PROPOSED WASTE MANAGEMENT FACILITY – WALVIS BAY

Environmental Scoping, Impact Assessment and Management Plan Report

Prepared for:	Namwaste (Pty) Ltd.
Prepared by:	Knight Piésold Consulting (Pty) Ltd.
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PROPOSED WASTE MANAGEMENT FACILITY IN WALVIS BAY

ENVIRONMENTAL SCOPING, IMPACT ASSESSMENT AND MANAGEMENT PLAN

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EXECUTIVE SUMMARY

Namwaste (Pty) Ltd proposes to construct and operate an integrated waste management facility within Portion 160 of the Remainder of Farm 38, Walvis Bay, Erongo Region, Namibia. The proposed site is located within an area with surrounding industrial land lease areas and an upcoming mixed-use urban residential development, Green Valley Township, approximately 2 km north-west of the proposed project site.

The applicant, Namwaste (Pty) Ltd, was established in 2023 as a subsidiary of Rent-A-Drum (Pty) Ltd, (Rent-A-Drum (Pty) Ltd., 2025) which aims to develop new industrial waste treatment and disposal facilities in Namibia, which will address the pressing shortage of solutions for industrial and hazardous waste management in Namibia and will contribute to the protection of the environment whilst also creating employment opportunities and fostering economic growth.

The Environmental Assessment Report, including Scoping, Impact Assessment and Management Plan is being undertaken in terms of the Namibian EIA Regulations (2012), and the following listed activities (numbering as per the Regulations) are being applied for:

- *1(b). The construction of facilities for the transmission and supply of electricity*
- *2.1. The construction of facilities for waste sites, treatment of waste and disposal of waste*
- *2.3. The import, processing, use and recycling, temporary storage, transit or export of waste*
- *8.1. The abstraction of ground or surface water for industrial or commercial purposes*
- *8.2. The abstraction of groundwater at a volume exceeding the threshold authorised in terms of a law relating to water resources*
- *8.6. Construction of industrial and domestic wastewater treatment plants and related pipeline systems*
- *9.1. The manufacturing, storage, handling or processing of a hazardous substance defined in the Hazardous Substances Ordinance, 1974*
- *9.2. Any process or activity which requires a permit, licence or other form of authorisation, or the modification of or changes to existing facilities for any process or activity which requires an amendment of an existing permit, licence or authorisation or which requires a new permit, licence or authorisation in terms of a law governing the generation or release of emissions, pollution, effluent or waste*
- *10.1 (a) The construction of oil, water, gas petrochemical and other bulk supply pipelines*
- *10.1 (b) The construction of public roads*

A public participation process was undertaken in 2024 over the period of 26 March – 12 April and included distribution of background information documents, placement of site notices, advertisements in newspapers and public meetings. A review of the Environmental Assessment Report took take place in January 2026.

The environmental impacts have been assessed, with various specialist studies undertaken for the project site. In the context of the proposed development, the change in land use, visual aesthetics, alteration in local topography and fugitive dust generation are of a high significance. In parallel, the positive socio-economic impacts of increased employment opportunities and economic development within Walvis Bay can also be considered as high. Other potential environmental impacts may include contamination of soil or water through accidental spills, noise generation, impacts on fauna and flora,

and impacts on cultural heritage. All negative environmental impacts can be reduced to a moderate or low significance with appropriate mitigation measures.

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ABBREVIATIONS

AIDS ..... Acquired Immunodeficiency Syndrome
ALARP ..... As Low as Reasonably Practicable
BID ..... Background Information Document
CEDAW ..... Convention on the Elimination of All Forms of Discrimination against Women
DAF ..... Dissolved Air Flotation
DAFU ..... Dissolved Air Flotation Unit
DEAF ..... Department of Environmental Affairs and Forestry
ECC ..... Environmental Clearance Certificate
EHS ..... Environmental Health and Safety
EIA ..... Environmental Impact Assessment
EMP ..... Environmental Management Plan
E&P ..... Exploration and Production
GDP ..... Gross Domestic Profit
GHG ..... Greenhouse Gas
GN ..... Government Notice
HDPE ..... High-Density Polyethylene
HIV ..... Human Immunodeficiency Virus
IFC ..... International Finance Corporation
ILO ..... International Labour Organization
MAWLR ..... Ministry of Agriculture, Water and Land Reform
MEFT ..... Ministry of Environment, Forestry and Tourism
MME ..... Ministry of Mines and Energy
MWT ..... Ministry of Works and Transport
NHC ..... National Heritage Council
NUST ..... Namibia University of Science and Technology
O&G ..... Oil and Gas
OBM ..... Oil Based Mud
OTL ..... Overhead Transmission Line
PM ..... Particulate Matter
PPE ..... Personal Protection Equipment
PSV ..... Platform Supply Vessel
SADC ..... Southern African Development Community
TCC ..... Thermo-mechanical cuttings cleaner
USA ..... United States of America
UV ..... Ultraviolet
WHO ..... World Health Organisation

1 INTRODUCTION

1.1 PROJECT OVERVIEW

Rent-A-Drum (Pty) Ltd (Rent-A-Drum) has been operating in the Namibian waste management sector for 36 years. The Rent-A-Drum Group was acquired by the Séché Environnement Group in 2023. The Séché Environnement Group owns a majority stake in the Rent-A-Drum Group, of which Namwaste (Pty) Ltd (Namwaste), is a subsidiary.

The Séché Environnement Group, an established French-owned company, which has been in operation for 40 years and operates in 16 countries throughout the world, is a major player in the circular economy and waste management, decontamination and emergency environmental services sector. The Rent-A-Drum Group currently offers integrated waste management solutions and has an operational footprint in 6 of Namibia's 14 regions, serving over 2,000 customers and employing approximately 450 full-time staff members.

The applicant for the project is Namwaste (Pty) Ltd (Namwaste), established in 2023. The company aims to develop new industrial waste treatment and disposal facilities in Namibia, which will address the pressing shortage of solutions for industrial and hazardous waste management in Namibia and will contribute to the protection of the environment whilst also creating employment opportunities and fostering economic growth.

Increased production of waste offshore Walvis Bay, existing commercial and industrial uses of the Port and the lack of suitable industrial waste treatment facilities necessitate a private sector solution to manage the waste on-shore, both from off-shore activities and port activities. Therefore, there is a need to establish suitable treatment facilities as close as possible to the source of generation.

1.2 PROJECT BACKGROUND AND MOTIVATION

Rent-A-Drum is aware that oil and gas exploration and production drilling has increased offshore Namibia in the past few years. Activity levels for exploration drilling will have 2-4 active drill rigs in Namibian waters for the next 3 years. Production drilling is set to increase above these levels. It is anticipated that at least 5 drilling rigs will be based in Walvis Bay for the next 5 years drilling at least 40 wells offshore. Should production drilling lead to production; large floating production storage and offloading (FPSOs) will be based offshore to allow oil production. Drilling and production of oil and gas reserves offshore will generate significant quantities of solid and liquid industrial waste with the possibility of hydrocarbon contamination. Increased production of waste offshore Walvis Bay, existing commercial and industrial uses of the Port and the lack of suitable industrial waste treatment facilities necessitate a private sector solution to manage the waste on-shore, both from off-shore activities and port activities.

Namwaste (Pty) Ltd identified an industrial service gap within Namibia and aim to satisfy this need through the development of waste management facilities in country, with an application for a waste treatment and disposal facility currently under construction near Arandis with an ECC granted in March 2025, and two additional proposed facilities in Lüderitz and Walvis Bay. This report is drafted for the application of an Environmental Clearance Certificate (ECC) for the proposed facility in Walvis Bay. A lease agreement will be signed between the Walvis Bay Municipality and Namwaste (Pty) Ltd once the ECC is issued for the proposed development to occur in an area of approximately 78 133 m^2 (7.81

hectares) on Portion 160 of the remainder of Farm 38, east-south-east of Walvis Bay and approximately 20 km from the Walvis Bay Port entrance. The site location is provided within Figure 1.

Figure 1: Project Location

2 DETAILS OF THE APPLICANT AND CONSULTANT

2.1 DETAILS OF THE APPLICANT

Table 1: Details of the Applicant and Environmental Assessment Practitioner

	Applicant	Environmental Assessment Practitioner
Name of company / organisation	Namwaste (Pty) Ltd	Knight Piésold Consulting (Pty) Ltd
Contact person	Thierry Provendier	Lloyd Lynch
Telephone Email	+264 64 460 977 t.provendier@rent-a-drum.com.na	+27 11 806 7111 llynch@knightpiesold.com
Physical address	Sam Nujoma Drive Windhoek	11 Nelson Mandela Avenue, Klein Windhoek Windhoek
Postal address	PO Box 30735 Pionierspark Windhoek	PO Box 86062 Eros Windhoek

2.2 DETAILS OF THE ENVIRONMENTAL CONSULTANTS

Knight Piésold is an international consulting company providing engineering and environmental services for the mining, power, water, transportation and construction sectors. Knight Piésold was founded in South Africa in 1921 and has expanded over the world in response to project requirements, with 30 offices established in 15 countries, namely Argentina, Australia, Botswana, Canada, Chile, China, Colombia, Ghana, Namibia, Peru, South Africa, Swaziland, the USA, and Vietnam.

Knight Piésold has an office in Windhoek, Namibia and provide engineering and environmental services to the transportation, mining and water sectors. The team has been involved in various environmental projects across Namibia. Knight Piésold Consulting (Pty) Ltd has been appointed as environmental assessment practitioners to undertake the Environmental study for the proposed waste management facility in Walvis Bay.

This report was prepared by Lloyd Lynch and Joseph Mulders with inputs from Dr Lima Maartens. It was reviewed by Amelia Briel. Curricula vitae are available in Annexure A. Specialist inputs were obtained from Knight Piésold's hydrogeology section, Dr John Kinahan, Urban Dynamics and Ward Karlson Consulting, all of which are annexed to the environmental assessment report.

3 POLICY AND LEGAL FRAMEWORK

The overarching legislative requirements for this report are contained within the Environmental Management Act 7 of 2007. The regulations under section 56 of the Environmental Management Act (GN No. 30 of 2012) and the "*List of activities that may not be undertaken without Environmental Clearance*" under section 27 of the Environmental Management Act were published in 2012 (GN No. 29 and 30 of 2012; Government of the Republic of Namibia, 2012).

Table 2 provides the activities that cannot be undertaken without an Environmental Clearance Certificate (ECC), and which are relevant to the proposed project.

Table 2: Listed activities being applied for

Listed activity	Expected activity
Energy Generation, Transmission and Storage Activities	
1 (b). The construction of facilities for the transmission and supply of electricity	The project involves the installation of generators for backup electrical supply and connection points to nearby electrical supply lines.
Waste management, treatment, handling and disposal	
2.1 The construction of facilities for waste sites, treatment of waste and disposal of waste	The project involves the construction of facilities to cater to the treatment, handling and storage of hazardous waste.
2.3. The import, processing, use and recycling, temporary storage, transit or export of waste	The project involves the construction of facilities to cater to the treatment, handling and storage of hazardous waste.
Water Resources Development	
8.1. The abstraction of ground or surface water for industrial or commercial purposes	As an alternate to piped water supply, the project may involve the abstraction of groundwater to be used for industrial purposes.
8.2. The abstraction of groundwater at a volume exceeding the threshold authorised in terms of a law relating to water resources	As an alternate to piped water supply, the project may involve the abstraction of groundwater to be used for industrial purposes.
8.6. Construction of industrial and domestic wastewater treatment plants and related pipeline systems	A slops treatment unit will be constructed for the treatment of industrial wastewater.
Hazardous Substance Treatment, Handling and Storage	
9.1. The manufacturing, storage, handling or processing of a hazardous substance defined in the Hazardous Substances Ordinance, 1974	The project involves the treatment, handling and storage of hazardous waste.
9.2. Any process or activity which requires a permit, licence or other form of authorisation, or the modification of or changes to existing facilities for any process or activity which requires an amendment of an existing permit, licence or authorisation or which requires a new permit, licence or authorisation in terms of a law	The project involves the treatment, handling and storage of hazardous waste.

Listed activity	Expected activity
governing the generation or release of emissions, pollution, effluent or waste	
9.4 The storage and handling of a dangerous goods, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of more than 30 cubic meters at any one location.	The project will include fuel storage facilities.
9.5 Construction of filling stations or any other facility for the underground and aboveground storage of dangerous goods, including petrol, diesel, liquid, petroleum, gas or paraffin.	Fuel storage facilities with capacity of 23 000 litres
Infrastructure	
10.1 (a) The construction of oil, water, gas petrochemical and other bulk supply pipelines	A water supply line of approximately 2.5 km will be constructed, connecting to the NamWater bulk supply line.
10.1 (b) The construction of public roads	An access road of approximately 1.2 km will be constructed.

Knight Piésold submitted an application form to the MEFT (in hard copy and via the online system). Annexure B provides the Screening Notice received from MEFT, in which they advise that a Scoping and Environmental Management Plan (EMP) report must be prepared. The application number is APP-002774.

This report also recognises that the project is proposed within the context of numerous other regulatory entities within Namibia, as detailed below.

Table 3: Regulatory Authorities

Authority	Purpose
Ministry of Environment, Forestry and Tourism	The Ministry of Environment, Forestry, and Tourism (MEFT) is dedicated to advancing biodiversity conservation in the Namibian environment by fostering the sustainable use of natural resources and promoting tourism development for the optimal social and economic well-being of its citizens. The MEFT undertakes the development, administration, and enforcement of environmental legislation and policy. Specifically, the MEFT's Department of Environmental Affairs and Forestry (DEAF) will oversee the decision-making process regarding the application for the Environmental Clearance Certificate (ECC).
Ministry of Mines and Energy	The Ministry of Mines and Energy (MME) is structured into six directorates, one of which is the Directorate of Energy. This specific directorate holds the responsibility for formulating and executing Namibia's energy sector policies, strategies, and plans. Given the necessity for transmission supply connection points in the proposed facility, the Ministry is recognised as a crucial stakeholder in the project.

Authority	Purpose
Ministry of Works and Transport	The Ministry of Works and Transport (MWT) is committed to guaranteeing and overseeing the delivery of secure, effective, and efficient infrastructure and services that align with the socio-economic requirements of the public. The Department of Transport, operating across various modes such as road, rail, air, and sea, bears the responsibility for transportation. Its mission revolves around ensuring the availability of safe and efficient transport services and infrastructure in the country, maintaining a balance with the demand in the various modes.
Ministry of Agriculture, Fisheries, Water, and Land Reform	The mission of the Ministry of Agriculture, Fisheries, Water, and Land Reform (MAFWLR) is to unlock the potential of the Agricultural, Water, Fisheries and Land Reform sectors, fostering efficient and sustainable socio-economic development for a prosperous Namibia. The Ministry plays a pivotal role in promoting, developing, managing, and utilising agricultural and water resources, and due to the planned abstraction of groundwater for the proposed facility, is considered a key stakeholder.
National Heritage Council	The National Heritage Council (NHC) of Namibia was formed under the National Heritage Act, No. 27 of 2004, serving as the governing body tasked with the administration of safeguarding and preserving Namibia's cultural and natural heritage resources. The NHC would need to review the Heritage Impact Assessment and provide consent for the project in terms of Sections 53(7) and 55(8) of the National Heritage Act, 2004 (Act No.27 of (2004)).

3.1 REGULATORY FRAMEWORK

The most pertinent legislation relevant to the application for the ECC is presented below, as prepared by LM Environmental Consulting.

Table 4: Namibian Regulatory Framework for the proposed Namwaste (Pty) Ltd Waste Management Facility in Walvis Bay

National Law
Acts of Parliament, Regulations, Ordinances, Proclamations
The Constitution of the Republic of Namibia 1990 (and First Amendment Act 34 of 1998, Second Amendment Act 7 of 2010, and Third Amendment Act 8 of 2014)
Employees' Compensation Act 30 of 1941 (as amended in South Africa prior to Namibian independence) (Amendment Act 5 of 1995 amends the Act substantially and changes its name from the Workmen's Compensation Act to the Employees' Compensation Act) (and the General Regulations 1961 (as amended))
Soil Conservation Act 76 of 1969 (as amended in South Africa to March 1978)
Hazardous Substance Ordinance 14 of 1974 (and the General Regulations 1979; no post-independence regulations have been promulgated)

National Law
International Health Regulations Act 28 of 1974 (as amended to December 1977); the International Health Regulations were replaced in turn by the International Health Regulations, 2005, which entered into force internationally on 15 June 2007 (*Source: World Health Organisation (WHO)*). Namibia is bound by these 2005 Regulations from that date in accordance with Articles 21(a) and 22 of the WHO Constitution.
Nature Conservation Ordinance 4 of 1975 (and the Regulations Relating to Nature Conservation 1976 and the amended Regulations)
Atmospheric Pollution Prevention Ordinance 11 of 1976 (Regulations are authorised by several sections of the Act; no post-independence regulations have been promulgated)
Foreign Investment Act 27 of 1990 (and amendment Act 24 of 1993) (and the Regulations 1992)
Petroleum (Exploration and Production) Act 2 of 1991 (and amendments: Petroleum Matters (Amendment and Validation) Act 27 of 1992; Minerals (Prospecting and Mining) Act 33 of 1992; Act 2 of 1993; Act 11 of 1997; and Petroleum Laws Amendment Act 24 of 1998) (and the Regulations relating to the health, safety and welfare of employees and the protection of other persons' property, the environment and natural resources 1999)
Regional Councils Act 22 of 1992 (and Amendment Acts 17 of 1997, 30 of 2000, 12 of 2002, 12 of 2010, 16 of 2010, and 7 of 2017) (and the Regulations: Commercialisation Regulations 2001; Joint Business Venture Regulations 2001; and Tender Board Regulations 2001)
Local Authorities Act 23 of 1992 (and amendments) (and the Model Pound Regulations 1994, the Model Electricity Supply Regulations 1996, Model Water Supply Regulations 1996, Model Sewerage and Drainage Regulations 1996, Model Regulations for the Control of Dogs in Local Authority Areas 2008, Commercialisation Regulations 2001 (amended in 2007), Joint Business Venture Regulations 2001 (amended in 2007), and Tender Board Regulations 2001 (replaced in 2011), and Recruitment and Selection Regulations for Local Authority Councils 2019)
Local Authorities Act 23 of 1992 & Walvis Bay Municipality: Solid and Hazardous Waste Management Regulations 2011; Municipality of Walvis Bay Strategic Plan (July 2021 – June 2026); and Municipality of Walvis Bay Integrated Environmental Policy Walvis Bay Moving Towards Realising Namibia's Vision 2030 (2022 – 2030)
Namibian Ports Authority Act 2 of 1994 (as amended by the National Transport Services Holding Company Act 28 of 1998, the Namibian Ports Authority Amendment Act 12 of 2000, and the State-owned Enterprises Governance Act 2 of 2006) (and the Port Regulations 2001) & Environmental Management Plan for the Operations of the Operations of the Commercial Harbour: Port of Walvis Bay (Faul *et al*., 2019).
Social Security Act 34 of 1994 (as amended by the State-owned Enterprises Governance Act 2 of 2006/ Public Enterprises Governance Act 2 of 2006, and the Labour Act 11 of 2007 (and the General Regulations 1995, and amendments))
Namibia Water Corporation Act 12 of 1997 (and amendments: Namibia Water Corporation Amendment Act 17 of 2001; Water Resources Management Act 24 of 2004 (it never came into force and has been repealed by the Water Resources Management Act 11 of 2013); State-owned Enterprises Governance Act 2 of 2006 (re-named the Public Enterprises Governance Act 2 of 2006); and the Water Resources Management Act 11 of 2013)
Affirmative Action (Employment) Act 29 of 1998 (as amended by Act 6 of 2007 and the Labour Act 11 of 2007) (and the General Regulations 1999)
Road Traffic and Transport Act 22 of 1999 (as amended by the Road Traffic and Transport Amendment Act 6 of 2008) (and the Road Traffic and Transport Regulations 2001)
National Heritage Act 27 of 2004 (as amended by the State-owned Enterprises Governance Act 2 of 2006/Public Enterprises Governance Act 2 of 2006) (and the National Heritage Regulations 2005)

National Law
Electricity Act 4 of 2007 (and the Electricity Regulations: Technical 2004, the Electricity Regulations: Administrative 2011, and the Namibian Electricity Safety Code 2011 (amended 2012))
Environmental Management Act 7 of 2007 (and the Environmental Impact Assessment Regulations 2012)
Labour Act 11 of 2007 (and the Labour Amendment Act 2 of 2012) (and the Regulations relating to the Health and Safety of Employees at Work 1997, the Labour General Regulations 2008, and the Regulations relating to Domestic Workers 2017)
Declaration of Dorob National Park as a Game Park 2010 and the Dorob National Park Rules and Regulations 2012
Disaster Risk Management Act 10 of 2012 (and the Disaster Risk Management Regulations 2013)
Water Resources Management Act 11 of 2013 and the Water Resources Management Regulations 2023
Public and Environmental Health Act 1 of 2015 (and section 20(1) of the National Health Act 2 of 2015) (and the Public Health Covid-19 General Regulations 2021) (and amendments)
Marine Notice No.04 of 2018: Garbage Management Requirements in Namibia under MARPOL Annex V
Policies, Guidelines, National Strategies & Action Plans
Policies
Conservation of Biotic Diversity and Habitat Protection 1994
Namibia: National Code on HIV/AIDS in Employment 2000
National Policy on HIV/AIDS 2007
National Gender Policy 2010 - 2020
National Health Policy Framework 2010-2020 - “towards quality health and social welfare services”
National Policy on Climate Change for Namibia 2011
Guidelines
Petroleum Products Regulations, 2000 Guidelines for Consumer Installations
National Policy on Coastal Management for Namibia 2012
National Strategies & Action Plans
Namibia’s Green Plan 1992
Vision 2030 2004
Towards a Coastal Policy for Namibia, Green Paper 2009
National Climate Change Strategy & Action Plan (2013 – 2020)
Namibia’s Second National Biodiversity Strategy and Action Plan (NBSAP 2) (2013 – 2022)
Namibia’s 5th National Development Plan (NDP5) – Working together towards prosperity (2017/18 – 2021/22)
National Solid Waste Management Strategy 2018
National Parks Environmental Management Plans (EMPs)
Management Plan for Dorob National Park 2021/2022-2030/2031
Town Planning Schemes, Structure Plans, & Land Use Plans
Walvis Bay Town Planning Amendment Scheme No 35 2015 (currently in use)

National Law
Walvis Bay Urban Structure Plan 2023
Strategic Environmental Assessments (SEAs)
(Updated) Strategic Environmental Assessment (SEA) for the coastal areas of the Erongo and Kunene Regions 2012

Table 5: International Regulatory Framework for the proposed Namwaste (Pty) Ltd Waste Management Facility in Walvis Bay

International Law
African Union (AU)
African Charter on Human and Peoples' Rights (Banjul Charter) 1981, the Protocol to the African Charter on Human and Peoples' Rights on the establishment of the African Court on Human and Peoples' Rights 1998 (non-binding), and the Protocol to the African Charter for Human and Peoples' Rights on the Rights of Women in Africa 2003
Convention for Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region and Protocol (Abidjan Convention) 1981 (Additional Protocol to the Abidjan Convention concerning Cooperation in the Protection and Development of Marine and Coastal Environment from Land-based Sources and Activities in the Western, Central and Southern African Region 2012)
African Convention on the Conservation of Nature and Natural Resources (Revised Version) 2003 (non-binding)
Agreement for the Establishment of the Africa Institute for the Environmentally Sound Management of Hazardous and Other Wastes Agreement 2004
Southern African Development Community (SADC)
Treaty of the Southern African Development Community (SADC) 1992 (and six amendments: Agreement Amending the Treaty 2001; Agreement Amending Article 22 of the Treaty 2007; Agreement Amending the Treaty 2008; Agreement Amending the Treaty 2009 (DES); Agreement Amending the Treaty 2009 (ORGAN); and Agreement Amending the Treaty 2015) (and Protocol to the Treaty establishing SADC on Immunities and Privileges 1992)
Charter of Fundamental Social Rights in SADC 2003
SADC Protocol on Gender and Development 2008 (and an Agreement Amending the SADC Protocol on Gender and Development 2016)
SADC Protocol on Environmental Management for Sustainable Development 2014 (not yet binding)
SADC Protocol on Employment and Labour 2014 (not yet binding)
United Nations (UN) / International Conventions
Constitution of the International Labour Organization (ILO) 1919 (as amended), and *Instrument of Amendment of the ILO Constitution, 1986 (not yet binding), and the Instrument of Amendment of the ILO Constitution 1997
Constitution of the World Health Organization (WHO) 1946 (and *Amendment to Article 7 of the Constitution of the World Health Organization 1965 (not yet binding); *Amendment to Article 74 of the Constitution of the World Health Organization 1978 (not yet binding); Amendments to Articles 24 and 25 of the Constitution of the World Health Organization 1986; and Amendments to Articles 24 and 25 of the Constitution of the World Health Organization 1998)
ILO Convention concerning Discrimination in Respect of Employment and Occupation (No. 111) 1958 (and including the Forced Labour Convention 1930 (No. 29); Abolition of Forced Labour Convention 1957 (No. 105); Freedom of Association and Protection of the Right to Organise Convention 1948 (No. 87); Right to Organise and Collective Bargaining Convention, 1949 (No. 98);

International Law
Equal Remuneration Convention 1951 (No. 100); Discrimination (Employment and Occupation) Convention 1958 (No. 111); Minimum Age Convention 1973 (No. 138); and Worst Forms of Child Labour Convention 1999 (No. 182))
International Convention on the Elimination of All Forms of Racial Discrimination 1966
International Covenant on Civil and Political Rights (ICCPR) 1966 (and the Optional Protocol to the International Covenant on Civil and Political Rights 1966 and the Second Optional Protocol to the International Covenant on Civil and Political Rights, aiming at the Abolition of the Death Penalty 1989)
International Covenant on Economic, Social and Cultural Rights (ICESCR) 1966
Convention Concerning the Protection of the World Cultural and Natural Heritage 1972
Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) 1979 and Optional Protocol to the Convention on the Elimination of all Forms of Discrimination against Women 1999
Vienna Convention for the Protection of the Ozone Layer 1985 and the Montreal Protocol on Substances that Deplete the Ozone Layer 1987 (and Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, adopted by the Second Meeting of the Parties at London on 29 June 1990 (London Amendment); Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, adopted by the Fourth Meeting of the Parties at Copenhagen on 25 November 1992 (Copenhagen Amendment); Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, adopted by the Ninth Meeting of the Parties at Montreal on 17 September 1997 (Montreal Amendment); Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, adopted by the Eleventh Meeting of the Parties at Beijing on 3 December 1999 (Beijing Amendment); and Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer, adopted by the Twenty-Eighth Meeting of the Parties at Kigali from 10 to 15 October 2016 (Kigali Amendment))
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention) 1989 and the Amendment to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal 1995
Convention on Biological Diversity (Biodiversity Convention) 1992, the Cartagena Protocol on Biosafety to the Convention on Biological Diversity, Montreal 2000, and the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity 2010
United Nations Framework Convention on Climate Change (UNFCCC) 1992, the Kyoto Protocol to the UN Framework Convention on Climate Change 1997 (and the not yet binding Doha Amendment to the Kyoto Protocol to the United Nations Framework Convention on Climate Change 2012), and the Paris Agreement 2015
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (Rotterdam Convention) 1998 (with Annexes as amended)
Stockholm Convention on Persistent Organic Pollutants (Stockholm Convention) 2001 (and amendments)
Convention for the Safeguarding of the Intangible Cultural Heritage 2003
Convention on the Protection and Promotion of the Diversity of Cultural Expressions 2005
United Nations Guiding Principles on Business and Human Rights 2011
International Best Practice
International Finance Corporation (IFC) Environmental Health and Safety (EHS) Guidelines 2007, the EHS Guidelines for Waste Management Facilities 2007, and the EHS Guidelines for Offshore Oil and Gas Development 2015

4 PROJECT DESCRIPTION

Information for this chapter was obtained from the Walvis Bay Integrated Waste Management, Treatment, Transfer and Recovery Facility Project Description (Rent-A-Drum (Pty) Ltd., 2025), provided as Annexure C.

4.1 PROJECT OVERVIEW

The envisioned project encompasses the establishment and functioning of a waste management facility that will be designed to meet the distinctive requirements of the offshore oil and gas exploration and production (E&P) sector. The E&P industry produces a wide range of industrial wastes in small quantities such as used and redundant chemicals, chemical containers and paints, as well as two specific waste streams (cuttings (solid) and slops (liquid)) in large quantities during the drilling phases.

The proposed site for the project, as presented within Figure 1, was selected based on the following factors:

- Availability of established plots for similarly zoned industrial activities;
- Pre-existing stakeholder consultations, specifically with the Walvis Bay Municipality; and
- Access to utilities, main roads and proximity to the Walvis Bay Port.

4.2 PROJECT PROGRAMME AND ACTIVITIES

4.2.1 CONSTRUCTION ACTIVITIES

Construction activities for the proposed facility are anticipated to start in September 2026, and will be comprised of the following activities:

- Fencing off project area;
- Earthworks to level the terrain;
- Connection to water, electricity and sewage networks;
- Infrastructure establishment; and
- Equipment assembly.

Following completion of the above activities, site commissioning will run from September 2027 to December 2028. The facility will be fully operational from January 2029.

4.2.2 OPERATIONAL ACTIVITIES

General operational activities will take place daily between 07:00 – 17:00 on weekdays, and 07:00 – 13:00 on Saturdays. The facility will be closed on Sundays and public holidays, with limited operations taking place. Due to the nature of oil and gas operations, certain operations will run continuously, specifically:

- Collection of waste from the port and return of empty containers to the vessels, which will require travel at night;
- Operation activities of the cuttings treatment unit; and
- Operation activities of the slops treatment unit.

The operational phase, planned to commence in January 2029, will comprise of the integrated waste management facility and yard tailored for the transfer, storage and treatment of oil and gas waste. The site will have the following primary site-specific activities including:

- Thermo-mechanical cuttings cleaner (TCC) or a Thermal Desorption Unit (TDU) treatment plant which treats oil-based mud cuttings and recovers base oil (slops and cuttings);
- Treatment of slops in a slops treatment unit (mainly a centrifuge)
- Discharge of treated effluent into the evaporation ponds or the municipal wastewater treatment works;
- Storage of cuttings and slops in suitable, bunded containment facilities;
- Temporary storage of waste (solid and liquid) in suitable, bunded containment facilities;
- Tank and skip washing.

The project site will also include the following ancillary infrastructure:

- Truck depot and bin yard;
- Stormwater/runoff management infrastructure;
- Effluent storage in ponds/dams for evaporation with surface area of 17 000m^2 or discharge into the municipal wastewater treatment works
- Plant/Vehicle wash bay;
- Analytical laboratory;
- Access road of approximately 1.2 km;
- Access control facilities and perimeter fencing;
- Weighbridges and control room;
- Fuel storage facilities with capacity of 23 000 litres;
- Erongo RED connection point;
- Backup generators: five each with 500 kVa capacity;
- Water connection point and water storage tank with capacity of 200 m^3;
- Camp for approximately 50 – 100 employees;
- Offices and administrative buildings; and
- Additional features such as ablutions, accommodation camp, workshops, sewage management facilities, etc.

The proposed site layout is provided within Figure 2. The above listed infrastructure is further discussed in the subsections below.

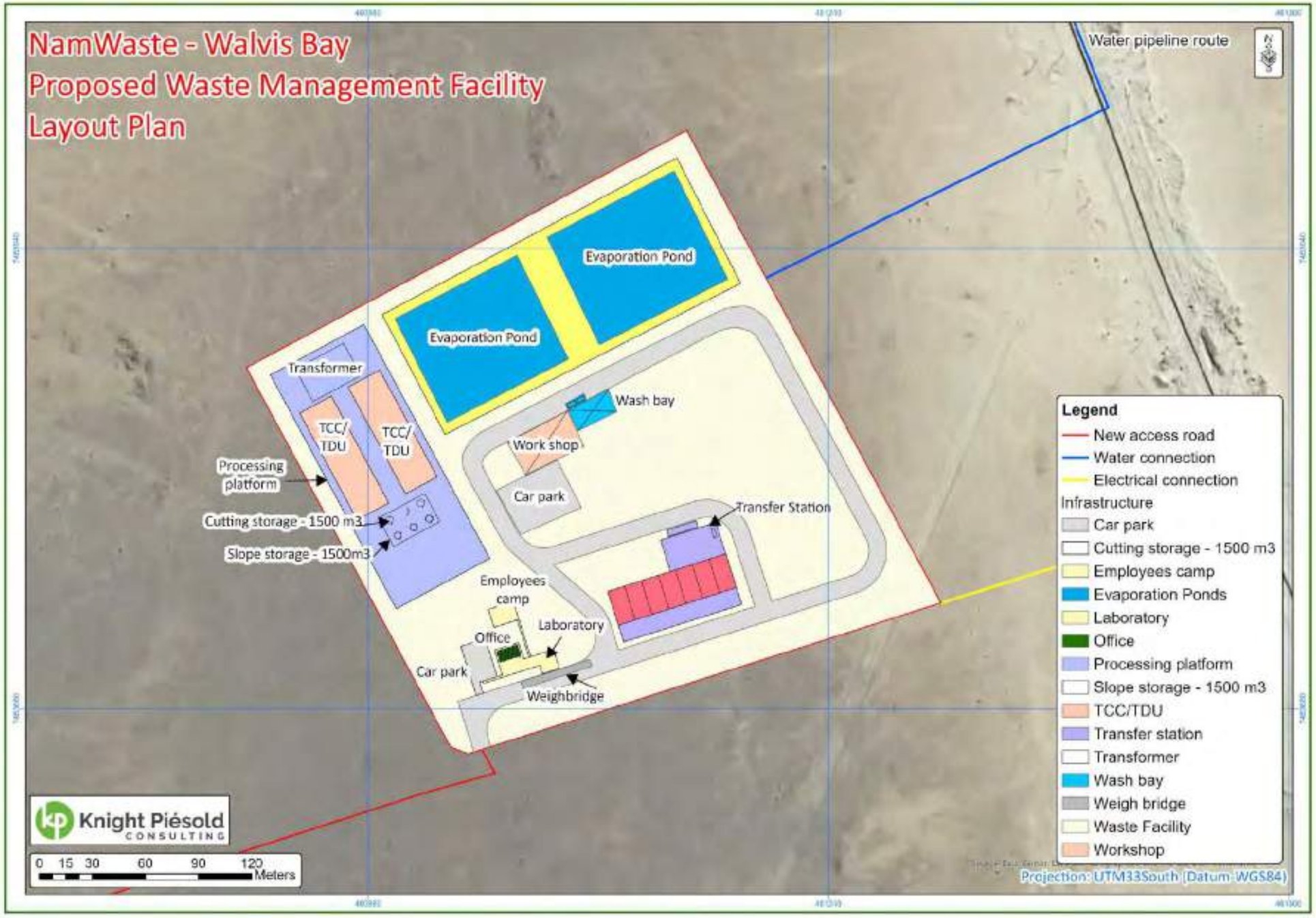

Figure 2: Proposed Site Layout

Figure 3: Map showing the Proposed Site, Access Road, and Nearest Water Pipeline

4.3 TREATMENT PROCESS

The waste streams, treatment processes, and outputs are shown in the process flow diagram below.

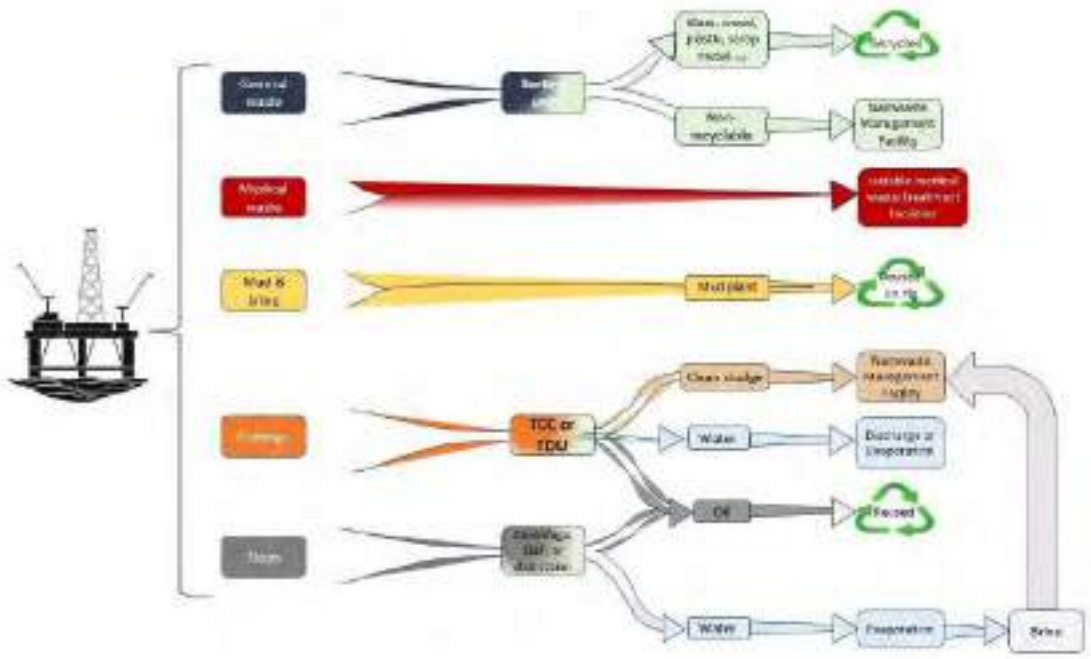

Figure 4: Process Flow Diagram

4.3.1 TRANSPORTATION OF WASTE STREAMS

Each waste load will require a Technical Services Acceptance Sheet (TSAS) outlining site procedures, hazards, and safety precautions before it can be scheduled for treatment. An 18-meter weighbridge will be installed at the facility entrance to record the weight of all vehicles before entry and after exit. Upon arrival, waste loads will be inspected and/or undergo verification analysis to ensure compliance with the TSAS and to identify any prohibited or restricted materials. If approved, the loads will proceed to a bunded offloading area, where bulk liquids will be discharged into storage tanks and solid wastes will be offloaded from containers using a forklift.

The Namwaste Walvis Bay facility will receive slops, cuttings and source separated recyclables from the riggs, and port for treatment and sorting. General waste from the riggs and the port will be transported directly to a disposal facility, while medical waste from the riggs will be transported directly to suitable medical waste treatment facilities. Site access is restricted to accepted waste only. As a precaution against cross-contamination, vehicles will be washed before leaving the site. The vehicles used for the transportation of the waste will include:

- Tanker Trucks: Bulk liquid waste (slops) – Six trips per day;
- Flatbed Trucks: Containerised cuttings – Six trips per day;
- Skip Trucks: Solid general and hazardous waste – Two trips per day;
- Super Sucker Trucks: Transfer of liquid waste from the PSV to the tanker trucks, at the port – Three trips per day; and
- Medium Duty Vehicles (3-5 tons): Solid general and hazardous waste – Four trips per day.

Considering the continuous nature of the E&P industry, the facility must be ready to accept waste even when vessels are present at the port, therefore operations will be conducted 24 hours a day. Anticipated minimum annual tonnages of waste expected is as follows:

- Cuttings – 2 500 tonnes;
- Slops – 3 500 tonnes;
- General Waste – 1 200 tonnes;
- Source Separated Recyclables – 120 tonnes; and
- Medical Waste – 12 tonnes.

After trucks have been weighed and cleared at reception, they will move within the facility to the appropriate, bunded, offloading area. Bulk liquids will be discharged into bunded storage tanks. Most solids will be containerised in DNV skips or similar and these will be offloaded via forklift.

4.3.2 CUTTINGS MANAGEMENT

4.3.2.1 THERMO-MECHANICAL CUTTINGS CLEANER

Containerised cuttings are transported from the vessel to the facility on flatbed trucks. Once the facility's reception process is completed, forklifts will unload the containers onto a bunded platform. Subsequently, a rotary head forklift will transfer the contents from the container into a sump or dam. Within this, an excavator will be employed as a mixer to homogenise the cuttings. To enhance environmental safety, the sump or dam will feature a 1 mm lining of High-Density Polyethylene (HDPE), and a sacrificial concrete layer will be cast over it. The homogenised cuttings will then be put into the TCC for a general drill cutting plant process flow as presented within Figure **5**.

The TCC is considered the most cost-effective and beneficial unit for processing drill cuttings. Functioning like a hammer mill, the TCC utilises friction-generated heat to vaporise and subsequently recover hydrocarbons from the cuttings. Operating at a lower temperature achieved through kinetic energy and frictional heat, the unit ensures the vaporisation of hydrocarbons while better preserving the original base oils present in the cuttings. This lower heat requirement not only results in reduced energy consumption but also enhances environmental friendliness.

The reclaimed base oil is reintegrated into the oil-based mud (OBM) for reuse or it can be utilised as an energy source. The solid fraction of the cuttings will be transported and responsibly disposed of at the proposed Class A disposal site of the Namwaste Management Facility near Arandis which will be operational Q3 2027. The recuperated water will, either be employed for the re-treatment of solids, or directed towards additional industrial applications. With a typical capacity of 4 to 6 tonnes per hour, the TCC ensures a recovery rate of over 95% for the base oil. The residual oil content on solids is minimal, typically less than 1 % and usually ranging between 0.2 – 0.3 %.

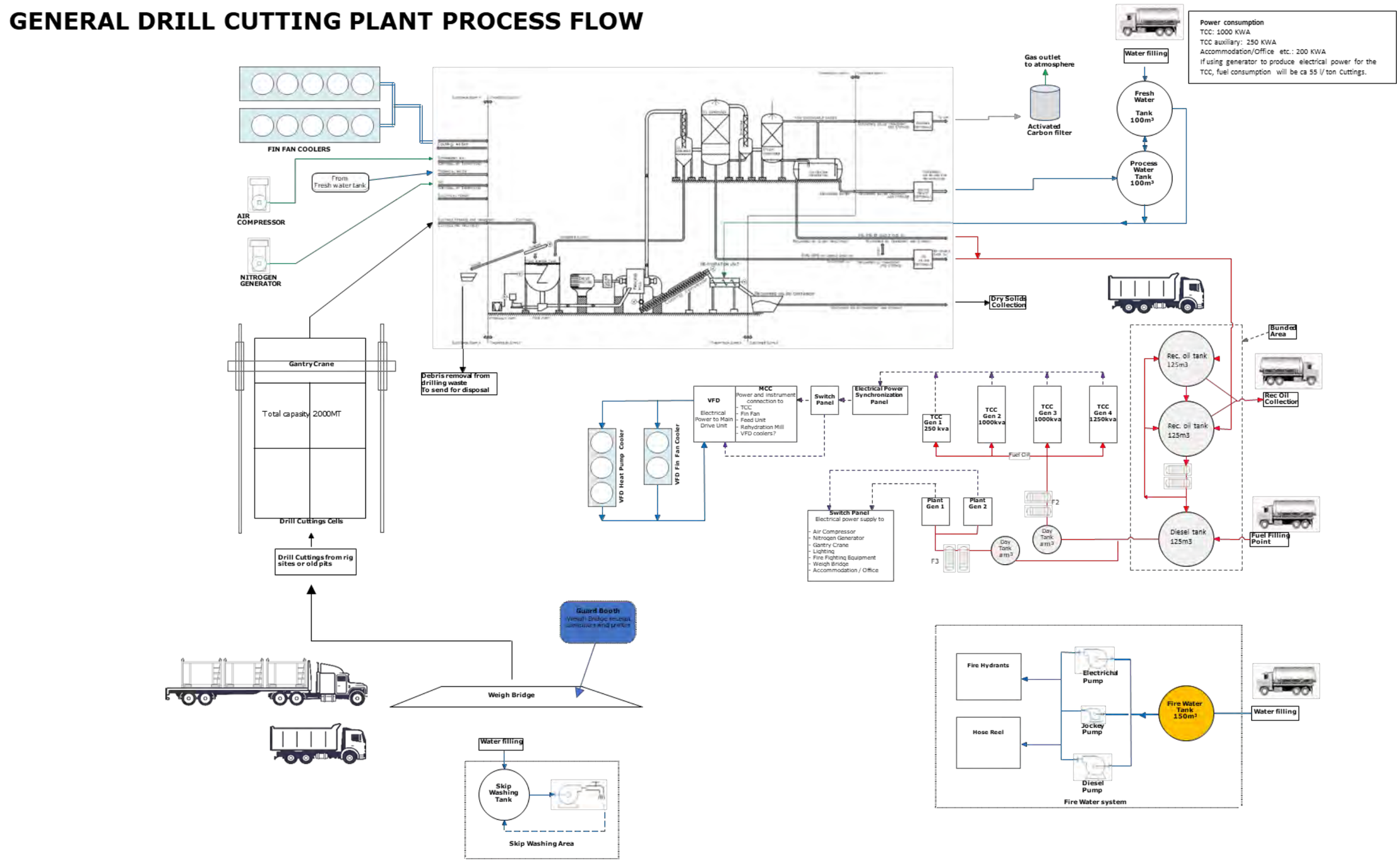

Figure 5: General drill cutting plant process

4.3.2.2 THERMAL DESORPTION UNIT (TDU)

A Thermal Desorption Unit (TDU) is an advanced waste treatment system designed to remove hydrocarbons and other volatile contaminants from materials such as drilling cuttings, oil sludge, and hazardous waste generated during oil and gas operations. It works by applying indirect heat to contaminated solids, causing water and oil components to evaporate without burning the material. The system uses a rotating heat exchanger (rotor), heated by circulating thermal oil and electric elements, to gradually raise the temperature of the material—first evaporating water, then oil at temperatures up to 500 °C.

The vaporised contaminants will be captured, condensed, and directed to a water/oil separator for further processing. The treated solids will be discharged, cooled, and mixed with recovered water to suppress dust before being loaded into skips or other containers. This method is particularly effective for treating oil-based drilling waste, as it recovers valuable oil and significantly reduces the environmental impact of disposal.

4.3.3 SLOPS MANAGEMENT

Slops are generally transferred in bulk from the rig utilizing the Platform Supply Vessel (PSV) tanks. Tanker trucks are used to transfer slops from the PSV tanks to the facility. Upon clearing the reception of the facility, the slops will be discharged into bunded storage tanks via pumps and homogenized.

The slops treatment unit will include various steps of treatment as described below and in Figure 6

1. Phase separation using a tri-canter centrifuge to separate hydrocarbons, water and solids. Solids will be discharged for disposal at a suitable landfill. Hydrocarbons will be discharged into a buffer tank for re-use (by others).
2. Chemical pre-treatment such as flocculation, pH correction, coagulation, acid treatment and similar chemical treatments / corrections.
3. Treated effluent will be discharged into the evaporation pond (s) or the municipal wastewater treatment plant.

The process for the slops treatment is summarised in Figure 7.

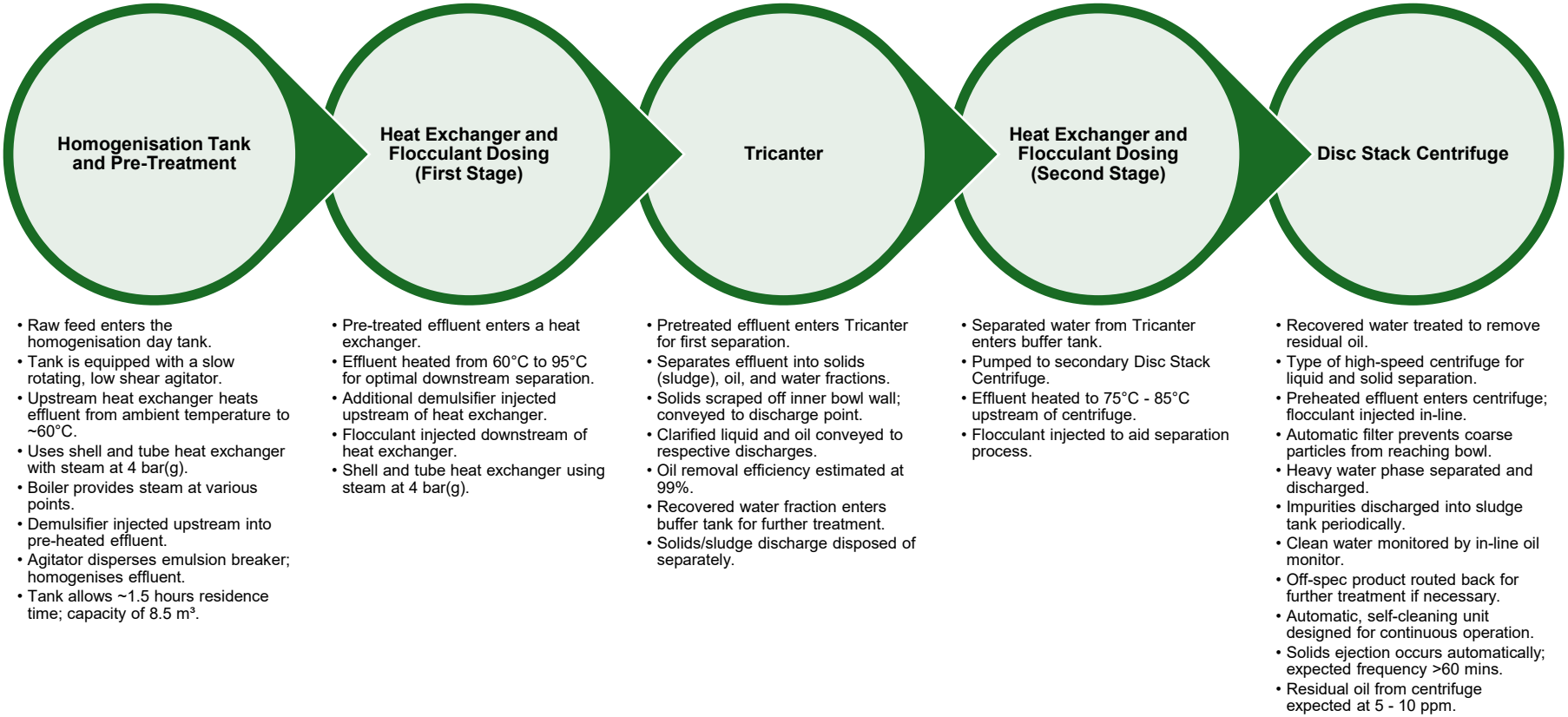

Figure 6: Slops treatment process

Treated effluent resulting from drilling and produced water is generally limited in reuse by the total concentration of dissolved solids (i.e., salts) and as such the treated effluent will be discharged into municipal wastewater treatment facility or evaporation ponds.

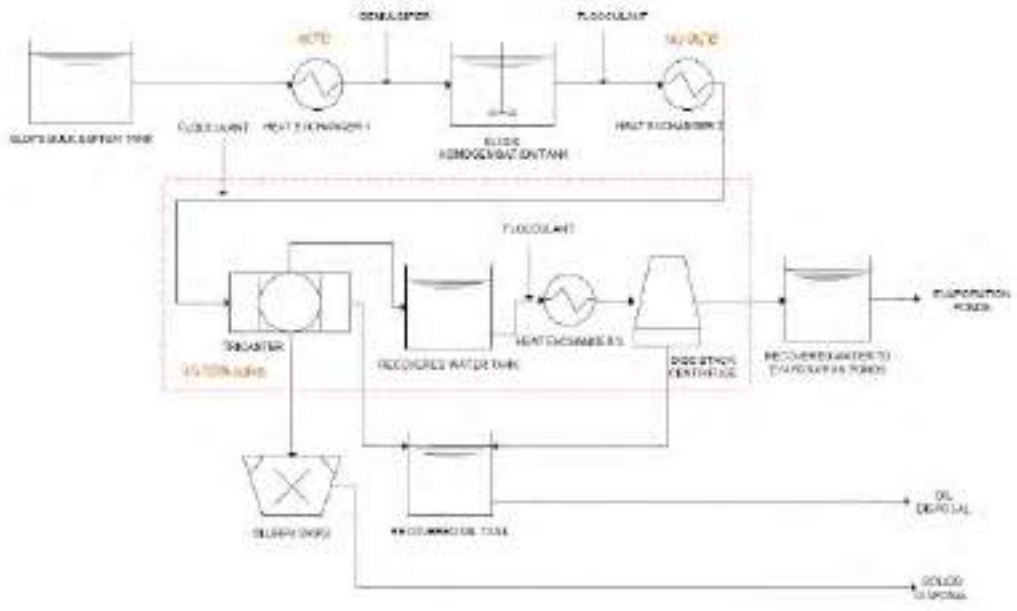

Figure 7: Slops treatment process

4.3.4 TEMPORARY STORAGE OF WASTE

The facility will cater for the temporary storage of hazardous and non-hazardous waste. Waste (solids and liquids) will be temporarily stored in suitable, bunded containment facilities on site.

4.3.5 OTHER CONTAINERIZED WASTES

While the primary waste streams generated during the offshore drilling phases are drill cuttings and drilling slops, offshore O&G exploration projects generate a variety of other waste streams in significantly smaller quantities. These encompass common wastes like packaging, recyclables, sewage, domestic effluent, scrap metals, and similar materials. Additionally, there are industrial hazardous waste streams, including used and redundant chemicals, chemical containers, and paints.

Upon completion of exploration and the commencement of production, additional waste streams may arise from hydrocarbon production. In this scenario, Namwaste foresees substantial volumes of produced water, potentially contaminated with hydrocarbons and salts, as well as tank bottoms primarily composed of heavy, long-chain hydrocarbons and other solids.

4.4 DECOMMISSIONING ACTIVITIES

No decommissioning activities are foreseen at present.

4.5 EMPLOYMENT

The proposed facility will create employment opportunities for approximately 96 staff during the operational phase. The breakdown of anticipated staff is provided within Table 6 below.

Table 6: Staffing Requirements

Role	Number	Role	Number
General manager and deputy manager	2	Deputy supervisors	6
HSE supervisor	2	Yellow plant	6
Administrative	3	Mechanical plant	12
Laboratory analyst	2	Drivers/assistants	36
Supervisors	9	General workers	18

4.6 ADDITIONAL INFRASTRUCTURE

Additional infrastructure envisaged for the site is comprised of the following:

- Appropriately designed warehouses, tanks and bunds for the storage of waste streams on site;
- Washing area for tanks and skips;
- Truck depot;
- Bin yard;
- Evaporation ponds:
    - The evaporation ponds will have a surface area 17 000 m^2 with a containment barrier of a 1 mm HDPE liner. The evaporation dam will be designed to evaporate 2 500 m^3/month (with a 30% margin of risk) and a depth of 1 m and freeboard of 0.5 m;
    - Approximately 20 floating, sprayer-less mechanical evaporators will be utilised to enhance evaporation efforts by drawing fresh air onto the pond's surface, creating waves to increase the exposed surface area;
- Stormwater and contaminated runoff management infrastructure:
    - Boreholes will be installed both upstream and downstream for groundwater quality monitoring;
    - Surface and groundwater quality will be consistently monitored;
    - Waste spillages on site roads will be promptly removed and appropriately treated or disposed of;
    - Spill kits will be on-site for immediate containment and rehabilitation of any spillages;
    - Contaminated soil from spills will be collected, treated if necessary, and disposed of responsibly;
    - Diesel, fuel, and oil will be stored in tanks within bund walls designed to hold at least 110% of the largest tank's volume or 25% of the total storage capacity, whichever is greater.

  - Plant/vehicle washing bay with contaminated runoff control;

- Fuel storage facilities:
  - 23 000 l capacity double walled diesel storage tank, in accordance with EN12285 standards;
  - The facility will have 1 – 2 dispensing points, 24-hour security and will be constructed with paved driveways, bund walls and floors with traps to manage spillages;
- Analytical laboratory to test and verify the classification of incoming waste streams, as well as treated waste as required;
- Access road and control facilities, further discussed under Section 4.7.5 below;
- On-site weather station;
- Workshops and stores;
- Offices and other administrative buildings; and
- Staff dining and ablution facilities, camp for approximately 50 – 100 employees.

