 tCO₂e (~194 tCO₂e), well below the 25 000 tCO₂e as per IFC PS 3.
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7.2 SOCIO-ECONOMIC ENVIRONMENT: ECONOMIC

The term "socio – economic impacts" embraces both social and economic impacts. The economic impacts likely aligned with the construction and operation of the ammonia pipeline include aspects such as employment creation, skills development and enhancement, overall economic stimulation through micro and macro spendings, maximising upstream and downstream opportunities and revenue generation to government. The significant economic impacts that have specific interest to the community and stakeholders, before mitigation are summarised in Figure 54. The impacts are discussed further in this section.

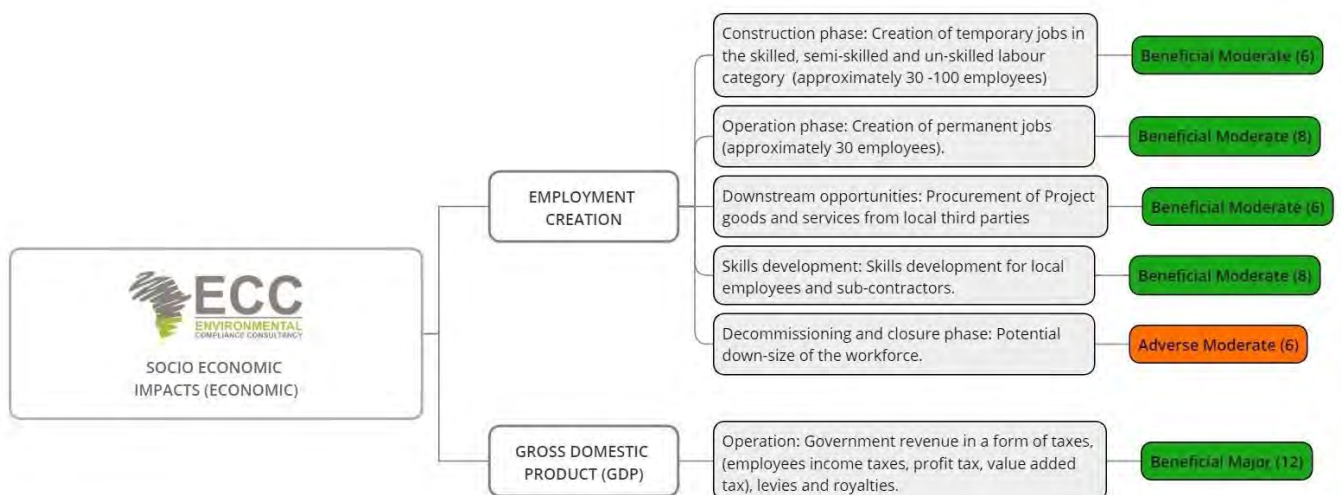


Figure 54 - Socio-economic impacts

7.2.1 FOREIGN INVESTMENT AND EMPLOYMENT OPPORTUNITIES

The Project is expected to create employment opportunities for both skilled and semi-skilled workers. Namibia is ranked amongst the world's most politically stable countries and through the Namibia Investment Promotion and Development Board (NIPDB), the government remains committed to stimulating economic growth and employment through the attraction and retention of investments. Namibia is a middle-income country whose economic success rests on multiparty parliamentary democracy that delivers sound economic management, good governance, fundamental civic freedoms and respect for human rights. This presents an opportunity to attract long-term relationships with foreign investors seeking a foothold and growth on the African continent.

The economic models indicate that the youth unemployment remained stagnant for the past two years at 38% (O'Neil, 2024). The Labour Force Survey conducted in 2019 stated that Erongo Region has an unemployment rate of 21.9% (Namibia Statistics Agency, 2019). This is driven by slow job creation and low sector productivity. The Project is expected to be one of several programs that assist the government efforts in tackling the high unemployment rate. Employments opportunities will be in a form of both short-term and long-term contracts for semi-skilled and skilled candidates, particularly with a focus on employing Walvis Bay or Swakopmund residents.

7.2.1.1 *Direct employment - construction phase*

It is anticipated that approximately 30 – 100 semi-skilled employees will be hired during the construction phase, with two security guards on night shift duty. These will be short-term employments due to the nature of construction activities and the short construction schedule (~ 2 years). This includes activities such as clearing the pipeline corridor (i.e. right of way), trench excavation for burying the pipeline where necessary, transporting the pipe, stringing and assemblance along the designated route. Specialised local service providers and sub-contractors will be contracted through a tender binding process. Local contractors and sub-contractors will be engaged for construction work, indicating that they will likely be sourced from the region. The nature of the impact is positive as employees would gain an income that will enable them to spend in the local economy. Due to the short-term duration of the construction phase, the magnitude of change is rated minor. Overall, a moderate beneficial impact on the economy is expected and no mitigation measures are required.

7.2.1.2 *Direct employment – operational phase*

Approximately 30 employees will be required during the operational phase. It is expected that these employees will be employed permanently for the duration of the Project operations. The impact is considered to have a regional impact as skilled employees will likely be required. Employees are likely to be sourced from various regional towns, including Walvis Bay, Swakopmund, Henties Bay or skilled graduates from the technical vocational training institute

in Arandis. The Namibian Institute of Mining and Technology (NIMT) is considered a key labour pool for projects of this nature. The Project is expected to remain operational until management of operations become unmanageable. This may entail a long-term impact. The magnitude of change is major, implying that there would be frequent spendings and if operations remain manageable and the workforce may be increased. The sensitivity of impact is rated medium due to the constrained workforce. The significance of impact is expected to be moderate – beneficial due to the regional impact. Recruitment policies will be in place to ensure locals are prioritised for employment opportunities. The impact ratings are shown in Figure 18. No mitigation measures are required.

7.2.1.3 Procurement of goods and services from local third parties

Various indirect employment opportunities will be created during both the construction and operational phases. During the construction phase, the Project will contract local service for service providers (contractors and sub-contractors) for construction work, which will translate into employment opportunities for local artisans, general labourers, handyman, casual workers etc. During operations, service providers may be contracted for maintenance, emergency response duties or external compliance auditing. It is planned that Project building materials will be sourced from local retail stores, while majority of the equipment and machinery not available in the local market will be imported through the Walvis Bay Nampont. Due to this, the probability of impact is rated “medium or potentially likely to occur”. The duration of impact is expected to be long-term provided that Project operations remain manageable.

The magnitude of change is major due to the continues opportunities and incomes that will be infused into the local business economy. The sensitivity of impact is expected to be medium due to the significant impact on the national economy. Overall, the beneficial impact is expected to be major, and no mitigation measures are required.

7.2.1.4 Skills development of local employees

The Proponent is committed to developing the necessary skills sets and enhancing capacity for various job roles. An ammonia training program will be implemented, whereby selected candidates will undergo training at scheduled intervals. Where skills are lacking, the Proponent will offer additional training, in addition to training on environmental protection, health, safety and emergency response. Skills development will be integrated into daily activities, with standard operating procedures (SOPs) established and regularly reviewed and updated as necessary. The transfer of knowledge and skills through on-the-job training will be beneficial to the workforce and will enhance their capacity. Skills will be acquired, and this process is irreversible, as individuals will have the opportunity to apply these skills for future job opportunities at local, regional or national levels. The magnitude of change is therefore expected to be high/major. The specialised skills acquired may also be transferred to others through coordinated training programs, apprenticeships, workshops and seminars. The

sensitivity is therefore rated medium. Overall, the significance of the impact is expected to be moderately beneficial.

7.2.1.5 Downsizing of the workforce during the decommissioning and closure phase

The downsizing or closure of the Project, while not currently planned, could result from a combination of challenges. These include global supply chain disruptions delaying critical equipment, regulatory uncertainty around hydrogen export laws, and economic viability concerns tied to funding and market demand. Technical challenges in deploying new hydrogen technologies and slow development of the global green hydrogen market further complicate the project's sustainability. Together, these factors could potentially impact the project's continuation.

However, it is likely that the environmental and rehabilitation teams would be retained to ensure ongoing care, maintenance and rehabilitation of the site. The impact on the affected workforce is indeed adverse, with a moderate magnitude of change as employees face a loss of income in the short-term. Workforce downsizing and retrenchment are prevalent in project management and impacts are direct and irreversible. However, the skills and experience they have acquired can enhance their employability, allowing them to seek opportunities in similar projects or industries. This potential for future employment may help mitigate some of the immediate financial stress and contribute to their long-term career development. The green hydrogen industry is emerging in Namibian, and there may be similar projects in future. The workforce redundancy is not expected to have a detrimental effect on the regional economy; however, it may impact the local economy, since the Project will likely retrench fewer than 30 employees. Therefore, the sensitivity of impact is rated medium, and the impact is expected to be adverse moderate.

7.2.2 IMPACTS ON GROSS DOMESTIC PRODUCT (GDP)

Revenues for the Namibian government consists of income tax, profit tax, value added tax, duties and levies, imports, exports and royalties (when required). All revenue requirements are remitted to the government and hence the energy and gas sector is expected to positively contribute to the national economy and gross domestic product (GDP). To operate legally, the Proponent is mandated to contribute a portion of the Project's income or profit to the government. Therefore, the probability is definite. The beneficial impact is expected to be direct and long-term for the duration of the Project, which is not determined at this stage. Monies paid to government are irreversible. The sensitivity of impact and magnitude of impact are high as fundings will be used to support public services and infrastructure development, such as education, healthcare, transportation and other social programs. The significance of impact is assessed as major – beneficial. The impact ratings are provided in Table 18.

Table 18 - Impact ratings related to the socio-economic environment

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction work	Community Job seekers Local economy	Creation of temporal jobs during the construction phase.	Beneficial Direct Reversible Short-term Regional Definite	Medium	Minor	Beneficial Moderate (6)
Project operations	Community Job seekers Local economy	Creation of skilled and semi – skilled job opportunities	Beneficial Direct Reversible Long-term Regional High probability	Medium	Major	Beneficial Major (8)
Project construction and operations	Community Local economy	Downstream opportunities for local suppliers' contractors and secondary contractors	Beneficial Indirect Reversible Long-term Local Medium probability	Medium	Major	Beneficial Moderate (6)
Coordinated training programs	Project workforce Community	Transfer of skills to eligible Namibians, allowing them to take up roles in current and future roles	Beneficial Direct Irreversible Permanent On-site High probability	Medium	Major	Beneficial Major (8)
Project decommissioning and closure	Community	Downsize of the workforce	Adverse Direct Irreversible Local Short-term High probability	Medium	Moderate	Adverse Moderate (6)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction and operations	Namibian government Local business entities	Government revenue in the form of taxes paid, profit tax, value added tax, duties and levies.	Beneficial Direct Irreversible National Long-term Definite	High	Very high	Beneficial Major (12)

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 pipeline. 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) for the proposed Project, and a report was generated in early November 2024 (Appendix E). The main objective of the investigation was to quantify the potential impacts resulting in air quality emissions due to the proposed construction activities of the pipeline on the surrounding environment and human health. Impacts associated with sporadic maintenance during operations have not been assessed, as they are considered negligible. Potential impacts resulting from pipeline ruptures are addressed in the Health and Safety section of this report. In the absence of guidelines on ambient air concentrations for Namibia, reference is made to the air quality objectives (AQO). These objectives are based on the World Health Organisation (WHO) interim targets and South African (SA) National Ambient Air Quality Standards (NAAQS).

The proposed construction steps for the pipeline are as follows:

- Step 1: Construction staging areas and storage yards.
- Step 2: Clear cutting the right-of-way (ROW).
- Step 3: Excavating the trench (track hoes with jack hammers are brought in to create the trench).

- Step 4: Pipe transport, stringing, and assembly (segments of pipe transported from stockpiles, welded together and sandblasted).
- Step 5: Obstacles: roads and streams (constructed underneath these obstacles by either boring for shallow depth or using horizontal directional drilling for deeper placement).
- Step 6: Testing and restoration.

The impact ratings are provided in Table 19. The impacts before mitigation measures are presented in Figure 55, for illustrative purposes only. The potential impacts are discussed further in the sections below.

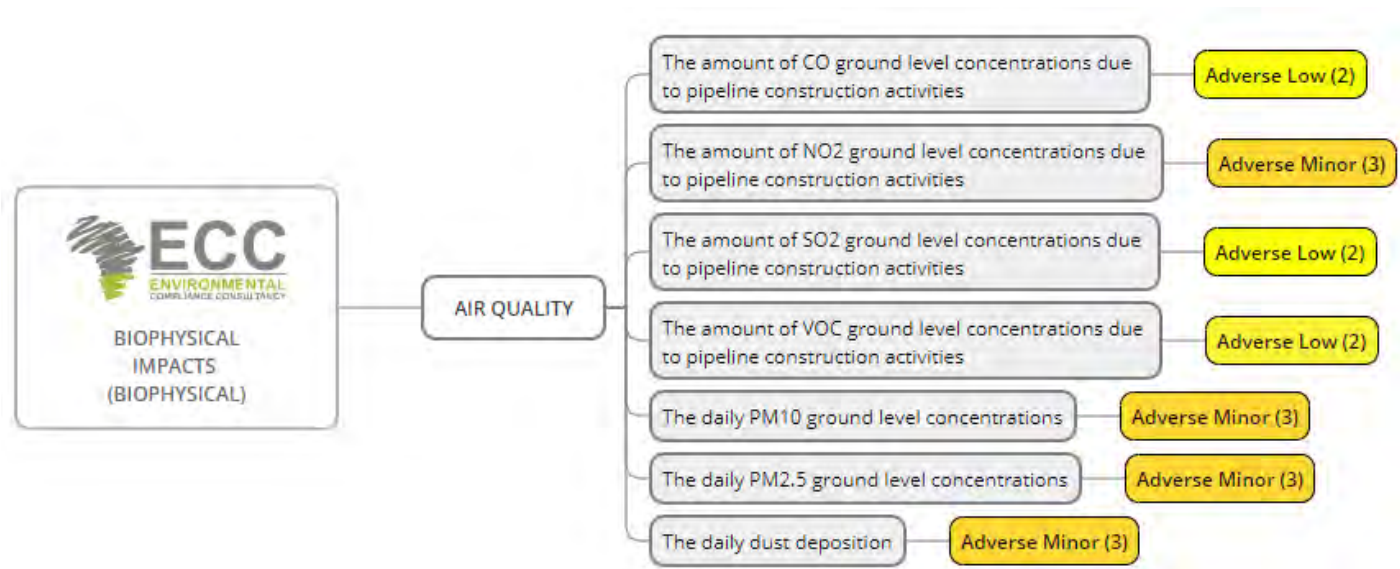


Figure 55 - Air quality impacts related to the construction phase

7.3.1.1 The volume of carbon monoxide (CO) ground level concentrations as a result of the ammonia pipeline construction

Carbon monoxide (CO) concentrations represent a notable primary pollutant emitted by vehicles. While CO itself is not a direct greenhouse gas, its interactions in the atmosphere can affect climate change. By reacting with OH radicals, CO indirectly prolongs the atmospheric lifetime of methane—a potent greenhouse gas (Wang, et al., 2022). The primary source of CO emissions is likely to be the vehicles used during the construction phase of the Ammonia Pipeline Project. During operations, vehicle usage is minimal, limited to occasional maintenance visits and periodic monitoring activities.

A profile of the simulated hourly and daily CO ground level concentrations due to pipeline construction activities for the various steps (i.e. Step 2 to Step 5), is provided in Figure 56 and Figure 57 respectively. AQO for CO was not exceeded due to the pipeline construction for hourly and daily simulated concentrations.

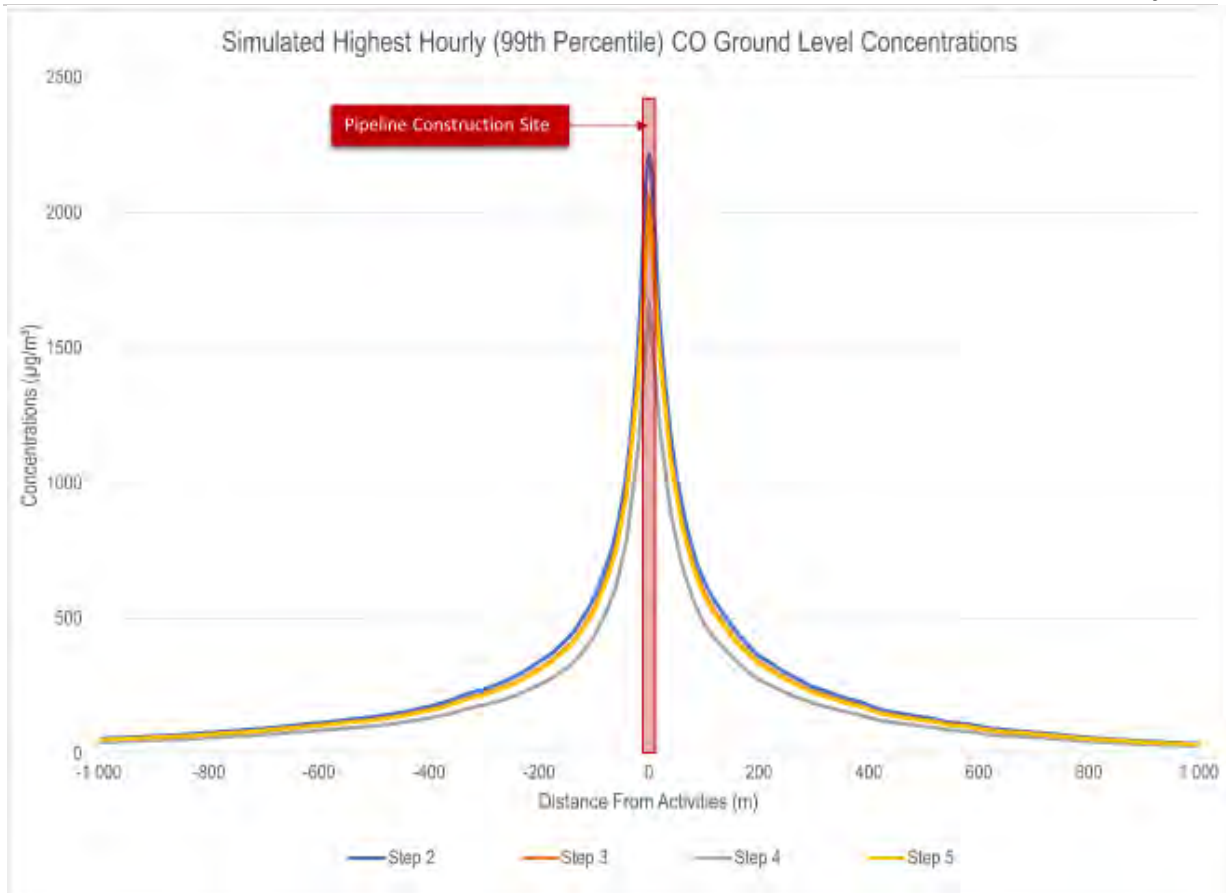


Figure 56 - Simulate hourly (99th percentile) CO ground level concentrations due to pipeline construction activities (Airshed, 2024)

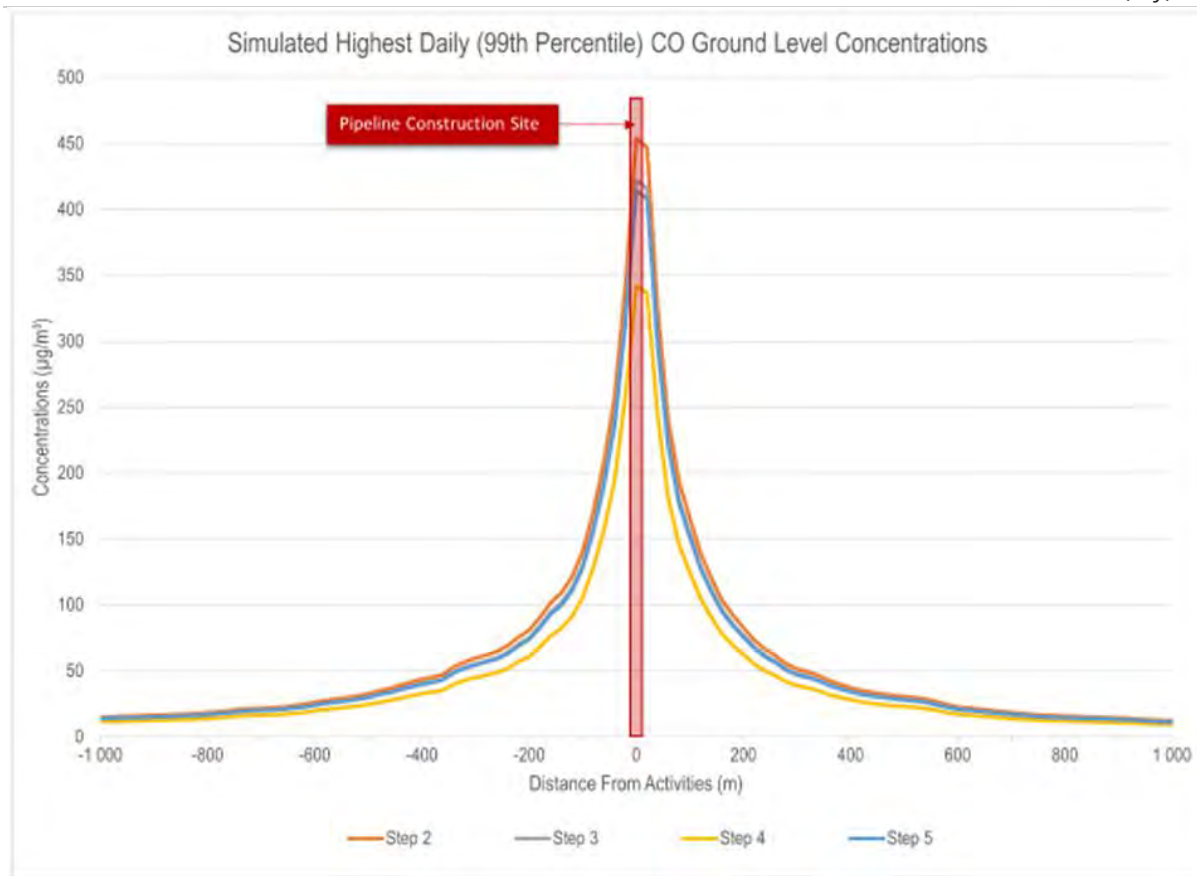


Figure 57 - Simulate daily (99th percentile) CO ground level concentration due to pipeline construction activities (Airshed, 2024)

The nature of the impact is adverse, directly affecting potential sensitive receptors (Section 5.2.1 of chapter 5), partly reversible and will occur over a short period of time due to the period of the construction phase (~2 years). CO is a primary pollutant produced by vehicles and is likely to be emitted as vehicles are used during construction.

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 hourly and daily CO ground level concentrations are well below the AQO levels set by WHO (hourly: 4000 $\mu\text{g}/\text{m}^3$; daily: 7000 $\mu\text{g}/\text{m}^3$) and SA NAAQS (30000 $\mu\text{g}/\text{m}^3$) as shown in Figure 56 and Figure 57. Overall, the significance of the impact is rated low. The mitigation measures are provided in the ESMP.

7.3.1.2 The volume of nitrogen dioxide (NO_2) ground level concentrations as a result of the ammonia pipeline construction

Nitrogen dioxide (NO_2) concentrations are characterised as a secondary pollutant emitted by vehicles. Secondary pollutants are not directly emitted, it however forms when primary pollutants react in the atmosphere (Envira, 2022). Nitrogen monoxide (NO) emissions are rapidly converted in the atmosphere into the more toxic NO_2 . NO_2 could lead to chronic respiratory issues and have various negative impacts on the environment such as acid rain and eutrophication. The rate of this conversion process is determined by the rate of the physical processes of dispersion and mixing of the plume and the chemical reaction rates as

well as the local atmospheric ozone concentration (Airshed Planning Professionals, 2024). NO₂ will be most likely be released during construction activities associated with the Ammonia Pipeline. During operations, vehicle usage is minimal, limited to occasional maintenance visits and periodic monitoring activities.

A profile of the simulated hourly and annual NO₂ ground level concentrations due to pipeline construction activities, is provided in Figure 58 and Figure 59 respectively. Simulated hourly (99th percentile) and annual NO₂ ground level concentrations due to pipeline construction exceeded the NO₂ AQO up to 220 m from the pipeline centreline. However, the closest AQSR to the pipeline centreline is ~ 300 m. Therefore, it is not expected to reach the nearest receptors.

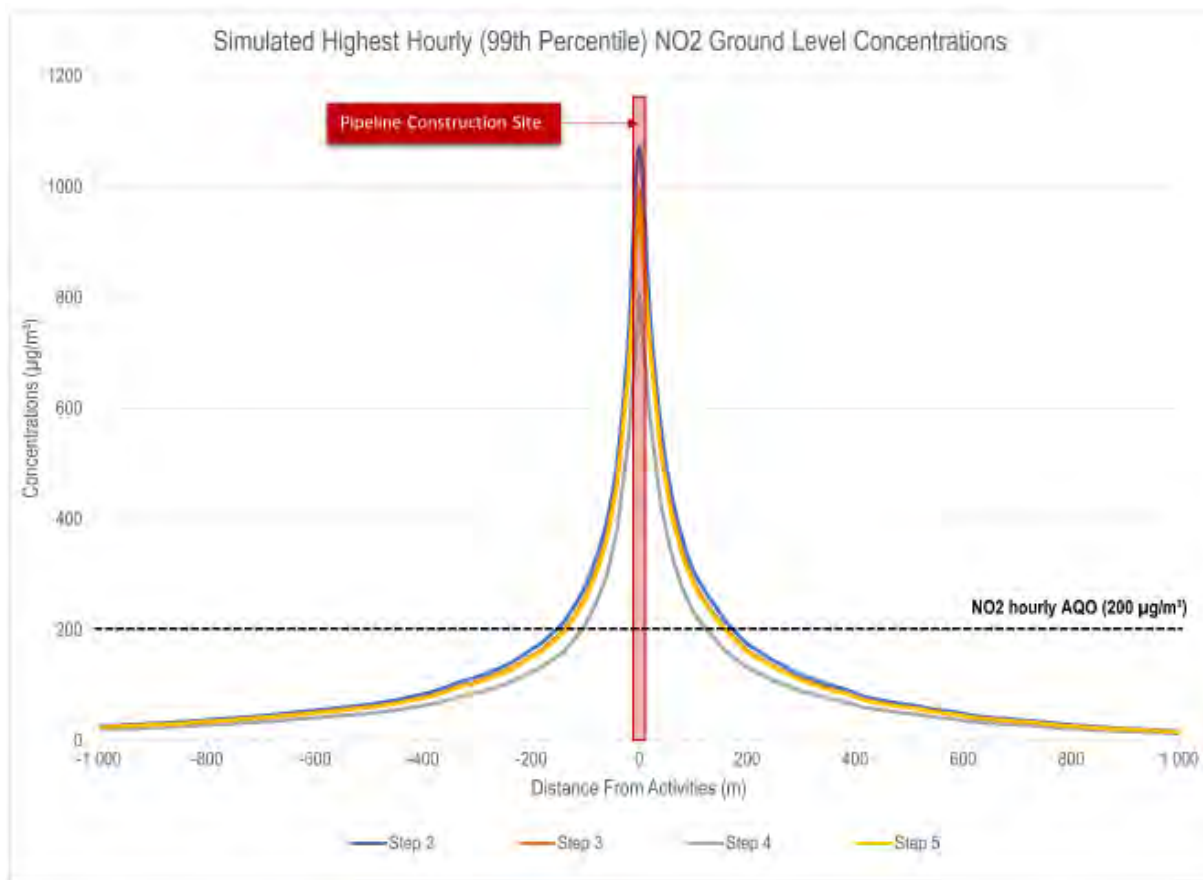


Figure 58 - Simulate hourly (99th percentile) NO₂ ground level concentrations due to pipeline construction activities (Airshed, 2024)

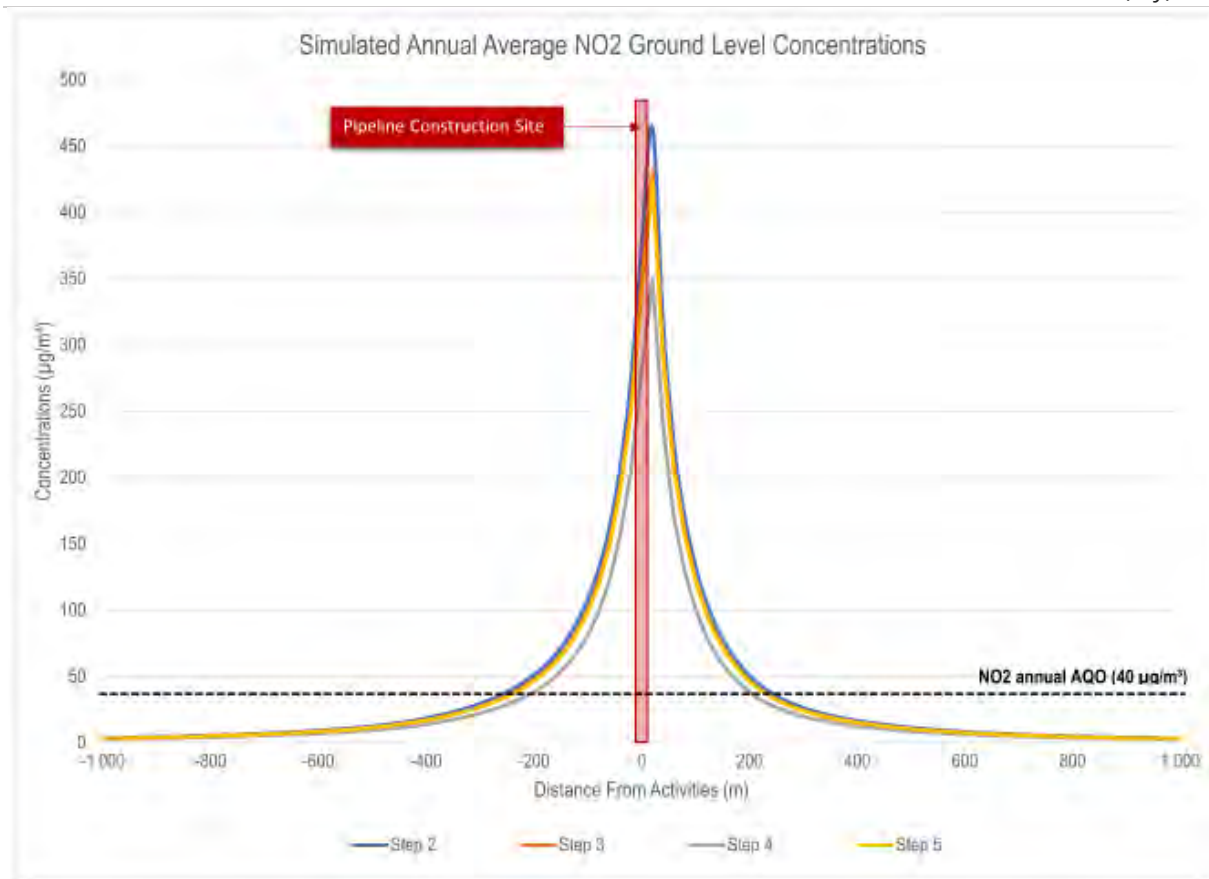


Figure 59 - Simulate annual average NO₂ ground level concentrations due to pipeline construction activities (Airshed, 2024)

The nature of the impact is adverse, directly affecting potential sensitive receptors, partly reversible and will occur over a short period of time due to the period of the construction phase (~2 years). NO₂ is likely to be emitted as a secondary pollutant from vehicles.

The sensitivity of the impact is low due to the local scale of the impact. The magnitude of change before mitigation is minor, as it is not anticipated that sensitive receptors will be affected by the gas. Overall, the significance of the impact is rated minor. The mitigation measures are provided in the ESMP.

7.3.1.3 The volume of sulphur dioxide (SO₂) ground level concentrations as a result of pipeline construction activities

Sulphur dioxide (SO₂) concentrations are a significant primary pollutant, likely emitted from vehicles used during the construction phase of the Project. Long term SO₂ exposure can be harmful to the human respiratory system leading to chronic respiratory issues and can accelerate climate change (United States Environmental protection Agency, 2025).

A profile of the simulated hourly, daily and annual SO₂ ground level concentrations due to pipeline construction activities, is provided in Figure 60, Figure 61 and Figure 62. It has been concluded that the AQO for SO₂ was not exceeded as a result of the pipeline construction.

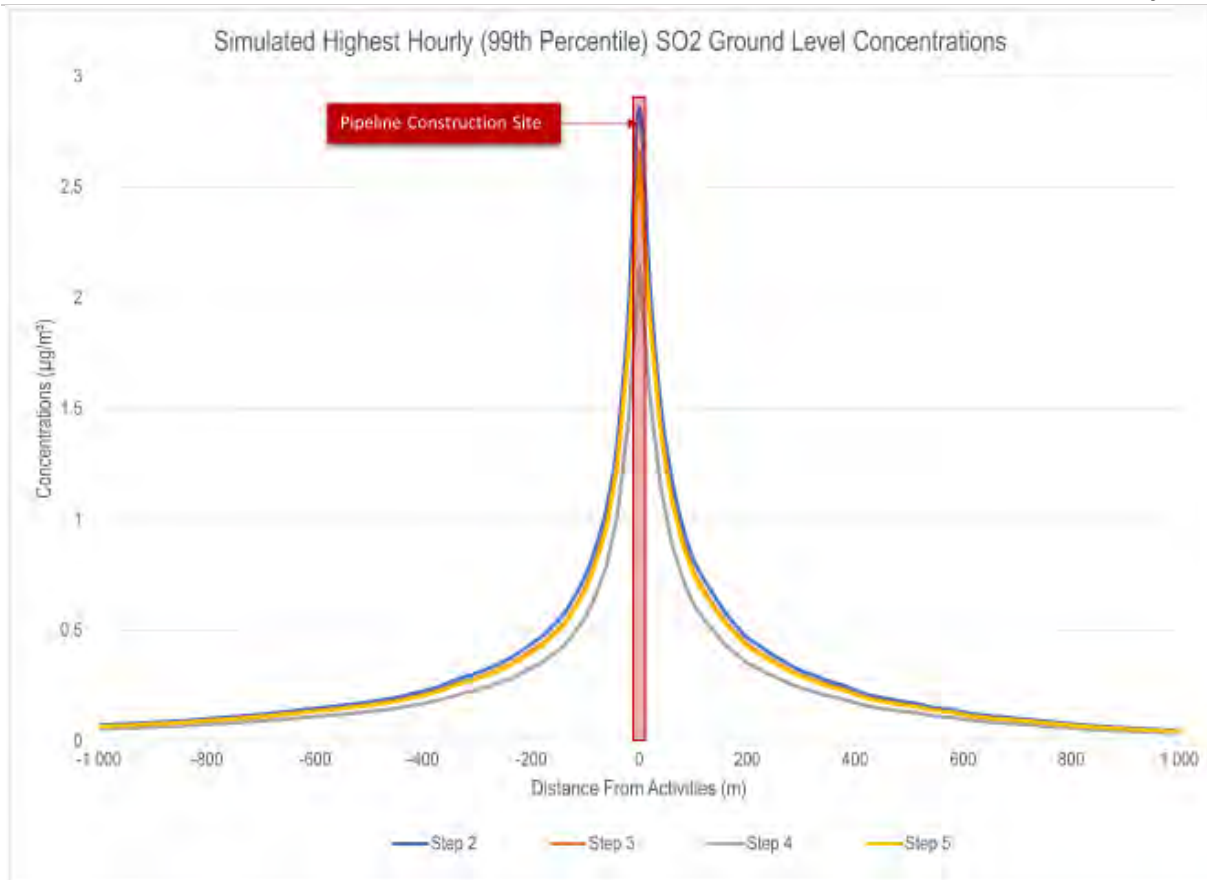


Figure 60 - Simulate hourly (99th percentile) SO₂ ground level concentrations due to pipeline construction activities (Airshed, 2024)

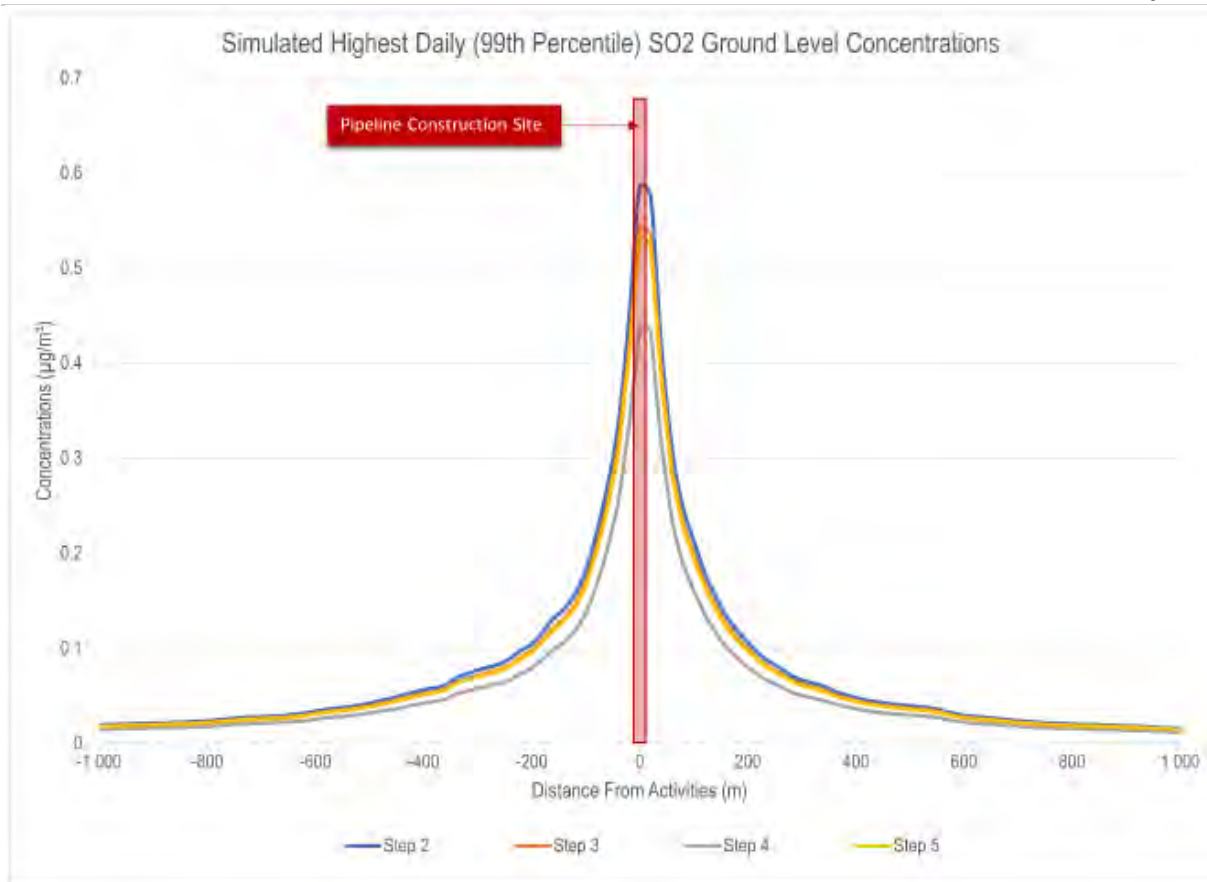


Figure 61 - Simulate daily (99th percentile) SO₂ ground level concentrations due to pipeline construction activities (Airshed, 2024)

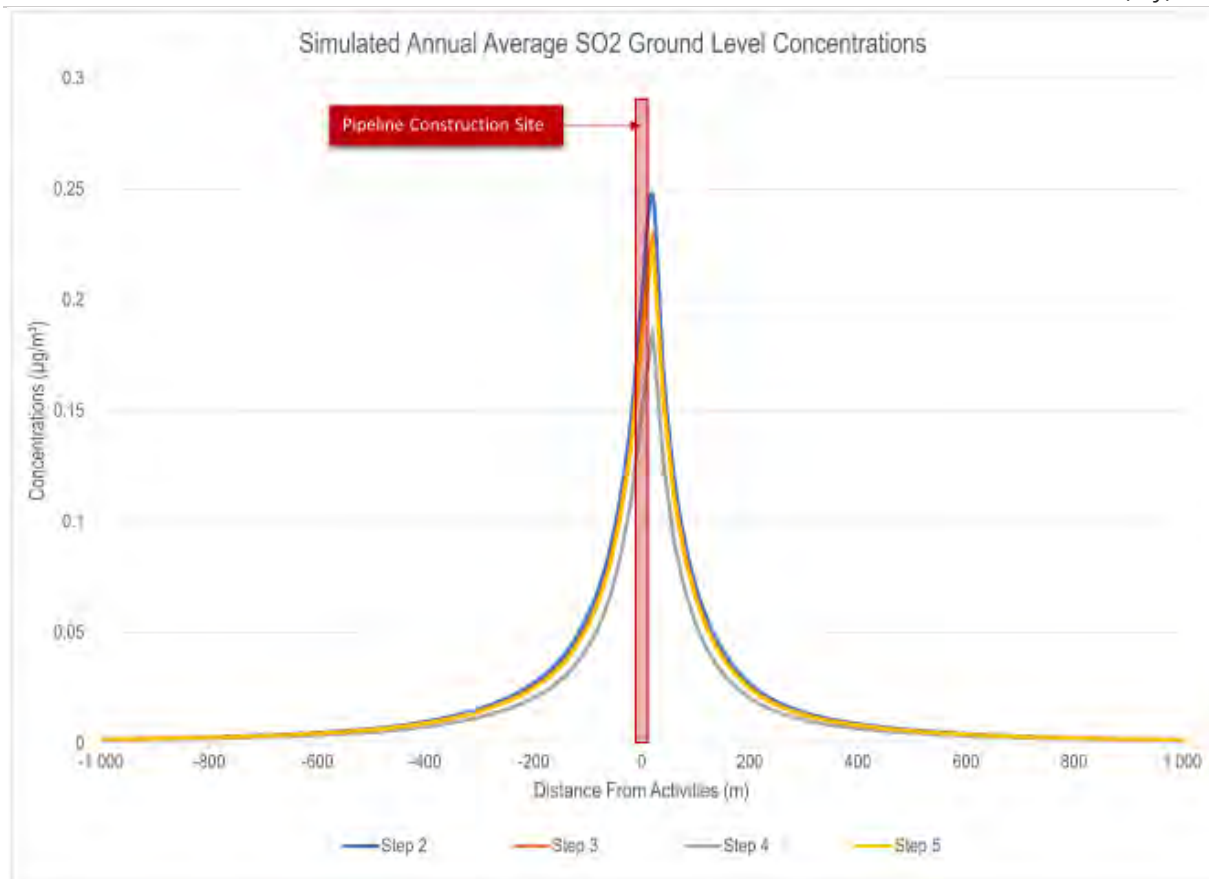


Figure 62 - Simulate annual average SO₂ ground level concentrations due to pipeline construction activities (Airshed, 2024)

The nature of the impact is adverse, directly affecting potential sensitive receptors, partly reversible and will occur over a short period of time due to the period of the construction phase (~2 years). SO₂ will likely be emitted in very small concentrations.

The sensitivity of the impact is low due to the local scale of the impact. The magnitude of change before mitigation is negligible, as the concentrations that are foreseen to be emitted is well below the hourly, daily and annual AQO which is 350 µg/m³, 50 µg/m³ and 50 µg/m³, respectively. Overall, the significance of the impact is rated low. The mitigation measures are detailed in the ESMP.

7.3.1.4 The volume of volatile organic compounds (VOC) ground level concentrations as a result of pipeline construction activities

Volatile organic compounds (VOCs) are components of petroleum (diesel) fuels, hydraulic fluids, paint thinners and dry-cleaning agents (United States Environmental Protection Agency, 2024). VOC vapours are likely to be emitted from vehicles using diesel fuel during the construction phase. Long term exposure to VOC vapours can cause a variety of health problems including eye, nose and throat irritation; headaches and loss of coordination; nausea; and damage to the liver, kidneys, or central nervous system (Minnesota Pollution Control Agency, 2025).

A profile of the simulated hourly and annual VOC ground level concentrations due to pipeline construction activities, is provided in Figure 63 and Figure 64 respectively. Simulated highest hourly VOC ground level concentrations due to pipeline construction exceeded the AQO up to 20 m from the pipeline centreline. The closest AQSR is ~300 m from the pipeline and thus unlikely to be in exceedance of the AQO. The simulated annual average VOC concentrations did not exceed the AQO.

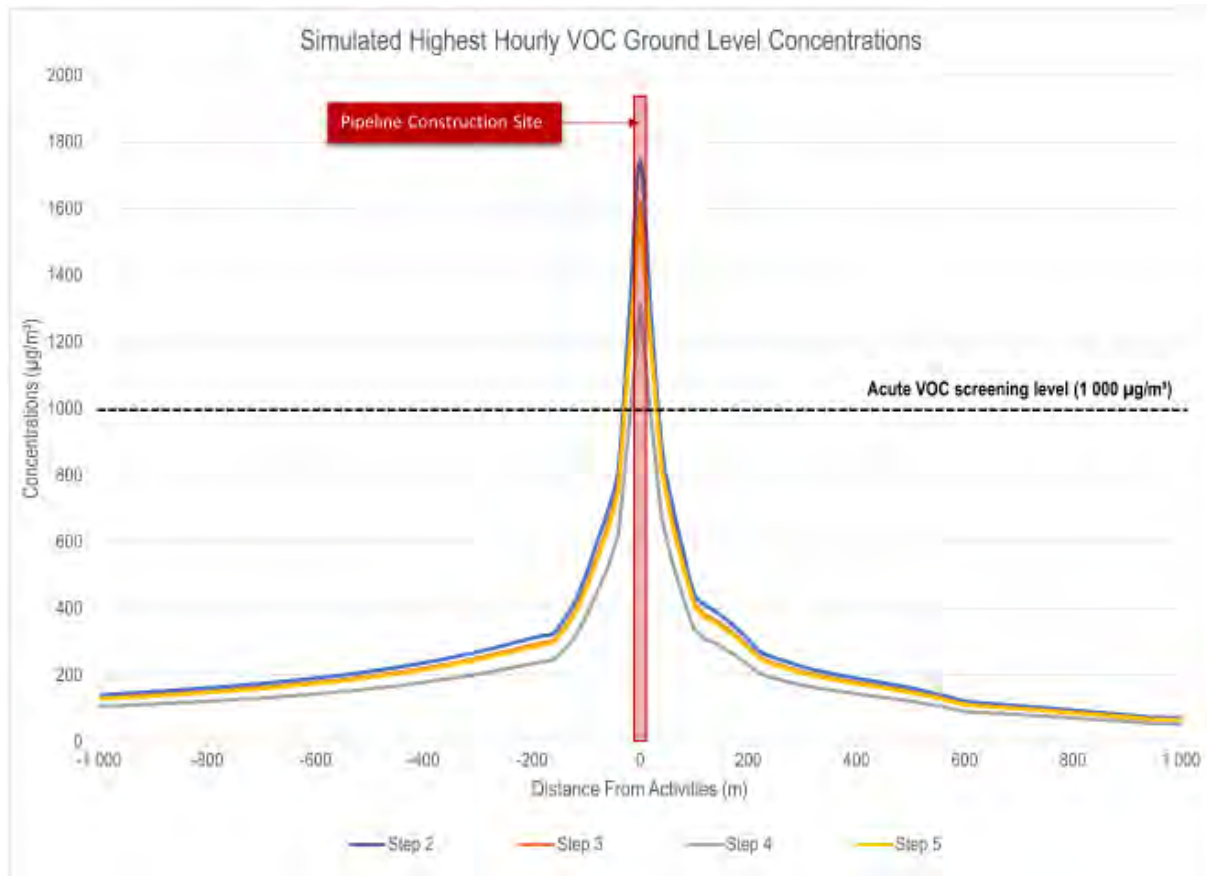


Figure 63 - Simulate highest hourly VOC ground level concentrations due to pipeline construction activities (Airshed, 2024)

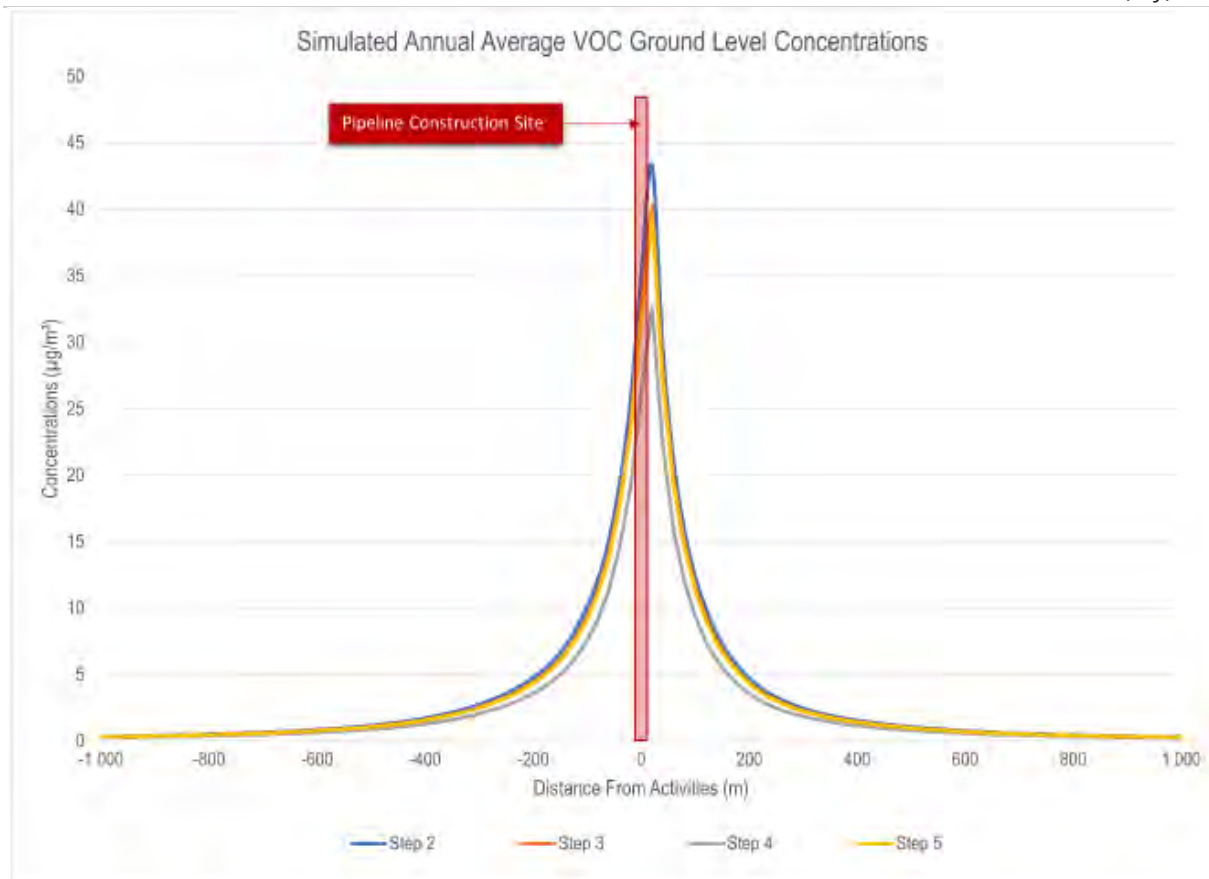


Figure 64 - Simulated annual average VOC ground level concentrations due to pipeline construction activities (Airshed, 2024)

The nature of the impact is adverse, directly affecting potential sensitive receptors, partly reversible and will occur over a short period of time due to the period of the construction phase (~2 years). VOCs are likely to be emitted from vehicles utilised during construction.

The sensitivity of the impact is low due to the local scale of the impact. The magnitude of change before mitigation is negligible, as the nearest sensitive receptors ~300 m from the pipeline will not be impacted. The significance of the impact is rated low. The mitigation measures are detailed in the ESMP.

7.3.1.5 The daily PM₁₀ ground level concentrations due to the ammonia pipeline construction

Thoracic particulate matter 10 (PM₁₀) 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). PM₁₀ 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).

A profile of the simulated daily (99th percentile) and annual PM₁₀ ground level concentrations due to pipeline construction activities, is provided in Figure 65 and Figure 66 respectively. The

simulated daily PM₁₀ ground level concentrations due to pipeline construction exceed the AQO up to 140 m from the pipeline centreline and annual average PM₁₀ ground level concentrations exceed the AQO up to 80 m. The closest AQSR is ~300 m from the pipeline and thus unlikely to be in exceedance of the AQO.

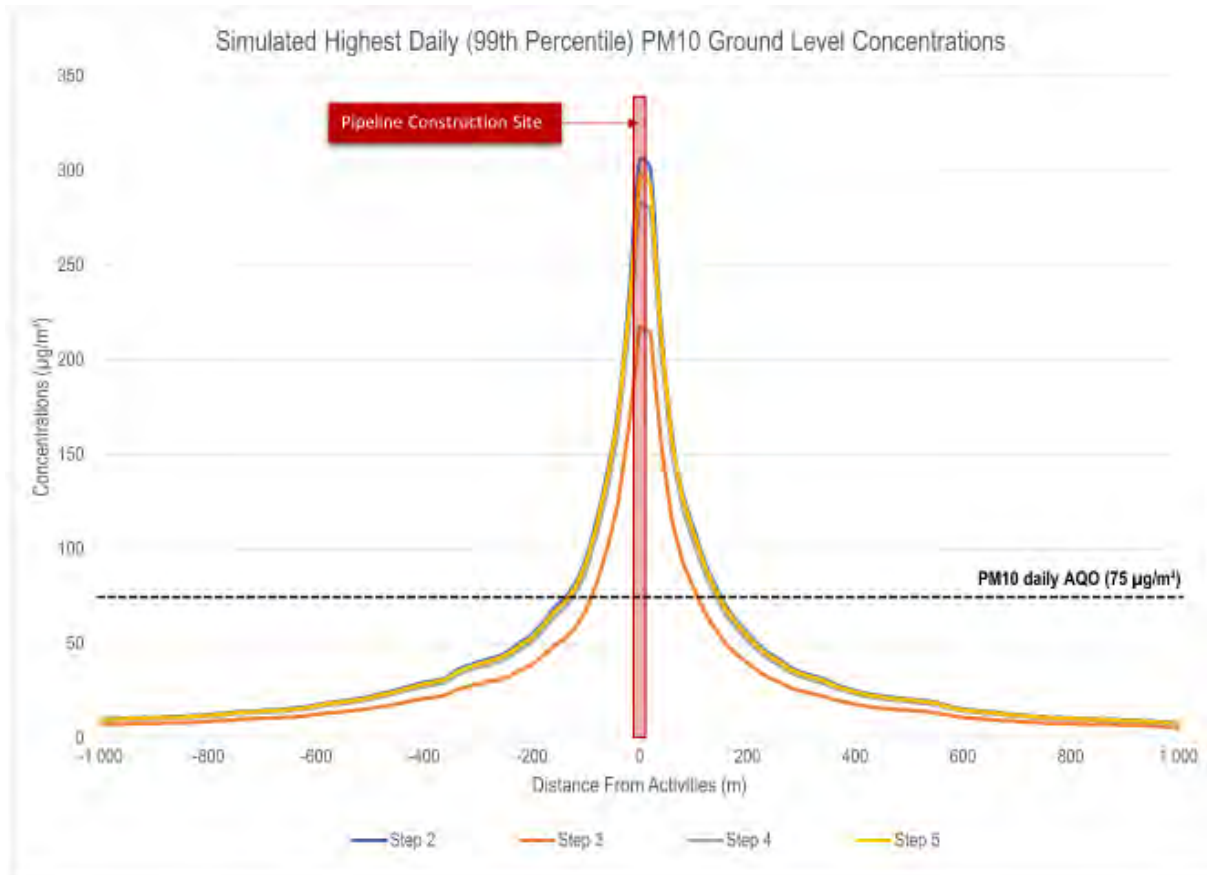


Figure 65 - Simulate daily (99th percentile) PM₁₀ ground level concentrations due to pipeline construction activities (Airshed, 2024)

The nature of the impact is adverse, directly affecting potential sensitive receptors, partly reversible and will occur over a short period of time due to the period of the construction phase (~2 years). The generation of PM₁₀ 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. The magnitude of change before mitigation is minor, as the nearest sensitive receptors ~300 m from the pipeline is unlikely to be impacted. The significance of the impact is rated minor. The mitigation measures are detailed in the ESMP.

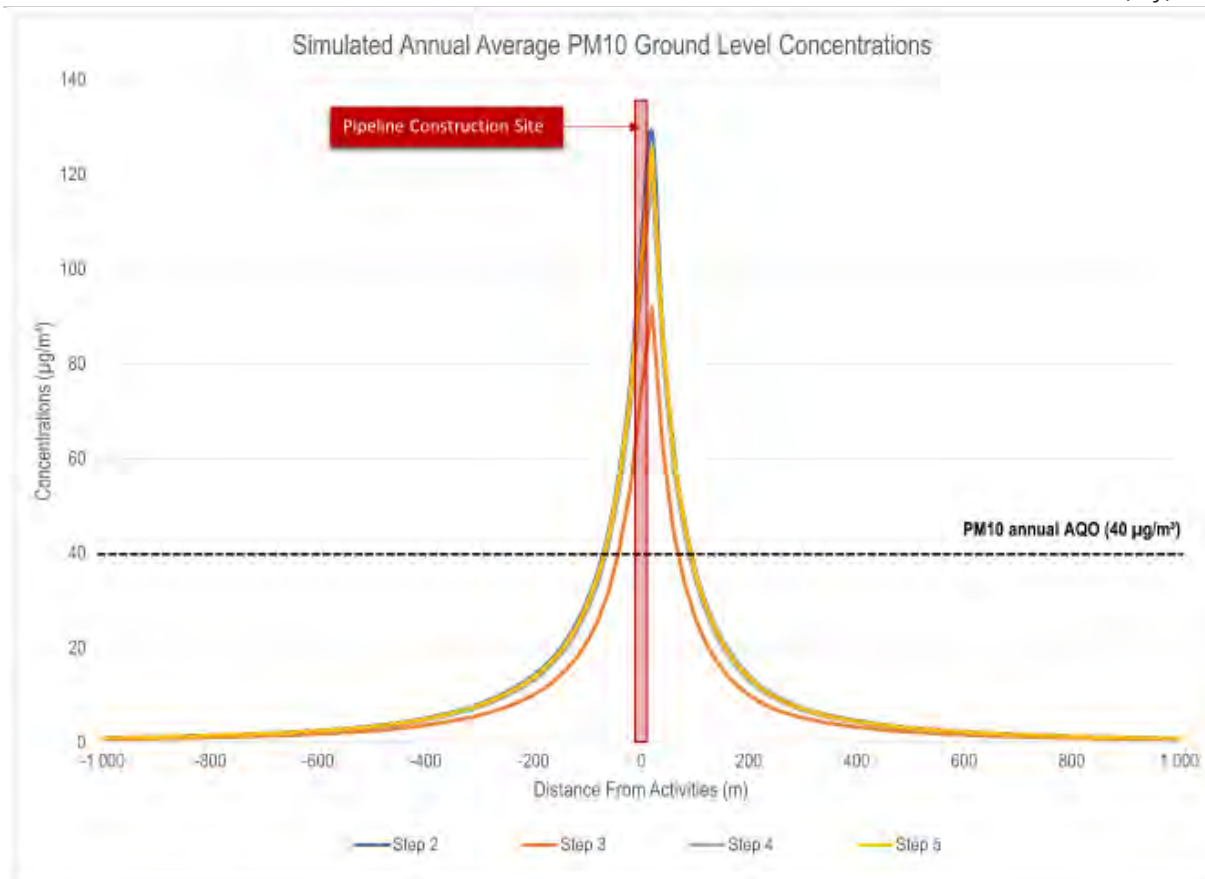


Figure 66 - Simulate annual average PM₁₀ ground level concentrations due to pipeline construction activities (Airshed, 2024)

7.3.1.6 *The daily PM_{2.5} ground level concentrations due to the ammonia pipeline construction*

Inhalable particulate matter 2.5 (PM_{2.5}) ground level concentrations will be generated during construction. 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 PM₁₀.

A profile of the simulated daily (99th percentile) and annual PM_{2.5} ground level concentrations due to pipeline construction activities, is provided in Figure 67 and Figure 68 respectively. Simulated daily (99th percentile) and annual average PM_{2.5} ground level concentrations due to pipeline construction exceed the AQO up to 80 m from the pipeline centreline. The closest AQSR is ~300 m from the pipeline and thus unlikely to be in exceedance of the AQO.

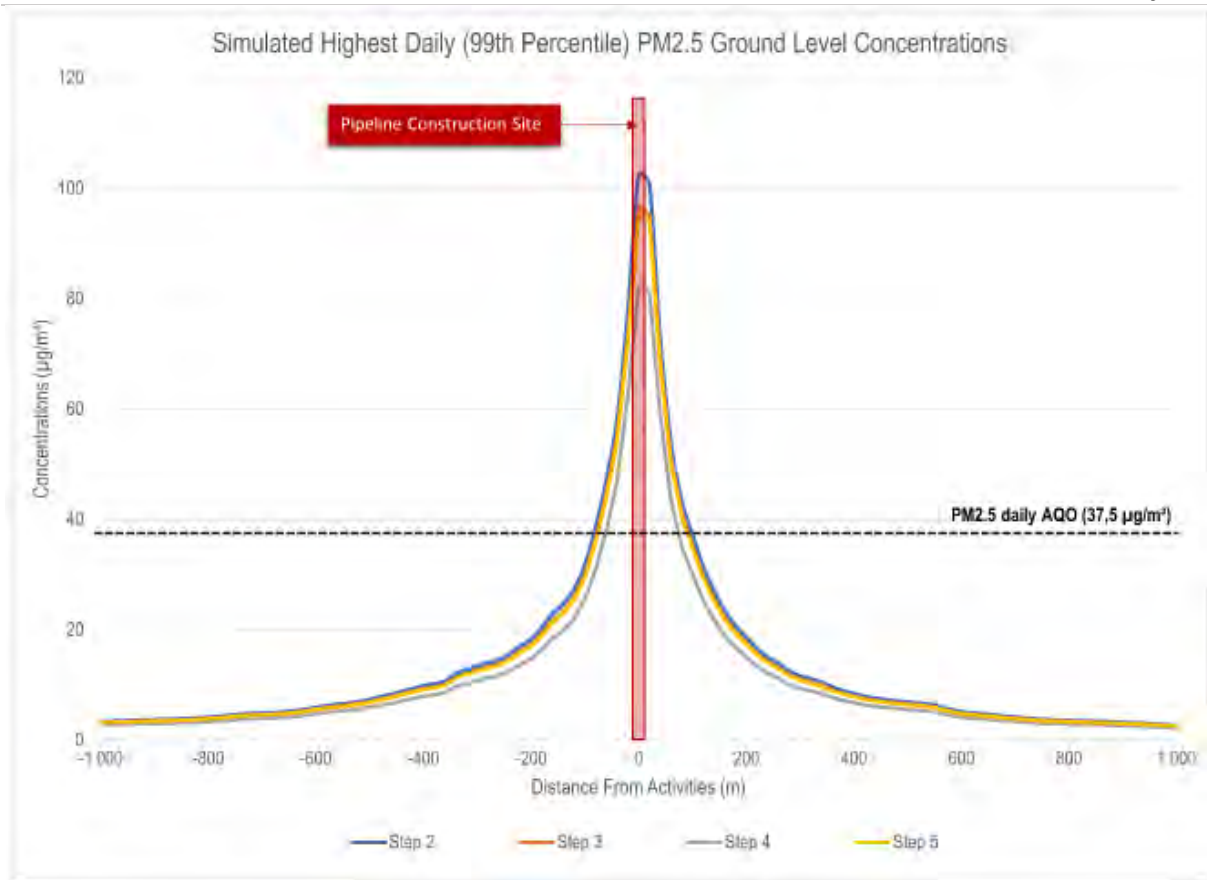


Figure 67 - Simulate daily (99th percentile) PM_{2.5} ground level concentrations due to pipeline construction activities (Airshed, 2024)

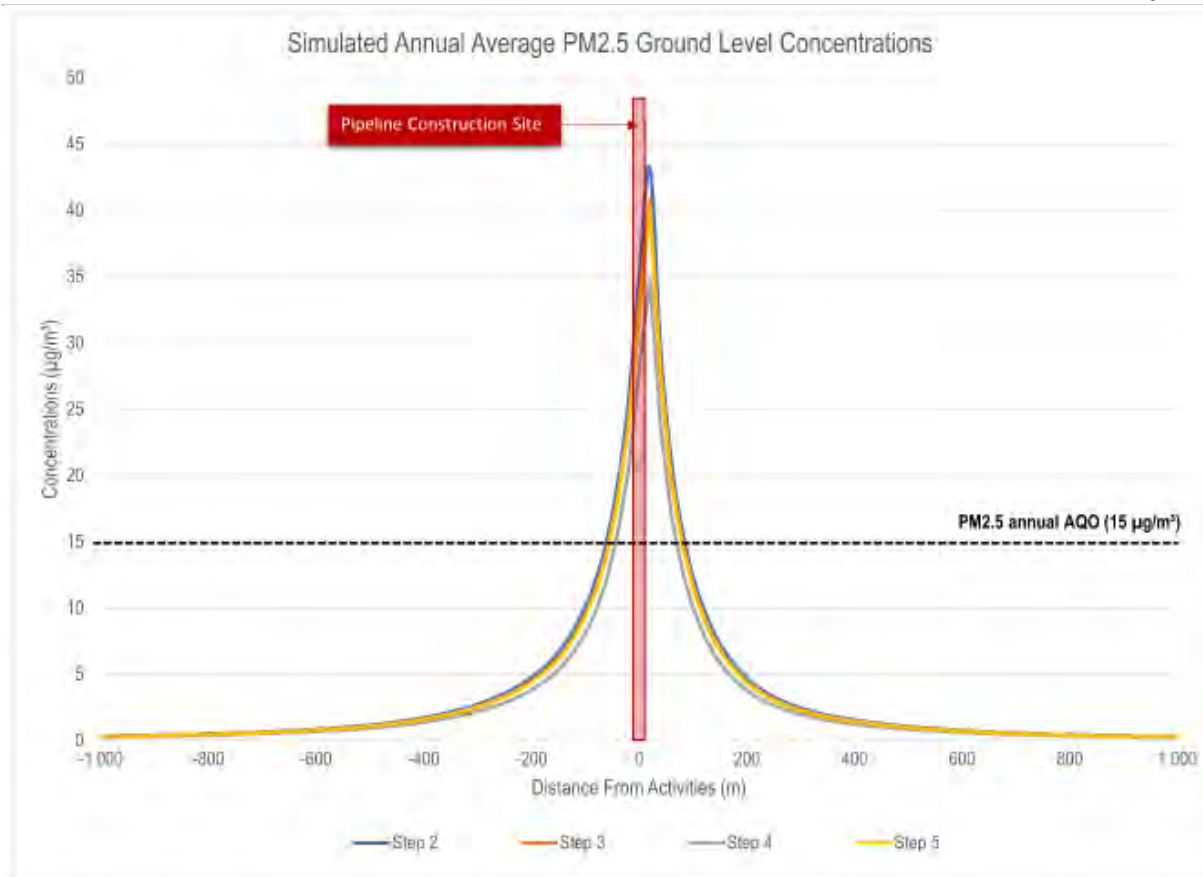


Figure 68 - Simulate annual average PM_{2.5} ground level concentrations due to pipeline construction activities (Airshed, 2024)

The nature of the impact is adverse, directly affecting potential sensitive receptors, partly reversible and will occur over a short period of time due to the period of the construction phase (~2 years). The generation of PM_{2.5} 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. The magnitude of change before mitigation is minor, as the nearest sensitive receptors ~300 m from the pipeline is unlikely to be impacted. The significance of the impact is rated minor. The mitigation measures are detailed in the ESMP.