4.7 SERVICES

4.7.1 WATER AND SEWAGE MANAGEMENT

The facility will require approximately 25 m^3 of water daily, sourced through direct connections to the municipal mains through a 100 mm pipeline running approximately 2.5 km to the NamWater bulk supply line (see Figure 3), and may be supplemented from boreholes on site.

Sewage will be treated on-site through the sewage package plant, the solid waste will be disposed of at the landfill site and the treated water will be discharged into the environment, depending on the quality or discharged into the evaporation pond or stored in septic tank for transportation and discharge at the municipal wastewater plant.

4.7.2 STORMWATER MANAGEMENT

The site will have stormwater diversion to limit and control run-on. Run-off from working areas will be segregated and directed towards ponds/dams for settling/evaporation. Pavements and potentially contaminated areas will have fats, oils and grease (FOGs) separation. Run-off from non-working areas will be controlled to limit potential for erosion and prevent co-mingling. There will be no uncontrolled discharge from the site.

The following will be implemented on the site:

- Installation of a network of background (upstream) and detection (downstream) boreholes for groundwater quality monitoring purposes in line with authorisation requirements as determined by the Competent Authority.
- Monitoring of surface and ground water quality in line with authorisation requirements as determined by the Competent Authority.

- Immediate removal of all waste spillages along roads within the site followed by appropriate treatment or disposal.
- Spill kits will be available on site to contain and rehabilitate spillages on site.
- All contaminated soil at any spills, will be collected, treated if required, and then disposed of responsibly.
- Diesel, fuel, and oil will be stored in tanks kept within bund walls to contain spills. The volume within the bund walls must be able to contain at least 110% of the maximum contents of the tanks. Where more than one container or tank is stored, the bund must be capable of storing at least 110 % of the largest tank or 25 % of the total storage capacity, whichever is greater.
- Contaminated water from the wash bay and workshop area, as well as from the waste treatment facility will be contained in suitable containment facilities.

4.7.3 ELECTRICITY

The electrical supply servicing the project area will be sourced from connections to the municipal Erongo RED electric supply lines, approximately 200 m east of the proposed project location (Figure 3). The facility will require a base electricity demand of 2 500 kVA, with additional power requirements of 750 kW for the Disc Stack centrifuge/Slops treatment process and a further 110 kW for the Enhanced Passive Evaporation process for use on site.

4.7.4 COMMUNICATION

Communication services will rely on existing telecommunication networks within the project area.

4.7.5 ACCESS

The proposed site can be accessed through the D1983 gravel road from the M36 road (Figure 3). A site access road of approximately 1.2 km will be constructed from the existing D1983 on the western side of the site. Access to the proposed facility will be controlled by means of a 2.4 m high perimeter fence and access control facilities, limiting access to approved delivery vehicles and site staff. The trucks entering and exiting the facility will pass over the weighbridge and be logged at the control room.

4.8 ALTERNATIVES

4.8.1 NO-PROJECT

If the project does not go ahead, the deficit in adequate waste management facilities within Namibia will remain.

4.8.2 SITE ALTERNATIVES

No alternative sites were identified for the proposed facility. The proposed site was determined through communications between Namwaste and the Walvis Bay Municipality. The current proposed site offers the most benefits for the proposed project.

4.8.3 TECHNOLOGICAL ALTERNATIVES

A comparison was made between a Thermal Desorption Unit (TDU) and a Thermo-Mechanical Cuttings Cleaner (TCC) for treating drilling cuttings.

The TDU is a proven technology for treating hydrocarbon-contaminated drilling waste. It uses indirect heat of up to 500 °C to volatilize water and hydrocarbons, which are then condensed and separated for recovery. While effective in removing contaminants, the TDU requires significant energy, is complex to operate, and has higher capital and operating costs.

When evaluated, the TCC appears as the preferred option. The TCC operates using kinetic energy and friction-generated heat to vaporise hydrocarbons at significantly lower temperatures than a TDU. This results in reduced energy consumption and a smaller environmental footprint, while maintaining high base oil recovery rates of over 95%. Residual oil content on treated solids is typically less than 1%, meeting disposal acceptance criteria. The recovered base oil can be reused in oil-based mud systems or as an energy source, while recovered water may be reused for further processing or other industrial applications.

Both technologies are technically viable, but the TCC is the most cost-effective and environmentally preferable choice. It demands less energy, is simpler to operate, and efficiently recovers hydrocarbons, meeting project goals. A final decision on the preferred technology to be employed has not been made.

4.8.4 SERVICE ALTERNATIVES

Alternative supplies for servicing the project area are under consideration but have not been fully addressed at this stage. These include measures that may reduce the reliance on the national service providers such as:

- Alternative water supply sources from the project, by means of on-site boreholes

5 PUBLIC PARTICIPATION PROCESS

A public participation process was undertaken in accordance with regulation 21 of the EIA Regulations (GN No. 30 of 2012). Relevant proof is contained in Annexure D.

5.1 NOTIFICATION

The project notification comprised the following actions:

- A notice board was fixed on site;
- Advertisements were placed in two Namibian newspapers once a week for two consecutive weeks (26th March and 2nd April 2024);
- A public meeting was held in Walvis Bay in the Naraville Community Hall on the 11th of April 2024; and
- E-mails were sent to pre-identified and other Interested and Affected Parties (I&APs) who requested to be registered on the project. The email included a Background Information Document (BID) and a map.

5.2 REVIEW PERIOD

The Environmental Scoping, Impact Assessment and Management Plan report was provided to interested and affected parties for review for two weeks, during the period of 28 January to 11 February 2026.

5.3 COMMENTS RECEIVED FROM INTERESTED AND AFFECTED PARTIES

The comments received during the review period are recorded in the Comments Received (Annexure E). Comments were received from the Namibian Civil Aviation Authority on 30 January 2026, regarding the project's proximity to the Walvis Bay International Airport regarding the site location, the infrastructure heights and measures to reduce light generation and prevent the attraction of avifauna to the evaporation pond. A meeting was held between Namwaste and representatives from the Walvis Bay International Airport on 18 February 2026 to discuss the received comments and subsequent amendments were made to Sections 7 and 8 this report. The comments and responses are presented within Table 7 below. Subsequent to the changes made, a letter of acceptance and consent for the project was received from Namibia Airports Company Ltd, dated 07 May 2026, and subsequent letter from the Namibia Civil Aviation Authority dated 11 May 2026 attached within Annexure E.

Table 7: Comments and Responses

Organisation & Contact Person	Method and Date of communication	Comments	Response
Namibia Civil Aviation Authority Ms Toska Sem	Letter dated 30 January 2026	The Namibia Civil Aviation Authority requested the following issues to be considered in the impact assessment: NAMCARs and NAMCATS-AH 139.01.34 – Requirements relating to safeguarding the aerodome surroundings and the Airport Master Plan of Walvis Bay International Airport	Considerations were included in the impact assessment towards effectively reducing potential hazards towards Walvis Bay International Airport and associated aircraft and operators, including the impact of lighting, wildlife and reflective surfaces. Refer to Sections 7 and 8 of the Scoping report.
		NAMCARs and NAMCATS-AH 139.11 – Requirements relating to Obstacle Restriction and Removal.	Namwaste submitted Appendix 13: Application for the Erection of Temporary, Mobile or Permanent Structure at Walvis Bay International Airport forms to the Namibia Airports Company and received approval for the application on 07 May 2026.
		NAMCARs and NAMCATS-AH 139.13 – Requirements relating to Visual Aids for Denoting Obstacles	The lighting or visual impacts were assessed in Sections 7 and 8 of the report and necessary mitigation measures to reduce the impacts were provided i.e. Lighting of the facility will be downward facing to reduce upward light generation. The proposed infrastructure does not exceed 10 m in height, and consent was granted for obstacle height in the letter received on 07 May 2026.

Organisation & Contact Person	Method and Date of communication	Comments	Response
		NAMCARs and NAMCATS-AH 139.16.5 – Requirements relating to Wildlife Hazard Management	Following consultation between representatives at Walvis Bay International Airport and Namwaste, the inclusion of additional measures to deter avifauna from the site within the EMP (Section 8)

6 DESCRIPTION OF THE BIOPHYSICAL AND SOCIAL ENVIRONMENT

6.1 CLIMATE

Walvis Bay, situated on the western coast of Namibia, experiences a unique climate characterised by its coastal location and influence from the cold Benguela Current. This results in a mild, arid desert climate with relatively low precipitation levels throughout the year, with an annual average of 3 mm and annual peaks of 6 mm (ClimateData.org, 2024).

Walvis Bay exhibits a relatively narrow temperature range due to its coastal location, with temperatures typically ranging between 15°C and 25°C (ClimateData.org, 2024), and with summers spanning from November to April and winters from May to October. Fog is a common occurrence, particularly during the summer months, which moderates temperatures and contributes to the town's distinctive microclimate. Due to its proximity to the Atlantic Ocean, Walvis Bay enjoys a relatively stable climate compared to the inland areas of Namibia.

6.2 VISUAL

Walvis Bay is characterised by its unique coastal landscape and diverse wildlife. The town is renowned for its expansive sand dunes, which stretch along the coastline, providing a stunning backdrop against the azure waters of the Atlantic Ocean. These dunes not only offer breathtaking views but also serve as habitats for a variety of desert-adapted flora and fauna.

The project area is located within proximity of the D1983 road, and consists of a sand dominated smooth profile, with several scattered shrubs as presented within Figure 8 below. The project area is situated approximately 6.2 km south-south-east of Dune 7, the highest dune within Namibia at 383 m in height. Dune 7 is located within the Dorob National Park, a protected area in Erongo, along the central Namibian coast, which stretches along the coastline for 1,600 kilometres.

Figure 8: Landscape of the project area

6.3 LAND USE

The land uses surrounding Walvis Bay comprise a diverse array of economic activities that capitalise on the region's natural resources and strategic coastal location. Predominantly, the area is utilised for commercial fishing, with the town serving as one of Namibia's primary fishing hubs. Additionally, agriculture, particularly livestock farming and crop cultivation in the hinterlands, plays a crucial role in sustaining livelihoods in the region. Tourism is also a growing sector, attracting visitors to explore the city's coastal attractions, such as dolphin cruises, sandboarding on the dunes, and birdwatching at the lagoon. Industrial activities, including port operations and salt production, further underscore the strategic importance of Walvis Bay as a maritime and logistical hub (NSA, 2011).

Land uses within proximity to the project area comprise of logistical, tourism, and industrial:

- Dune 7 approximately 6.2 km from the project site;
- Walvis Bay International Airport approximately 5 km from the project site;
- B.C. Stone Products (Pty) Ltd approximately 3.9 km from the project site;
- Walvis Bay Wind Farm approximately 5 km from the project site;
- Hannan Green Acres Project approximately 2.9 km from the project site; and
- Coastal Precast and Paving (Pty) Ltd's quarry approximately 4.8 km from the project site.

6.4 TOPOGRAPHY & DRAINAGE

Walvis Bay exhibits a varied topography shaped by both coastal and desert landscapes. The town is characterised by expansive sand dunes that gently slope towards the Atlantic Ocean, creating a striking visual contrast against the deep blue waters. These dunes, sculpted by prevailing winds over thousands of years, contribute to the unique coastal scenery of Walvis Bay. Inland, the terrain transitions into vast stretches of arid desert, punctuated by occasional rocky outcrops and dry riverbeds. The project site is comprised of a relatively smooth sand dominated landscape.

In terms of drainage, Walvis Bay is primarily characterised by its ephemeral river systems and coastal lagoons. The ephemeral rivers, such as the Kuiseb River to the south and the Khan River to the north, experience sporadic flows during periods of rainfall, carrying sediment and runoff from the interior to the coast. The project site is situated approximately 14 km north of the ephemeral channel of the Kuiseb River, with no immediate drainage lines present within the proposed project area.

6.5 GEOLOGY

Walvis Bay forms part of the central zone of the Damara Sequence (between 850 and 600 million years old). This is the part of Namibia underlain by schists, quartzites, meta-greywackes, marbles, and calc-silicates. These rocks have been intensely folded and locally have a north-north-east/south-south-west strike. Part of the pre-Damaran basement, gneiss and granite lithologies are quite common and intrude the Damara metasediments as outcrops. Karoo-age dolerite dykes also intrude on the Damara metasediments. Formations of the Damara Supergroup are covered by recent, shallow deposits of unconsolidated material, mainly of aeolian origin in the vicinity of Walvis Bay (Mendelsohn, Jarvis, Roberts, & Robertson, 2022).

The Kuiseb River sustains a productive porous aquifer, considered one of the most productive aquifers in Namibia. The water table underneath the entire town is shallow, less than 1.5m deep, but saline and not extracted for human consumption. The direction of the water flow in this aquifer is west and south-west. This aquifer is bordered in the north by the Erongo Groundwater Basin, which is closely associated with

the waterless gravel plains of the central Namib Desert – marked by its low to very low potential and poor quality.

6.6 AIR QUALITY AND NOISE

Plume Labs monitors the ambient air quality in Walvis Bay. Dust fallout is anticipated to be the primary air pollutant within the area, with concentrations of PM_{10} and $PM_{2.5}$ often exceeding the limits established by the World Health Organisation (WHO) (PlumeLabs, 2024). The ambient air quality is expected to be good, since there are limited largescale anthropogenic activities.

Nearby contributions to gaseous emissions and dust fallout include the generation of fugitive dust fallout associated with vehicular traffic, construction activities, industrial activities, quarry activities, air traffic, residential emission sources, as well as windborne dust emissions. Elevated windborne dust emissions are anticipated for the project area based on the soil types, sparse scattered vegetation and dominant coastal winds. There are no available ambient air quality data for the proposed site, however, based on the ambient air quality of the Walvis Bay Municipality, it is anticipated that the air quality at the site could be of good quality.

Noise within the project area is expected to be low due to the distance from major activities, with the primary sources of noise generated from vehicular movements, air traffic, and natural sources such as wind.

A detailed air quality and noise assessment was undertaken by Ward Karlson Consulting (Pty) Ltd, with the detailed reports provided within Annexure F and Annexure G, respectively.

6.6.1 AIR QUALITY

The baseline survey incorporated both passive and active sampling techniques to establish a robust baseline of ambient air quality. Passive samplers were deployed 30th April to 30th June 2025, utilising diffusion tubes to measure long-term concentrations of nitrogen dioxide (NO_2) and sulfur dioxide (SO_2), along with an Osiris real-time dust monitor to assess short-term particulate matter levels (PM_{10} and $PM_{2.5}$). Results are presented within Table 8 and Table 9 below, with monitoring locations presented within Figure 9.

The diffusion tube results showed consistently low concentrations of NO_2 and SO_2, with averages of 1.2 µg/m^3 and 2.4 µg/m^3, respectively, against Ambient Air Quality Standards (AAQS) of 10 µg/m^3 annually for NO_2 and 40 µg/m^3 24-hour AAQS for SO_2. This reflects the area's sparse population, minimal traffic, and limited industrial activity, indicative of the absence of pronounced anthropogenic combustion sources.

Conversely, the Osiris monitor recorded elevated levels of particulates, with PM_{10} at 33.5 µg/m^3 and $PM_{2.5}$ at 11.6 µg/m^3, which are characteristic of arid environments like Walvis Bay. These levels align with the arid landscape's natural conditions, where windblown dust, resuspension of soil, and scant vegetation all contribute significantly to particulate levels. The baseline data suggest that particulate matter in the region is largely driven by natural processes, with human-introduced pollutants remaining minimal due to the undeveloped nature of the surroundings (Ward Karlson Consulting (Pty) Ltd, 2025a).

Table 8:Baseline Ambient Air Quality Survey Results (Ward Karlson Consulting (Pty) Ltd, 2025a)

ID	Long-term Concentration (µg/m^3)	
	NO_2	SO_2
DT 1	1.4	2.5
DT 2	1.3	1.4
DT 3	1.3	0.7
DT 4	1.6	1.8
DT 5	1.1	1.3
DT 6	0.9	0.8
DT 7	1.2	5.5
DT 8	1.1	4.4
Average	1.2	2.4
AAQS	10 (annual)	40 (24-hour)

Table 9: Baseline Particulate Matter Survey Results (Ward Karlson Consulting (Pty) Ltd, 2025a)

ID	Short-term Concentration (µg/m^3)	
	PM_{10}	$PM_{2.5}$
PM Sampling Location (DT1)	33.4	11.6
AAQS	45 (24-hour)	15 (24-hour)

Figure 9: Air Quality Monitoring Locations (Ward Karlson Consulting (Pty) Ltd, 2025a)

6.6.2 NOISE

A thorough baseline noise survey was undertaken on 30th April 2024, following ISO 1996-1-3 standards, using a Casella 'type 1' sound level meter to collect sound pressure data. Measurements across ten strategic locations (Figure 10) provided a comprehensive overview of the ambient noise environment, establishing a baseline for evaluating future impacts for the proposed project site.

Figure 10: Noise Monitoring Locations (Ward Karlson Consulting (Pty) Ltd, 2025b)

The survey indicated that ambient noise levels at all monitoring locations were below the IFC commercial noise threshold of 70 dB(A), as presented within Table 10 below. The highest recorded LAeq was recorded at 55.5 dB(A). Marginally elevated noise levels around the project site were experienced as a result of the wind influence on the SLM. Observations indicated a generally quiet environment, with an average baseline noise level of 51.0 dB(A) (Ward Karlson Consulting (Pty) Ltd, 2025b).

Table 10:Ambient Noise Survey Results (Ward Karlson Consulting (Pty) Ltd, 2025b)

NM ID	Measured Noise Level (dB(A))			Noise Limit (dB(A))	Limit Exceeded	Description of Ambient Noise Sources
	LAeq	LAmin	LAmax			
NM 1	53.7	36.1	66.6	70	No	The wind and distant vehicles.
NM 2	48.1	31.5	61.0	70	No	
NM 3	50.7	37.3	63.6	70	No	
NM 4	44.9	30.4	58.2	70	No	
NM 5	55.5	39.5	64.0	70	No	
NM 6	43.7	31.3	60.7	70	No	
NM 7	55.0	37.0	72.7	70	No	
NM 8	46.3	32.0	72.2	70	No	
NM 9	46.6	32.4	68.8	70	No	
NM 10	43.5	28.2	72.6	70	No	

6.7 SURFACE WATER

Walvis Bay, located on the western coast of Namibia, exhibits a unique surface water system characterised by ephemeral rivers and coastal lagoons. The town is influenced by several ephemeral rivers, including the Kuiseb River to the south and the Swakop River to the north, with catchment areas of 15,500 km^2 and 30,100 km^2, respectively (Paillou, Lopez, Marais, & Scipal, 2020). These rivers experience intermittent flows, typically occurring during periods of rainfall in the interior regions. The ephemeral nature of these rivers is attributed to the arid climate of the area, where precipitation is sporadic and unpredictable. Despite their infrequent flows, these rivers play a crucial role in shaping the coastal landscape of Walvis Bay, carrying sediment and runoff from the interior to the coast.

The Kuiseb River is the closest river to the project site, approximately 14 km away and is one of the prominent ephemeral rivers that influence the landscape surrounding Walvis Bay. Originating in the Khomas Highlands, east of the Namib Desert, the Kuiseb River flows westward towards the Atlantic Ocean, passing through arid and semi-arid regions along its course (Paillou, Lopez, Marais, & Scipal, 2020). However, like many rivers in this part of Namibia, the Kuiseb River's flow is intermittent, primarily dependent on rainfall events in its catchment area.

6.8 GROUNDWATER

A hydrogeology specialist assessment was undertaken for the project site, with the detailed report presented in Annexure H. The geology overlying the project area consists of Damara Supergroup rocks, including the Nosib group and the intrusive granites, which are inherently impermeable with little or no primary porosity. Groundwater flow is predominantly in secondary features like faults and joints.

According to the Namibian hydrogeological zone map (Ministry of Agriculture, Water and Rural Development, 2011), the project is located within the hydrogeological zones with very low and limited groundwater potential. The low and limited groundwater potential can be explained by the low rainfall and the Namib Desert's aridity, which limits sufficient aquifers' recharge.

The fractured zones are, however, poorer aquifers due to low connectivity between individual fractures and fracture apertures decreasing with depth. Fresh rock units are usually characterised by very low hydraulic conductivity.

The groundwater flow is expected to follow the natural topography and drainage patterns for this area, which is the area's natural topography and drainage patterns and flow towards the Atlantic Ocean to the west. The flow will be directed through structures, likely taking advantage of north-west – south-east thrust faults and the Okahandja Lineament.

The town of Walvis Bay relies on groundwater extracted from the Kuiseb aquifer for their domestic and industrial use. NamWater abstracts groundwater from the shallow alluvial Kuiseb River sediments with high-capacity production boreholes at the Swartbank, Rooinab A, Rooibank B and Dorob wellfields.

There are no identified groundwater users within the vicinity of the project area.

The aquifer around the Walvis Bay Waste Management site is classified as a non-aquifer system, defined as an aquifer occurring in fractured or potentially fractured rocks that do not have a high primary permeability. The aquifer's extent is limited, and water quality is poor (Parsons, 1995). Therefore, a low level of protection is required (Knight Piesold Consulting (Pty) Ltd, 2025).

6.9 TERRESTRIAL FLORA AND FAUNA

Walvis Bay falls within the Namib Desert ecoregion, characterised by its unique combination of coastal and desert environments (Namibia Nature Foundation, 2022). The ecoregion extends along the coastal plain of western Namibia, from the Uniab River in the north to the town of Lüderitz in the south. This ecoregion encompasses the coastal plains, sand dunes, and rocky outcrops along the Atlantic Ocean, extending inland to include parts of the Namib Desert. The harsh arid climate, limited rainfall, and prevailing fog contribute to the formation of distinctive ecosystems adapted to extreme conditions.

6.9.1 FAUNA

Avifaunal richness near Walvis Bay is concentrated at the Ramsar-listed Walvis Bay Lagoon IBA and at the Rooikop sewage ponds, where permanent water sustains large congregations of waterbirds. Avifaunal species include Greater Flamingo (*Phoenicopterus ruber*) and Lesser Flamingo (*P. minor*), Cape Teal (*Anas capensis*), Red-knobbed Coot (*Fulica cristata*), Maccoa Duck (*Oxyura maccoa*), Cape Shoveler (*Anas smithii*), Great Crested Grebe (*Podiceps cristatus*), Black-necked Grebe (*P. nigricollis*), Pied Avocet (*Recurvirostra avosetta*), Little Grebe (*Tachybaptus ruficollis*), Black-winged Stilt (*Himantopus himantopus*) and Sanderling (*Calidris alba*). Large coastal species occur commonly at the lagoon but also move through the airport airspace under particular wind regimes, notably Great White Pelican (*Pelecanus onocrotalus*), which exploits thermal updrafts along the dune belt during east-wind conditions, and Cape Cormorant (*Phalacrocorax capensis*), which can be displaced inland by strong westerlies and has on occasion landed on the runway. Terrestrial and generalist birds of the gravel plains, airport precinct and adjacent settlements include Helmeted Guineafowl (*Numida meleagris*), Pied Crow (*Corvus albus*), Speckled Pigeon (*Columba guinea*), Blacksmith Lapwing (*Vanellus armatus*), Three-banded Plover (*Charadrius tricollaris*), Cape Wagtail (*Motacilla capensis*), House Sparrow (*Passer domesticus*), White-backed Mousebird (*Colius colius*), Familiar Chat (*Cercomela familiaris*), African Reed Warbler (*Acrocephalus baeticatus*), Yellow-bellied Eremomela (*Eremomela icteropygialis*), Sabota Lark (*Calendulauda sabota*), Red-capped Lark (*Calandrella cinerea*), Gray's Lark (*Ammomanopsis grayi*), Greater Striped Swallow (*Hirundo cucullata*) and Common House Martin (*Delichon urbicum*) (Hauptfleisch, 2018).

Reptiles have high species richness and endemism within the Namib Desert, as they have evolved adaptations to survive in this harsh environment more efficiently than most birds and large mammals that may occur within the biome. Approximately 70 reptile species occur within the ecoregion, including several endemic reptiles including the two desert lizards, the wedge-snouted sand lizard (*Meroles cuneirostris*) and the small-scaled sand lizard (*M. micropholidotus*), the barking gecko (*Ptenopus kochi*) and the day gecko (*Rhoptropus bradfieldi*) (Martin & Burgess, 2024).

The Namib Desert is home to many small rodent species that occur among the rocky habitats in the western deserts, in the sand dunes, and in the vegetation of the gravel plains. The larger ungulates found in the Namib Desert include gemsbok (*Oryx gazella*) (most widespread ungulates in the desert habitat), springbok (*Antidorcas marsupialis*), and Hartmann's zebra (*Equus zebra hartmannae*). Klipspringers (*Oreotragus oreotragus*), steenboks (*Raphicerus campestris*), baboons and leopards occur along the courses of the Kuiseb and Swakop Rivers. The predators of the Namib Desert include cheetahs, brown hyenas, spotted hyenas, Cape foxes and bat-eared foxes (Martin & Burgess, 2024).

The desert does not have a very high level of avian richness. Six bird species are considered endemic to the Namib Desert, namely, the dune lark (*Certhilauda erythrochalamys*), Benguela long-billed lark (*C. benguelensis*), Gray's lark (*Ammomanes grayi*), bank cormorant (*Phalacrocorax neglectus*), tractrac chat (*Cercomela tractrac*), and Rüppell's korhaan (*Eupodotis rueppellii*) (Martin & Burgess, 2024). In addition, to the above, several coastal birds are known to occur within the national parks south of Walvis Bay, with the most important being the Cape cormorant (*Phalacrocorax capensis*) ("endangered") and greater flamingo (*Phoenicopterus roseus*) ("vulnerable"), as well as the Greater Crested Tern (*Thalasseus bergii*), Kelp Gull (*Larus dominicanus*), White-breasted Cormorants (*Phalacrocorax lucidus*) and the Damara Tern

(*Sternula balaenarum*). Most seabirds breeding in Namibia are restricted to areas where they are safe from land predators, although some species can breed on the mainland coast, either cryptically on the open ground or in inaccessible places.

During the site visit, no evidence of faunal sightings, tracks or scat was observed within the project area.

6.9.2 FLORA

Within the Central Namib ecoregion exists distinct vegetative areas. A narrow vegetation strip of approximately 200 m wide runs along the coastline north of the Swakop River. Inland of the strip exist vast gravel plains which are predominantly barren of flora except for lichens. Further inland, towards the extreme east of the Central Namib, the gravel plains become increasingly vegetated with annuals, predominantly with members of the *Stipagrostis* genus and scattered shrub individuals of *Moringa ovalifolia* and *Euphorbia virosa* (Martin & Burgess, 2024).

The most notable plant to occur within the Central Namib ecoregion is *Welwitschia mirabilis*. These plants possess two fibrous leaves which persist throughout the entire life of the plant and are considered the longest-lived leaves of the plant kingdom. These plants are often found in broad, flat channels on gravel plains and scattered more than 20 m apart, with a distribution ranging from the Kuiseb River to the Namibe province in southern Angola (Martin & Burgess, 2024).

During the site visit undertaken for the project area, it was noted that the project site provides severely limited vegetative cover, with only one floral species recorded, *Euphorbia mauritanica* (yellow milk bush) (Figure 11), present in low density as scattered individuals within the project area.

Figure 11: *Euphorbia mauritanica* within the project area

6.10 SOILS

The soil types of Walvis Bay, encompass a range of arid and desert soil classifications, reflecting the unique environmental conditions prevalent in the region (Mendelsohn, Jarvis, Roberts, & Robertson, 2022). The dominant soil types in this area include:

- Arenosols, characterised by their sandy texture and low organic matter content, are common in the coastal dune fields surrounding Walvis Bay. These soils are well-drained and often found in areas influenced by wind deposition and aeolian processes (IUSS Working Group WRB, 2015).
- Gypsisols, characterised by accumulations of calcium sulphate, these soils present very low fertility levels and can sustain only the hardiest of plants (IUSS Working Group WRB, 2015).
- Leptosols, shallow soils with limited development, are also prevalent in the region, particularly in rocky and mountainous terrain near Walvis Bay. These soils typically have a high proportion of gravel and rock fragments, making them unsuitable for intensive agriculture but important for supporting specialised desert vegetation (IUSS Working Group WRB, 2015).
- Regosols, characterised by their loose structure and limited horizon development, are found in areas with recent sediment deposition and active erosion processes, such as river valleys and alluvial plains near Walvis Bay. These soils are highly variable and often subject to frequent disturbance, posing challenges for land management and agricultural practices (IUSS Working Group WRB, 2015).

Despite the predominance of sandy and gravelly soils, certain areas in the region may also contain Vertisols, characterised by their high clay content and tendency to shrink and swell with changes in moisture levels (Mendelsohn, Jarvis, Roberts, & Robertson, 2022).

6.11 SOCIO-ECONOMICS

A social impact assessment was undertaken by Urban Dynamics (Pty) Ltd (2025) for the project area, and the following subsections are populated using information from the report for the socio-economic profile of Erongo Region and the Walvis Bay Urban Constituency, where the town of Walvis Bay is located and where the project area is situated. The full report can be viewed under Annexure D.

6.11.1 POPULATION DEMOGRAPHICS

The Walvis Bay Urban and Rural constituencies are the main population and economic centres of the Erongo Region. According to the 2023 Population and Housing Census, Namibia's population was 3 022 041, while the Erongo Region accounted for 240 206 people, making it the second fastest-growing region nationally with an annual growth rate of 3.9% between 2011 and 2023 (NSA, 2025; NSA, 2024). Between 2011 and 2023, Walvis Bay's population increased from 62 096 to 102 704, a growth of more than 40 000 people over just a decade. This reflects an average annual growth rate of 4.23%, notably exceeding both regional and national averages and is driven by migration linked to port, logistics, and industrial employment opportunities.

Population density contrasts sharply between the urban and rural areas. While Namibia averages 3.7 persons/km² and Erongo 3.8 persons/km², Walvis Bay Urban recorded 461 persons/km², compared to only 19 persons/km² in Walvis Bay Rural (NSA, 2025). This demonstrates the high concentration of settlement and infrastructure within the urban core and the sparse population in the rural hinterland.

Demographic shifts in the Erongo Region from 2001 to 2011 show a slight decrease in the proportion of the population under 15 years from 35% to 34%, while the working-age group (15 to 59 years) increased from 64% to 67%, normally due to in-migration for employment, with the working age within the Walvis Bay Urban Constituency being 72 %.

The sex ratio in the region during the same period, decreased from 115 males per 100 females to 112/100, which is still higher than the national ratio of 94. In Walvis Bay, it was 117 males per 100 females in 2011, likely due to an influx of single males working in fishing and construction (NSA, p. 2012).

Age distribution reflects a predominantly working-age population, with 57.4% of Erongo residents aged 20–59 years, compared with the national average of 54.1%. In Walvis Bay Urban, 66.6% of the population is working-age, 25.4% are under 19, and 8.0% are 60 years and older. In Walvis Bay Rural, 66.0% are working-age, 29.2% under 19, and 4.8% elderly (NSA, 2025). Average household size decreased from 3.3 in 2011 to 3.1 in 2023, consistent with urbanisation and smaller family structures (NSA, 2025).

6.11.2 EDUCATION PROFILE

According to the Educational Management Information System (EMIS), 2023 report, the Erongo Region had seventeen (17) secondary schools, sixteen (16) combined schools, and forty-six (46) primary schools in 2022. Twenty of these schools are situated within Walvis Bay (Urban Dynamics (Pty) Ltd, 2025).

The 2011 literacy rates for people older than 15 years for the Walvis Bay Urban Constituency stood at 99% which is higher than the regional average of 92%. Additionally, only 1% of the population in the constituency had never attended school, compared to the regional average of 8% (NSA, p. 2012). The 2023 Census

reported a regional literacy rate of 95.4%, significantly higher than the national average of 87.3%. Literacy in Walvis Bay Urban is 98.7%, while Walvis Bay Rural records 93.6% (NSA, 2025).

Learner enrolment rose from 43,213 in 2018 to 53,577 in 2022, with ten new schools constructed in that period (EMIS, 2023). However, the average number of learners per school increased from 626 to 678, exceeding the national mean of 432. The learner-to-teacher ratio rose slightly to 27.1 learners per teacher, while 95.5% of teachers hold formal qualifications. Despite strong performance indicators, infrastructure expansion lags behind population growth, resulting in overcrowded classrooms and pressure on resources.

6.11.3 HEALTH PROFILE

According to the Ministry of Health and Social Services, the region currently has four district hospitals located in the main urban centres: Swakopmund, Walvis Bay, Usakos, and Omaruru. Additionally, there are three health centres and thirteen clinics. Notably, 22 of these healthcare facilities are situated within Walvis Bay, comprised of two hospitals, 16 clinics, and two health centres within the Walvis Bay Urban area (Urban Dynamics (Pty) Ltd, 2025), while the Rural Constituency has two clinics and no hospitals, relying on outreach and referral systems.

Health service access in the Erongo Region surpasses the national average, with 97.8% of households having safe drinking water and only 11% without toilet facilities, compared to national figures of 91.4% and 46%, respectively. Approximately 91% of residents live within 10 km of a health facility, exceeding the national rate of 76%, and the under-five mortality rate is lower than the national rate (Urban Dynamics (Pty) Ltd, 2025).

6.11.4 LIVELIHOOD PROFILE

In 2010, the Erongo Region had the second-highest mean annual household consumption in Namibia, amounting to N$ 47 100, while the national average was N$ 39 300. By 2016, this figure had increased to N$ 66,900, with the national average rising to N$ 57 200 (NSA, 2016).

The 2023 Population and Housing Census Labour Force Report indicates that Namibia's strict unemployment rate is 24.8%, with a broad rate of 33.5%. In the Erongo Region, unemployment is higher at 32.0%, with Walvis Bay Urban and Walvis Bay Rural reporting strict unemployment rates of 29.8% and 34.6%, respectively. Youth unemployment is a major concern, with rates of 40.1% in Walvis Bay Urban and 44.9% in Walvis Bay Rural, both above the national average of 38.6%. Labour force participation in Walvis Bay is strong, with rates of 68.8% in Urban and 70.9% in Rural areas, exceeding both national and regional averages. Most households in Erongo derive their main income from wages and salaries, at 73%, with even higher rates in Walvis Bay Urban (80.1%) and Walvis Bay Rural (74.6%). Historical data from the 2015/16 NHIES shows higher mean annual household consumption in the Erongo Region at N$66,900, compared to the national average of N$57 200, and it is likely that Walvis Bay's consumption levels are above the regional average due to its economic activities (Urban Dynamics (Pty) Ltd, 2025).

The region's industrial and service sectors, particularly mining, fishing, and tourism, provide substantial employment opportunities and significantly contribute to the local economy. The arid nature of the constituency contributes to this and emphasises the importance of employment creation (Urban Dynamics (Pty) Ltd, 2025).

6.11.5 HOUSING PROFILE

Housing conditions in the Erongo Region were generally better than the national average. Thirty eight percent (38%) of households in Namibia occupied detached or semi-detached houses in 2011. In the

Erongo region and Walvis Bay Urban Constituency, 51.8% and 53.2% of households lived in similar structures, respectively. However, the percentage of households living in improvised housing (shacks) in the region 32.5% and constituency 31% was higher than the national average of 16% (NSA, 2012). Average household size is 3.1 persons in Walvis Bay Urban and 3.3 in Walvis Bay Rural (NSA, 2025). Access to safe drinking water is nearly universal (97.8%), but 11% of households lack sanitation facilities (NSA, 2024).

Rapid in-migration has increased housing demand, expanding low-income areas and informal structures. Municipal infrastructure coverage remains strong, though continued investment is needed to improve sanitation and waste management capacity.

6.11.6 ECONOMIC PROFILE

In 2016, the Erongo Region was the second-largest contributor to Namibia's GDP, accounting for 12.93% of the national total (Urban Econ, 2019). Traditionally reliant on natural resources, the region has seen significant economic diversification in recent years. By 2023, the Erongo Region's contribution to the national GDP had increased to approximately 13.93%, underscoring its vital role in Namibia's economy. This growth has been driven by key sectors such as mining, energy, tourism, fishing, and transportation, reflecting the region's expanding economic landscape (ERC, 2023). The major industries catering towards economic growth within the region include:

- **Tourism:** Tourism plays a pivotal role in the region’s economy, with the coastal towns of Swakopmund and Walvis Bay being major attractions. The hospitality sector has grown significantly, contributing to both employment and GDP. The region's diverse natural attractions, from the Namib Desert to the Atlantic coast, continue to draw tourists from around the world.
- **Mining:** Mining remains a cornerstone of the Erongo Region’s economy, with significant operations in uranium, gold, marble, granite, and salt extraction. Major uranium mines include Swakop Uranium (Husab), Rössing, Trekkopje (Orano), the Etango Project and Langer Heinrich.
- **Fisheries:** The fishing industry in Namibia contributes approximately 2.5% to the country's GDP as of 2022. This sector has traditionally been significant but is increasingly being overshadowed by other industries like oil, gas, and green energy. Additionally, fishing accounts for about 20% of Namibia's export earnings.
- **Transportation:** The Walvis Bay Corridors, managed by the Walvis Bay Corridor Group, is a key development indicative facilitating national, regional, and international trade. The corridors link Namibia to Southern Africa and extend transatlantic connections. Overall, the Erongo Region's strategic location, rich natural resources, and ongoing infrastructure developments position it as a key player in Namibia's economic future. The upgrade to Walvis Bay’s Class A international airport further enhances the region's connectivity. The Swakopmund airport, while of regional importance, complements this network, contributing to the region's overall transport infrastructure.

6.12 ARCHAEOLOGY

Dr John Kinahan was appointed to conduct a heritage specialist study of the area for the proposed new waste management facility. The sections below provide details of both the desktop and field assessment undertaken in February 2024, with the full report provided within Annexure I.

6.12.1 DESKTOP ASSESSMENT

The Walvis Bay area is extremely rich in archaeological sites, although most of these date to within the last three hundred years and are concentrated within the !Khuiseb Delta (Kinahan & Kinahan, 2024). These sites provide a unique material record of trading relations between indigenous pastoral communities and visiting European ships. The density of archaeological sites decreases sharply within 10 km of the delta and large parts of the area inland of Walvis Bay which is currently under industrial development have few archaeological sites of any significance. In addition, much of this area was in the past used as a training ground for the South African Defence Force and the desert terrain was extensively disturbed by tanks and other tracked vehicles and the use of live artillery fire in training exercises.

6.12.2 FIELD SURVEY

A detailed survey of the proposed waste facility site covered both the project site and some adjacent ground. The survey was carried out as a series of parallel foot transects spaced according to the surface archaeological visibility. Archaeological sites, if found, are logged with a hand-held GPS and documented according to standard criteria of affinity, size, and general condition.

The area of the proposed waste facility i.e. Farm 38, Walvis Bay and its surroundings form a featureless plain comprising Neogene age Rooikop gravels partly overlain by a lag of disaggregated Gobabeb gravels. There is no vegetation cover and the soil is highly saline. The area has been extensively disturbed by vehicle traffic. No archaeological features were observed during the survey (Kinahan & Kinahan, 2024).

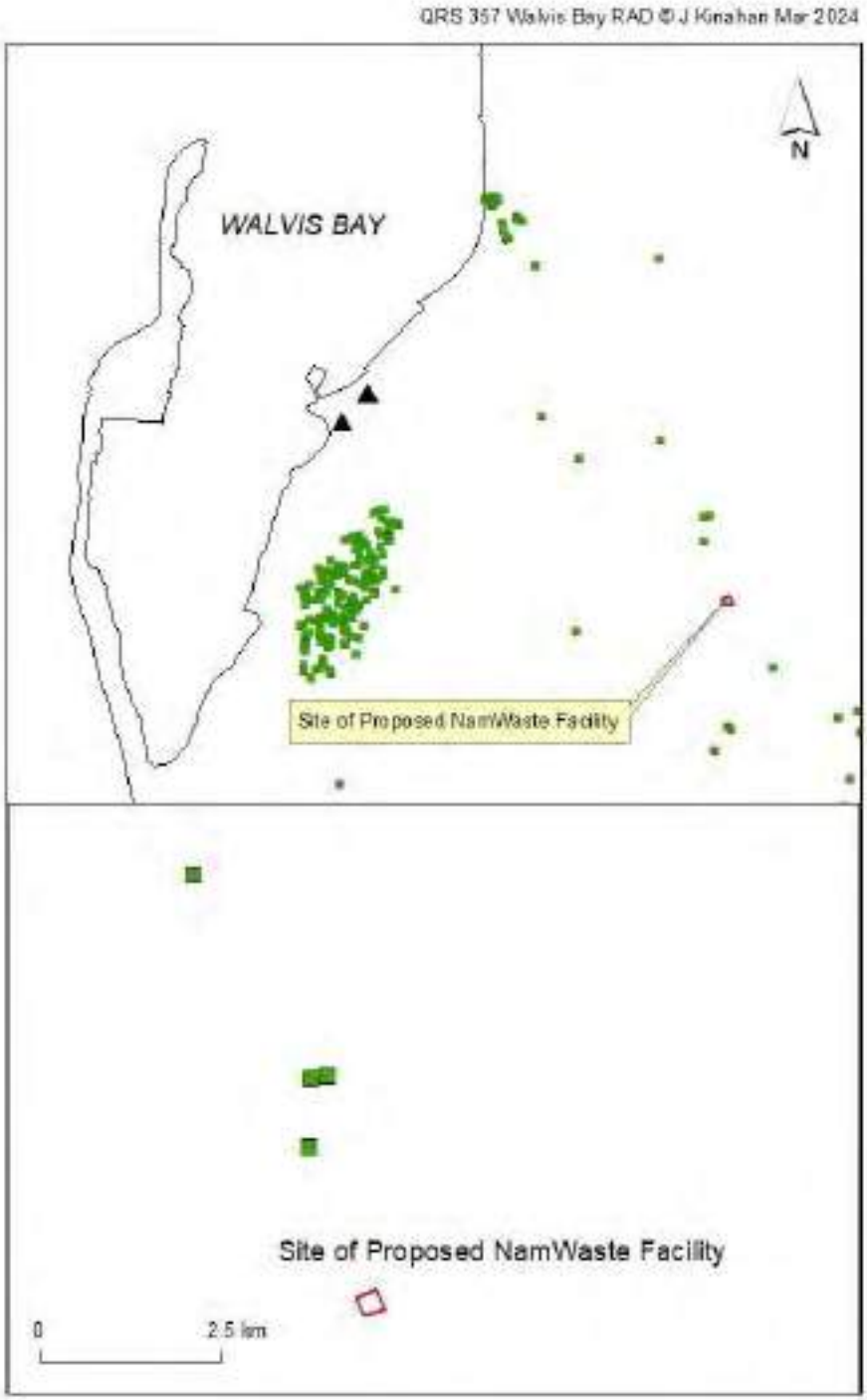

Figure 12: The proposed waste facility on Farm 38, Walvis Bay, in relation to known archaeological sites (green squares) and proclaimed National Monuments (black triangles) (Kinahan & Kinahan, 2024).

7 IMPACT ASSESSMENT

7.1 DEFINING THE NATURE OF THE IMPACT

An impact is essentially any change to a resource or receptor brought about by the presence of the proposed project component or by the execution of a proposed project related activity. The terminology used to define the nature of an impact is detailed in Table 11 below.

Table 11: Impact Nature

Term	Definition
Positive (+)	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative (-)	An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.
Direct impact (D)	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors (e.g. between occupation of a site and the pre-existing habitats, or between an effluent discharge and receiving water quality).
Indirect impact (I)	Impacts that result from other activities that are encouraged to happen as a consequence of the project (e.g. in-migration for employment placing a demand on resources).
Cumulative impact (C)	Impacts that act together with other impacts (including those from concurrent or planned future third-party activities) to affect the same resources and/or receptors as the Project.
Residual impact	Those impacts that remain following the implementation of the mitigation measures proposed.

7.2 ASSESSING SIGNIFICANCE

The Knight Piésold impact significance rating system is based on the following equation:

Significance of Environmental / Social Impact = Consequence x Probability

The consequence of an impact can be derived from the following factors:

- Severity / Magnitude – the degree of change brought about in the environment;
- Reversibility - the ability of the receptor to recover after an impact has occurred;
- Duration - how long the impact may be prevalent; and
- Spatial Extent - the physical area which could be affected by an impact.

The severity, reversibility, duration, and spatial extent are ranked using the criteria indicated in Table 12 and then the overall consequence is determined by adding up the individual scores and multiplying it by the overall probability (the likelihood of such an impact occurring). Once a score has been determined, this is checked against the significance descriptions indicated in Table 13.

Table 12: Ranking Criteria

Severity / magnitude (M)	Reversibility (R)	Duration (D)	Spatial extent (S)	Probability (P)
5 – Very high – The impact causes the characteristics of the receiving environment/ social receptor to be altered by a factor of 80 – 100%	5 – Irreversible – *Environmental* - where natural functions or ecological processes are altered to the extent that it will permanently cease. *Social* - Those affected will not be able to adapt to changes and continue to maintain-pre impact livelihoods.	5 – Permanent - Impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.	5 – International - Impacts that affect internationally important resources such as areas protected by international conventions, international waters etc.	5 – Definite - The impact will occur
4 – High – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 60 – 80%		4 – Long term - impacts that will continue for the life of the Project but ceases when the Project stops operating.	4 – National - Impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences.	4 – High probability – 80% likelihood that the impact will occur
3 – Moderate – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 40 – 60%	3 – Recoverable *Environmental* - where the affected environment is altered but natural functions and ecological processes may continue or recover with human input. *Social* - Able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support or intervention.	3 – Medium term - Impacts are predicted to be of medium duration (5 – 15 years)	3 – Regional - Impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystem.	3 – Medium probability – 60% likelihood that the impact will occur
2 – Low – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 20 – 40%		2 – Short term - Impacts are predicted to be of short duration (0 – 5 years)	2 – Local - Impacts that affect an area in a radius of 2 km around the site.	2 – Low probability - 40% likelihood that the impact will occur
1 – Minor – The impact causes very little change to the characteristics of the receiving environment/ social receptor and the alteration is less than 20%	1 – Reversible *Environmental* - The impact affects the environment in such a way that natural functions and ecological processes are able to regenerate naturally. *Social* - People/ communities are able to adapt with relative ease and maintain pre-impact livelihoods.	1 – Temporary - Impacts are predicted to intermittent/ occasional over a short period.	1 – Site only - Impacts that are limited to the site boundaries.	1 – Improbable - 20% likelihood that the impact will occur

Table 13: Significance Definitions

Score According to Impact Assessment Matrix	Significance Definitions	Colour Scale Ratings	
		Negative Ratings	Positive Ratings
Between 0 and 29 significance points indicate **Low Significance**	An impact of low significance is one where an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value.	**Low**	**Low**
Between 30 and 59 significance points indicate **Moderate Significance**	An impact of moderate significance is one within accepted limits and standards. The impact on the receptor will be noticeable and the normal functioning is altered, but the baseline condition prevail, albeit in a modified state. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is As Low as Reasonably Practicable (ALARP). This does not necessarily mean that "moderate" impacts have to be reduced to "low" impacts, but that moderate impacts are being managed effectively and efficiently to not exceed accepted standards.	**Moderate**	**Moderate**
60 to 100 significance points indicate **High Significance**	An impact of high significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. An impact with high significance will completely modify the baseline conditions. A goal of the EIA process is to get to a position where the project does not have any high negative residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be high residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). It is then the function of regulators and stakeholders to weigh such negative factors against the positive factors, such as employment, in coming to a decision on the project.	**High**	**High**

A detailed impact significance table for the Project is found in Table 14. The descriptions of each impact in this section should be read in conjunction with this table.

7.3 IMPACT ASSESSMENT PER ENVIRONMENTAL ASPECT

7.3.1 CLIMATE

7.3.1.1 CONSTRUCTION PHASE

Localised GHG emissions from construction vehicles and generators:

The release of GHG emissions from construction phase activities will contribute to global climate change emission levels. The impact is considered to have moderate significance prior to mitigation measures, decreasing to low significance after mitigation.

7.3.1.2 OPERATIONAL PHASE

Increased GHG emissions:

Increased GHG emissions are expected from the operations of the waste treatment facility as well as from truck movements between the port and the facility. The impact is considered to be moderate before mitigation, decreasing to low after mitigation.

Localised microclimate alterations:

Operational activities are expected to alter the immediate microclimate surrounding the facility as a result of heat generation and ambient releases of GHGs. The impact is considered to be moderate before and low after mitigation.

7.3.2 VISUAL

7.3.2.1 CONSTRUCTION PHASE

Alteration in site aesthetics:

Construction of the proposed facility will alter the natural landscape aesthetics of the project area, permanently transforming the immediate landscape along the D1983 road approaching the C14 National Road leading towards Walvis Bay. The impact is considered to have a high significance and cannot be avoided.

7.3.2.2 OPERATIONAL PHASE

Light generation from the site will occur at night and should be managed and monitored to ensure that the light generated does not influence operational activities of the Walvis Bay International Airport. This is an impact of low significance due to the industrial designation of the land by the Walvis Bay Municipality and the distance to nearby sensitive receptors.

7.3.3 LAND USE

7.3.3.1 CONSTRUCTION PHASE

Change in Land Use:

The site is currently designated for industrial use by the Walvis Bay Municipality, however it is currently unutilised. Once construction is undertaken, the land use of the site will be changed permanently, therefore this impact is considered to have a high significance.

7.3.3.2 OPERATIONAL PHASE

No impacts are expected to occur.

7.3.4 TOPOGRAPHY

7.3.4.1 CONSTRUCTION PHASE

An impact on the topography of the site is to be expected following the construction of the proposed facility. The impact will be of high significance before and after mitigation given its high likelihood of occurrence.

7.3.4.2 OPERATIONAL PHASE

No impacts are expected to occur.

7.3.5 GEOLOGY

No impacts on the geology are expected to occur.

7.3.6 AIR QUALITY

7.3.6.1 CONSTRUCTION PHASE

Increase in fugitive dust / PM_{10} emissions from earthworks, general construction activities and track-out with the potential to impact on human health:

During the construction phase, the generation of dust as a result of vehicular movements and construction activities is expected, however, the impact is considered to have low significance, and will remain low after mitigation.

Emissions from vehicles used for construction:

Gaseous emissions will be generated by vehicular movements during the construction phase of the facility, from various localities to and from the project site, as well as within the project site. This impact is considered to be of low significance prior to mitigation, and will remain low once mitigation measures are implemented.

7.3.6.2 OPERATIONAL PHASE

Increased emissions due to waste treatment:

Operational activities, such as waste stream logistics, will result in increased emissions impacting air quality through the following:

- Increase in criteria pollutant levels at SRs during normal operations due to diesel combustion and emissions from the TCC/TDU and boiler (i.e. increased emissions due to waste treatment operations)
- Increase in criteria pollutant levels at SRs during emergency / back-up power operations due to diesel combustion and emissions from generators, the TCC/TDU and boiler.

These impacts are considered to be of low significance before and after mitigation measures.

Increased fugitive dust generation:

Waste stream handling and logistics, specifically vehicular movements, will result in elevated dust generation both on and off site, as fugitive dust will be mobilised on both tarred and unsurfaced roads used for transport routes. The impact is considered to have low significance before and after mitigation measures.

7.3.7 NOISE

7.3.7.1 CONSTRUCTION PHASE

Increase in noise emissions:

During the construction phase, noise generation from vehicles, construction equipment and activities are anticipated through site preparation and general construction activities. The impact of noise generation is considered to be of low significance before and after mitigation, as the project site is located in an area with other activities which generate noise, such as the Walvis Bay International Airport, the C14 national road, as well as the nearby industrial facilities and quarry.

Based on the results, it was indicated that construction activities will be below the construction noise threshold of 65 dB(A) at approximately 140 m from the project boundary under worst-case construction activities. As there are no receptors within this distance from the project boundary the construction phase activities are not expected to generate noise levels that exceed applicable construction noise threshold at any of the assessed receptors.

7.3.7.2 OPERATIONAL PHASE

Noise generated by facility infrastructure and operations:

Operational noise will be generated by facility infrastructure and vehicular movements and is an impact of low significance as ambient noise levels will continuously be generated. The impact will have a cumulative impact due to additional vehicular movements to and from the project area.

7.3.8 SURFACE WATER

7.3.8.1 CONSTRUCTION PHASE

No impacts are expected to occur for surface water resources, as the nearest system, the ephemeral Kuiseb River, is approximately 14 km away from the project area. The potential for spillages and contaminated runoff does exist, however the nature of the surrounding environment and distance required or runoff to reach the Kuiseb River, the potential for the impact is negligible.

7.3.8.2 OPERATIONAL PHASE

No impacts are expected to occur for surface water resources, as the nearest system, the Kuiseb River, is approximately 14 km away from the project area.

7.3.9 GROUNDWATER

7.3.9.1 CONSTRUCTION PHASE

Groundwater contamination through spills:

Potential groundwater contamination by hydrocarbons and other potential spills is considered to be of moderate significance prior to mitigation, after which the impact is considered to be of low significance.

Reduction local groundwater levels through abstraction:

The site may abstract water from boreholes on site to supplement water volumes during the construction phase, which may reduce local groundwater levels as a result of abstraction. This impact presented moderate significance prior to mitigation, after implementation of which it is reduced to low significance.

7.3.9.2 OPERATIONAL PHASE

Groundwater contamination through spills:

Potential groundwater contamination by hydrocarbons and other potential spills is considered to be of moderate significance prior to mitigation, after which the impact is considered to be of low significance.

Reduction in groundwater quality due to contaminated seepage or leakage:

Potential groundwater contamination due to hazardous chemical spillages is a potential impact, which may impact on the Kuiseb aquifer. This impact is considered to have a moderate rating prior to mitigation measures, after which the impact is reduced to low significance.

Reduction local groundwater levels through abstraction:

The site may abstract water from boreholes on site when required to supplement water volumes, which may reduce local groundwater levels as a result of abstraction. This impact presented moderate significance prior to mitigation. With abstraction serving as an if and when needed supplement to water supplies, this impact is reduced to low significance as abstraction will not be permanently required.

7.3.10 SOIL

7.3.10.1 CONSTRUCTION PHASE

Contamination of soil:

Contamination by means of a hazardous spill is a potential impact on soil. However, the amount and usage of hazardous substances on site during construction is limited and, therefore, the impact is rated as having a very low significance before and after mitigation.

Soil erosion:

The probability of soil erosion is high, with elevated potential for erosion through site clearance and construction activities, along with the natural soil erosion though wind. The impact is considered to have low significance due to the low vegetation density and rainfall expected for the project site, as well as construction activities and built infrastructure covering the available soils.

7.3.10.2 OPERATIONAL PHASE

Contamination by means of a hazardous spill is a potential impact on soil. However, the impact is rated as having a moderate significance before mitigation, with a high probability of occurrence as hazardous material will be dealt with daily on site, and after mitigation as various design and operational measures will reduce the significance of this impact as low.

7.3.11 TERRESTRIAL FAUNA AND FLORA

7.3.11.1 CONSTRUCTION PHASE

Loss / Disturbance of flora:

The construction of the plant and associated ancillary infrastructure will require the clearing of the land and the use of earthmoving machinery, which could interfere with existing vegetation within the proposed site, which will disturb the existing flora, and may lead to specimen loss. This impact is considered to be of low significance both before and after mitigation, however specimen loss can be considered permanent.

Loss / Disturbance of faunal habitat / Habitat fragmentation:

This construction activity will result in disturbance to likely access corridors between the limited and localised habitat disturbance and potential habitats located along the existing pipeline. This disturbance will persist throughout the project's operational life; however, it will affect a small area of uniform, previously disturbed habitat. Ecological sensitivity within the affected area is low, with only reptiles and amphibians occurring in close proximity to the existing pipeline. While access to this habitat may be temporarily reduced during construction, the effect is expected to be minimal. In addition, the presence of the evaporation pond may attract opportunistic avifauna to the project site, potentially altering flight paths across the area. Consequently, the impact is considered low to negligible in significance, despite its permanent nature.

Road Fatalities:

Potential faunal loss may occur as a result of road fatalities, which is considered as an indirect impact of moderate significance prior to mitigation measures, after which it is considered as low significance.

Animals dying or moving away due to contamination/disturbance of immediate environment:

The construction activities will disturb nearby fauna, through the generation of sound which may frighten nearby animals, increased human presence within the area, and through habitat loss within the project area. This impact is considered to be a short-term localised impact, with a low significance.

7.3.11.2 OPERATIONAL PHASE

Road Fatalities:

Potential faunal loss may occur as a result of road fatalities, which is considered as an indirect impact of moderate significance prior to mitigation measures, after which it is considered as low significance.

Introduction of invasive plant species:

Vehicular movements of trucks between the port and site may potentially lead to the dispersion of invasive plant species through the transport of seeds caught on personnel or within vehicle tyres. This impact is considered to be of low significance due to the low floral presence within the project area and along the access routes.

Establishment of pest species:

Inadequate housekeeping on site may lead to the establishment of pest species within the project area, e.g. rats or flies. This impact is considered to be of moderate significance and can further be reduced through mitigation measures to low significance.

Plant dieback due to contamination of immediate environment:

Potential hazardous chemical spills, both on site and whilst wastes are in transit, can result in floral loss in the immediate vicinity of possible spills, an indirect impact of low significance, which can be mitigated.

Animals dying or moving away due to contamination/disturbance of immediate environment:

The operational activities will disturb nearby fauna, through vehicular movements, the generation of sound, increased human presence within the area, and through direct exposure to spills within the project area and along the transport routes. This is considered to be an impact of low significance, as fewer native fauna are expected to venture near the site during the operational phase.

7.3.12 ARCHAEOLOGY

No impacts are expected.

7.3.13 SOCIO-ECONOMIC

7.3.13.1 CONSTRUCTION PHASE

Increased traffic generation:

The construction phase is expected to lead to increased traffic within the area. Specifically, the regional movement of construction materials via routes such as the M36, D1983 roads, and internal access gravel roads could lead to increased traffic, affecting Walvis Bay residents and commuters travelling to Swakopmund via the D1984, and Walvis Bay Airport. The impact is considered to be of moderate significance prior to and after mitigation.

Employment opportunities:

During the construction phase, there will be a range of temporary job opportunities available, from general construction workers to artisans and plant operators. While contractors may bring some skilled workers, many positions can be filled by local residents. This is a positive impact of high significance.

Health and Safety - Exposure to hazards:

On-site construction activities, including the transfer of building materials, will involve the use of heavy machinery, handling hazardous materials, and generating dust and pollutants. These factors pose

health risks to workers and nearby residents. The impact is considered to be of moderate significance, reduced to low significance after implementation of mitigation measures.

7.3.13.2 OPERATIONAL PHASE

Increased traffic generation:

Operational transport activities are anticipated to result in increased traffic congestion, potential delays, safety concerns, elevated noise levels along the Railway Street, 5th Street East, Hanna Mupetami, M36, D1983 roads, and internal access gravel roads could lead to increased traffic, affecting Walvis Bay. The impact is considered to be of moderate significance after implementation of mitigation measures.

Employment opportunities:

During operations, 96 full-time employment opportunities will be created. While some skilled positions may be filled by personnel brought in specifically for their expertise, the majority of jobs could be filled by local residents. This is a positive impact of high significance.

Health and Safety - Exposure to hazards:

During the operational phase of the facility, ongoing activities such as operating treatment plants, handling and storing hazardous materials and chemicals, transporting waste, and using heavy equipment pose health risks to employees and nearby residents. This impact is considered to be of high significance, reduced to moderate significance after the implementation of mitigation measures.

Economic opportunities:

This facility is expected to play a role in boosting the local economy of Walvis Bay and the wider Erongo Region, through creating employment opportunities and requiring third parties to provide services. This is a positive impact of high significance.

Table 14: Impact Significance

Project activity or issue	Potential impact	Nature of impact		Significance before mitigation							Significance after mitigation as per EMP						
		+ / -	D/I/C	M	R	D	S	P	TOTAL	SP	M	R	D	S	P	TOTAL	SP
Climate																	
Construction activities	Localised GHG emissions from construction vehicles and generators	-	D	1	3	1	5	5	50	M	1	3	1	5	2	20	L
Operational activities	Increased GHG emissions	-	D	1	2	4	4	4	44	M	1	2	3	3	3	27	L
Operational activities	Localised microclimate alterations	-	D	1	3	4	1	4	36	M	1	3	4	1	3	27	L
Visual																	
Construction activities	Alteration in site aesthetics	-	D	5	5	5	2	5	85	H	5	5	5	1	5	80	H
Operational activities	Nocturnal light generation	-	D	3	1	5	1	2	20	L	3	1	5	1	1	10	L
Land Use																	
Construction activities	Change in Land use	-	D	5	5	5	1	5	80	H	5	5	5	1	5	80	H
Operational activities	No impacts expected																
Topography																	
Construction activities	Alteration in topography	-	D	5	5	5	1	5	80	H	5	5	5	1	5	80	H
Operational activities	No impacts expected																
Geology																	
Construction activities	No impacts expected																
Operational activities	No impacts expected																
Air quality																	
Construction activities	Increase in fugitive dust / PM_{10} emissions from earthworks, material handling, construction and track-out with the potential to impact on human health	-	D	2	1	1	2	3	18	L	1	1	1	4	3	21	L
	Increase in exhaust emissions (gaseous and PM emissions) from vehicles with the potential to impact on human health	-	D	1	1	1	2	3	15	L	1	1	1	2	3	15	L
Operational activities	Increase in criteria pollutant levels at SRs during normal operations due to diesel combustion and emissions from the TDU and boiler (i.e. increased emissions due to waste treatment operations)	-	D	1	1	4	2	3	24	L	1	1	4	2	3	24	L
	Increase in criteria pollutant levels at SRs during emergency / back-up power operations due to diesel combustion and emissions from generators, the TDU and boiler.	-	D	2	1	1	2	2	12	L	2	1	1	2	2	12	L
Operational activities - Waste stream logistics	Increase fugitive dust generation because of waste stream handling and logistics.	-	D	2	1	4	2	2	18	L	2	1	4	2	2	18	L
Noise																	
Construction activities	Increase in noise emissions	-	D	1	1	1	2	3	15	L	1	1	1	2	3	15	L
Operational activities	Noise generated by facility infrastructure and operations	-	D	1	1	4	2	3	24	L	1	1	4	2	3	24	L
Surface Water																	
Construction activities	No impacts expected																
Operational activities	No impacts expected																

Project activity or issue	Potential impact	Nature of impact		Significance before mitigation							Significance after mitigation as per EMP						
		+ / -	D/I/C	M	R	D	S	P	TOTAL	SP	M	R	D	S	P	TOTAL	SP
Groundwater																	
Hazardous chemical spills (e.g. fuel)	Groundwater Contamination	-	D	2	3	4	2	3	33	M	2	3	4	2	2	22	L
Leakage or seepage of contaminants	Reduction in groundwater quality due to contaminated seepage or leakage	-	D	3	5	5	3	2	32	M	3	5	5	3	1	16	L
Abstraction of groundwater when required	Reduction local groundwater levels through abstraction	-	D	3	1	4	3	3	33	M	3	1	4	3	2	22	L
Soil																	
Hazardous chemical spills (e.g. fuel, process chemicals, etc.)	Contamination of Soil	-	D	2	1	1	1	5	25	L	1	1	1	1	2	8	L
Construction activities	Soil Erosion	-	D	2	1	1	1	3	15	L	1	1	1	1	5	20	L
Hazardous chemical spills (e.g. fuel, process chemicals, etc.)	Contamination of Soil	-	D	4	3	4	1	4	48	M	4	3	4	1	2	24	L
Terrestrial Fauna and Flora																	
Construction activities	Loss / Disturbance of flora	-	D	1	5	5	1	3	36	M	1	5	5	1	2	24	L
Construction activities	Loss / Disturbance of faunal habitat / Habitat fragmentation	-	D	1	5	5	1	2	24	L	1	5	5	1	1	12	L
Transport of construction materials to project site	Road Fatalities	-	I	3	5	2	2	3	36	M	3	5	2	2	1	12	L
Hazardous chemical spills (e.g. fuel, process chemicals, etc.)	Animals dying or moving away due to contamination of immediate environment	-	I	3	3	2	2	2	20	L	3	3	2	2	1	11	L
Transport of waste materials to project site	Road Fatalities	-	I	3	5	4	3	2	30	M	3	5	4	3	1	15	L
	Introduction of invasive plant species	-	I	2	3	4	2	2	22	L	2	3	4	2	1	11	L
Poor waste management / housekeeping	Establishment of pest species	-	I	3	3	4	1	3	33	M	3	3	4	1	1	11	L
Hazardous chemical spills (e.g. fuel, process chemicals, etc.)	Plant dieback due to contamination of immediate environment	-	D	2	5	4	2	2	26	L	2	5	2	2	2	22	L
	Animals dying or moving away due to contamination of immediate environment	-	D	3	5	4	2	2	28	L	3	5	4	2	1	14	L
Archaeology																	
Construction activities	No impacts expected																
Operational activities	No impacts expected																
Socio-economic																	
Construction activities	Increased Traffic	-	D	4	1	2	3	5	50	M	3	1	2	3	5	45	M
Construction activities	Employment Opportunities	+	D	2	3	2	3	5	50	M	2	3	3	3	5	55	M
Construction activities	Health and Safety - Exposure to hazards	-	D	4	3	2	2	5	55	M	2	3	2	2	3	27	L
Operational activities	Increased Traffic	-	D	4	3	4	2	3	39	M	2	3	4	3	3	36	M
Operational activities	Employment Opportunities	+	D	3	3	4	3	5	65	H	3	3	4	3	5	65	H
Operational activities	Health and Safety - Exposure to hazards	-	D	4	3	4	2	4	52	M	3	3	4	2	4	48	M
Operational activities	Economic Opportunities	+	D	3	3	4	3	4	52	M	3	3	4	3	5	65	H

8 ENVIRONMENTAL MANAGEMENT PLAN

This section provides an Environmental Management Plan (EMP) to summarise the mitigation and management actions outlined in the previous sections. This is done in order to streamline the implementation and monitoring thereof.

The applicant is to ensure full compliance not only with this EMP but also with all Namibian Legislation, and as far as possible all best practice guidelines.

The EMP is split into a Construction and Operation Phase, in Table 15 and Table 16 respectively. As no decommissioning phase is currently anticipated, it has been omitted from this Environmental Assessment Report.

Permitting requirements for the facility are provided within Table 17, with relevant monitoring requirements presented within Table 18.

Table 15: Environmental Management Plan – Construction Phase

Project activity or issue	Potential impact	Mitigating action	Responsible Person	Mitigating action
Climate				
Construction activities	Localised GHG emissions from construction vehicles and generators	• Ensure that vehicles and machinery utilised are in good working order to minimise carbon exhaust emissions. • Ensure vehicles and generators are used only when necessary. • Use low sulphur diesel.	Contractor Environmental Compliance Officer (monitoring)	Vehicle maintenance reports Monthly inspection reports
Visual				
Construction activities	Alteration in site aesthetics	• Demarcate and fence all construction areas and ensure proper housekeeping to reduce visual impact of these areas. • Ensure trenches are filled and compacted to restore the surface level prior to the addition of topsoil. • Rehabilitate the temporary construction areas through the application of suitable topsoil. • Install encased, directional emitting light fittings that are downward facing to reduce upward light generation. • Where possible, paint structures with low reflective, high absorption paints to reduce light reflection. • Use dark surfaces for roads and walkways to promote light absorption and reduce upward light reflection, where possible.	Contractor Environmental Compliance Officer (monitoring)	Monthly construction reports Monthly inspection reports
Land use				
Construction activities	Change of land use	• Demarcate areas to be disturbed and keep these to a minimum. • Utilise the most practical access routes and municipal connection alignments to avoid natural areas as far as possible.	Contractor Environmental Compliance Officer (monitoring)	Monthly construction reports Monthly inspection reports
Topography and Drainage				
	Alteration in local topography	• No mitigation measures necessary	N/A	N/A
Air Quality				
Construction activities	Increased dust generation which may impact sensitive receptors	• Only remove vegetation when soil stripping is required and limit it to areas required for surface infrastructure. Adequate demarcation of these areas must be undertaken on the ground. • Carry out watering of unsurfaced roads and cleared areas for dust suppression. • Where watering is not effective to suppress dust, implement a chemical dust palliative. • Provide personal protective equipment (PPE) to prevent or minimise dust inhalation by employees who may be exposed to dust. • Avoid scabbling (roughening of concrete surfaces) if possible • Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place. • Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	Contractor Environmental Compliance Officer (monitoring)	Monthly construction reports Monthly inspection reports

Project activity or issue	Potential impact	Mitigating action	Responsible Person	Mitigating action
		• Record all inspections of haul routes and any subsequent action in a site logbook. • Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).		
Noise				
Construction activities	Increase in noise emissions	• Operate vehicles and equipment only during normal working hours, i.e., from Monday to Saturday from 06:00 to 18:00. • Monitoring of noise levels, both ambient and occupational, should be undertaken in the event of a complaint being received. • Regularly maintain equipment and machinery to ensure minimum noise levels during construction. • Avoid unnecessary revving of engines and switch off equipment when not required. • Audible reversing warning systems on mobile construction vehicles should be of a type which, whilst ensuring that they give proper warning, have a minimum noise impact on persons outside sites, where possible. When reversing, mobile plant and vehicles should travel in a direction away from sensitive receptors whenever possible. Where practicable, alternative reversing warning systems should be employed to reduce the impact of noise outside sites.	Contractor Environmental Compliance Officer (monitoring)	Monthly construction reports Monthly inspection reports
		• Set up and maintain a complaints mechanism for affected parties to voice their concerns. Implement actions to avoid or mitigate the reasons for their grievances.	Environmental Compliance Manager	Established grievance mechanism
Groundwater				
Construction activities	Groundwater Contamination	• Immediately clean up all accidental pollution (oil spills, diesel spills, concrete etc.). • Implement proper pollution control measures to avoid contamination of soil and seepage into groundwater. • Store all hazardous materials in appropriately bunded areas. • Keep all relevant Material Safety Data sheets (MSDS) on site. • Store, transport, use and dispose of chemicals as per the manual / MSDS. • Implement standard procedures to control and minimise surface and groundwater pollution that include: - Maintaining oil traps; - Maintaining bunding of all facilities that store hazardous materials; - Maintaining washing and ablution facilities; - Providing and maintaining solid waste collection facilities; - Providing spill kits and monitor spills; - Monitoring vehicle oil leaks.	Contractor Environmental Compliance Officer (monitoring) Environmental Compliance Manager	Monthly construction reports Monthly inspection reports Incident reports
Soil				
Construction activities	Hazardous spillage	• Store hazardous substances in appropriately bunded areas.	Contractor	Monthly construction reports

Project activity or issue	Potential impact	Mitigating action	Responsible Person	Mitigating action
		• Use a drip-tray when refuelling vehicles or machinery. • If a spillage occurs, clean it up immediately and dispose soil at an appropriate site, or store on site, as hazardous waste.	Environmental Compliance Officer (monitoring) Environmental Compliance Manager	Monthly inspection reports Incident reports
Fauna				
Construction activities	Loss / Disturbance of fauna	• No animal may be injured, fed, trapped, hunted or harmed in any way. • Prevent destruction of rocky habitats and associated flora which serve as habitat to various terrestrial vertebrates (and invertebrates). • When encountered on site, remove and relocate important slow-moving species such as tortoises, chameleon, etc. prior to construction activities as well as when serendipitously encountered throughout the proposed development areas. • Prevent and discourage indiscriminate killing of perceived dangerous species (e.g. snakes, etc.) as this would diminish and negatively affect the local fauna. No form of poaching, illegal collecting of veld foods (e.g. bird eggs, etc.), etc. should be tolerated, especially during the construction phase. • Educate/inform contractors and staff on dangerous and protected species to avoid and the consequences of killing and/or illegal collection of such species. • Use only existing tracks/roads when travelling in the area.	Contractor Environmental Compliance Officer (monitoring)	Monthly inspection reports Induction materials and attendance register
		• Construct the evaporation pond with a mesh covering to limit accessibility to avifauna. • Where feasible, install water scarecrows to minimize waterfowl from approaching the evaporation pond. • Where feasible, investigate and install bird deterrents such as audio or visual deterrents to minimize waterfowl from approaching the evaporation pond (ensure that additional impacts are kept minimal)	Contractor Environmental Compliance Officer (monitoring)	Monthly construction reports Monthly inspection reports
		• Initiate a suitable and appropriate refuse removal policy as littering could result in certain animals becoming accustomed to humans and associated activity and result in typical problem animal scenarios – e.g. crows, black-backed jackal, brown hyena, various gulls, etc.	Contractor Environmental Compliance Officer (monitoring)	Site specific waste management plan established
		• When encountered on site, remove and relocate perceived dangerous species (e.g. snakes) to similar undisturbed habitats in the general area. • Avoid off road driving in areas prone to scarring (e.g. gravel/gypsum/salt plains/flats/pans). Avoid nocturnal driving, as this may result in the destruction of slow-moving fauna – e.g. various reptiles and other nocturnal species. • Avoid and/or limit the use of lights during nocturnal activities as this influence and/or affects various nocturnal species – e.g. especially migrating Palaearctic birds, bats, owls, etc. and contribute to “light pollution”. Use focused lighting for least effect.	Contractor Environmental Compliance Officer (monitoring) Environmental Compliance Manager	Monthly construction reports Monthly inspection reports Incident reports
		• Installation of portable toilets as a suitable contained sewerage system for the least impact on the environment.	Contractor Environmental Compliance Officer (monitoring)	Monthly construction reports Monthly inspection reports
Flora				

Project activity or issue	Potential impact	Mitigating action	Responsible Person	Mitigating action
Construction activities	Loss / Disturbance of flora	• Avoid all areas not directly targeted for development infrastructures. • Prevent and discourage illegal collection of flora as this would diminish and negatively affect the local flora. • Use only existing tracks/roads when travelling in the area. • Avoid off road driving in areas prone to scarring (e.g. gravel/gypsum/salt plains/flats/pans) or dominated by lichens. • If any landscaping is to be undertaken, incorporate only indigenous vegetation. • Educate/inform contractors and staff on protected species to avoid and the consequences of illegal collection of such species. • Prohibit the use of any pesticides or herbicides.	Contractor Environmental Compliance Officer (monitoring)	Monthly construction reports Monthly inspection reports
Alien Invasive Plant Species				
Construction activities	Establishment of alien invasive species	• Prevent the planting of potentially alien invasive plant species for ornamental purposes as part of the landscaping should this be thought necessary. • Remove and destroy all invasive alien plants encountered in the project area. • Implement a policy of “no tolerance” towards any invasive alien plant species encountered in future in the area. This should include the removal and destruction of these species throughout the proposed development areas. • Limit land clearing activities at the site and infrastructure areas to prevent random soil disturbances favouring invasive alien plant species. • Do not use chemicals to eradicate alien spp. but rather conduct manual methods. • Ensure that vehicles accessing the route are free of vegetation, especially if contractors are used which also use their vehicles in urban areas. • Do not plant any invasive alien plant species as part of the landscaping. •	Contractor Environmental Compliance Officer (monitoring) Environmental Compliance Manager	Induction materials and attendance register Monthly construction reports Monthly inspection reports Establishment of a site-specific alien and invasive management plan
		• Conduct annual maintenance (alien plant removal) after rainy season.	Environmental Compliance Manager	Bi-annual EMP compliance reporting
Socio-economic				
Construction activities	Increased Traffic	• Implement a traffic management plan to regulate movement of heavy vehicles within the facility. • Coordinate construction vehicle movements to ensure efficient flow, particularly between 08:00 and 17:00. • Implement signage and speed control measures on site to improve road safety for both construction vehicles and other road users. • Schedule regular maintenance of impacted roads on site, particularly the gravel sections, to address wear and tear caused by heavy construction vehicles. • Promptly repair any road damage on site to ensure safe and smooth traffic flow during construction.	Contractor Environmental Compliance Officer (monitoring)	Establishment of a site-specific traffic management plan Vehicle maintenance records

Project activity or issue	Potential impact	Mitigating action	Responsible Person	Mitigating action
Construction activities	Employment Opportunities	• Require contractors to adhere to local recruitment policies. Contractors should actively liaise with the Walvis Bay Municipality, local job centres and community groups to identify and recruit potential candidates from Walvis Bay. • Ensure that all contractors comply with national labour laws, including fair wages, working conditions, and non-discriminatory practices. This compliance should be regularly monitored and enforced. • Contractors to provide pre-construction training programmes to equip construction workers with the necessary skills for construction work. This can include basic construction skills, safety training, and specialised skills for operating machinery. • Contractors to implement targeted recruitment strategies to encourage the participation of women in the construction workforce. This includes offering training programmes tailored to women, providing flexible working conditions, and ensuring a safe working environment.	Contractor Procurement Manager	Training materials and attendance registers Local employment requirements incorporated into contractor appointment
		• Promote the involvement of local SMEs by providing them with opportunities to supply goods and services to the construction project. This can include subcontracting work to local construction firms and purchasing materials from local suppliers.	Contractor Procurement Manager	Engagement with local SMEs
		• Conduct comprehensive health and safety training for all construction workers. This should cover the use of personal protective equipment (PPE), safe handling of materials, and emergency response procedures. • Establish a system for monitoring and reporting on the employment of local workers. This should include regular updates on the number of local hires, the types of jobs they are performing, and any training they have received.	Contractor Health, Safety and Environment Manager (monitoring)	Induction materials and attendance register PPE register Reporting on number of local employees
Construction activities	Health and Safety - Exposure to hazards	• Develop, implement and maintain comprehensive health and safety protocols, including regular safety training for all workers. • Ensure the use of personal protective equipment (PPE) for all workers on-site. • Ensure that all workers involved in material transfer are trained in safe handling practices. • Establish designated routes for the transportation of building materials to minimise the risk of accidents.	Contractor Health, Safety and Environment Manager (monitoring)	Induction materials and attendance register PPE register
		• Use covered trucks for transporting materials to minimise dust emissions. • Conduct regular maintenance and inspection of machinery and equipment to prevent malfunctions and accidents. • Clearly mark hazardous areas and restrict access to authorised personnel only. • Implement safe handling practices for the transfer of building materials, including the use of appropriate lifting equipment and techniques.	Contractor Environmental Compliance Officer (monitoring)	Monthly construction reports Monthly inspection reports Vehicle maintenance records
		• Apply dust suppression techniques, such as regular watering of construction areas and roads.	Contractor Environmental Compliance Officer (monitoring)	Monthly inspection reports

Project activity or issue	Potential impact	Mitigating action	Responsible Person	Mitigating action
Archaeology				
Construction Activities	Destruction of undiscovered archaeological heritage	• Engage with the National Heritage Council (NHC) of Namibia regarding the proposed project. • Educate all staff on the provisions of the National Heritage Act 27 of 2004 with regard to the protection of all archaeological sites and the need to report any new finds. • Should a possible or suspected site be discovered (e.g. a grave), immediately stop work, cordon the area off and photograph the area/site; immediately inform the project manager/supervisor, and contact an Archaeologist and the NHC of Namibia. • Should a grave site be discovered, the Namibian Police should be contacted together with the NHC. • Under no circumstances are archaeological and/or cultural heritage sites to be disturbed or any relics to be removed from such a site.	Contractor Environmental Compliance Officer (monitoring)	Induction materials and attendance register Incident Reports

Table 16: Environmental Management Plan – Operational Phase

Project activity or issue	Potential impact	Mitigating action	Responsible Person	Mitigating action
Climate				
Operational activities	Increased GHG emissions	• Ensure that vehicles and machinery utilised are in good working order to minimise carbon exhaust emissions. • Ensure vehicles and generators are used only when necessary. • Use low sulphur diesel.	Operations Manager Health, Safety and Environment Manager (monitoring)	Vehicle maintenance reports Fuel logs
Visual				
Operational activities	Light generation	• Maintain all painted surfaces and repaint regularly (as needed). • Monitor, maintain and where feasible upgrade light sources as new and more efficient technologies become available.	Operations Manager	Maintenance inspections and reports
Air Quality				
Operational activities	Increased emissions	• Keep vehicles in good working order. • Use low sulphur diesel. • Provide personal protective equipment (PPE) to prevent or minimise dust inhalation by employees who may be exposed to dust.	Operations Manager Health, Safety and Environment Manager (Monitoring)	Vehicle maintenance reports Fuel logs PPE register
		• Set up a network of dust gauges to determine dust fallout at areas with intensive activity and also close to sensitive receptors.	Environmental Compliance Manager	Monthly air quality reports
Noise				
Operational activities	Increase in noise emissions	• Should any complaints be received, monitor noise levels within operational areas. Both ambient and occupational exposure levels should be measured and corrective actions implemented to reduce any observed exceedances. • Regularly maintain equipment and machinery to ensure minimum noise levels during operations. • Avoid unnecessary revving of engines and switch off equipment when not required. • Keep internal access routes well maintained and avoid steep gradients. • Where practicable, start-up plant and vehicles sequentially rather than all together. • The movement of plant equipment onto and around the site should have regard to the normal operating hours of the site or surrounding environment. • Audible reversing warning systems on mobile plant and vehicles should be of a type which, whilst ensuring that they give proper warning, have a minimum noise impact on persons outside sites, where possible. When reversing, mobile plant and vehicles should travel in a direction away from sensitive receptors whenever possible. Where practicable, alternative reversing warning systems should be employed to reduce the impact of noise outside sites.	Operations Manager Health, Safety and Environment Manager (monitoring)	Vehicle maintenance reports Routine access route checks
		• Set up and maintain a complaints mechanism for affected parties to voice their concerns. Implement actions to avoid or mitigate their grievances.	Environmental Compliance Manager	Established grievance mechanism

Project activity or issue	Potential impact	Mitigating action	Responsible Person	Mitigating action
Groundwater				
Operational activities	Groundwater Contamination	• Immediately clean up all accidental pollution (oil spills, diesel spills, concrete etc.). • Implement proper pollution control measures to avoid contamination of soil and seepage into groundwater. • Keep all relevant Material Safety Data sheets (MSDS) on site. • Store, transport, use and dispose of chemicals as per the manual / MSDS. • Implement standard procedures to control and minimise surface and groundwater pollution that include: - Maintaining oil traps; - Maintaining bunding of all facilities that store hazardous materials; - Maintaining washing and ablution facilities; - Providing and maintaining solid waste collection facilities; - Providing spill kits and monitor spills; and - Monitoring vehicle oil leaks. • Establishing a regular schedule for groundwater sampling, typically bi-annually, to track changes over time. • Follow standardised procedures for purging and sampling to minimise contamination and ensure accurate results. • Analyse samples for various parameters, including major ions, organic, and hydrocarbons. • Water levels in the boreholes should be monitored monthly. • Analyse collected data and report identified trends, potential contamination events, and compliance with regulatory standards.	Operations Manager Health, Safety and Environment Manager (monitoring) Environmental Compliance Manager	Incident reports Monthly groundwater level database Biannual groundwater analysis reports
Soil				
Operational activities	Hazardous spillage	• Store hazardous substances in appropriately bunded areas. • Use a drip-tray when refuelling vehicles or machinery. • If a spillage occurs, clean it up immediately and dispose soil at an appropriate site, or store on site, as hazardous waste.	Operations Manager Health, Safety and Environment Manager (monitoring)	Vehicle maintenance records Incident reports
Fauna				
Operational activities	Loss / Disturbance of fauna	• No animal may be injured, fed, trapped, hunted or harmed in any way. • Remove and relocate important slow-moving species such as tortoises, chameleon, etc. when serendipitously encountered throughout the proposed development areas. • Prevent and discourage indiscriminate killing of perceived dangerous species (e.g. snakes, etc.) as this would diminish and negatively affect the local fauna. No form of poaching, illegal collecting of veld foods (e.g. bird eggs, etc.), etc. should be tolerated, especially during the construction phase. • Educate/inform contractors and staff on dangerous and protected species to avoid and the consequences of killing and/or illegal collection of such species.	Operations Manager Health, Safety and Environment Manager (monitoring)	Induction materials and attendance register

Project activity or issue	Potential impact	Mitigating action	Responsible Person	Mitigating action
		• Maintain avifaunal deterrents for the evaporation pond. • Record and monitor bird sightings associated with the site.	Operations Manager Environmental Compliance Manager	Maintenance reports Incident reports
		• Initiate a suitable and appropriate refuse removal policy as littering could result in certain animals becoming accustomed to humans and associated activity and result in typical problem animal scenarios	Operations Manager Environmental Compliance Manager	Established waste management plan
		• Remove and relocate perceived dangerous species (e.g. snakes) to similar undisturbed habitats in the general area, when encountered on site. • Avoid all areas, especially rocky areas on the eastern/southeastern boundary, not directly targeted for development infrastructures. • Use only existing tracks/roads when travelling in the area. • Avoid off road driving in areas prone to scarring (e.g. gravel/gypsum/salt plains/flats/pans). Avoid nocturnal driving, as this may result in the destruction of slow-moving fauna – e.g. various reptiles and other nocturnal species. • Avoid and/or limit the use of lights during nocturnal activities as this influence and/or affects various nocturnal species – e.g. especially migrating Palaearctic birds, bats, owls, etc. and contribute to "light pollution". Use focused lighting for least effect.	Operations Manager Health, Safety and Environment Manager (monitoring) Environmental Compliance Manager	Incident reports Groundwater level monitoring reports
Flora				
Operational activities	Loss / Disturbance of flora	• Avoid off road driving in areas prone to scarring (e.g. gravel/gypsum/salt plains/flats/pans) or dominated by lichens. • Prevent and discourage illegal collection of flora as this would diminish and negatively affect the local flora. • Educate/inform contractors and staff on protected species to avoid and the consequences of illegal collection of such species. • Prohibit the use of any pesticides or herbicides.	Operations Manager Health, Safety and Environment Manager (monitoring)	Visual observations/checklists Induction materials and attendance register
Alien Invasive plant species				
Operational activities	Establishment of alien invasive species	• Prevent the planting of potentially alien invasive plant species for ornamental purposes as part of the landscaping should this be thought necessary.	Environmental Compliance Manager	Visual observations/checklists
		• Implement a policy of "no tolerance" towards any invasive alien plant species encountered in future in the area. This should include the removal and destruction of these species throughout the proposed development areas. • Remove and destroy all invasive alien plants encountered in the project area. • Do not use chemicals to eradicate alien spp. but rather conduct manual methods. • Ensure that vehicles accessing the route are free of vegetation, especially if contractors are used which also use their vehicles in urban areas. • Do not plant any invasive alien plant species as part of the landscaping.	Operations Manager Health, Safety and Environment Manager (monitoring) Environmental Compliance Manager	Establishment of a site-specific alien and invasive management plan

Project activity or issue	Potential impact	Mitigating action	Responsible Person	Mitigating action
		• Conduct annual maintenance (alien plant removal) after rainy season	Operations Manager Health, Safety and Environment Manager (monitoring) Environmental Compliance Manager	Bi-annual EMP compliance reporting
Socio-economic				
Operational activities	Increased Traffic	• Implement a traffic management plan to monitor the impact of additional vehicles and minimise congestion within the facility. • Schedule truck movements to avoid peak traffic times and ensure efficient flow, particularly between 08:00 and 17:00 on weekdays (i.e., Monday - Friday). • Implement safety protocols, including speed control measures and clear signage on site. • Conduct regular safety audits and training for truck drivers. • Schedule noisy activities during less sensitive hours to minimise disruption to residents, specifically between 08:00 and 17:00 on weekdays (Monday to Friday). On Saturdays, operations should occur from 07:00 to 13:00. On public holidays and Sundays, operations should be limited, with noise generating activities limited. • Schedule regular maintenance of impacted roads at the site, particularly the current gravel sections, to address wear and tear caused by heavy vehicles. • Promptly repair any road damage at the site to ensure safe and smooth traffic flow during operations.	Operations Manager Health, Safety and Environment Manager (monitoring)	Establishment of a site-specific traffic management plan Induction materials and attendance register Vehicle maintenance records Road inspection and maintenance records
Operational activities	Employment Opportunities	• Implement policies that prioritise hiring from within Walvis Bay, from within the Erongo Region and then within Namibia. Collaborate closely with local job centres, community groups, and educational institutions to identify and recruit qualified individuals. • Where possible, develop strategies to promote gender equality in recruitment and hiring practices. This includes actively encouraging applications from women and implementing policies that ensure fair treatment and advancement opportunities for both genders. Partner with local organisations and initiatives that support women's empowerment and workforce integration. • Where possible, forge partnerships with reputable institutions such as Namibia University of Science and Technology (NUST) to design and implement tailored training programmes. These initiatives should equip Namibian residents, including women, with essential technical and managerial skills crucial for careers in the waste management sector and the circular economy. • Establish structured internship and apprenticeship programmes aimed at providing practical experience to local residents, including recent graduates and students from Namibian educational institutions. • Offer support to ongoing education and certification opportunities to employees participating in the workforce, with a focus on promoting	Human Resources Public Relations Manager	Internal recruitment policies focusing on local employment and promoting gender equality Memorandum of understanding with relevant partnerships Internal policies promoting career development and enhancement

Project activity or issue	Potential impact	Mitigating action	Responsible Person	Mitigating action
		gender balance in training initiatives. This ensures continuous skill development and supports long-term career growth within the sector.		
Operational activities	Health and Safety - Exposure to hazards	• Conduct regular safety training for all workers, focusing on the safe handling of hazardous materials and chemicals and the operation of machinery. • Ensure continuous use of personal protective equipment (PPE) for all workers, including respiratory protection, gloves, and safety goggles. • Implement dust suppression techniques, such as regular watering of operational areas and roads if applicable. • Use covered trucks for transporting waste materials to minimise dust emissions. • Install air quality monitoring stations around the site to manage pollutant levels and ensure compliance with environmental standards. • Perform regular maintenance and inspection of machinery and equipment to prevent accidents and ensure safe operation. • Clearly mark hazardous areas with restricted access and provide appropriate signage and safety barriers. • Develop, implement and maintain comprehensive emergency response plans, including procedures for handling spills, fires, and other emergencies both on site and along transport routes. • Conduct regular emergency drills to ensure readiness and familiarise workers with emergency protocols. • Implement strict protocols for the storage, handling, and disposal of hazardous materials to prevent accidents and exposure.	Operations Manager Health, Safety and Environment Manager	Induction materials and attendance register PPE register Established emergency response and preparedness plan Emergency drills attendance registers
Operational activities	Economic Opportunities	• Where possible, prioritise local suppliers and contractors for services and supplies needed for the facility's operations. • Where possible, invest in community development projects, such as infrastructure, healthcare, and education, as part of the CSR initiatives to improve the wellbeing of local residents. • Support improvements in waste value-chain operations, including sorting at source, recycling, and reuse, to promote sustainability and local economic opportunities.	Procurement Manager Public Relations Manager	Internal policies promoting local suppliers and contractors Internal corporate social responsibility initiatives
Archaeology				
Operational activities	Destruction of undiscovered archaeological heritage	• Educate all staff on the provisions of the National Heritage Act 27 of 2004 with regard to the protection of all archaeological sites and the need to report any new finds. • Should a possible or suspected site be discovered (e.g. a grave), immediately stop work, cordon the area off and photograph the area/site; immediately inform the project manager/supervisor, and contact an Archaeologist and the NHC of Namibia. • Under no circumstances are archaeological and/or cultural heritage sites to be disturbed or any relics to be removed from such a site.	Operations Manager Health, Safety and Environment Manager (monitoring)	Induction materials and attendance register Incident Reports

Table 17: Permitting Requirements

Legislation	Regulatory Authority	Permit/Approval	Contact Details
Nature Conservation Ordinance 4 of 1975 (and amendments) (and the Regulations Relating to Nature Conservation 1976 and the amended Regulations)	Ministry of Environment, Forestry and Tourism (MEFT)	A permit is required prior to the picking, cutting/chopping/picking off, taking, gathering, uprooting, damaging or destroying, or transporting any protected plant.	Mr Johnson Ndokosho Director, Directorate of Forestry Tel: 081-9528544 (Permit Reception) E-mail: johnson.ndokosho@meft.gov.na
Petroleum Products and Energy Act 1990 (and amendments) and the Petroleum Products Regulations 2000 (and amendments)	Ministry of Industries, Mines and Energy (MIME)	Consumer Installation Certificate	Mr Andreas Sheehama Chief Petroleum Inspector Tel: 284 8300 Email: Andreas.Sheehama@mme.gov.na Email: Andreassheehama77@gmail.com
National Heritage Act 27 of 2004 (as amended by the State-owned Enterprises Governance Act 2 of 2006, later re-named the Public Enterprises Governance Act 2 of 2006, and the Abolition of Payment by Cheque Act 16 of 2022 (and the National Heritage Regulations 2005)	Ministry of Education, Arts and Culture	Inform the National Heritage Council of Namibia should any archaeological material be found during the construction/operational phases.	Ms Erica Ndalikokule Acting Director 52 Robert Mugabe Avenue Windhoek Tel: 061-244375 Email: info@nhc-nam.org

Legislation	Regulatory Authority	Permit/Approval	Contact Details
Environmental Management Act 7 of 2007 (and the Environmental Impact Assessment Regulations 2012)	Ministry of Environment, Forestry and Tourism (MEFT), Directorate of Environmental Affairs and Forestry (DEAF)	Environmental Clearance Certificate	Mr Timoteus Mufeti Environmental Commissioner Tel. 081-9528609 (Environmental Affairs Reception) Email: Timoteus.Mufeti@meft.gov.na
Labour Act 11 of 2007 (as amended by the Labour Amendment Act 2 of 2012, the Whistleblower Protection Act 10 of 2017, and the Abolition of Payment by Cheque Act 16 of 2022) (and the Regulations relating to the Health and Safety of Employees at Work 1997, the General Regulations 2008, and the Regulations relating to Domestic Workers 2017)	Ministry of Justice and Labour Relations	Permission is needed to run 12-hour shifts (should it be required)	Ms Kyllikki Sihlahla Labour Commissioner Tel. 061-2066800 Email: Kyllikki.Sihlahla@mol.gov.na
Water Resources Management Act 11 of 2013 (and the Water Resources Management Regulations 2023 and the Regulations relating to appeals to Water Tribunal 2023)	Ministry of Agriculture, Fisheries, Water and Land Reform (MAFWLR)	Water Licenses	Mr Teofilus Nghitila Executive Director/Water and Marine Resources Accounting Officer **Tel:** 061-2087691 Email: ED-TNPA@mawlr.gov.na

Table 18: Monitoring Requirements

Type	Parameter	Frequency
Air Quality	Dust fallout, NO_2, SO_2	Monthly from the onset of construction activities and throughout the life of the facility
Groundwater levels	Groundwater levels	Monthly from the onset of construction activities and throughout the life of the facility, dependent on the conditions of Licenses issued by MAFWLR
Groundwater quality	Groundwater quality (standard parameters, metals, major ions, pesticide and fertilizer traces)	Biannually from the onset of construction phase throughout the life of the facility, dependent on the conditions of Licenses issued by MAFWLR
Consumer Fuel Installation	As per the MIME's conditions to the Consumer Installation Certificate	
Hazardous materials management	Hydrocarbon spills of more than 200 litres	*Ad hoc*; inform the Minister, MIME by completing form PP/11 (Petroleum Products Regulations 2000)
Stormwater and soil erosion	Soil erosion rates	*Ad hoc* (rainy season)
Invasive plant species	Identification, uprooting and destruction of any alien and invasive plants in the site boundaries and along access routes.	Annually from onset of the construction activities and throughout the life of the facility
Environmental Management Plan (EMP)	Implement and observe the EMP; Environmental performance / corrective measures to be taken as or when required	Environmental Monitoring Reports to be submitted to the Directorate of Environmental Affairs and Forestry (DEAF), Ministry of Environment, Forestry and Tourism (MEFT) every six (6) months

9 CONCLUSION

This Environmental Assessment Report will be submitted to the MEFT for review, and for a decision whether to grant or refuse the ECC application.

The way forward for the scoping phase are as follows:

- Submission of final Report to MEFT for review
- MEFT to provide a record of decision
- Notify registered I&APs of the final outcome.

The Environmental Assessment Report is considered to have sufficiently identified the potential impacts associated with the proposed integrated waste management facility. Mitigation measures were identified for the promotion of positive impacts and minimisation of negative impacts, as provided for within the EMP.

Negotiations with the Walvis Bay Municipality are still currently underway to secure service provision for the proposed project. It is recommended that once consent from the Municipal Council has been received, that an assessment of the available municipal water supply be undertaken with consideration of the future demand for the town of Walvis Bay to ensure adequate supply will be available for the project.

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11 CERTIFICATION

This report was prepared and reviewed by the undersigned.

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Approval that this document adheres to Knight Piésold Quality Systems: LL

ANNEXURE A – CV'S

APPENDIX A– CV'S

LLOYD LYNCH (Pr.Sci.Nat)

SENIOR ENVIRONMENTAL SCIENTIST

Lloyd is a Senior Environmental Scientist with 9 years of experience with a focus on aquatic science. He is a registered professional scientist and an accredited DWS: SASS version 5 practitioner. During his career, Lloyd has conducted aquatic specialist assessments across Southern Africa, both for stand-alone assessments as well as scheduled biomonitoring, making use of both SASS and FAII. He has also assisted with a variety of other tasks ranging from public participation consultations, ESIA baseline input, both air and water quality reporting and project management.

Knight Piésold (Pty) Ltd.
South Africa

REGISTRATIONS / CERTIFICATIONS

- SACNASP, South African Council for Natural Scientific Professions, Pr.Sci.Nat, Reg No. 116026
- Department of Water and Sanitation: SASS 5 Accredited Practitioner, 2017, 2020, 2023

SPECIFIC RELEVANT EXPERIENCE

- **uMkhomazi Water Supply Project Phase 1, South Africa:** Senior Environmental Scientist leading biodiversity aspects of the project
- **Kamoa Copper Mine, DRC:** ESIA and ESMP update.
- **Tourism Development at Meob Bay, Namibia:** Undertook the Environmental Impact Assessment (EIA) for the Meob Bay Tourism Development in accordance with the Namibian EIA Regulations of 2012.
- **Mutanda Mining, DRC:** Responsible for the design and implementation of an extensive groundwater and surface water monitoring programme, including analysis of laboratory results, reporting, air quality monitoring, biodiversity assessments and the establishment of rehabilitation trials.
- **Environmental Scoping and Impact Assessment, Waste Management Facilities in Lüderitz and Walvis Bay, Namibia**: Developed environmental and social feasibility studies for two oil & gas management facilities in Walvis Bay and Lüderitz towards submissions for the necessary authorisations with the competent authority.
- **Environmental Support and EIA, Haib Copper Project, Namibia:** The development of feasibility studies for the Haib Copper Project towards development of a project level Environmental Management Programme (EMPr) and submissions for the necessary authorisations and undertaking specialist assessments for the project.
- **Two Rivers Platinum Aquatic Biomonitoring:** Conducted routine aquatic biomonitoring surveys in the Klein, Groot and Dwars rivers.
- **Two Rivers Platinum Financial Provisioning:** Undertook annual reviews of the rehabilitation, monitoring and closure costs associated with the mine and determined annual shortfalls.
- **Tembo Nickel Project Due Diligence:** Undertook a due diligence assessment in line with the IFC Performance Standards for a potential nickel mine in Tanzania.

WORK HISTORY

Company Name	Position	Dates
Knight Piésold (Pty) Ltd, South Africa	Senior Environmental Scientist	Jan 2024 - Present
Knight Piésold (Pty) Ltd, South Africa	Environmental Scientist	2021 - Dec 2023
Knight Piésold (Pty) Ltd, South Africa	Aquatic Scientist	2019 - 2020
Knight Piésold (Pty) Ltd, South Africa	Junior Environmental Scientist	2016 - 2019
University of Johannesburg	Contract Lecturer	2015

EDUCATION

- MSc Aquatic Health, University of Johannesburg, 2014
- BSc Honours, Zoology, University of Johannesburg, 2012
- BSc Zoology and Botany, University of Johannesburg, 2011

SPECIALIZATIONS

- In situ and chemical water quality
- South African Scoring System (Version 5)
- Macro Invertebrate Response Assessment Index (MIRAI)
- Ichthyofaunal identification
- Fish Response Assessment Index (FRAI)
- Habitat assessments

COUNTRIES OF WORK EXPERIENCE

- South Africa
- Democratic Republic of Congo
- Eswatini
- Namibia
- Tanzania

JOSEPH MÜLDERS (Pr.Sci.Nat.)

SENIOR ENVIRONMENTAL SCIENTIST

Joseph Mülders is Senior Environmental Scientist based at Knight Piésold's Sandton office. He has 10 years of experience in the environmental services industry and is a registered Professional Natural Scientist (Environmental Science). Joseph has been involved in social and environmental risk, safeguards assessments and monitoring, spatial classification of socio-economic and environmental systems. He specialises in environmental and social due diligence, impact assessments and risk analysis, environmental monitoring, rehabilitation and offset quantification and design, stakeholder consultation, environmental monitoring and compliance. Joseph has experience in various African countries in terms of delivering projects to international best practice standards focusing on socio-economically sustainable development and management of natural resources.

Knight Piésold (Pty) Ltd.
South Africa

REGISTRATIONS / CERTIFICATIONS

- South African Council for Natural Scientific Professions (SACNASP), Pr.Sci.Nat. Reg No. 115316

SPECIFIC RELEVANT EXPERIENCE

- **Biodiversity Offset Implementation Planning- uMkhomazi Water Project Phase 1, South Africa:** Review, update Biodiversity Offset Report, secure landowner agreements, finalise Biodiversity Offset and Compensation Plan and manage implementation of site-specific interventions and compensation programmes.
- **Project Preparation of DFFE/IUCN/GEF8 Full sized Project, South Africa:** Design of a 5-year full sized GEF 8 project aiming at the restoration and sustainable management of land for improved livelihoods in the degraded landscapes of Free State and Northwest Provinces of South Africa
- **Social Baseline Assessment, KCC, DRC:** Conduct and contribute to social baseline studies, impact assessment and social performance plan
- **ESIA and EMP Review and Update, Kamoa Kakula Copper, DRC:** Review and update the Environmental and Social Impact Assessment (ESIA) as per legal requirements at Kamoa Kakula Copper Project.
- **ESIA Update, Mumi Sulphide Project, DRC:** Update and develop Environmental and Social Impact Assessment (ESIA) as per additional activities at Mutanda Mine DRC.
- **Environmental Control Officer, Middelburg Ferrochrome, South Africa:** Conduct monthly compliance audits against licence and authorisations for dam construction activities at MFC
- **Environmental Scoping and EIA, Waste facilities in Lüderitz and Walvis Bay, Namibia**: Develop environmental and social feasibility studies for two oil & gas management facilities in Walvis Bay and Lüderitz towards submissions for the necessary authorisations with the competent authority.
- **Environmental and Social Due Diligence, Tsumeb Smelter, Namibia:** Conducted an environmental and social due diligence for the Tsumeb Smelter and develop a record of existing and potential social and environmental liabilities currently associated with the Tsumeb Smelter.
- **Environmental Support and EIA, Haib Copper Project, Namibia:** The development of feasibility studies for the Haib Copper Project towards development of a project level Environmental Management Programme (EMPr) and submissions for the necessary authorisations.
- **Water Use License Application, Gamsberg TSF 2, South Africa:** Implement a WULA for the development of TSF for Phase 2 of the Gamsberg Mine in Northern Cape, South Africa
- **Regulatory EIA MMG Kinsevere, DRC:** Develop a regulatory EIA for the Ubuntu Farm Project in Southern DRC.
- **MUMI Biodiversity Offset Plan, DRC:** Development of a Biodiversity Offset Concept Note which provides an outline and rationale for a biodiversity offset and explores the

EDUCATION

- MSc, Environmental Management, University of Pretoria, South Africa, 2015
- BSc (Hons) Environmental Management and Analysis, University of Pretoria, South Africa, 2009
- BSc, Zoology, University of Pretoria, South Africa, 2008

SPECIALISATIONS

- Environmental monitoring
- Rehabilitation and offset quantification design
- Stakeholder Consultation
- Environmental due diligence
- Impact assessments and risk analysis
- Project management

COUNTRIES OF WORK EXPERIENCE

- Namibia
- Malawi
- Mali
- Mozambique
- South Africa
- Uganda

JOSEPH MÜLDERS (Pr.Sci.Nat.)

SENIOR ENVIRONMENTAL SCIENTIST

basic requirements, possibilities, and strategies available for MUMI to undertake a detailed and biodiversity offset plan costed within a frame.

- **DFFE/UNDP/GEF6 Full Sized Project, South Africa:** Developed and implemented the Social and Environmental Risk Management Program. Designed and implemented the project wide integrated monitoring and evaluation plan. Acting Project Manager for 4 months.
- **DFFE/IUCN/GEF7 Full sized Project, South Africa:** Project design and developed the Environmental and Social Management Plan (ESMP).
- **uThukela Water Resource Classification System (WRCS), South Africa**: Coordinated the classification and quantification of socio-economic impacts to communities as linked to changing water allocation scenarios.
- **Loulo, Gounkoto and Morila Gold Mines, Mal**i: Biodiversity Offset, quantifying residual impacts and proposing mechanisms for internalising costs of impacts back into the biodiversity capital value of Mali.
- **Kibali Gold Mine, DRC:** Biodiversity Offset, developed a biodiversity offset based on the past, current and future biodiversity impacts and benefits since the start of operations.
- **Makuya Nature Reserve, South Africa:** Park Management Plan, systems ecologist and spatial planner.
- **Kusile Power Station, South Africa:** Scoping and Basic Assessment, including public consultation and environmental specifications (EAP).
- **Kusile Power Station, South Africa:** Wetland Rehabilitation Strategy, baseline assessment, condition analysis and strategic design.
- **Kusile Power Station, South Africa:** Wetland Offset Strategy, baseline assessment, stakeholder engagement, offset quantification and strategy design.

WORK HISTORY

Company Name	Position	Dates
Knight Piésold (Pty) Ltd, South Africa	Senior Environmental Scientist	July 2023 - Present
South African National Department of Forestry, Fisheries and Environment	Acting Director	2021 - 2023
South African National Department of Forestry, Fisheries and Environment	Deputy Director	2014 - 2021
Prime Africa Consult	Systems Ecologist	Nov 2014 - Nov 2021

lima@iway.na
limamaartens@gmail.com
+264 61 255750
+264 81 2458790
Windhoek, Namibia

Skills

Environmental Scoping
Environmental Impact Assessments
Environmental Management Plans
Environmental Auditing
Environmental and Social Due Diligence & Legal Compliance
Technical Reviews & Proofreading
Project Management
Research & Monitoring

Education And Training

2000
Ph.D.: Fisheries Science
Rhodes University
Grahamstown, South Africa

1992
B.Sc. Hons: Animal Physiology
Stellenbosch University
Stellenbosch, South Africa
1991
B.Sc.: Zoology and Physiology
Stellenbosch University
Stellenbosch, South Africa

1987
Senior Certificate
Windhoek High School
Windhoek, Namibia

Languages
Afrikaans: First Language
English: Proficient

Membership in Professional Bodies

Associate Membership, Institute of Sustainability and Environmental Professionals (ISEP), United Kingdom;
Lead Practitioner and Reviewer, Environmental Assessment Professionals of Namibia (EAPAN);
Full Member, Namibian Chamber of Environment (NCE);
Member, Namibia Scientific Society

Lima Maartens

Summary

I have 32 years of experience in natural resource management, lecturing, environmental science and management, and consulting. Sectors that I worked in as an Environmental Assessment Practitioner include exploration (including offshore oil and gas), mining and quarrying, renewable energy (solar and wind), tourism, manufacturing, agriculture, aquaculture and mariculture, township, property (including medicine storage facilities) and waterfront developments, transport (rail and road), and infrastructure.

Employment Record

LM Environmental Consulting – Environmental Assessment Practitioner
10/2009 – Current; Windhoek, Namibia
Valencia Uranium (Pty) Ltd – Environmental Manager
09/2006 – 09/2009; *Windhoek, Namibia*
De Beers Marine Namibia (Pty) Ltd – Senior Environmental Scientist
01/2004 – 08/2006, *Windhoek, Namibia*
Simonis Storm Securities – Analyst
09/2002 – 12/2003, *Windhoek, Namibia*
University of Namibia – Lecturer
10/2000 – 06/2002, *Windhoek, Namibia*
Ministry of Fisheries and Marine Resources – Fisheries Biologist
01/1993 – 09/2000, *Swakopmund, Namibia*

Additional Skills

Oxford Climate Society, Oxford School of Climate Change: *Completion of the School of Climate Change* (2023 and 2022)
SHEilds Ltd., United Kingdom: *NEBOSH Certificate in Environmental Management* (2018)
NOSA, Windhoek, Namibia: *Applying SHE (Safety, Health, Environment) Principles and Procedures* (2012)
Centre for Environmental Management, Potchefstroom, South Africa: *Introduction to Integrated Waste Management for Environmental Managers* (2009)
Crystal Clear, South Africa: *IEMA Approved Foundation Environmental Auditor* (2006)
Maccauvlei Training & Conference Centre, Vereeniging, South Africa: *Conflict Handling & Negotiation Strategies* (2005)
Centre for Environmental Management, Potchefstroom, South Africa: *Implementing Environmental Management Systems (ISO 14001:2004)* (2005)
University of Stellenbosch Executive Development: *Project Management* (2004)

Publications

I have published five peer-reviewed scientific research articles (and three as co-author), six popular articles (and one as co-author), one book chapter (and one book chapter as co-author), 202 technical reports (LM Environmental Consulting), three technical reports (for De Beers Marine Namibia), and one conference paper.

AMELIA BRIEL (Pr.Sci.Nat)

SECTION MANAGER : ENVIRONMENTAL

Amelia Briel is the Section Manager for the Environmental Section of Knight Piésold South Africa and oversees all projects at a strategic level. She has 21 years' experience in Environmental Management and ESG (Environmental, Social and Governance). She is a registered Professional Natural Scientist (Environmental Science). She previously worked for a government agency responsible for regulatory approvals and was involved in mining authorisations, environmental impact assessments, closure applications and performance audits. She specialises in large-scale Environmental and Social Impact Assessments (ESIAs), stakeholder consultation, Feasibility Studies, environmental and social baseline studies, Mine Closure Plans, environmental monitoring and compliance. Furthermore, she assists mining companies to comply with the Global Industry Standard on Tailings Management (GISTM). Amelia has experience in various African countries in terms of delivering regulatory approvals in line with local requirements and in delivering projects to international best practice standards.

Knight Piésold (Pty) Ltd.
South Africa

REGISTRATIONS / CERTIFICATIONS

- South African Council for Natural Scientific Professions, (SACNASP), Professional Natural Scientist (Pr.Sci.Nat.), Reg No. 114335

SPECIFIC RELEVANT EXPERIENCE

- **Kamoa Copper Mine, DRC:** ESIA and ESMP update.
- **Mutanda Mining, DRC:** ESIA, social baseline studies, environmental baseline studies and monitoring, GISTM Topic II Knowledge Base.
- **Kamoto Copper Company, DRC:** Social baseline studies.
- **Unki Platinum Mine, Zimbabwe:** Closure plan for Tailings Facility.
- **Impala Platinum, South Africa & Zimbabwe:** Emergency response plans for GISTM.
- **Karowe Diamond Mine, Botswana:** GISTM studies related to human rights and socio-economic conditions.
- **Ambatovy Nickel, Mine, Madagascar:** Asset Retirement Obligation (closure cost).
- **Mutanda Mining, DRC:** Conceptual Closure Plan and Cost Model.
- **Jibal Qutman and Hawiah Gold Projects, Saudi Arabia:** Project manager for ESIAs.
- **Closure Plan for mine residue facilities, Zambia:** Risk assessment, land use planning and closure planning.
- **Iduapriem Gold Mine, Ghana:** Environmental, Social and Health Impact Assessment.
- **Bisha Mining Share Company, Eritrea:** Detailed Mine Closure Plan and cost model.
- **Anglo American PLC, Global:** Assessment of the environmental pollution risks associated. with all Mine Residue Facilities in the Anglo-American global operations.
- **MMG Kinsevere, Kinsevere Copper Mine, DRC:** Various ESIAs, Biodiversity Action Plan, Mine Closure Plan and closure cost model, environmental monitoring.
- **AngloGold Ashanti, Siguiri Gold Mine, Guinea:** Environmental feasibility study and Environmental Impact Notice for the Combination Plant Project.
- **Anvil Mining / MMG, Mutoshi Copper Project, DRC:** Artisanal Mining Survey, Environmental, Social Baseline Survey and stakeholder consultation.
- **Anglogold Ashanti, Mongbwalu Gold Project, DRC:** Management plans for the mine's ISO 14001 Environmental Management System, including waste, biodiversity, heritage, soil and land use, noise, air quality, including an emergency and contingency response plan.