7.3.1.7 The daily dust deposition due to the ammonia pipeline construction

During construction activities, nuisance (visible) dust will be generated. Construction activities involve removing all or most of the vegetation, trees and other obstacles, as well as trench excavation. A profile of the simulated maximum daily dust deposition rates due to pipeline construction activities, is provided in Figure 69. Simulated daily dust deposition exceeds to the AQO for residential areas up to 140 m from the pipeline centreline and thus unlikely to exceed AQO at the closest AQSR.

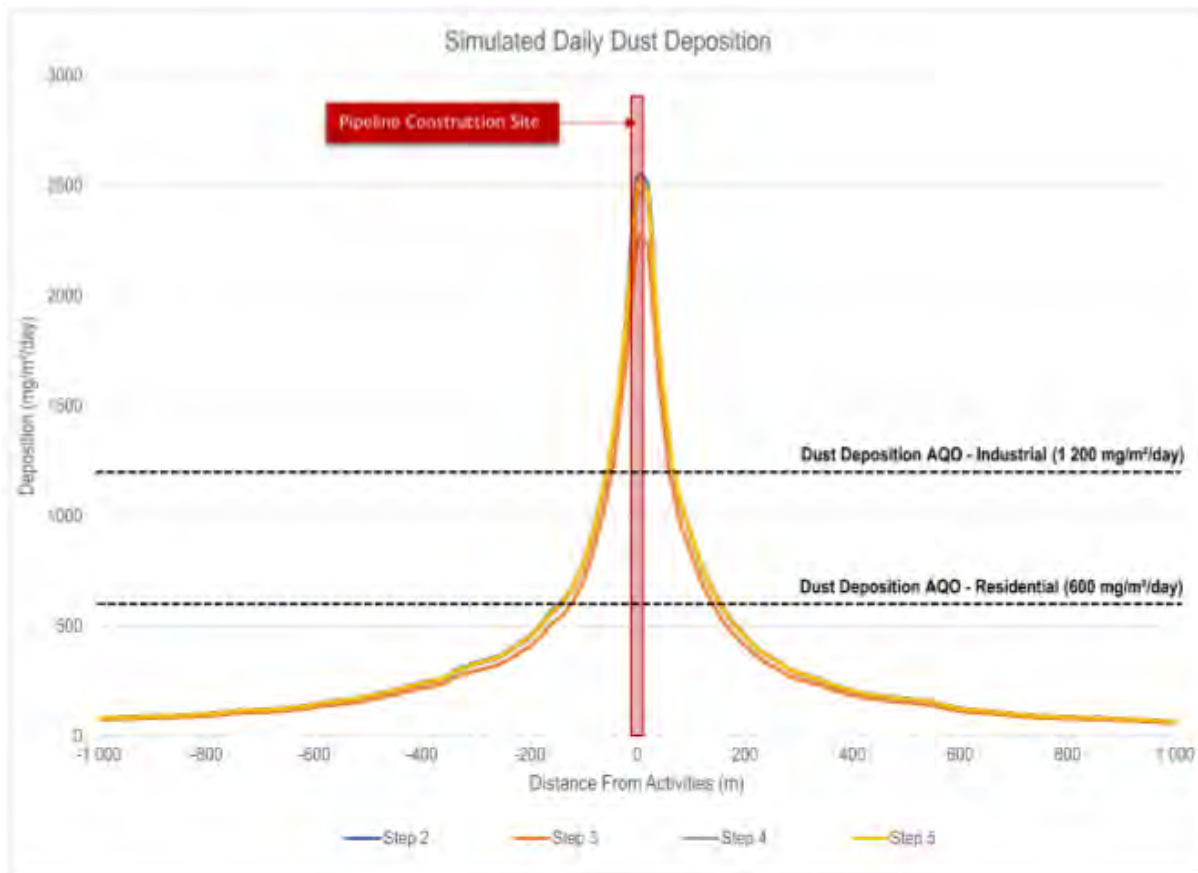


Figure 69 - Simulate maximum daily dust deposition due to pipeline construction activities (Airshed, 2024)

The nature of the impact is adverse, directly affecting potential sensitive receptors, partly reversible and will occur over a short period of time due to the period of the construction phase (~2 years). Dust generation is likely, as activities will take place within the dune belt, ~ 3 km from Walvis Bay.

The sensitivity of the impact is low due to the local scale of the impact. The magnitude of change before mitigation is minor, as the nearest sensitive receptors ~300 m from the pipeline is unlikely to be impacted. The significance of the impact is rated minor. The mitigation measures are detailed in the ESMP.

Table 19 - Air quality impacts

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction and decommissioning phase	Air quality	The amount of CO ground level concentrations due to pipeline construction and decommissioning	Adverse Direct Partly reversible Short term Local Likely	Low	Negligible	Low (2)
		The amount of NO ₂ ground level concentrations due to pipeline construction and decommissioning	Adverse Direct Partly reversible Short term Local Likely	Low	Minor	Minor (3)
		The amount of SO ₂ ground level concentrations due to pipeline construction and decommissioning	Adverse Direct Partly reversible Short term Local Likely	Low	Negligible	Low (2)
		The amount of VOC ground level concentrations due to pipeline construction and decommissioning	Adverse Direct Partly reversible Short term Local Likely	Low	Negligible	Low (2)
		The daily PM ₁₀ ground level concentrations during construction and decommissioning	Adverse Direct Partly reversible Short term Local Likely	Low	Minor	Minor

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		The daily PM _{2.5} ground level concentrations during construction and decommissioning	Adverse Direct Partly reversible Short term Local Likely	Low	Minor	Minor
		The daily dust deposition during construction and decommissioning	Adverse Direct Partly reversible Short term Local Likely	Low	Minor	Minor

7.3.2 VISUAL IMPACTS AND SENSE OF PLACE

The detailed visual and sense of place impacts of the Ammonia Pipeline activities on the Walvis Bay and Afrodite communities, Arandis, road users and tourists are illustrated in Figure 70 and shown in Table 20.

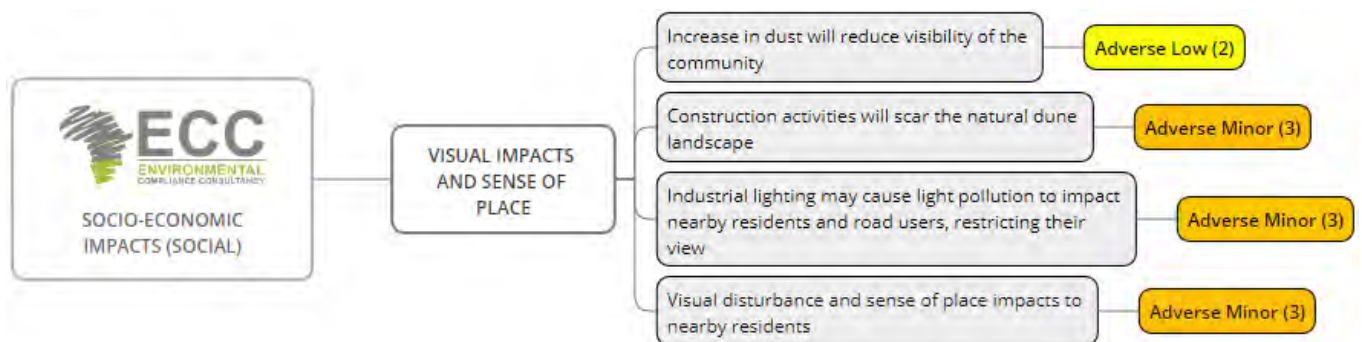


Figure 70 - Visual and sense of place impacts

7.3.2.1 Increase in dust during construction may reduce visibility

During the construction of the Ammonia Pipeline Project, dust emissions will occur during earthworks, which includes trenching and excavation. The impact is adverse, directly interacting with receptors, reversible and over a short period due to the duration of the construction activities (~2 years). The probability of the impact is possible as the dust deposit can reach 140 m from the proposed pipeline, however the nearest sensitive receptors are ~300 m from the proposed pipeline location (Airshed Planning Professionals, 2024).

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 low. Mitigation measures are indicated in the ESMP.

7.3.2.2 Scarring of the natural dune landscape may have visual impacts

The construction activities of the proposed Project involve the removal of potential fauna, flora and topsoil, which disturbs the natural dune landscape. The nature of the impact is adverse, directly impacting the biophysical environment, partly reversible and over a short period due to the duration of the construction activities. The development of the pipeline is likely to change the landscape as any construction activity will disturb a vacant and natural area. However, the Project location is not frequented regularly 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.

7.3.2.3 Industrial lighting during construction at night may restrict the view on nearby residents and road users

It is assumed that construction may occur during nighttime. The industrial lighting used during nighttime activities for the construction of the ammonia pipeline may pose issues for B2 road users, potentially leading to night blindness, and contribute to light pollution in nearby residential areas. The impact is adverse, directly impacting receptors in the immediate area, reversible and over a short period of time as construction of the ammonia pipeline is not expected to exceed 2 years. The industrial lighting could be distracting and, in extreme cases, may obstruct the view of B2 road users, increasing the likelihood of the impact.

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 (~300 m from pipeline) as the residential areas adjacent to the B2 also have continuous lighting. The overall significance of the impact is minor. Mitigation measures are indicated in the ESMP.

7.3.2.1 Visual and sense of place disturbance to nearby residents

The Project could cause a visual disturbance for residents of Kuisebmund, Afrodite Beach and Arandis, as the pipeline may be visible from these residential areas. It is likely that the pipeline between the proposed ammonia production plant at Farm 58 and the ammonia terminal at the north port area will be underground and not visible to people, however the ammonia pipeline between the proposed ammonia terminal and the Walvis Bay existing NAMCOR jetty will be above ground and may cause visual and sense of place disturbance. Additionally, potential rocky terrain near Arandis may cause the pipeline to be constructed above ground at these sections.

The impact is adverse, directly impacting receptors, partly reversible through decommissioning phase and over a long term due to the duration of the Project. The visible sections of the ammonia pipeline occurs where development already exists, and the pipeline intends to follow existing structure as much as possible.

Although the impact is considered on a regional scale, it is not expected to have perceptible change to people's lives and the magnitude of change is minor, resulting in a slight loss of sense of place and a minor visual disturbance for the residents. The overall significance of the impact is moderate.

Table 20 - 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 Possible	Low	Minor	Low (2)
		Construction activities will scar the natural dune landscape	Adverse Direct Partly reversible Short term Local Likely	Low	Minor	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)
Construction and operations		Visual disturbance and sense of place	Adverse Direct Partly reversible	Low	Minor	Minor (3)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		impacts to nearby residents	Long term Local Possible			

7.3.3 NOISE IMPACTS

A noise impact assessment was carried out by Airshed Planning Professionals (Appendix F). The main objective of the noise specialist study was to determine the significant impact of noise generated from the Project during construction on the acoustic environment and noise sensitive receptors (NSRs). Piping noise associated with the movement of the ammonia during operations are usually very localised and not considered significant. 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 proposed construction steps for the pipeline are as follows:

- Step 1: Construction staging areas and storage yards.
- Step 2: Clear cutting the right-of-way (ROW).
- Step 3: Excavating the trench (track hoes with jack hammers are brought in to create the trench).
- Step 4: Pipe transport, stringing, and assembly (segments of pipe transported from stockpiles, welded together and sandblasted).
- Step 5: Obstacles: roads and streams (constructed underneath these obstacles by either boring for shallow depth or using horizontal directional drilling for deeper placement).
- Step 6: Testing and restoration.

The detailed potential noise impacts of the Ammonia Pipeline activities on the Walvis Bay and Arandis communities and other sensitive receptors are shown in Table 21. The impacts from this assessment are presented in Figure 71 for illustrative purposes only, before mitigation. The potential impacts are discussed further in the sections below.

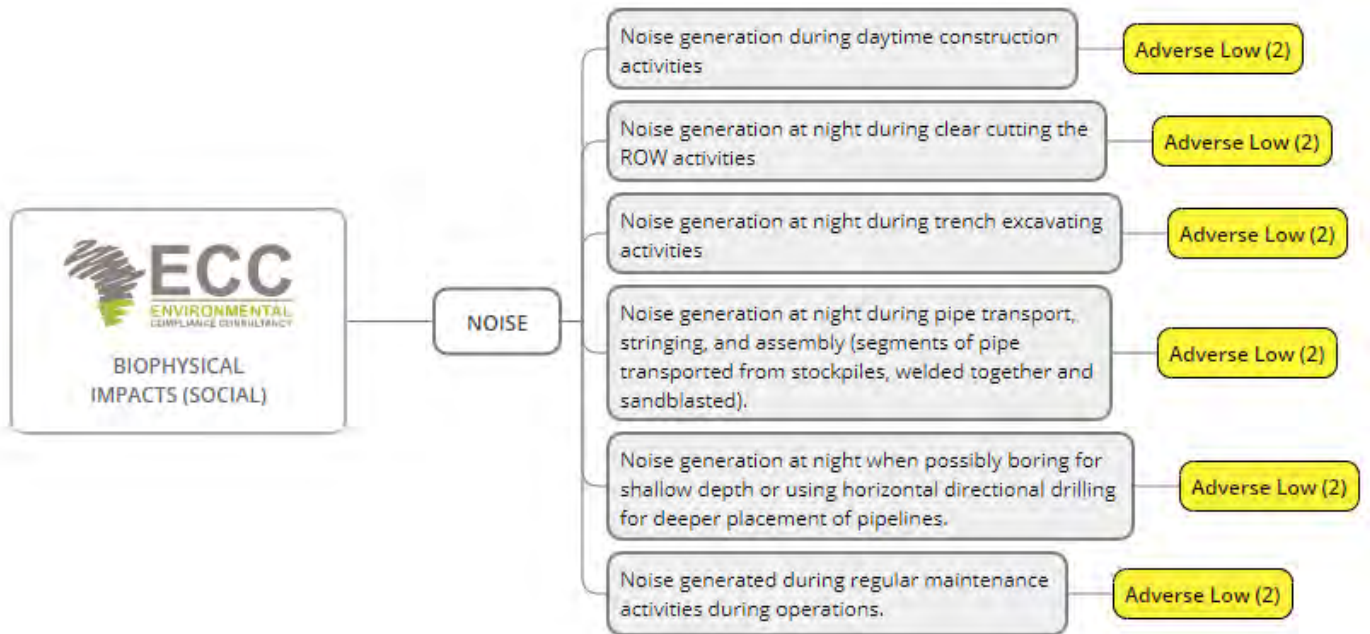


Figure 71 - Noise impacts

A profile of the simulated noise levels due to pipeline construction activities for the various steps (i.e. Step 2 to Step 5), is provided in Figure 72.

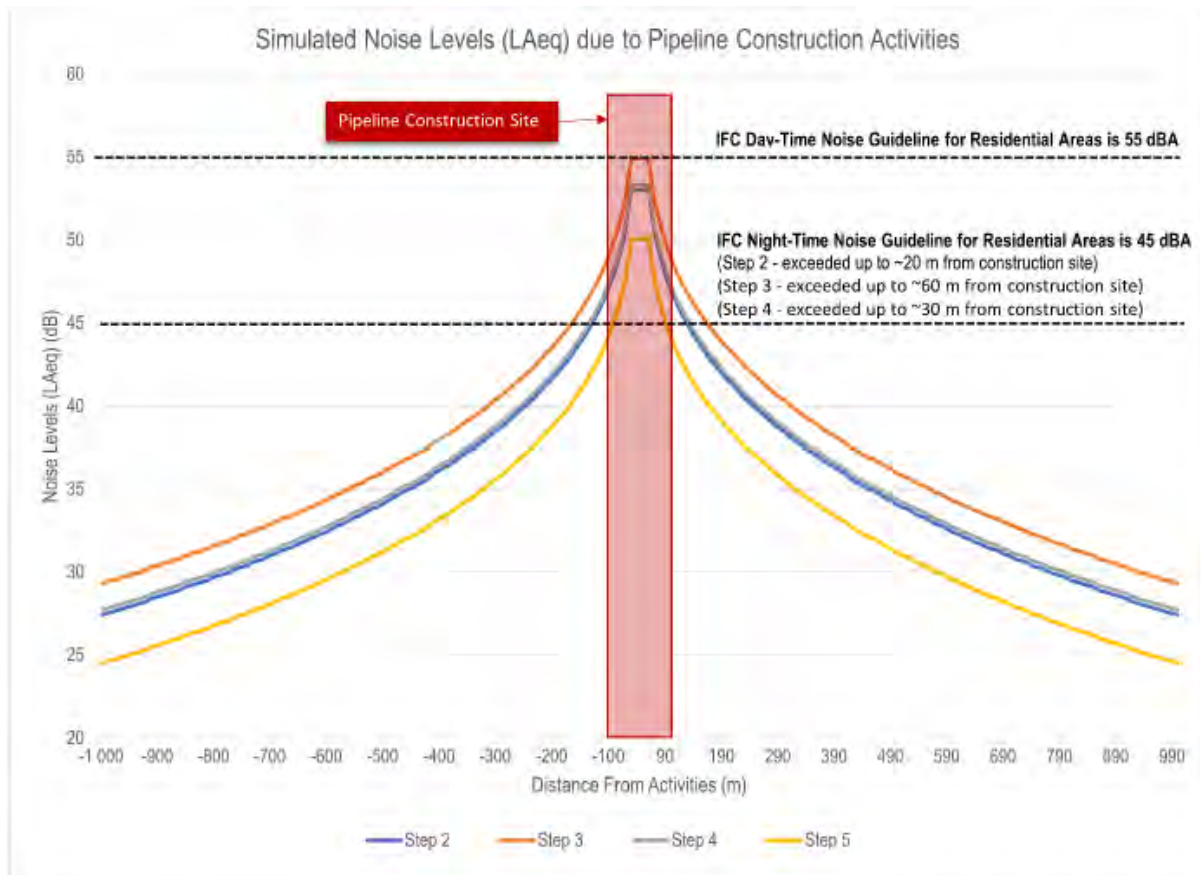


Figure 72 - Profile for simulated day-time noise levels (LAeq) due to pipeline construction activities (Airshed, 2024)

7.3.3.1 Noise generation during daytime construction activities

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 potential NSR's. The impact is reversible, as the noise is expected to subside once the construction phase is completed. The impact will occur over a short period of time due to the foreseen duration of the construction phase (~2 years). Noise generated is expected and is likely to occur.

The magnitude of the impact is negligible, as the IFC day-time noise guidelines for residential areas are not exceeded (40.4 dBA) and no reaction is expected from the 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.

7.3.3.2 Noise generation at night during clear cutting the ROW activities

Pipeline construction typically occurs during the day, however activities can occur during the night depending on the Project's requirements, and the need to minimise disruption to traffic or businesses. Clear cutting the ROW refers to the process of removing branches, vegetation

and other obstacles improving visibility, or removing underground roots from interfering with pipes, thus keeping the pipeline coating in good condition (Lanracorp.inc, 2024).

The impact is impact is adverse, directly affecting potential receptors and reversible. The impact will occur over a short period of time due to the foreseen duration of the construction phase (~2 years). The impact is possible contingent on the Project requirements and timeline.

The sensitivity of the impact is low due to noise slightly extending past the Project site. The IFC night-time noise guidelines for residential areas are exceeded up to 20 m (Step 2) from the construction site (assuming the construction site is up to 100 m from the pipeline). The closest NSR to the pipeline centreline is ~300 m, therefore the IFC noise guidelines for residential areas are not expected to be exceeded at NSRs. The overall significance of the impact is low. Mitigation measures are detailed in the ESMP.

7.3.3.3 Noise generation at night during trench excavation activities

Trench excavation during pipeline construction involves digging activities along a planned route to ensure enough space for the pipeline, support services and the necessary protective coatings. Equipment such as trenchers, backhoe loaders and excavators will be used, which produces noise.

The impact is impact is adverse, directly affecting potential receptors and reversible. The impact will occur over a short period of time due to the foreseen duration of the construction phase (~2 years). The impact is possible as activities during the night are contingent on the Project requirements and timeline.

The sensitivity of the impact is low due to the local scale. The IFC night-time noise guidelines for residential areas are exceeded up to 60 m (Step 3) from the construction site (assuming the construction site is up to 100 m from the pipeline). The closest NSR to the pipeline centreline is ~300 m, therefore the IFC noise guidelines for residential areas are not expected to be exceeded at NSRs. The overall significance of the impact is low. Mitigation measures are detailed in the ESMP.

7.3.3.4 Noise generation at night during pipe transport, stringing, and assembly (segments of pipe transported from stockpiles, welded together and sandblasted)

The pipeline material will be transported using trucks or specialized machinery. Noise will be generated during the transportation of this material as during the onloading and offloading of the material at the desired locations. Stringing, which involves laying the pipeline sections along the planned route will also occur. Assembly of the pipeline includes welding of the pipe sections, which involves welding machinery and equipment that apply heat and pressure to join the pipes (PrimeWeld, 2025) will also occur, generating noise. Furthermore, Sandblasting, which is used to clean and prepare the pipe surface before coating, the high-pressure air and abrasive materials used in the process will generate noise.

The impact is adverse, directly affecting potential receptors and reversible. The impact will occur over a short period of time due to the foreseen duration of the construction phase (~2 years). The impact is possible as activities during the night are contingent on the Project requirements and timeline.

The sensitivity of the impact is low due to the local scale. The IFC night-time noise guidelines for residential areas are exceeded up to 30 m (Step 4) from the construction site (assuming the construction site is up to 100 m from the pipeline). The closest NSR to the pipeline centreline is ~300 m, therefore the IFC noise guidelines for residential areas are not expected to be exceeded at NSRs. The overall significance of the impact is low. Mitigation measures are detailed in the ESMP.

7.3.3.5 Noise generation at night when possibly boring for shallow depth or using horizontal directional drilling for deeper placement of pipelines

The boring of shallow depth and/or using horizontal directional drilling are processes during the placement of the pipeline. The impact is adverse, directly affecting potential receptors and reversible. The impact will occur over a short period of time due to the foreseen duration of the construction phase (~2 years). The impact is possible as activities during the night are contingent on the Project requirements and timeline.

The sensitivity of the impact is low due to the impact occurring on-site. The magnitude of change is negligible as the IFC night-time noise guidelines for residential areas are not exceeded during this activity. The overall significance of the impact is low. Mitigation measures are detailed in the ESMP.

7.3.3.6 Noise generated during regular maintenance activities during operations

Throughout pipeline operations, systematic and non-intrusive monitoring will be implemented as a preventative measure to identify early signs of corrosion, leaks, or ruptures. These activities are essential to ensure the continued safety, reliability, and efficiency of the pipeline system. In parallel, regular maintenance procedures will be carried out to uphold the structural integrity and operational performance of the pipeline. It is likely that noise will be produced during these activities.

The impact is adverse, directly affecting potential nearby receptors and reversible. The impact will be temporary only during maintenance. Maintenance activities are likely as it is important to ensure the pipeline efficiency from a safety and productive perspective. The sensitivity of the impact is low due to the local scale. The magnitude of change is rated negligible due to the very minor and temporary nuisance caused by the noise during maintenance. The overall significance of the impact is low. Mitigation measures are described in the ESMP.

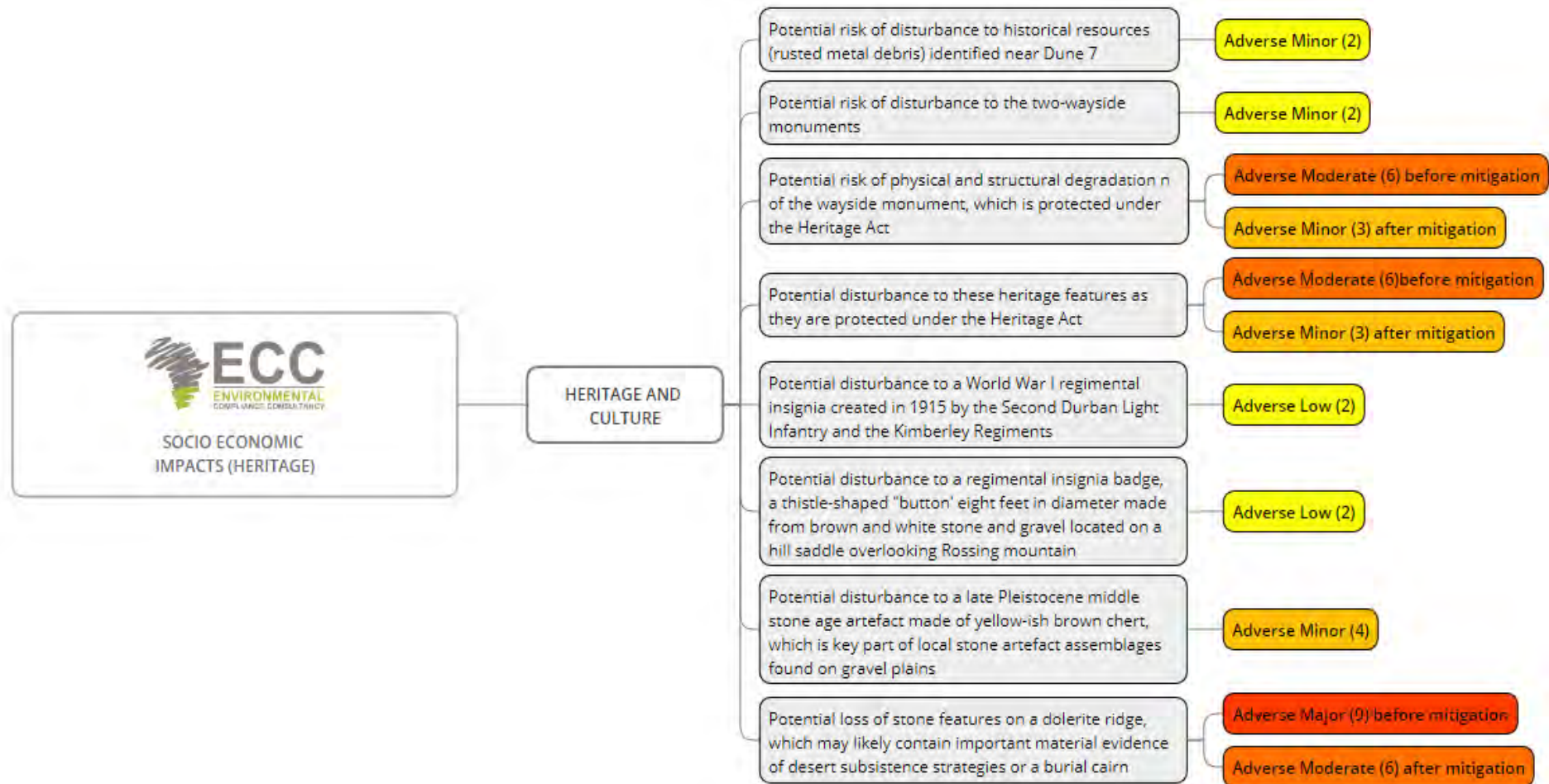
Table 21 - Noise impacts

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction phase	Noise	Noise generation during daytime construction activities	Adverse Direct Reversible Short term Local Likely	Low	Negligible	Low (2)
		Noise generation at night during clear cutting the ROW activities	Adverse Direct Reversible Short term Local Possible	Low	Minor	Low (2)
		Noise generation at night during trench excavating activities	Adverse Direct Reversible Short term Local Possible	Low	Minor	Low (2)
		Noise generation at night during pipe transport, stringing, and assembly (segments of pipe transported from stockpiles, welded together and sandblasted).	Adverse Direct Reversible Short term Local Possible	Low	Minor	Low (2)
		Noise generation at night when possibly boring for	Adverse Direct Reversible Short term On-site	Low	Negligible	Low (2)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		shallow depth or using horizontal directional drilling for deeper placement of pipelines.	Possible			
Maintenance activities during operations		Noise generated during regular maintenance activities during operations	Adverse Direct Reversible Temporary Local Likely	Low	Negligible	Low (2)

7.3.4 HERITAGE IMPACTS

The heritage impact assessment section evaluates the potential disturbance to heritage features identified along the proposed ~112 km ammonia pipeline route (both hot and cold). The National Heritage Act No 27 of 2004 serves as the regulatory framework for the identification, protection, preservation, management and promotion of Namibia's heritage resources (sites, structures and artefacts). The significance of these heritage resources is assessed based on their archaeological, palaeontological, historical value, as well as their aesthetic appeal, uniqueness, state of preservation and research potential (Nankela, 2024). Construction activities and other anthropogenic activities could potentially unearth and disturb heritage resources. Therefore, it is important that best practise measures are enhanced across all operational areas of the Project to avoid, minimise or mitigate negative impacts on identified heritage resources. An overview of the potential impacts, before mitigation and after mitigations, is shown in Figure 73, for illustrative purposed only.



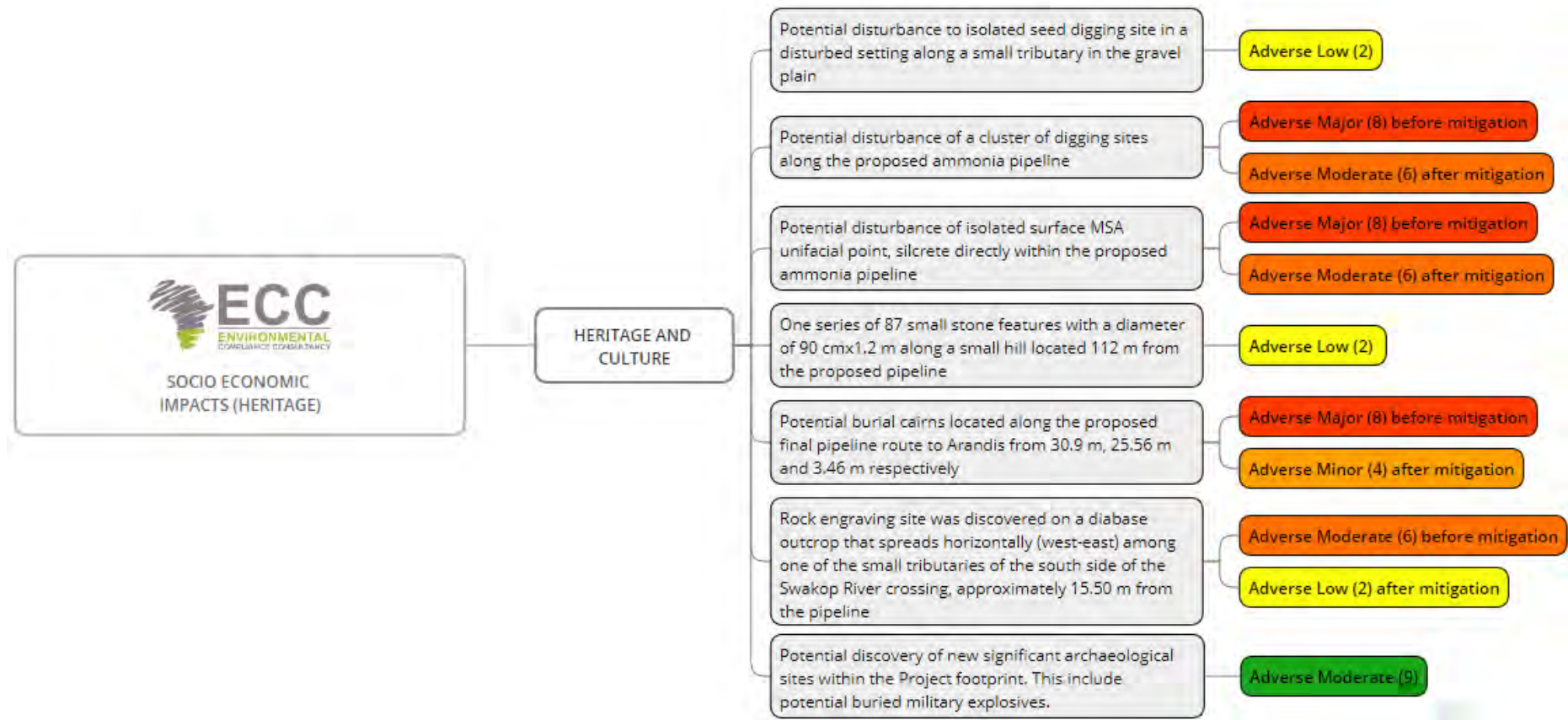


Figure 73 - An overview of the potential heritage impacts

The archaeological heritage survey was undertaken by Dr. Nankela in mid-2024 and aimed to identify and document archaeological sites, artifacts and other heritage resources in the immediate Project area. The area of interest stretches 100 m to either side of the pipeline, although heritage resources outside this corridor were also recorded. The field survey identified twenty-two (22) heritage features in the vicinity of the ~112 km ammonia proposed route, ~5 km outside of Arandis (hot) to the ammonia terminal area (cold). Chapter 5, section 5.5 shows the overview of the heritage findings in the Project area.

The archaeologist report is provided in Appendix G, and the impacts are discussed in detail in the sections below.

7.3.4.1 Potential risk of disturbance to historical resources (rusted metal debris) identified near Dune 7

Five (5) potential historic sites (site 1 to site 4 and site 7 as shown in Figure 6) in the High Dune Belt area were identified, comprising of an isolated heap of discarded debris of broken bottles, rusted canned beef cans, unidentified corrugated materials, buried and surface corrugated asbestos structures with fishing nets and baskets. This likely belonged to “bokkop soldiers” who participated in military training exercises, fishing and trading activities with indigenous traders between the 17th and 19th centuries. These sites are situated between 180 and 200 metres from the proposed ammonia pipeline and their significance in terms of the Heritage Act No. 27 of 2004 is considered very low (Nankela, 2024). It is unlikely that they will be encroached upon or disturbed as they are located over 100 m from the pipeline corridor. The nature of this impact is adverse and direct. This impact is irreversible, and the magnitude of change is low. The duration of the impact is permanent; the extent of the impact is onsite, the probability of this impact occurring is unlikely and the sensitivity of the receptor is low. Therefore, this impact has been rated low (Table 22).

7.3.4.2 Potential risk of disturbance to the two-wayside monuments

The field survey also identified two (2) wayside crosses (with no human remains), likely honouring victims of the road accidents between Walvis Bay and Swakopmund as shown in chapter 5, section 5.5.2. While these crosses are regarded as sacred features, they are not considered significant under the National Heritage Act No. 27 of 2004 and are unlikely to be encroached upon or disturbed as they are located between 120 and 500 m away from the proposed pipeline route. The nature of this impact is adverse and direct. This impact is irreversible, and the magnitude of change is low. The duration of the impact is permanent; the extent of the impact is onsite, the probability of this impact occurring is unlikely and the sensitivity of the receptor is low. Therefore, this impact has been rated low.

7.3.4.3 Potential risk of physical and structural degradation of the wayside monument (Maxuilili G.I. Nathaniel). The monument is protected under the Heritage Act No.27 of 2004

The study also recorded a wayside monument, dedicated to Maxuilili G.I. Nathaniel, a veteran of Namibia’s struggle for independence, who died at the site on 23 June 1999 (as shown in

chapter 5, section 5.5.3). This monument is located approximately 800 m from the proposed ammonia pipeline route (hot) and is considered sacred under the National Heritage Act No. 27 of 2004. His remains were re-buried at the declared Heroes Acre in Windhoek. The monument is unlikely to be disturbed as it is further away from the pipeline corridor, although flagged as a "no go zone" due to its figurative status. The nature of this impact is adverse and direct. This impact is irreversible, and the magnitude of change is low. The duration of the impact is permanent; the extent of the impact is onsite, the probability of this impact occurring is unlikely and the sensitivity of the receptor is high. Therefore, this impact has been rated moderate.

7.3.4.4 Potential disturbance to a World War I regimental insignia created in 1915 by the Second Durban Light Infantry and the Kimberley Regiments.

Field surveys have identified several historically significant features within the Namib Desert, particularly related to its historical use as a station along the former narrow-gauge railway between Swakopmund and Karibib. These features are notably concentrated around key World War I battlefields at Reit, Pforte, Trekkopje, and Jakalswaters (Kinahan and Stejskal 2011). One prominent example is a regimental insignia constructed from stone by the Durban Light Infantry and Kimberley Regiments (Second Battalions) during the April–May 1915 campaign. This feature, located on Farm 158, was declared a national monument in 1915 (chapter 5, section 5.5.4). Although the site is of national heritage significance under the National Heritage Act (Act No. 27 of 2004), it is not considered vulnerable and lies at a safe distance of approximately 284.49 metres from the proposed ammonia pipeline alignment. The nature of the impact is adverse, and the type of impact is direct. The impact is irreversible and magnitude of change of the impact is high. The duration of the impact is permanent, and the extent of the impact is national. The probability of this impact occurring due to its proximity to the pipeline is unlikely and the sensitivity and value of the receptor is low, therefore the overall impact is rated adverse low.

7.3.4.5 Potential disturbance to a regimental insignia badge, a thistle-shaped "button" eight feet in diameter, made from brown and white stone and gravel located on a hill saddle overlooking Rossing Mountain

The regimental insignia was constructed during the World War I campaign (circa April–May 1915) by the Second Battalion of the Kimberley Regiment and the Durban Light Infantry. Its historical importance is associated with a broader network of World War I heritage features found throughout the Namib Desert. The site lies beyond the boundaries of the proposed ammonia pipeline route. The nature of the impact is adverse, and the type of impact is direct. The impact is irreversible and magnitude of change of the impact is high. The duration of the impact is permanent, and the extent of the impact is national. The probability of this impact occurring due to its proximity to the pipeline is unlikely and the sensitivity and value of the receptor is low, therefore the overall impact is rated adverse low.

- 7.3.4.6 *potential disturbance to a late Pleistocene Middle Stone Age artefact made of yellowish-brown chert, which is a key part of local stone artefact assemblages found on gravel plains.*

The Late Pleistocene Middle Stone Age artefacts identified at this site, primarily composed of chert, appear to be in their primary depositional context. This enhances the site's research value, as the artefacts represent a significant component of local stone tool assemblages commonly found on the gravel plains of the Namib Desert, particularly within hydrothermal vein quartz and crystalline quartz geological settings. The site holds heritage significance, rated as 3 under the National Heritage Act (Act No. 27 of 2004), with a vulnerability rating of 2 as indicated in the heritage study (Appendix G). Although it is situated approximately 74.06 metres from the proposed ammonia pipeline and will not be directly impacted, a minimum buffer zone of 50 metres is recommended. Additionally, the site should be clearly designated as a no-go area to prevent any incidental disturbance. The nature of the impact is adverse, and the type of impact is direct. The impact is irreversible and magnitude of change of the impact is high. The duration of the impact is permanent, and the extent of the impact is national. The probability of this impact occurring due to its proximity to the pipeline is unlikely and the sensitivity and value of the receptor is medium, therefore the overall impact is rated adverse minor.

- 7.3.4.7 *Potential loss of stone features on a dolerite ridge, which may likely contain important material evidence of desert subsistence strategies or a burial cairn*

A cluster of at least four well-preserved stone features, likely disturbed cairns, has been identified along the crest of a dolerite ridge. These features are located approximately 6.41 metres from the proposed ammonia pipeline route towards Arandis, placing them within a potentially impacted zone. Given their proximity, the site is considered vulnerable to disturbance from construction activities. However, the implementation of a buffer zone of 5 to 10 metres, along with the designation of the immediate area as a no-go zone, would effectively safeguard the features. The site is considered significant under the National Heritage Act (Act No. 27 of 2004), and with a vulnerability rating of 4, it is at high risk of direct impact if appropriate mitigation measures are not enforced. The nature of the impact is adverse, and the type of impact is direct. The impact is irreversible and magnitude of change of the impact is high. The duration of the impact is permanent, and the extent of the impact is national. The probability of this impact occurring due to its proximity to the pipeline is possible and the sensitivity and value of the receptor is high, therefore the overall impact is rated adverse major.

- 7.3.4.8 *potential disturbance to isolated seed digging site in a disturbed setting along a small tributary in the gravel plain*

The isolated seed digging site is likely associated with short-term occupations by small hunter-gatherer groups who extracted wild grass seeds from underground caches created by harvester ants (*Messor* spp.). Located near a river course, the site shows signs of slight erosion, which diminishes its overall scientific value. Consequently, it has been assigned a significance rating of 2 under the National Heritage Act (Act No. 27 of 2004), with a

vulnerability rating of 2 out of 5. Although it is situated approximately 74.06 metres from the proposed ammonia pipeline and is not expected to be directly affected, the establishment of a 50-metre buffer zone and designation of the site as a no-go area are recommended to ensure its protection. The nature of the impact is adverse, and the type of impact is direct. The impact is irreversible and magnitude of change of the impact is high. The duration of the impact is permanent, and the extent of the impact is national. The probability of this impact occurring due to its proximity to the pipeline is unlikely and the sensitivity and value of the receptor is low, therefore the overall impact is rated adverse low.

7.3.4.9 Potential disturbance of a cluster of digging sites along the proposed ammonia pipeline

A cluster of at least four seed digging sites (chapter 5, section 5.5.9), located at GPS coordinates Lat: 22°56'6.10"S and Long: 14°37'21.37"E, have been identified within the proposed ammonia pipeline corridor on the calcite gravel plain. The site measures approximately 1 to 2 meters in diameter and is believed to reflect short-term occupation by small hunter-gatherer groups who harvested wild grass seeds from underground caches created by harvester ants (*Messor* spp.) in nearby river courses and tributaries. The site is well preserved, dispersed within 5 to 10 meters of each other, and are clearly identifiable through satellite imagery. Associated artefacts include a superficially rusted small drum, likely in secondary deposition. The site holds moderate significance under the National Heritage Act (Act No. 27 of 2004) with a significance rating of 3 but are highly vulnerable due to their direct location within the pipeline path. The nature of the impact is adverse, and the type of impact is direct. The impact is irreversible and magnitude of change of the impact is high. The duration of the impact is permanent, and the extent of the impact is national. The probability of this impact occurring due to its proximity to the pipeline is likely and the sensitivity and value of the receptor is medium, therefore the overall impact is rated adverse major.

To mitigate potential impacts, recommended management measures include conducting test excavations to confirm the nature of these features or adjusting the pipeline alignment by at least 50 meters to avoid the cluster. Additionally, the area should be formally designated as a no-go zone to protect these heritage resources.

7.3.4.10 Potential disturbance of isolated surface MSA unifacial point, silcrete directly within the proposed ammonia pipeline

A cluster of at least four seed digging sites (Figure 25), located at GPS coordinates Lat: 22°56'6.10"S and Long: 14°37'21.37"E, has been identified within the proposed ammonia pipeline corridor on the calcite gravel plain. Each site measures approximately 1 to 2 meters in diameter and is believed to reflect short-term occupation by small hunter-gatherer groups who harvested wild grass seeds from underground caches created by harvester ants (*Messor* spp.) in nearby river courses and tributaries. The sites are well preserved, dispersed within 5 to 10 meters of each other, and are clearly identifiable through satellite imagery. Associated artefacts include a superficially rusted small drum, likely in secondary deposition. These sites hold moderate significance under the National Heritage Act (Act No. 27 of 2004) with a

significance rating of 3 but are highly vulnerable due to their direct location within the pipeline path. The nature of the impact is adverse, and the type of impact is direct. The impact is irreversible and magnitude of change of the impact is high. The duration of the impact is permanent, and the extent of the impact is national. The probability of this impact occurring due to its proximity to the pipeline is likely and the sensitivity and value of the receptor is medium, therefore the overall impact is rated adverse major.

To mitigate potential impacts, recommended management measures include conducting test excavations to confirm the nature of these features or adjusting the pipeline alignment by at least 50 meters to avoid the cluster. Additionally, the area should be formally designated as a no-go zone to protect these heritage resources.

7.3.4.11 Potential disturbance to these heritage features (superficial shell midden accumulations of skeletal remains of marine and terrestrial vertebrates). These are protected under the Heritage Act.

Lastly, two (2) superficial shell-midden accumulations containing skeletal remains of marine and terrestrial vertebrates were identified at the extinct mouth of the Tumas Rivers and tidal lagoon, dating to approximately 1 600 years. While the typology of these shell middens is unknown, the remains are linked to more recent human activities associated with the construction of the coastal railway and coastal defence installation at Rand Rifles (Nankela, 2024). These sites are significant under the Heritage Act No. 27 of 2004 and as a result have been flagged as “no go zone”. However, they are neither sensitive nor vulnerable to disturbance as they are located between 127 and 129 m away from the proposed pipeline route (cold).

A significant portion of the gravel plain has been disturbed by ongoing infrastructure development and recreational activities, including quad biking and off-road driving around the Dune 7 area and the development of utility service infrastructure (installation of water pipelines, overhead powerline grid and renewable energy facilities). Impacts on archaeological sites or heritage resources identified in the Project area are expected to be irreversible and will impact the site’s cultural identity, community cohesion and historical understanding. The extent of the impact will be confined to the site and as with all impacts on archaeological sites and resources, the duration of impact is expected to be permanent.

While none of the identified heritage resources are located within 100 m of the pipeline route, the probability of encroaching or disturbing these resources is low. Consequently, the magnitude of impact is assessed as minor. Although the wayside monument dedicated to Maxuili G.I Nathaniel and the superficial shell midden are not vulnerable to disturbances, they are regarded highly sensitivity due to their significant status under the Heritage Act No. 27 of 2004. As such, these sites should be preserved to protect their cultural and historical value. During the environmental clearance application process, the Proponent will seek consent from the National Heritage Council (NHC) for these sites and comply with the buffer

zones established for these sites. Overall, the potential impact is assessed to range from adverse minor to adverse moderate in relation to Project footprint and significance in terms of the Heritage Act No. 27 of 2004. The nature of this impact is adverse and direct. This impact is irreversible, and the magnitude of change is low. The duration of the impact is permanent; the extent of the impact is onsite, the probability of this impact occurring is unlikely and the sensitivity of the receptor is high. Therefore, this impact has been rated adverse moderate.

7.3.4.12 Potential disturbance to stone features near the proposed pipeline

During the second phase of field surveys conducted, a group of gathered stone features on the eastern side of a dolerite ridge was observed as shown in Chapter 5 section 5.5.12. These features measure 90 cm x 1.2 m while overlooking the railway line and flat plains and is 112 m from the proposed site. The stones are not of heritage value, as they were likely gathered, collected, and then crushed as ballast stone for the construction of the historic railway between 1897 and 1902 that runs between Swakopmund and Omaruru (RCHeritage Services CC, 2025).

The nature of the impact is adverse, direct and permanent should the site be disturbed. The extent of the impact will be confined to the site and as with all impacts on archaeological sites and resources. Due to the distance between the project site and the archaeological finding, the probability of the impact is unlikely. The magnitude of the impact is minor, according to the heritage impact assessment, the site is not vulnerable to the proposed final pipeline route to Arandis. The sensitivity of the impact is low due to the low heritage value. Overall, the significance of the impact is adverse low.

7.3.4.13 Potential disturbance of burial cairns located along the proposed final pipeline route to Arandis

Potential burial cairns were observed in four (4) different sites as shown in Chapter 5, Figure 17. The first site (Site 14) where burial cairns were identified featured structures composed of loose diabase fragments arranged in roughly circular patterns, with diameters ranging from 1.2 to 1.6 meters. The second site (Site 15) contained cairns of similar morphology, constructed from medium-sized loose diabase stones, also arranged in roughly circular formations, with diameters between 1.4 and 1.7 meters.

The third site (Site 16) was recorded during this field campaign and differed from the previous ones using small, loose quartzite fragments arranged in a near-perfect circular form, measuring between 1.3 and 1.5 meters in diameter. A final potential burial cairn (Site 17) was also documented during this campaign. It consisted of diabase fragments arranged in a roughly elliptical shape, with dimensions ranging from 0.8 to 1.6 meters in diameter. The nature of the impact is adverse, direct and permanent should the site be disturbed. This potential burial feature is significant in terms of the National Heritage Act no. 27 of 2004 and therefore the extent is national, and the impact is rated likely as the nearest sites are found is

3.46 m away. The magnitude of change is major due to the national significance, and the sensitivity is moderate. The overall significance is adverse major prior to mitigations.

It is recommended by archaeological/heritage specialist that the burial cairn sites must undergo GPR surveys and test excavations are also required at potential burial cairns to confirm their identities as burial sites in the unlikely event that they cannot be avoided. These actions require a heritage permit and heritage consent if the sites are confirmed to be burial sites, as exhumation, relocation and reburial will then be commissioned to relocate them outside the proposed development.

7.3.4.14 Potential impacts to Rock engraving site among one of the small tributaries on the south side of the Swakop River crossing

A rock engraving site was identified on the diabase ridge, in the vicinity of the Richthofen in Naukluft National Park. The engravings are housed on an upright panel facing up but with little patina, making it difficult to see for an untrained eye as shown in Chapter 5, Figure 18. All the figures are quite large in morphology, measuring between 20 cm x 1.4 m, and have been executed in light pecking and abrasion. The nature of the impact is adverse, direct and permanent should it be disturbed during the pipeline project.

Rock art is significant in terms of the National Heritage Act no. 27 of 2004, therefore, the magnitude of change was rated moderate. The sensitivity of the impact is rated low as the artworks are poorly preserved, largely due to water action and the location of the site is 53,3 m away. The overall significance is adverse moderate prior to mitigations.

It is recommended by archaeological/heritage specialist that the rock engraving site must undergo GPR survey. Additionally, it is advised to deviate behind the outcrop and erect buffer zones at 10 m and 20 m from the pipeline.

7.3.4.15 Potential discovery of archaeological or paleontological remains (including possible burial sites, military explosives) buried or preserved under shallow sedimentary deposits in the Project area

The field survey conducted mainly identified surface archaeological features within the immediate Project area. There is potential that buried sub-surface archaeological, paleontological or historic resources within the Project footprint may be discovered during site preparation, construction and maintenance activities or exposed by natural gradual aeolian erosions over time. No major earthworks are anticipated; however, this does not preclude the possibility discovering military explosives particularly in the Dune 7 area, which served as a military training ground for the South African Defence Force in the 1960's. Heritage resources and potential disturbances could result from employees' lack of awareness. It is crucial to exercise caution in the Project area, particularly in the unlikely event that military explosives are discovered.

The probability of impact is assessed as medium (possible) as the Project area is associated with historical military and marine activities. The impact will be confined to the Project site as Project work will be confined exclusively to the pipeline corridor. The duration of impact is anticipated to be short-term due to the short duration of construction activities (~2 years). The magnitude of change and sensitivity of impact are rated high as there is potential to discover military explosives, which would warrant attention for safe extraction, storage or preservation. This impact is considered as beneficial as these discoveries will enable the Proponent, contractors and sub-contractors to effectively act and preserve these resources in accordance with streamlined procedures, best practises and standard operating procedures. Effective preservation not only reduces risks related to potential hazards but also enhances regulatory compliance and promotes occupational health and safety of the workforce.

The following critical management measures, identified by Nankela (2024) are also included in the ESMP:

- The Chance Find Procedure should be adopted, and the guidelines should be followed in the event that heritage features are discovered in the Project area;
- Restrict Project activities to the pipeline corridor while adhering to the buffer zones for 'no go zones';
- Orientate fieldwork employees, contractors and subcontractors on potential surface and sub-surface heritage finds in the Project area, particularly potential military explosives in the Dune 7 area;
- Conduct regular site inspection and compliance monitoring to promptly identify any potential encroachments or disturbance of heritage resources; and
- Ensure that internal standard operating procedures (SOPs) include the preservation of heritage resources in the Project area.

Table 22 - Heritage impacts prior to mitigation measures

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction and maintenance activities	Cultural heritage (five historical sites located near Dune 7)	Potential risk of disturbance to historical resources (rusted metal debris) identified near Dune 7	Adverse Direct Irreversible Permanent On-site Unlikely	Low	Minor	Adverse Low (2)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
	Cultural heritage (two wayside monument with no human remains)	Potential risk of disturbance to the two-wayside monuments	Adverse Direct Irreversible Permanent On-site Unlikely	Low	Minor	Adverse Low (2)
	Cultural heritage (wayside monument honouring Maxuilili G.I Nathaniel)	Potential risk of physical and structural degradation of the wayside monument, which is protected under the Heritage Act	Adverse Direct Irreversible Permanent On-site Unlikely	High	Minor	Adverse Moderate (6)
	Cultural heritage (superficial shell midden accumulations of skeletal remains of marine and terrestrial vertebrates)	Potential disturbance to these heritage features as they are protected under the Heritage Act	Adverse Direct Irreversible Permanent On-site unlikely	High	Minor	Adverse Moderate (6)
	Cultural heritage (World War I regimental insignia created in 1915)	Potential disturbance to a World War I regimental insignia created in 1915 by the	Adverse Direct Irreversible Permanent National Unlikely	Low	Major	Adverse Low (2)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
		Second Durban Light Infantry and the Kimberley Regiments				
	Cultural heritage (regimental insignia badge, a thistle-shaped "button")	Potential disturbance to a regimental insignia badge, a thistle-shaped "button" eight feet in diameter made from brown and white stone and gravel located on a hill saddle overlooking Rossing mountain	Adverse Direct Irreversible Permanent National Unlikely	Low	Major	Adverse Low (2)
	Cultural heritage (late Pleistocene middle stone age artefact made of yellow-ish brown chert)	Potential disturbance to a late Pleistocene middle stone age artefact made of yellow-ish brown chert, which is key part of local stone artefact assemblages found on gravel plains	Adverse Direct Irreversible Permanent National Unlikely	Medium	Major	Adverse Minor (4)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
	Cultural heritage (stone features on a dolerite ridge)	Potential loss of stone features on a dolerite ridge, which may likely contain important material evidence of desert subsistence strategies or a burial cairn	Adverse Direct Irreversible Permanent National Possible	High	Major	Adverse Major (9)
	Cultural heritage (isolated seed digging site)	Potential disturbance to isolated seed digging site in a disturbed setting along a small tributary in the gravel plain	Adverse Direct Irreversible Permanent On-site Unlikely	Low	Major	Adverse Low (2)
	Cultural heritage (cluster of digging sites)	Potential disturbance of a cluster of digging sites along the proposed ammonia pipeline	Adverse Direct Irreversible Permanent National Likely	Medium	Major	Adverse Major (8)
	Cultural heritage (isolated surface MSA unifacial point)	Potential disturbance of isolated surface MSA unifacial point, silcrete directly within	Adverse Direct Irreversible Permanent National Likely	Medium	Major	Adverse Major (8)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
		the proposed ammonia pipeline				
	Cultural heritage (stone feature)	One series of 87 small stone features with a diameter of 90 cmx1.2 m along a small hill located 112 m from the proposed pipeline	Adverse Direct Irreversible Permanent Onsite Unlikely	Low	Low	Adverse Low (2)
	Cultural heritage (4 Potential burial cairn)	Potential burial cairns located along the proposed final pipeline route to Arandis from 30.9 m, 25.56 m and 3.46 m respectively	Adverse Direct Irreversible Permanent National Likely	Medium	Moderate	Adverse Major (8)
	Cultural heritage (rock engraving site)	Rock engraving site was discovered on a diabase outcrop that spreads horizontally (west-east) among one of the small tributaries of the south side of the Swakop River	Adverse Direct Irreversible Permanent Regional Likely	Low	Moderate	Adverse Moderate (6)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
		crossing, approximately 15.50 m from the pipeline				
	Cultural heritage	Potential discovery of new significant archaeological sites within the Project footprint.	Beneficial Direct Permanent National Possible	High	Major	Beneficial Moderate (9)

7.3.5 TRAFFIC IMPACTS

A traffic impact assessment was conducted by Zutari Namibia (Pty) Ltd in September 2024 for the pipeline portion between the Walvis Bay north port area and the extent between Farm 58 and Arandis (Appendix H) to evaluate the impact of added traffic on the community and existing road conditions. The impacts of added traffic due to the pipeline activities on the commuters, nearby communities, motorists and tourists before and after mitigations are illustrated in Figure 74 and shown in Table 26.

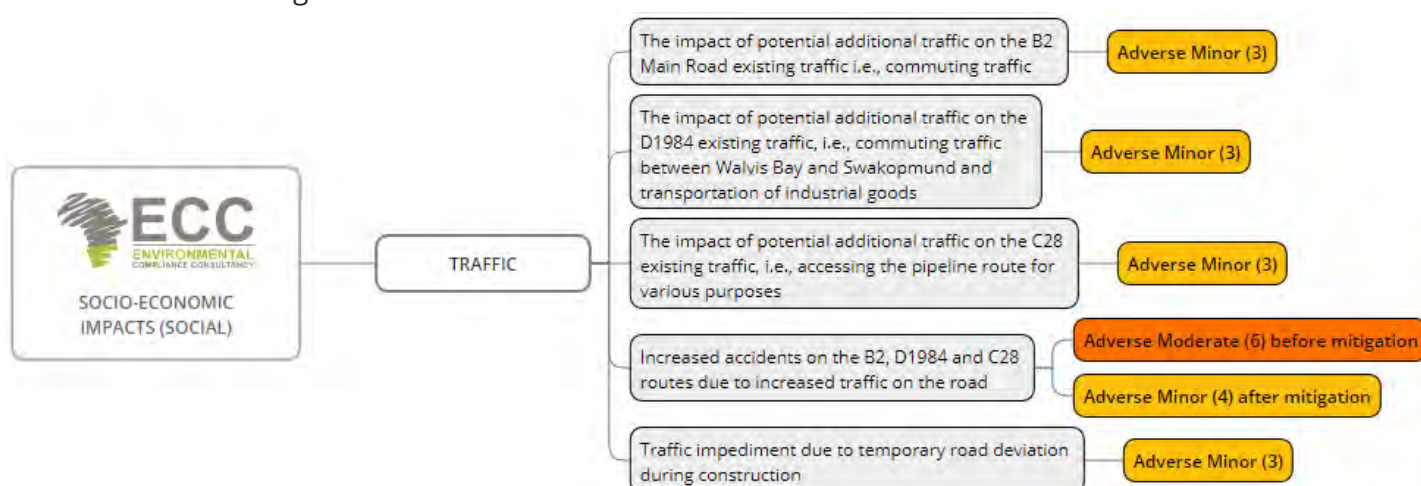


Figure 74 - Overview of traffic impacts

7.3.5.1 Impacts of potential additional traffic on the B2 main road existing traffic

The proposed Project may generate increased traffic on the B2 main road 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 (25 years). The impact is likely, as

transportation will be utilised during both construction and operation for various Project-related activities, as detailed below in the additional traffic data.

Additional traffic data

Additional traffic will include materials transported during construction, approximately 30-100 employees to be transported, monitoring of operations and daily to weekly removal of waste. The additional traffic during the Ammonia Pipeline Project is estimated below, as shown in Table 23 (Zutari Namibia, 2024).

Table 23 - Estimated average daily traffic (ADT) volumes on the B2 during the construction and operations of the Project

Description	ADT Light	ADT Heavy	ADT Total
B2:			
Vehicles added during the construction phase	10	16	26
Vehicles added during the operational phase	6	4	10

The sensitivity of the impact is low, as it is not expected to alter traffic in a way that would affect people's livelihoods. The magnitude of change is negligible due to the limited increase in traffic on the B2 road. The overall significance of the impact is minor. Mitigation measures are indicated in the ESMP.

7.3.5.2 The impact of potential additional traffic on the D1984 existing traffic

The Ammonia Pipeline Project will result in additional traffic on D1984 throughout the Project's duration. The impact is adverse, directly affecting road users, reversible and over the long term (25 years). The impact is likely, as transportation will be utilised during both construction and operations on D1984 as this route will be used to access the ammonia production plant to the ammonia pipeline area and other Project-related activities, as detailed below in the additional traffic data.

Additional traffic data

Taking into consideration materials transported during construction, monitoring of activities, number of employees and daily removal of waste; the additional traffic during the Ammonia Pipeline Project is estimated below, as shown in Table 24 (Zutari Namibia, 2024).

Table 24 - Estimated average daily traffic (ADT) volumes on the D1984 during the construction and operations of the Project

Description	ADT Light	ADT Heavy	ADT Total
D1984:			
Vehicles added during the construction phase	10	16	26
Vehicles added during the operational phase	6	4	10

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 due to the limited increase in traffic on the D1984 road. The overall significance of the impact is minor. Mitigation measures are indicated in the ESMP.

7.3.5.3 The impact of potential additional traffic on the C28 existing traffic

The Ammonia Pipeline Project will result in additional traffic on C28 throughout the Project's duration. The C28 route will be used when accessing the Naukluft ammonia pipeline route, as the line moves perpendicular to the road. The impact is adverse, directly affecting road users on that road, reversible and over the long term (25 years). The impact is likely, as C28 will be utilised during both construction and operations to access the pipeline, as shown in the additional traffic data.

Additional traffic data

During the Project, the construction team, materials for construction, foremen, waste removal as well as infield surveys, maintenance and repairs during operations is considered in the study. In Table 25, the estimated additional traffic expected during the Ammonia Pipeline Project.

Table 25 Estimated average daily traffic volumes on C28 during the construction and operations of the Project

Description	ADT Light	ADT Heavy	ADT Total
C28:			
Vehicles added during the construction phase	5	7	12
Vehicles added during the operational phase	6	4	10

The sensitivity of the impact is low, as it is not expected to alter traffic in a way that would affect people's livelihoods. The magnitude of change is negligible due to the limited increase in traffic on the C28 road. The overall significance of the impact is minor. Mitigation measures are indicated in the ESMP.

7.3.5.4 Increased accidents on the B2, D1984 and C28 routes due to increased traffic on these roads

The increased traffic on the B2 main road, D1984 and C28 may result in added risk of potential traffic accidents on these roads. The impact is adverse, directly affecting all road users, irreversible as serious injuries may be sustained, or lives may be lost. The extent of the impact is regional due to the extent of roads that may be used as a result of the Project. The impact may be possible and over a long period due to the duration of the Project (25 years).

The sensitivity of the impact is medium due to the regional scale and extent of the roads impacted by the Project and the magnitude of change is major due to potential serious injuries sustained or death that may result from road accidents. The overall significance of the impact is moderate.

Mitigation measures include:

- Improve road markings and signage at high risk areas;
- Proper scheduling of trips to avoid peak traffic hours especially with heavy duty vehicles;
- Utilise less congested roads i.e., C28 and D1984; and
- Explore opportunities to widen the B2 road in areas with high traffic volumes.

7.3.5.5 Traffic impediment due to temporary road deviation during construction

During construction of the ammonia pipeline, some of the roads may be temporarily deviated at certain crossings which may cause slowed traffic at certain sections and may be a nuisance to road users. The impact is adverse, and reversible once the construction phase has been completed. The impact will likely only occur during construction which is over a short period (~2 years).

The sensitivity of the impact is low due to the local scale as only a portion of the road will be deviated, and the magnitude of change is moderate due to the number of road users that will be delayed. The overall significance of the impact is minor. The mitigation measures are described in the Project ESMP.

Table 26 - Traffic impacts

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction and operations	Community, motorists, tourists	The impact of potential additional traffic on the B2 Main Road existing traffic i.e., commuting traffic	Adverse Direct Reversible Long term Regional Likely	Low	Negligible	Minor (3)
		The impact of potential additional traffic on the D1984 existing traffic, i.e., commuting traffic between Walvis Bay and Swakopmund and	Adverse Direct Reversible Long term Local Likely	Low	Negligible	Minor (3)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		transportation of industrial goods				
		The impact of potential additional traffic on the C28 existing traffic, i.e., accessing the pipeline route for various purposes	Adverse Direct Reversible Long term Local Likely	Low	Negligible	Minor (3)
		Increased accidents on the B2, D1984 and C28 routes due to increased traffic on the road	Adverse Direct Irreversible Long term Regional Possible	Medium	Major	Moderate (6)
		Traffic impediment due to temporary road deviation during construction	Adverse Direct Reversible Short term Local Likely	Low	Moderate	Minor (3)

7.3.6 SOCIAL/COMMUNITY IMPACTS

The significant social/community impacts before mitigation are summarised in Figure 75 for illustrative purposes. Details related to each specific impact are discussed further in this section and in Table 27.

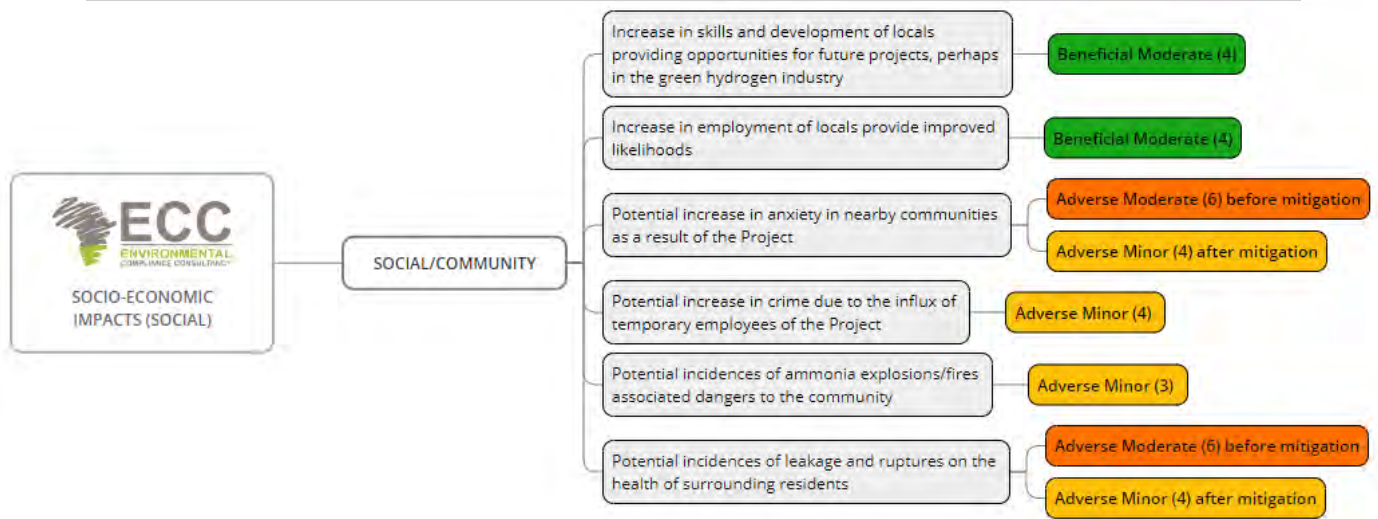


Figure 75 - Social/community impacts

7.3.6.1 Impacts on the skills and development of employees

Skills development is widely acknowledged as a key factor in Namibia's socio-economic progress. Green hydrogen, as a component of the green economy, is relatively new to Namibia, and it has been noted that many new and emerging green jobs typically require advanced qualifications and managerial expertise (International Labour Organisation). Cleanergy Solutions Namibia has established a green hydrogen academy to offer comprehensive training for future employees in the field. Training includes the production and usage of hydrogen and ammonia as fuel for heavy duty equipment like trucks, locomotives and mining equipment, as well as gensets creating independency on imported fossil fuels (Cleanergy Solutions Namibia , 2023). Moreover, green hydrogen projects offer on-the-job training, preparing individuals for future green jobs in an industry that is rapidly growing and in high demand.

The impact is beneficial, directly affecting Namibian citizens. The impact is irreversible and permanent due to the valuable skills acquired and training offered. The sensitivity of the impact is low as the impact is most likely beneficial to the local community, and the magnitude of change is moderate due to the significant opportunity in developing the skills of future 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). Green hydrogen projects will provide employment to locals, which will enhance the quality of life of the Walvis Bay – Swakopmund community. It has been reported that the current unemployment rate in Erongo region has an unemployment rate of approximately 21.9% (Namibia Statistics Agency, 2019). Approximately 100 to 120 jobs will be created during all phases of the Project.

The nature of the impact is directly beneficial. 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 (25 years). The likelihood of the impact is definite, as employment will provide income to households, contributing to daily 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 the livelihood of people. The overall significance of the impact is beneficial moderate.