WORK HISTORY

Company Name	Position	Dates
Knight Piesold (Pty) Ltd, South Africa	Section Manager : Environmental / Senior Environmental Scientist / Environmental Scientist	Aug 2007 - Present
Gauteng Department of Agriculture, Conservation and Environment	Assistant Director / Principal Environment Officer / Environment Officer	2003 - 2007

EDUCATION

- MSc (Environmental Toxicology), RAU (now the University of Johannesburg), South Africa, 2001
- BSc (Hons) (Zoology), RAU, South Africa, 1998
- BSc (Biological Science), RAU, South Africa, 1997

SPECIALISATIONS

- Large-scale ESIAs
- Stakeholder Consultation
- Mine Closure Planning
- Environmental Monitoring and Compliance
- Project management

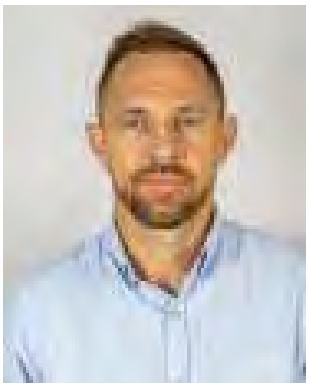
COUNTRIES OF WORK EXPERIENCE

- South Africa
- Namibia
- Eswatini
- Democratic Republic of Congo
- Zambia
- Ghana
- Guinea
- Eritrea
- Tanzania
- Botswana
- Zimbabwe

CILLIERS MOSTERT (Inc. Eng.)

MANAGNG DIRECTOR

Cilliers Mostert has over 25 years' experience in the design, construction, and project management of engineering projects. He joined Knight Piésold in 2012 at the company's Windhoek office in Namibia. He has extensive project management experience in a vast range of engineering projects from design and build to mining projects. He also has extensive on-site experience in civil, structural, mass earthworks and concrete frame projects. He returns to Namibia after having worked in the United Kingdom for over 13 years. Since joining Knight Piésold he has been mainly involved in the project management and design of major mining and infrastructure projects all over Namibia from feasibility to completion stage.



Knight Piésold Consulting (Pty) Ltd., Namibia

REGISTRATIONS / CERTIFICATIONS

- Incorporated Engineer, Namibia No EI2013-08.

SPECIFIC RELEVANT EXPERIENCE

- **Haliburton Walvis Bay, Design and Construction of Liquid Mud Plant**: **Project Manager**, Engineering Designs and Construction of Liquid Mud Plant in Walvisbay Port.
- **Andrada Mining Namibia, Uis Tin Mine: Project Manager**, setting and return water dams and water management.
- **Bannermann Resources, Etango 8 Heap Leach Project: Project Manager,** Definite Feasibility Study for a Uranium heap leach project in Namibia, Estimated Project Value N$ 600 million.
- **Kamoto Copper Company T17 Pit Expansion - Road and River Diversion: Project Manager**, concept designs for a road and river diversion for the expansion of T17 pit in the DRC for, Estimated Project Value N$ 200 million.
- **Lepidico, Karibib Lithium Project: Project Manager**, Infrastructure and Earthworks Construction Design, Hydrology, Geotechnical Investigation, Project Value N$45 million.
- **Rosh Pinah Zinc Mine, Namibia: Project Manager**, Tailings Storage Facility Expansion Construction Management, Design and Site Supervision, Project Value N$80 million.
- **Perkoa Mine Flood Incident, Burkina Faso: Project Manager**, post flood incident investigation, expert report and design of stormwater mitigation measures.
- **Dundee Precious Metals, TSF Starter Wall Construction, Namibia: Project Manager**, design and construction of the TSF starter wall, Project Value N$20 million.
- **Rosh Pinah Zinc Mine, Namibia: Project Manager**, geotechnical support for the new paste plant construction.
- **Namdeb Asset Register, Oranjemund: Project Manager** and Senior Engineer for compiling and verification of Namdeb's asset register to the value of N$35 billion.
- **Oshakati, Namibia: Project Manager** for the design, tender, adjudication and future site monitoring for the deepening and lining of 40 kilometres of the Okatana river system, Oshakati, Stormwater networks for the existing and future town areas of Oshakati and 15 bridges in and around Oshakati to prevent future flooding. Project value N$1.35 billion.
- **Komsberg Farming, Ariamsvlei: Project Manager**, Civil and Structural Design, Construction Monitoring and Supervision for bulk Infrastructure, water and sewer infrastructure and packing and transportation warehouses. Project value: N$300 million.
- **Windhoek, Namibia: Project Manager** for the design, tender and site supervision of the additions and extensions to the Ministry of Justice Building. Project value: N$120 million.

EDUCATION

- National Diploma Civil Engineering, Cape Peninsula University of Technology, 1996
- NVQ Level 4 (United Kingdom) -Construction Contracting Operations – Project Management and General
- NVQ Level 4 (United Kingdom) -Construction Contracting Operations – Health and Safety

SPECIALIZATIONS

- Project Management
- Contract Management
- Infrastructure Design
- Construction & Contract Administration

COUNTRIES OF WORK EXPERIENCE

- Namibia
- United Kingdom
- South Africa
- Angola
- DRC
- Zambia
- Lesotho
- Botswana

CILLIERS MOSTERT (Inc. Eng.)

MANAGNG DIRECTOR

- **Canary Wharf, London, UK: Senior Project Manager** for two major residential and commercial design and build developments: Development 1: 660 High specification apartments consisting out of five reinforced concrete high-rise towers and a single storey basement car park, project value £210 Million. Development 2: 530 High specification apartments, commercial units and a three-storey basement car park, project value of £180 Million. Works included major ground works, sheet and concrete secant pilling, reinforced concrete frames with lift and stair cores with slip form shuttering, envelope works, all mechanical & electrical elements, all fit out works as well as major landscaping works. Delivered turn-key projects to the client 6 months and 8 months respectively ahead of a four and three-and-a-half-year program.

WORK HISTORY

Company Name	Position	Dates
Knight Piésold Consulting (Pty) Ltd., Namibia	Managing Director	2022 - Present
Knight Piésold Consulting (Pty) Ltd., Namibia	Director	2016 - 2021
Knight Piésold Consulting (Pty) Ltd., Namibia	Lead Incorporated Engineer	2012 - 2016
CJ O'Shea Ltd	Senior Project Manager (UK)	2001 - 2011
Keymann Personnel	Project Manager / Resident Engineer (UK)	1998 - 2000
Neill Zaaimann Construction	Site Agent (Cape Town)	1997 - 1998

ANNEXURE B – SCREENING NOTICE

REPUBLIC OF NAMIBIA

Ministry of Environment, Forestry & Tourism

2024-02-05

Dear Lloyd Lynch,

This email serves to inform you that your application **APP-002774** has been verified

Taking the following into considerations:

- Location of the project
- Polution potential
- Scale of operation of the project

Please upload the following documments:

- Scoping Report
- EMP
- Consent letter or support doc from relevant Authority
- Proof of Consultation (Minutes, Newspaper adverts, etc)
- Confirmation of screening notice received (through email) in terms of assessment procedures (Section 35 (1)(a)(b) of the Environmental Management Act, No 7 of 2007)
- Preliminary Site Map with coordinates (decimal degrees) and a Legend
- CV of Environmental Assessment Practitioner (EAP)

ANNEXURE C – WALVIS BAY INTEGRATED WASTE MANAGEMENT, TREATMENT, TRANSFER AND RECOVERY FACILITY PROJECT DESCRIPTION

REG NUMBER: 2014/0032
Sam Nujoma Drive (next to Tony Rust Race Track) | PO Box 30735, Pionierspark, Windhoek, Namibia
Tel: +264 61 244 097 | Fax: +264 88 623 797 | Email: reception@rent-a-drum.com.na
DIRECTORS: CHS J LOUW (CEO, DIRECTOR), ROSA C LOUW (DIRECTOR)

Walvis Bay Integrated Waste Management, Treatment, Transfer and Recovery Facility

Project Description

17 December 2025
Rev 07

RENT-A-DRUM
The Leaders in Waste Management since 1989

REG NUMBER: 2014/0032
Sam Nujoma Drive (next to Tony Rust Race Track) | PO Box 30735, Pionierspark, Windhoek, Namibia
Tel: +264 61 244 097 | Fax: +264 88 623 797 | Email: reception@rent-a-drum.com.na
DIRECTORS: CHS J LOUW (CEO, DIRECTOR), ROSA C LOUW (DIRECTOR)

1. Introduction

1.1 Applicant background and purpose of application

Rent-A-Drum (Pty) Ltd (Rent-A-Drum), which has been operating in the Namibian waste management sector for 36 years was acquired by the Séché Environnement Group (Séché) in 2023. Rent-A-Drum currently offers integrated waste management solutions and has an operational footprint in 6 of Namibia's regions, serving over 2,000 customers and employing approximately 450 full time staff members. Séché, an established French-owned company which has been in operation for 40 years and operates in 16 countries throughout the world is a major player in the circular economy and waste management, decontamination and emergency environmental services sector.

Rent-A-Drum, through its subsidiary, Namwaste (Pty) Ltd (hereafter referred to as Namwaste), aims to develop new industrial waste treatment and disposal facilities in Namibia, which will address the pressing shortage of solutions for industrial and hazardous waste management in the Country and will contribute to the protection of the environment whilst also creating employment opportunities and fostering economic growth. The partnership will make a significant investment in Namibia over the next 10 years, to ensure that hazardous waste is managed in line with international best practice. Rent-A-Drum is aware that oil and gas exploration and production drilling has increased offshore Namibia in the past few years. Activity levels for exploration drilling will have 2-4 active drill rigs in Namibian waters for the next 3 years. Production drilling is set to increase above these levels. It is anticipated that at least 5 drilling rigs will be based in Walvis Bay for the next 5 years drilling at least 40 wells offshore. Should production drilling lead to production; large floating production storage and offloading (FPSOs) will be based offshore to allow oil production. Drilling and production of oil and gas reserves offshore will generate significant quantities of solid and liquid industrial waste with the possibility of hydrocarbon contamination.

Increased production of waste offshore Walvis Bay, existing commercial and industrial uses of the Port and the lack of suitable industrial waste treatment facilities necessitate a private sector solution to manage the waste on-shore, both from off-shore activities and port activities.

Rent-a-Drum's business case is based on receiving a minimum of ~40,000 tons of liquid waste and ~30,000 tons of cuttings (solid waste) generated from 5 drilling rigs operating from Walvis Bay per year. Therefore, there is a need to establish suitable treatment facilities as close as possible to the source of generation.

Séché, through Rent-A-Drum, is committed to using its expertise to develop and implement safe and sustainable solutions for waste management in Namibia. A portion of the investment to be made in the waste management sector will be allocated to the development of the Walvis Bay Integrated

Waste Management, Treatment, Transfer and Recovery Facility offering waste treatment and recovery solutions in Walvis Bay and specifically to the industrial sector in this region.

1.2 Location

Namwaste is proposing to develop an integrated waste management, treatment, transfer and recovery facility in Walvis Bay, Namibia. Walvis Bay is a small port town on the Atlantic Ocean in the Erongo region of southern Namibia. Walvis Bay town is located just north of the Tropic of Capricorn in the Kuiseb River Delta and lies at the end of the TransNamib Railway to Windhoek, and on B2 road. Besides being an export terminal for certain products, there is a small fishing and sealing industry as well as diamond industry.

The proposed site is located on Portion 160 of Remainder of Farm 38, ESE of Walvis Bay and approximately 20 km from the Port entrance, as shown in Figure 1. The proposed site is approximately 78 133 m^2 (7.81 ha) in extent. The corner coordinates of the site are indicated in Table 1.

The nearest residential housing stands exist approximately 15 km West NNE of the site. The landscape is partly exposed rock and sandy lands with little established vegetation typical of the surrounding environment.

The site was selected as a preferred alternative for the project based on several factors including:

1. Land use zoning as industrial;
2. Availability of established plots for similarly zoned industrial activities;
3. Stakeholder consultations, and in particular with the Walvis Bay Municipality; and
4. Access to utilities, main roads and proximity to the port.

Figure 1: Locality map for the proposed Walvis Bay Integrated Waste Management, Treatment, Transfer and Recovery Facility.

Table 1: Coordinates of the proposed Project site.

Corner	Longitude	Latitude
1	14.6185155	-23.0230970
2	14.6209455	-23.0218930
3	14.6223409	-23.0243059
4	14.6197324	-23.0250695
5	14.6196350	-23.0250328

1.3 Industries to be serviced and waste types to be accepted

The facility will largely be tailored to the specific needs of the offshore oil and gas exploration and production (E&P) industry. The E&P industry produces a wide range of industrial wastes in small quantities such as used and redundant chemicals, chemical containers and paints as well as two specific waste streams in large quantities during drilling phases: cuttings and slops. The E&P industry produces two specific waste streams (cuttings (~15% oil, 15% water & 70% solids (rock)) and slops (~10% oil, 80% water & 10% solids (rock)) in large quantities during drilling as well as a wide range of industrial waste such as used and redundant chemicals, chemical containers and paints in smaller quantities. General solid waste and medical waste is also generated by the personnel on the riggs.

In addition, drilling fluids (mud and brine), which are used to aid the drilling of wells, become contaminated with hydrocarbons during the process and require treatment prior to reuse.

1.4 Project activities overview

Project activities will consist of waste management specific activities and supporting / ancillary activities common to industrial sites. Waste management specific activities which will take place on the site include:

- Treatment of cuttings and mud and recovery of hydrocarbons using a Thermo-mechanical Cuttings Cleaner (TCC) or a Thermal Desorption Unit (TDU);
- Treatment of slops in a slops treatment unit (mainly a centrifuge);
- Discharge of treated effluent into the evaporation ponds or the municipal wastewater treatment works;
- Storage of cuttings and slops in suitable, bunded containment facilities;
- Temporary storage of waste (solid and liquid) in suitable, bunded containment facilities;
- Tank and skip washing.

Ancillary infrastructure and supporting activities required to conduct primary activities include:

- Truck depot and Bin yard;
- Stormwater/ run-off management infrastructure for collection and containment of any contaminated water;
- Effluent storage in ponds/dams for evaporation with surface area of 17,000m^2 or discharge into the municipal wastewater treatment works;
- A plant/vehicle washing bay with contaminated runoff control;
- Laboratory to test and verify the classification of incoming and/or treated waste as required;
- Access road (~1.2km) to the facility;
- Access control facilities including perimeter fencing;

- Weighbridges and control room;
- Fuel storage facilities with capacity of 23 000L;
- Water storage tank with a capacity of 200 m^3;
- Back-up generators – 5x 500kVA
- Offices and other administrative buildings;
- Staff dining and ablution facilities;
- Camp for ~50-100 employees;
- Workshops and stores,
- Weather station;
- Utility connections:
    - Electricity connections – connection to municipal supply located approximately 200m from the site. Requirement of 2500 kVA.
    - Water supply from municipal 25m^3 per day.
    - Sewage management – Package sewer plant.

The location of the proposed infrastructure and/or activities are indicated in Figure 2.

Figure 2: Conceptual layout of the facility

1.5 Biodiversity preservation and restoration strategy

The preservation of biodiversity has been one of the Séché Group's core values since its inception over 40 years ago. A dedicated team of ecologists drive sustainable development by linking landscape, biodiversity and environment into all activities of the Group. The development of this approach has evolved over time and Séché is now implementing biodiversity preservation and restoration programs across operations internationally in alignment to its voluntary commitments to Act4Nature.

Biodiversity preservation and restoration will be included in the design and ongoing development and management of the Walvis Bay Integrated Waste Management, Treatment, Transfer and Recovery Facility. Specialist studies are being undertaken as part of the Environmental and Social Impact Assessment (ESIA) and these, together with consultation with experts, will inform the biodiversity strategy for the site. The aim will be to protect, restore and regenerate biodiversity as well as to educate and build relationships / connections to enhance biodiversity protection in the communities in close proximity to the facility.

1.6 Operating Standards

All activities conducted at the facility and associated operations will meet or exceed Good International Industrial Practice (GIIP). The following standards will be met:

- Corporate and project authorizations related to E&P drilling in Namibia;
- World Bank and especially International Finance Corporation (IFC) Performance standards and guidance notes and in particular the IFC's Environmental, Health, and Safety (EHS) *Guidance for upstream oil and gas as well as the EHS guidance for waste management*, and IFC EHS Guidelines, *Environmental, Health, and Safety Guidelines for Offshore Oil and Gas Development;*
- International Petroleum Industry Environmental Conservation Association (IPIECA) and Open Government Partnership (OGP) guidelines and directives, including OGP's Guidelines for *Waste Management – with Special Focus on Areas with Limited Infrastructure;*
- IFC EHS Guidelines, Environmental, Health, and Safety Guidelines for Offshore Oil and Gas Development, 2015;
- Country of operation (laws and regulations of Namibia); and
- Séché Environnement Corporate Policy and directives.

2. Description of Project Activities/Components

The project will be implemented in a phased approach:

- Phase 1- 2027: during the construction of the facility, the site will be used as a transfer station. During this time the slops will be concentrated in the ponds;
- Phase 2 – 2028: the facility will be used for treatment. The slops will be treated to reduce the volume to be transported to the final disposal site; and

- Phase 3 – 2030: the cuttings will be treated to recover the oil and reuse it.

2.1 Waste transport

Slops, cuttings and source separated recyclables from the riggs, and port will be sent to the Namwaste Walvis Bay facility for treatment and sorting. General waste from the riggs and the port will be transported directly to a disposal facility. Medical waste from the riggs will be transported directly to suitable medical waste treatment facilities. The vehicles used and the estimated number of trips per vehicle type is indicated in Table 2.

Table 2: Types of vehicles to be used for the transportation of waste.

Type of vehicle	Number of vehicles per day	Waste stream
Tanker trucks	6	Bulk liquid waste (slops)
Flatbed trucks	6	Containerized cuttings
Skip trucks	2	Solid general and hazardous waste
Super sucker trucks	3	Transfer of liquid waste from the PSV to the tanker trucks, at the port.
Medium duty vehicles (3-5 tons)	4	Solid general and hazardous waste

2.2 Waste acceptance and offloading procedure

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

One 18-m steel-deck weighbridge will be installed at the entrance to the facility. This system will be used to record the mass of all waste loads delivered to the facility. Every vehicle carrying waste destined for treatment at the facility will be weighed before entering the facility and upon leaving the facility.

All arriving waste loads will be inspected by the Lab Technician and/or be subjected to verification analysis for conformance to the TSAS which should accompany the load before it enters the facility. Arriving waste loads will be further evaluated in respect of wastes that are prohibited or restricted. Should there be no notable discrepancies or deviations from the aforementioned criteria, the load will be accepted for processing.

After trucks have been weighed and cleared reception, they will proceed to the bunded offloading area. Bulk liquids will be discharged into bunded storage tanks. Most solids will be containerized in DNV skips or similar and these will be offloaded via forklift.

2.3 Primary waste streams

The primary waste streams and the estimated minimum tonnages of each waste stream to be managed at the facility are provided in Table 3 below.

Table 3: Primary drill waste streams to be managed on site.

Waste streams	Minimum tonnages per month
Cuttings	2,500 tons
Slops	3,500 tons
General Waste	1,200 tons
Source Separated Recyclables	120 tons
Medical Waste	12 tons

2.4 Waste Treatment and Management Processes

The waste will be treated using various treatment processes to recover the re-usable waste. The following main activities will take place on the site:

- Treatment of cuttings and mud and recovery of hydrocarbons using a Thermo-mechanical Cuttings Cleaner (TCC) or Thermal Desorption Unit (TDU);
- Treatment of slops in a slops treatment unit which will include a tricanter, a disk stack centrifuge, tanks for pH correction, coagulation, and flocculation;
- Storage of cuttings and slops in suitable, bunded containment facilities (for treatment on site or transport to a suitable facility for treatment);
- Temporary storage of waste (solid and liquid) in suitable, bunded containment facilities; and
- Tank and skip washing.

The treatment or management method applicable to each waste to be treated or managed at the facility is shown in Figure 3 below.

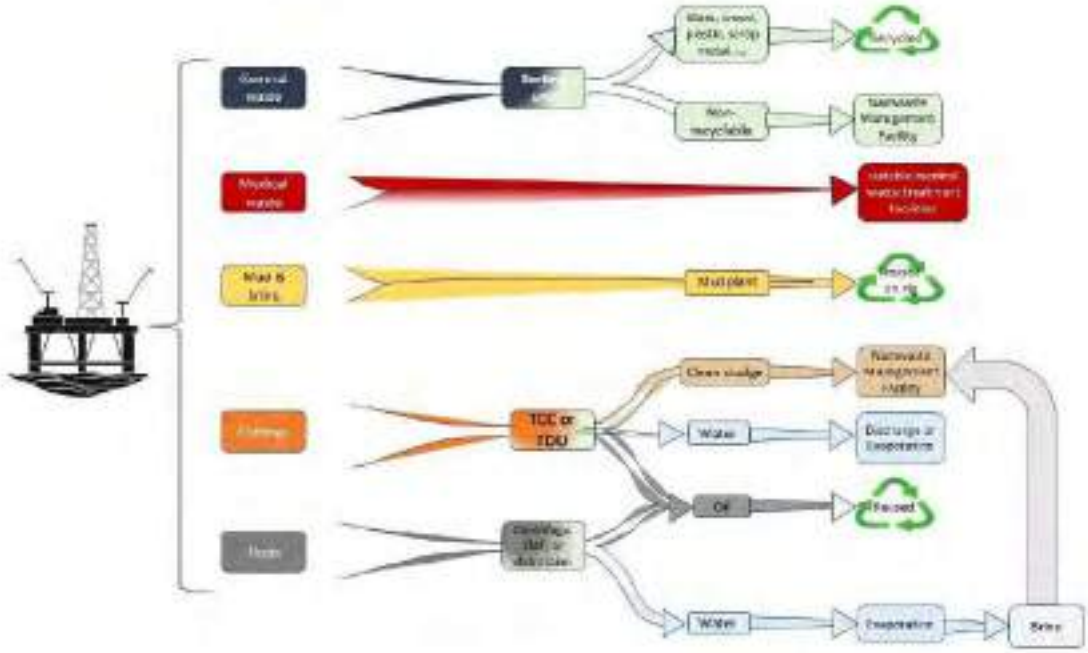


Figure 3: Waste Treatment Process Flow Diagram

2.4.1 Cuttings Treatment

2.4.1.1 Thermo-Mechanical Cuttings Cleaner

Cuttings come containerized from the vessel. The containers are collected on flatbed trucks. Upon clearing the reception of the facility, they will be offloaded by forklift onto a bunded platform. A rotary head forklift will empty the container into a sump or dam, where the cuttings will be homogenized using an excavator as a mixer. The sump or dam will be lined with HDPE over which a sacrificial concrete layer will be cast. The homogenized cuttings will then be put into the TCC for a general drill cutting plant process flow. A general drill cutting plant process flow is shown in Figure 4 below.

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GENERAL DRILL CUTTING PLANT PROCESS FLOW

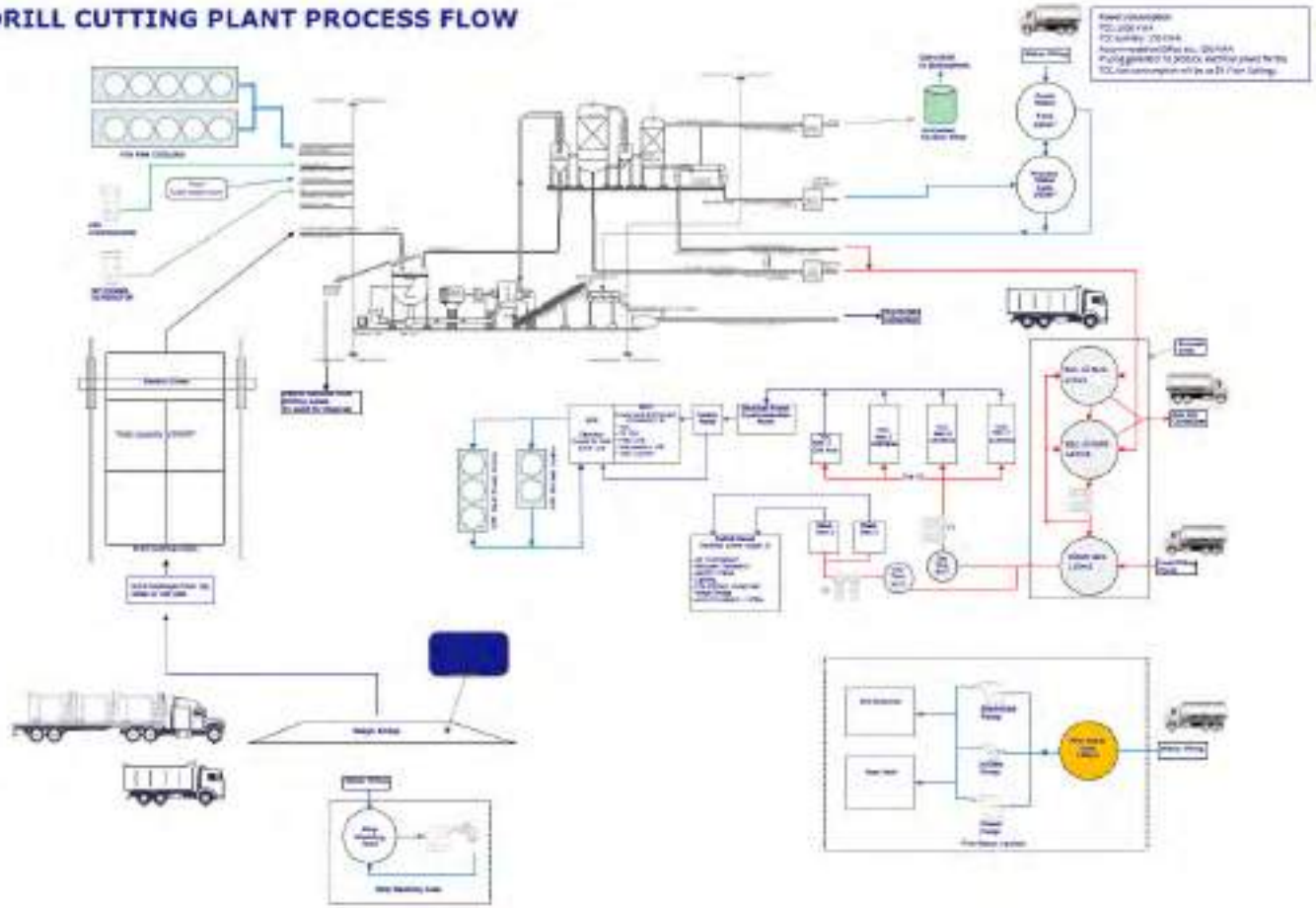

Figure 4: General drill cutting plant process flow

A TCC is considered the least cost and most beneficial unit for treating drill cuttings. The TCC can be described as a hammer mill that uses heat generated by friction to vaporize and then recover hydrocarbon from the cuttings. The unit uses a lower temperature from kinetic energy / "frictional" heat to vaporize the hydrocarbons. This allows for better preservation of the original base oils contaminating the cuttings. Less heat allows for lower energy consumption and is therefore more environmentally friendly.

Recovered base oil is returned to customers and reused in oil-based mud (OBM) or alternatively used for energy. The solid portion of the cuttings will be transported to and disposed of at the proposed Namwaste Management Facility's Class A disposal site, close to Arandis. Recovered water will be used to re-treat solids or can be sent for further industrial uses. The TCC generally has 4-6 tons per hour capacity which results in recovery of 95+% of the base oil. Less than 1% (usually 0.2-0.3%) residual oil content on solids remains.

A general process flow and layout of a cuttings treatment facility is shown in Figure 5 and Figure 6 below.

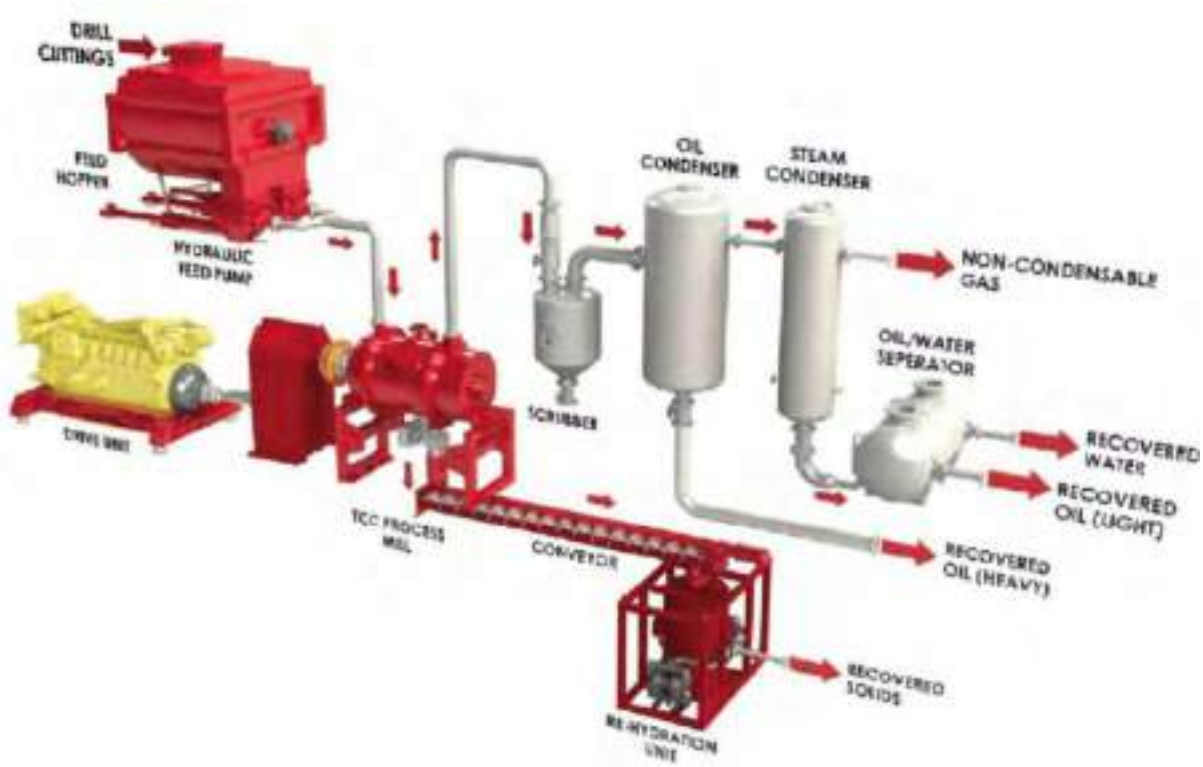

Figure 5: General layout of a cuttings treatment facility

Figure 6: General layout of a Cuttings Treatment Facility

2.4.1.2 Thermal Desorption Unit

A Thermal Desorption Unit (TDU) is a specialized system used for the treatment of drilling cuttings, oil sludge, and hazardous waste material generated during oil exploration, production, refining, and storage. The TDU treats contaminated solids by heating them to temperatures that vaporize the contaminants. It acts on the principle that when heat is applied to waste material, it causes the volatile contaminants to separate from the solids. These contaminants are then captured, condensed, and treated, leaving the cleaned solids behind. TDUs are particularly effective for treating oil-based drill cuttings and other hydrocarbon-contaminated materials.

Drill cuttings are fed into the processing chamber of the TDU, where the rotating heat exchanger (rotor) heats up with cuttings via indirect heat. Indirect heating is accomplished through the circulation of heated oil, as well as by the use of electrical heating elements. The first section of the rotor evaporates water from the cuttings, while the subsequent section evaporates oil from the cuttings at temperatures up to 500 °C. A condenser liquidizes the evaporated water and oil, which then flow into the water/oil separator. The solids are discharged at the end of the process, where they are then cooled and mixed with recovered water to avoid dust emissions when fed into solids containers (skips etc.). The typical thermal desorption process is shown in Figure 7 below.

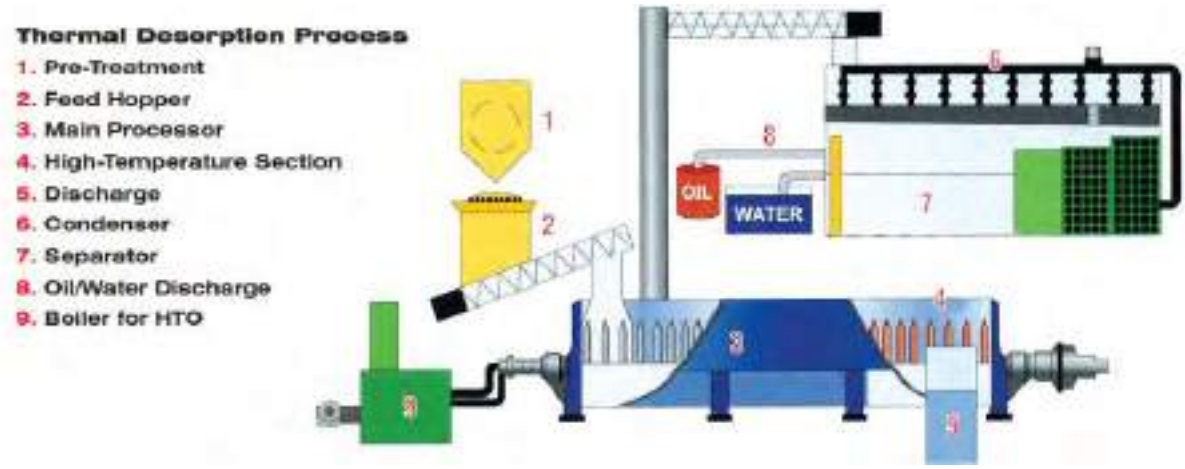

Figure 7: Thermal Desorption Process

2.4.2 Slops Treatment Unit

Slops are generally transferred in bulk from the rig utilizing the Platform Supply Vessel (PSV) tanks. Tanker trucks are used to transfer slops from the PSV tanks to the facility. Upon clearing the reception of the facility, the slops will be discharged into bunded storage tanks via pumps and homogenized.

The slops treatment unit will include various steps of treatment as described below and in Figure 8

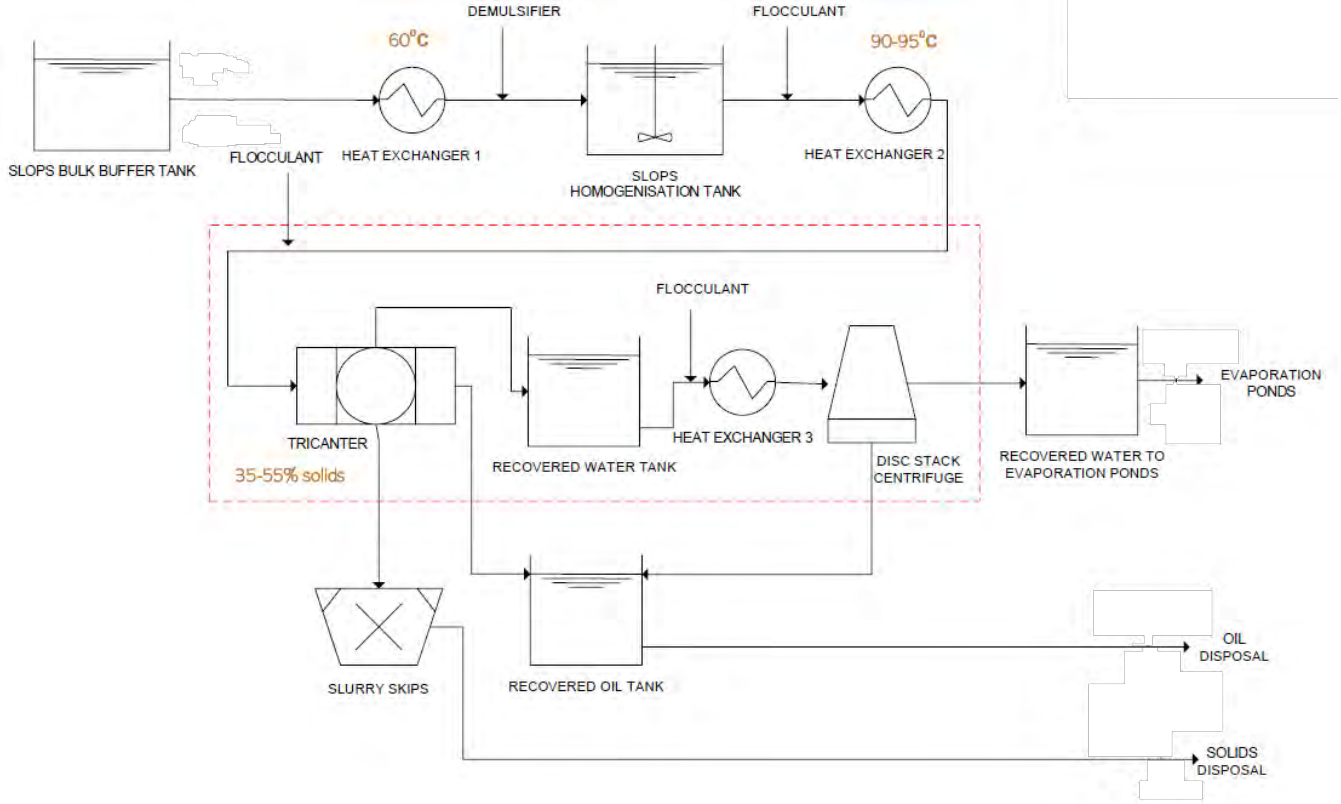

Figure 8:

1. Phase separation using a tri-canter centrifuge to separate hydrocarbons, water and solids. Solids will be discharged for disposal at a suitable landfill. Hydrocarbons will be discharged into a buffer tank for re-use (by others).
2. Chemical pre-treatment such as flocculation, pH correction, coagulation, acid treatment and similar chemical treatments / corrections.
3. Treated effluent will be discharged into the evaporation pond (s) or the municipal wastewater treatment plant.

The process for the slops treatment is discussed in the sections below:

Homogenisation tank and pre-treatment

Since the raw feed is an inhomogeneous mixture, it enters the homogenisation day tank, which is fitted with a slow rotating, low shear agitator. A heat exchanger is installed upstream of the tank, to

heat the incoming effluent from ambient temperature to ~60°C. The heat exchanger used is a shell and tube heat exchanger, best suited for effluent with this level of solids (~10%), and uses steam (at 4 bar(g)) as heating fluid. A boiler is included for the provision of steam at the various points of use.
The selected demulsifier is injected upstream of the tank, into the pre-heated effluent stream. The pre-treated effluent enters the homogenisation tank, where the agitator assists in dispensing the emulsion breaker throughout the slops effluent, and assist in homogenising the effluent prior to downstream treatment. The tank makes provision for a residence time of ~1.5 hours (tank size 8.5 m^3 with freeboard).

Heat exchanger and flocculant dosing
Downstream of the homogenisation tank, the pre-treated effluent enters a heat exchanger, where the effluent is heated from 60°C to 95°C for optimal separation in the downstream separation process. Additional demulsifier is injected upstream of the heat exchanger, and flocculant is injected downstream of the heat exchanger, before going into the downstream separation process. As with the upstream heat exchanger, a shell and tube heat exchanger using steam (at 4 bar(g)) as heating fluid will be used.

Tricanter
The pretreated effluent enters the Tricanter unit, which is the first separation step. The pretreated effluent, after heating, and demulsifier and flocculant injection, enters the Tricanter. The Tricanter is a three-phase separation unit, and separates the slops effluent into a solids fraction, in the form of a sludge, as well as two liquid fractions, the oil and the water. The pretreated slops effluent is fed into the high-speed rotating bowl, through the feed tube, and is accelerated to bowl speed. The solids settle on the inner bowl wall, due to the action of centrifugal force. The solids are scraped off the wall by a scroll armoured with hard metal, which again transport the solids to the solids discharge point. The clarified liquid, as well as the recovered oil, is conveyed to the heavy phase discharge, and the light phase discharge respectively.

The oil removal efficiency of the Tricanter is estimated at 99%, leading to an expected oil content in the recovered water fraction of ~1 000 ppm. The recovered water fraction from the Tricanter will enter a buffer tank, for further treatment downstream. The expected solids content of the recovered water is 5000 – 10 000 ppm. The oil discharge from the Tricanter will enter a buffer tank for disposal (by others). Similarly, the solids/sludge discharge from the Tricanter, will also be disposed of.

Heat exchanger and flocculant dosing
The separated water from the Tricanter enters a buffer tank, from where it is pumped to the secondary separation unit, a Disc Stack Centrifuge. Upstream of the unit, the effluent is heated again to ensure the effluent is at the optimal temperature (75°C - 85°C) for best possible separation. A flocculant is also injected to aid the downstream separation process.

Disk stack centrifuge

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The recovered water is treated further via Disc Stack Centrifuge for the removal of residual oil. The disc stack centrifuge is a type of high-speed centrifuge used to separate liquids and solids or different liquid phases based on their densities.

The preheated effluent (via heat exchanger) enters the disk stack centrifuge, after injection of additional flocculant in-line. An automatic filter is installed in-line, preventing any coarse particles from reaching the bowl and blocking the rising channel within the disc stack. The effluent flows from above into the center of the separator bowl. The heavy water phase is separated from the finest oil particles and is conveyed under pressure by a centripetal pump to the discharge. The separated impurities accumulated in the sludge space are discharged into the sludge tank periodically.

The clean water (product) is monitored by an in-line oil monitor, before being discharged into the product water tank. Should the oil content exceed the required level (5 – 10 ppm), the off-spec product is automatically routed back to the inlet buffer tank, upstream of the heat exchanger. The oil fraction is discharged separately into the oily waste buffer tank.

The Disc Stack Centrifuge is an automatic, self-cleaning unit. The unit is designed based on continuous operation. The unit only needs to be flushed when the unit is stopped. Flushing can be done with water at 75°C. This unit will perform ejections (desludges) continuously to remove the solids from the bowl while in operation to reduce downtime as no opening of the bow etc. is required while operating.

The solids ejection takes place automatically. The desludging frequency depends on the solids loading and therefore depends on the upstream decanter centrifuge efficiency in terms of particle removal. For this application, since the feed to the machine will be the recovered liquid from the Tricanter, the desludging ejection frequency is expected to be > 60 mins. The expected residual oil from the disk stack centrifuge is 5 - 10 ppm.

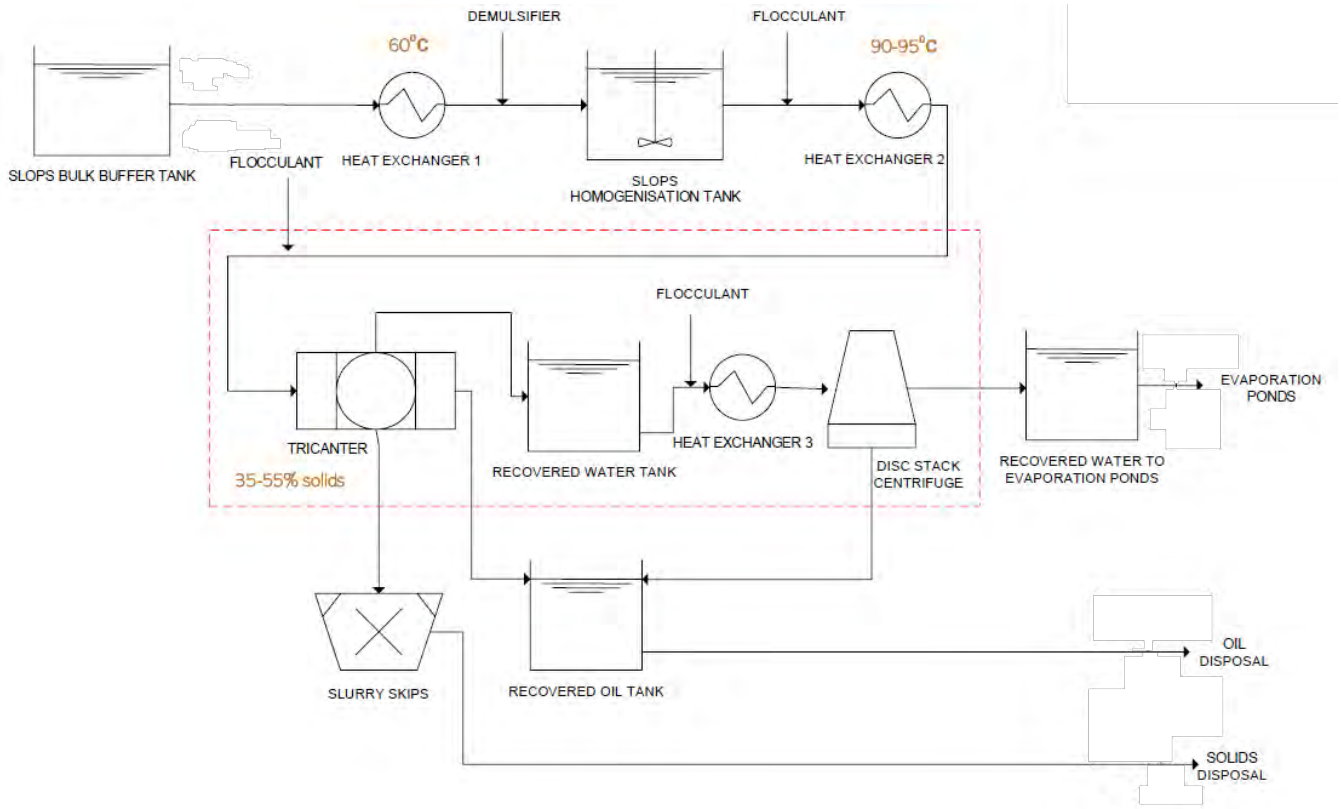

Figure 8: Slops unit process flow

Treated effluent resulting from drilling and produced water is generally limited in reuse by the total concentration of dissolved solids (i.e., salts) and as such the treated effluent will be discharged into the evaporation ponds or the municipal wastewater treatment works.

2.4.3 Temporary storage of waste

The facility will cater for the temporary storage of hazardous and non-hazardous waste. Waste (solids and liquids) will be temporarily stored in suitable, bunded containment facilities on site.

2.4.4 Other containerized wastes

While the primary waste streams generated during the offshore drilling phases are drill cuttings and drilling slops; offshore O&G exploration projects generate a variety of other waste streams in significantly smaller quantities. These include a wide variety of common wastes such as packaging, recyclables, sewage and domestic effluent, scrap metals and similar. In addition to these, there are industrial hazardous waste streams such as used and redundant chemicals, chemical containers and paints.

General waste will be separated into recyclables and non-recyclables at the source. Non-recyclables will be transported for disposal at a suitable landfill. Recyclables will be sorted at the existing Materials Recovery Facility (MRF) in Walvis Bay and will be bailed and transported to suitable recycling facilities. Hazardous waste will be transported for disposal at a suitable landfill.

Once exploration is complete and production occurs, there are additional waste streams that are produced from the production of hydrocarbons. In this case, Namwaste anticipates large volumes of produced water (potentially contaminated with hydrocarbons and salts) as well as tank bottoms which are largely comprised of heavy, long-chain hydrocarbons and other solids.

2.5 Ancillary Infrastructures

The following ancillary infrastructures will be developed on site:

2.5.1 Fuel Storage tanks

The facility will have a fuel storage tank with capacity of 23 000L, of diesel for refuelling of the trucks. The facility will have the following:

- There will be 1 - 2 dispensing points.
- The site will be under 24-hour security, fenced in and gated with access control on a 24-hour basis.
- It will be a double wall tank in accordance with EN12285 standards.
- Spill containment infrastructure, with an oil/water separator will be installed to protect against spillages in accordance with the Ministry of Mines and Energy's requirements.
- The proposed facility will include bund walls and floors with traps to contain spillages which might happen during the handling of diesel.
- The tank will be linked via underground pipes to the relevant fuel dispenser points (curbside pump).
- The curbside pump will be installed over a spill slab with a trap to prevent any spilled diesel from leaching into the soil. The trap sump will be linked to a 3-chamber separator which will collect any spilled diesel for proper disposal.
- The driveway areas will be paved. The tank will be supplied with fuel by road tankers (operated by properly licensed operators and drivers) which will discharge via filler points.

Filling of the tank will be carried out on an "as and when required" basis, but it is envisaged that tanks will require filling on average two times per month.

- A concrete slab will be constructed around the island, under the canopy (around pumps), over the tank and around the filler point.
- The refuelling area is covered by an overhead canopy.
- The entire driveway area, the area surrounding the dispensing points and area below the canopy will be raised by land infill and sloped and landscaped and provided with proper drainage in order not to be subject to storm water damage/flooding.

2.5.2 Tanker and Skip Washing Bay

After off-loading the waste, the tanks and skips will be washed before leaving the site to avoid cross contamination. Contaminated water from the wash bay and workshop area, as well as from the waste treatment facility area will be contained in suitable containment facility.

2.5.3 Stormwater/contaminated runoff management infrastructure

All storage will be bunded. The site will have stormwater diversion to limit and control run-on. Run-off from working areas will be segregated and directed towards ponds/dams for evaporation. Pavements and potentially contaminated areas will have fats, oils and grease (FOGs) separation.

Run-off from non-working areas will be controlled to limit potential for erosion and prevent co-mingling. There will be no uncontrolled discharge from the site.

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

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

- Contaminated water from the wash bay and workshop area, as well as from the waste treatment facility will be contained in suitable containment facilities.

2.5.4 Evaporation Ponds

Treated effluent from the waste treatment process will be discharged into the evaporation ponds on site and left to evaporate, relying on both natural and enhanced evaporation to reduce the water volume sufficiently. The brine from cleaning of the evaporation pond will be pre-treated on site to reduce the water content, prior to disposal to an approved disposal site. The development of two evaporation ponds is proposed to be sized 7 000 m^2 and 10 000 m^2 respectively each with a containment barrier of a 1mm HDPE liner. The evaporation dam will be designed to evaporate 2500m^3/month (with a 30% margin of risk) and a depth of 1 m (below surface), with a freeboard of 0.5m (above surface).

2.5.4.1 Enhanced Passive Evaporation Process

The targeted evaporation from the ponds is 2 500 m^3/month. It was found that this level of evaporation cannot be achieved through natural evaporation alone, and therefore alternatives were investigated for enhanced evaporation. Mechanical surface evaporators are used to increase evaporation from evaporation ponds and have many references worldwide.

Floating units (as shown in Figure 9) have specifically been designed for areas where there is very stringent legislation regarding spray drift and potential negative impacts on the surrounding environment.

The floating units are sprayer-less evaporators, which therefore negates the problems with spray-drift. The unit sucks in fresh, less humid air from above the pond and forces it down into the boundary layer of impoundment surface, sweeping the boundary layer, and enhancing the evaporation rates. The process also causes small waves on the surface of the evaporation dam, thereby increasing the surface area, which means more evaporation surface area enhancing the natural evaporation. For the required evaporation rate for this application, it is envisaged that ~20 units are required.

Figure 9: Floating surface evaporator unit for enhanced evaporation

2.5.5 Site Access

The proposed site can be accessed through the D1983 gravel road from the M36 road. A site access road of approximately 1.2km will be constructed from the existing D1983 as shown on Figure 10.

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Figure 10: Site Access Road

2.5.6 Water Supply

The facility will require approximately 25m³ per day of water. The water supply pipeline will be constructed from the existing Namwater connection point located approximately 2.5km north of the proposed site as shown in Figure 11.

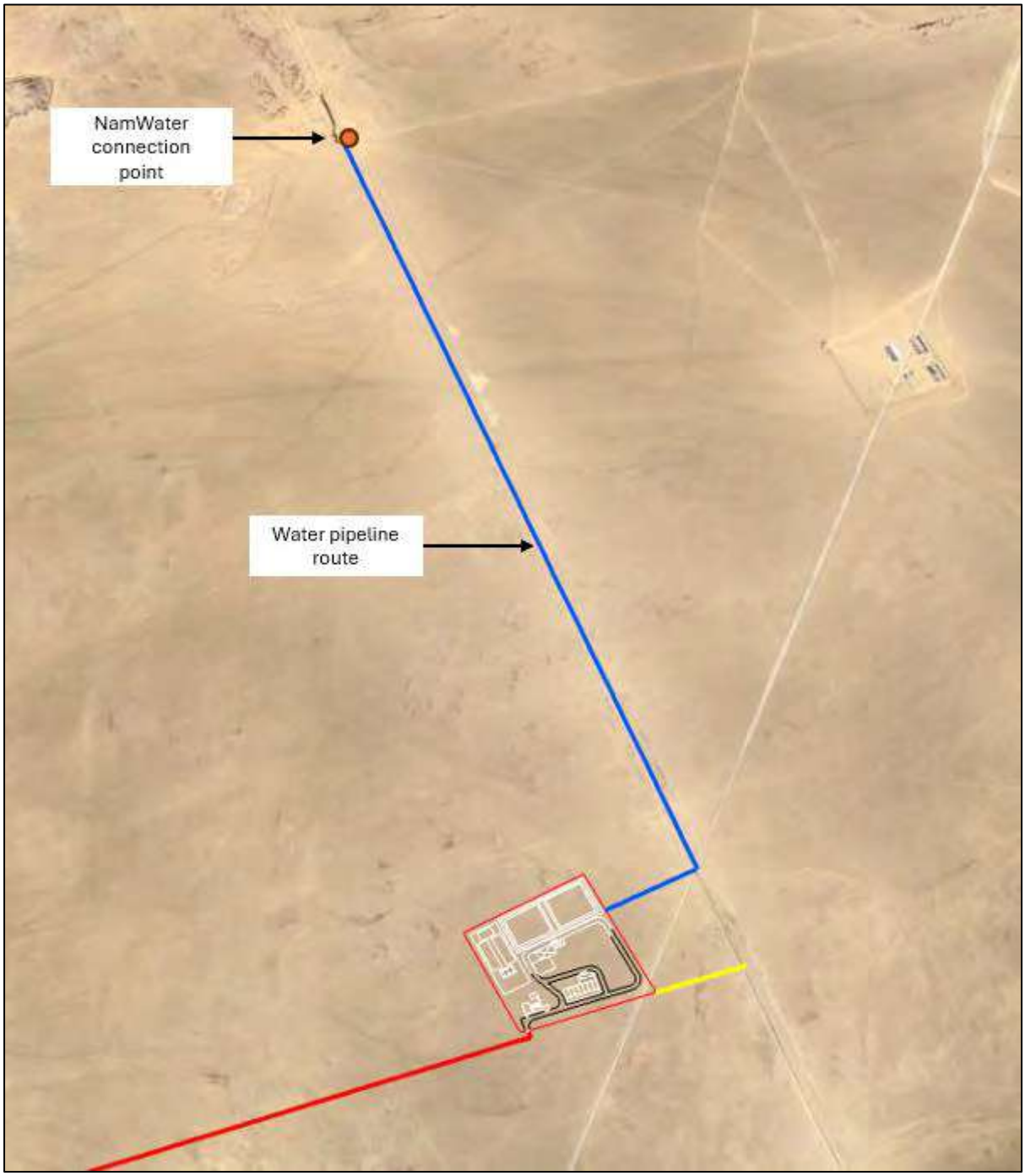

Figure 11: Water Supply route

2.5.7 Electricity Supply

The facility will require a maximum electricity supply of 2500 kVA - TCC + 750 kW Disc Stack centrifuge/Slops treatment process + 110 kW Enhanced Passive Evaporation process for use on site. The electricity will be sourced from the existing connection point located approximately 200m east of the site as shown in Figure 12.