7.3.6.3 Potential increase in anxiety in nearby communities as a result of the Project

Social anxiety surrounding ammonia/hydrogen industry and associated projects such as the ammonia pipeline, stems from public concern over the health, safety, and environmental risks. Communities living near these pipelines may fear toxic leaks, explosions, or long-term exposure, especially if not adequately engaged during pre-construction. The impact is adverse, direct and partly reversible through proactive engagement, transparent communication and proper safety planning. The impact is over a long-term due to the life cycle of the Project (25 years). The impact is likely given that the industry is relatively new in Namibia and due to public health concerns.

The sensitivity of the impact is medium due to the regional scale of the Project, and the magnitude of change is minor as the impact is not likely to change people's livelihoods. The overall significance of the impact is moderate.

Mitigation measures for this impact include:

- Transparent risk communication, making information easily accessible;
- Proactive community engagement and consultation involving all interested and affected parties;
- Use third-party experts to conduct and integrate a project specific emergency response plan; and
- Provide a platform and registry through which grievances are recorded and addressed.

7.3.6.4 Potential increase in crime due to the influx of temporary employees of the Project

During the Project, increase in potential relocation, increase in population of small towns and job uncertainties could lead to increase in crime ranging from petty theft to serious offenses. The impact is adverse, direct and partly reversible as more permanent jobs could be introduced as the industry grows. The impact could potentially occur during construction activities (~2 years) as operations would not require a large staff. The impact is rated regional due to the extent of the Project. The impact is possible as this is not a guaranteed outcome.

The sensitivity of the impact is medium due to the regional scale of the Project, and the magnitude of change is minor due the number of employees. The overall significance of the impact is minor. Mitigation measures are described in the Project ESMP.

7.3.6.5 Potential incidences of ammonia explosions/fires and associated dangers to the community

A health and safety report was conducted by CMB.TECH in 2025 (Appendix D). However, a comprehensive HAZOP study will be conducted by an independent third-party before construction of the Ammonia Pipeline. The main objective of the current study is to identify high risk factors impacting sensitive receptors (nearby communities and workforce).

While ammonia is not inherently flammable, pipeline explosions or fires (in extreme cases) may occur during operations if external, concentrated heat or fire compromises the system (CMB.TECH, 2025). The impact adverse, direct and irreversible should lives be lost. The impact is expected to be permanent as due to potential fatalities impact local communities. The Proponent intends on applying several engineering controls such as the use carbon steel material which is a corrosion resistant material, protective coating and cathodic protection systems to prevent underground corrosion. Additionally, pressure controls and leak detection systems will be implemented. It should be noted that ammonia itself does not generally burn in outdoor environments and does not sustain combustion. The impact is, therefore, rare.

The sensitivity of the impact is high due to the impact on community lives. The magnitude of change is very high/unknown due to the sever impact on the livelihood of people and nearby communities. The overall significance of the impact is minor. Mitigation measures are found in the ESMP.

7.3.6.6 Potential incidences of leakage and ruptures on the health of surrounding residents

Ammonia leakages may occur due external impacts such as vehicle accidents, human error and aging infrastructure. The impact is adverse, impacting the nearby communities directly and irreversible in the worst-case scenario. The release of ammonia could lead respiratory burns and issues, skin and eye irritation, injuries to the public and evacuations of nearby communities. The impact is adversely affecting nearby communities directly. The impact is irreversible and permanent, should fatalities and severe health issues occur.

The sensitivity of the impact is high due to the impact on community lives. The magnitude of change is very high/unknown due to the sever impact on the livelihood of people and nearby communities. The overall significance of the impact is moderate. The preventative and mitigation measures are detailed below and the ESMP.

Below are preventative measures the Proponent has in place (CMB.TECH, 2025):

- The ASME B31.3 and ASME B31.8 describes test and inspection requirements that will allow the Proponent to check the quality of the construction and validate if the

installation is constructed in a safe manner. This includes non-destructive testing and post weld heat treatment;

- Suitable coating (marine coating) will be applicable and the use of correct insulation which will maintain safe operation conditions will protect the core pipe by creating a barrier.
- Safety distances will be established especially for residential areas, according to the final comprehensive HAZOP study;
- Above-ground pipeline will be fenced off and signage will be erected to warn people not to trespass;
- Signage will also be erected for underground pipeline sections; and
- The lifespan of the pipeline will be lengthened through constant and regular monitoring and maintenance. This can be conducted by intelligent pigging, drones, maintaining valves by testing them on regular basis as specified in the ASME B31.3 and company specifications.

Mitigation measures include:

- Routine pipeline inspections and ensuring immediate repair to coating damage;
- Regular site inspections to monitor compliance with safety standards, documenting any non-conformances and identify the corrective actions required;
- Buffer zones are to be applied around residential areas;
- Comprehensive Emergency Response Plans;
- Coordination with local fire department;
- Evacuation plans for nearby residents and facilities should be documented; and
- Public awareness campaigns that should be implemented for nearby landowners, contractors and the general public.

Further mitigation measures are discussed in the Project ESMP.

Table 27 - Impacts on the community

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Ammonia pipeline Project construction and operations	Community	Increase in skills and development of locals providing opportunities for future projects, perhaps in the green	Beneficial Direct Irreversible Permanent Local Definite	Low	Moderate	Beneficial Moderate (4)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		hydrogen industry				
		Increase in employment of locals provide improved livelihoods	Adverse Direct Reversible Long term Local Definite	Low	Moderate	Beneficial Moderate (4)
		Potential increase in anxiety in nearby communities as a result of the Project	Adverse Direct Partly reversible Long term Regional Likely	Medium	Minor	Moderate (6)
		Potential increase in crime due to the influx of temporary employees of the Project	Adverse Direct Partly reversible Short term Regional Possible	Medium	Minor	Minor (4)
		Potential incidences of ammonia explosions/fires associated dangers to the community	Adverse Direct Irreversible Permanent Local Rare	High	Very High/Unknown	Minor (3)
		Potential incidences of leakage and ruptures on the health of surrounding residents	Adverse Direct Irreversible Permanent Local Unlikely	High	Very High/Unknown	Moderate (6)

7.3.7 OCCUPATIONAL HEALTH AND SAFETY IMPACTS

Occupational health and safety (OHS) refers to the practise 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 as per Labour Act, 2007 (Act No. 11 of 2007), to ensure that their workplaces are safe, healthy and free from hazards that could cause harm to workers.

To ensure a proper and safe design, various measures will take place during the engineering and construction phases of the Project. A few examples of the preventative measures to be taken include the hazard and operability study (HAZOP) review, which is a structured and systematic examination of the complex system of the Ammonia pipeline, to identify potential hazards and operability issues that could affect the safety and efficiency of the operation. Other preventative measures include the HAZID, ENVID, QRA and mechanical design according to the American Society of Mechanical Engineers (ASME) and a material selection review, which have all been included in CMB TECH's health and safety specialist report (Appendix D).

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, 2007 (Act No. 11 of 2007) and ISO 45001:2018 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 a 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 practises on-site.

This section provides the potential occupational health and safety risks associated with the activities of the ammonia pipeline. The occupational health and safety impacts are assessed in Table 28. The occupational health and safety impacts that may arise as a result of Project activities before mitigation ,in cases of a high rating also described after mitigation, are presented in Figure 76 for illustrative purposes only.

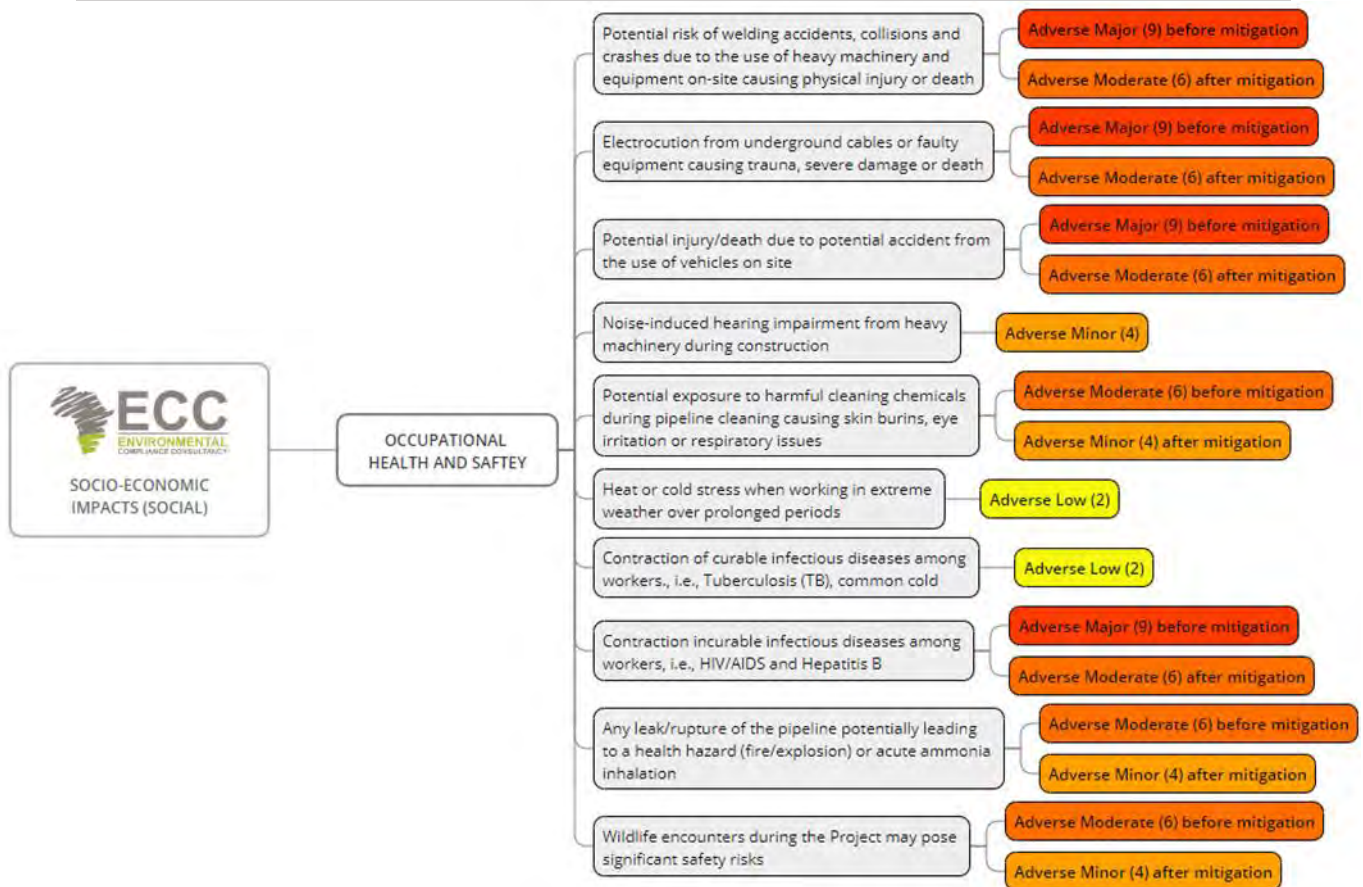


Figure 76 - Occupational health and safety impacts or risks

7.3.7.1 Potential risk of welding accidents, collisions and crashes due to the use of heavy machinery and equipment on-site causing physical injury or death

Construction work frequently entails intricate operations involving dangerous materials, heavy equipment and power tools—all of which require specialised training and expertise to do properly. There is a considerable chance of accidents that could occur due to the fast-paced, high-pressure work atmosphere, especially when employees are utilising power tools, heavy machinery, or are working near one another. The possible injuries exist on a broad spectrum and ranges from minor cuts and bruises to serious fractures or brain injuries. In the worst-case scenario, accidents involving machinery, falls, or collisions with large machinery could result in fatalities.

The nature of the impact is adverse and will directly affect workers on site. The impact is rated as permanent and irreversible, as in the worst-case scenario injuries could be permanent or lead to death. It is expected that contractor workers will be hired through a tendering process, which implies that they possess the required skills and expertise in the industry. As a result, injuries are more likely to occur due to accidents rather than a result of incompetency or practical inexperience. The probability of impact occurring is rated as possible. Heinrich's Accident Triangle suggests that the likelihood of serious incidents increases when minor incidents and unsafe acts are frequent or left unaddressed (OSHA outreach courses, 2025).

The magnitude of impact is rated very high/unknown due to varying degrees of injury severity that can occur, ranging from minor injuries to potentially life-threatening incidents. The sensitivity of impact is rated as high as injuries could lead to permanent disabilities, which limit workers future employment opportunities and their ability to perform certain tasks. Overall, the significance of impact, before mitigation measures, is rated adverse major. The impact ratings are provided in Table 28.

Mitigation measures include:

- Employment of trained and competent employees;
- Employees are informed of health and safety risks, and training is provided as necessary, as per a training schedule and programmes;
- The development and implementation of standard operating procedures (SOP) which includes correct PPE to be worn for the required task at hand; and
- Heavy machinery to be switched off and locked and tagged out when not in use.

Further mitigation measures are included in the ESMP.

7.3.7.2 Electrocution from underground cables or faulty equipment causing trauma, severe damage or death

In the construction phase, there is a risk posed from working with any electrical equipment which would require specific training and knowledge to be conducted safely. It is therefore anticipated that the Proponent will retain personnel with the appropriate qualifications and expertise to perform this task.

Injuries related to this will occur while working with the equipment, therefore, the impact is considered adverse and direct. Due to the varying degrees of physical damage that is associated with an injury related to electrocution, the impact is rated as irreversible and permanent. In 2013, newspaper reports documented a serious electrical incident at Paladin Energy's Langer Heinrich Mine, in which two contractors were injured, and one employee tragically lost their life (Hartman, 2013).

The impact will occur on-site. Although personnel will consistently adhere to safety precautions, the probability of an event is rated as possible due to industrial workspaces and associated use of electrical tools that are typically regarded as high-risk environments.

The magnitude of the impact is rated as very high/unknown, as injuries may range from minor to severe, including potentially life-threatening incidents. The sensitivity of the impact is rated high, as if injuries with electrical equipment were to occur, it could impair workers' ability to perform their duties or affect their future employability. Overall, the significance of impact is expected to be adverse major, before mitigation measures. The impact ratings are provided in Table 1.

Mitigation measures include:

- Development and implementation of an SOP which includes correct PPE to be worn such as insulated gloves;
- Emergency response and first aid should be easily accessible;
- Regular equipment inspections and maintenance shall occur; and
- Mandatory training or employment of skilled laborers.

Further mitigation measures are included in the ESMP.

7.3.7.3 Potential injury/death due to potential accident from the use of vehicles

The construction of the ammonia pipeline will require frequent travel to and from various work sites, necessitating the use of vehicles. Driving is an inherently high-risk activity, with the potential for severe injuries or fatalities due to road accidents. Nationwide statistics from the Motor Vehicle Accident (MVA) Fund indicate that, as of 17 November 2024, the Erongo Region accounted for 12% of the total crashes reported across all regions, with 338 crashes recorded. This reflects a 12% increase compared to the previous year. Injuries in the region rose to 602, while fatalities decreased slightly to 32 (The Brief, 2024). The risk of accidents increases with extended time on the road, as well as exposure to fog and sandstorms, posing a significant safety concern for personnel.

This impact is rated adverse, direct and irreversible, as the injuries sustained could be severe and potentially lead to death. The impact may be permanent depending on the severity of vehicle accidents. Impacts related to the use of vehicles will occur locally and are possible.

The magnitude of the impact is rated as very high/unknown due to the severity of the impact outcomes. The sensitivity of the receptor is high, as injuries sustained in vehicle related accidents could affect their future employability and overall standard of life. Overall, the significance of the impact is expected to be adverse major. The impact ratings are displayed in Table 28.

Mitigation measures include:

- Competent drivers with valid vehicle licenses for the code of vehicle they are operating;
- The necessary speed limit signage should be displayed on site;
- A culture of cautious driving should be encouraged on and off site and driving to the conditions of the road; and
- Vehicles should be serviced and maintained regularly.

Further mitigation measures are described in the Project ESMP.

7.3.7.4 *Noise induced hearing impairment from heavy machinery during construction*

Hearing impairment is a prominent issue when working with heavy machinery. In the construction of the ammonia pipeline, however, the use of heavy machinery will be limited to activities such as welding. It is expected that PPE, such as ear plugs, will be provided to the construction workers.

This impact is rated as adverse, direct and on-site. The impact is irreversible if it were to occur, as hearing impairment induced by using heavy machinery may not be restored without adopting expensive solutions such as hearing aids. The duration of the impact is rated as short-term as the construction phase is expected to be (~2 years). The probability of an event occurring is rated as possible, as any prolonged exposure to heavy machinery can cause noise induced hearing loss.

In this case, the magnitude of the impact is rated as low/minor as the heavy machinery used within this Project is limited since it solely involved the construction of a pipeline. The sensitivity of the receptor is medium, as the effect is not expected to severely impact the quality of life of the employee. The overall significance of the impact is rated as adverse minor. Mitigation measures are outlined in the ESMP. The impact ratings are displayed in Table 28.

7.3.7.5 *Potential exposure to harmful chemicals during pipeline maintenance and cleaning causing skin burns, eye irritation or respiratory issues*

Various chemical detergents such as acid cleaners or caustic cleaners, corrosion and rust inhibitors, as well as exposure to ammonium hydroxide through residual formation, may pose potential safety hazards. This is a risk when dealing with any sort of construction process and therefore the necessary PPE is highly recommended, such as gloves, masks and goggles.

The impact is rated as adverse, direct and irreversible as exposure to strong chemicals in the most severe scenarios could lead to permanent scarring or damage. The impact may occur on site and is rated as possible.

The magnitude of the impact is very/unknown due to the evident high health risk and irreparable damage that could result. Injuries sustained from exposure to harmful chemicals could be permanent, especially if it occurs in sensitive areas such as the eyes or via ingestion. If it were to occur, the sensitivity of the receptor is high as an incident could severely affect the quality of life of an employee. Overall, the significance of the impact is moderately adverse.

Mitigation measures include:

- Correct protective equipment shall be provided and correct training will occur;
- Correct PPE shall be worn at all times;
- The MSDS must be valid, up to date and consulted before working with the chemical;
- Employees should be informed and trained in dealing with harmful chemicals;

- Safety and medical kits should be accessible to deal with any injuries that may arise;
and
- Contact information of the local hospital/ambulance can be accessed in the ESMP.

Further mitigation measures are provided in the ESMP.

7.3.7.6 Heat or cold stress when working in extreme weather over prolonged periods

The coast of Namibia is characterised by a warm and arid climate. Due to the proximity of farm 58 to the ocean, the climate is milder than the interior regions of Namibia. A characteristic of this coastal region is the prominent easterly winds which occur during the winter months. Conditions such as these could be unpleasant to work in therefore, it is recommended that workers be supplied with the necessary PPE, which is required by national legislation, under regulations relating to the health and safety of employees at work (Government Notice 156/1997). Therefore, heat stress and heat stroke could occur.

The impact is adverse, direct and reversible, and it is possible to control a person's body temperature by using the appropriate PPE, i.e., extra clothing and seeking shelter and drinking the appropriate amounts of cool water, e.g. 250 ml (1 cup) every 15–20 minutes during work in hot environments (U.S Department of Labour, n.d.). This extent of the impact is on-site as employees are more likely to be exposed to the elements during working hours. The likelihood of such an event occurring is possible, especially in the warm and dry summer and cold winters. The magnitude of social impact is minor, and the duration of the impact is expected to occur over a short period of time provided that the necessary rectification measures are implemented. The sensitivity of the receptor is low as workers are generally provided with the appropriate PPE and drinking water. Overall, the significance of an impact such as this is low.

7.3.7.7 Contraction of curable infectious diseases among workers (i.e., Tuberculosis or a common cold)

The contraction of curable infectious diseases can be contracted in any environment. Work related environments are particularly vulnerable due to the handling of the same equipment amongst workers and the proximity employees in the workspace or when travelling together for extended periods of time.

The impact is rated as adverse, direct and reversible as these infections are curable, provided the employee gets the medical assistance required in the appropriate timeframe. The magnitude of the social impact is minor due to the curable nature of the diseases and is therefore also temporary. The probability of this occurring is likely, as viruses and bacteria which cause diseases are omnipresent. The sensitivity of the receptor is low due to the curable nature of the disease and there is no long-term perceptible change to the livelihood of workers. The overall significance of the impact is adversely low.

7.3.7.8 *Contraction of incurable infectious diseases among workers (ie., HIV/AIDS and Hepatitis B)*

Incurable diseases such as HIV/AIDs are prominent on the continent of Africa. Specifically with sub-Saharan Africa remaining the epicenter of HIV/AIDS across the globe with 67% of the 38.4 million people living with the disease being from the region (Enos Moyo, 2023).

The impact is adverse, direct and irreversible as these diseases are incurable. The duration of an impact such as this is permanent, as it could likely lead to death in the most severe cases, if medical treatment is not received. The magnitude of social change is very high/unknown as incurable diseases such as this can change the quality of people's lives and could result in fatalities. The probability of it occurring is possible with a high sensitivity of the receptors as the impacts posed could be severe. Overall, the significance of the impact is majorly adverse.

Mitigation measures include:

- HIV/AIDS awareness campaigns should be implemented;
- If employees exhibit signs or symptoms, they should be sent to the nearest hospital or doctor immediately;
- Prevention kits should be distributed;
- On-site voluntary testing and counseling should occur;
- A good hygiene culture to be enforced; and
- Implement vaccination programs for all workers.

7.3.7.9 *Any leak/rupture of the pipeline potentially leading to a health hazard (fire/explosion) or acute ammonia inhalation*

In any emergency, the worst-case scenarios are assessed due to the acute toxicity of gaseous anhydrous 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. An incident occurred at the Merlus Fishing Factory (Observer, 2025) where multiple workers became ill and some were hospitalised due to exposure to ammonia that leaked from a nearby fishing boat and the plume blown into the factory. Ammonia is flammable when exposed to a high amount of heat and could cause a fire/explosion.

The impact is adverse, direct and irreversible as the worst-case scenario could gravely affect human health and could lead to fatalities. The effects could be permanent as an explosion or ammonia poisoning may cause irreversible damage to tissues, organs, or neurological function (Agency for Toxic Substances and Disease Registry (ATSDR), 2004). This impact may occur on a local scale. However, the probability of events such as these occurring is unlikely as many preventative measures will be implemented as per the CMB TECH Health and Safety Report as well as the ESMP.

The magnitude of change is very high/unknown because if a rupture/leak were to occur, the effects would be severe as ammonia is toxic and in extreme cases exposure can even be fatal (healthline, 2025). The sensitivity of the impact is high. Overall, the impact is adverse major.

There are, however, mitigation measures in place which include:

- Installation of ammonia detection systems;
- Buffer zones around residential areas;
- Emergency response planning;
- Public awareness programmes;
- Ammonia containment systems around high-risk zones (gas escape chambers and muster rooms);
- Regular inspections and maintenance of the pipeline;
- Spill containment measures and emergency plans for water; and
- Corrosion control measures will be implemented.

7.3.7.10 Wildlife encounters including snakes and scorpions during the Project may pose significant safety risks

The wildlife at Farm 58 and the Namib Naukluft National Park section within which the pipeline falls is limited and mainly consists of various species of ungulates, such as gemsbok, scavengers such as jackal or avifauna such as ostrich. Scorpions and snakes are most often encountered during night-time walks or when using UV light. Additionally, snakes are often seasonal and most frequently observed after rains. The threat posed by these faunae is minimal however if an incident occurs, the effect would be adverse, direct and irreversible as in severe cases an incident with a wild animal can lead to death. The duration of the impact is rated as permanent as the worst-case scenario could lead to serious injuries or even death. An impact such as this could occur on a local scale as fauna are not only found on-site, for example they could also be encountered while driving to site. The threat posed by these animals is minimal, therefore the probability of an impact such as this occurring is unlikely. The magnitude of the impact is very high/unknown as the behavior of wild animals is unpredictable, but the impact could be severe. The sensitivity of the receptor is high as wild animals could pose a major threat to human lives. Overall, the significance of the impact is moderately adverse.

Mitigation measures for this include:

- Advise all employees to be vigilant and report any sightings of animals in the vicinity to MEFT – Park Management, Snakes of Namibia – Namibian Herpetology Trust or Namibia Wildlife Rescue (NWR) as required;
- Drive cautiously in-between sites to avoid collisions with wild animals; and
- Inform employees not to feed or try to engage with any of the wild animals.

Further mitigation measures are discussed in the ESMP.

Table 28 - 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 welding accidents, collisions and crashes due to the use of heavy machinery and equipment on-site causing physical injury or death	Adverse Direct Irreversible Permanent On-site Possible	High	Very high / unknown	Major (9)
		Electrocution from underground cables or faulty equipment causing trauma, severe damage or death	Adverse Direct Irreversible Permanent On-site Possible	High	Very high / unknown	Major (9)
Construction and operations		Potential injury/death due to potential accident from the use of vehicles on site	Adverse Direct Irreversible Permanent Local Possible	High	Very high / unknown	Major (9)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction phase		Noise-induced hearing impairment from heavy machinery during construction	Adverse Direct irreversible Short-term On-site Possible	Medium	Low/minor	Minor (4)
Construction phase		Potential exposure to harmful cleaning chemicals during pipeline cleaning causing skin burins, eye irritation or respiratory issues	Adverse Direct Irreversible Permanent On-site Possible	High	Very high/Unknown	Moderate (6)
		Heat or cold stress when working in extreme weather over prolonged periods	Adverse Direct Reversible Short term On-site Possible	Low	Low/minor	Low (2)
		Contraction of curable infectious diseases among workers., i.e., Tuberculosis (TB), common cold	Adverse Direct Reversible Temporary On-site likely	Low	Low/minor	Low (2)
		Contraction incurable	Adverse Direct	High	High/major	Major (9)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
		infectious diseases among workers, i.e., HIV/AIDS and Hepatitis B	Irreversible Permanent On-site Possible			
Operational phase		Any leak/rupture of the pipeline potentially leading to a health hazard (fire/explosion) or acute ammonia inhalation	Adverse Direct Irreversible Permanent local Unlikely	High	Very high/unknown	Moderate (6)
Construction and operational phase		Wildlife encounters during the Project may pose significant safety risks	Adverse Direct Irreversible Permanent Local Unlikely	High	Very high/unknown	Moderate (6)

7.4 BIOPHYSICAL ENVIRONMENT

7.4.1 SOIL IMPACTS

The specific impacts on soil, before mitigation, are presented in Figure 77 for illustrative purposes only. Impacts are discussed in detail in the sections thereafter (Table 29).

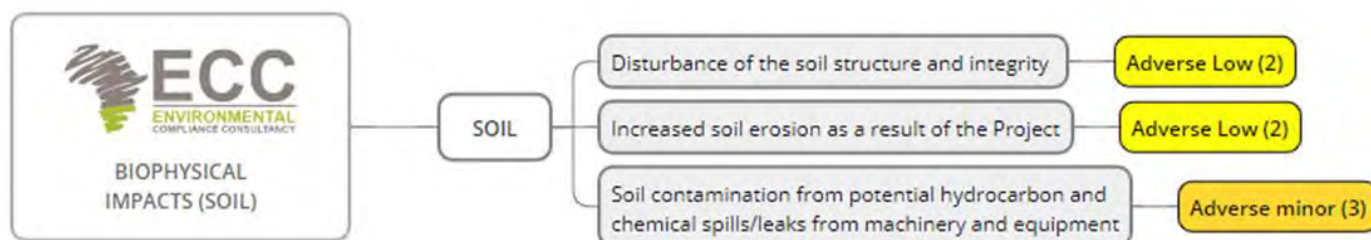


Figure 77 - Soil impacts

7.4.1.1 Impact on soil structure and integrity resulting in compaction during the construction phase

During construction (excavation and trenching) activities, the soil structure and integrity may be drastically disturbed and/or altered. The status of the soil quality is viewed as semi-disturbed. The pipeline servitude is located near (~2 km) residential areas (Green Valley, Narraville) in Walvis Bay and ~ 5 km from Arandis Town, following the path of the TransNamib railway network and the NamPower 220 kV line. The impact is adverse, direct and partly reversible due to potential soil rehabilitation to be applied prior to operations. The construction activities will take place over a short time (~2 years). The impact is likely as mixing and removal of soil (disturbance) forms part of the construction process.

The magnitude of the change is negligible, as these soils are moderately disturbed and have low productivity due to the extreme arid conditions. The sensitivity rating is low, as disturbance will only occur on-site. The overall significance of the impact is low. Mitigation measures are indicated in the ESMP.

7.4.1.2 Increased soil erosion as a result of the Project

During the construction of pipelines, activities such as the linear removal of vegetation and trenching will lead to increased wind erosion as a result of decreased aggregate stability (Brehm & Culman, 2022). Wind erosion is a prominent phenomenon in the area of Walvis Bay, Swakopmund and Arandis which experience south westerly winds in the afternoon. The impact is adverse, direct and partly reversible due to potential measures taken during rehabilitation practises throughout the construction stage, which will occur over a short period of time (~2 years). The impact is expected to be likely due to the construction activities involved.

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

7.4.1.3 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* throughout the construction and operational stages of the Project.

The impact is adverse, direct and partly reversible due to potential soil rehabilitation methods to be applied. A long-term plan will include a detailed rehabilitation plan after the construction phase and spill prevention and management plan during operations. The Project construction

will take place over a short period (~2 years). The impact may be definite due to the use of accidental faulty equipment or machinery or due to accidental spillages that tend to occur.

The magnitude of change is minor, due to slight deterioration of the already eroded and unproductive soil quality. The sensitivity of the impact is low due to the impact on-site. The overall significance of the impact is minor. Mitigation measures are indicated in the ESMP.

Table 29 - Impacts on soil

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction phase	Soil	Disturbance of the soil structure and integrity and causing compaction	Adverse Direct Partly reversible Short term On-site Likely	Low	Negligible	Low (2)
		Increased soil erosion as a result of the Project	Adverse Direct Partly reversible Short term On-site Likely	Low	Negligible	Low (2)
		Soil contamination from potential hydrocarbon and chemical spills/leaks from machinery and equipment	Adverse Direct Partly reversible Short term On-site Definite	Low	Minor	Minor (3)

7.4.2 GROUNDWATER IMPACTS

A groundwater, soil and surface water impact assessment of the Ammonia Pipeline project was developed by Mr. Luke Tower in July 2025 (Appendix J). The impact assessment follows ECC's Impact Prediction and Evaluation Methodology and considers first principles of contamination impact assessments, namely the source, pathway and receptor approach.

The rock body over which the ammonia pipeline (~112 km in length) falls, varies between rock bodies with very low and limited groundwater potential (making up most of the area traversed by the pipeline) to a porous aquifer with moderate groundwater potential (small section crossed over the Swakop River). The groundwater potential map can be found in chapter 5, section 5.14 under hydrogeology. The specific impacts on groundwater, before mitigation, are presented in Figure 78 for illustrative purposes only. Impacts are discussed in detail in the sections thereafter (Table 30).

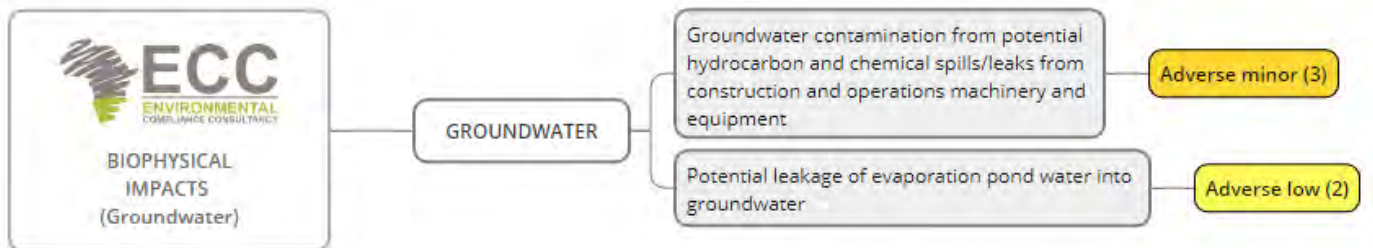


Figure 78 - Groundwater impacts

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

Potential unforeseen leaks from damage(s) sustained, defective machinery/equipment or accidental spillages (hydrocarbons and chemicals) may occur during the Project construction and seep into the ground. The pipeline crosses the Swakop River perpendicular to the flow path of the river which with an aquifer which has moderate groundwater potential. However, majority of the groundwater in the general pipeline site is limited with very low potential. The impact is adverse, direct and irreversible. In the event of a large spill, contamination of groundwater is permanent. The impact is rated as possible as a precautionary approach due to accidental spills of different types of chemicals hence unknown properties.

The magnitude of change is minor due to the quality and quantity of groundwater in majority of the region, however this depends on the amount of leakage, time taken for cleanup and the physical properties of the soil. The sensitivity of the impact is low due to the local impact. The overall significance of the impact is minor. Mitigation measures are indicated in the ESMP.

7.4.2.2 Groundwater (secondary aquifer) contamination due to a leak in the pipeline resulting in a deterioration of water quality

Potential ammonia leakage or eruption from a pipeline during operations could contaminate groundwater – secondary aquifer. Pools of cold (~-33°C) liquid ammonia on the ground can be formed either as a result of rainout from the release (especially in foggy or humid conditions) or from continued spills from the line. Based on its properties, ammonia and the ammonium ion are not expected to significantly adsorb to soil, especially in an arid hot region where soil moisture is expected to be very low. Hence, in arid and often windy weather conditions, ammonia is likely to evaporate faster than infiltrating the soil and groundwater. That said, if retained in soils, surface runoff and flooding may mobilise ammonia and nitrates resulting in

concentrated deposition elsewhere, infiltration to the groundwater environment or discharge to the ocean (Towers, 2025).

The impact is adverse, direct and partly reversible should infiltration to the secondary aquifer occur as rehabilitation measures will be applied to reduce the severity of the impact. In an event where soil is infiltrated and ammonia leakage reaches the secondary aquifer, rehabilitation and cleanup efforts could allow the impact to last a medium term (5–15 years). However, the impact is deemed unlikely due to pipeline monitoring programs (leak detection), the hydro-physical characteristics of the secondary aquifer and the physical behaviour of ammonia.