Figure 12: Electricity Supply Route

2.5.8 Sewage Treatment

Sewage will be treated on-site through the sewage package plant, the solid waste will be disposed of at the landfill site and the treated water will be discharged into the environment, depending on the quality or discharged into the evaporation pond or stored in septic tank for transportation and discharge at the municipal wastewater plant.

2.6 Operating hours, staffing, access control and security

There will be no public access to the site. Only authorized and pre-approved transporters will be granted access to the site.

2.6.1 Operating hours

General operations will take place daily from 07h00 am – 17h00 on weekdays (i.e., Monday - Friday). On Saturdays, operations will be conducted from 07h00 am – 13h00. On public holidays and Sundays, operations are limited, and the site is closed. However, due to the nature of O&G operations, treatment plants and similar operations require to be conducted 24 hours per day, 7 days per week schedule. This is specific to the following activities:

1. Collection of waste from the port and return of empty containers to the vessels which will include night travel;
2. Operation of the cuttings treatment unit; and
3. Operation of the Slops Treatment Unit may be required to be operated 24 hours per day.

2.6.2 Staffing

The proposed staffing in terms of types of employment and number of employees is indicated in Table 4.

Table 4: Proposed staffing.

Staff	Number of employees
General manager and deputy	2
HSE supervisor	2
Administrative	3
Laboratory analyst	2
Supervisors	9
Deputy supervisors	6
Yellow plant	6
Mechanical plant	12
Drivers/assistants	36
General workers	18
Total	**96**

2.6.3 Access control and security

The entire facility will be fenced with at least a 2.4m high fence. Security access at gates will be controlled. 24-hour security will be in place at all times.

General operations will take place daily from 07h00 am – 17h00 on weekdays (i.e., Monday - Friday). On Saturdays, operations will be conducted from 07h00 am – 13h00. On public holidays and on Sundays operations are limited, and the site is closed for deliveries.

2.7 Construction and operational timelines

The interim project timelines are provided in Table 5.

Table 5: Provisional Project Timelines.

Timeline	Activity
August 2025 - December 2025	ESIA
September 2026 – September 2027	Construction • Fencing of the area • Earthwork to level the terrain • Connection to water, electricity and sewage networks • Civil engineering • Equipment assembly
September 2027 – December 2028	Commence with site commissioning
January 2029	Commence with site operations

ANNEXURE D – SOCIAL IMPACT ASSESSMENT

WALVIS BAY - INTEGRATED WASTE MANAGEMENT, TREATMENT, TRANSFER, AND RECOVERY FACILITY:

SOCIAL IMPACT ASSESSMENT

MAY 2026

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PROJECT NAME	Walvis Bay - Integrated Waste Management, Treatment, Transfer, and Recovery Facility: Social Impact Assessment
STAGE OF REPORT	Draft 1 August 2024 Draft 2 September 2024 Final May 2026
CLIENT	Knight Piésold (Pty) Ltd. P.O. Box 86062 Eros, Windhoek Namibia
LEAD SPECIALIST	Heidri Bindemann-Nel
DATE OF RELEASE	May 2026
CONTRIBUTORS TO THE REPORT	Ernst Simon

DECLARATION

I, Heidri Bindemann-Nel, hereby declare that I do:

(a) have knowledge of and experience in conducting assessments (my area of expertise), including knowledge of the Act, these regulations, and guidelines that have relevance to the proposed activity;

(b) perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;

(c) comply with the Act, these regulations, guidelines, and other applicable laws, as relevant to my area of expertise.

I also declare that there is, to my knowledge, no information in my possession that reasonably has or may have the potential of influencing –

(i) any decision to be taken with respect to the application in terms of the Act and the regulations; or

(ii) the objectivity of this report, plan, or document prepared in terms of the Act and these regulations.

Signed: _____

Heidri Bindemann-Nel

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Abbreviation:	Description:
CPP	Coastal Precast & Paving
CSR	Corporate Social Responsibility
DAFU	Dissolved Air Flotation Unit
E & O	Exploration and Production
ECC	Environmental Clearance Certificate
EHS	Health, and Safety
EIA	Environmental Impact Assessment
EMIS	Educational Management Information System
EMP	Environmental Management Plan
ERC	Erongo Regional Council
ESA	Environmental Scoping Assessment
ESIA	Environmental, Social Impact Assessment
FENATA	Federation of Namibian Tourism Associations
GDP	Gross domestic product
GIIP	Good International Industrial Practice
GRN	Government of the Republic of Namibia
GFCF	Gross Fixed Capital Formation
HDPE	High-density polyethylene
HW	Household Waste
I&Aps	Interested and Affected Parties
IFC	International Finance Corporation
IWMF	Intergraded Waste Management Facility
MoHSS	Ministry of Health and Social Services
MRF	Material Recovery Facility
Nacoma	Namib Coast Biodiversity Conservation and Management
NHIES	Namibia Household Income & Expenditure Survey
NIDS	Namibia Inter-censal Demographic Survey
NSA	Namibia Statistic Association
NUST	Namibia University of Science and Technology
OBM	Oil-Based Mud
OGP	Open Government Partnership
OSHA	Occupational Safety and Health Administration
O&G	Oil and Gas
PSV	Platform Supply Vessel
RoN	Republic of Namibia
RFA	Road Fund Administration
SADC	Southern African Development Community
SEA	Strategic Environmental Assessment
SIA	Social Impact Assessment
TCC	Thermo-mechanical Cuttings Cleaner
TSA	Tourism Satellite Account

1 INTRODUCTION

This Social Impact Assessment (SIA) has been prepared for the proposed Walvis Bay Integrated Waste Management, Treatment, Transfer and Recovery Facility (IWMF). The facility will be developed by Namwaste (Pty) Ltd, a subsidiary of Rent-A-Drum and part of the Séché Environnement Group, an international leader in waste management and circular economy solutions. It will be Namibia's first large-scale industrial and hazardous waste management facility, strategically located to serve the emerging offshore oil and gas sector as well as existing industries and the Municipality of Walvis Bay.

The SIA has been undertaken by Urban Dynamics Africa (Pty) Ltd, who were appointed by Knight Piésold Consulting (Pty) Ltd, the Environmental Assessment Practitioner (EAP) for the project, to conduct the social component of the assessment.

The purpose of this SIA is to identify, assess, and manage the potential social impacts of the project during its construction, commissioning, and operation, while also exploring opportunities to enhance socio-economic benefits. The assessment specifically considers the effects of the project on communities in Walvis Bay and the surrounding areas, and proposes measures to mitigate adverse impacts while strengthening positive outcomes such as job creation, training, and local business development. It further ensures compliance with Namibian legislation, municipal planning frameworks, and Good International Industry Practice (GIIP), while supporting transparent and inclusive stakeholder engagement to promote accountability in decision-making.

For clarity and ease of reference, the report is structured into four main components:

- **Project Location** – Geographic and administrative context, site surroundings, and environmental setting
- **Project Overview** – Description of the proposed facility, its infrastructure, and activities.
- **Socio-Economic Profile** – Presents baseline information on demographics, economic activities, and social dynamics in the Walvis Bay Rural and Walvis Bay Urban constituencies of the Erongo Region.
- **Perceived Impacts** – Summarises key issues raised during stakeholder consultations and reflects on experiences from comparable Integrated Waste Management Facilities (IWMFs).
- **Assessment of Anticipated Impacts** – Evaluates the potential social impacts of the project, considers mitigation measures, and outlines recommendations for inclusion in the Environmental Management Plan (EMP).

2 LEGAL AND REGULATORY ENVIRONMENT

The proposed facility is subject to a wide range of legal, regulatory, and policy frameworks at national, regional, and local levels. These instruments guide sustainable development, environmental protection, and social accountability in Namibia.

Figure 1 provides a summary of the key legislation, standards, and policies applicable to the project, highlighting their provisions and implications for the facility.

Table 1: Legislative and Policy Framework Relevant to the Proposed Facility

Legislation/Standard/ Policy	Provisions	Project Implications
The Constitution of The Republic of Namibia, 1990	Article 95 mandates the sustainable use of natural resources and environmental protection.	Uphold environmental protection and sustainable development principles.
Environmental Management Act, 2007 (Act No. 7 Of 2007)	Establishes the framework for environmental management, including Environmental Impact Assessments (EIAs) and public participation (Section 27). Provides detailed regulations for conducting EIAs, including requirements for public participation. Under the Environmental Management Act, mandates stakeholder engagement and consultation with Interested & Affected Parties (I&APs) during the EIA process.	Obtain an environmental clearance certificate; evaluate social and environmental impacts; ensure public participation. Conduct thorough public consultations during the EIA process. Engage stakeholders and consult with I&APs, ensuring public participation and addressing concerns throughout the EIA process.
The Environmental Management Act, 2007 (Act No. 7 Of 2007) Associated Regulations Of 2012	Listed activities that require an Environmental Clearance Certificate before starting, ensuring significant impacts are assessed.	Assess and mitigate significant social and environmental impacts; involve public consultation. Listed activities include Waste management and water resource management.
Environmental Management Act No. 7 Of 2007 Sia Guidelines.	Part of the EIA process; evaluates the social consequences of projects, ensuring potential impacts on communities are considered and addressed.	Conduct an SIA to evaluate and mitigate social impacts, involving inclusive and comprehensive public consultation.
Walvis Bay Zoning Plan & Structure Plan	Emphasises public consultation and stakeholder engagement, ensuring community interests are considered in local waste management by-laws.	Adhere to local regulations; involve the community in project planning; transparently address feedback and concerns.
Urban And Regional Planning Act, 2018	Governs urban and regional planning, ensuring sustainable development and orderly land use.	Ensure sustainable and orderly planning of the facility, considering the social impact on local communities.

Legislation/Standard/ Policy	Provisions	Project Implications
Local Authorities Act, 1992	Provides for the management of local authorities, including town planning and development, with a focus on transparency and community involvement.	Comply with local authority regulations; address community feedback; ensure transparency in decision-making processes.
Public And Environmental Health Act No. 1 Of 2015	Regulates nuisances that can impact public health and the environment.	Implement measures to protect public health and safety, particularly in waste management.
Hazardous Substances Ordinance, 1974 (Ordinance No. 14 Of 1974)	Regulates the control of hazardous substances, including their manufacture, importation, sale, and use. It classifies substances based on their potential hazards and sets requirements for handling and transportation.	Classify hazardous substances accordingly, and ensure compliant handling and transport procedures.
Road Traffic and Transport Act, 1999 (Act No. 22 Of 1999)	Governs the transport of goods on Namibian roads, including hazardous waste. Specifies vehicle requirements, including appropriate signage, driver qualifications, and safety measures.	Ensure vehicles and drivers comply with the specified requirements for hazardous waste transport.
Occupational Health and Safety Regulations, 2007	Addresses worker safety in the handling and transport of hazardous waste. Sets out requirements for personal protective equipment (PPE), training, and emergency procedures to minimise risks.	Provide appropriate PPE, ensure staff training, and implement emergency procedures to protect workers.
Namibia Standards Institution (NSI) Standards	NSI has developed standards related to the transport of hazardous materials, including packaging, labelling, and safety measures, aligned with international best practices.	Adhere to NSI standards for packaging, labelling, and safety during hazardous waste transport.
Water Resources Management Act, 2013, And 2023 - Effluent Discharge Regulations	Requires permits for the discharge of effluents into the environment to ensure they meet environmental standards for water resources and ecosystems protection. The 2023 regulations provide updated guidelines for effluent management.	Obtain necessary effluent discharge permits; ensure compliance with water quality standards to prevent environmental contamination.
Namibian Civil Aviation Regulations (Nam-Cars), Government Notice 1 Of 2001 (Gg 2467)	Establishes the framework for aerodrome safety, obstacle limitation, and other aviation-related considerations in the context of surrounding land use.	Ensure compliance with aerodrome safety regulations; address any potential conflicts with aviation operations due to the proposed facility's location

3 LOCALITY OVERVIEW

This section provides the geographic and administrative context of the Erongo Region and situates the proposed IWMF within its local setting. It describes the region's economic importance, outlines the project site, and highlights surrounding land uses, nearby receptors, and climatic considerations relevant to the Social Impact Assessment (SIA).

3.1 GEOGRAPHIC AND ADMINISTRATIVE OVERVIEW

The proposed IWMF will be located within the Erongo Region, one of Namibia's most economically diverse and rapidly growing regions. Erongo is bordered by Kunene to the north, Hardap to the south, and Otjozondjupa and Khomas to the east, with the Atlantic Ocean forming its western boundary. Administratively, the region is divided into seven constituencies: Swakopmund, Walvis Bay Urban, Walvis Bay Rural, Arandis, Daures, Karibib, and Omaruru. Figure 1 shows the Erongo Region and the position of Walvis Bay within this broader regional setting.

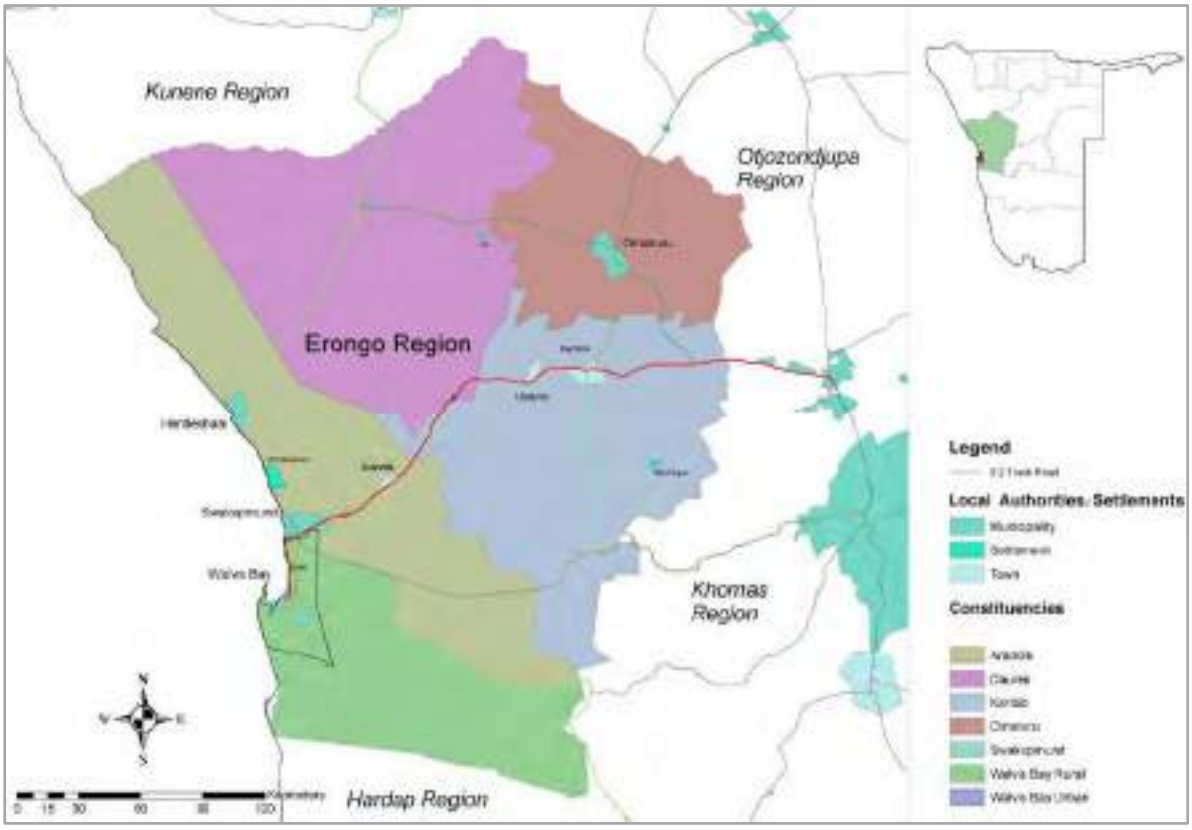

Figure 1: The Erongo Region

The region hosts several municipalities and town councils, including Walvis Bay, Swakopmund, Arandis, Omaruru, Henties Bay, Karibib, and Usakos, as well as settlement areas such as Uis, Okombahe, and Otjimbingwe, governed by the Erongo Regional Council. The Port of Walvis Bay plays a nationally strategic role, serving as Namibia's primary logistics hub and connecting the country and neighbouring Southern African Development Community (SADC) states to international markets via the B2 trunk road and major corridors such as the Trans-Kalahari, Trans-Caprivi, and Trans-Cunene.

3.2 PROJECT SITE

The proposed IWMF will be located on Portion 160 of the Remainder of Farm 38, approximately 20 km east of the Port of Walvis Bay, southeast of the M36 road and east of the D1983 road, within the Walvis Bay Rural Constituency. The site covers 7.8 hectares (78,133 m²) and is currently zoned as "undetermined" under the Walvis Bay Zoning Scheme, although it has been earmarked for industrial development.

Figure 2 shows the project area within Walvis Bay, while Figure 3 provides a more detailed view of the site locality.

Figure 2: The Project Area within Walvis Bay (KP, 2024)

Source: (Rent A Drum, 2025)

The surrounding area is characterised by industrial lease activities, including the Walvis Bay oval track, King Charcoal factory, CPP Quarry, and BC Stone operations. The physical environment consists of sandy and rocky terrain with sparse vegetation typical of the central Namib coastal plain.

According to the project description (2025), the nearest existing residential housing stands are located approximately 15 km to the west-north-northeast of the site. However, a key receptor for future social impacts is the Green Valley Township, located approximately 2 km northwest of Portion 160. Once fully developed, this mixed-use residential and commercial development is expected to accommodate several thousand households.

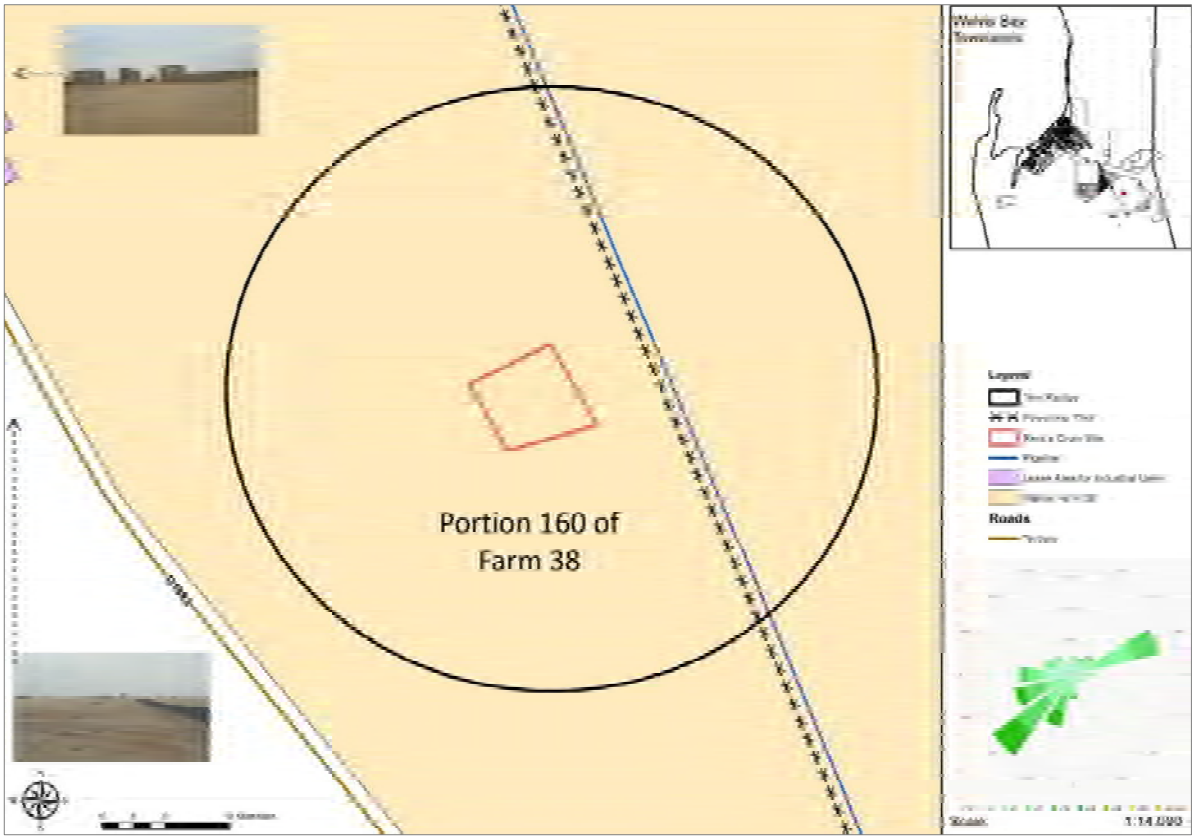

Figure 3: Site Locality

The site is influenced by the coastal desert climate of central Namibia, where prevailing winds are predominantly south-westerly, with average annual speeds of 4–6 m/s and seasonal peaks of higher intensity. These winds typically blow inland across the coastal plain, influencing the potential for dust dispersion, odour transport, and air quality impacts in surrounding areas. The wind rose for Walvis Bay in Figure 3 confirms the dominance of south-westerly winds throughout the year, with less frequent winds recorded from the north and east. Most winds occur in the 4–6 m/s range, with seasonal peaks of higher intensity occurring less frequently, predominantly associated with strong south-westerly wind events.

4 FACILITY OVERVIEW

This section provides an overview of the proposed Walvis Bay Integrated Waste Management, Treatment, Transfer and Recovery Facility (IWMF) to be developed and operated by Namwaste (Pty) Ltd, a subsidiary of Rent-A-Drum. The description is based on the Project Description Rev 07 (December 2025) and outlines the facility layout, industries to be serviced, waste streams to be managed, infrastructure to be developed, and operational arrangements.

4.1 INDUSTRIES TO BE SERVICED AND WASTE TYPES TO BE ACCEPTED

The facility is primarily designed to service the offshore oil and gas exploration and production (E&P) industry operating from the Port of Walvis Bay. This industry generates substantial volumes of drill cuttings and drilling slops, which require specialised treatment to recover hydrocarbons and ensure environmentally compliant disposal.

In addition to drill cuttings and slops, offshore E&P activities generate smaller quantities of other industrial and hazardous waste streams, including:

- Used and redundant chemicals;
- Chemical containers and paints;
- Drilling fluids (mud and brine) contaminated with hydrocarbons.

General solid waste and medical waste generated offshore and at the port will not be treated at the IWMF. These waste streams will be transported directly to appropriately licensed off-site facilities for disposal or treatment in accordance with Namibian regulatory requirements. Source-separated recyclables will similarly be handled off-site through existing materials recovery and recycling facilities

The estimated minimum monthly waste quantities associated with the project are presented in Table 2.

Table 2: Primary Waste Streams to be Managed

Waste Stream	Minimum Tonnages Per Month
Cuttings	2,500 tons
Slops	3,500 tons
General Waste	1,200 tons
Source-Separated Recyclables	120 tons
Medical Waste	12 tons

Source: (Rent-A-Drum, 2025).

4.2 INFRASTRUCTURE

The Walvis Bay IWMF will comprise purpose-built waste treatment units supported by ancillary infrastructure required to ensure safe, efficient, and environmentally compliant operations.

4.2.1 Core Treatment Infrastructure

The main waste treatment infrastructure will include:

- A Thermo-Mechanical Cuttings Cleaner (TCC) or alternatively a Thermal Desorption Unit (TDU) for the treatment of drill cuttings and recovery of hydrocarbons;
- A dedicated slops treatment unit, incorporating tricanter and disk stack centrifuge technology;
- Temporary storage of waste (solid and liquid) in suitable, bunded containment facilities;
- Tank and skip washing facilities integrated into routine operations.

4.2.2 Supporting and Ancillary Infrastructure

Supporting infrastructure will include:

- Truck depot and bin yard;
- Stormwater and contaminated runoff management systems;
- Evaporation ponds with a combined surface area of approximately 17,000 m² (7,000 m² and 10,000 m² ponds), fitted with HDPE liners, with enhanced passive evaporation units; alternatively, treated effluent may be discharged to the municipal wastewater treatment works subject to approval;
- Plant and vehicle washing bays with runoff containment;
- Laboratory facilities for waste testing and classification;
- Weighbridge and control room;
- Fuel storage facility with a capacity of approximately 23,000 litres of diesel;
- Water storage tank with a capacity of approximately 200 m³;
- Five (5) 500 kVA backup generators;
- Workshops and storage areas;
- Administrative offices, staff dining, and ablution facilities;
- Perimeter fencing, access control, and 24-hour security;
- On-site accommodation camp for approximately 50–100 employees.

Utility connections will include:

- The facility will require a maximum electricity supply of 2500 kVA - TCC + 750 kW Disc Stack centrifuge/Slops treatment process + 110 kW Enhanced Passive Evaporation process for use on site;
- Municipal water supply of approximately 25 m³/day;
- On-site package sewage treatment plant for sewage management.

A conceptual layout of the facility is shown in Figure 4**.**

Figure 4: Concept Facility Layout Plan

Source: (Rent-A-Drum, 2025).

4.3 WASTE TREATMENT AND MANAGEMENT PROCESSES

Waste received at the IWMF will undergo specialised treatment processes designed to recover reusable hydrocarbons and ensure that residual waste is managed in accordance with Namibian legislation and Good International Industry Practice (GIIP).

4.3.1 Drill Cuttings Treatment

Drill cuttings will be treated using either a TCC or a TDU, which separate hydrocarbons from the solid fraction through thermal or thermo-mechanical processes. Recovered base oils will be returned for reuse or alternative approved applications. Treated solids with low residual hydrocarbon content will be transported to a licensed disposal facility

4.3.2 Slops Treatment

Slops will be treated in a dedicated unit using:

- Tricanter centrifuges for three-phase separation (oil, water, solids);
- Chemical pre-treatment (pH correction, coagulation, flocculation);
- Disk stack centrifuges for secondary polishing of treated water.

Recovered hydrocarbons will be stored for off-site reuse or disposal by others, while solids will be disposed of at approved facilities. Treated effluent will be discharged to evaporation ponds or, subject to approval, to the municipal wastewater treatment works.

Drill cuttings and slops will be stored in suitable bunded containment areas before and after treatment to prevent spills and environmental contamination. Wash water from tank and skip washing operations will be captured and managed through the facility's effluent system.

Overall waste handling and treatment processes are shown in Figure 5, 6, and 7.

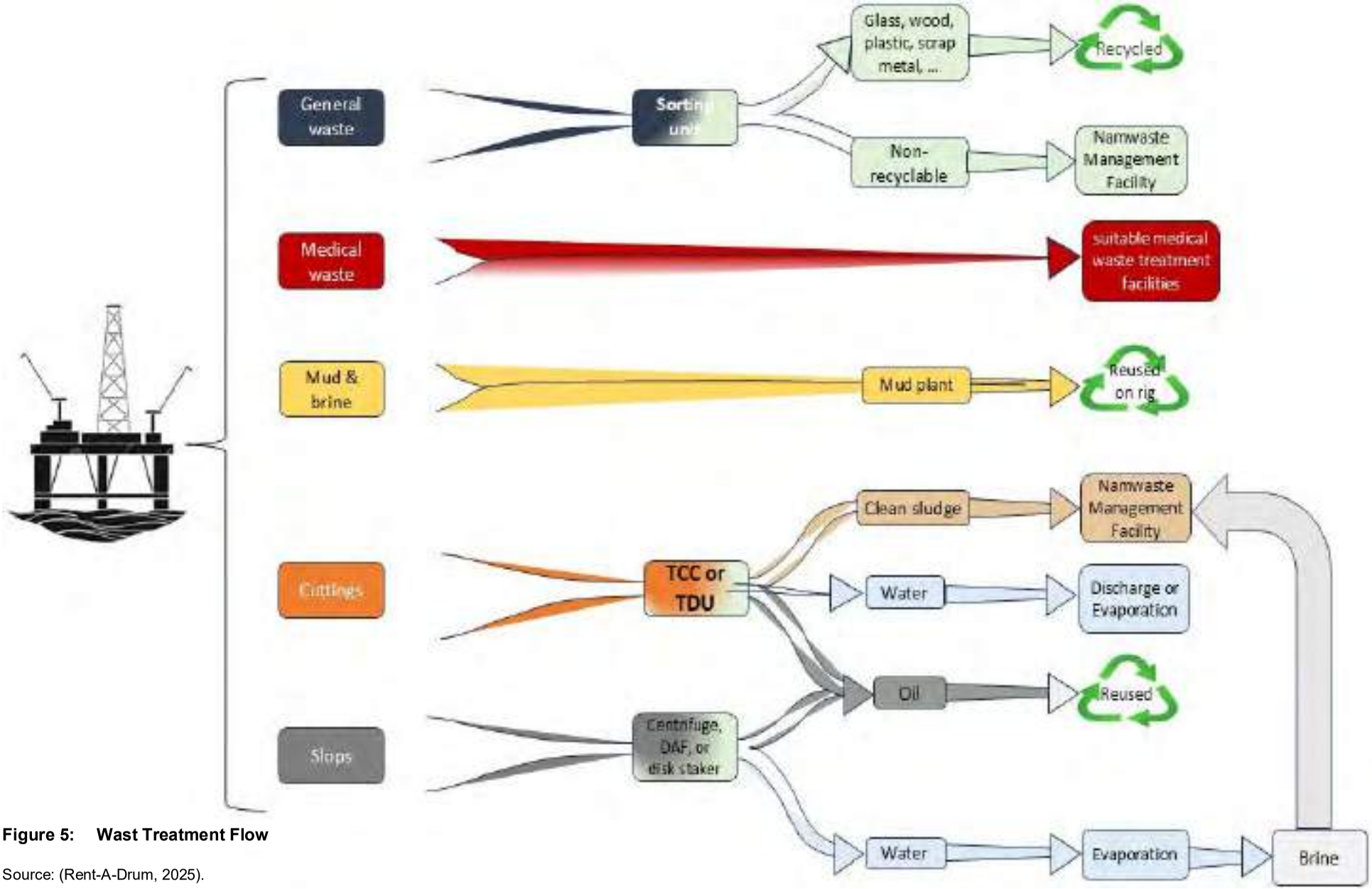

Figure 5: Wast Treatment Flow

Source: (Rent-A-Drum, 2025).

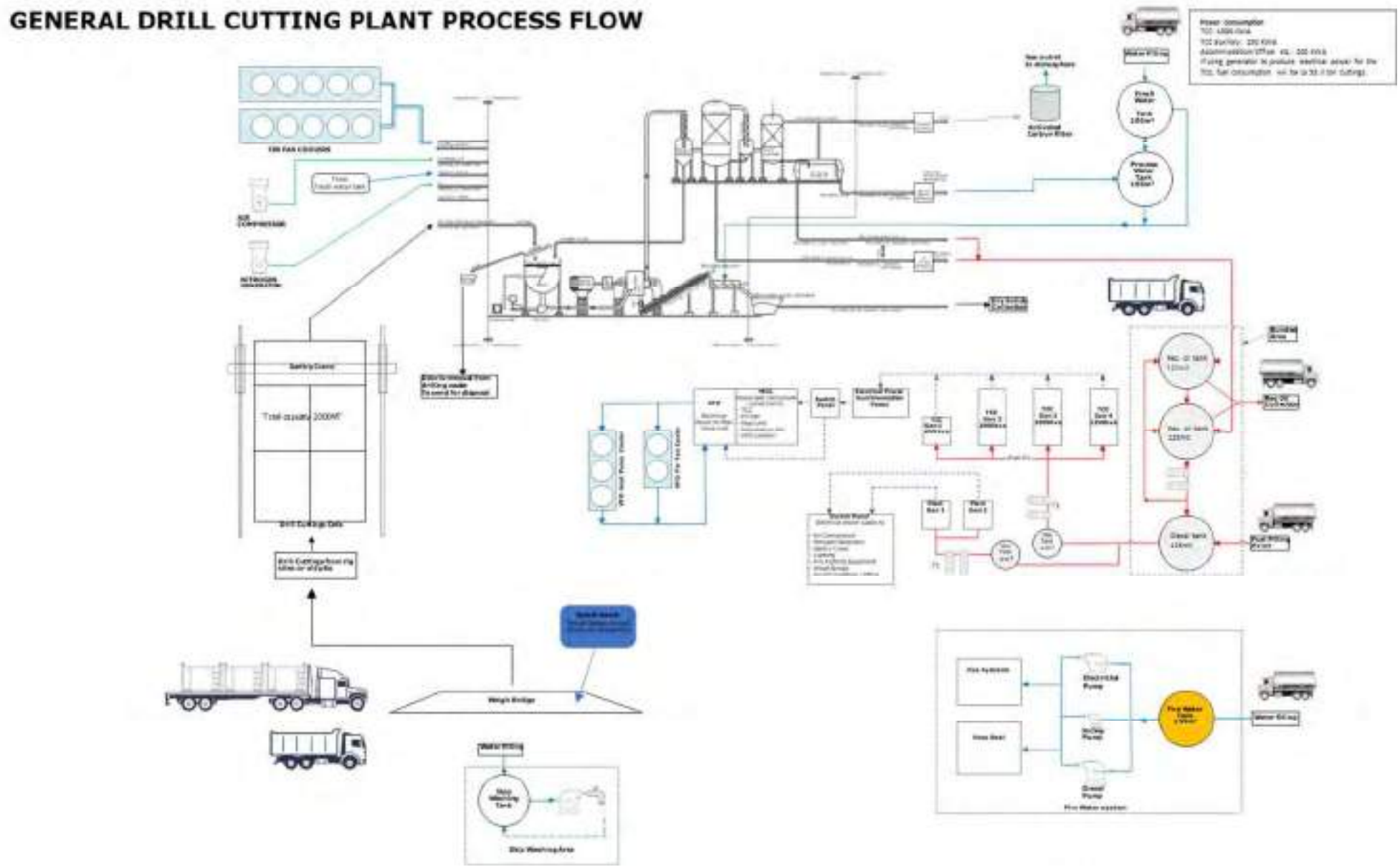

Figure 6: General Drill Cutting Plant Process Flow

Source: (Rent-A-Drum, 2025).

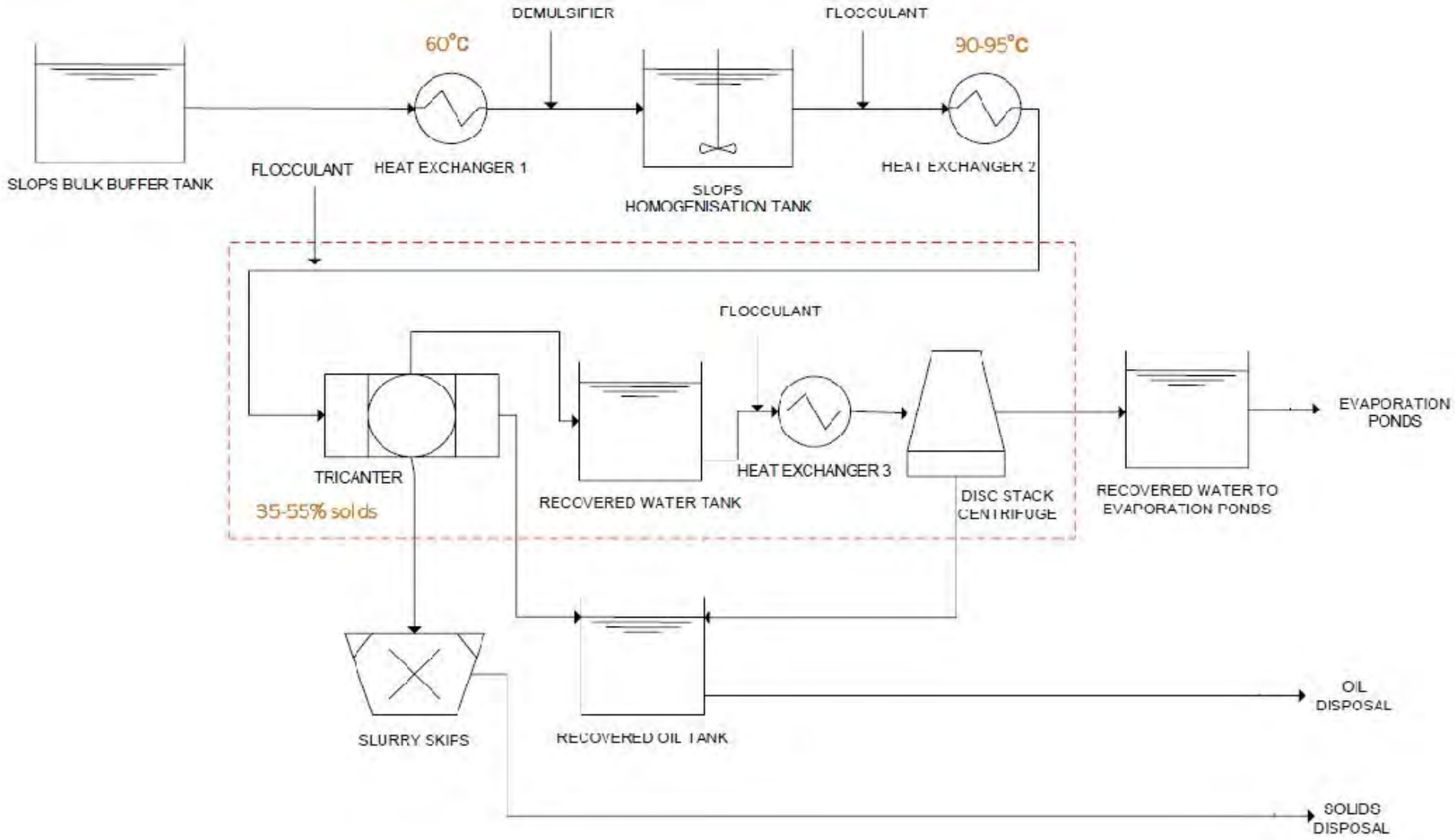

Figure 7: Slops Unit Process Flow

Source: (Rent-A-Drum, 2025).

4.4 WASTE TRANSPORT

Waste will be transported from offshore drilling rigs and port operations to the facility using a combination of tanker trucks, flatbed trucks, skip trucks, super sucker trucks, and medium-duty vehicles, depending on the waste stream and point of transfer.

Liquid wastes (slops) will be transferred from platform supply vessels (PSVs) to tanker trucks at the Port of Walvis Bay, while solid wastes, including drill cuttings, will be transported in containerised skips and bins. General and hazardous solid wastes generated in smaller quantities will also be transported using appropriate licensed vehicles.

The estimated daily vehicle movements associated with facility operations are summarised in Table 3.

Table 3: Waste Transport Vehicles

Type of Vehicle	Number of Vehicles Per Day	Waste Stream
Tanker trucks	6	Bulk liquid waste (slops and cuttings).
Flatbed trucks	6	Containerized solid general and hazardous waste
Skip trucks	2	Solid general and hazardous waste.
Skip truck/medium duty vehicle	3	Transfer of liquid waste from the PSV to the tanker trucks, at the port.
Medium duty vehicles (3-5 tons)	4	Solid general and hazardous waste

Source: (Rent-A-Drum, 2025).

The facility will be accessed from the M36 main road via the D1983 gravel road, with a dedicated approximately 1.2 km access road constructed to link the D1983 to the site. The site access points and the proposed transport routes from the Port of Walvis Bay are illustrated in Figure 8 and Figure 9.

Figure 8: Access Points

Source: (Rent-A-Drum, 2025).

Figure 9: Proposed Transport Routes

4.5 HOURS, STAFFING AND TIMEFRAME

Operating Hours will generally be from 07h00–17h00 (Monday–Friday) and 07h00–13h00 (Saturday). However, some processes (such as the TCC and slops treatment unit) may operate on a 24/7 basis to align with offshore oil and gas schedules.

Staffing: Approximately 96 staff members will be employed across management, supervision, operations, and support roles. The breakdown is provided in Table 4.

Table 4: Proposed Staff

Staff	Number of Employees
General manager and deputy	2
HSE supervisor	2
Administrative	3
Laboratory analyst	2
Supervisors	9
Deputy supervisors	6
Yellow plant	6
Mechanical plant	12
Drivers/assistants	36
General workers	18
Total	96

Source: (Rent-A-Drum, 2025).

Project Timelines: Construction is scheduled for September 2026–September 2027, commissioning from late 2027–December 2028, and operations commencing in January 2029. These are summarised in Table 5.

Table 5: Project Timelines

Timeline	Activity
Aug–Dec 2025	ESIA finalisation
Sept 2026 – Sept 2027	Construction (fencing, earthworks, utilities, civil works, equipment assembly)
Sept 2027 – Dec 2028	Commissioning
Jan 2029	Commencement of operations

Source: (Rent-A-Drum, 2025).

5 THE SOCIO-ECONOMIC ENVIRONMENT

This section presents the baseline socio-economic environment relevant to the proposed Walvis Bay IWMF. The baseline establishes the context for assessing potential social impacts by describing the characteristics of communities that may be directly or indirectly affected.

The primary area of influence includes the Walvis Bay Rural and Walvis Bay Urban constituencies of the Erongo Region. Walvis Bay Urban accommodates the town itself, Namibia's principal port and logistics hub, while Walvis Bay Rural is characterised by peri-urban extensions, scattered households, and emerging residential developments near the proposed site.

From a social perspective, households in Walvis Bay Rural represent the most immediate receptors of potential impacts such as land use change, traffic movements, and facility operations. The wider population of Walvis Bay Urban is also relevant given their role in local labour supply, reliance on municipal services, and indirect exposure to socio-economic outcomes linked to improved waste management.

Together, these constituencies account for nearly half of the Erongo Region's population, making them the most relevant focus for this baseline. The following subsections present demographic, social, and economic characteristics to establish the context in which the project will interact with local communities.

5.1 DEMOGRAPHIC PROFILE

According to the 2023 Population and Housing Census, Namibia's population reached 3,022,041, reflecting an average annual growth rate of 3% between 2011 and 2023 (NSA, 2024). The Erongo Region accounted for 240,206 people, making it the second fastest-growing region after Khomas, with an annual growth rate of 3.9% (NSA, 2025).

Walvis Bay, comprising the Urban and Rural Constituencies, recorded 102,704 residents in 2023. This means that Walvis Bay alone accounts for 42.8% of Erongo's total population. Between 2011 and 2023, the population of Walvis Bay grew from 62,096 to 102,704 — an increase of more than 40,000 people in just over a decade. This translates into an average annual growth rate of 4.23%, which is significantly higher than both the regional and national averages. The strong growth reflects sustained in-migration driven by the port, logistics, and fishing industries, as well as the more recent expansion of offshore oil and gas activities.

Table 6 summarises the population changes in Namibia, Erongo Region, and Walvis Bay between 2011 and 2023. It clearly shows how Walvis Bay's growth has outpaced both the region and the country.

Table 6: Population Growth in Namibia, Erongo and Walvis Bay, 2011–2023

Area	Population 2011	Population 2023	Mean Annual Rate of Growth
Namibia	2,113,077	3,022,041	3.0%
Erongo	150,809	240,206	3.9%
Walvis Bay (Urban & Rural)	62,096	102,704	4.23%

Source: (NSA, 2024); (NSA, 2025).

Looking ahead, projections suggest that if historic trends continue, Erongo's population could reach about 352,200 by 2033, with Walvis Bay increasing to approximately 160,200 residents. These figures are indicative and will depend on the pace of developments such as port expansion, uranium mining, and offshore oil and gas exploration.

5.1.1 Population Density

The distribution of population across Namibia and Erongo is shown in Figure 10. Nationally, average density in 2023 was 3.7 persons per km², while Erongo recorded a slightly higher density of 3.8 persons per km² (NSA, 2024). However, these averages show highly uneven settlement patterns.

In 2023, Walvis Bay Urban recorded the highest density in the region at 461 persons per km², while Walvis Bay Rural had only 19 persons per km² (NSA, 2025).

Figure 10: Population Density and Distribution, 2023

Source: (NSA, 2024); (NSA, 2025).

5.1.2 Age and Sex Distribution

Figure 11 compares Namibia's and Erongo's age composition. In 2023, Namibia's population remained youthful, with 38.5% under 19 years, 54.1% in the working-age group (20–59), and 7.5% aged 60 years and above. Erongo reflects a similar structure but with a stronger concentration of working-age residents: 36.7% under 19, 57.4% aged 20–59, and only 5.8% aged 60+ (NSA, 2024).

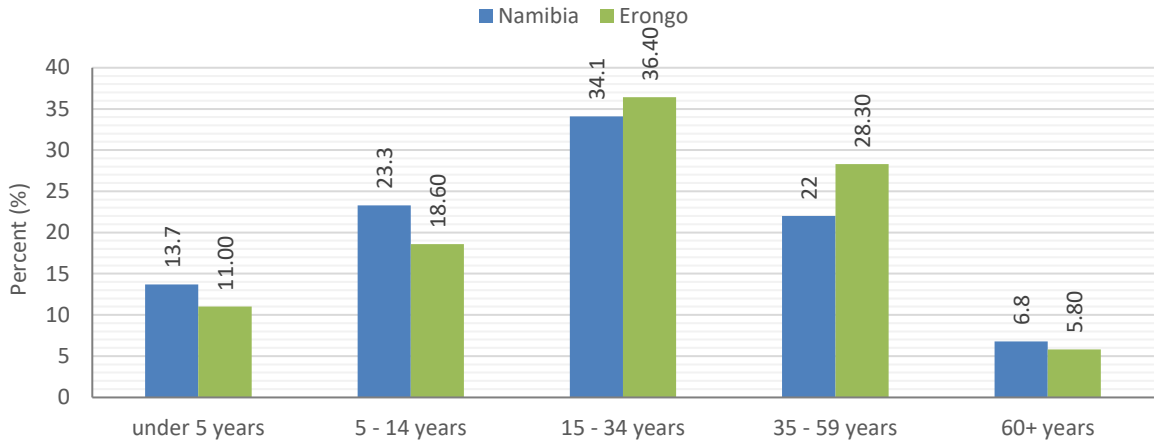

Figure 11: Age Composition for Namibia and the Erongo Region, 2023

Source: (NSA, 2024).

At constituency level, Walvis Bay Urban had 66.6% of residents in the working-age group, 25.4% under 19, and 8.0% aged 60+. Walvis Bay Rural showed a similar pattern with 66.0% working-age, 29.2% under 19, and 4.8% elderly (NSA, 2025).

Both constituencies therefore record a higher share of working-age residents than the national average of 54.1%, underlining the town's role as an employment hub. Figure 12 presents the age–sex pyramids for the region and Walvis Bay, showing these demographic contrasts.

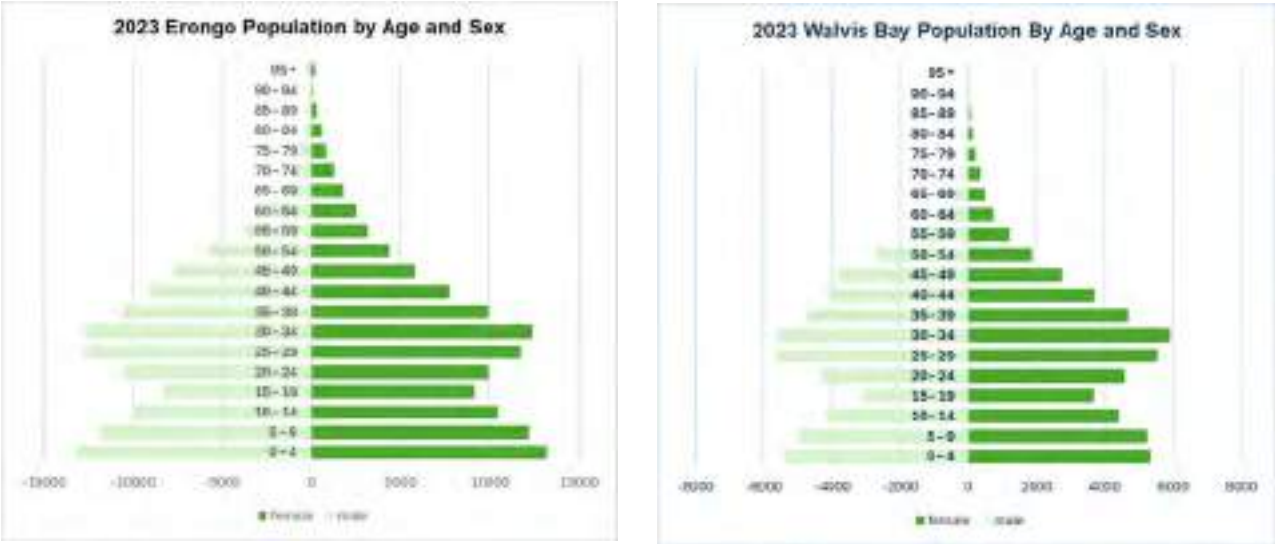

Figure 12: Age and Sex Pyramids for Erongo and Walvis Bay, 2023

Source: (NSA, 2025).

5.1.3 Household Size

Nationally, the average household size declined from 4.4 in 2011 to 3.8 in 2023. In Erongo, households have consistently been smaller, decreasing from 3.3 in 2011 to 3.1 in 2023 (NSA, 2025).

Within the region, Walvis Bay Rural recorded the largest households in 2023, averaging 3.3 persons, while Walvis Bay Urban had the smallest at 3.1, consistent with its compact urban character (NSA, 2025). Figure 13 shows these differences.

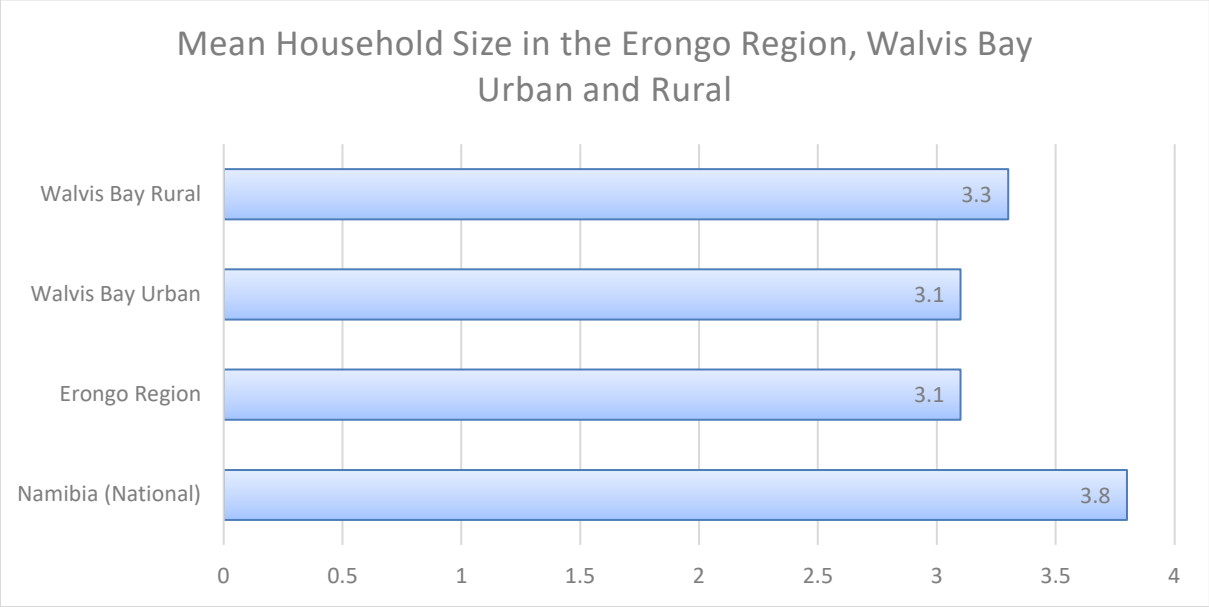

Figure 13: Mean Household Sizes in Namibia, Erongo, and Key Constituencies, 2023

Source: (NSA, 2024).

5.2 SOCIAL SERVICE PROVISION

The provision of social services enables a population of that area to live meaningful lives and enables members to realise their potential. Health and Education are the main social services considered as basic to the successful development of a population.

5.2.1 Educational Profile

According to the MoE EMIS (2023) report, the Erongo Region had 17 secondary schools, 16 combined schools, and 46 primary schools in 2022. Of these, 20 schools were located in Walvis Bay, as shown in Figure 14.

Figure 14: Locality of Schools within Walvis Bay, 2024

Source: (NSA, 2024).

The 2023 Population and Housing Census recorded a literacy rate of 95.4% in Erongo Region, compared to the national average of 87.3% (NSA, 2025). Within Walvis Bay, literacy differs across constituencies. The Walvis Bay Urban Constituency recorded a very high literacy rate of 98.7%, with only 1.3% reporting never having attended school. In contrast, the Walvis Bay Rural Constituency recorded a literacy rate of 93.6%, with 6.4% reporting no formal schooling. Female literacy rates are consistently higher than male literacy rates across both constituencies.

As shown in Figure 15 learner enrolment in the region increased from 43,213 in 2018 to 53,577 in 2022. To meet this demand, 10 additional schools were constructed, yet the average number of learners per school still rose from 626 in 2018 to 678 in 2022, well above the national average of 432 learners per school in 2022 (EMIS, 2019) (EMIS, 2023).

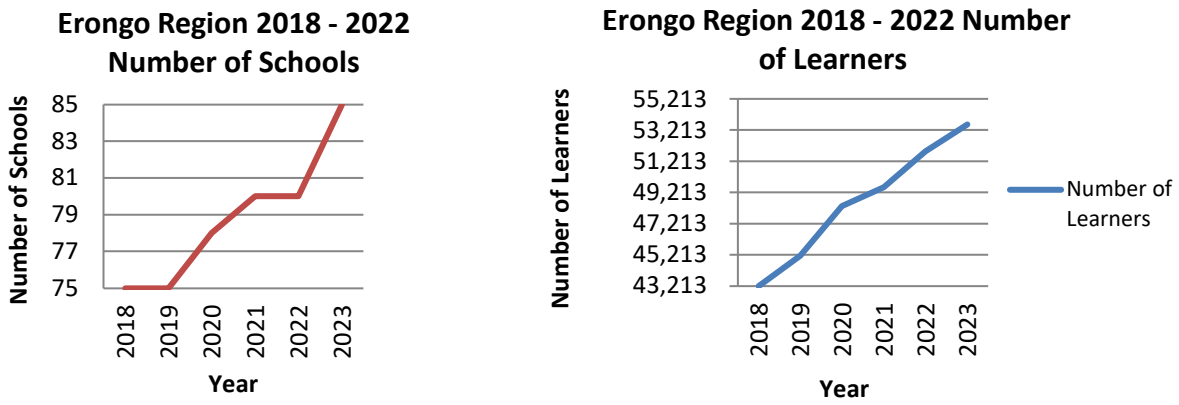

Figure 15: Number of Schools and Learners: Trends Between 2018 to 2022

Source: (EMIS, 2023).

The quality of education is also reflected in learner–teacher ratios. As illustrated in Figure 16, the, the ratio in Erongo increased from 24.7 in 2018 to 27.1 in 2022, while the national ratio stood at 27.4 in 2022. This indicates that Erongo has maintained a slightly more favourable ratio compared to the national average. Teacher qualifications also improved during this period, with formally trained teachers rising from 92.2% in 2018 to 95.5% in 2022 (EMIS, 2019) (EMIS, 2023).