The magnitude of change is minor, due to several hydro-physical and water resource potential factors of the secondary/fractured aquifer, including low infiltration rate and limited supply potential for groundwater use. Further factors are listed in the specialist study. The sensitivity of the impact is low due to the local scale. The overall significance of the impact is low. Mitigation measures are described in the specialist report and Project ESMP.

7.4.2.3 Groundwater (porous aquifer) contamination due to a leak in the pipeline resulting in a deterioration of water quality

During operation, an ammonia pipeline leak may occur which results in the deterioration of the water quality through infiltration of the porous aquifer. Similarly to the secondary/fractured aquifer, the porous aquifer, low rainfall and high evaporation rates that reduce infiltration and the probability of contaminant transport. However, when considering the porous aquifer associated with the Swakop River alluvium, the groundwater quality may be improved as compared to the secondary fractured rocks in the region (Towers, 2025).

The impact is adverse, direct and partly reversible if the porous aquifer is infiltrated, as rehabilitation measures will be implemented to lessen its severity. The duration of the impact is medium term (5–15 years) allowing time for rehabilitation and remediation measures to take effect. The impact is unlikely due to pipeline monitoring programs (leak detection), climatic conditions and the physical behaviour of ammonia.

The magnitude of change is moderate, due to the moderate groundwater potential of the porous aquifer. The sensitivity of the impact is low due to the local scale. The overall significance of the impact is low. Mitigation measures are described in the specialist report and Project ESMP.

Table 30 - Impacts on groundwater

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction phase	Groundwater	Groundwater contamination from potential hydrocarbon and chemical spills/leaks from construction and operations machinery and equipment	Adverse Direct Irreversible Permanent Local Possible	Low	Minor	Minor (3)
Operational phase	Secondary aquifer - groundwater	Groundwater contamination due to a leak in the pipeline resulting in a deterioration of water quality.	Adverse Direct Partly reversible Medium term Local Unlikely	Low	Minor	Low (2)
	Porous aquifer - groundwater	Groundwater contamination due to a leak in the pipeline resulting in a deterioration of water quality (and potential use of the water resource)	Adverse Direct Partly reversible Medium term Local Unlikely	Low	Moderate	Low (2)

7.4.3 SURFACE WATER

The major ephemeral river that the pipeline crosses is the Swakop River plain, at ~24 km from Swakopmund. The source of this river is in the Khomas area flowing westwards. The ammonia pipeline extends to the existing NAMCOR jetty for export via ships in the Atlantic Ocean. The specific impacts on surface water, before mitigation and if required after mitigation, are

presented in Figure 79 for illustrative purposes only. Surface water impacts are discussed in detail in the sections thereafter (Table 31).

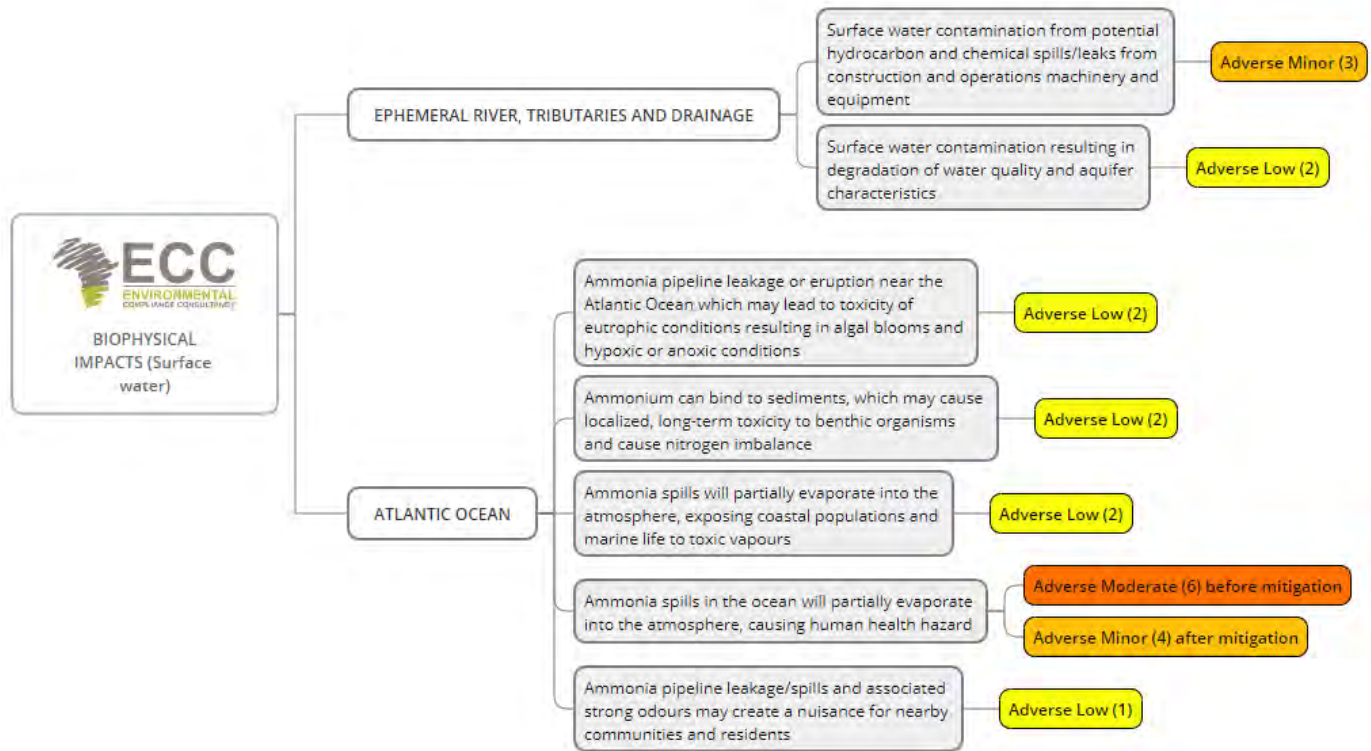


Figure 79 - Impacts on surface water

7.4.3.1 Surface water contamination from potential hydrocarbon and chemical spills/leaks from construction machinery and equipment

Unexpected leaks or accidental spillages of hydrocarbons and chemicals—resulting from damaged or faulty machinery and equipment may occur during the Project construction stage, potentially leaching into nearby ephemeral river drainages and potential tributaries. The impact is adverse, direct and partly reversible should mitigation measures be applied and regular water monitoring programs be incorporated. In a scenario where a (> 200 L) large spill occurs from machinery and equipment and contaminates the nearby drainage areas or tributaries, the impact will be over a short term (<5 years) as immediate response to clean spills will mitigate the leachate response of a chemical/hydrocarbon and certain chemicals will degrade over time. This impact is possible, as minor chemical or hydrocarbon spills could occur which can be transported by sporadic flow.

The magnitude of change is moderate, impacting the quality of the water and potentially harming surrounding vegetation, aquatic organisms and downstream users. The sensitivity of the impact is low due to the local extent of the surface water flow. The overall significance of the impact is minor. Mitigation measures are indicated in the ESMP.

7.4.3.2 *Surface water contamination resulting in degradation of water quality and aquifer characteristics*

During operations, ammonia will be transported in the pipeline daily and potential leakage or rupture may occur as a result of corrosion, joint failure, external damage, poor maintenance, or worn-out material. If ammonia is released from the pipeline, it will turn into a vapour. Large releases are not foreseen due to shut off valves at various sections on the pipeline and various other preventative measures. It should be noted that anhydrous ammonia is highly soluble in water. If ammonia is released during excessive rainfall events, it will dissolve to form ammonium (NH_4^+) and hydroxide ions (OH^-). Ammonium is relatively soluble in water and can move through soil, especially in sandy soils or where there is high groundwater flow. When ammonium enters the ephemeral river system after excessive rainfall events, it could be transported downstream impacting aquatic ecosystems or accumulate in low-lying floodplains. This could lead to toxicity to aquatic life, eutrophication and soil degradation. The impact is adverse, direct and partly reversible through spill response protocols.

This impact may occur over a medium period (5-15 years) to provide ample time for response and corrective measures to be observed. Ammonia leakages and ruptures are rare due to the robust pipeline design which include protective lining (cathodic protection), proper measures in place for installation, prior hydrostatic testing, real time monitoring during operations and leak detection sensors resulting in rapid shutdown and containment.

The magnitude of change is moderate, due to the loss of aquatic organisms, impact on water quality to downstream users, and cause of algal bloom and eutrophication and potential flow to low-lying floodplains and the Atlantic Ocean. The sensitivity of the impact is low due to the local extent. The overall significance of the impact is low. Mitigation measures are indicated in the groundwater soil and surface water specialist study and ESMP.

7.4.3.3 *Ammonia pipeline leakage or eruption near the Atlantic Ocean which may lead to toxicity of eutrophic conditions*

During the operations of the ammonia pipeline near the ocean, potential leaks or ruptures may be triggered. Ammonia breaks down into nitrates that can lead to nutrient imbalances, causing eutrophic conditions resulting in algal blooms and hypoxic or anoxic conditions (Towers, 2025). Low to no oxygen condition as a result of rapid algal growth may lead to mortality of marine organisms, loss of biodiversity, degradation of intertidal ecosystems and disruption in ecological functions.

The impact is adverse, direct and partly reversible through active response and the availability of a Marine Spill Contingency Plan (MSCP) or an approved Works Plan by Directorate of Maritime Affairs (DMA) focused on ammonia-specific risks and impacts. The impact may occur over a medium period (5-15 years), allowing for gradual recovery through targeted rehabilitation efforts. Ammonia leakages and ruptures are considered unlikely due to the robust pipeline design, which incorporates protective linings and cathodic protection, proper

installation practices, pre-commissioning hydrostatic testing, real-time operational monitoring, and integrated leak detection sensors that enable rapid shutdown and containment in the event of a failure.

The magnitude of change is major, due to the loss of aquatic organisms and damage to sensitive intertidal and aquatic habitats. The sensitivity of the impact is low due to the local extent. The overall significance of the impact is low. Mitigation measures are indicated in the ESMP.

7.4.3.4 Ammonia released in the ocean may lead to long-term toxicity to benthic organisms

In emergency cases whereby ammonia spills occur and is released in the ocean, ammonia dissolves in water to form ammonium (NH_4^+) and hydroxide (OH^-). Ammonium tends to bind to organic matter which overall reduces immediate dispersion in the water column it eventually settles and accumulates within seabed sediments. Such accumulation poses risks to benthic organisms, as prolonged exposure to elevated ammonium levels can lead to localized toxicity, impairing respiration and reproduction in bottom-dwelling fauna (Magalhães, Joye, Moreira, Wiebe, & Bordalo, 2005). Sediment-bound ammonium may gradually be released back into the water, disrupt natural nutrient cycling, potentially causing nitrogen imbalances that favour algal overgrowth and reduce overall ecosystem stability (Howarth & Marino, 2006). The nature of the impact adverse, direct and irreversible due to the influence on the nitrogen cycle should ammonium reach the benthic sediments. The impacts could have permanent effects on the marine system. The impact itself occurring is deemed unlikely due to the pipeline design, systems in place to prevent spills and mitigations as set out under section 7.4.3.3.

The magnitude of change is major, due to the long-term effects and nutrient imbalances in the marine environment. The sensitivity of the impact is low due to the local extent. The overall significance of the impact is low. Mitigation measures are indicated in the ESMP.

7.4.3.5 Ammonia spills in the ocean will partially evaporate into the atmosphere, exposing coastal populations and marine life to toxic vapours

When ammonia is released in the ocean, it will partially volatilise into the atmosphere creating a pungent, stinging and irritating vapour toxic to marine life and coastal populations (Safety4sea, 2024). Coastal populations and marine life include macroinvertebrates of sandy and rocky shores, marine birds and marine mammals. For seabirds and mammals that surface to breathe, exposure may lead to respiratory distress or displacement from the affected areas. The nature of the impact adverse, direct and partly reversible due to proactive response measures, supported by a Marine Spill Contingency Plan (MSCP) specifically designed to address ammonia-related risks and impacts, including protocols for rapid containment and monitoring. The impact may occur over a medium period (5-15 years), for rehabilitation efforts to be observed. As mentioned under section 7.4.3.3., the impact is

unlikely to occur because of preventative measures in place discussed under chapter 5 section 5.4.4.4 and Appendix D.

The magnitude of change is major, as ammonia exposure can cause severe distress to marine life and coastal populations, altering migratory patterns with the potential to result in fatalities in extreme cases. The sensitivity of the impact is low due to the local extent. The overall significance of the impact is low. Mitigation measures are indicated in the ESMP.

7.4.3.6 Ammonia spills in the ocean will partially evaporate into the atmosphere, causing human health hazard

As discussed under section 7.4.3.5, ammonia spilled in the ocean is partially soluble but also highly volatile. Once airborne, it can disperse over coastal areas and pose a hazard to human populations through inhalation. Airborne ammonia can cause severe irritation of the eyes, nose, throat, and lungs. At high concentrations, it can lead to bronchospasm, pulmonary edema, and even fatal outcomes (Agency for Toxic Substances and Disease Registry (ATSDR), 2004). There are various case studies of ammonia leaks/spills and associated vapour causing harm to employees and/or community members. It was documented that an ammonia gas leak at New Mangalore Port caused panic with several dock workers and residents reporting burning eyes and difficulty breathing leading to a temporary halt in operations (The Hindu, 2014).

The nature of the impact adverse, direct and irreversible due to ammonia vapours that could cause reactions in humans such as irritation or burns. The impact is deemed permanent as a result of reactions to exposure and potential severe cases and fatalities. The probability of the impact occurring remain unlikely, due to preventative measures, engineering controls, pressure controls and leak detection systems that will be implemented.

The magnitude of change is major/unknown due to potential long-term or permanent effects, which, in worst-case scenarios, could result in fatalities. The sensitivity of the impact is considered high, as it may adversely affect livelihoods to the extent that communities are unable to sustain their pre-impact way of life. The overall significance of the impact is moderate prior to mitigations.

Mitigation measures include:

- Properly implement preventative measures and systems into pipeline design and operations;
- Strict adherence to the International Maritime Organization (IMO) IBC Code for hazardous chemicals;
- Develop and implement a Marine Spill Contingency Plan (MSCP);
- Rapid monitoring of air quality on a regular basis; and
- Real-time plume modelling to predict affected coastal areas and guide evacuations.

Further mitigation measures are set out in the Project ESMP.

7.4.3.7 Ammonia pipeline leakage/spills and associated strong odours may create a nuisance for nearby communities and residents

Ammonia is characterised by a strong, pungent odour that can be detected outdoors at relatively low concentrations, typically around 25 parts per million (ppm) (Iowa Farmer Today, 2025). In an emergency scenario whereby an ammonia leakage or spill occurs ammonia vapours may disperse into the surrounding environment, resulting in noticeable odours in nearby communities. Although these concentrations do not necessarily reach hazardous concentrations, the smell may cause significant discomfort and may be regarded as a nuisance by residents and other nearby receptors. The impact is considered adverse, directly impacting receptors. Moderate spills are reversible and temporary, should active response and rehabilitation be applied. The probability of the impact is rated unlikely.

The magnitude of change is minor, due to the short-lived odour inconvenience should a spill/leak occur. The sensitivity of the impact is considered low, as it primarily affects the local community. The overall significance of the impact is low.

Table 31 - Impacts on surface water – ephemeral rivers, drainage and Atlantic Ocean

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction phase	Ephemeral rivers, drainage	Surface water contamination from potential hydrocarbon and chemical spills/leaks from construction and operations machinery and equipment	Adverse Direct Partly reversible Short term Local Possible	Low	Moderate	Minor (3)
Operational phase		Surface water contamination resulting in degradation of water quality and aquifer characteristics	Adverse Direct Partly irreversible Medium term Local Rare	Low	Moderate	Low (2)
	Atlantic Ocean - marine and coastal environment	Ammonia pipeline leakage or eruption near the Atlantic Ocean which may lead to toxicity of eutrophic conditions resulting in algal blooms and hypoxic or anoxic conditions	Adverse Direct Partly reversible Medium term Local Unlikely	Low	Moderate	Low (2)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		Ammonium can bind to sediments, which may cause localized, long-term toxicity to benthic organisms and cause nitrogen imbalance	Adverse Direct Irreversible Permanent Local Unlikely	Low	Major	Low (2)
		Ammonia spills will partially evaporate into the atmosphere, exposing coastal populations and marine life to toxic vapours	Adverse Direct Partly reversible Medium term Local Unlikely	Low	Major	Low (2)
	Atlantic Ocean – community health and safety	Ammonia spills in the ocean will partially evaporate into the atmosphere, causing human health hazard	Adverse Direct Irreversible Permanent Local Unlikely	High	Very High/Unknown	Moderate (6)
	Atlantic Ocean – community odour nuisance	Ammonia pipeline leakage/spills and associated strong odours may create a	Adverse Direct Reversible Temporary Local Unlikely	Low	Minor	Low (1)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		nuisance for nearby communities and residents				

7.4.4 BIODIVERSITY IMPACTS: FLORA

The ammonia pipeline is approximately 112 km from the Walvis Bay north port to Arandis, moving along different landscapes and transitioning vegetation types. The central coastal area is mostly covered by gravel plains, dune fields and rocky outcrops consisting of sparse vegetation of mostly drought-tolerant species. The flora assessment included a complete assessment of trees, shrubs (>1 m in height), grasses, herbs and other species (e.g., bulbs, ferns, etc.) observed on site. Additionally, important species were photographed as evidence and/or if a second opinion was to be acquired from other botanical experts.

Three (3) vegetation types that were encountered for the pipeline route:

- Southern Namib;
- Central Namib; and
- Semi-desert and Savannah Transition Zone (Escarpment area)

The specific construction related impacts to flora in the Project area, before mitigation, are presented in Figure 80 for illustrative purposes only. The potential Project impacts on flora diversity are discussed further in the sections below (Table 32).

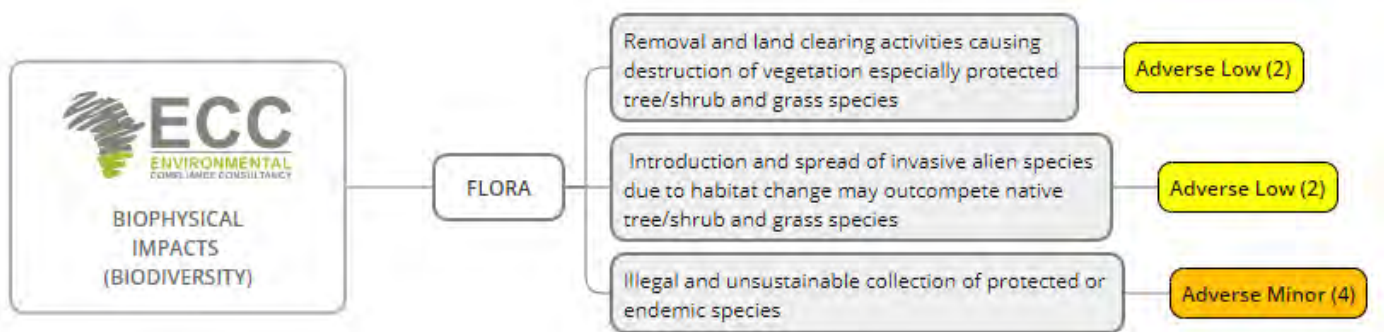


Figure 80 - Potential impacts on flora before mitigation

7.4.4.1 Removal or destruction of protected/sensitive flora (tree/shrubs and grass species)

The biodiversity specialist study conducted by Cunningham (2024), identified a total of 18 species of larger trees/shrubs throughout the proposed Project area and a total of 50 species when including “other” smaller plants <1 m in height (e.g., *Aloe* spp., herbs, etc.). During the rapid assessment, no grass species were observed at the proposed routes during months considered the “wet season” (Nov – Apr). The use of heavy machinery during excavation of a

trench to bury the proposed ammonia pipeline is expected to be detrimental to tree/shrub and herb species associated with the affected areas/habitats prior to mitigation.

Important species identified on the Project pipeline route include:

- **Endemic species:** *Arthraerua leubnitziae*, *Commiphora saxicola*, *Zygophyllum stapffii*
- **Species protected by the Forest Act No. 12 of 2001:** *Acacia erioloba*, *Commiphora saxicola*, *Euclea pseudebenus*, *Faidherbia albida*, *Tamarix usneoides*
- **Species listed as CITES Appendix 2:** *Euphorbia virosa*

However, none of the Namibian protected, rare or endemic larger tree, shrub, herb and grass species are exclusively associated with the Project area.

Construction activities such as excavation of trenches for the ammonia pipeline and the creation of access roads will lead to the removal or destruction of vegetation, potentially protected tree/shrub and herb species. The nature of the impact is adverse, affecting flora directly and is expected to be partly reversible as some areas may be able to be rehabilitated, revegetated and maintained once construction is completed, while other areas may only be rehabilitated after the Project has ceased (~50 years). The impact will occur over a long-term period due to the duration of Project and successful rehabilitation to be observed. The impact is concentrated to the pipeline route only and is likely, due to the total amount of species identified along the route that will be disturbed.

The magnitude of change is moderate due to the potential loss of protected, endemic and rare species, and the sensitivity of the receptor is low because the impacted area is the ammonia pipeline route only. The significance of the impact is minor. Mitigation measures are indicated in the Project ESMP (Appendix A).

7.4.4.2 Construction activities may cause the destruction of sensitive habitats

The areas cleared during the construction phase by mechanical methods would result in the removal or destruction of some sensitive habitats, causing flora associated with these sensitive habitats to either be displaced or destroyed. Sensitive habitats in and near the Project site identified during the biodiversity study are described in chapter 5, however they are listed below:

- **Ephemeral drainage lines – i.e., Khan, Swakop & Tumas Rivers (and associated tributaries)**
- **Light coloured “white and grey” geology – Husab/Rössing/ Witpoortberg areas**
- ***Welwitschia mirabilis* flats/gravel plains**
- **30 km Coastline between Walvis Bay and Swakopmund – important bird area**
- **Lappet-faced vulture nesting sites**

The nature of the impact is adverse, affecting sensitive habitats (flora) directly and is expected to be irreversible as many of the flora within these sensitive habitats are protected due to their endemism, rarity of threatened status, therefore the whole species may be at risk. The

impact is rated permanent as it could impact the species permanently at worst case scenario. The impact will affect sensitive habitats on the pipeline routes only and is likely because of how the locations of sensitive habitats identified coincide with the proposed pipeline routes.

The magnitude of change is major due to the potential destruction of habitats composed of various protected, endemic and rare species, and the sensitivity of the receptor is low because the impacted area is the ammonia pipeline route only. The significance of the impact is moderate.

Mitigation measures include the following:

- Avoid development and associated infrastructure in sensitive areas in the immediate area of the pipeline route. This would minimise the negative effect on the local environment, especially unique features serving as habitat to various vertebrate flora species;
- Avoid trees with raptor nests (especially lappet-faced vultures as these bird numbers are declining dramatically throughout their range and are classified as endangered by the IUCN 2023, respectively);
- Avoid white geology hills/ridges – e.g., *Commiphora* spp (Arandis, Swakop River, Husab areas);
- Avoid the destruction of welwitschia dominated areas (e.g., ephemeral drainage lines & welwitschia flats areas).
- The recommended pipeline route between Farm 58 and Arandis would be to follow existing infrastructure, i.e, the Swakop pipeline route (biodiversity study, Appendix K).
- The sensitive habitats to avoid between the Walvis Bay Port area and Farm 58, general Farm 58 area and between Farm 58 and Arandis is shown in Figure 81, Figure 82 and Figure 83 respectively.

Table 32 describes the impacts on flora associated with the Project route.



Figure 81 - Important *Salsola* spp. dune hummock habitats shown by the white dashed oblongs along the pipeline route between Walvis Bay North Port and Farm 58



Figure 82 - Important rocky ridges and small vegetated ephemeral drainage lines in the Farm 58 area are shown by the white dashed oval



Figure 83 - Sensitive areas between Farm 58 and Arandis: well vegetated ephemeral Khan River (black dashed arrows); Tumas River (white dashed arrows) and Swakop River (blue dashed arrows); Welwitschia Flats (yellow dotted circle); larger inselbergs and rocky ridges (black dotted oblongs)

7.4.4.3 Introduction and spread of invasive alien species

During construction, the clearing of land and disturbance of the soil may provide an opportunity for invasive alien species to colonise the cleared sites, spread and outcompete native species. Invasive alien species are one of the major threats to biodiversity as they possess highly competitive traits, reducing the range of other native species. During the biodiversity study, two invasive alien species were observed throughout the pipeline routes - *Nicotiana glauca* (wild tobacco) and *Prosopis* spp. (mesquite spp.) mainly associated with the Khan and Swakop Rivers, as well as leakages along the existing water pipeline between Arandis and Swakopmund.

The nature of the impact is adverse, directly impacting native flora. The spread of invasive alien species is reversible, should mitigation measures be enforced during operations and the decommissioning phase. The duration of the impact will be short term (~2 years), which is the

duration of the construction phase of the Project and the impact is likely to occur due to the clearance of land. 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 on-site impact. The overall significance of the impact is deemed low. Mitigation measures are discussed in the ESMP.

7.4.4.4 Illegal and unsustainable collection of protected or endemic species

During construction, contractors and workers are employed, which increases the risk of potential illegal extraction of endemic/protected/rare flora species found on the proposed Pipeline routes. Namibia is renowned for its rich diversity of endemic succulent plants, which unfortunately, makes it a target for the poaching of flora such as *Conophytum saxetanum* (rock plant or little stone plant), *Cyphostemma currorii* (Butter Tree) and *Lithops franciscii* (Living Stone or Pebble Plant) (Strauss, Nanyeni, & Pietersen, 2024).

The impact is adversely direct and irreversible due to loss of protected species and may have a permanent effect. The probability of the impact is possible as the potential route is quite extensive, and various vegetation may be encountered.

The magnitude of change is moderate due to the potential loss of protected, endemic and rare species and the sensitivity will be low due to the local scale of the impact. The overall significance of the impact is deemed minor. Mitigation measures are discussed in the ESMP.

Table 32 - Impacts on Flora

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction and decommissioning phase	Trees, shrubs, herbs and grasses	Construction may lead to the removal or destruction of vegetation especially protected tree/shrub and herb species	Adverse Direct Partly reversible Long term On-site Likely	Low	Moderate	Minor (3)
Construction phase		Construction activities may cause the destruction of sensitive habitats	Adverse Direct Irreversible Permanent On-site Likely	Low	Major	Moderate (4)

Activity	Receptor	Impact	Nature of impact	Value & Sensitivity	Magnitude of change	Significance of impact
Construction and decommissioning phase		Construction activities may lead to the risk of the spread of invasive alien species impact shrub, herb and grass species	Adverse Direct Reversible Short term On-site Likely	Low	Minor	Low (2)
Employment, procurement of contractors, good and services	Trees, shrubs and herbs	Illegal and unsustainable collection of protected or endemic species leads to reduced biodiversity and loss of keystone species	Adverse Direct Irreversible Permanent Local Possible	Low	Moderate	Minor (3)

7.4.5 BIODIVERSITY IMPACTS: REPTILES

It is expected that approximately 63 reptile species are present in the Erongo 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 Erongo Region followed by snakes (19 species with 9 species being endemic) (Cunningham, 2024).

The proposed pipeline construction phase is expected to be detrimental to reptiles associated with the affected areas/habitats. However, access routes are not expected to be detrimental to most reptiles as there are numerous existing tracks throughout the Walvis Bay to Arandis area. None of the unique/important species are exclusively associated with the proposed development area (Cunningham, 2024).

The specific impacts to reptiles in the Project area, before mitigation, are presented in Figure 84 for illustrative purposes only. The potential Project impacts on reptiles are discussed further in the sections below and in Table 33.

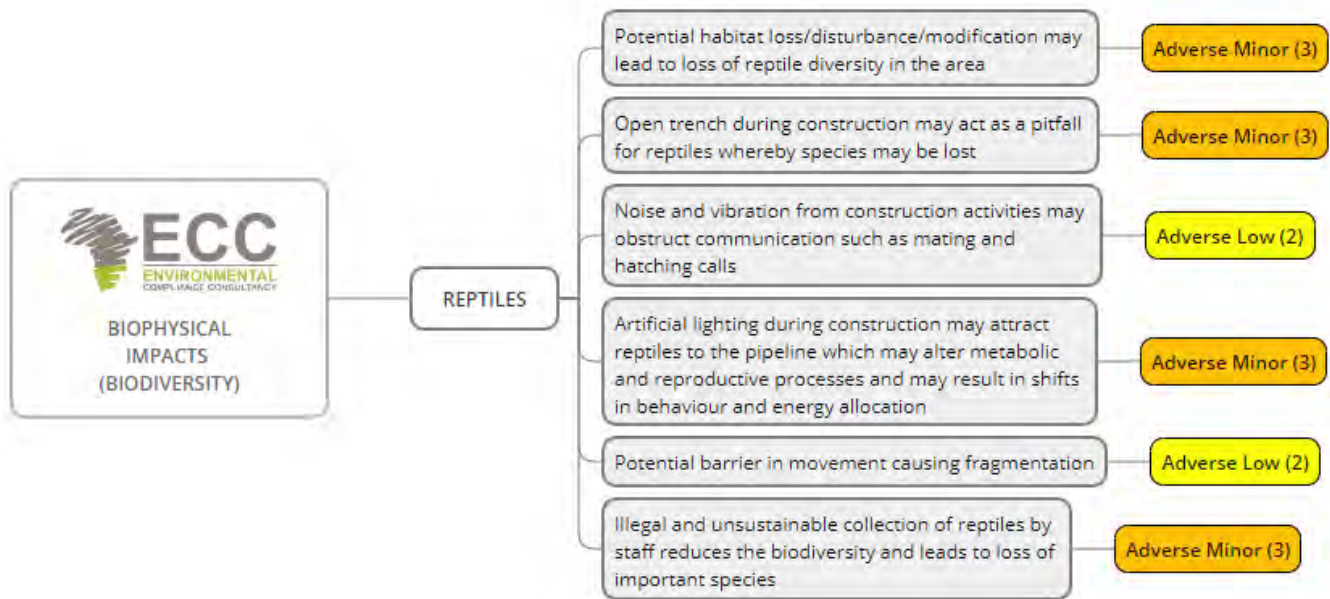


Figure 84 - Impacts on reptiles before mitigation

7.4.5.1 Impact of habitat loss/disturbance/modification on reptiles

Vegetation removal during the construction phase may lead to the destruction, disturbance or modification of reptile habitats. During the rapid site assessment conducted only 1 reptile species was confirmed from the various routes traversed, *Phelsuma (Rhopropus) afer* (common Namib day gecko), while a total of 34 species has been confirmed from the general area by P. Cunningham over the past 18 years (Cunningham, 2024). The low number of species is most likely due to the extreme barren coastal and Farm 58 areas and overall dry conditions between Arandis and Walvis Bay North Port (along the various proposed pipeline routes).

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 presence of the pipeline may lead to the loss of habitats over a long duration. The probability of the impact is likely, because of the extent of the pipeline which passes through various habitats and ecological environments. The magnitude of change is moderate, due to the potential loss of important habitats for reptiles within the development 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.

7.4.5.2 Open trenches during construction may act as a pitfall for reptiles

During construction, an open trench could act as a giant pitfall trap. Species of lizards, geckos and snakes in the area may explore the open trenches 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 as trenching is not expected during operations. Open trenches are an activity part of the construction process; therefore, it is expected that the impact will be short-term. The impact is likely due to reptiles that may pass and roam in and around the Proposed site, as well as the favourable rocky habitat with small sparsely vegetated ephemeral drainage lines that host a variety of reptiles at Farm 58. The magnitude of change is moderate 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 minor. The mitigation measures are described in the ESMP.

7.4.5.3 Noise and vibration impact on reptiles

Noise from machinery and tools used when creating trenches, boring activities and welding of pipe sections 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). Another excessive noise may lead to confusion and potential injury of reptiles on the Project site.

The potential impact is determined as adverse, directly impacting reptiles and reversible following the construction phase and sporadic maintenance activities. The impact will occur on and off for a short period during the construction phase and maintenance activities and is therefore deemed temporary. The impact is likely, as noise and vibrations are inevitable during construction of a pipeline. The magnitude of change is minor due to the measurable change caused to reptiles and the sensitivity will be low due to the local scale. The overall significance of the impact is deemed low. Noise control measures are further discussed in the ESMP.

7.4.5.4 Artificial light impact on reptiles

Artificial lighting may attract reptiles to the proposed site, which may have serious implications on reptile behaviour and physiology, especially in environments where natural light cycles play a major role in their survival. 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). Additionally, reptiles rely on natural light/dark cycles to regulate sleep-wake patterns, hormone production and thermoregulation. Exposure to artificial light at night can disrupt these rhythms, leading to reduced sleep quality, altered feeding behaviour and lower stress resilience (Thawley & Kolbe, 2020).

The impact is adverse, directly impacting reptile behaviour and physiology. The impact is reversible once the construction phase ceases and will occur for a short term, during construction activities (~2 years). Local reptiles are likely to be impacted as light is required during certain times and activities of the Project. Where the pipeline transverses through a national park, activities are restricted to the daytime (i.e. between sunrise and sunset). 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 local scale of the impact. The overall significance of the impact is deemed minor. Mitigation measures are described in the ESMP.

7.4.5.5 Potential barrier in movement causing fragmentation

The development of the ammonia pipeline, access roads and the creation of trenches provide a barrier and hinder the natural movement of reptiles in the area of development. The impact is adverse, direct and reversible once construction has been completed. The impact will occur over a short term due to the duration of the construction phase (~2 years). The impact, however, is quite possible due to the extent of the ammonia pipeline length (~93 km) affecting local reptiles. The magnitude of change is minor as the movement of reptiles may be hindered. The sensitivity is low due to the local scale. The significance of the impact before mitigation is low. Mitigation measures are outlined in the Project ESMP.