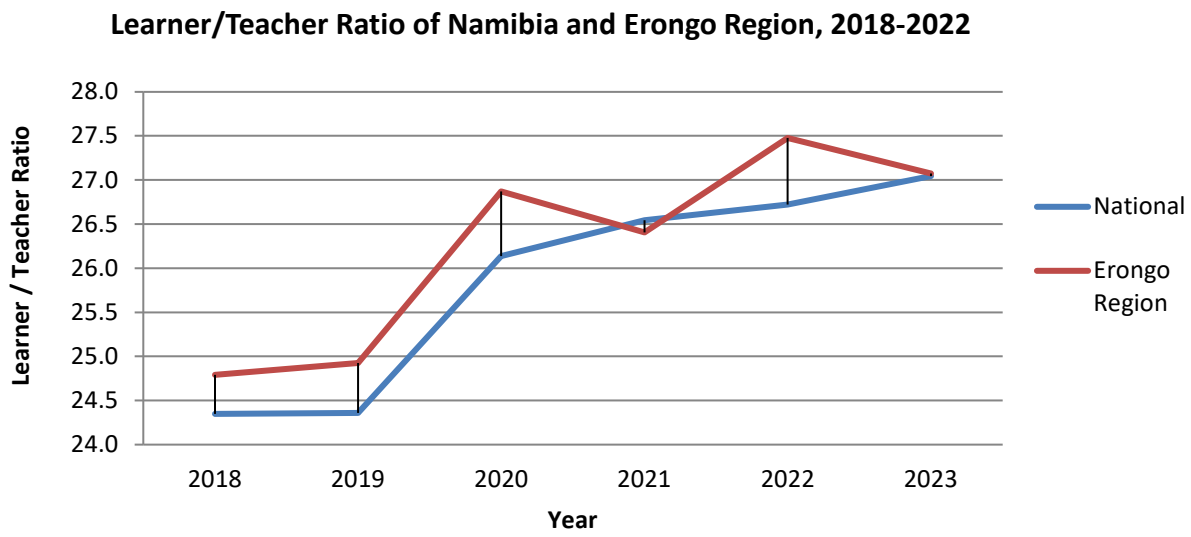

Figure 16: Learner/Teacher Ratio of Namibia and Erongo Region, 2018-2022

Source: (EMIS, 2019); (EMIS, 2023).

5.2.2 Health Profile

The Ministry of Health and Social Services (MoHSS, 2023) is responsible for delivering health services across the Erongo Region. According to the National Infrastructure Atlas (2023), the region is served by 7 hospitals, 44 clinics, and 4 health centres. In Walvis Bay Urban, there are 2 hospitals, 16 clinics, and 2 health centres, while Walvis Bay Rural has 2 clinics but no hospitals. These facilities are mapped in Figure 17.

Figure 17: Locality of Healthcare Facilities within Walvis Bay, 2024

Source: (NSA, 2024).

Access to health services in Erongo is generally above the national average. In 2023, 97.8% of households in the region had access to safe drinking water, compared to 91.4% nationally (NSA, 2024). Sanitation access is also higher, with only 11% of households lacking toilet facilities, compared to 46% nationally.

As shown in Table 7, Erongo also performs relatively well in other health indicators. For example, 91% of people live within 10 km of a health facility, compared to the national average of 76%, while the under-five mortality rate is lower at 52 per 1,000 live births, compared to 69 per 1,000 nationally.

Table 7: Health Indicators for the Erongo Region

Indicator	Erongo Region	Namibia
% People within 10 km of health facility	91	76
Public hospital beds per 1000 people	2.25	3.2
Under 5 mortality per 1000	52	69
% Households with access to safe water	97.8	91.4
% Households with no toilet facility	11	46

Source: (MoHSS, 2012); (NSA, 2014); (NSA, 2016); (NSA, 2024)

Life expectancy in Erongo improved significantly between 2001 and 2011. As shown in Table 8 male life expectancy increased from 53.8 years in 2001 to 62.6 years in 2011, while female life expectancy rose from 59.4 years to 67 years over the same period (NSA, 2014).

Table 8: Life Expectancy (In Years) By Area, Sex and Census Years 2001 and 2011

Area	2001		2011	
	Male	Female	Male	Female
National	47.6	50.2	53.3	60.5
Erongo Region	53.8	59.4	62.6	67

No updated life expectancy figures are available beyond 2011; these remain the latest official Census-based estimates.

Source: (NSA, 2014).

Overall, Walvis Bay and the Erongo Region demonstrate strong access to education and health services, with literacy and safe water access well above national averages. However, challenges remain in overcrowded schools, sanitation gaps in informal settlements, and ensuring sustained quality of education and health care under growing population pressures.

5.3 LIVELIHOOD PROFILE

Household consumption and income patterns in Walvis Bay reflect the town's status as Namibia's main port city and a hub for fishing, logistics, and trade. The local economy is more diversified than Lüderitz, but still heavily reliant on salaries and wages, particularly from port-related industries, transport, and fishing.

5.3.1 Employment and Unemployment

According to the 2023 Population and Housing Census Labour Force Report, Namibia recorded a strict unemployment rate of 24.8%, while the broad unemployment rate (including the potential labour force) stood at 33.5%. In the Erongo Region, unemployment was higher at 32.0%, while in Walvis Bay, rates varied between the urban and rural constituencies.

- Walvis Bay Urban reported a strict unemployment rate of 29.8%, with a combined unemployment and potential labour force (PLF) rate of 38.3%.

- Walvis Bay Rural reported a strict unemployment rate of 34.6%, with a combined unemployment and PLF rate of 42.6%.

Youth unemployment remains a key concern. In Walvis Bay Urban, 40.1% of the youth (aged 15–34) were unemployed in 2023, while the rate in Walvis Bay Rural was even higher at 44.9%, compared to the regional average of 40.7% and the national rate of 38.6%.

Table 9: Unemployment Rates and Labour Indicators, 2023

Area	Unemployment Rate (%)	Combined UR & PLF (%)	Employment-to-Population Ratio (EPR, %)	Labour Force Participation Rate (LFPR, %)	Youth Unemployment (%)	NEET (%)
Namibia	24.8	33.5	44.5	61.2	38.6	41.7
Erongo Region	32.0	41.9	43.8	64.4	40.7	38.7
Walvis Bay Urban	29.8	38.3	48.3	68.8	40.1	34.5
Walvis Bay Rural	34.6	42.6	46.4	70.9	44.9	40.4

Source: (NSA, 2023a); (NSA, 2025).

5.3.2 Labour Force Participation

Labour force participation in Walvis Bay is higher than both the national and regional averages. In 2023, Walvis Bay Urban recorded a labour force participation rate (LFPR) of 68.8%, while Walvis Bay Rural stood slightly higher at 70.9%, compared to 61.2% nationally and 64.4% regionally.

5.3.3 Main Sources of Income

The 2023 Population and Housing Census shows that most households in Erongo derive their main source of income from wages and salaries (73%) compared to the national average of 65.9%. In Walvis Bay Urban, reliance on salaries is even higher (80.1%), while Walvis Bay Rural recorded 74.6%. Other household income sources include business/non-farming activities (10.5% in Urban; 8.2% in Rural) and remittances (4.9% in Urban; 6.3% in Rural) (NSA, 2024); (NSA, 2025).

5.3.4 Household Consumption (Historical Context)

The most recent Namibia Household Income & Expenditure Survey (NHIES) (2015/16) recorded mean annual household consumption of N$66,900 in the Erongo Region, above the national average of N$57,200 (NSA, 2016). While constituency-level figures for Walvis Bay are not available, the town's economic base in logistics, fishing, and manufacturing indicates that household consumption levels are likely above the regional average. Updated figures will only be available once the new NHIES results are published.

These are nominal values not adjusted for inflation, and updated figures will only be available once the new NHIES results are published.

5.4 ECONOMIC PROFILE OF THE REGION

In 2016, the Erongo Region was the second-largest contributor to Namibia's GDP, accounting for 12.93% of the national total (Urban Econ, 2019). Traditionally reliant on natural resources, the region has seen significant economic diversification in recent years. By 2023, the Erongo Region's contribution to the national GDP had increased to approximately 13.93%, underscoring its vital role in Namibia's economy. This growth has been driven by key sectors such as mining, energy, tourism, fishing, and transportation, reflecting the region's expanding economic landscape (ERC, 2023).

5.4.1 Tourism

According to the 6th Tourism Satellite Account (TSA) Report 2022, the hospitality and tourism industry in Namibia contributed N$ 14.3 billion directly to the Gross Domestic Product (GDP). This is equivalent to 6.9% of the total GDP and is responsible for 55,571 direct employment opportunities, including over 2,900 tourism-based jobs created in community conservation areas in 2018. In terms of investment, the Gross Fixed Capital Formation (GFCF) in Tourism was estimated at N$ 401 million in 2022, representing 1.3% of the overall GFCF (MEFT, 2022).

Eighty-two 82% of visitors to Namibia are tourists. Community-based tourism is also expanding in popularity. Tourists to Namibia come mainly from South Africa, Angola, Germany, and the United Kingdom. According to the Federation of Namibian Tourism Associations (FENATA), the average daily expenditure for Western European visitors is N$ 2,617 per day. Business tourists have the highest per capita expenditure per day, while holidaymakers have the highest expenditure per capita per trip (CIRRUS, 2021).

Tourism plays a pivotal role in the region’s economy, with the coastal towns of Swakopmund and Walvis Bay being major attractions. The hospitality sector has grown significantly, contributing to both employment and GDP. The region's diverse natural attractions, from the Namib Desert to the Atlantic coast, continue to draw tourists from around the world (ERC, 2022).

5.4.2 Mining

Mining remains a cornerstone of the Erongo Region’s economy, with significant operations in uranium, gold, marble, granite, and salt extraction. The region's rich mineral resources have attracted substantial investment and fostered economic growth. The Port of Walvis Bay further enhances the region's economic significance, serving as a critical hub for international trade and logistics (ERC, 2022).

Major uranium mines include the Rössing, Husab, and Langer Heinrich mines. The region's mining sector is experiencing rapid expansion, driven by global demand for raw materials (ERC, 2022).

The salt works in Walvis Bay, Swakopmund, and Cape Cross have long-term concessions for salt extraction from seawater. Namibia is the largest salt producer in sub-Saharan Africa, with significant exports to South Africa and West Africa (ERC, 2022).

5.4.3 Fisheries

The fishing industry in Namibia contributes approximately 2.5% to the country's GDP as of 2022. This sector has traditionally been significant but is increasingly being overshadowed by other industries like oil, gas, and green energy. Additionally, fishing accounts for about 20% of Namibia's export earnings, highlighting its importance to the economy despite the growing focus on other sectors (Fishing Industry News SA, 2023) (FAO, 2023).

5.4.4 Transportation

The Walvis Bay Corridors, managed by the Walvis Bay Corridor Group, is a key development indicative facilitating national, regional, and international trade. The corridors link Namibia to Southern Africa and extend transatlantic connections. Overall, the Erongo Region's strategic location, rich natural resources, and ongoing infrastructure developments position it as a key player in Namibia's economic future.

Figure 18: The Corridors to Walvis Bay

Source: (Brundige D.)

At the core of this network lies Walvis Bay, with its natural deep-water harbour providing a seamless route for cargo transhipment between African, European, and American markets. Recognized as Africa's premier port for efficiency and quality, it handles over 6 million tonnes of cargo annually, serving as a gateway to 190 million consumers in the Southern African Development Community. Managed by the Namibian Ports Authority (NamPort), this port plays a pivotal role in regional and international trade.

The upgrade to Walvis Bay's Class A international airport further enhances the region's connectivity. The Swakopmund airport, while of regional importance, complements this network, contributing to the region's overall transport infrastructure.

The port of Walvis Bay in the Erongo Region is a vital link, connecting four major transport corridors that facilitate trade across SADC countries, Europe, the Americas, and beyond. Managed by NamPort and supported by Lüderitz harbour, it's a crucial hub for commerce.

Additionally, TransNamib's rail system is linked to Transnet rail in South Africa. This rail network stretches from the South African border to the Angolan border in the north and from the central part of the country to its coastal harbour towns (TransNamib, 2024).

Figure 19: TransNamib Rail System

(TransNamib, 2024)

6 IDENTIFICATION OF KEY SOCIAL IMPACTS

During the scoping phase, the primary objective was to gather input from a diverse range of stakeholders, including the general public and other Interested and Affected Parties (I&APs), concerning the potential issues or impacts associated with the proposed Integrated Waste Management Facility (IWMF). To facilitate this, a comprehensive list of relevant stakeholders was compiled.

A Background Information Document (BID) was prepared to provide essential contextual information to I&APs prior to the public meeting. This BID was distributed via email to all stakeholders on the database. Additionally, invitations to the public meeting were published in *The Namibian* and *New Era* newspapers on 26 March and 2 April 2024. A notice was also placed at the project site and at the Walvis Bay Town Council offices.

The public meeting took place in Walvis Bay at the Narraville Community Centre on 12 April 2024 and served as a platform for engagement and discussion. Minutes of this meeting, together with the attendance register, are included in Annexure D for reference. A separate meeting was held with the Walvis Bay Municipality at their offices on 22 February 2024 to ensure local authority engagement.

During these sessions, the technical details and rationale for the project were presented, with emphasis on its necessity and potential social and environmental impacts. I&APs were encouraged to ask questions and provide feedback, fostering an open and transparent dialogue. Attendees were also invited to identify key concerns to be addressed in the assessment process.

In addition to stakeholder engagement, a literature review was undertaken to incorporate insights from similar projects and to contextualise stakeholder concerns within broader industry experience.

The public consultation process provided valuable insights into stakeholder concerns regarding the proposed IWMF in Walvis Bay. Key issues raised included traffic congestion, environmental protection, community engagement, public safety, and economic opportunities. Addressing these concerns will be essential in gaining community support and ensuring the successful implementation of the project. By incorporating stakeholder input into the planning and implementation phases, the project can better align with local needs and contribute to sustainable development in the region.

Following completion of the Final ESIA Report, all registered Interested and Affected Parties (I&APs) were notified of its availability for public review. The notification was distributed via email and included details on how to access the report and submit comments.

Proof of this notification is provided in Annexure G, and the distribution list corresponds with the stakeholder database included in Annexure E.

6.1 SOCIAL IMPACTS IDENTIFIED BY STAKEHOLDERS

The stakeholders identified several potential impacts related to the project:

- **Traffic Congestion**: Potential increase in traffic and safety due to the continuous hauling of waste from the port to the facility. This could lead to further congestion on local roads, and safety concerns due to the hazardous nature of the loads.
- **Hazardous Waste Management:** Ensuring that hazardous waste is handled and disposed of safely to prevent soil and water contamination.
- **Air and Water Quality:** Potential impacts on air and water quality from waste processing activities.
- **Local Employment:** Ensuring that job opportunities generated by the project are made available to local residents.
- **Local Businesses:** Opportunities for local businesses to participate in the supply chain and service contracts related to the facility.
- **Economic Growth:** The broader economic impact on the community, including increased spending and investment in the area.
- **Training Programs:** Providing training and skill development programs to equip the local workforce for employment in the facility.
- **Stakeholder Involvement:** Maintaining ongoing communication with the community and involving them in decision-making processes.

The public consultation process has provided valuable insights into the social concerns of the stakeholders regarding the proposed IWMF in Walvis Bay. Addressing these concerns—traffic congestion, environmental protection, community engagement, public safety, and economic benefits—will be crucial in gaining community support and ensuring the project's success. By incorporating these concerns into the project planning and implementation phases, the facility can better align with the needs and expectations of the local community, contributing to sustainable development in the region.

6.2 LITERATURE REVIEW OF SOCIAL IMPACTS

This review synthesises insights from various sources, including government documents, academic papers, and impact assessments, to understand the potential socio-economic impacts associated with this type of project.

6.2.1 Potential Socio-Economic Impacts during the Construction Phase

- **Traffic Impact:** According to Cohen and Benenson (2019), the construction phase will lead to increased traffic from construction vehicles, detours, road closures, and heavy equipment, significantly impacting local roads. This congestion can result in delays and longer commute times for residents and workers. Furthermore, Barton et al. (2018) point out that heavy equipment traffic near residential and commercial areas poses safety risks to pedestrians and drivers, requiring strict traffic management measures. Doe

(2020) also notes that detours and road closures can disrupt normal business operations, affecting accessibility and customer flow, potentially leading to economic losses.

- **Employment Impact:** According to the International Labour Organisation (2017), construction is expected to create significant employment opportunities, both directly and indirectly. Direct job creation will involve construction workers, engineers, and supervisors, while indirect opportunities will arise in sectors such as transportation, logistics, and local businesses. This influx of employment is expected to positively impact the community, fostering income growth and enhancing workforce skills, thereby supporting sustainable economic development in the region (Environmental Protection Department, 2023).
- **Health and Safety Impacts on Residents and Workers:** According to the Health Effects Institute (2004), construction activities can present significant health risks, such as exacerbated respiratory issues due to dust and emissions for nearby residents. The International Labour Organisation (2017) highlights that construction work involves safety hazards, including risks of accidents and injuries from heavy equipment, impacting both workers and the surrounding community.

6.2.2 Potential Socio-Economic Impacts during the Operational Phase

- **Traffic Impact:** According to Cohen and Benenson (2019), the operational phase of an IWMF is likely to increase traffic on local roads, potentially causing congestion and extended commute times. Effective management of this traffic influx is crucial to minimise disruptions to daily travel routines.
- **Employment Creation:** According to Smith and Williams (2015), the operation and maintenance of an IWMF are expected to create long-term job opportunities, enhancing local economic growth and stability. Roles such as waste management specialists, technicians, and administrative staff will provide stable employment for local residents. These positions will improve economic resilience by offering consistent income and supporting career development, and will also drive expertise in waste management, aligning with regional sustainable development goals (Environmental Protection Department, 2023).
- **Health and Safety Impacts on Residents and Workers:** According to research, the operation of an IWMF presents several health risks due to dust, noise, and vibrations. For workers, dust exposure from waste handling can lead to respiratory illnesses, while high noise levels from machinery can cause hearing impairments and stress. Whole-body vibrations from operating heavy machinery may contribute to musculoskeletal disorders. For residents, dust emissions can deteriorate air quality, affecting respiratory health, and continuous noise can disrupt the tranquillity of residential areas, impacting sleep and well-being. Vibrations from machinery may also cause structural vibrations in

nearby buildings, contributing to discomfort (Environmental Protection Department, 2023).

- **Economic Impact:** According to Smith and Williams (2015), an IWMF is projected to stimulate local employment and income growth significantly by generating job opportunities in operations and maintenance. This employment boost is expected to not only enhance local economic stability but also contribute to the overall socio-economic development of the region.

  Moreover, Jones (2018) indicates that the establishment of the IWMF is anticipated to catalyse increased economic activity in related sectors such as transportation, logistics, and support services. These sectors play crucial roles in facilitating the operation and maintenance of the facility, thereby fostering a broader economic impact on the regional economy. The anticipated economic benefits underscore the potential of the IWMF to contribute positively to local and regional economic growth through job creation and enhanced economic activity in ancillary sectors.

- **Property Values:** According to Lin (2005), property values in the surrounding areas of an IWMF site are expected to decrease significantly due to the facility's location. The distance from densely populated or commercially active areas mitigates concerns about perceived and actual nuisances associated with waste management facilities, such as odour, noise, and traffic congestion. This geographical isolation helps minimise potential impacts on local property values, providing a buffer against economic depreciation that could otherwise affect nearby communities.

The literature review provides a good understanding of the socio-economic impacts associated with the IWMF throughout its lifecycle. During the construction phase, significant concerns include health and safety risks, employment impacts, and traffic disruptions. In the operational phase, the focus shifts to health and safety impacts, employment creation, economic benefits, property values, traffic management, and safety risks. Addressing these impacts through targeted mitigation strategies is crucial for maximising benefits and ensuring sustainable development, balancing the facility's positive contributions with the need to protect and support the local community.

The valid impacts identified have been assessed and rated according to the rating system shown in the table below. Mitigation measures were developed for each potential impact where appropriate. Impacts found to be invalid have been discarded.

6.3 ISSUES LISTING

Based on the potential social impacts identified through the public consultation process, the brief literature study and placed in the socio-economic context of the region and the coastal town, the following key issues need to be considered in the assessment of the social impact of the proposed IWMF.

Table 10: Assessment after Mitigation & Enhancement Measures

No.	Impact Description	Comments	Valid?	Nature
1.	Traffic and Transport during the Construction Phase	Increased traffic from construction vehicles, detours, road closures, and heavy equipment may cause congestion and safety risks, affect local roads and disrupt business operations.	Yes	Negative
2.	Traffic and Transport during the Operational Phase	The operational phase is likely to see increased traffic on local roads, potentially leading to more congestion and extended commute times.	Yes	Negative
3.	Employment during Construction	The construction phase will generate short-term job opportunities in the construction sector and supporting industries, contributing to economic stability and workforce skill enhancement.	Yes	Positive
4.	Employment during Operations	Long-term job creation in operations and maintenance will provide stable employment for local residents, enhancing economic resilience and supporting regional sustainable development goals.	Yes	Positive
5.	Safety / Health Risk during the Construction Phase	Health risks such as respiratory diseases, accidents, and injuries due to dust, emissions, and construction activities pose concerns for both residents and workers.	Yes	Negative
6.	Safety / Health Result During The Operational Phase	Health risks such as respiratory diseases, accidents, and injuries due to dust, emissions, and operational activities pose concerns for both residents and workers.	Yes	Negative
7.	Economic Impact	The IWMF is projected to stimulate local economic growth by creating jobs and enhancing activity in related sectors such as transportation and logistics, thereby positively impacting the regional economy.	Yes	Positive
8.	Health Concerns and Impact on Future Development Areas	Air pollution from the IWMF could pose health risks to future development areas nearby, potentially affecting long-term community well-being.	Yes	Negative
9.	Decrease Property Values	The site is located within an allocated industrial area, where the prevailing wind directions ensure that the residential area to the northeast remains unaffected by odour, noise, and traffic congestion. This strategic positioning is expected to preserve local property values.	No	Negative
10.	Security Risks	Potential theft and vandalism at the facility require security measures. This issue is an external impact on the facility and does not directly affect the community.	No	Negative
11.	Social Inequalities	The facility will not impact low-income and minority communities due to its equitable site selection, adherence to international standards, stakeholder consultations, and inclusive economic opportunities, thereby avoiding environmental injustice.	No	Negative

The valid impacts identified have been assessed and rated according to the rating system shown in the table below. Mitigation measures were developed for each potential impact where appropriate. Impacts found to be invalid have been discarded.

Table 11: Rating Methodology

Severity / Magnitude	Reversibility	Duration	Spatial Extent	Probability
5 – Very High / Don't Know	5 – Irreversible	5 – Permanent	5 – International	5 – Definite / Don't Know
4 – High		4 – Long Term (Impact Ceases After Operational Life)	4 – National	4 – High Probability
3 – Moderate	3 – Recoverable (Needs Human Input)	3 – Medium Term (5 – 15 Years)	3 – Regional	3 – Medium Probability
2 – Low		2 – Short Term (0 – 5 Years)	2 – Local	2 – Low Probability
1 – Minor	1 – Reversible (Regenerates Naturally)	1 - Immediate	1 – Site Only	1 – Improbable
0 – None				0 - None

The consequence of an impact is calculated as the sum of severity, reversibility, duration and spatial extent. The formula - *Consequence (severity + reversibility + duration + spatial scale) x Probability* - is then used to calculate the significance of the impact. More than 60 significance points indicate high significance, between 30 and 60 significance points indicate medium significance and less than 30 significance points indicate low significance.

7 ASSESSMENT OF ANTICIPATED IMPACTS

This section considers and assesses the identified valid impacts for both the construction and operational phases of the facility. It reviews the impacts and reassesses them after mitigation to indicate if and to what extent the impacts can be successfully mitigated or enhanced.

7.1 TRAFFIC IMPACTS DURING CONSTRUCTION

7.1.1 Impact Significance

- **Nature of the Potential Impacts:**

The construction phase is expected to lead to several traffic-related impacts on both the local area and the broader region due to the transportation of equipment from other areas to the project site. This includes potential traffic congestion, safety risks, and environmental concerns. Specifically, the movement of construction materials along routes such as the B2, M36, and D1983 roads, as well as internal gravel access roads, could result in increased traffic, affecting residents of Walvis Bay and commuters travelling to Swakopmund via the D1984 and Walvis Bay Airport. The presence of heavy vehicles and construction activities may also heighten safety concerns, contribute to noise disturbances, and generate dust pollution. Figure 9 shows the site relative to the road network and access point. These impacts have the potential to be negative.

- **Severity/Magnitude:**

High (4): The severity of the impact of vehicle movement between suppliers and the building site resulting in increased traffic volumes, reduced road safety, elevated noise levels, and dust generation is rated as high because of the various impact types as well as relatively high increase in heavy vehicle traffic within the town.

- **Reversibility:**

Reversible (1): The negative impacts from construction activities, such as congestion and noise, will cease upon completion of construction.

- **Duration:**

Short Term (2): These impacts are temporary and will cease once construction activities are completed.

- **Spatial Extent:**

Regional (3): Although the primary impacts, such as traffic congestion, noise, and dust, will be concentrated in areas directly affected by construction activities, the spatial extent is regional due to the transportation of equipment and materials from across the region.

- **Probability:**

  Definite (5): It is certain that these impacts will occur because construction cannot be done without these transport activities.

- **Significance Rating:**

Severity / magnitude	Reversibility	Duration	Spatial extent	Probability
4 –High	1 – Reversible	2 – Short Term	3 – Regional	5 – Definite

The overall significance is calculated is calculated to be 50 {(4+1+2+3) x5} which is of medium significance.

7.1.2 Mitigation Measures

The following mitigation measures are practically possible to reduce the anticipated impacts:

- **Traffic Management Plan:**

  - Expand the Traffic Management Plan to include transport routes beyond the town, where applicable, with coordination with regional and national road authorities to ensure the safe passage of heavy vehicles transporting materials. Where supplies and materials are procured within Walvis Bay, such consultation may not be required. The plan should incorporate time restrictions to avoid peak hours on major highways and ensure minimal disruption to other road users.

- **Permits and Compliance:**

  - Ensure that all transport companies involved in the project obtain the necessary permits for oversized or overweight loads. They must adhere strictly to the designated routes and time schedules to prevent road congestion and overloading of infrastructure.

- **Safety Measures:**

  - Implement a traffic management plan to monitor the impact of additional heavy vehicles and minimise congestion along routes such as the M36, and the D1983 roads, and the gravel access roads.
  - Coordinate construction vehicle movements to ensure efficient flow, particularly between 08:00 and 17:00.
  - Implement appropriate signage and speed control measures at the site to improve road safety for both construction vehicles and other road users.

- **Noise Control:**

  - Schedule noisy activities during 08:00 and 17:00 to minimise disruption to residents.

- **Dust Mitigation:**

➢ Apply dust suppression techniques, such as watering gravel roads with salt water or, if possible, tarring the access roads.
➢ Implement speed limits to reduce dust emissions.

- **Road Maintenance:**

➢ The Walvis Bay Municipality should schedule regular maintenance of impacted roads, particularly the gravel sections, to address wear and tear caused by heavy construction vehicles. Funding for such maintenance to be negotiated from the Road Fund Administration (RFA) from mass distance charges. The access road must be maintained by the project proponent until such time as it becomes part of a broader industrial area with formalised roads.
➢ Promptly repair any road damage to ensure safe and smooth traffic flow during construction.

7.1.3 Post-Mitigation Impact Assessment

The severity of impacts on vehicle movement and safety concerns will be mitigated from high (4) to medium (3) due to the proposed enhanced traffic management and safety protocols, while the other aspects—reversibility, duration, spatial extent, and probability—will remain unchanged.

- **Significance Rating after Mitigation Measures:**

Severity / Magnitude	Reversibility	Duration	Spatial Extent	Probability
3 – Medium	1 – Reversible	2 – Short Term	3 – Regional	5 – Definite

The overall significance is calculated to be 45 {(3+1+2+3) x5}, which remains of medium significance.

7.1.4 Conclusion

Overall, the mitigation measures proposed to be implemented are expected to mitigate the potential traffic and transport impacts during the construction phase from a medium significance of 50 to a medium significance of 45.

7.2 EMPLOYMENT DURING CONSTRUCTION

7.2.1 Impact Significance

- **Nature of the Impact:**

During the construction phase, there will be a range of temporary job opportunities available, from general construction workers to artisans and plant operators. While contractors may bring some skilled workers, some positions can be filled by local residents. The exact total workforce required is still being determined, but there will be a strong emphasis on hiring locals, potentially leading to permanent employment opportunities. However, the construction will require a specialised workforce that may be brought in and this is likely to lower the number of locally available jobs.

By prioritising local hiring and promoting gender equality during the construction phase, the waste management facility can play a pivotal role in stimulating sustainable economic growth in Walvis Bay, benefiting the community directly through job creation and skill development. This section assesses these potential impacts, suggesting mitigation and enhancement measures. The impact will be positive.

- **Magnitude:**

Low (2): Given the high unemployment rates in the region (27%) and in Walvis Bay (26%) (NSA, 2025), the creation of employment opportunities is limited, the impact magnitude is therefore rated as low.

- **Reversibility:**

Recoverable (3): The positive impact will cease with the end of construction.

- **Duration:**

Short Term (2): The impact lasts only for the duration of the construction phase which will be 1 to 5 years.

- **Spatial Extent:**

Regional (3): some employment opportunities will be sourced locally and from the region with the majority of specialist skills sourced from outside the region.

- **Probability:**

Definite (5): The occurrence of this impact during the construction phase is certain.

- **Significance Rating:**

Severity / Magnitude	Reversibility	Duration	Spatial Extent	Probability
2 – Low	3 – Recoverable	2 – Short Term	3 – Regional	5 – Definite

The overall significance of the impact is calculated to be 50 {(2+3+2+3) x5} which is of medium significance.

7.2.2 Enhancement Measures

The following enhancement measures are practically possible to enhance the benefits of employment creation during the construction of the facility:

- **Local Recruitment Requirements:** Require contractors to adhere to local recruitment policies. Contractors should actively liaise with local job centres and community groups to identify and recruit potential candidates from Walvis Bay.
- **Compliance with Labour Laws:** Ensure that all contractors comply with national labour laws, including fair wages, working conditions, and non-discriminatory practices. This compliance should be regularly monitored and enforced.
- **Skills Training and Capacity Building:** Require the contractor to provide pre-construction training programmes to equip local residents with the necessary skills for construction work. This may include basic construction skills, occupational health and safety training, and specialised skills for operating machinery.
- **Inclusion of Women in the Workforce:** Implement targeted recruitment strategies to encourage the participation of women in the construction workforce. This includes offering training programmes tailored to women, providing flexible working conditions, and ensuring a safe working environment.
- **Support for Small and Medium Enterprises (SMEs):** Promote the involvement of local SMEs by providing them with opportunities to supply goods and services to the construction project. This can include subcontracting work to local construction firms and purchasing materials from local suppliers.
- **Health and Safety Training:** Conduct comprehensive health and safety training for all construction workers. This should cover the use of Personal Protective Equipment (PPE), safe handling of materials, and emergency response procedures.
- **Regular Monitoring and Reporting:** Establish a system for monitoring and reporting on the employment of local workers. This should include regular updates on the number of local hires, the types of jobs they are performing, and any training they have received.

7.2.3 Post-Enhancement Impact Assessment

- **Nature of impact:**

Maximising local employment opportunities during construction enhance benefits to the local community through local recruitment, training, and capacity building. This includes increasing female participation in the workforce and supporting local SMEs where possible.

The magnitude of the impact remains low with the implementation of enhancement measures aimed at further boosting training and thereby increasing the duration of the impact to medium term. The ratings for reversibility, spatial extent and probability remain unchanged from before the enhancement measures were implemented.

- **Significance Rating after Enhancement Measures:**

Magnitude	Reversibility	Duration	Spatial Extent	Probability
2 –Low	3 – Recoverable	3 – Medium Term	3 – Regional	5 – Definite

The overall significance of the impact is calculated to be 55 {(2+3+3+3) x5} which is positive of medium significance.

7.2.4 Conclusion

The overall significance of the creation of employment opportunities during the construction phase is medium and improves by implementing skills development, local procurement policies, community engagement, job placement support, and sustainability practices.

7.3 HEALTH & SAFETY IMPACTS DURING THE CONSTRUCTION PHASE

7.3.1 Impact Significance

- **Nature of the Safety/Health Impacts:**

On-site construction activities, including the transfer of building materials, will involve the use of heavy machinery, handling hazardous materials, and generating dust and pollutants. These factors pose health risks to workers and nearby residents. The activities will include excavation, infrastructure building, equipment installation, and material transfer, presenting multiple safety and health risks such as dust generation, exposure to pollutants, and physical hazards from material handling and transportation. The potential impact is negative in nature.

- **Severity/Magnitude:**

High (4): Exposure to dust and pollutants can lead to respiratory issues, while the operation of heavy machinery, handling of hazardous materials, and transfer of building materials can result in physical injuries and other health complications.

- **Reversibility:**

Recoverable (3): Some health impacts, such as minor respiratory issues or injuries, can be treated and managed with human intervention. However, more severe impacts may require significant medical intervention and rehabilitation.

- **Duration:**

Short Term (2): These impacts will persist for the duration of the construction period.

- **Spatial Extent:**

Local (2): The primary impacts will be localised to the construction site and immediate surrounding areas, as well as along the access roads of the site.

- **Probability:**

Definite (5): Given the nature of construction work, these impacts are definite.

- **Significance Rating:**

Severity / Magnitude	Reversibility	Duration	Spatial Extent	Probability
4 – High	3 – Recoverable	2 - Short Term	2 – Local	5 – Definite

The overall significance of the impact is calculated to be 55 {(4+3+2+2) x5}, which is a negative impact of medium significance.

7.3.2 Mitigation Measures

To mitigate the safety and health risks during the construction phase, the following measures should be implemented:

- **Health and Safety Protocols:**

➢ Comprehensive health and safety protocols, including regular safety training for all workers.
➢ Ensure the use of PPE for all workers on-site.

- **Dust and Pollutant Control:**

➢ Apply dust suppression techniques, such as regular watering of construction areas and roads with salt water.
➢ Use covered trucks for transporting materials to minimise dust emissions.
➢ Install dust gauges (buckets) around the site to track and manage pollutant levels.

- **Machinery and Equipment Safety:**

➢ Conduct regular maintenance and inspection of machinery and equipment to prevent malfunctions and accidents.
➢ Clearly mark hazardous areas and restrict access to authorised personnel only.

- **Safe Handling and Transfer of Building Materials:**

➢ Implement safe handling practices for the transfer of building materials, including the use of appropriate lifting equipment and techniques.
➢ Ensure that all workers involved in material transfer are trained in safe handling practices.
➢ Establish designated routes for the transportation of building materials to minimise the risk of accidents.

7.3.3 Post-Mitigation Impact Assessment

Should the proposed mitigation measures be implemented, the significance of the impact will be reduced as follows: the severity will decrease from high (4) to low (2), and the probability rating will drop from definite (5) to medium (3), due to the introduction of improved safety protocols and enhanced dust control measures. Despite this reduction in severity and probability, the ratings for reversibility and duration remain unchanged. This reflects that while the mitigation measures effectively reduce the severity of significant health and safety impacts, they do not influence the likelihood of these impacts occurring.

- **Significance Rating after Mitigation Measures:**

Severity / Magnitude	Reversibility	Duration	Spatial Extent	Probability
2 – Low	3 – Recoverable	2 - Short Term	2 – Local	3 – Medium

The overall significance of the impact is calculated to be 27 {(2+3+2+2) x3}, which negative impact of low significance.

7.3.4 Conclusion

The construction phase of the facility presents significant health and safety risks. However, the implementation of comprehensive health and safety protocols, effective dust and pollutant control measures, and stringent safe handling practices can reduce the severity of these impacts. With the mitigation measures, the impact significance is expected to reduce from 55 to 27, which is a significant reduction.

Proactive management of safety and health risks during the construction phase is essential for safeguarding the well-being of workers and nearby communities, ensuring compliance with regulatory standards, and achieving successful project outcomes.

7.4 TRAFFIC IMPACTS DURING OPERATIONS

7.4.1 Impact Significance

- **Nature of the Impact:**

Waste transport to the NAMWASTE Walvis Bay facility will include various types of vehicles handling different waste streams, as detailed the table below. Slops, cuttings, and source-separated recyclables from the rigs and the port will be sent to the facility for treatment and sorting. General waste from the rigs and the port will be transported directly to a disposal facility. Medical waste from the rigs will be transported directly to suitable medical waste treatment facilities. The estimated number of trips per vehicle type is indicated in Table 12.

Table 12: Types of Vehicles to Be Used for the Transportation of Waste to the Facility

Type of Vehicle	Number of vehicles per day	Waste stream
Tanker trucks	4	Bulk liquid waste (slops and cuttings).
Flatbed trucks	4	Containerised solid general and hazardous waste
Skip trucks	2	Solid general and hazardous waste.
Skip truck/medium duty vehicle	2	Transfer of liquid waste from the PSV to the tanker trucks, at the port.
Medium duty vehicles (3-5 tons)	4	Solid general and hazardous waste

The site will be accessed from the M36 main road via the D1983 gravel road, with an access road linking the D1983 to the site, as shown in Figure 8. These roads form part of the existing public road network and fall under the responsibility of the relevant road authority.

Operational transport activities are anticipated to result in increased traffic volumes, which may contribute to congestion, potential delays, safety concerns, elevated noise levels, and dust generation along key transport routes. These routes include Railway Street, 5th Street East, Hanna Mupetami Road, the M36, the D1983, and internal access gravel roads serving the site. Several of these routes are already constrained and, in some sections, are in poor condition, which may be exacerbated by additional heavy vehicle movements. Increased traffic along these routes may therefore affect traffic conditions within Walvis Bay. The area surrounding the port entrance, including Railway Street, is already under pressure due to the high volume of trucks delivering and collecting goods, as shown in Figure 20.

Figure 20: Traffic Conditions at the Port Entrance and along Railway Street

- **Severity/Magnitude:**

High (4): During the operational phase, a significant impact on vehicle movement and safety is anticipated due to the addition of 16 trucks to the daily traffic volume travelling through the town to and from the harbour. This impact will be exacerbated by the already congested traffic conditions in the area, contributing to the cumulative effect of heavy vehicle traffic in the town.

- **Reversibility:**

The impact is rated as 3 (recoverable). Impacts such as congestion and noise can be reversed through road improvements and improved traffic regulation.

- **Duration:**

Long Term (4): These impacts are expected to persist throughout the operational life of the facility.

- **Spatial Extent:**

Local (2): The primary impacts will be localised to areas directly affected by the transport routes that include the area surrounding the Railway Street 5th street East, Hanna Mupetami, M36, D1983 roads, and internal access gravel roads near the facility.

- **Probability:**

Definite (5): Given the nature of continuous truck operations, these impacts are certain to occur.

- **Significance Rating:**

Severity / Magnitude	Reversibility	Duration	Spatial Extent	Probability
4 – High	3 – Recoverable	4 – Long Term	2 – Local	5 – Definite

The overall significance is calculated to be 65 {(4+3+4+2) x5}, which is of high significance.

7.4.2 Mitigation Measures

The following mitigation measures are practically possible to reduce the anticipated impacts:

- **Traffic Management:**

➢ Implement a traffic management plan to monitor the impact of additional heavy vehicles and minimise congestion along routes such as the Railway Street 5th street East, Hanna Mupetami, M36, D1983 roads, and internal access gravel roads.

➢ Schedule truck movements to avoid peak traffic times and ensure efficient flow, particularly between 08:00 and 17:00 on weekdays (i.e., Monday - Friday).

- **Safety Measures:**

➢ Implement safety protocols, including speed control measures and clear signage.
➢ Conduct regular safety audits and training for truck drivers.

- **Noise Control:**

➢ Schedule noisy activities during less sensitive hours to minimise disruption to residents, specifically between 08:00 and 17:00 on weekdays (Monday to Friday). On Saturdays, operations should occur from 07:00 to 13:00. On public holidays and Sundays, operations should be limited, with the site closed.

- **Dust Mitigation:**

➢ Apply dust suppression techniques, such as watering gravel roads with salt water or, if possible, tarring the access roads.

- **Road Maintenance:**

➢ The Walvis Bay Municipality should schedule regular maintenance of impacted roads, particularly the gravel sections, to address wear and tear caused by heavy construction vehicles. Funding for such maintenance to be negotiated from the RFA from mass distance charges. The access road must be maintained by the project proponent until such time as it becomes part of a broader industrial area with formalised roads.
➢ Promptly repair any road damage to ensure safe and smooth traffic flow during construction.

7.4.3 Post-Mitigation Impact Assessment

The severity of impacts on vehicle movement and safety concerns during the operational phase will be mitigated from medium (3) to low (2) due to the proposed enhanced traffic management and safety protocols, while the other aspects—reversibility, duration, spatial extent, and probability—will remain unchanged.

- **Significance Rating after Mitigation Measures:**

Severity / Magnitude	Reversibility	Duration	Spatial Extent	Probability
2 – Low	3 – Recoverable	4 – Long Term	2 – Local	5- Definite

The overall significance after mitigation is calculated to be 55 {(2+3+4+2) x5}, which remains a negative impact of medium significance.

7.4.4 Conclusion

Overall, the mitigation measures proposed for implementation are expected to reduce the potential traffic and transport impacts during the operational phase from a high significance of 65 to a medium significance of 55. By proactively addressing traffic congestion, noise levels, dust generation, and road maintenance, the project aims to minimise disruption to local communities

and ensure compliance with environmental standards. Continuous monitoring and adaptation of these measures will be crucial to sustaining improvements throughout the operational phase, ensuring minimal long-term impacts.

It will be crucial, over time, to develop a new dedicated road to the port to separate port-related traffic from general traffic; however, the planning and implementation of such infrastructure will be the responsibility of the Walvis Bay Municipality.

7.5 EMPLOYMENT DURING OPERATIONS

7.5.1 Impact Significance

- **Nature of the Impact:**

  During operations, 96 full-time employment opportunities will be created. While some skilled positions may be filled by personnel brought in specifically for their expertise, the majority of jobs could be filled by local residents. Positions within the facility include general managers, HSE supervisors, administrative staff, laboratory analysts, plant operators, drivers/assistants, and general workers combine as outlined in Table 4. Employment opportunities during operation will contribute positively to the local economy and community. The impact will be positive.

- **Magnitude:**

  Moderate (3): Given the high unemployment rates in the region (27%) and in Walvis Bay (26%) (NSA, 2025), the creation of 96 full-time employment opportunities represents a meaningful positive contribution to local livelihoods. However, the scale of employment generation is not sufficient to substantially alter overall unemployment levels at a regional or municipal scale; therefore, the impact magnitude is assessed as moderate.

- **Reversibility:**

  Recoverable (3): Direct employment impacts can be enhanced with human intervention and improved even further with training and capacity building.

- **Duration:**

  Long Term (4): The impact is expected to be sustained over the operational lifespan of the facility.

- **Spatial Extent:**

  Regional (3): Local communities and regional skilled workers will benefit from the involvement of international companies specialising in waste management and related sectors, bringing essential expertise to the project.

- **Probability:**

Definite (5): It is certain that employment opportunities will be created during the operational phase.

- **Significance Rating:**

Severity / Magnitude	Reversibility	Duration	Spatial Extent	Probability
3 - Moderate	3 – Recoverable	4 – Long Term	3 – Regional	5 – Definite

The overall significance of the impact is calculated to be 65 {(3+3+4+3) x5} which is a positive impact of high significance.

7.5.2 Enhancement Measures

In order to maximise the positive impact on local employment, including gender equality, and ensure inclusive growth, mitigation and enhancement measures should prioritise the following:

- **Local Hiring Practices:**

➢ Implement policies that prioritise hiring from within Walvis Bay, from within the Erongo Region and then within Namibia.
➢ Collaborate closely with local job centres, community groups, and educational institutions to identify and recruit qualified individuals.

- **Gender Inclusion in Employment:**

➢ Develop strategies, where possible, to promote gender equality in recruitment and hiring practices, including encouraging applications from women and implementing policies that support fair treatment and advancement opportunities for all genders.
➢ Where possible, partner with local organisations and initiatives that support women's empowerment and workforce integration.

- **Partnerships with Local Institutions:**

➢ Explore partnerships with reputable institutions such as the Namibia University of Science and Technology (NUST) to design and implement targeted training programmes for employees.
➢ These initiatives will focus on equipping employees, including women, with relevant technical and managerial skills to support career development within the waste management sector and the circular economy.

- **Internship and Apprenticeship Programmes:**

➢ Provide internship and apprenticeship opportunities, where feasible, for Namibian students and graduates, including candidates from the local and regional area, to gain practical work experience aligned with the facility's operational needs.

- **Continued Education and Certification:**

➢ Offer support to ongoing education and certification opportunities to employees participating in the workforce, with a focus on promoting gender balance in training initiatives. This ensures continuous skill development and supports long-term career growth within the sector.

7.5.3 Post-Enhancement Impact Assessment

- **Severity/Magnitude:**

Moderate (3): The establishment of training programs will enhance the local workforce's capabilities, contributing to sustainable economic growth.

- **Reversibility:**

Recoverable (3): Direct employment impacts can be enhanced with human intervention and improved even further with training and capacity building.

- **Duration:**

Long Term (4): The benefits of skill development programs are expected to endure beyond the operational lifespan, benefiting the local economy.

- **Spatial Extent:**

Regional (3): The focus on enhancing local skills will predominantly benefit the regional workforce, improving local employment opportunities.

- **Probability:**

Definite (5): The implementation of skill development programs during operation is certain, given the project's commitment to maximising local and national benefits.

- **Significance Rating after Enhancement Measures:**

Severity / Magnitude	Reversibility	Duration	Spatial Extent	Probability
3 – Moderate	3 –Recoverable	4 – Long Term	3 – Regional	5 – Definite

The overall significance of the impact is calculated to be 65 {(3+3+4+3) x5} which is a positive impact with high significance.

7.5.4 Conclusion

In conclusion, the operational phase of the waste management facility will have a positive contribution through the creation of employment opportunities, with a focus on Namibian participation, including suitably qualified local and regional candidates. The project will also support positive skills development outcomes primarily among its workforce through targeted training initiatives aligned with operational requirements. Where feasible, collaboration with institutions such as the Namibia University of Science and Technology (NUST) may further enhance relevant technical and managerial skills within the waste management sector.

Collectively, these measures will positively support the effective operation of the facility and contribute, in a realistic and targeted manner, to longer-term workforce development in Walvis Bay and the broader region. Ongoing review and adaptation of employment and training practices will help ensure their effectiveness and maximise positive socio-economic outcomes.

7.6 HEALTH & SAFETY IMPACTS DURING THE OPERATIONAL PHASE

7.6.1 Impact Significance

- **Nature of Impact:**

The proposed Integrated Waste Management Facility will manage waste through treatment plants, handling hazardous materials, and transporting waste using heavy equipment. It will employ up to 96 people and include a camp to house 50 to 100 employees on-site.

The facility's operations will affect both nearby Green Valley residents and employees living on site. Impacts include noise, odour, traffic, and potential health risks from hazardous materials. Despite these challenges, the IWMF aims to integrate into the local community, providing jobs and supporting economic development.

- **Severity/Magnitude:**

High (4): The severity of health and safety impacts during the operational phase is assessed as high, due to the potential for serious injuries or fatalities associated with machinery operation, vehicle movements, on-site accommodation, and the handling and storage of hazardous materials and chemicals. While air quality–related impacts, including dust and pollutant exposure, have been assessed as low significance, the potential consequences of major accidents, spills, fires, or emergency events involving dangerous substances could be severe if they occur, particularly for employees and on-site residents. These risks justify a high severity rating, notwithstanding their low likelihood.

- **Reversibility:**

Recoverable (3): Human input into managing health and safety risks is able to limit the impacts.

- **Duration:**

Long Term (4): These impacts will persist throughout the operational life of the facility.

- **Spatial Extent:**

Local (2): The primary health and safety impacts will be localised to the operational site and immediate surrounding areas and the roads from the harbour to the site.

- **Probability:**

High (4): Given the nature of the facility's operations, it is highly probable that these impacts will occur.

- **Significance Rating:**

Severity / Magnitude	Reversibility	Duration	Spatial Extent	Probability
4 – High	3 – Recoverable	4– Long Term	2 – Local	4 – high

The overall significance is calculated to be 52 {(4+3+4+2) x4}, which is a negative impact of medium significance.

7.6.2 Mitigation Measures

The potential health and safety impacts can be mitigated through the following mitigation measures:

- **Health and Safety Protocols:**

➢ Conduct regular safety training for all workers, focusing on the safe handling of hazardous materials and chemicals and the operation of machinery.
➢ Ensure continuous use of PPE for all workers, including respiratory protection, gloves, and safety goggles.

- **Dust and Pollutant Control:**

➢ Implement dust suppression techniques, such as regular watering of operational areas and roads if applicable.
➢ Use covered trucks for transporting waste materials to minimise dust emissions.
➢ Install air quality monitoring stations around the site to manage pollutant levels and ensure compliance with environmental standards.

- **Machinery and Equipment Safety:**

➢ Perform regular maintenance and inspection of machinery and equipment to prevent accidents and ensure safe operation.
➢ Clearly mark hazardous areas with restricted access and provide appropriate signage and safety barriers.

- **Emergency Preparedness:**

➢ Develop and implement comprehensive emergency response plans, including procedures for handling spills, fires, and other emergencies.
➢ Conduct regular emergency drills to ensure readiness and familiarise workers with emergency protocols.
➢ Compile and implement an emergency preparedness plan associated with transportation of waste materials. Ensure safety and spill remediation equipment is on hand at all times and drivers are trained to respond to incidents.

- Liaise with local authorities on assistance that may be required in the event of emergencies. Sign a memorandum of understanding or a service level agreement, as appropriate.

- **Hazardous Materials Handling:**

- Implement strict protocols for the storage, handling, and disposal of hazardous materials to prevent accidents and exposure.

7.6.3 Post-Mitigation Impact Assessment

- **Severity/Magnitude:**

Should the proposed mitigation measures be implemented during the operational phase, they will reduce the severity of the impact from high (4) to moderate (3) due to improved safety protocols and enhanced dust control measures. However, because of the on-site camps, the probability of impacts remains high. This indicates that while mitigation efforts can significantly reduce severity, they cannot entirely eliminate the potential for health and safety impacts.

- **Significance Rating after Mitigation Measures:**

Severity / Magnitude	Reversibility	Duration	Spatial Extent	Probability
3 – Moderate	3 – Recoverable	4 – Long Term	2 – Local	4 – High

The overall significance is calculated to be 48 {(3+3+4+2) x4}, which is a negative impact of moderate significance.

7.6.4 Conclusion

Overall, the suggested mitigation measures will lower the impact significance from 52 to a reduced medium significance level of 48. However, the planned camp for 50-100 employees on-site should be reconsidered. Consideration should be given to accommodating employees in the nearby Green Valley instead or in Walvis Bay.

7.7 ECONOMIC OPPORTUNITIES DURING THE OPERATIONAL PHASE

7.7.1 Impact Significance

- **Nature the Impact:**

The IWMF, situated in the Erongo Region and Walvis Bay will primarily serve the oil industry by offering comprehensive waste management services. During the operational phase of the project, this facility is expected to play a significant role in boosting the local economy of Walvis Bay and the wider Erongo Region through various strategic initiatives:

- **Local Business Development:** By contracting local businesses for services such as waste collection, transport, and equipment maintenance, the facility is expected to stimulate the growth of small and medium enterprises, thereby strengthening the region's economic fabric.

The impact will be positive in nature.

- **Magnitude:**

Moderate (3): The positive impact on economic opportunities is moderate due to the potential for local Small, Medium and Micro Enterprises (SMMEs) development and business growth.

- **Reversibility:**

Reversible (3): The positive economic impacts could diminish if not managed with broader economic benefits and forward-thinking implementation in mind.

- **Duration:**

Long term (4): The operation of the IWMF is expected to generate positive economic benefits through job creation, business development, and contributions to the local economy, which may continue even after its operational life ceases.

- **Spatial Extent:**

Regional (3): The economic impacts will extend beyond the immediate area and into the Erongo Region.

- **Probability:**

High probability (4): Given the nature of the facility's operations, it is highly probable that these economic benefits will occur.

- **Significance Rating:**

Magnitude	Reversibility	Duration	Spatial Extent	Probability
3 - Moderate	3 – Reversible	4– Long Term	3 – Regional	4 - High Probability

The overall significance is calculated to be 52 {(3+3+4+3) x4}, which is a positive impact of medium significance.

7.7.2 Enhancement Measures

- **Support for Local Businesses:**

➢ Prioritise local suppliers and contractors for services and supplies needed for the facility's operations.

- **Community Investment:**

➢ Support community development initiatives through the company's Corporate Social Responsibility (CSR) programmes, which may include projects related to infrastructure, healthcare, education, or environmental awareness, subject to feasibility and alignment with CSR priorities.

➢ Where appropriate, engage with local government and community organisations to identify suitable CSR initiatives that respond to identified community needs.

➢ Where feasible, support initiatives that promote improved value chain practices, such as sorting at source, recycling, and reuse, in line with broader waste management and circular economy objectives.

7.7.3 Post- Enhancement Impact Assessment

Enhancement measures implemented during the operational phase will improve economic opportunities. The probability rating has improved from high probability (4) to definite (5), reflecting a higher likelihood of positive economic outcomes. The ratings for magnitude, reversibility, spatial extent, and duration will remain unchanged.

- **Significance Rating after Enhancement Measures:**

Magnitude	Reversibility	Duration	Spatial Extent	Probability
3- Moderate	3 – Recoverable	4 – Long Term	3 - Regional	5 - Definite

The overall significance is calculated 65 {(3+3+4+3) x5}, which is a positive impact of high significance.

7.7.4 Conclusion

Implementing the enhancement measures may increase the significance of the economic benefits from medium 52 to high 65.

8 CONCLUSION AND RECOMMENDATIONS

The SIA for the proposed IWMF at Walvis Bay, Erongo Region, Namibia has identified and evaluated nine potential impacts. Among these, two impacts were deemed invalid within the project's context and are highly unlikely to occur. These invalid impacts are:

1) Decrease in property values
2) Social inequalities
3) Security risks

Of the remaining valid potential impacts, three are positive and highly likely to occur:

1) Employment opportunities during construction
2) Employment opportunities during operations
3) Economic impact

However, four of the valid potential impacts are negative in nature, though likely to occur:

1) Health and safety risks during construction
2) Health and safety impacts during operations
3) Traffic Impacts during construction
4) Traffic impacts during operations

8.1 OVERALL ASSESSMENT

The proposed Integrated Waste Management Facility (IWMF) is anticipated to have a moderate negative social impact overall. However, considering the socio-economic context of Namibia, the strategic goals outlined in Vision 2030, and the objectives pursued through the National Development Plan 3 (NDP 3), the project is expected to yield numerous long-term positive outcomes. These positive impacts are likely to outweigh the short-term negative effects, provided that the mitigatioFn measures recommended in this Social Impact Assessment (SIA) are effectively implemented.

The following tables summarise the outcomes of the impact assessments conducted for the project activities, both before and after the proposed mitigation or enhancement measures are applied.

Table 13 presents the significance of potential impacts prior to the implementation of mitigation measures. This initial assessment indicates the areas where the project could have a considerable negative or positive influence on the surrounding environment and community.

Table 13: Assessment before Mitigation Measures

Project activity or issue	Potential impact	Nature of impact + / -	D/I/C	Significance before mitigation M	R	D	S	P	TOTAL	SP
CONSTRUCTION ACTIVITIES										
Construction activities	Increased Traffic	-	D	4	1	2	3	5	50	M
Construction activities	Employment Opportunities	+	D	2	3	2	3	5	50	M
Construction activities	Health and Safety - Exposure to hazards	-	D	4	3	2	2	5	55	M
OPERATIONAL ACTIVITIES										
Operational activities	Increased Traffic	-	D	4	3	4	2	5	65	H
Operational activities	Employment Opportunities	+	D	3	3	4	3	5	65	H
Operational activities	Health and Safety - Exposure to hazards	-	D	4	3	4	2	4	52	M
Operational activities	Economic Opportunities	+	D	3	3	4	3	4	52	M

Table 14 shows the significance of these same impacts after the recommended mitigation measures and enhancements from the Environmental Management Plan (EMP) have been applied. The results demonstrate that, with proper mitigation, many of the negative impacts can be reduced to moderate or even low significance, while positive impacts, particularly in terms of employment opportunities, are likely to be enhanced.

Table 14: Assessment after Mitigation & Enhancement Measures

Project activity or issue	Potential impact	Nature of impact		Significance after mitigation / enhancements as per EMP						
		+ / -	D/I/C	M	R	D	S	P	TOTAL	SP
CONSTRUCTION ACTIVITIES										
Construction activities	Increased Traffic	-	D	3	1	2	3	5	45	M
Construction activities	Employment Opportunities	+	D	2	3	3	3	5	55	M
Construction activities	Health and Safety - Exposure to hazards	-	D	2	3	2	2	3	27	L
OPERATIONAL ACTIVITIES										
Operational activities	Increased Traffic	-	D	2	3	4	2	5	55	M
Operational activities	Employment Opportunities	+	D	3	3	4	3	5	65	H
Operational activities	Health and Safety - Exposure to hazards	-	D	3	3	4	2	4	48	M
Operational activities	Economic Opportunities	+	D	3	3	4	3	5	65	H

The suggested mitigation measures are practical and, in many cases, have become standard operating procedures for similar facilities. These measures are summarised as the primary recommendations for the project.

8.2 RECOMMENDATIONS

To ensure the success and social acceptability of the IWMF project, the following recommendations are made:

1) **Reconsider the residential component on the site:** The residential component on the site is in conflict with the existing or proposed noxious industrial land use and should be carefully reconsidered, as it may not be allowed. Housing workers on site may also reduce the opportunity for local employment and secondary economic benefits.
2) **Implement comprehensive health and safety measures:** Stringent health and safety protocols must be enforced during both construction and operational phases to minimise risks to workers and nearby residents.
3) **Engage with the Community:** Transparent communication and proactive engagement with local communities must be maintained to address concerns and build support for the project.
4) **Equitable Job Creation:** Hiring local workers and providing training programs to enhance workforce skills, ensuring that employment opportunities benefit the local population should be prioritised.
5) **Traffic Management:** Effective traffic management plans to minimise congestion and safety risks during both construction and operational phases should be developed and implemented.
6) **Emergency Response:** Detailed plans and protocols are required to deal with emergency incidents, especially along transportation routes.
7) **Monitor and Mitigate Environmental Impacts:** Dust, noise, and vibration levels must be monitored regularly and measures to mitigate the impacts implemented to protect community health and well-being.

8) **Alternative Access Road:** Walvis Bay Municipality should develop a new dedicated road to the port and separate port traffic from normal traffic as per the Walvis Bay Urban Spatial Plan.

More specifically, the following mitigation measures must be incorporated into the Environmental Management Plan:

8.3 MITIGATION MEASURES

8.3.1 During Construction Phase

1) **Dust Suppression and Control:** Apply dust suppression techniques such as watering gravel roads, implementing speed limits, and regular monitoring to control dust emissions. Consideration must be given to surface the access road to the site. Install dust gauges (buckets) around the site to track and manage pollutant levels.

2) **Noise Control:** Implement noise control measures such as using quieter machinery, scheduling noisy operations during less sensitive times of day, and installing noise barriers where feasible. Conduct regular noise monitoring to ensure compliance with local regulations and standards.

3) **Road Maintenance:** The Walvis Bay Municipality should schedule regular maintenance of impacted roads, particularly the gravel sections, to address wear and tear caused by heavy construction vehicles. Funding for such maintenance to be negotiated from the RFA from mass distance charges. The access road must be maintained by the project proponent until such time as it becomes part of a broader industrial area with formalised roads.

4) **Safety and Health Protocols:** Enhance safety protocols and dust control measures to reduce health and safety risks. Conduct regular safety training for workers on the safe handling of hazardous materials and operation of machinery.

5) **Traffic Management:** Implement traffic management plans to reduce the negative impacts associated with construction transport.

8.3.2 During Operational Phase

1) **Health and Safety Protocols:** Conduct regular safety training and ensure continuous use of PPE for all workers.

2) **Emergency planning and response:** Develop and implement comprehensive emergency response plans, including procedures for handling spills, fires, and other emergencies.

3) **Dust and Pollutant Control:** Implement dust suppression techniques and use covered trucks for transporting waste materials to minimise dust emissions. Install dust gauges (buckets) around the site to manage pollutant levels and ensure compliance with environmental standards.

4) **Machinery and Equipment Safety:** Perform regular maintenance and inspection of machinery and equipment to prevent accidents and ensure safe operation.

5) **Handling of Hazardous Materials:** Implement strict protocols for the storage, handling, and disposal of hazardous materials to prevent accidents and exposure.

8.4 ENHANCEMENT MEASURES

To maximise positive impacts on local employment and ensure inclusive growth, the following enhancement measures should be prioritised:

1) **Local Hiring Practices:** Implement policies that favour hiring from Walvis Bay, the Erongo Region, and Namibia. Collaborate with local job centres, community groups, and educational institutions to recruit qualified individuals.
2) **Gender Inclusion in Employment:** Develop strategies to promote gender equality in recruitment and hiring practices. Actively encourage applications from women and implement policies that ensure fair treatment and career advancement opportunities for all genders. Partner with local organisations supporting women's empowerment.
3) **Partnerships with Local Institutions:** Explore partnerships with institutions such as the Namibia University of Science and Technology (NUST), where appropriate, to support targeted training initiatives primarily for employees, with a focus on building technical and managerial skills relevant to the waste management sector and the circular economy.
4) **Internship and Apprenticeship Programmes:** Establish structured internship and apprenticeship programmes to provide practical experience to local residents, including recent graduates and students from Namibian educational institutions.
5) **Continued Education and Certification:** Support ongoing education and certification opportunities for employees, where practicable, to promote skills development and career progression, with due consideration given to gender balance in training participation.
6) **Support for Local Businesses:** Prioritise the use of local suppliers and contractors for facility operations, where possible. Opportunities to support local business capacity development may be considered where this aligns with operational and procurement requirements.
7) **Community Investment:** Contribute to community development initiatives through the company's CSR programmes, where feasible and aligned with CSR priorities. Such initiatives may include projects related to education, skills development, environmental awareness, or improved value chain practices such as sorting at source, recycling, and reuse. Engagement with local authorities or community organisations may be undertaken to identify suitable opportunities.

By addressing these recommendations and implementing the specified mitigation measures, the IWMF project can achieve its objectives while minimising negative socio-economic impacts and maximising positive outcomes for the local and regional community.

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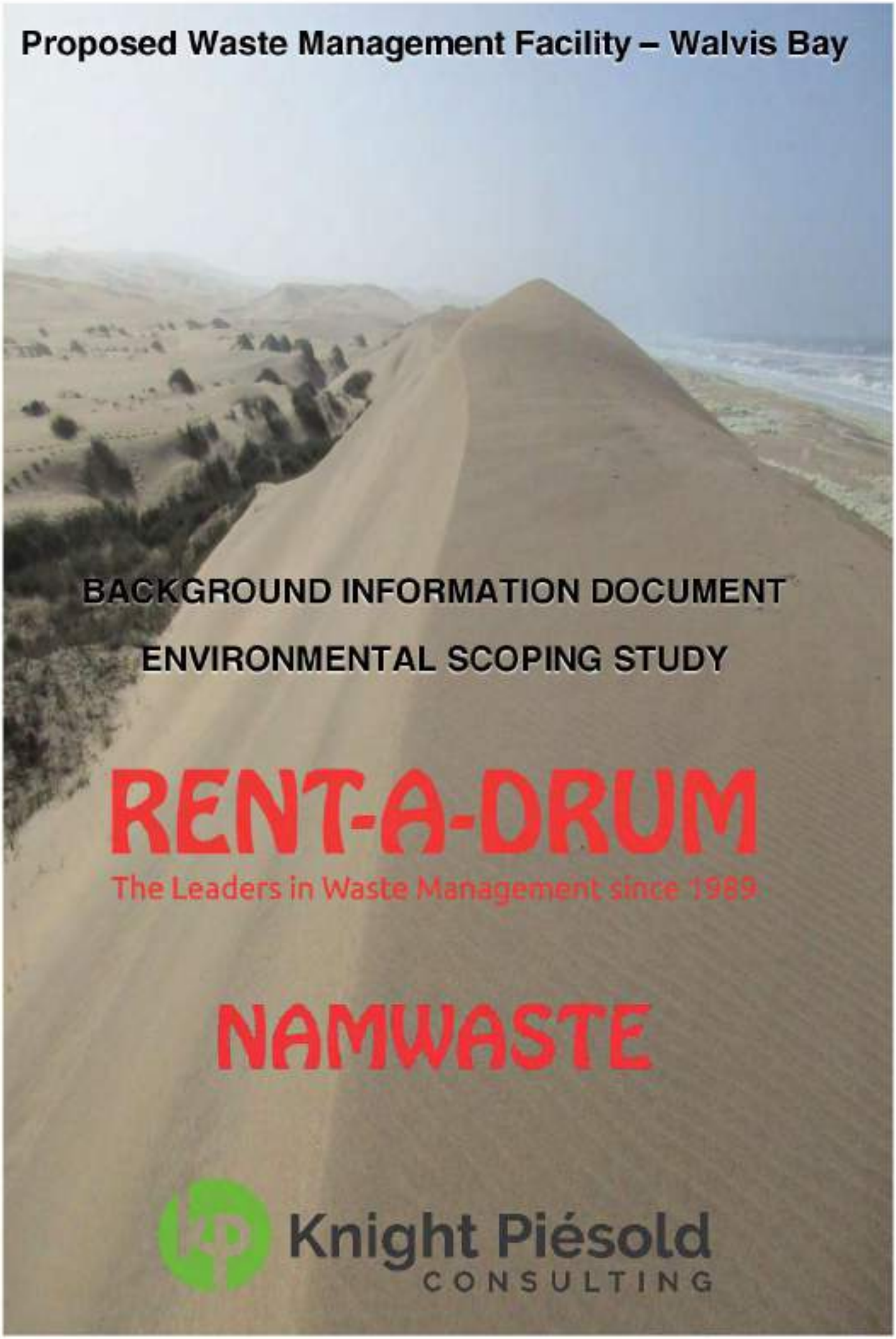
ANNEXURE A

Background Information Document



Proposed Waste Management Facility – Walvis Bay

BACKGROUND INFORMATION DOCUMENT

ENVIRONMENTAL SCOPING STUDY

RENT-A-DRUM

The Leaders in Waste Management since 1989

NAMWASTE

Knight Piésold CONSULTING

BACKGROUND

Rent-A-Drum (Pty) Ltd (Rent-A-Drum) has been operating in the Namibian waste management sector for 34 years. The Sêché Environnement Group acquired a majority stake in the Rent-A-Drum Group in 2023. Namwaste (Pty) Ltd, the applicant for the proposed project, is a subsidiary of Rent-A-Drum. Namwaste (Pty) Ltd has applied to the Environmental Commissioner for an Environmental Clearance Certificate in terms of Environmental Management Act, 2007 for the Proposed Waste Management Facility in Walvis Bay.

This document aims to provide background information on the proposed Project to enable interested and affected parties to provide their comments or concerns.

PROJECT DESCRIPTION

Rent-A-Drum, through its subsidiary, Namwaste (Pty) Ltd., aims to develop new industrial waste treatment and disposal facilities in Namibia, which will address the pressing shortage of solutions for industrial and hazardous waste management in the Country and will contribute to the protection of the environment whilst also creating employment opportunities and fostering economic growth.

Namwaste is proposing to develop an integrated waste management, treatment, transfer and recovery facility in Walvis Bay, Namibia. Portion 160 of the Proposed Portion A of the Remainder of Farm 38, Walvis Bay, of approximately 7.8133 ha, has been identified and secured, approximately 20 km from the Port entrance. The site is located just north of the Tropic of Capricorn in the Kuiseb River Delta and lies at the end of the TransNamib Railway to Windhoek, and on B2 road.

The facility will largely be tailored to the specific needs of the offshore oil and gas exploration and production industry.

The primary site-specific activities include the following:

- Thermo-mechanical cuttings cleaner treatment plant which treats Oil Based Mud Cuttings and recovers base oil (slops and cuttings)
- General and hazardous solid and liquid waste treatment including but not limited to:

    - Neutralization
    - Stabilization
    - Solidification
    - Evaporation
- Reduction of the hazardous nature of the waste through chemical treatment using various chemical additives (e.g., hydrogen peroxide, ozone, chlorine, lime etc.)
- Water treatment (slops treatment unit including centrifuge, chemical treatment, Dissolved Air Flotation Unit (DAF), oxidation, and polishing)
- Handling, treatment, baling, shredding and similar, of waste materials, recyclables and other materials. A manual dirty material recovery facility will be constructed and operated
- Scrap metal, wood, plastic, etc., processing for recycling and reuse
- Storage of waste streams onsite in appropriate bunds, warehouses and tanks
- Tank and skip washing
- Discharge of treated effluent – destination to be determined
- Storage tanks for drilling materials and liquid wastes in silos and tanks also referred to as a tank farm or mud plant
- Truck depot
- Bin yard.

Ancillary infrastructure associated with the project will include stormwater management infrastructure, access control facilities, fuel storage facilities, weighbridges and control rooms, offices and administrative buildings, workshops, chemical stores and staff dining and ablution facilities. In addition, an analytical laboratory will be present to test and verify the classification of incoming and treated waste.

Utilities servicing the plant will include the following:

- Electricity supply from municipal supply and/or solar plant
- Water supply from municipal mains and/or boreholes
- Sewage line connection to municipal mains.

The map below provides the proposed project location.

Kuisebmond
Narraville
Walvis Bay
Meeresig
Proposed
Namwaste
Facility
0 750 1500 3000 4500 6000
Meters

Potential environmental impacts have been identified and are presented in the table below, together with proposed mitigation measures.

ANTICIPATED IMPACTS AND PROPOSED MITIGATION	
Impact	Mitigation
Change in land use	• Demarcate sensitive areas • Declare these as "no go" areas
Increase noise levels	• Working hours restricted • All vehciles and machinery to conform with regional noise standards
Increased emissions impacting air quality	• Development and implementation of routine emissions and ambient air quality monitoring program to determine whether there are any significant increases in emissions • Limit vehicle idling and keep vehicles well maintained to minimise gaseous emissions
Increase in water use	• Undertake study to ascertain available water resources
Reduced biodiversity	• Species of conservational concern to be carefully handled and replanted/relocated elsewhere
Increase surface water runoff	• Implement erosion control measures • Design surface water infrastructure such as culverts and drains
Topsoil loss and contamination	• Store topsiol in secure stockpiles • Store hazardous substances in appropriately bunded areas or specified containers
Potential leachate impacting groundwater quality	• Implement proper design and operational measures to avoid or minimise the generation and/or release of contaminated water to the receiving environment • Stormwater infrastructure must be constructed and operated with the aim of minimising the potential for pollution in groundwater • Install a groundwater monitoring network around the elements of the waste treatment facility capable of affecting groundwater
Socio-economic benefit	• A number of job opportunities will be created

ENVIRONMENTAL SCOPING AND IMPACT ASSESSMENT PROCESS

According to Regulations 5 and 6 of the Namibian EIA Regulations in Government Notice (GN) 30 of 2012; an Environmental Clearance Certificate (ECC) must be obtained prior to the undertaking of any activities listed in GN (29) of 2012. An application for an ECC has been submitted to the Ministry of Environment, Fisheries and Tourism (MEFT) in terms of Section 32 of the Environmental Management Act (2007). The environmental scoping and impact assessment process includes project application and screening with the MEFT, followed by environmental scoping and impact assessment phases, as well as the compilation of an Environmental Management Plan (EMP) to ensure that the potential environmental and social impacts are avoided, minimised and /or mitigated throughout the project phases. During the scoping and impact assessment phases, specialist studies will be undertaken such as socio-economic, cultural heritage and hydrogeological assessments. This background information document serves as the start of the Environmental scoping and public participation processes for the Project.

All Interested and Affected Parties (I&AP) are invited to register as such and participate in the public process. To register as an I&AP, please submit your full name and contact details to Knight Piésold at the details provided below with the project title as the email subject. The Environmental Scoping Report, once drafted, will be made available online for a public review period of 30 days. Registered I&APs will be informed of the review period dates and details via email and sms.

FOR FURTHER INFORMATION PLEASE CONTACT:

Lloyd Lynch llynch@knightpiesold.com or

Amelia Briel abriel@knightpiesold.com

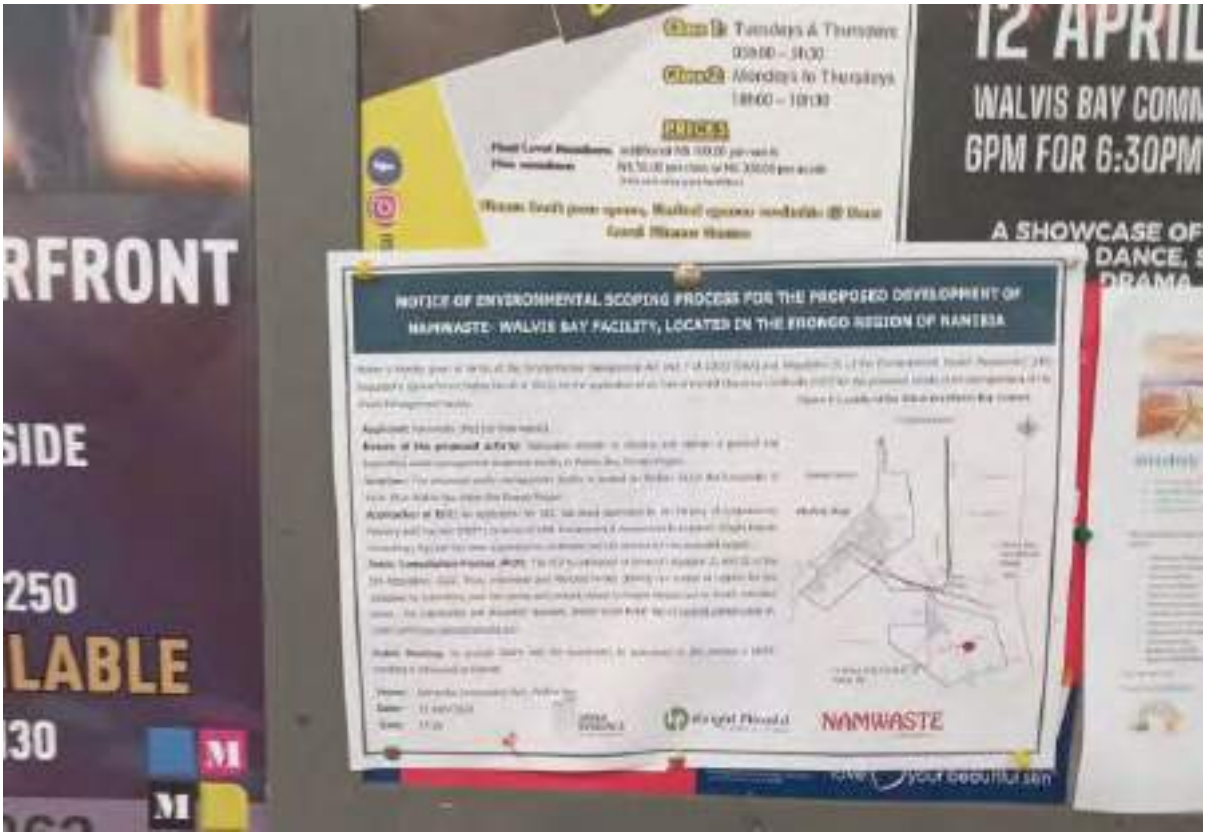
ANNEXURE B

Public Meeting Notices

SITE NOTICE

COUNCIL NOTICE

NOTICES AT OK AND SPAR



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NOTICE OF ENVIRONMENTAL IMPACT AND SOCIAL IMPACT PROCESS FOR THE PROPOSED DEVELOPMENT OF NAMWASTE SOLID WASTE FACILITY LOCATED IN THE ERONGO REGION OF NAMIBIA

Proposed activity/ies: Namwaste (Pty) Ltd intends to develop and operate a general and hazardous waste management treatment facility in Walvis Bay, Erongo Region.

Location: The proposed waste management facility is located on Portion 160 of Remainder of Farm 38 in Walvis Bay within the Erongo Region.

Application of EIOC: An application for EIOC has been submitted to the Ministry of Environment, Forestry and Tourism (MEFT) in terms of EMA.

Environmental Assessment Practitioner: Knight Piésold Consulting (Pty) Ltd has been appointed to undertake the EIA process for the proposed project.

Public Consultation Process (PCP): The PCP is conducted in terms of regulation 21 and 22 of the EIA Regulations, 2012.

Thus, Interested and Affected Parties (IAPs) are invited to register on the database by submitting your full names and contact details to Knight Piésold on the details provided below.

For registration and document requests, please email Noah Nel at noah@desertlaw.com or Lloyd Lynch at lloyd.lynch@knightpiesold.com.

Public Meeting: To provide IAPs with the opportunity to participate in the process a public meeting is scheduled as follows:

Venue: Narraville Community Hall, Walvis Bay
Date: 11 April 2024
Time: 17:30

NAMWASTE

NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT PROCESS FOR THE PROPOSED DEVELOPMENT OF NAMWASTE SOLID WASTE FACILITY LOCATED IN THE OMAHEKE REGION OF NAMIBIA

Proposed activity/ies: Namwaste (Pty) Ltd intends to develop and operate a general and hazardous waste management treatment facility in Gobabis, Omaheke Region.

Location: The proposed waste management facility is located on Erf 2046 Gobabis Extension 5 in Gobabis within the Omaheke Region.

Application of EIOC: An application for EIOC has been submitted to the Ministry of Environment, Forestry and Tourism (MEFT) in terms of EMA.

Environmental Assessment Practitioner: Knight Piésold Consulting (Pty) Ltd has been appointed to undertake the EIA process for the proposed project.

Public Consultation Process (PCP): The PCP is conducted in terms of regulation 21 and 22 of the EIA Regulations, 2012. Thus, Interested and Affected Parties (IAPs) are invited to register on the database by submitting your full names and contact details to Knight Piésold on the details provided below. For registration and document requests, please email Noah Nel at noah@desertlaw.com or Lloyd Lynch at lloyd.lynch@knightpiesold.com.

Public Meeting: To provide IAPs with the opportunity to participate in the process a public meeting is scheduled as follows:

Venue: Tjunkuda Hall, Gobabis
Date: 9 April 2024
Time: 17:30

NAMWASTE

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MOVABLE GOODS AUCTION

NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT PROCESS FOR THE PROPOSED DEVELOPMENT OF SUNRISE WASTE MANAGEMENT FACILITY LOCATED IN THE EKONGO REGION OF NAMIBIA

Public Meeting: To provide IAPs with the opportunity to participate in the process a public meeting is scheduled as follows:

Venue: Neparuke Community Hall, Walvis Bay

Date: 11 April 2024

Time: 17:30

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NAMWASTE

Indigenous Language Pages

ANNEXURE C

22 February 2024 Recon Site Meeting Minutes

MEETING MINUTES

Namwaste
Walvis Bay Municipality Meeting

Reconnaissance Meeting:

Date:	22 February 2024	**File No.:**	1284
Time:	14:30– 15:30	**Cont. No.:**	<<Continuity_Number>>
Place:	WWEM Office Room, Walvis Bay,		
Note Taker:	Tresia Amwaalwa		

Participants:	Refer to attached attendance register (embedded file)
Regrets:	None
Distribution:	

Minutes and Action Items:

Item No.	Description
1.0	**Welcome**
	Mr. Uushana from WBM welcomes all.
2.0	**Introduction of Participants**
	All participants introduced themselves.
3.0	**Objectives**
	Heidri Bindemann-Nel from UDA explained the objectives of the meeting.
4.0	**Technical Background**
	Mr. Provendier from Rent a Drum provided some technical back ground on the project related to question that was asked.
5.0	**Discussions**
	The main points raised during discussions are as follows:
5.1	**The Green Valley Community:** The proposed site is located on Portion 160 of Farm 38, east of the D1983 road, situated less than 1km from the Green Valley community. Discussions have highlighted concerns regarding the impact of air quality on nearby land uses, particularly focusing on the Green Valley informal housing development to the west of the D1983. However, it is noteworthy that to the east of the site, existing land uses include various

Urban Dynamics (Pty) Ltd. |46 Nelson Mandela Ave., | Klein Windhoek, Windhoek | Namibia
T +264 61 240 300 | E info@udanam.com

Item No.	Description
	activities such as the Oval track, King Charcoal factory, CPP Quarry, and BC Stone operations, all of which are known for their potential to impact air quality in the area. Importantly, some of these existing land uses already involve hydrocarbons.
5.2	**Impact of waste water:** Mr. Dreyer expressed concerns about the potential ramifications of releasing wastewater into the sewage system, which is presently operating at full capacity. Mr. Provendier clarified by explaining that the site will include an evaporation plant for treating wastewater. He further elaborated that the wastewater to be discharged will not originate from the waste treatment process, but will exclusively come from the ablution blocks used by the 40 workers.
5.3	**Security of the site:** Mr. Dreyer highlighted the importance of ensuring security at the site. In response, Mr. Louw affirmed that the area will be securely fenced off and equipped with appropriate security measures.
5.4	**Alternative hazardous waste site:** Mr. Louw emphasised that the site will generate hazardous waste. Mrs. Nel inquired about an alternative hazardous waste site, specifically the proposed area designated in Walvis Bay's Structural Plan, which has earmarked a location for hazardous materials near the airport on Farm 58. Mr. Louw clarified that hazardous waste will be transported from Portion 160 to the proposed Namwaste Management Facility (NMF) near Arandis for safe treatment and disposal.
5.5	**Route determination:** Given that the client has not yet disclosed the quantity of waste to be handled, Mr. Provendier currently lack the necessary information to estimate the route or determine the number of trucks required for transportation from the port to the site. Therefore, he is unable to provide this information at this time.
5.6	**The potential impact on the river and dam:** An additional concern was raised during the meeting, emphasising the locality of the site from the nearby river and the three NamWater reservoirs near Mile 7 in the study.
6.0	**Summary of decisions**
6.1	Urban Dynamics will commence with a public consultation phase in April, which will include a public meeting in Walvis Bay. Ms. Amulenya indicated that the municipality will assist with inviting stakeholders to the meetings.
7.0	**Meeting closure**
	Attendees were invited to visit the site with Urban Dynamics.

Attendance registers

No.	Participant's name	Gender (Tick √)		Organisation	Position	Contact number	e-mail address or Postal address
12.	Rohan Isaac	M	F	Rent-A-Drum	Coastal Manager	081 245 2858.	rohan@rent-a-drum.com.na
13.	Tresia		✓	UDA	Town Planner	0813548251	tresia@udanam.com
14.	Deville Dreyer	M		Municipality	Chief Health	081 1283887	ddreyer@walvisbaycc.org.na
15.	Lovisa Hailaula		✓	Municipality	Environmental Officer	064-214306	lhailaula@walvisbaycc.org.na
16.	Nangula Amulenya		✓	Municipality	Environmental Coordinator	064-214305	namulenya@walvisbaycc.org.na
17.	DAVID UASHONA	✓		"	MANAGER: IWM	0811220814	DUHISHONA@.....
18.	Heidri-Nel		✓	UDA	EP	0816517336	heidri@udanam.com
19.	Morelize Mostert		✓	Geo Bus. Solution	GIS Practitioner	0818278705	morelize@geosol.com.na
20.	Thierry Provendier	✓		Rent-a-Drum	Director of Ops		Mr T. Provendier@rent-a-drum.co
21.	Virginia. T		✓	Interwaste SA		+27 083 707 1919	VirginiaT@interwaste.co.za
22.							
23.							
24.							

ANNEXURE D

12 April 2024 Public Meeting Minutes and Attendees Register

PUBLIC MEETING FOR THE NAMWAST WASTE MANAGEMENT FACILITY – WALVIS BAY

Date: 11/04/2024 **Region:** Erongo Region **Place:** Narraville Community Hall **Name of activity:** Public Meeting

No.	Participant's name	Gender (Tick ✓) M	F	Organisation	Position	Contact number	e-mail address or Postal address
1.	Theofelus Hafeni		✓	We care youth Empowerment	Founder	0814757123	wecareyouth theofelus30@gmail.com
2.	Lise Steyn		✓	Interwaste	Environmental Scientist	082 491 8149	l.steyn@interwaste.co.za
3.	Hulisani Netshiavuh		✓	Interwaste	Environmental Scientist	0726064102	hulisanih@interwaste.co.za
4.	Heleni Jatamen		✓	Urban Dynamics	Enviromet	0816517336	Helein@uclaunch.com
5.	Ernst Sam	✓		UDA.	Sociologist	0811245788	ernst@udaram.
6.	T. Mhoney		✓	Resident		0816081746	theapanymhoney@gmail.com
7.	Lloyd Lynch	✓		Knight Presold	Senior Environmental Scientist	083296113	llynch@knightpiesold.com
8.	Hilke Hamukuaja		✓	RAD	PR Manager	0811277913	Pr@rent-a-drum.com.na
9.	Sandra Gordon		✓	Resident		0811419153	sandra.gordon@ol.na
10.	Paulina Nghihalemote		✓	Kuisembmund	resident	0814443403	Paulinakapau.com@gmail
11	Niel Busch	✓		Narraville	resident	0814270548	

PUBLIC MEETING FOR THE NAMWAST WASTE MANAGEMENT FACILITY – WALVIS BAY

Date: 11/04/2024 **Region:** Erongo Region **Place:** Narraville Community Hall **Name of activity:** Public Meeting

No.	Participant's name	Gender (Tick √)		Organisation	Position	Contact number	e-mail address or Postal address
		M	F				
1.	NAOMI ISAACS		✓	NARRAVILLE		0814072391	—
2.	Saara Samuel		✓	Narraville		0817990392	Samuelsaara01@gmail.com
3.	Collin Johannes	✓		Narraville		0813749244	
4.	Titus SHALongo	✓		Namwast		0817264048	
5.	Mushimba Elizabeth		✓	Narraville		0813571346	
6.	Muniazo Jypena	✓		Narraville		0813883016	jypenandjambimuniazodonald@gmail.com
7.							
8.							
9.							
10.							
11							

MEETING MINUTES

Namwaste
Walvis Bay Public Consultation

Public Meeting:

Date:	11 April 2024	**File No.:**	1284
Time:	17:30– 19:00		
Place:	Narraville Community Hall, Walvis Bay,		
Note Taker:	Heidri Nel		

Participants:	Refer to attached attendance register
Regrets:	None
Distribution:	

Minutes and Action Items:

Item No.	Description
1.0	**Welcome:**
	The meeting facilitator, Ernst Simon from Urban Dynamics Africa (UDA), extended a warm welcome to all attendees.
2.0	**Purpose:**
	Ernst provided insights into the purpose of the meeting.
3.0	**Project Background:**
	Ernst introduced the project teams and provided an overview of Urban Dynamics Africa. Lloyd Lynch from Knight Piésold (KP) Consulting Engineers gave insights into KP's role in the project.
5.0	**Project Infrastructure & Technical Background:**
	Lise Steyn from Interwaste provided insight into the project infrastructure and technical background.
6.0	**The ECC Process:**
	Lloyd explained the phases of the Environmental Clearance Certificate (ECC) process and the project's current status.
7.0	**Project Site:**
	Lloyd provided an overview of the project site.
8.0	**Project Impacts:**
	Lloyd discussed the potential environmental impacts of the project, while Ernst addressed the possible social impacts.

Urban Dynamics (Pty) Ltd. |8 Hugo Hann Street, | Klein Windhoek, Windhoek | Namibia
T +264 61 240 300 | E info@udanam.com

Item No.	Description
9.0	**Questions and Comments:**
	The community had the opportunity to raise concerns and provide feedback regarding the project.
9.1	**Q:** When will the facility become operational? **A**: Construction is set to begin within 8 months, with operations expected to commence by October 2025.
9.2	**Q**: What impact will the project have on local job opportunities? **A:** Priority will be given to recruiting local individuals and young people, with a commitment to employing 40% of local residents for sorting roles. Additionally, there will be opportunities for truck drivers to transport waste to and from the port to the site. Skilled workers from Walvis Bay currently located elsewhere may also return for job opportunities.
9.3	**Q:** Will there be training opportunities? **A:** Yes, training will focus on skill transfer and developing local expertise. This includes training local residents in skills relevant to operating the facility.
9.4	**Q:** What types of waste will the facility handle? **A:** The facility will primarily manage waste from oil industry vessels. Additionally, Walvis Bay's current Rent-a-Drum recycling facility will handle household waste, wood, and steel. Hazardous waste will be transported to the proposed Hazardous Waste facility near Arandis.
9.5	**Q:** How will unauthorised access by trash pickers be prevented? **A:** The facility will be fenced and equipped with security measures to prevent unauthorised access. Waste from the boats will be securely packed, ensuring it remains in a controlled environment and minimising the possibility of interference by trash pickers.
9.6	**Q:** What will be the traffic impact? **A:** The project will involve five trucks continuously hauling waste from the port to the facility 24/7. This will result in a cumulative traffic impact over time. It is crucial to consider this long-term impact on traffic flow and plan accordingly to mitigate potential congestion or safety concerns.
10.0	**Conclusion:**
	The meeting concluded at approximately 19:00. Ernst indicated that all attendees would be registered as Interested and Affected Parties and would receive the final report.

Proposed Waste Management Facility: NAMWASTE Walvis Bay

Public Consultation Meeting

Narraville Community Hall, Walvis Bay
11/04/2024

Knight Piésold — Adding value. Delivering results

Agenda/Outline

1. Introductions
2. Purpose
3. Project Background
4. Project Infrastructure
5. ECC Process
6. Project Site
7. Project Impacts

Introductions

Project Core Team

- **Namwaste (Pty) Ltd** NAMWASTE
  - Thierry Provendier (Rent-A-Drum)
  - Hilka Hamukuaja (Rent-A-Drum)
  - Lise Steyn (Interwaste)
  - Hulisani Netshisaulu (Interwaste)
- **Knight Piésold Consulting (Pty) Ltd**
  - Lloyd Lynch
  - Joe Mulders
  - Lima Maartens
- **Urban Dynamics(Pty) Ltd**
  - Heidri Nel
  - Ernst Simon

Project Background

Urban Dynamics Africa

- Urban Dynamics Africa (Pty) Ltd is a Namibian based consulting company.
- We provide professional services in the fields of urban and regional planning, socio-economic research, social impact assessments, indicator & monitoring systems development, property portfolio management, environmental management & feasibility studies.

Project Background

KP Namibia

- Knight Piésold Consulting (Pty) Ltd began operations in Namibia in 2008 with the opening of the Windhoek office.
- We provide engineering design and construction supervision services to the infrastructure, transportation, water resources, power, building, and mining industries.
- Various Awards:
  - Diamond Arrow Awards from PMR Africa: Top consulting engineering firm in Namibia (2022 and 2023) .
  - Consulting Engineers of Southern Africa (CESA): Several awards for projects completed in Namibia.

Purpose

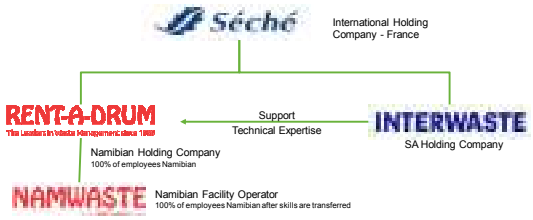
Public Meeting

- Inform Stakeholders of the Proposed Project
- Inform Stakeholders of the Authorisations Required (ECC)
- Gain Inputs / Concerns from Public
- Open Channels of Communication

Project Background
Namwaste (Pty) Ltd

- Rent-A-Drum (Pty) Ltd (Rent-A-Drum), which has been operating in the Namibian waste management sector for 34 years was acquired by the Séché Environnement Group in 2023. Rent-A-Drum currently offers integrated waste management solutions and has an operational footprint in 6 of Namibia's regions, serving over 2,000 customers and employing approximately 550 full time staff members.
- Rent-A-Drum, through its subsidiary, Namwaste (Pty) Ltd., aims to develop new industrial waste treatment and disposal facilities in Namibia, which will address the pressing shortage of solutions for industrial and hazardous waste management in the Country.

Project Background
Summary of Group Structure for the Project



Project Background
Proposed Project

- Development of new industrial waste treatment and disposal facilities in Namibia
  - Lüderitz
    - Approximately 3.2 km from Port entrance
  - Walvis Bay
    - Approximately 20 km from Port entrance
- Increased production of waste offshore of both Lüderitz and Walvis Bay, existing commercial and industrial uses of the Port and the lack of suitable industrial waste treatment facilities necessitate a private sector solution to manage the waste on-shore, both from off-shore activities and port activities.

Project Background
Project Location: Walvis Bay

Project Infrastructure Overview
Project Infrastructure Overview

- Thermo-mechanical cuttings cleaner (TCC) treatment plant
- Slops treatment plant
- Incinerator
- Waste and drilling fluid storage infrastructure
- Tank and skip washing bay
- Storage tanks for drilling fluid in silos and tanks
- Truck depot & bin yard

Project Infrastructure Overview
Ancillary Infrastructure

- Stormwater/runoff management infrastructure
- Plant/vehicle wash bay with contaminated runoff control measures
- Analytical laboratory – Test and verify classification of incoming and treated wastes
- Access Road
- Access control facilities
- Weighbridges and control room
- Fuel storage facilities
- Offices and administrative buildings
- Borehole monitoring network
- Additional features such as ablutions, accommodation camp, workshops, sewage management facilities, etc.
- Utilities:
  - Electricity supply from municipal supply
  - Water supply from municipal mains or from Namwater (potable water) and potential supply from boreholes will be investigated
  - Municipal sewage connection

Project Infrastructure Overview
Example of Proposed Infrastructure Units

Treatment Processes
Project Waste Streams & Drilling Fluids

- Waste streams
  - Slops → ~ 10% oil, 80% water & 10% solids (rock).
  - Cuttings → ~ 15% oil, 15% water & 70% solids (rock).
  - General and hazardous solid waste
  - Medical waste
- Drilling fluids
  - Mud → oil, water or synthetic based – suspends rocks in well and lubricates drill bit.
  - Brine → water with high salt content – controls pressure in well and cools drill bit.

Treatment Processes
End Products

- Recovered oil - back to client
- Recovered water – discharge to ocean, evaporation and/or reuse on site
- Solids (e.g. non-organics, salts & heavy metals) from slops and cuttings treatment – disposed to landfill
- Incinerator ash – sent to landfill for use in treatment recipes
- Recyclables – sent for processing
- Solid hazardous waste (e.g. paint cans) – disposed to landfill

Treatment Processes
Process Flow

Treatment Processes
Cuttings & mud treatment

- Thermo-mechanical cuttings cleaner (TCC) grinds cuttings which forms frictional heat used to separate oil, water & solids.
- Oil is condensed using heat and recovered.
- Steam is condensed to form water and recovered.
- Solids are disposed to landfill.

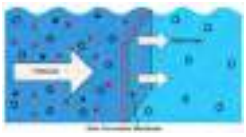
Treatment Processes
Slops & brine treatment

- Centrifuge separates solids and liquids.
- Solids are disposed to landfill.
- Liquid component treated → pH is corrected, coagulation and flocculation process.

Treatment Processes

Slops treatment

- Treated water proceeds to Dissolved Air Flotation Unit (DAFU) – air bubbles attach to impurities and flocculated particles and floats them to the water's surface.
- Solids are skimmed off and put into the main solids waste stream for disposal to landfill.
- Treated water from DAFU is polished through filtering, oxidization and/or reverse osmosis.
- Treated effluent (water) can either be discharged to the water treatment plant or ocean, evaporated and reuse on site



Treatment Processes

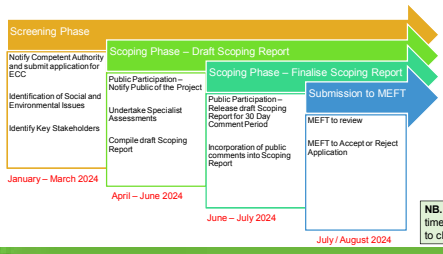
Tank & skip washing

- Tanks and skips are cleaned before leaving the site with water and a degreaser.
- Contaminated water is treated through the slops treatment process.

Before After

Environmental Clearance Certificate Process

ECC Process



NB. The estimated timelines are subject to change

Environmental Clearance Certificate Process

Listed activities that may be triggered

Listed activity
2.1 The construction of facilities for waste sites, treatment of waste and disposal of waste
2.2. Any activity entailing a scheduled process referred to in the Atmospheric Pollution Prevention Ordinance, 1976
2.3. The import, processing, use and recycling, temporary storage, transit or export of waste
5.1(b). Light industrial use to heavy industrial use
8.1. The abstraction of ground or surface water for industrial or commercial purposes
8.2. The abstraction of groundwater at a volume exceeding the threshold authorised in terms of a law relating to water resources
8.6. Construction of industrial and domestic wastewater treatment plants and related pipeline systems
9.1. The manufacturing, storage, handling or processing of a hazardous substance defined in the Hazardous Substances Ordinance, 1974
9.2. Any process or activity which requires a permit, licence or other form of authorisation, or the modification of or changes to existing facilities for any process or activity which requires an amendment of an existing permit, licence or authorisation or which requires a new permit, licence or authorisation in terms of a law governing the generation or release of emissions, pollution, effluent or waste
9.4 The storage and handling of a dangerous goods, including petrol, diesel, liquid petroleum gas or paraffin, in containers with a combined capacity of more than 30 cubic meters at any one location.

Environmental Clearance Certificate Process

ECC Process

- MEFT Pre-Application Meeting (29 Jan 2024)
- Application with MEFT: APP-002775
- Feedback from MEFT (5 Feb 2024): Environmental Scoping Report
- Current Phase: Draft Scoping Report
- Estimated Completion: July/August 2024

Specialist studies:

1. Hydrogeology Specialist Study
2. Geophysics Assessment
3. Archaeological Specialist Study
4. Social Specialist Study
5. Air Quality and Noise Specialist Study

Environmental Clearance Certificate Process

ECC Process – Public Consultation Process

- Completed steps on Public Consultation Process:
  - Identification of I&APs / stakeholders
  - Placement of newspaper adverts (The Namibian and New Era – 26 March and 02 April 2024)
  - Placement of site notices (Local Notice Boards and Near Project Site)
  - Focus group meetings with key stakeholders (18 – 20 February 2024)
  - Public Meeting (11 April 2024)
- Next Steps on Public Consultation Process:
  - Notifications of availability of Draft Scoping Report for Review (30-day review) – ~June 2024
  - Compilation of Comments and Response Report – ~July 2024
  - Notifications of Final Report submission to MEFT – ~July/August 2024

Project Site Overview
Project Site

- Selected Project Site: 7.8 ha site on ERF 160 of the remainder of Farm 38
- Site Selection:
  - Land use zoning as industrial;
  - Availability of established plots for similarly zoned industrial activities;
  - Pre-existing stakeholder consultations, specifically with the Walvis Bay Municipality; and
  - Access to utilities, main roads and proximity to the Walvis Bay Port.
- Sand dominated, sparsely vegetated site with gentle gradient located off the D1983 road

Project Site Overview
Project Site Proposed Layout

Project Site Overview
Project Site Environmental Features: Physical Environment

- Predominantly flat topography
- Harsh, arid climate with limited rainfall
- Dominated by sand
- Uniform soil profile in and surrounding project site
- Hydrogeological zones characterised by shallow, saline groundwater
- Based on municipal air quality data, good air quality is anticipated*
  - Air Quality Specialist Assessment to confirm baseline conditions
- Ephemeral Kuiseb River approximately 14 km south of the project site
- No cultural heritage artefacts recorded within the project area

Project Site Overview
Project Site Environmental Features: Biological Environment

- Situated within Namib Desert ecoregion
  - Transition zone between Central Namib and Succulent Karoo
- Several scattered plant specimens observed in project area
  - *Arthraerua leubnitziae* - Not Evaluated by IUCN Red List
- No evidence of live fauna, scat or tracks observed
- Low biodiversity expected

Potential Project Impacts
Potential Environmental Impacts

- Climate
  - Release of carbon dioxide stored in vegetation
  - Localised GHG emissions
  - Localised microclimate alterations
- Visual
  - Alteration in site aesthetics
  - Emissions from incinerator
- Land Use
  - Change in Land Use
- Topography
  - Alteration in local topography
- Air Quality
  - Increased dust generation
  - Emissions from vehicles
  - Increased emissions due to waste treatment

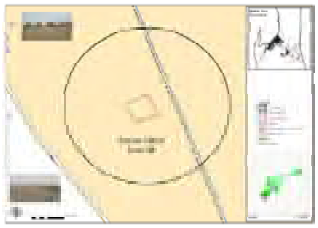
Potential Project Impacts
Potential Environmental Impacts

- Noise
  - Increase in noise emissions
- Groundwater
  - Groundwater contamination through spills
  - Reduction of local groundwater levels through abstraction
- Soil
  - Contamination of soil
  - Soil erosion
- Terrestrial Fauna and Flora
  - Loss / Disturbance of flora
  - Loss / Disturbance of faunal habitat / Habitat fragmentation
  - Road Fatalities
  - Introduction of invasive plant species
  - Establishment of pest species

Project Site Overview

Project Site Environmental Features: Social Environment

- Portion 160 of the Rem. Farm 38:
  - Next to lease areas for industrial use
  - Oval track, King Charcoal factory, CPP Quarry and BC Stone operations portions close to the site
  - Green Valley Development located north-west of the proposed site
  - Access to water and power connections



Project Site Overview

Project Site Features:

- Dominant Wind Directions:
  - East-northeast and Southwest.
  - Prevailing wind directions quite favourable.
- Transport Logistics:
  - Access to the site from the Harbour via Hanna Mupetami Road, on to the MR36, and D1983 and to Arandis via MR44 seems feasible but the cumulative impact needs to be determined.

Project Impacts

Potential Social Impacts

- Traffic
  - Increased truck traffic and noise adds to the already high heavy vehicle traffic flows through Hanna Mupetami Street. While there will be a few trucks per day, the cumulative impact is of concern.
  - Additional traffic increases the potential of road accidents
  - The access road is unsurfaced and this will cause substantial dust along
- Safety/ Health Risks
  - A health and safety issue, construction and operations requires the necessary health and safety protocols.
  - Dust and pollutants transport operation and operational activities at the site may impact social receptors on neighbouring sites as well as the residential development at Green Valley
- Employment
  - Local job opportunities will be created and local economic development is likely to be strengthened and forward and backward integration can be expected.

Project Impacts

Potential Social Impacts

- Local Economic Development
  - Proposed facility creates a new industry, serving the emerging oil and gas sector
  - Enhance other opportunities within the waste management sector.
  - Promoting local employment and gender equality through preferential employment guidelines

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Lloyd Lynch
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ANNEXURE E

Stakeholder’s List

VARIOUS STAKEHOLDER GROUPS FOR THE WALVIS BAY						
Category	**Name**	**Title**	**Name**	**Surname**	**Designation**	**Email**
1. GOVERNMENT MINISTRY / DEPARTMENT/ INTUITION/ PARASTATAL						
Government ministry/ department/ institution/ parastatal	Directorate of Education, Arts and Culture- Erongo Region	Ms.	Ernfriede	Stephanus	Director	-
Government ministry/ department/ institution/ parastatal	Erongo Red	Mr.	Fessor	Mbango	Chief Executive Officer	support@erongored.com.na
Government ministry/ department/ institution/ parastatal	Erongo Red	Ms.	Alta	Smit	Personal Assistant	support@erongored.com.na
Government ministry/ department/ institution/ parastatal	Ministry of Agriculture, Water and Land Reform	Ms.	Margaret	Kalo	Chief Public Relation Officer	Margaret.Kalo@mawf.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Agriculture, Water and Land Reform	Ms.	Maria	Amakali	Director: Water Resource Management	gwamakali@gmail.com
Government ministry/ department/ institution/ parastatal	Ministry of Agriculture, Water and Land Reform	Mr.	Percy. W	Misika	Executive Director	Percy.Misika@mawf.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Environment, Forestry and Tourism	Ms.	Saima	Angula	Deputy Director for Environmental Assessments	saima@webmail.co.za
Government ministry/ department/ institution/ parastatal	Ministry of Environment, Forestry and Tourism	Mr.	Timoteus	Mufeti	Environmental Commissioner	timoteus.mufeti@met.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Fisheries and Marine Resources	Dr.	Moses	Maurihungirire	Executive Director	moses.maurihungirire@mfmr.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Fisheries and Marine Resources	Ms	Rauna	Kalola	Public Relations Officer	rauna.kalola@mfmr.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Health and Social Services	Ms.	Manga	Libita	Public Relations Officer	Public.Relations@mhss.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Industrialisation, Trade and SME Development	Hon.	Lucia	Iipumbu	MP	Lucia.Iipumbu@mitsmed.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Industrialisation, Trade and SME Development	Dr.	Micheal	Humavindu	Deputy Executive Director	Micheal.Humavindu@mitsmed.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Industrialisation, Trade and SME Development	Hon.	Verna	Sinimbo	Deputy Minister	Verna.Sinimbo@mitsmed.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Industrialisation, Trade and SME Development	Amb.	Steve	Katjiuanjo	Executive Director	Steven.Katjiuanjo@mitsmed.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Information and Communication Technology	Mr.	Mbeuta	Ndjarakana	Permanent Secretary	Belinda.vries@mict.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Mines and Energy	Ms.	Maggy	Shikongo	Chief Geoscientist	Maggy.Shino@mme.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Mines and Energy	Mr.	Tupa	Iyambo	Chief Petroleum Inspector	Tupa.Iyambo@mme.gov.na

Government ministry/ department/ institution/ parastatal	Ministry of Mines and Energy	Ms.	Miina	Auene-Gahutu	Deputy Director, Windhoek	miina.auene-gahutu@mme.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Urban and Rural Development	Mr.	Dana	Beukes		Dana.Beukes@mlr.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Urban and Rural Development	Mr.	Tobias	Newaya	Town Planner	tnewaya@murd.gov.na
Government ministry/ department/ institution/ parastatal	Ministry of Works and Transport	Mr.	Julius	Ngweda	Chief Public Relation Officer	jngweda@mwtc.gov.na
Government ministry/ department/ institution/ parastatal	Namibia Airports Company	Mr.	Bisey	/Uirab	Chief Executive Officer	uirabb@airports.com.na
Government ministry/ department/ institution/ parastatal	Namibia Airports Company	Ms.	Liz	Jacobs	PA	Jacobsl@airpors.com.na
Government ministry/ department/ institution/ parastatal	Namibia Airports Company	Ms.	Chrizelda	George	Airport Manager	george@airports.com.na
Government ministry/ department/ institution/ parastatal	Namibia Civil Aviation Authority	Mr.	Golden	Siteka	Senior Manager	siteketag@dca.com.na
Government ministry/ department/ institution/ parastatal	Namibia Development Corporation	Mr.	Pieter	De Wet	Managing Director	pieter.dewet@ndc.org.na
Government ministry/ department/ institution/ parastatal	Namibia Estate Agents Board	Mr.	Richard	Steen	Manager	manager.neab@iway.na
Government ministry/ department/ institution/ parastatal	Namibia Ports Authority	Mr.	Gottfried	Araeb	Manager: Projects	g.araeb@namport.com.na.
Government ministry/ department/ institution/ parastatal	Namibia Ports Authority	Ms.	Justina	Evelinus	Manager: Property Management	j.evelinus@namport.com.na
Government ministry/ department/ institution/ parastatal	Namibia Post & Telecommunications Ltd	Mr.	Festus	Hangula	Chief Executive Officer	ceopa@nampost.com.na
Government ministry/ department/ institution/ parastatal	Namibia Training Authority	Mr.	Richwell	Lukonga	General Manager	info@nta.com.na
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Government ministry/ department/ institution/ parastatal	Namibian Industrial Development Agency	Mr.	Uparura	Kuvare	Executive Director	Uparura.Kuvare@nida.com.na
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Government ministry/ department/ institution/ parastatal	NamPower	Mr.	Gert	Fourie	Engineering, Planning and Design	gert.fourie@nampower.com.na
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Government ministry/ department/ institution/ parastatal	National Planning Commission	Ms.	Wilhencia	Uiras	Executive Director,	wuiras@npc.gov.na
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Government ministry/ department/ institution/ parastatal	Roads Authority Namibia	Mr.	Conrad Mutonga	Lutombi	Chief Executive Officer	sisandej@ra.org.na
Government ministry/ department/ institution/ parastatal	Roads Authority Namibia	Ms.	Lumbu	Elina	Acting Senior Specialist:	lumbue@ra.org.na
Government ministry/ department/ institution/ parastatal	TransNamib Ltd	Mr.	Johny	Smith	Chief Executive Officer	johny.smith@transnamib.com.na
2) ERONGO REGIONAL COUNCIL						-
Erongo Regional Council	Erongo Regional Council- The Governor	Mr.	Neville	Itope	Erongo Regional Council- The Governor	governor@erongorc.gov.na
Erongo Regional Council	Erongo Regional Council	Ms.	L. H.	Doëses	Chief Regional Officer	cro@erongorc.gov.na
Erongo Regional Council	Erongo Regional Council	Mr.	N.	Meroro	Deputy-Director: Development Planning	nmeroro@erongorc.gov.na
3) MUNICIPALITY OF WALVIS BAY						
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Municipality of Walvis Bay	Municipality of Walvis Bay	Ms.	Kristy	Asino	Town Planner	kasino@walvisbaycc.org.na
Municipality of Walvis Bay	Municipality of Walvis Bay	Mr.	Efraim	Nambahu	Town Planner	-
Municipality of Walvis Bay	Municipality of Walvis Bay		-	-	Secretary of the CEO	zjob@walvisbaycc.org.na
Registered Interested & Affected Party – Walvis Bay						
Registered Interested & Affected Party – Walvis Bay	Namibia Civil Aviation Authority (NCAA)	Ms.	Rauna	Mungonena	Aerodrome Safety Inspector / Safety: Aerodromes and Ground Aids	mungonenar@ncaa.na
Registered Interested & Affected Party – Walvis Bay	ECC- Environmental Compliance Consultancy	Mr.	Stephan	Bezuidenhout	Director / Principal Environmental Practitioner	stephan@eccenvironmental.com
Registered Interested & Affected Party – Walvis Bay	DWN - Ministry of Agriculture, Water & Land Reform	Mr.	Hambabi	Mattheus	Chief Hydrologist: Water Quality Control & Investigations/Division Water Environment	Mattheus.Hambabi@mawlr.gov.na
Note that there were additional stakeholders invited by the Walvis Bay Municipality						

ANNEXURE F

NAMWASTE Walvis Bay - Project Description Rev 07 (December 2025)

REG NUMBER: 2014/0032
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DIRECTORS: GYS J LOUW (CEO, DIRECTOR), ROSA C LOUW (DIRECTOR)

Walvis Bay Integrated Waste Management, Treatment, Transfer and Recovery Facility

Project Description

17 December 2025
Rev 07

RENT-A-DRUM
The Leaders in Waste Management since 1989

REG NUMBER: 2014/0032
Sam Nujoma Drive (next to Tony Rust Race Track) | PO Box 30735, Pionierspark, Windhoek, Namibia
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1. Introduction

1.1 Applicant background and purpose of application

Rent-A-Drum (Pty) Ltd (Rent-A-Drum), which has been operating in the Namibian waste management sector for 36 years was acquired by the Séché Environnement Group (Séché) in 2023. Rent-A-Drum currently offers integrated waste management solutions and has an operational footprint in 6 of Namibia's regions, serving over 2,000 customers and employing approximately 450 full time staff members. Séché, an established French-owned company which has been in operation for 40 years and operates in 16 countries throughout the world is a major player in the circular economy and waste management, decontamination and emergency environmental services sector.

Rent-A-Drum, through its subsidiary, Namwaste (Pty) Ltd (hereafter referred to as Namwaste), aims to develop new industrial waste treatment and disposal facilities in Namibia, which will address the pressing shortage of solutions for industrial and hazardous waste management in the Country and will contribute to the protection of the environment whilst also creating employment opportunities and fostering economic growth. The partnership will make a significant investment in Namibia over the next 10 years, to ensure that hazardous waste is managed in line with international best practice. Rent-A-Drum is aware that oil and gas exploration and production drilling has increased offshore Namibia in the past few years. Activity levels for exploration drilling will have 2-4 active drill rigs in Namibian waters for the next 3 years. Production drilling is set to increase above these levels. It is anticipated that at least 5 drilling rigs will be based in Walvis Bay for the next 5 years drilling at least 40 wells offshore. Should production drilling lead to production; large floating production storage and offloading (FPSOs) will be based offshore to allow oil production. Drilling and production of oil and gas reserves offshore will generate significant quantities of solid and liquid industrial waste with the possibility of hydrocarbon contamination.