7.4.5.6 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 in and around the pipeline site. Commonly traded and smuggled reptiles include the following, to name a few (Altherr & Lameter, 2020):

- *Pachydactylus rangei* (Namib Sand Gecko) – endemic to the Namib Desert and high demand in pet trade;
- *Pachydactylus kochii* (Namib Web-footed Gecko) – endemic and smuggled often due to unique appearance; and
- *Ptenopus carpi* (Carp's Barking Gecko) – endemic to Namib Desert, high confiscation rate in smuggling cases.

The nature of the impact is adverse, direct and irreversible due to permanent loss of important reptile individuals, should the culprit not be identified. The probability of the impact occurring 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 low due to the local extent of the impact. The overall significance of the impact is considered minor. Mitigation measures are further discussed in the ESMP.

Table 33 - Impacts on reptiles

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction phase	Reptile	Potential habitat loss/disturbance/modification may lead to loss of reptile diversity in the area	Adverse Direct Partly reversible Long term On-site Likely	Low	Moderate	Minor (3)
		Open trench during construction may act as a pitfall for reptiles whereby species may be lost	Adverse Direct Partly reversible Short term On-site Likely	Low	Moderate	Minor (3)
Construction phase and maintenance activities		Noise and vibration from construction activities may obstruct communication such as mating and hatching calls	Adverse Direct Reversible Temporary Local Likely	Low	Minor	Low (2)
Power supply during construction phase		Artificial lighting may attract reptiles to the pipeline which may alter metabolic and reproductive processes and may result in shifts in behaviour and	Adverse Direct Reversible Short term Local Likely	Low	Minor	Minor (3)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		energy allocation				
Construction and operational phase		Potential barrier in movement causing fragmentation	Adverse Direct Reversible Short term Local Possible	Low	Minor	Low (2)
Employment, procurement of contractors, good and services		Illegal and unsustainable collection of reptiles by staff reduces the biodiversity and leads to loss of important species	Adverse Direct Irreversible Permanent Local Possible	Low	Moderate	Minor (3)

7.4.6 BIODIVERSITY IMPACTS: 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 ephemeral drainage lines potentially serving 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). The ephemeral Tumas River, located between the Kuiseb and Swakop Rivers, flows even more sporadically and is effectively blocked by the high dunes in the area (i.e., east of the dune belt area). Other water bodies in the area (except for leakages associated with various water pipelines) are generally saline of nature and not suitable habitat for amphibians.

The specific impacts to amphibians in the Project area before mitigation are presented in Figure 85 for illustrative purposes only. The potential Project impacts on amphibians are discussed further in the sections below and in Table 34.

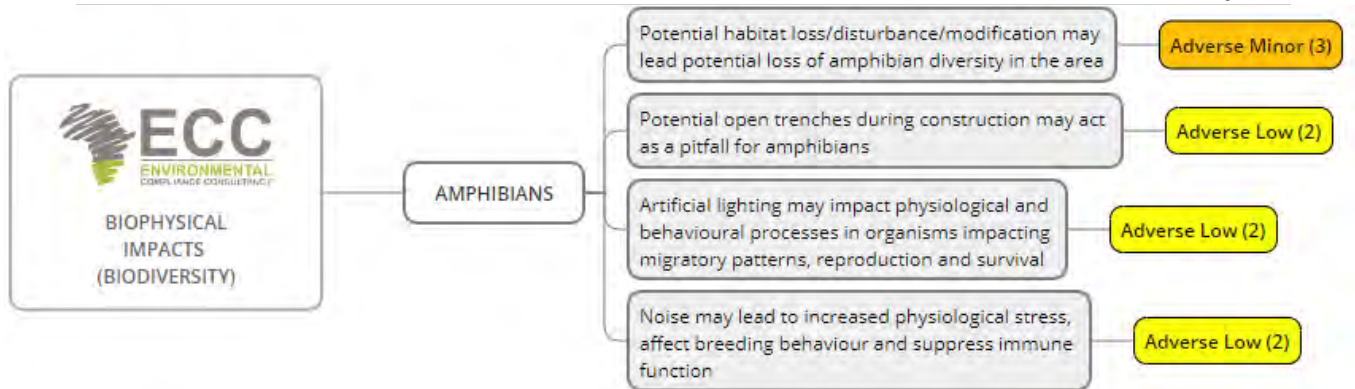


Figure 85 - Impacts on amphibians before mitigation

7.4.6.1 Impact of habitat loss/disturbance/modification on amphibians

During the construction of the ammonia pipeline potential amphibian habitats, especially near water sources, may be disturbed, destroyed or modified, which results in the loss of amphibian individuals, impacting species diversity. No amphibian individuals were encountered during the rapid site assessment, however at least 7 amphibian species may be present in the area, of which 3 species are endemic. The 3 endemics are as follows: *Poyntonophrynus dombensis* (Dombe Toad), *Poyntonophrynus hoeschi* (Hoesch's Pygmy Toad) and *Phrynomantis annectens* (Marbled Rubber Frog). These species are not exclusively associated with any of the proposed pipeline routes.

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 as the pipeline runs for approximately 93 km, however, the dry conditions and low rainfall makes the Walvis Bay to Arandis area unfavourable for amphibian species. The magnitude of change is moderate, due to the potential loss of important habitats for amphibians within the general development area. The sensitivity of receptor is low as only amphibians on-site will be affected. The overall significance of the impact is deemed minor. Mitigation measures are outlined in the ESMP.

7.4.6.2 Open trench during construction may act as pitfall traps for amphibians

During construction, trenches will be created for laying underground pipelines and preparation for civil structures, which function as pitfall traps. Amphibian species may become trapped or killed in the process. These may pose a threat to amphibian individuals.

The impact is adverse, direct and partly reversible. The impact will occur over a short duration during the construction phase (~2 years). The probability of the impact is rated possible as the area is represented by low diversity and abundance of amphibians in the Erongo Region. The magnitude of change is moderate 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. Mitigation measures are provided in the Project ESMP.

7.4.6.3 *Artificial light impact on amphibians*

Artificial light used during Project construction activities may impact nocturnal amphibians by affecting their physiological and behavioural processes such as migratory patterns, reproduction and survival. The impact is adversely direct, reversible once construction ceases and may be experienced over a short duration while construction is underway (~ 2 years). The impact is possible due to the extent and duration of the Project. 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 related to artificial lighting are outlined in the ESMP.

7.4.6.4 *Noise and vibration impact on amphibians*

Noise and vibration during excavation and creation of trenches during construction and maintenance activities during operations may lead to increased physiological stress, affect breeding behaviour as many frogs rely on vocalisations to attract mates and suppress immune function and colouration changes. The nature of the impact is adverse, directly impacting amphibian's ability to reproduce and survive. The impact is, however, temporary and reversible, as loud equipment and machinery are turned off once at times during construction and maintenance activities. The activities will only occur on site, and it is possible that the low numbers of amphibians are affected by noise and vibration related activities.

The magnitude of change is minor due to potential measurable change in the behaviour and survival of amphibian individuals, and the sensitivity is low due to the extent of the impact. The overall impact of noise and vibration to amphibians are low. Mitigation measures related to noise and vibrations are included in the ESMP.

Table 34 - 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 On-site Possible	Low	Moderate	Minor (3)
Construction phase		Potential open trenches during construction may act as a pitfall for amphibians	Adverse Direct Partly reversible Short term On-site Possible	Low	Moderate	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 Short term Local Possible	Low	Minor	Low (2)
Construction phase and maintenance activities		Noise may lead to increased physiological stress, affect breeding behaviour	Adverse Direct Reversible Temporary On-site Possible	Low	Minor	Low (2)

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

7.4.7 BIODIVERSITY IMPACTS: MAMMALS

Overall terrestrial diversity and endemism of all mammal species is classified as “low” to “average” in the western central part of Namibia. Cunningham (2024) states that approximately 55 species of mammals are known and/or expected to occur in the region, 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 Walvis Bay to Arandis 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 species (9.1%) is endemic and 5 species listed as vulnerable (45.5%).

The impact of the proposed ammonia pipeline construction and associated activities are expected to be detrimental to mammals and their affected areas/habitats. A pipeline access route is not expected to be detrimental to most mammals as there are numerous existing tracks throughout the Development area and the overall width of the actual construction activities is narrow Furthermore, none of the expected or unique/important mammal species are exclusively associated with the proposed pipeline area (Cunningham, 2024). The specific impacts on mammals before mitigation measures are presented in Figure 86 for illustrative purposes only. Impacts are discussed in detail in the sections thereafter and in Table 35.

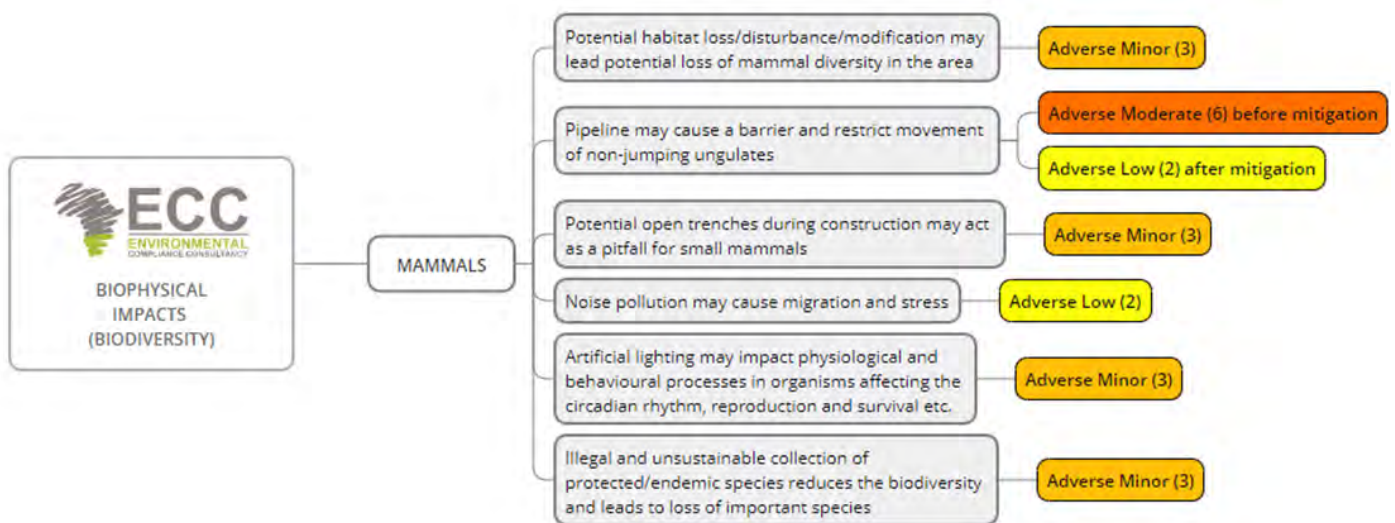


Figure 86 – Overview on the impacts on mammals

7.4.7.1 *Impact of habitat loss/disturbance/modification on mammals*

During the rapid site assessment carried out by P. Cunningham, a total of 7 species of mammals were confirmed from the various routes traversed, while a total of 28 species have been confirmed from the regional area by P. Cunningham over the past 15 years. Of the 7 species observed and/or confirmed from the area during the rapid site assessment, *Equus zebra hartmannae* (Hartmann's mountain zebra), classified as "vulnerable" by the IUCN (2023) and the *Parahyaena [Hyaena] brunnea* (brown hyena), classified as "near threatened" by the IUCN (2023), are viewed as the most important. No bats were observed during the study but important species that could occur in the Walvis Bay to Arandis area are *Cistugo seabrai* (Namibian wing-gland bat) and the *Laephotis namibensis* (Namib long-eared bat).

Habitat alteration and overutilisation are the two primary processes threatening most mammals, with species probably underrepresented for the regional area being the bats and rodents, as these groups have not been well documented from the arid central western part of Namibia (Cunningham, 2024).

The nature of the impact is adverse, directly impacting mammals and may be partly reversible when measures are put in place to rehabilitate the proposed site following construction and, in some cases, operations. The impact is expected to last for an extended period, as both construction and operational phases will require time to implement proper rehabilitation practises and observe measurable improvements.. The impact is over a local scale as mammals tend to move within the local area. The probability of the impact is likely as habitats will be disturbed causing the loss of small mammals or the migration of mammals in general.

The magnitude of change is moderate, due to the potential loss of mammals influencing diversity due to habitat loss or alterations. The sensitivity of receptor is low due to the local scale of the impact. The overall significance of the impact is deemed minor. Mitigation measures are outlined in the ESMP.

7.4.7.2 *Pipeline poses a barrier to non-jumping ungulates*

The pipeline will follow both above-ground and below-ground routes, as some areas have rocky underground geology that makes underground construction impractical or unfeasible. Above ground pipeline infrastructures would act as a physical barrier to non-jumping ungulates (e.g., gemsbok, Hartmann's mountain zebra, affecting their regional migration and foraging patterns. In 2015, a study was conducted by P. Cunningham to determine the impacts of aboveground pipeline infrastructure on vertebrate fauna over a 40 km section from the Swakopmund Base Station to the Langer Heinrich Mine junction. It was determined that most springbok crossed the pipeline with heights between 40 - 70 cm (91.1%) with the greatest number crossing at 50 - 60 cm (44%), while gemsbok crossed with difficulty (e.g., individuals only) at 60 cm. This indicates that a pipeline height of >70 cm is an effective barrier to most springbok and >60 cm for gemsbok, while anything >80 cm is a total barrier (e.g., only 0.4% of springbok crossings were above 80 cm) (Cunningham, Marais, & Van Zyl, 2015).

The effect of aboveground pipeline infrastructure >80 cm is expected to be detrimental to most ungulates and would impede their movement. Ungulate activity is associated with the availability of vegetation, especially along ephemeral drainage lines. Most pipeline crossing attempts were made in the vicinity of vegetated drainage lines (Cunningham, Marais, & Van Zyl, 2015).

The nature of the impact is adverse, directly impacting mammals and is viewed as reversible should the pipeline be removed in the future. The impact is expected to be over a long duration as mammals may be restricted during construction activities as well as operations. The impact is considered over a regional scale due to loss of mobility to be able to roam on a regional scale. The probability of the impact is likely due to the anticipated Project activities.

The magnitude of change is moderate due to the barrier in mammals' natural movement, and the implications associated such as habitat fragmentation, restricting movement to access water and impacting foraging behaviour. The sensitivity of receptor is medium due to the regional scale of the impact. The overall significance of the impact is deemed moderate.

Mitigation measures include:

- Bury pipeline where possible especially at drainage lines used as wildlife foraging corridors;
- Should pipeline be above ground then raised wildlife crossing points should be 100 m in width and located at natural movement corridors (i.e., drainage lines);
- It is recommended that the pipeline be buried for extended sections, with elevation considered only in areas where burial is not feasible; and
- Pipeline route should be designed to avoid critical/sensitive habitats such as *Salsola* spp. dune hummocks, well vegetated Khan/Swakop/Tumas Rivers, ephemeral drainage lines, rocky outcrops (especially white geology areas) and small drainage lines.

7.4.7.3 *Open trenches during construction may act as pitfall traps for small mammals*

During pipeline construction, trenches will be created over a long distance and may be a pitfall traps for small mammals in the Project area. During recent years the capture success for small mammals using Sherman Small Mammal Traps were 8.06% of 3 species (*Proboscideus flavicaudatus* [round-eared elephant shrew], *Gerbillurus paeba* [hairy-footed gerbil] and *Rhabdomys pumilio* [Four-striped Grass Mouse]); 7.4% of 1 species (*Tatera leucogaster* [bushveld gerbil]); 7.1% of 2 species (*Gerbillurus vallinus* [brush-tailed hairy-footed gerbil] & *Elephantulus intufi* [bushveld elephant-shrew]) and 4.4% of 1 species (*Gerbillurus paeba*) were achieved in the neighbouring Ongolo/Tumas; Farm Geluk; Hope/Goreb and Tumas/Reptile areas, respectively (Cunningham, 2024). The low capture success rates of between 4.4 - 8.06% are indicative of the general marginal habitat, low rodent densities and overall dry conditions.

The impact is adverse, direct and partly reversible once the construction phase has been completed. The duration of the impact will be short-term, as the construction phase will be ~ 2 years. Although the low capture rate of small mammals mentioned above, the impact is likely due to the length of the pipeline route (112 km). The magnitude of change is minor due to the small measurable loss of mammal individuals, and the sensitivity of the receptor is low because the impact will occur on-site. The overall significance of the impact is minor. Mitigation measures are detailed in the Project ESMP.

7.4.7.4 Noise and vibration impact on mammals

Noise and vibration from machinery, vehicles and equipment used during pipeline construction and maintenance activities during operations may cause acute stress responses in mammals. Long term effects to noise and vibration include alteration to migration patterns, reproductive behaviour such as mating calls and obstruction in communication. Larger mammals such as the *Felis silvestris* (African Wild Cat) and *Panthera pardus* (Leopard) are sensitive to human disturbance and may abandon territories or hunting grounds due to ongoing construction. Small mammals such as rodents, meerkats, bat eared foxes and other scavengers often live in burrows, which are vulnerable to disturbance from ground vibrations caused by construction activities.

The potential impact is determined as adverse, directly impacting mammals and may be reversible once construction has ceased and after brief maintenance activities. The duration of noise and vibration will be on and off during the construction phase and maintenance activities and is therefore deemed temporary. The impact is likely, given that noise and vibration are unavoidable during pipeline construction. The magnitude of change is minor due to the measurable change and disturbance caused to mammals and the sensitivity will be low due to the local impact. The overall significance of the impact is rated low. Noise control measures are further discussed in the ESMP.

7.4.7.5 Artificial light impact on mammals

Artificial lighting during construction impacts mammals, particularly those adapted to nocturnal lifestyles, especially rodents. Light in natural environments influences a variety of physiological and ecological processes directly and indirectly and, as a result, the effects of light pollution on species, communities and ecosystems are emerging as significant (Russart & Nelson, 2018). Similarly to noise and vibration, artificial light is likely to deter large mammals. Small mammals' reproduction and survival may be threatened by altered predator-prey dynamics, disrupted reproductive cycles, and changes in foraging behaviour.

The nature of the impact is adverse and directly affecting large and small mammals. The impact is reversible and short lived during the construction phase (~2 years). The impact will be localised, as artificial light may extend beyond the boundaries of the Project site. The impact of artificial light on mammals are likely as it will be used at least during the construction phase.

The magnitude of the impact is minor due to the small measurable impact on mammals and the sensitivity will be low due to the local scale of the impact. The significance of the impact is rated minor, and mitigation measures are provided in the Project ESMP.

7.4.7.6 *Illegal and unsustainable collection of protected/endemic mammal species*

Throughout the Project duration, most likely during construction, staff or potential partners may engage in the illegal collection or poaching of endemic, protected, or rare mammal species present in the broader development area.

Namibian protected mammal species expected to be found from the current or previous studies in the development area that are prone to illegal poaching:

- *Macroscelides proboscideus flavicaudatus* (Round-eared Elephant-shrew) – Endemic
- *Orycteropus afer* (Aardvark) - Protected Game
- *Xerus princeps* (Mountain Ground Squirrel) – Endemic
- *Petromys typicus* (Dassie Rat) - 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 (Hyaena) brunnea* (Brown Hyena) – Insufficiently known; Vulnerable
- *Suricata suricatta marjoriae* (Suricate) – Endemic
- *Otocyon megalotis* (Bat-eared Fox) – Vulnerable; Protected game
- *Vulpes chama* (Cape Fox) – Vulnerable
- *Acinonyx jubatus* (Cheetah) – Vulnerable; Protected game

Common mammals prone to poaching within the central western area of Namibia are cheetahs and small mammals (bushmeat poaching). Cheetahs are primarily poached for illegal pet trade, trophy hunting or as a result of human-wildlife conflict (Gichohi, 2018). Bushmeat hunting accounts for between a third and half of all registered poaching cases in Namibia, often targeting mammals such as aardvark, hares and cane rats (Denker, 2024).

The nature of the impact adverse, direct and permanent. The impact is expected to target local mammals during the Project phases. The probability is possible as important mammals that roam around may be illegally collected.

The magnitude of change is moderate, because it involves a sizable impact directed towards sensitive/protected species and potentially the surrounding natural ecosystem. The sensitivity of receptor is low due to the local extent. The significance of the impact before mitigation is minor. Mitigation measures are described in the ESMP.

Table 35 - 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 Likely	Low	Moderate	Minor (3)
		Pipeline may cause a barrier and restrict movement of non-jumping ungulates	Adverse Direct Reversible Long term Regional Likely	Medium	Moderate	Moderate (6)
Construction phase		Potential open trenches during construction may act as a pitfall for small mammals	Adverse Direct Partly reversible Short term On-site Likely	Low	Minor	Minor (3)
Construction phase and maintenance activities		Noise pollution may cause migration and stress	Adverse Direct Reversible Temporary Local Likely	Low	Minor	Low (2)
Power supply		Artificial lighting may impact physiological and behavioural processes in organisms affecting the	Adverse Direct Reversible Short term Local Likely	Low	Minor	Minor (3)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		circadian rhythm, reproduction and survival etc.				
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 Local Possible	Low	Moderate	Minor (3)

7.4.8 BIODIVERSITY IMPACTS: AVIFAUNA

The bird diversity in the regional area is estimated at 111 - 170 species and 2 - 4 species being endemic (Mendelsohn, Jarvis, Mendelsohn, & Robertson, 2022). Important bird areas include the Walvis Bay wetland – considered the most important coastal wetland in southern Africa and one of the top 3 in Africa and supports mainly Palaearctic migrants, often comprising up to 88% of the birds – e.g., up to 1% of the global Chestnut-banded Plover (approximately 2000 individuals) are expected to occur in the Walvis Bay area (Cunningham, 2024). 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*).

The proposed pipeline construction activities are expected to be detrimental to birds associated with the affected areas/habitats. However, a pipeline access route is not expected to be detrimental to most birds as there are numerous existing tracks throughout the development area, and the overall footprint is small. Furthermore, none of the unique/important species are exclusively associated with the proposed development area. The specific impacts on mammals before mitigation measures are presented in Figure 87 for illustrative purposes only. Impacts are discussed in detail in the sections thereafter and in Table 36.

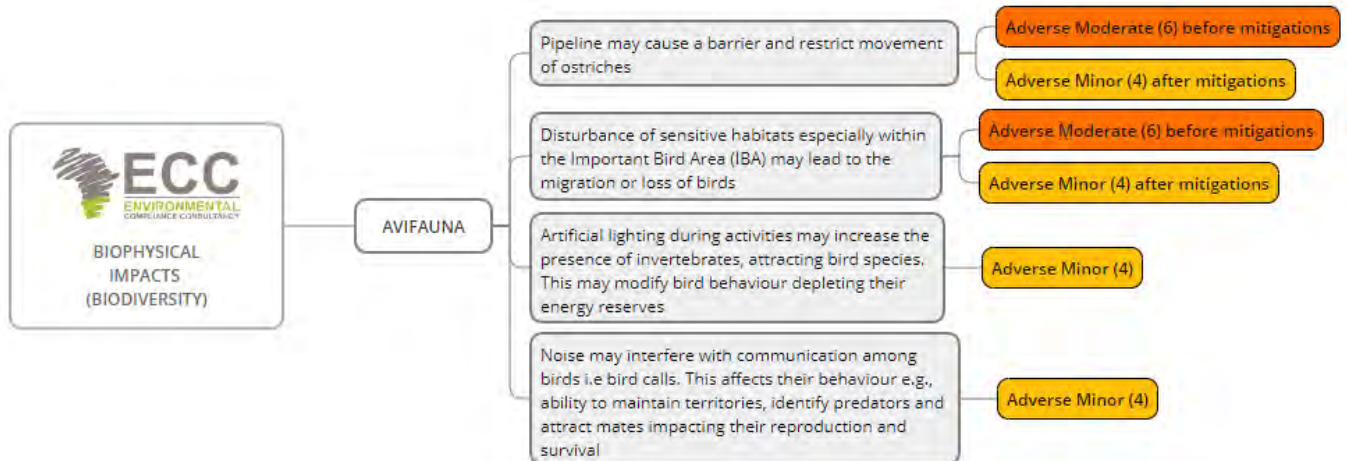


Figure 87 – Overview of the impacts on avifauna

7.4.8.1 Pipeline may cause a barrier and restrict movement of ostriches

The ammonia pipeline will follow both above-ground and below-ground routes, due to rocky underground geology present in some areas. Above ground pipeline infrastructures would act as a physical barrier and restrict movement of ostriches. Ostriches, being large terrestrial birds, require expansive and undisturbed habitats for foraging, nesting and movement. Therefore, any infrastructure projects, including pipelines, that disrupt these habitats could potentially have adverse effects on ostrich populations (African Wildlife Foundation, 2025). In a detailed study on the effects of an aboveground pipeline infrastructure on avifauna conducted by (Cunningham, Marais, & Van Zyl, 2015), it was determined that ostriches did not cross the pipeline at all and viewed it as an effective barrier. Raised – earth covered – crossing points, 30 m in width were not used by ostrich and is expected to be detrimental to ostrich movement.

The nature of the impact is adverse, directly impacting avifauna and is reversible should the pipeline be removed in the future. The impact is expected to be over a long duration considering the ammonia pipeline will be present during both construction and operations. The impact is considered over a regional scale due to reduced habitat and restricted movement regionally. The probability of the impact is likely due to the anticipated Project plan.

The magnitude of change is moderate due to the barrier to ostrich natural movement and the implications associated such as habitat fragmentation, limited access to critical water points and foraging grounds. The sensitivity of receptor is medium due to the regional scale of the impact. The overall significance of the impact is deemed moderate.

Mitigation measures include:

- Bury pipeline where possible especially at drainage lines used as wildlife foraging corridors;

- Should pipeline be above ground then raised wildlife crossing points should be 100 m in width and located at natural movement corridors (i.e., drainage lines);
- Design pipeline routes to avoid known ostrich habitats, especially breeding areas and migratory corridors; and
- Ensure wide, unobstructed zones on either side of the pipeline in known ostrich activity areas.

7.4.8.2 Disturbance of sensitive habitats especially within the Important Bird Area (IBA)

During the Project, sensitive habitats of birds may be disturbed, modified or destructed. The ammonia pipeline extends from the existing jetty at the Walvis Bay north port area to Arandis. The entire coastline is classified as an IBA (Important Birding Area) known as the 30 km beach (national IBA status) as well as a known bird flyway, especially for Palearctic migrant species and birds moving between the various important coastal foraging sites. The IBA is also a known Damera tern breeding grounds (Cunningham, 2024). Additionally, Lappet-faced vultures are known to breed throughout the central coastal area of the Project and although not confirmed along the various pipeline routes, such nesting sites should be avoided should they be observed during the Project. It should be noted that the peak breeding season are between May – July (winter months) and the preferred distance from these habitats should be 500 m. Nesting trees are viewed as important as the vultures are classified as endangered by the IUCN (2023) with population trends decreasing throughout their range.

The nature of the impact is adverse, directly impacting avifauna sensitive habitats and is partly reversible when rehabilitation efforts are enforced during operations and should the pipeline be decommissioned. The impact is anticipated to be over a medium term, as rehabilitation efforts are likely to take place after construction, and it may take time for disturbed sensitive habitats to recover. The impact is considered over a regional scale due to the effects on migratory birds. The probability of the impact is likely due to the extent of ammonia pipeline.

The magnitude of change is moderate due to the sizable impact on sensitive habitats and foraging habits of birds. The sensitivity of the receptor is medium due to the regional scale of the impact. The overall significance of the impact is deemed moderate.

Mitigation measures include:

- Avoid trees with raptor nests (especially lappet-faced vulture as these bird numbers is declining dramatically throughout their range and are classified as endangered by the IUCN 2023, respectively);
- Other important species are the larger *Acacia erioloba* (camel thorn) specimens used by the endangered lappet-faced vultures as nesting sites before the commencement of development activities in areas where these occur and avoid; and
- Rehabilitation of the disturbed areas – i.e., initial development access route “scars” and associated tracks, as well as temporary accommodation sites. Preferably workers should be transported in/out to the construction sites daily to avoid excess damage to

the local environment (e.g., wood collection, poaching, etc.). Such rehabilitation would not only confirm the various development companies' environmental integrity but also show true local commitment to the environment.

7.4.8.3 Artificial light impact on avifauna

Artificial lighting during construction may increase the presence of invertebrates, attracting bird species. This may modify bird behaviour depleting their energy reserves. Birds, especially nocturnal species or those migrating at night, may be drawn to areas with artificial lighting due to the abundance of insects. However, this constant attraction to light may cause disruptions in their normal behaviours. Some studies show that birds may alter their foraging, nesting, and migration patterns in response to artificial lighting, which could affect their energy expenditure (Welbers, et al., 2017).

The nature of the impact is adverse and directly affecting avifauna. The impact is reversible and is likely to occur over a short term during the construction phase (~2 years). The impact will be over a regional scale due to the migratory nature. The artificial light impact on avifauna discussed above are possible, however avifauna will most likely be deterred by the light.

The magnitude of the impact is minor due to the temporary impact on avifauna and the sensitivity will be medium due to the impact on regional birds. The significance of the impact is deemed minor, and mitigation measures are detailed in the Project ESMP.

7.4.8.4 Noise and vibration impact on avifauna

Noise and vibration could significantly interfere with communication and vocalisation such as bird calls and defending territory. This may affect their courtship and predator-prey relationships.

The nature of the impact is adverse, directly impacting avifauna and reversible after the construction phase and after brief maintenance. The impact will occur sporadically during construction and maintenance activities and will impact birds over a regional scale. The impact is possible although most avifauna will be deterred by the noise. The magnitude of change is minor as noise impacts 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 minor. Mitigation measures are described in the Project ESMP.

Table 36 - Impacts on avifauna

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
Construction and operational phase	Avifauna	Pipeline may cause a barrier and restrict movement of ostriches	Adverse Direct Reversible Long term Regional Likely	Medium	Moderate	Moderate (6)
		Disturbance of sensitive habitats especially within the Important Bird Area (IBA) may lead to the migration or loss of birds	Adverse Direct Partly reversible Medium term Regional Likely	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	Adverse Direct Reversible Short term Regional Possible	Medium	Minor	Minor (4)
Construction and maintenance activities		Noise may interfere with communication among birds i.e. bird calls. This affects their behaviour e.g., ability to maintain territories, identify	Adverse Direct Reversible Temporary Regional Possible	Medium	Minor	Minor (4)

Activity	Receptor	Impact	Nature of impact	Value & sensitivity	Magnitude of change	Significance of impact
		predators and attract mates impacting their reproduction and survival				

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 practise requires that, as a minimum, cumulative impacts are assessed during the ESIA process. Cumulative impacts can arise when multiple environmental resources are affected by a single activity, or when a single receptor is exposed to multiple impacts from the proposed project, this is referred to as intraspecific cumulative impacts. Cumulative impacts may also arise because of the combination of two or more projects, this is referred to as interspecific cumulative impacts. 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; and
- Step 5: Identification of mitigation measures to avoid or reduce cumulative impacts.

The cumulative impacts that may arise because of the Project before mitigations and some cases after mitigation are presented in Figure 88, for illustrative purposes only and are outlined in Table 37 and Table 38.

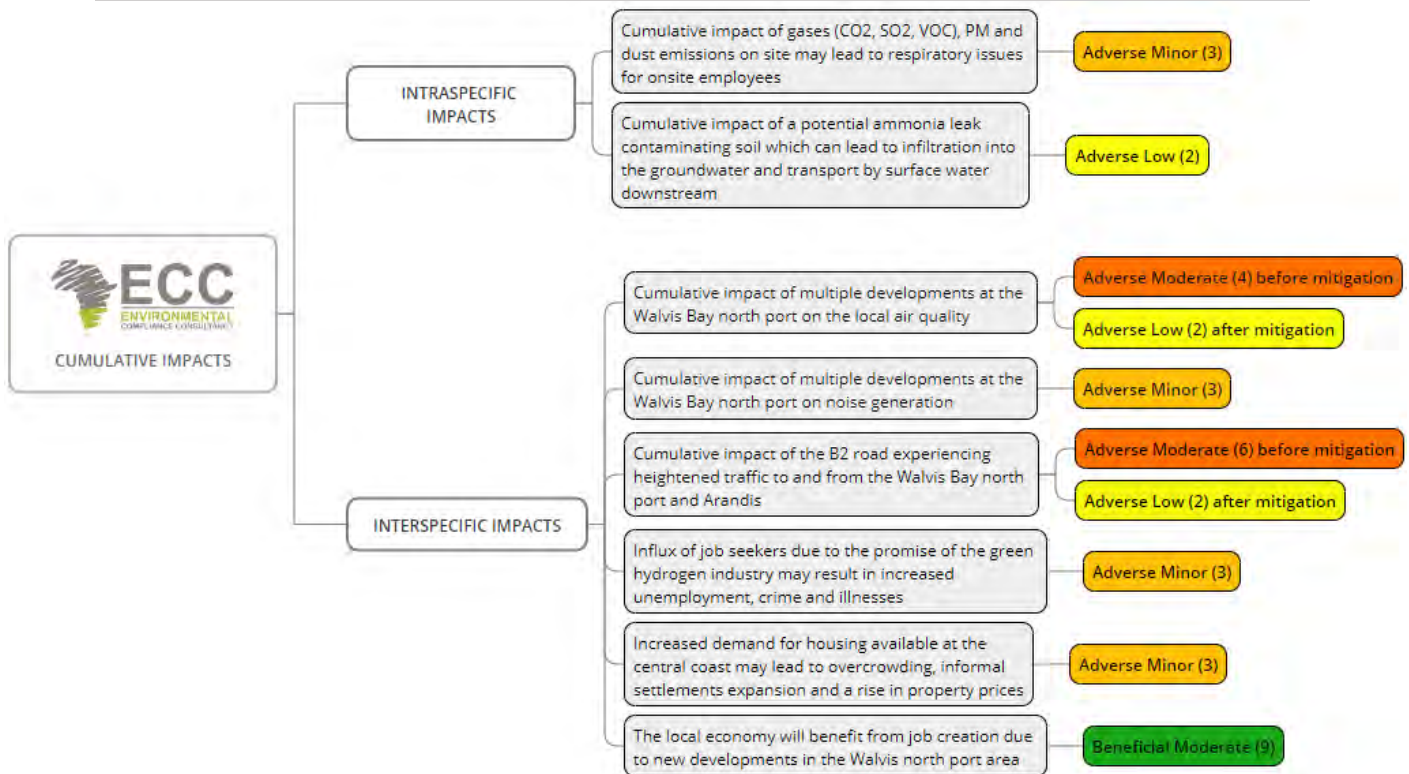


Figure 88 - Intraspecific and interspecific cumulative impacts

7.5.1 INTRASPECIFIC CUMULATIVE IMPACTS

7.5.1.1 *Cumulative impact of gases (CO₂, SO₂, VOC), PM and dust emissions on site may lead to respiratory issues for onsite employees*

During the construction phase, the operation of various equipment and machinery, such as excavation, sandblasting and vehicles has the potential to release fine particulate matter, airborne chemicals, CO₂ emissions, and other gases. These emissions can adversely impact air quality, potentially leading to respiratory issues for employees on site. The nature of the impact is adverse and cumulative as a result of various sources contributing to air quality degradation. The impact is irreversible, and the duration of the impact is short term, 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 minor as the appropriate PPE will be used as a preventive measure, and additional mitigation strategies will be implemented to ensure the health and safety of employees. The probability of this occurring is likely, and the sensitivity is low, as the impact will be limited to the Project site, and the occupational health and safety equipment and measures will be in place. Overall, the significance of the impact is minor. Mitigation measures are included in Table 37.

7.5.1.2 *Cumulative impact of a potential ammonia leak contaminating soil which can lead to infiltration into the groundwater and transport by surface water downstream*

During operations, soil contamination may occur due to potential leaks from the pipeline. Ammonia released could persist in the soil and, during surface water runoff, be transported downstream. Additionally, ammonia may infiltrate into groundwater, potentially affecting the

quality of both surface water and groundwater resources. The nature of the impact is adverse and cumulative due to two different resources (groundwater and surface water) that could be impacted as a result of one activity. The impact is partly reversible due to immediate rehabilitation intervention, and the duration of the impact is medium term. The extent of this impact is local, and the magnitude of the impact is minor due to the limited seasonal surface flow. The probability of this occurring is unlikely due to several factors such as the pipeline design to prevent leaks, low rainfall and high evaporation rates and rehabilitation control measures. Overall, the significance of the impact is low.

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 construction activities, along with potential developments at the Walvis Bay north port area may contribute to the generation of airborne particulate matter (PM₁₀ and PM_{2.5}), chemical gases and added SO₂/CO₂ emissions due to the additional use of vehicles. The emissions of primary and secondary pollutants can affect local air quality and pose health risks to residents, particularly those with respiratory conditions.

Although multiple developments are also expected to occur near Arandis, the majority of proposed projects are anticipated to be ≥5 km from the town and nearest receptors, therefore air quality impacts are negligible to Arandis.

The nature of the impact is adverse and cumulative as a result of various sources contributing to potential air quality degradation. The impact is irreversible, and the duration of the impact is long-term due to the expected developments occurring over different timeframes. The magnitude of the impact is moderate due to the prolonged changes to the air quality. The probability of this impact occurring is likely and the sensitivity is low due to the local scale and the distance of the nearest receptors from the Project activities. The overall significance of the impact is moderate. Mitigation measures are included in Table 38.

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

Noise is expected to be generated during the Project construction activities. The noise generated from multiple developments may be a nuisance to nearby Walvis Bay residents.

Although multiple developments are also expected to occur near Arandis, the majority of the proposed projects are anticipated to be ≥5 km from the town and nearest receptors, therefore noise impacts are negligible to Arandis.

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 adverse, reversible, and the duration of the impact is long term due to the prolonged cumulative impact of multiple developments. The

magnitude of the impact is moderate due to the nuisance the impact may cause nearest receptors should IFC guideline not be followed. The probability of this impact occurring is likely and the sensitivity is low due to the local scale. Overall, the significance of the impact is minor. Mitigation measures are included in Table 38.

7.5.2.3 Cumulative impact of the B2 road experiencing heightened traffic to and from the Walvis Bay north port and Arandis

The Project, along with other new developments in the Walvis Bay North Port area and around Arandis, may increase traffic volumes, potentially causing congestion and disrupting the flow of traffic on the B2 road. The anticipated increase in 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 surrounding developments and impacts on both traffic and the road quality. The impact is partly reversible, and the duration of the impact is long term due to the life cycle of the Projects. The scale of this impact is regional, and the magnitude of the impact is minor. 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 medium due to the regional scale. The significance of the impact is moderate. Mitigation measures are included in Table 38.

7.5.2.4 Influx of job seekers due to the promise of the green hydrogen industry may result in increased unemployment, crime and illnesses

It is becoming apparent that hydrogen will play a pivotal role in decarbonising the global economy and Namibia has the capacity to establish itself as a leading competitor in the industry, with the potential for highly favourable cost structures (Namibia Green Hydrogen Programme, 2024). The green hydrogen industry provides hope for many unemployed youths with the promise of jobs in Walvis Bay and Arandis resulting in increased relocation, this may in turn lead to increased unemployment rates, overcrowding, elevated crime rates and spread of illnesses. The nature of the impact is adverse and cumulative due to relocation for various opportunities within the industry. The impact is partly reversible, and the duration of the impact is long term due to the Project lifecycles. The magnitude of the impact is minor as the negative impacts can be mitigated through housing developments and improved infrastructure, which can stimulate economic growth. The probability of this impact occurring is possible and the sensitivity is low due to the local scale. The significance of the impact is minor. Mitigation measures are included in Table 38.

7.5.2.5 Increased demand for housing available at the central coast may lead to overcrowding, informal settlements expansion and a rise in property prices

The proposed Project along with the recent and future developments in the Walvis Bay north port and Arandis may require additional housing. Priority will be given to local candidates for employment; however, the relocation of permanent or temporary employees may also be considered if necessary. If proper housing is not available, this may lead to overcrowding, informal settlements expansion and a rise in property prices making the cost of living higher.

The nature of the impact is adverse and cumulative due to relocation for various potential companies. The impact is partly reversible, should these Projects complete the decommissioning phase, and the duration of the impact is long term. The magnitude of the impact is minor, as this could create potential for expansion of new residential development. The probability of this impact occurring is possible and the sensitivity is low due to the local scale. The significance of the impact is minor. Mitigation measures are included in Table 38.

7.5.2.6 The local economy will benefit from job creation due to future developments in the Walvis Bay north port area, Swakopmund and Arandis

The Walvis Bay north port area is currently being evaluated for new business ventures and opportunities, driven by the availability of vacant land and its proximity to the Walvis Bay commercial port. New developments are also proposed in Arandis, especially as a result of the green hydrogen industry. The Proponent aims to develop an ammonia production facility in Arandis as part of its near-term expansion plans. Additionally, the Hylron Oshivela pilot plant launched in late 2023 near Arandis using solar-powered green hydrogen to produce ~15,000 t/year of green iron with 400 jobs created during construction (Mining and Energy, 2025). These potential developments may result in a notable increase in local employment opportunities, offering a range of jobs across various skill levels and qualifications, as well as stimulating higher levels of regional economic activity. Furthermore, local businesses may emerge to provide a variety of goods and services required by the new business ventures in different fields. The nature of this impact is beneficial, cumulative and partly reversible. The duration of the impact is long term, due to Project lifecycles. 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 37 - Intraspecific cumulative impacts of the Ammonia Pipeline 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 SO₂/CO₂ emissions and other gases.	Minor (3)	– Apply water sprays or chemical suppressants on regularly travelled, unpaved road sections. This would result in a control efficiency of between 50% and 90%. – Maintenance and repair of diesel engines should be carried out as prescribed by manufacturer in order to maximise combustion and reduce gaseous emissions. – Fuel efficient driving practices on site, during construction, may also help lower exhaust emissions from vehicles and machinery and reduce vehicle entrainment, such as stipulating a maximum speed on all unpaved roads. In addition, other fuel-efficient practises that may lower exhaust emissions include limiting idling of machinery, driving in an upper gear rather than a lower gear as much as possible, ensuring tire pressure are always adequate etc. – Products, liquid fuels, and chemicals should be stored in areas where there are provisions for containment of spills. – Reduce the area of construction (i.e. distance from the pipeline centreline) where it is close to receptors. – Ensure that international air quality standards and best practises are adhered to. – Transition vehicle fleets from any potential diesel-powered to hybrid or electric powered vehicles, which have lower carbon emissions.

Receptor	Impacts	Significance of impact	Impact management
Soil	Activity: Ammonia pipe leaks Impact: Potential ammonia leak contaminating soil which can lead to infiltration into the groundwater and transport by surface water downstream	Low (2)	– Baseline water quality to be retrieved from at least four (4) boreholes nearest the pipeline (downstream) within the Swakop River and at least two (2) baseline samples upstream. – Annual monitoring of the groundwater quality is recommended, either from these same boreholes, or from dedicated monitoring boreholes installed in the river alluvium. – The use of water during emergencies and for managing vapour plumes should be undertaken with caution and avoided where possible to prevent the pooling, mixing, or infiltration of water enriched with absorbed ammonia. – Safety valves should be strategically placed allowing the river crossing segment to be isolated if needed, such as during flood events or leaks.

Table 38 - Interspecific cumulative impacts of the Ammonia Pipeline 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 SO₂/CO₂ emissions and other gases.	Moderate (4)	– Apply water sprays or chemical suppressants on regularly travelled, unpaved road sections. This would result in a control efficiency of between 50% and 90%. – Maintenance and repair of diesel engines should be carried out as prescribed by manufacturer in order to maximise combustion and reduce gaseous emissions. – Fuel efficient driving practises on site, during construction, may also help lower exhaust emissions from vehicles and machinery and reduce vehicle entrainment, such as stipulating a maximum speed on all unpaved roads. In addition, other fuel-efficient practises that may lower exhaust emissions include limiting idling of machinery, driving in an upper gear rather than a lower gear as much as possible, ensuring tire pressure are always adequate etc. – Products, liquid fuels, and chemicals should be stored in areas where there are provisions for containment of spills. – Reduce the area of construction (i.e. distance from the pipeline centreline) where it is close to receptors. – Ensure that international air quality standards and best practises are adhered to. – Transition vehicle fleets from any potential diesel-powered to hybrid or electric powered vehicles, which have lower carbon emissions.

Receptor	Impacts	Significance of impact	Impact management
Noise	Activity: Project activities coupled with the development of other Projects at the Walvis Bay north port area. Impact: Noise pollution.	Minor (3)	– All diesel-powered equipment and vehicles should be kept at a high level of maintenance. This should particularly include regular 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 individual vehicle engine, transmission, and body noise/vibration. This is achieved through the implementation of an equipment maintenance program. – Avoid unnecessary equipment idling at all times. – 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	Moderate (6)	– 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. – Stagger transportation schedules to avoid peak hours. – 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, Arandis and the affected areas in the Erongo Region.

Receptor	Impacts	Significance of impact	Impact management
	quality of roads and the necessity of for maintenance.		
Employment and social wellbeing	Activity: The relocation of job seekers to Walvis Bay, Swakopmund and Arandis due to the promise of jobs in the green hydrogen industry. Impact: May lead to increased unemployment rates in Walvis Bay, crime and illnesses.	Minor (3)	– Involve local residents and community leaders in planning for relocation due to new hydrogen/ammonia projects. Engaging with the community ensures that their needs and concerns are addressed, and that solutions are tailored to local circumstances. – Engage with local authorities to develop comprehensive, long-term plans for workforce integration, housing development, and infrastructure to ensure sustainable growth and minimise potential negative impacts on local residents.
Social and local community	Activity: Increase demand for housing due to new Projects. Impact: Overcrowding and increase in house/rental prices.	Minor (3)	– Local candidates should be given priority for the job positions. – Collaboration with local governments, community organisations, and residents should be considered to develop long-term solutions that consider both the needs of new arrivals and existing populations.
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 businesses, cultivating an entrepreneurial environment and enhancing local	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. – 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 and Arandis developments.

Receptor	Impacts	Significance of impact	Impact management
	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.		

8 CONCLUSION

A complete and comprehensive Environmental and Social Impact Assessment (ESIA) has been undertaken for the Ammonia Pipeline 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.

Table 39 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 39 - Impacts after mitigation measures

Socioeconomic environment: economic		Socioeconomic environment: social		Biophysical environment	
Impacts on employment and job creation	B8	Impacts on air quality	N2	Impacts on soil and groundwater	N2
Impacts on national and local economy	B8	Visual impacts	N2	Impacts on surface water	N2
Project closure impacts	N4	Traffic impacts	N2	Biodiversity – Flora	N2
		Heritage and cultural impacts	N3	Biodiversity - amphibians	N2
		Noise impacts	N1	Biodiversity – Reptiles	N3
		Community health and safety impacts	N4	Biodiversity - mammals	N3
		Occupational health and safety impacts	N4	Biodiversity - Avifauna	N4

BIBLIOGRAPHY

- Acciona. (2020). Green hydrogen: the energy of the future essential for decarbonisation. Retrieved from Acciona: https://www.acciona.com/green-hydrogen/?_ad=02021864894
- African Wildlife Foundation. (2025). *Ostrich*. Retrieved from African Wildlife Foundation: <https://www.awf.org/wildlife-conservation/ostrich>
- Agency for Toxic Substances and Disease Registry (ATSDR). (2004). *Toxicological Profile for Ammonia*. U.S. Department of Health and Human Services.
- Airshed Planning Professionals. (2024). *Air Quality Impact Assessment for the Ammonia Pipeline from Farm 58 to the Ammonia Terminal to Port, Close to Walvis Bay*. Pretoria: Airshed Planning Professionals.
- Altenburg, T., & Kantel, A. (2024). *Green Hydrogen in Namibia: opportunities and risks*. Bonn: German Institute of Development and Sustainability.
- Altherr, S., & Lameter, K. (2020). Stolen Wildlife III: The EU - a main hub and destination for illegally caught exotic pets. *Academia Biology*.
- Amelang, S. (2023, December 14). *Conversion into ammonia will be a "dominant transport technology" for hydrogen – report*. Retrieved from Clean Energy Wire: <https://www.cleanenergywire.org/news/conversion-ammonia-will-be-dominant-transport-technology-hydrogen-report>
- American India Foundation. (2020, August 09). *The Effects of Sound on Reptile*. Retrieved from American India Foundation: [https://aif.org/the-effects-of-sound-on-reptiles/#:~:text=Noise%20pollution%20is%20one%20of,susceptibility%20to%20diseases%20\(2\).](https://aif.org/the-effects-of-sound-on-reptiles/#:~:text=Noise%20pollution%20is%20one%20of,susceptibility%20to%20diseases%20(2).)
- Atlas of Namibia Team. (2022). *Atlas of Namibia: its land, water and life*. Windhoek: Namibia Nature Foundation.
- BirdLife International. (2024). *Data Zone*. Retrieved from BirdLife International: <https://datazone.birdlife.org/site/factsheet/walvis-bay-iba-namibia>
- Brehm, T., & Culman, S. (2022). Pipeline installation effects on soils and plants: A review and quantitative synthesis. *Agrosystems, Geosciences & Environment*.
- Britannica. (2011, June 29). Gypsols. Retrieved from Britannica: <https://www.britannica.com/science/Gypsol>
- California Air Resource Board. (2024). *Inhalable Particulate Matter and Health (PM2.5 and PM10)*. Retrieved from California Air Resource Board: <https://ww2.arb.ca.gov/resources/inhalable-particulate-matter-and-health>
- Chamber of Mines of Namibia. (2020, August 24). *Swakop Uranium: contributing to Namibia's sustainable growth and prosperity*. Retrieved from Chamber of Mines of Namibia: <https://chamberofmines.org.na/blog-post/swakop-uranium-contributing-namibias-sustainable-growth-prosperity/>
- Chiripanhura, B., & Teweldemedhin, M. (2016). An Analysis of the Fishing Industry in Namibia: The Structure, Performance, Challenges, and Prospects for Growth and Diversification. *African Growth & Development Policy modeling consortium*.
- Christians, F. (2020). Primary healthcare and family medicine in Namibia. *African Journal of Primary Health Care and Family Medicine*.

- Cleanergy Solutions Namibia (Pty) Ltd. (2023). H2 Academy. Retrieved from Cleanergy Solutions Namibia: <https://www.cleanergynamibia.com/hydrogen-academy#:~:text=H2%20Academy&text=The%20site%20in%20Walvis%20Bay,at%20a%20public%20refuelling%20station.>
- CMB.TECH. (2024). *Cleanergy Solutions Namibia*. Retrieved from CMB.TECH: <https://cmb.tech/h2-infra/cleanergy-solutions-namibia>
- CMB.TECH. (2025). *Health and Safety Report*. Antwerp.
- Constellation. (2024). What is Clean Energy? Maryland: Constellation NewEnergy, Inc.
- Craven, P., & Vorster, P. (2006). Patterns of plant diversity and endemism in Namibia. *Bothalia*, 175-189.
- Cunningham, P. (2024). *Biophysical assessment (vertebrate fauna and flora); Ammonia & Hydrogen pipelines + ammonia terminal (Arandis- Farm 58 - Walvis Bay area's)*. Karasburg: Environment and Wildlife Consulting Namibia.
- DarkSky. (2024). *Light pollution harms wildlife and ecosystems*. Retrieved from DarkSky: <https://darksky.org/resources/what-is-light-pollution/effects/wildlife-ecosystems/>
- Denker, H. (2024, October 25). *Law enforcement alone will not end wildlife crime*. Retrieved from Conservation Namibia: <https://conservationnamibia.com/articles/law-enforcement-and-wildlife-crime-2024.php#:~:text=Meat%20poaching%20is%20one%20of,protein%20for%20most%20rural%20Namibians.>
- Department of Energy, Environment and Climate Action. (2024). *Soil acidity*. Retrieved from Agriculture Victoria: <https://agriculture.vic.gov.au/farm-management/soil/soil-acidity#:~:text=Acidity%20has%20the%20following%20effects,leached%20below%20the%20root ing%20zone.>
- Dilnashin, H., Birla, H., Hoat, T. X., Singh, H. B., Singh, S. P., & Keswani, C. (2020). Chapter 32 - Applications of agriculturally important microorganisms for sustainable crop production. *Molecular Aspects of Plant Beneficial Microbes in Agriculture*, 403-415.
- Endjala, M. (2024, March 14). Namport revenue increases with N\$ 1.5 billion. Retrieved from Windhoek Observer: <https://www.observer24.com.na/namport-revenue-increases-with-n1-5-billion/>
- Enos Moyo, P. M. (2023). Key populations and Sub-Saharan Africa's HIV response. *National Center for Biotechnology Information*.
- Envira. (2022, January 10). *Primary and secondary pollutants: these are the most dangerous*. Retrieved from Envira: <https://envira.global/primary-and-secondary-pollutants-most-dangerous/>
- Erongo Regional Council. (2015). *Fishing*. Retrieved from Erongo Regional Council: <https://www.erc.com.na/economy/fishing/>
- Erongo Regional Council. (2022). *Erongo Regional Profile 2022*. Swakopmund: Erongo Regional Council.
- Evans Ogdens, L. J. (1996). *Collision Course: The Hazards of Lighted Structures and Windows to Migrating Birds*. Toronto: World Wildlife Fund Canada.
- Gichohi, N. (2018, May 16). *Fighting for cheetahs amidst an illegal pet trade*. Retrieved from African Wildlife Foundation: <https://www.awf.org/blog/fighting-cheetahs-amidst-illegal-pet-trade?>

-
- GIZ. (2020). *Sector Brief Namibia: Tourism*. Bonn and Eschborn, Germany: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.
-
- GIZ. (2022). *Sector Brief Namibia: Tourism*. Windhoek: GIZ.
-
- Government of the Republic of Namibia. (2024). *A blueprint for Namibia's green industrialisation*. Windhoek: Government of the Republic of Namibia.
-
- Hartman, A. (2013, October 31). *Namibia: Langer Heinrich Worker Dies*. Retrieved from allAfrica: <https://allafrica.com/stories/201310311335.html>
-
- Hartman, A. (2023, September 27). *Arandis gets N\$60 million charcoal factory*. Retrieved from the Namibian: <https://www.namibian.com.na/arandis-gets-n60-million-charcoal-factory/>
-
- Hayes, T. B., Falso, P., Gallipeau, S., & Stice, M. (2010). The cause of global amphibian declines: a developmental endocrinologist's perspective. *Journal of Experimental Biology*, 921-933.
-
- healthline. (2025). What is Ammonia Poisoning.
-
- Hofmeyr, A. (2024, July 30). *Namib Desert Animals and where to see them in Namibia*. Retrieved from African Budget Safaris: <https://www.africanbudgetsafaris.com/blog/namib-desert-animals/>
-
- lipumbu, S. (2024, March 27). Understanding census data. Retrieved from Erongo: Proposed Terminal at Namport for Storage and Handling of INDUSTRIAL MINERALS, BASE AND RARE METALS, WALVIS BAY, ERONGO REGION
-
- info namibia. (2025). *Namib Naukluft Park*. Retrieved from info namibia: <https://www.info-namibia.com/activities-and-places-of-interest/sossusvlei/namib-naukluft-park>
-
- Institute for Public Policy Research. (2023, October 13). *Namibia Quarterly Economic Review*. Retrieved from IPPR: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://ippr.org.na/wp-content/uploads/2023/10/Namibia-QER-2023-Q3.pdf
-
- miUCN. (2022, February 13). *List of Namibian species with IUCN Red List Status*. Retrieved from Namibia Biodiversity Database: <https://biodiversity.org.na/redlistspp.php>
-
- Jaro Consultancy. (n.d.). *Wildlife Credits and Incentive to Conserve*. Retrieved from How Wildlife Credits works: <https://wildlifecredits.com/how-we-work>
-
- Kariko, W. (2025, April 12). *Nandi-Ndaitwah opens first zero emissions hyrlon in southern Africa*. Retrieved from the Namibian: <https://www.namibian.com.na/nandi-ndaitwah-opens-first-zero-emissions-hyrlon-in-southern-africa/>
-
- Lanracorp.inc. (2024). *The Importance of Right of Way Tree Trimming*. Retrieved from Lanracorp.inc: <https://lanracorp.com/right-of-way-tree-trimming/#:~:text=This%20means%20clearing%20away%20branches,%2C%20roads%2C%20a%20and%20railways%20run.>
-
- Law.Africa Legislation Commons. (2017). *Forest Regulations, 2015 Government Notice 170 of 2015*. Republic of Namibia.
-
- Levy, G. J., & Shainberg, I. (2005). Sodic soils. *Encyclopedia of Soils in the Environment*, 504-513.
-
- Liebenberg-Enslin, H., von Oertzen, D., & Mwananawa, N. (2020). Dust and radon levels on the west coast of Namibia - What did we learn? *Atmospheric Pollution Research*, 2100-2109
-
- Mathekga, R. (2022, August 22). Can Namibia turn oil into prosperity? Retrieved from Geopolitical Intelligence Services AG: <https://www.gisreportsonline.com/r/namibia-oil-discovery/>
-

Mining and Energy. (2025, March 16). Hyiron Oshivela produces first green hydrogen in Namibia. Retrieved from Mining and Energy: https://miningandenergy.com.na/hyiron-oshivela-produces-first-green-hydrogen-in-namibia/#google_vignette

Minnesota Pollution Control Agency. (2025). *Volatile organic compounds (VOCs)*. Retrieved from Minnesota Pollution Control Agency: <https://www.pca.state.mn.us/pollutants-and-contaminants/volatile-organic-compounds-vocs#:~:text=and%20environmental%20concerns-,Exposure%20to%20VOC%20vapors%20can%20cause%20a%20variety%20of%20health,are%20suspected%20or%20proven%20carcinogens.>

Namib Hydrossearch. (2022). *Cleanergy Green Hydrogen Demonstration Plant (GHP) Walvis Bya, Namibia: Environmental Impact Assessment: Surface and Hydrogeology Specialist Study*. Namib Hydrossearch

Namibia Economist. (2023, September 28). *Husab mine reached for profits in 2022 for first time*. Retrieved from Namibia Economist: <https://economist.com.na/82916/mining-energy/husab-mine-makes-great-strides-in-2022-mine-expected-to-make-profit-for-the-first/#:~:text=According%20to%20the%20report%20which,as%20well%20as%20social%20investments.>

Namibia Green Hydrogen Programme. (2024). *Building towards Namibia's Green Hydrogen Future*. Retrieved from Namibia Green Hydrogen Programme: <https://gh2namibia.com/>

Namibia Ministry of Health and Social Services . (2017). *Namibia 2014/15 Health Accounts Report*. Windhoek: MoHSS.

Namibia Ministry of Health and Social Services. (2015). *The Namibia AIDS response progress report 2015*. Windhoek: MoHSS.

Namibia Statistics Agency. (2019). *Namibia Labour Force Survey 2018 Report*. Windhoek: Namibia Statistics Agency.

Namibia Statistics Agency. (2024). *2023 Population & Housing census*. Windhoek: Namibia Statistics Agency. Retrieved from City population.

Namibia Statistics Agency. (2025). *2023 Population and Housing Census Labour Force Report*. Windhoek: Namibia Statistics Agency.

Namibia Today. (2025, January 26). *Namibia's Port of Walvis Bay: Gateway to Southern Africa's Economy*. Retrieved from Namibia Today: <https://namibiatoday.com/namibian-shoppers-now-have-a-gateway-to-south-africas-best-lifestyle-deals-with-offshop-co-za/>

Namibian Institute of Mining & Technology (NIMT). (2025). *Introducing NIMT*. Retrieved from NIMT: <https://www.nimtnam.com/introducing-nimt>

Namport. (2023). *At a glance*. Retrieved from To Be the Best Performing Seaports in Africa: <https://www.namport.com.na/about-namport/at-a-glance/317/#:~:text=Namport's%20key%20roles%3A&text=Contribute%20to%20the%20competitiveness%20of,development%20and%20cross%2Dborder%20trade>

Nangolo, N. (2023, February 02). *Erongo tourism showing signs of "positive" recovery*. Retrieved from Erongo: <https://www.erongo.com.na/tourism-ero/erongo-tourism-showing-signs-of-positive-recovery2023-02-02>

National Planning Commission. (2021). *The impact of mining sector to the Namibia economy*. Windhoek: Republic of Namibia: National Planning Commission.

-
- New Era. (2023, August 28). *N\$2 BILLION PORT EXPANSION FOR ENERGY EXPLOSION...INCLUDES OIL AND GAS SUPPLY BASE IN WALVIS BAY*. Retrieved from New Era: <https://neweralive.na/n2-billion-port-expansion-for-energy-explosion-includes-oil-and-gas-supply-base-in-walvis-bay-2/>
-
- NIOSH. (2023). *NIOSH Pocket Guide to Chemical Hazards: Ammonia*. Retrieved from The National Institute for Occupational Safety and Health (NIOSH): <https://www.cdc.gov/niosh/npg/npgd0028.html>
-
- Observer, W. (2025). Seven Merlus Fishing workers hospitalised after ammonia inhalation.
-
- Organisation for Economic Co-operation and Development. (2023). *General government revenue*. Retrieved from OECD Data: <https://data.oecd.org/gga/general-government-revenue.htm>
-
- OSHA outreach courses. (2025, March 03). *Safety Triangle Analysis: Predicting Injuries and Deaths*. Retrieved from OSHA outreach courses: <https://www.oshaoutreachcourses.com/blog/safety-triangle-the-safe-pyramid/>
-
- Perry, G., Buchanan, B. W., Fisher, R., Salmon, M., & Wise, S. E. (2008). Effects of artificial night lighting on amphibians and reptiles in urban environments. *Herpetological Conservation*, 211-228.
-
- PrimeWeld. (2025). *The Role of Welding in Construction*. Retrieved from PrimeWeld: <https://primeweld.com/blogs/news/the-role-of-welding-in-construction#:~:text=Welding%20involves%20using%20heat%20to,for%20its%20strength%20and%20durability.>
-
- Professional Evaluation and Certification Board. (2024). *The Importance of Occupational Health and Safety*. Retrieved from PECB: <https://pecb.com/article/the-importance-of-occupational-health-and-safety>
-
- RCHeritage Services CC. (2024). Heritage Impact Assessment Report for proposed construction of an ammonia pipeline from Farm 58 to Walvis Bay Port terminal area, Erongo Region, Namibia. Windhoek: RCHeritage Services CC.
-
- Riscom. (2024). *Quantitative Risk Assessment (QRA) for the ammonia terminal at Walvis Bay, Ammonia and Hydrogen at Walvis Bay, Namibia*. Riscom.
-
- Rössing Uranium Limited. (2011). *Rössing Uranium Limited Working for Namibia*. Rössing Uranium Limited.
-
- Russart, K. L., & Nelson, R. J. (2018). Artificial light at night alters behavior in laboratory and wild animals. *Journal of Experimental Zoology and Ecologically Integrated Physiology*, 401-408.
-
- Schneider, V. (2014, January 20). *Arandis: The uranium capital of the world*. Retrieved from aljazeera: <https://www.aljazeera.com/features/2014/1/20/arandis-the-uranium-capital-of-the-world>
-
- Shikololo, A. (2023, June 20). Over 15 000 jobs to be created. Retrieved from New Era : <https://neweralive.na/posts/over-15-000-jobs-to-be-created>
-
- Shiwayu, G., & Hartmann, A. (2023, September 29). Cornerstone of N\$ 3.5b green hydrogen plant laid at Walvis . Retrieved from The Namibian: <https://namibian.com.na/cornerstone-of-n35b-green-hydrogen-plant-laid-at-walvis/>
-
- Stratford, D., & Stone, A. (2024, August 1). *African archaeology has neglected Namibia's desert*. Retrieved from the namibian: <https://www.namibian.com.na/african-archaeology-has-neglected-namibias-deserts/>
-

Strauss, E., Nanyeni, L., & Pietersen, T. (2024, October 30). Plant poaching receives more attention in Namibia's fight against wildlife crime. Retrieved from Conservation Namibia: <https://conservationnamibia.com/articles/plant-poaching-2024.php#:~:text=Some%20of%20Namibia's%20plant%20species,that%20host%20highly%20targeted%20species.>

Superior Groundcover Incorporated. (2020, August 4). *How do construction sites cause erosion?* Retrieved from Erosion Control on Construction Sites: <https://www.superiorgroundcover.com/erosion-control-on-construction-sites/#:~:text=Soil%20erosion%20happens%20when%20construction,in%20place%20and%20prevent%20erosion.>

Thawley, C. J., & Kolbe, J. J. (2020). Artificial light at night increases growth and reproductive output in Anolis lizards. *Processing Biological Science*.

The Brief. (2024, November 22). *Motor vehicle crashes record 16% increase year to date - MVA*. Retrieved from The Brief: <https://thebrief.com.na/2024/11/motor-vehicle-crashes-record-16-increase-year-to-date-mva/>

The Namibian. (2021, November 18). *Namib reptiles "disappearing at an alarming rate"*. Retrieved from The Namibian: <https://www.namibian.com.na/namib-reptiles-disappearing-at-an-alarming-rate/>

Towers, L. (2025). *Groundwater and Surface Water Impact Assessment: Ammonia Pipeline*. Windhoek: Environmental Compliance Consultancy.

U.S. Fish & Wildlife Services. (n.d.). *Threats to Birds: Collisions (Nighttime Lighting)*. Retrieved from U.S. Fish & Wildlife Services: <https://www.fws.gov/story/threats-birds-collisions-nighttime-lighting#:~:text=Why%20is%20this%20harmful%20to,colliding%20with%20buildings%20and%20infrastructure.>

Uanguta, E. (2024, August 10). *Namibia: Balancing Sustainable and Fossil Energy for the future*. Retrieved from the namibian: <https://www.namibian.com.na/namibia-balancing-sustainable-and-fossil-energy-for-the-future/>

United Nations Development Programme. (2024). *Namibia SDG push framework: Unlocking New Pathways to SDG Acceleration*. New York, NY: United Nations Development Programme.

United States Environmental protection Agency. (2025, January 10). *Sulfur Dioxide Basics*. Retrieved from United States Environmental protection Agency: <https://www.epa.gov/so2-pollution/sulfur-dioxide-basics#:~:text=What%20are%20the%20health%20effects,these%20effects%20of%20SO2.>

Wang, Y., Ming, T., Li, W., Yuan, Q., de Richter, R., & al, e. (2022). Atmospheric removal of methane by enhancing the natural hydroxyl radical sink. *Greenhouse Gases: Science and*, 784-795.

Wassenaar, T. D., Henschel, J. R., Pfaffenthaler, M. M., Mutota, E. N., Seely, M. K., & Pallet, J. (2013). Ensuring the future of the Namib's biodiversity: Ecological restoration as a key management response to a mining boom. *Journal of Arid Environments*, 126-135.

World Population Review. (2024). *Namibia Population 2024 (Live)*. Retrieved from World Population Review: <https://worldpopulationreview.com/countries/namibia>

WWF Namibia. (2023, May). *Clean Energy: Towards a brighter future for Namibia - WWF Namibia Briefing*. Retrieved from WWF Namibia: chrome-

extension://efaidnbmnnnibpcajpcglclefindmkaj/https://wwfafrica.awsassets.panda.org/downloads/wwf_coming_clean_on_energy_1.pdf

APPENDIX A – ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

APPENDIX B – PUBLIC CONSULTATION DOCUMENT

APPENDIX C – EAP CVS

APPENDIX D – HEALTH AND SAFETY REPORT

APPENDIX E – AIR QUALITY IMPACT ASSESSMENT

APPENDIX F – NOISE IMPACT ASSESSMENT

APPENDIX G – HERITAGE IMPACT ASSESSMENT

APPENDIX H – TRAFFIC IMPACT ASSESSMENT

APPENDIX I – CLIMATE CHANGE IMPACT ASSESSMENT

APPENDIX J – GROUNDWATER AND SURFACE WATER IMPACT ASSESSMENT

APPENDIX K – BIODIVERSITY (VERTEBRATE FAUNA AND FLORA) IMPACT ASSESSMENT

APPENDIX L – ADDENDUM REPORT