Increased production of waste offshore Walvis Bay, existing commercial and industrial uses of the Port and the lack of suitable industrial waste treatment facilities necessitate a private sector solution to manage the waste on-shore, both from off-shore activities and port activities.

Rent-a-Drum's business case is based on receiving a minimum of ~40,000 tons of liquid waste and ~30,000 tons of cuttings (solid waste) generated from 5 drilling rigs operating from Walvis Bay per year. Therefore, there is a need to establish suitable treatment facilities as close as possible to the source of generation.

Séché, through Rent-A-Drum, is committed to using its expertise to develop and implement safe and sustainable solutions for waste management in Namibia. A portion of the investment to be made in the waste management sector will be allocated to the development of the Walvis Bay Integrated

Waste Management, Treatment, Transfer and Recovery Facility offering waste treatment and recovery solutions in Walvis Bay and specifically to the industrial sector in this region.

1.2 Location

Namwaste is proposing to develop an integrated waste management, treatment, transfer and recovery facility in Walvis Bay, Namibia. Walvis Bay is a small port town on the Atlantic Ocean in the Erongo region of southern Namibia. Walvis Bay town is located just north of the Tropic of Capricorn in the Kuiseb River Delta and lies at the end of the TransNamib Railway to Windhoek, and on B2 road. Besides being an export terminal for certain products, there is a small fishing and sealing industry as well as diamond industry.

The proposed site is located on Portion 160 of Remainder of Farm 38, ESE of Walvis Bay and approximately 20 km from the Port entrance, as shown in Figure 1. The proposed site is approximately 78 133 m^2 (7.81 ha) in extent. The corner coordinates of the site are indicated in Table 1.

The nearest residential housing stands exist approximately 15 km West NNE of the site. The landscape is partly exposed rock and sandy lands with little established vegetation typical of the surrounding environment.

The site was selected as a preferred alternative for the project based on several factors including:

1. Land use zoning as industrial;
2. Availability of established plots for similarly zoned industrial activities;
3. Stakeholder consultations, and in particular with the Walvis Bay Municipality; and
4. Access to utilities, main roads and proximity to the port.

Figure 1: Locality map for the proposed Walvis Bay Integrated Waste Management, Treatment, Transfer and Recovery Facility.

Table 1: Coordinates of the proposed Project site.

Corner	Longitude	Latitude
1	14.6185155	-23.0230970
2	14.6209455	-23.0218930
3	14.6223409	-23.0243059
4	14.6197324	-23.0250695
5	14.6196350	-23.0250328

1.3 Industries to be serviced and waste types to be accepted

The facility will largely be tailored to the specific needs of the offshore oil and gas exploration and production (E&P) industry. The E&P industry produces a wide range of industrial wastes in small quantities such as used and redundant chemicals, chemical containers and paints as well as two specific waste streams in large quantities during drilling phases: cuttings and slops. The E&P industry produces two specific waste streams (cuttings (~15% oil, 15% water & 70% solids (rock)) and slops (~10% oil, 80% water & 10% solids (rock)) in large quantities during drilling as well as a wide range of industrial waste such as used and redundant chemicals, chemical containers and paints in smaller quantities. General solid waste and medical waste is also generated by the personnel on the riggs.

In addition, drilling fluids (mud and brine), which are used to aid the drilling of wells, become contaminated with hydrocarbons during the process and require treatment prior to reuse.

1.4 Project activities overview

Project activities will consist of waste management specific activities and supporting / ancillary activities common to industrial sites. Waste management specific activities which will take place on the site include:

- Treatment of cuttings and mud and recovery of hydrocarbons using a Thermo-mechanical Cuttings Cleaner (TCC) or a Thermal Desorption Unit (TDU);
- Treatment of slops in a slops treatment unit (mainly a centrifuge);
- Discharge of treated effluent into the evaporation ponds or the municipal wastewater treatment works;
- Storage of cuttings and slops in suitable, bunded containment facilities;
- Temporary storage of waste (solid and liquid) in suitable, bunded containment facilities;
- Tank and skip washing.

Ancillary infrastructure and supporting activities required to conduct primary activities include:

- Truck depot and Bin yard;
- Stormwater/ run-off management infrastructure for collection and containment of any contaminated water;
- Effluent storage in ponds/dams for evaporation with surface area of 17,000m^2 or discharge into the municipal wastewater treatment works;
- A plant/vehicle washing bay with contaminated runoff control;
- Laboratory to test and verify the classification of incoming and/or treated waste as required;
- Access road (~1.2km) to the facility;
- Access control facilities including perimeter fencing;

- Weighbridges and control room;
- Fuel storage facilities with capacity of 23 000L;
- Water storage tank with a capacity of 200 m^3;
- Back-up generators – 5x 500kVA
- Offices and other administrative buildings;
- Staff dining and ablution facilities;
- Camp for ~50-100 employees;
- Workshops and stores,
- Weather station;
- Utility connections:
    - Electricity connections – connection to municipal supply located approximately 200m from the site. Requirement of 2500 kVA.
    - Water supply from municipal 25m^3 per day.
    - Sewage management – Package sewer plant.

The location of the proposed infrastructure and/or activities are indicated in Figure 2.

Figure 2: Conceptual layout of the facility

1.5 Biodiversity preservation and restoration strategy

The preservation of biodiversity has been one of the Séché Group's core values since its inception over 40 years ago. A dedicated team of ecologists drive sustainable development by linking landscape, biodiversity and environment into all activities of the Group. The development of this approach has evolved over time and Séché is now implementing biodiversity preservation and restoration programs across operations internationally in alignment to its voluntary commitments to Act4Nature.

Biodiversity preservation and restoration will be included in the design and ongoing development and management of the Walvis Bay Integrated Waste Management, Treatment, Transfer and Recovery Facility. Specialist studies are being undertaken as part of the Environmental and Social Impact Assessment (ESIA) and these, together with consultation with experts, will inform the biodiversity strategy for the site. The aim will be to protect, restore and regenerate biodiversity as well as to educate and build relationships / connections to enhance biodiversity protection in the communities in close proximity to the facility.

1.6 Operating Standards

All activities conducted at the facility and associated operations will meet or exceed Good International Industrial Practice (GIIP). The following standards will be met:

- Corporate and project authorizations related to E&P drilling in Namibia;
- World Bank and especially International Finance Corporation (IFC) Performance standards and guidance notes and in particular the IFC's Environmental, Health, and Safety (EHS) *Guidance for upstream oil and gas as well as the EHS guidance for waste management*, and IFC EHS Guidelines, *Environmental, Health, and Safety Guidelines for Offshore Oil and Gas Development;*
- International Petroleum Industry Environmental Conservation Association (IPIECA) and Open Government Partnership (OGP) guidelines and directives, including OGP's Guidelines for *Waste Management – with Special Focus on Areas with Limited Infrastructure;*
- IFC EHS Guidelines, Environmental, Health, and Safety Guidelines for Offshore Oil and Gas Development, 2015;
- Country of operation (laws and regulations of Namibia); and
- Séché Environnement Corporate Policy and directives.

2. Description of Project Activities/Components

The project will be implemented in a phased approach:

- Phase 1- 2027: during the construction of the facility, the site will be used as a transfer station. During this time the slops will be concentrated in the ponds;
- Phase 2 – 2028: the facility will be used for treatment. The slops will be treated to reduce the volume to be transported to the final disposal site; and

- Phase 3 – 2030: the cuttings will be treated to recover the oil and reuse it.

2.1 Waste transport

Slops, cuttings and source separated recyclables from the riggs, and port will be sent to the Namwaste Walvis Bay facility for treatment and sorting. General waste from the riggs and the port will be transported directly to a disposal facility. Medical waste from the riggs will be transported directly to suitable medical waste treatment facilities. The vehicles used and the estimated number of trips per vehicle type is indicated in Table 2.

Table 2: Types of vehicles to be used for the transportation of waste.

Type of vehicle	Number of vehicles per day	Waste stream
Tanker trucks	6	Bulk liquid waste (slops)
Flatbed trucks	6	Containerized cuttings
Skip trucks	2	Solid general and hazardous waste
Super sucker trucks	3	Transfer of liquid waste from the PSV to the tanker trucks, at the port.
Medium duty vehicles (3-5 tons)	4	Solid general and hazardous waste

2.2 Waste acceptance and offloading procedure

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

One 18-m steel-deck weighbridge will be installed at the entrance to the facility. This system will be used to record the mass of all waste loads delivered to the facility. Every vehicle carrying waste destined for treatment at the facility will be weighed before entering the facility and upon leaving the facility.

All arriving waste loads will be inspected by the Lab Technician and/or be subjected to verification analysis for conformance to the TSAS which should accompany the load before it enters the facility. Arriving waste loads will be further evaluated in respect of wastes that are prohibited or restricted. Should there be no notable discrepancies or deviations from the aforementioned criteria, the load will be accepted for processing.

After trucks have been weighed and cleared reception, they will proceed to the bunded offloading area. Bulk liquids will be discharged into bunded storage tanks. Most solids will be containerized in DNV skips or similar and these will be offloaded via forklift.

2.3 Primary waste streams

The primary waste streams and the estimated minimum tonnages of each waste stream to be managed at the facility are provided in Table 3 below.

Table 3: Primary drill waste streams to be managed on site.

Waste streams	Minimum tonnages per month
Cuttings	2,500 tons
Slops	3,500 tons
General Waste	1,200 tons
Source Separated Recyclables	120 tons
Medical Waste	12 tons

2.4 Waste Treatment and Management Processes

The waste will be treated using various treatment processes to recover the re-usable waste. The following main activities will take place on the site:

- Treatment of cuttings and mud and recovery of hydrocarbons using a Thermo-mechanical Cuttings Cleaner (TCC) or Thermal Desorption Unit (TDU);
- Treatment of slops in a slops treatment unit which will include a tricanter, a disk stack centrifuge, tanks for pH correction, coagulation, and flocculation;
- Storage of cuttings and slops in suitable, bunded containment facilities (for treatment on site or transport to a suitable facility for treatment);
- Temporary storage of waste (solid and liquid) in suitable, bunded containment facilities; and
- Tank and skip washing.

The treatment or management method applicable to each waste to be treated or managed at the facility is shown in Figure 3 below.

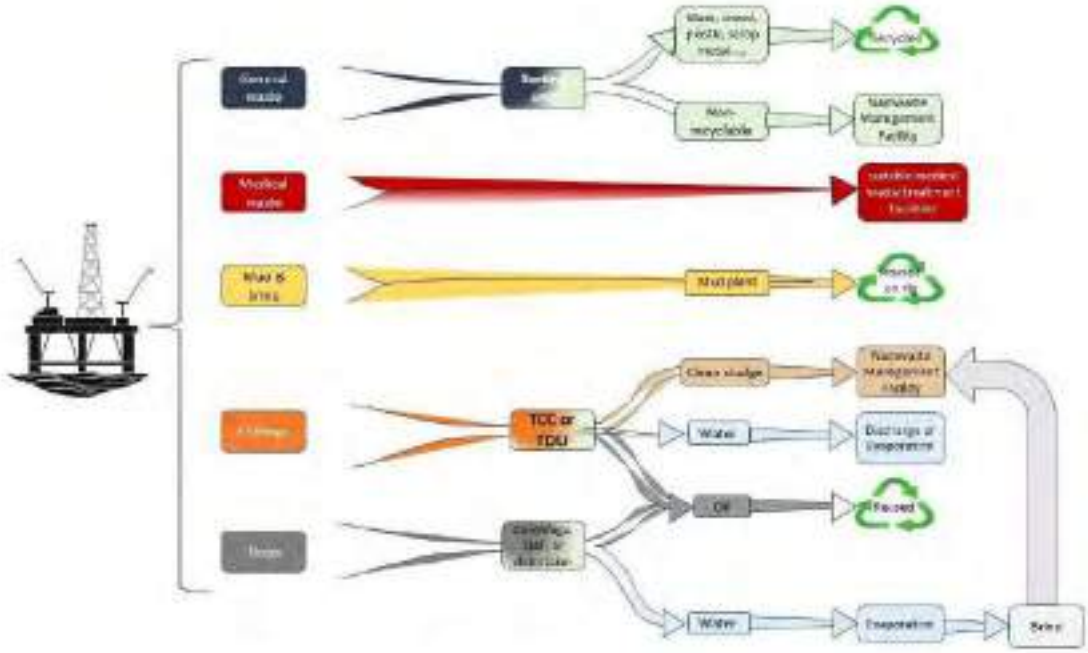

Figure 3: Waste Treatment Process Flow Diagram

2.4.1 Cuttings Treatment

2.4.1.1 Thermo-Mechanical Cuttings Cleaner

Cuttings come containerized from the vessel. The containers are collected on flatbed trucks. Upon clearing the reception of the facility, they will be offloaded by forklift onto a bunded platform. A rotary head forklift will empty the container into a sump or dam, where the cuttings will be homogenized using an excavator as a mixer. The sump or dam will be lined with HDPE over which a sacrificial concrete layer will be cast. The homogenized cuttings will then be put into the TCC for a general drill cutting plant process flow. A general drill cutting plant process flow is shown in Figure 4 below.

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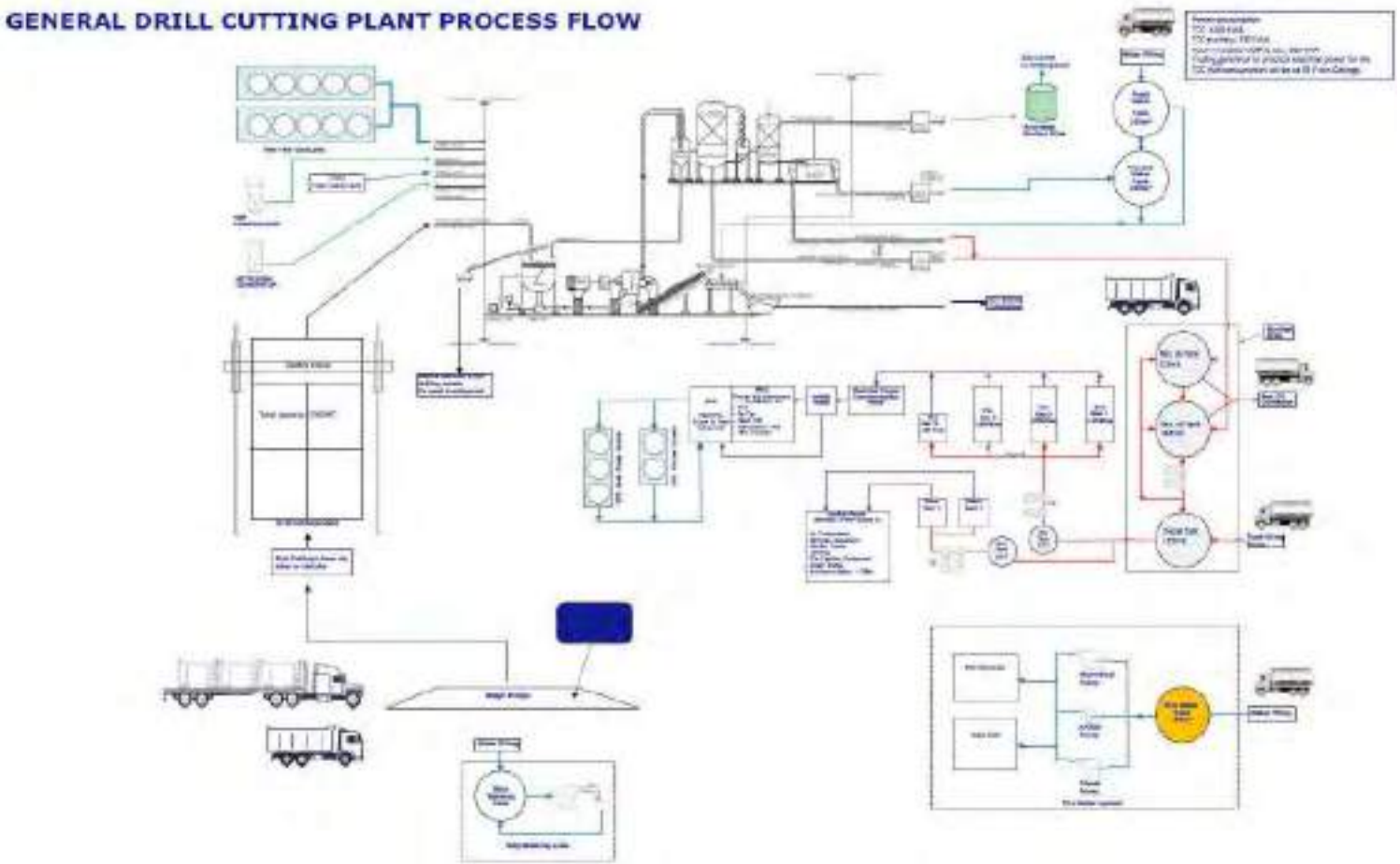

Figure 4: General drill cutting plant process flow

A TCC is considered the least cost and most beneficial unit for treating drill cuttings. The TCC can be described as a hammer mill that uses heat generated by friction to vaporize and then recover hydrocarbon from the cuttings. The unit uses a lower temperature from kinetic energy / "frictional" heat to vaporize the hydrocarbons. This allows for better preservation of the original base oils contaminating the cuttings. Less heat allows for lower energy consumption and is therefore more environmentally friendly.

Recovered base oil is returned to customers and reused in oil-based mud (OBM) or alternatively used for energy. The solid portion of the cuttings will be transported to and disposed of at the proposed Namwaste Management Facility's Class A disposal site, close to Arandis. Recovered water will be used to re-treat solids or can be sent for further industrial uses. The TCC generally has 4-6 tons per hour capacity which results in recovery of 95+% of the base oil. Less than 1% (usually 0.2-0.3%) residual oil content on solids remains.

A general process flow and layout of a cuttings treatment facility is shown in Figure 5 and Figure 6 below.

Figure 5: General layout of a cuttings treatment facility

Figure 6: General layout of a Cuttings Treatment Facility

2.4.1.2 Thermal Desorption Unit

A Thermal Desorption Unit (TDU) is a specialized system used for the treatment of drilling cuttings, oil sludge, and hazardous waste material generated during oil exploration, production, refining, and storage. The TDU treats contaminated solids by heating them to temperatures that vaporize the contaminants. It acts on the principle that when heat is applied to waste material, it causes the volatile contaminants to separate from the solids. These contaminants are then captured, condensed, and treated, leaving the cleaned solids behind. TDUs are particularly effective for treating oil-based drill cuttings and other hydrocarbon-contaminated materials.

Drill cuttings are fed into the processing chamber of the TDU, where the rotating heat exchanger (rotor) heats up with cuttings via indirect heat. Indirect heating is accomplished through the circulation of heated oil, as well as by the use of electrical heating elements. The first section of the rotor evaporates water from the cuttings, while the subsequent section evaporates oil from the cuttings at temperatures up to 500 °C. A condenser liquidizes the evaporated water and oil, which then flow into the water/oil separator. The solids are discharged at the end of the process, where they are then cooled and mixed with recovered water to avoid dust emissions when fed into solids containers (skips etc.). The typical thermal desorption process is shown in Figure 7 below.

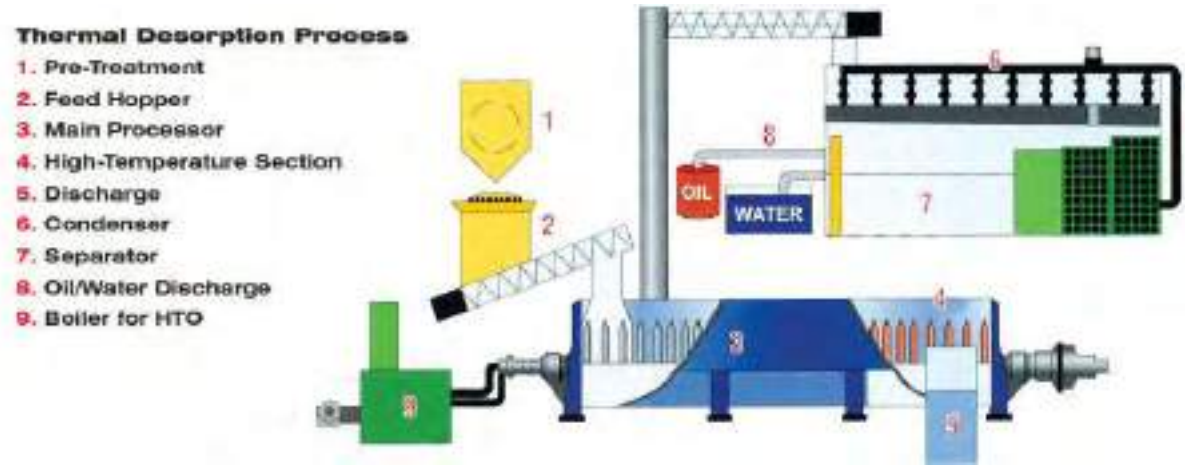

Figure 7: Thermal Desorption Process

2.4.2 Slops Treatment Unit

Slops are generally transferred in bulk from the rig utilizing the Platform Supply Vessel (PSV) tanks. Tanker trucks are used to transfer slops from the PSV tanks to the facility. Upon clearing the reception of the facility, the slops will be discharged into bunded storage tanks via pumps and homogenized.

The slops treatment unit will include various steps of treatment as described below and in Figure 8

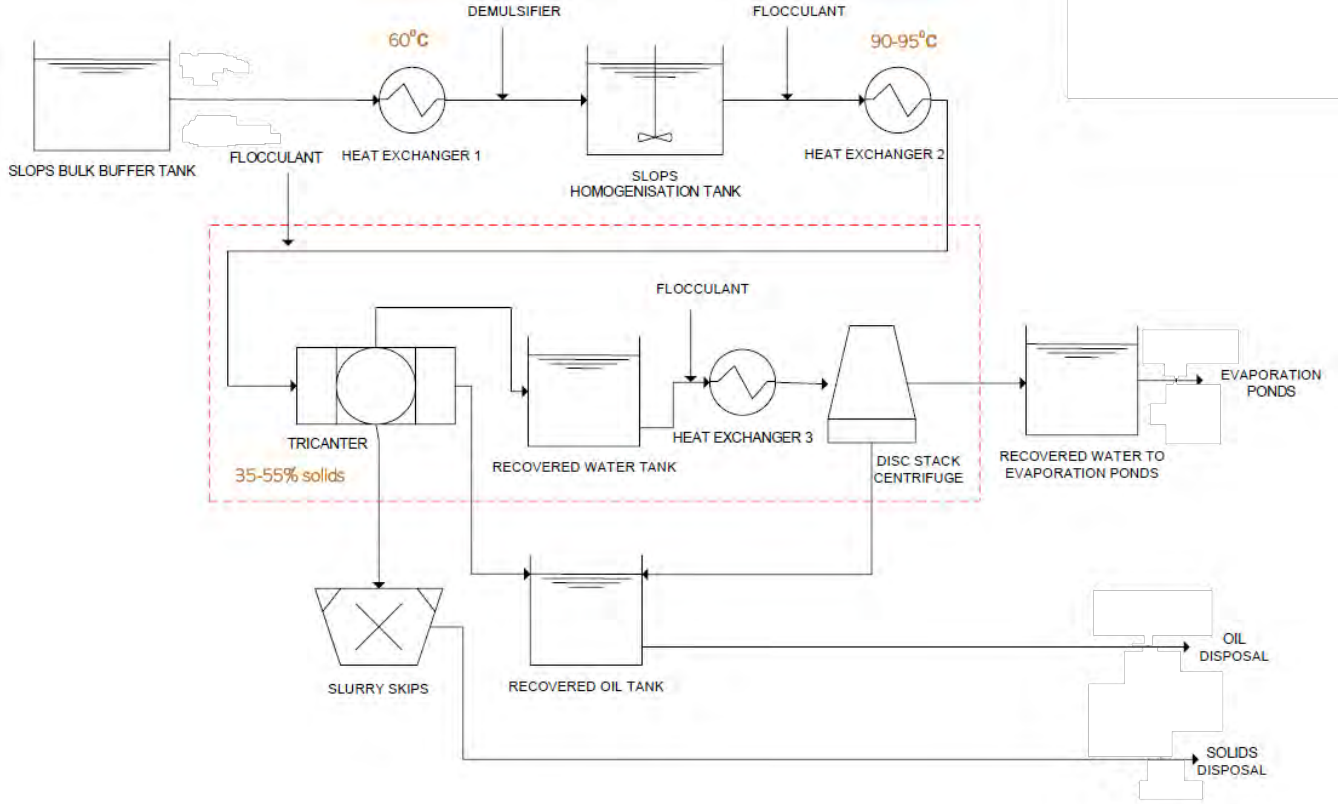

Figure 8:

1. Phase separation using a tri-canter centrifuge to separate hydrocarbons, water and solids. Solids will be discharged for disposal at a suitable landfill. Hydrocarbons will be discharged into a buffer tank for re-use (by others).
2. Chemical pre-treatment such as flocculation, pH correction, coagulation, acid treatment and similar chemical treatments / corrections.
3. Treated effluent will be discharged into the evaporation pond (s) or the municipal wastewater treatment plant.

The process for the slops treatment is discussed in the sections below:

Homogenisation tank and pre-treatment

Since the raw feed is an inhomogeneous mixture, it enters the homogenisation day tank, which is fitted with a slow rotating, low shear agitator. A heat exchanger is installed upstream of the tank, to

heat the incoming effluent from ambient temperature to ~60°C. The heat exchanger used is a shell and tube heat exchanger, best suited for effluent with this level of solids (~10%), and uses steam (at 4 bar(g)) as heating fluid. A boiler is included for the provision of steam at the various points of use.
The selected demulsifier is injected upstream of the tank, into the pre-heated effluent stream. The pre-treated effluent enters the homogenisation tank, where the agitator assists in dispensing the emulsion breaker throughout the slops effluent, and assist in homogenising the effluent prior to downstream treatment. The tank makes provision for a residence time of ~1.5 hours (tank size 8.5 m^3 with freeboard).

Heat exchanger and flocculant dosing
Downstream of the homogenisation tank, the pre-treated effluent enters a heat exchanger, where the effluent is heated from 60°C to 95°C for optimal separation in the downstream separation process. Additional demulsifier is injected upstream of the heat exchanger, and flocculant is injected downstream of the heat exchanger, before going into the downstream separation process. As with the upstream heat exchanger, a shell and tube heat exchanger using steam (at 4 bar(g)) as heating fluid will be used.

Tricanter
The pretreated effluent enters the Tricanter unit, which is the first separation step. The pretreated effluent, after heating, and demulsifier and flocculant injection, enters the Tricanter. The Tricanter is a three-phase separation unit, and separates the slops effluent into a solids fraction, in the form of a sludge, as well as two liquid fractions, the oil and the water. The pretreated slops effluent is fed into the high-speed rotating bowl, through the feed tube, and is accelerated to bowl speed. The solids settle on the inner bowl wall, due to the action of centrifugal force. The solids are scraped off the wall by a scroll armoured with hard metal, which again transport the solids to the solids discharge point. The clarified liquid, as well as the recovered oil, is conveyed to the heavy phase discharge, and the light phase discharge respectively.

The oil removal efficiency of the Tricanter is estimated at 99%, leading to an expected oil content in the recovered water fraction of ~1 000 ppm. The recovered water fraction from the Tricanter will enter a buffer tank, for further treatment downstream. The expected solids content of the recovered water is 5000 – 10 000 ppm. The oil discharge from the Tricanter will enter a buffer tank for disposal (by others). Similarly, the solids/sludge discharge from the Tricanter, will also be disposed of.

Heat exchanger and flocculant dosing
The separated water from the Tricanter enters a buffer tank, from where it is pumped to the secondary separation unit, a Disc Stack Centrifuge. Upstream of the unit, the effluent is heated again to ensure the effluent is at the optimal temperature (75°C - 85°C) for best possible separation. A flocculant is also injected to aid the downstream separation process.

Disk stack centrifuge

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The recovered water is treated further via Disc Stack Centrifuge for the removal of residual oil. The disc stack centrifuge is a type of high-speed centrifuge used to separate liquids and solids or different liquid phases based on their densities.

The preheated effluent (via heat exchanger) enters the disk stack centrifuge, after injection of additional flocculant in-line. An automatic filter is installed in-line, preventing any coarse particles from reaching the bowl and blocking the rising channel within the disc stack. The effluent flows from above into the center of the separator bowl. The heavy water phase is separated from the finest oil particles and is conveyed under pressure by a centripetal pump to the discharge. The separated impurities accumulated in the sludge space are discharged into the sludge tank periodically.

The clean water (product) is monitored by an in-line oil monitor, before being discharged into the product water tank. Should the oil content exceed the required level (5 – 10 ppm), the off-spec product is automatically routed back to the inlet buffer tank, upstream of the heat exchanger. The oil fraction is discharged separately into the oily waste buffer tank.

The Disc Stack Centrifuge is an automatic, self-cleaning unit. The unit is designed based on continuous operation. The unit only needs to be flushed when the unit is stopped. Flushing can be done with water at 75°C. This unit will perform ejections (desludges) continuously to remove the solids from the bowl while in operation to reduce downtime as no opening of the bow etc. is required while operating.

The solids ejection takes place automatically. The desludging frequency depends on the solids loading and therefore depends on the upstream decanter centrifuge efficiency in terms of particle removal. For this application, since the feed to the machine will be the recovered liquid from the Tricanter, the desludging ejection frequency is expected to be > 60 mins. The expected residual oil from the disk stack centrifuge is 5 - 10 ppm.

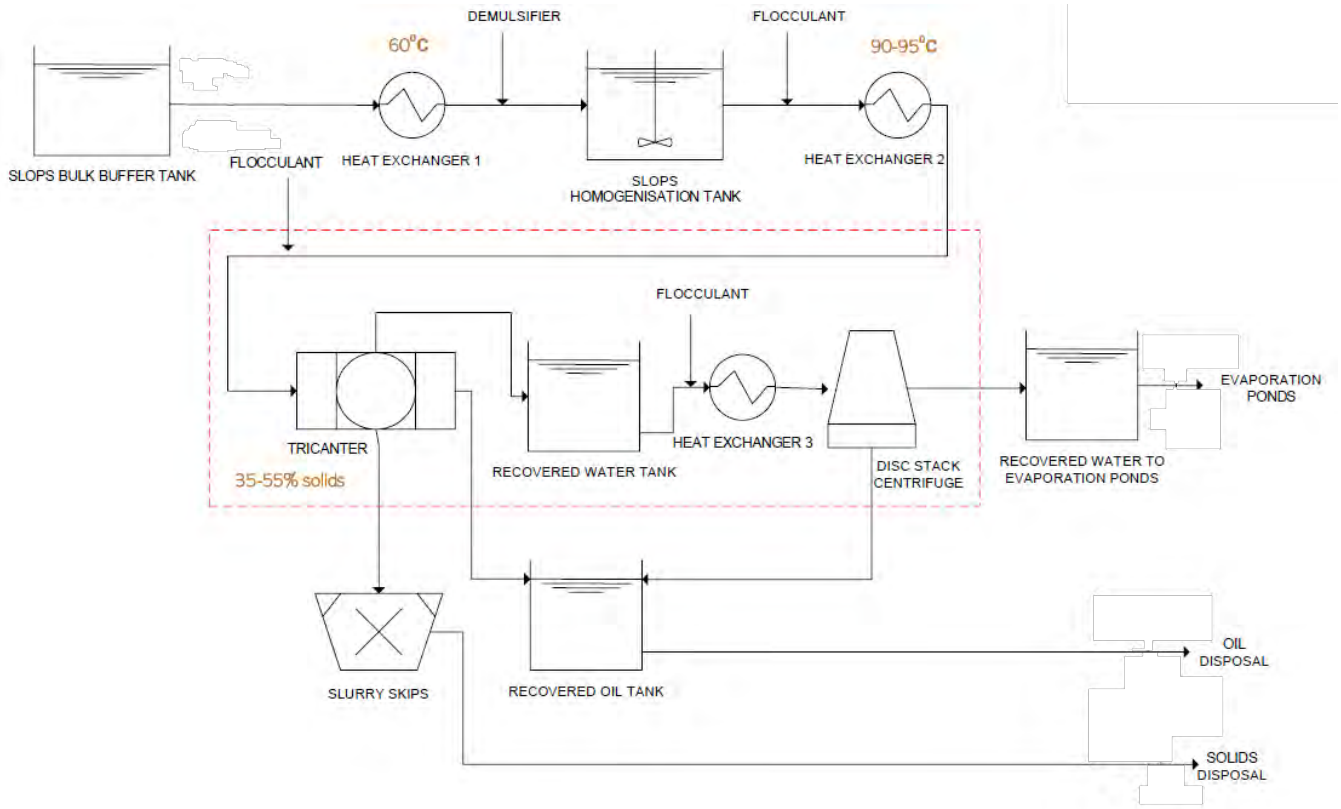

Figure 8: Slops unit process flow

Treated effluent resulting from drilling and produced water is generally limited in reuse by the total concentration of dissolved solids (i.e., salts) and as such the treated effluent will be discharged into the evaporation ponds or the municipal wastewater treatment works.

2.4.3 Temporary storage of waste

The facility will cater for the temporary storage of hazardous and non-hazardous waste. Waste (solids and liquids) will be temporarily stored in suitable, bunded containment facilities on site.

2.4.4 Other containerized wastes

While the primary waste streams generated during the offshore drilling phases are drill cuttings and drilling slops; offshore O&G exploration projects generate a variety of other waste streams in significantly smaller quantities. These include a wide variety of common wastes such as packaging, recyclables, sewage and domestic effluent, scrap metals and similar. In addition to these, there are industrial hazardous waste streams such as used and redundant chemicals, chemical containers and paints.

General waste will be separated into recyclables and non-recyclables at the source. Non-recyclables will be transported for disposal at a suitable landfill. Recyclables will be sorted at the existing Materials Recovery Facility (MRF) in Walvis Bay and will be bailed and transported to suitable recycling facilities. Hazardous waste will be transported for disposal at a suitable landfill.

Once exploration is complete and production occurs, there are additional waste streams that are produced from the production of hydrocarbons. In this case, Namwaste anticipates large volumes of produced water (potentially contaminated with hydrocarbons and salts) as well as tank bottoms which are largely comprised of heavy, long-chain hydrocarbons and other solids.

2.5 Ancillary Infrastructures

The following ancillary infrastructures will be developed on site:

2.5.1 Fuel Storage tanks

The facility will have a fuel storage tank with capacity of 23 000L, of diesel for refuelling of the trucks. The facility will have the following:

- There will be 1 - 2 dispensing points.
- The site will be under 24-hour security, fenced in and gated with access control on a 24-hour basis.
- It will be a double wall tank in accordance with EN12285 standards.
- Spill containment infrastructure, with an oil/water separator will be installed to protect against spillages in accordance with the Ministry of Mines and Energy's requirements.
- The proposed facility will include bund walls and floors with traps to contain spillages which might happen during the handling of diesel.
- The tank will be linked via underground pipes to the relevant fuel dispenser points (curbside pump).
- The curbside pump will be installed over a spill slab with a trap to prevent any spilled diesel from leaching into the soil. The trap sump will be linked to a 3-chamber separator which will collect any spilled diesel for proper disposal.
- The driveway areas will be paved. The tank will be supplied with fuel by road tankers (operated by properly licensed operators and drivers) which will discharge via filler points.

Filling of the tank will be carried out on an "as and when required" basis, but it is envisaged that tanks will require filling on average two times per month.

- A concrete slab will be constructed around the island, under the canopy (around pumps), over the tank and around the filler point.
- The refuelling area is covered by an overhead canopy.
- The entire driveway area, the area surrounding the dispensing points and area below the canopy will be raised by land infill and sloped and landscaped and provided with proper drainage in order not to be subject to storm water damage/flooding.

2.5.2 Tanker and Skip Washing Bay

After off-loading the waste, the tanks and skips will be washed before leaving the site to avoid cross contamination. Contaminated water from the wash bay and workshop area, as well as from the waste treatment facility area will be contained in suitable containment facility.

2.5.3 Stormwater/contaminated runoff management infrastructure

All storage will be bunded. The site will have stormwater diversion to limit and control run-on. Run-off from working areas will be segregated and directed towards ponds/dams for evaporation. Pavements and potentially contaminated areas will have fats, oils and grease (FOGs) separation.

Run-off from non-working areas will be controlled to limit potential for erosion and prevent co-mingling. There will be no uncontrolled discharge from the site.

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

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

- Contaminated water from the wash bay and workshop area, as well as from the waste treatment facility will be contained in suitable containment facilities.

2.5.4 Evaporation Ponds

Treated effluent from the waste treatment process will be discharged into the evaporation ponds on site and left to evaporate, relying on both natural and enhanced evaporation to reduce the water volume sufficiently. The brine from cleaning of the evaporation pond will be pre-treated on site to reduce the water content, prior to disposal to an approved disposal site. The development of two evaporation ponds is proposed to be sized 7 000 m^2 and 10 000 m^2 respectively each with a containment barrier of a 1mm HDPE liner. The evaporation dam will be designed to evaporate 2500m^3/month (with a 30% margin of risk) and a depth of 1 m (below surface), with a freeboard of 0.5m (above surface).

2.5.4.1 Enhanced Passive Evaporation Process

The targeted evaporation from the ponds is 2 500 m^3/month. It was found that this level of evaporation cannot be achieved through natural evaporation alone, and therefore alternatives were investigated for enhanced evaporation. Mechanical surface evaporators are used to increase evaporation from evaporation ponds and have many references worldwide.

Floating units (as shown in Figure 9) have specifically been designed for areas where there is very stringent legislation regarding spray drift and potential negative impacts on the surrounding environment.

The floating units are sprayer-less evaporators, which therefore negates the problems with spray-drift. The unit sucks in fresh, less humid air from above the pond and forces it down into the boundary layer of impoundment surface, sweeping the boundary layer, and enhancing the evaporation rates. The process also causes small waves on the surface of the evaporation dam, thereby increasing the surface area, which means more evaporation surface area enhancing the natural evaporation. For the required evaporation rate for this application, it is envisaged that ~20 units are required.

Figure 9: Floating surface evaporator unit for enhanced evaporation

2.5.5 Site Access

The proposed site can be accessed through the D1983 gravel road from the M36 road. A site access road of approximately 1.2km will be constructed from the existing D1983 as shown on Figure 10.

REG NUMBER: 2014/0032
Sam Nujoma Drive (next to Tony Rust Race Track) | PO Box 30735, Pionierspark, Windhoek, Namibia
Tel: +264 61 244 097 | Fax: +264 88 623 797 | Email: reception@rent-a-drum.com.na
DIRECTORS: IZYS J LOUW (CEO, DIRECTOR), ROSA C LOUW (DIRECTOR)

Figure 10: Site Access Road

2.5.6 Water Supply

The facility will require approximately 25m³ per day of water. The water supply pipeline will be constructed from the existing Namwater connection point located approximately 2.5km north of the proposed site as shown in Figure 11.

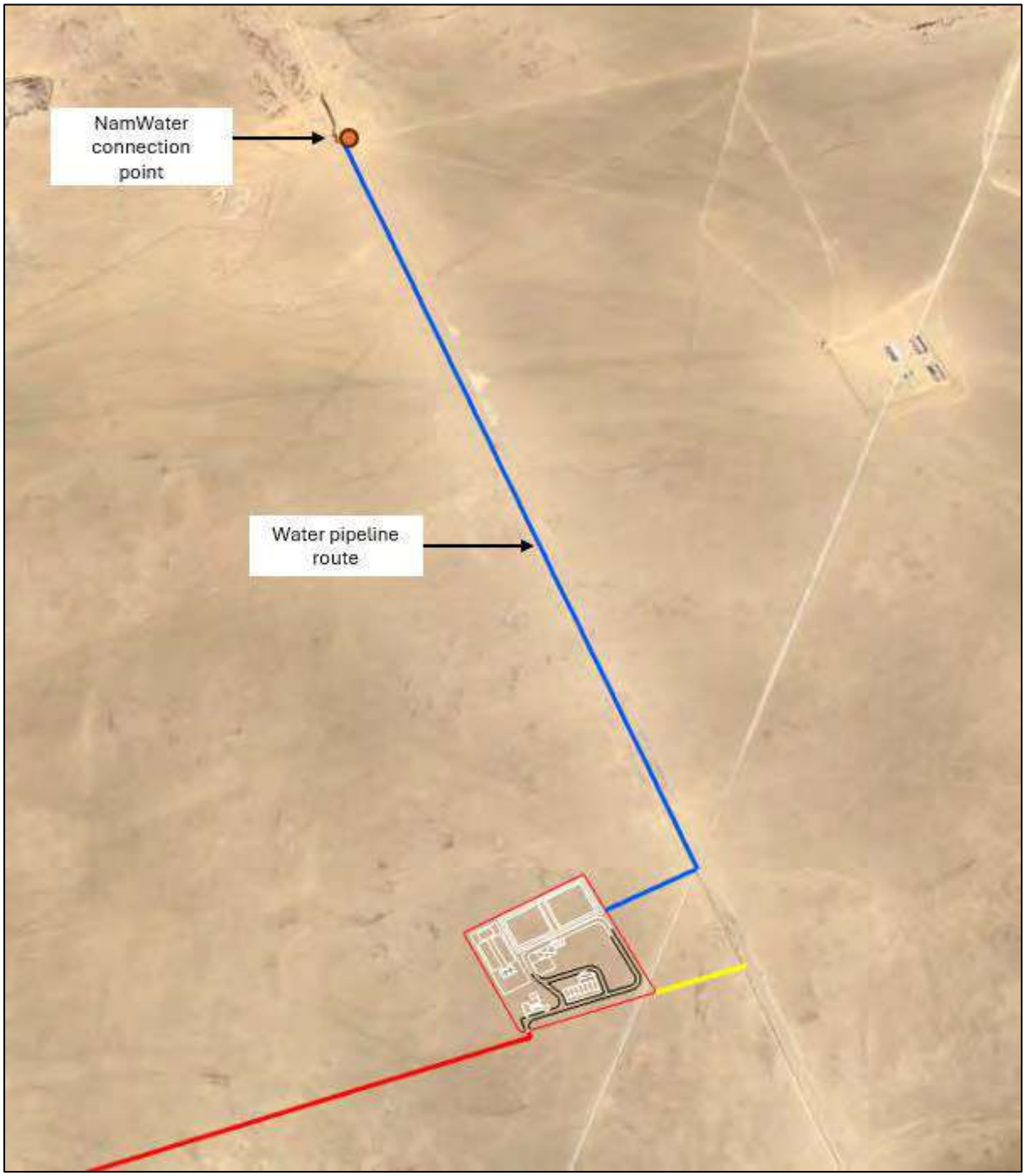

Figure 11: Water Supply route

2.5.7 Electricity Supply

The facility will require a maximum electricity supply of 2500 kVA - TCC + 750 kW Disc Stack centrifuge/Slops treatment process + 110 kW Enhanced Passive Evaporation process for use on site. The electricity will be sourced from the existing connection point located approximately 200m east of the site as shown in Figure 12.

Figure 12: Electricity Supply Route

2.5.8 Sewage Treatment

Sewage will be treated on-site through the sewage package plant, the solid waste will be disposed of at the landfill site and the treated water will be discharged into the environment, depending on the quality or discharged into the evaporation pond or stored in septic tank for transportation and discharge at the municipal wastewater plant.

2.6 Operating hours, staffing, access control and security

There will be no public access to the site. Only authorized and pre-approved transporters will be granted access to the site.

2.6.1 Operating hours

General operations will take place daily from 07h00 am – 17h00 on weekdays (i.e., Monday - Friday). On Saturdays, operations will be conducted from 07h00 am – 13h00. On public holidays and Sundays, operations are limited, and the site is closed. However, due to the nature of O&G operations, treatment plants and similar operations require to be conducted 24 hours per day, 7 days per week schedule. This is specific to the following activities:

1. Collection of waste from the port and return of empty containers to the vessels which will include night travel;
2. Operation of the cuttings treatment unit; and
3. Operation of the Slops Treatment Unit may be required to be operated 24 hours per day.

2.6.2 Staffing

The proposed staffing in terms of types of employment and number of employees is indicated in Table 4.

Table 4: Proposed staffing.

Staff	Number of employees
General manager and deputy	2
HSE supervisor	2
Administrative	3
Laboratory analyst	2
Supervisors	9
Deputy supervisors	6
Yellow plant	6
Mechanical plant	12
Drivers/assistants	36
General workers	18
Total	**96**

2.6.3 Access control and security

The entire facility will be fenced with at least a 2.4m high fence. Security access at gates will be controlled. 24-hour security will be in place at all times.

General operations will take place daily from 07h00 am – 17h00 on weekdays (i.e., Monday - Friday). On Saturdays, operations will be conducted from 07h00 am – 13h00. On public holidays and on Sundays operations are limited, and the site is closed for deliveries.

2.7 Construction and operational timelines

The interim project timelines are provided in Table 5.

Table 5: Provisional Project Timelines.

Timeline	Activity
August 2025 - December 2025	ESIA
September 2026 – September 2027	Construction • Fencing of the area • Earthwork to level the terrain • Connection to water, electricity and sewage networks • Civil engineering • Equipment assembly
September 2027 – December 2028	Commence with site commissioning
January 2029	Commence with site operations

ANNEXURE G

Proof Of Public Notification for Final ESIA Review

Namwaste: Walvis Bay ESIA Public Review

HB Heidi <heidi@sdasun.com>

To: [illegible] 'Mathew.hambo@mael.gov.na', 'support@wongoracom.na', [illegible] 'Margaret.lasi@mael.gov.na', 'pamaxa@gmail.com', 'Terry.Boxal@mael.gov.na', **+49 others**

Cc: Lloyd Lynch

Reply | Reply All | Forward | ...

Wed 28/01/2026 2:15 pm

Click here to download pictures. To help protect your privacy, Outlook prevented automatic download of some pictures in this message.

Dear stakeholder,

We welcome you to review the Environmental Scoping, Impact Assessment and Management Plan report for the proposed Waste Management Facility in Walvis Bay, with Namwaste (Pty) Ltd as the project proponent. Knight Piésold Consulting (Pty) Ltd (KP) has been appointed as the independent Environmental Assessment Practitioner to manage the Environmental Clearance Certificate (ECC) application process.

Notice is hereby given in terms of the Environmental Management Act, 7 of 2007 and Regulation 21 of the Environmental Impact Assessment (EIA) Regulations (January 2012) that the draft report for the above-mentioned proposed Project has been made available online for a 14-day public review period from 28 January - 12 February 2026. To ensure that your issues and/or comments are included in the final report, these should be provided to KP in writing to the addresses provided below by 12 February 2026:

- Project - [illegible]
- Lloyd Lynch - [illegible]
- Joseph Mulders - [illegible]
- Heidi Biedermann-Nel - [illegible]

The draft report and associated appendices can be accessed by the link below:

Namwaste WB - Project Sites

Kind Regards

Lloyd Lynch, [illegible]
Senior Environmental Scientist
Knight Piésold (Pty) Ltd.

T: +27 11 888 1311
2 Discovery Place, The Hedge, Sandhurst
Sandton | Gauteng | 2196 | South Africa

ANNEXURE E – COMMENTS RECEIVED

REF:NCAA:AGA:004/2026
Enquiries: Theoline Kauraisa
kauraisgt@ncaa.na
+264 83 235 2366

Mr. Lloyd Lynch
Knight Piésold Consulting
PO Box 86026
Eros
Windhoek

30 January 2026

Dear Mr. Lynch,

SUBJECT: NOTICE OF ENVIRONMENTAL CLEARANCE CERTIFICATE (ECC) APPLICATION: PROPOSED WASTE MANAGEMENT FACILITY – WALVIS BAY

Reference is made to your correspondence on the captioned matter above.

The Namibia Civil Aviation Authority (NCAA) acknowledges receipt of the Environmental Scoping, Impact Assessment and Management Plan Report for the proposed Waste Management facility at Walvis Bay.

Pursuant to NAMCARs Part 139 following are the regulatory provisions to be considered during your assessment, including but not limited to:

1. NAMCARs and NAMCATS-AH 139.01.34 – requirements relating to safeguarding of aerodrome surroundings and the Airport Master Plan of Walvis Bay International Airport (FYWB).
2. NAMCARs and NAMCATS-AH 139.11 – requirements relating to Obstacle Restriction and Removal.
3. NAMCARs and NAMCATS-AH 139.13 – requirements relating to Visual Aids for Denoting Obstacles.
4. NAMCARs and NAMCATS-AH 139.16.5 – requirements relating to Wildlife Hazard Management.

Below is the link to access the above-mentioned documents:

1. NAMCARs Part 139, amendments (2023) thereto - https://www.ncaa.com.na/index.php/document-downloads/industrial-documents/legislation/secondary-legislation/namcars-part-139-2023/viewdocument/2024

Board Members: Mr. Bethuel T. Mujetenga (Chairperson), Ms. Martina N. Hitesanye (Deputy Chairperson)
Ms. Josephine N. Shigwedha, Mr. Fernando Somaeb, Mr. Meklizedek Uupindi, Ms. Anselma K. Haushiku
Ms. Toska Sem (Executive Director)

Finally, kindly ensure to consult Namibia Airports Company as the aerodrome operator for Walvis Bay International Airport that may be directly affected by the proposed waste management facility.

I trust you find the above in order.

Yours sincerely,

Ms Toska Sem
Executive Director

NAMIBIA CIVIL AVIATION AUTHORITY
NCAA
2025 -01- 30
PRIVATE BAG 12003
AUSSPANNPLATZ
WINDHOEK
OFFICE OF THE EXECUTIVE DIRECTOR

NCAA
NAMIBIA CIVIL AVIATION AUTHORITY
Private Bag 12003 Windhoek Namibia | (Tel) +264 83 235 2100 | (Web) http://www.ncaa.com.na

REF:NCAA:AGA: 073/2026
Enquiries: Theoline Kauraisa
kauraisat@ncaa.na
+264 83 235 2366

Leonard.
For your noting + action,
cc: Angela
Ralph
Angelina
12/5/26.

11 May 2026

Mr Bisey /Uirab
The Chief Executive Officer
Namibia Airports Company
PO Box 23061
Windhoek

Dear Mr /Uirab,

SUBJECT: PERMANENT ERECTION OF NAMWASTE – WASTE PROCESS PLANT IN WALVIS BAY

Reference is made to your letter dated 07 May 2026 on the above-captioned matter.

We wish to inform you that the review of the information provided in your application concluded that NCAA has no objection to the permanent erection of the facility to process waste on Erf 160 of the remainder of Farm 38 in Walvis Bay.

Additionally, pursuant to NAMCARs 139.11.2, the review of the application further provided that the erection of the **10m high waste process treatment facility** at the following location coordinates does not infringe the Obstacle Limitation Surfaces (OLS) of FYWB:

- **Point 1: 23°01'23.55" S, 14°37'06.70"E**
- **Point 2: 23°01'22.63" S, 14°29'40.80"E**
- **Point 3: 23°01'26.93" S, 14°37'11.05"E**
- **Point 4: 23°01'27.85" S, 14°37'09.19"E**

NAC must ensure that the **10m high waste process treatment facility** remain within the limits specified above and ensure that they are marked and/or lighted as per the requirements.

Finally, the NCAA reserves the authority to initiate the removal of any object that will constitute a hazard to aircraft operations as prescribed in NAMCARs 139.11.7.

Board Members: Mr. Bethuel T. Mujelenga (Chairperson), Ms. Martha N. Hifenanye (Deputy Chairperson), Ms. Josephine N. Shigwedha, Mr. Fernando Samaela, Mr. Meklnedek Duplindi, Ms. Angelina Haushiku
Ms. Toska Sem (Executive Director)

Your usual cooperation is highly appreciated.

Yours sincerely,

NAMIBIA CIVIL AVIATION AUTHORITY
NCAA
2026 -05- 11
PRIVATE BAG 12003
AUSSPANNPLATZ
WINDHOEK
OFFICE OF THE EXECUTIVE DIRECTOR

Ms Teska Sem
Executive Director

Namibia Airports Company Limited
(Registration No. 98/472)
Established in terms of Act 25 of 1998
P.O. Box 23061, Windhoek
5th Floor, Sanlam Centre
145 Independence Avenue
Tel: +264 61 2955000
Fax: +264 61 2955022
E-mail: communications@airport.com.na
Website: www.airports.com.na

07 May 2026

Ms. Toska Sem
Executive Director
Namibia Civil Aviation Authority
Private Bag 12003
Ausspannplatz
Windhoek

Dear Ms. Sem

PERMANENT ERECTION OF NAMWASTE – WASTE PROCESS PLANT IN WALVIS BAY

Namwaste (Pty) LTD has expressed interest in erecting a facility to process waste on Erf 160 of the remainder of Farm 38 in Walvis Bay. As such, Namwaste submitted an application for the erection of the structure in relation to the established obstacle limitation surfaces at Walvis Bay International Airport

The location coordinates of the structures are as follows.

Notably, the following points are determined to be the boundaries of the waste process treatment facility to be constructed.

a) **Point 1**: 10m total height above ground level and at 92AMSL, at 23°01'23.55"S 14°37'06.70"E at a distance of ±5 526m to the Aerodrome Reference Point (ARP)

b) **Point 2**: 10m total height above ground level and at 92AMSL, at 23°01'22.63"S 14°37'08.56"E at a distance of ±5 476m to the Aerodrome Reference Point (ARP)

c) **Point 3**: 10m total height above ground level and at 92AMSL, at 23°01'26.93"S 14°37'11.05"E at a distance of ±5 557m to the Aerodrome Reference Point (ARP)

d) **Point 4**: 10m total height above ground level and at 92AMSL, at 23°01'27.85"S 14°37'09.19"E at a distance of ±5 607m to the Aerodrome Reference Point (ARP)

After careful review of the application, it was established that the erection of this facility, which extends to 10m above ground by Namwaste (Pty) Ltd on the portion of Farm 38, at the proposed location and its highest expected elevation, does not infringe the Obstacle Limitations Surfaces established for Walvis Bay International Airport. Therefore, NAC does not have any objection to the proposed project.

Directors: Dr Leake Hangala (Chairperson), Ms Eliza Petersen (Deputy Chairperson), Mr Lucien Moulton, Mr Ferdinand Nghiyolwa and Mr [illegible]
Chief Executive Officer: [illegible]

We have attached FSS-AGA-FORM-032 as well as the related documents for your consideration.

Please accept Madam Executive Director, the assurance of our highest consideration.

Yours sincerely

Bisey /Uirab
CHIEF EXECUTIVE OFFICER

NAMIBIA AIRPORTS COMPANY LTD
OFFICE OF THE CHIEF EXECUTIVE OFFICER
07 MAY 2026
Tel: +264 61 285 6001
PO Box 22021, WINDHOEK, NAMIBIA

Appendix A. Namwaste Permanent Structure Application - Appendix 13 Aerodrome Manual

Appendix 13

APPLICATION FOR THE ERECTION OF TEMPORARY, MOBILE OR PERMANENT STRUCTURE AT FYWB

PART 1: Particulars of the Applicant

1.1 Full Name: **Namwaste (Pty) Ltd** 1.2 Trade Name: **Namwaste**
1.3 Full Business / Residential address: **PO Box 30735 Windhoek, Namibia** **Sam Nujoma Drive (next to Tony Rust Race Track) Windhoek**
1.4 City/town. **Windhoek**
1.5 Postal address: **PO Box 30735 Windhoek** 1.6 Email address: **t.provendier@rent-a-drum.com.na**
1.7 Telephone Number. **+26461244097** 1.8 Telex or other contact (if any)
1.9 Project owner / operator (if different from the applicant): **Namwaste (Pty) Ltd**
1.10 I the applicant hereby declare by that the particular provided in the application are true in every respect Signature 30/3/2026 Date

PART 2: Particulars of the Structure to be erected

All coordinates shall conform to World Geodetic System 1984(WGS-84) reference frame

2.1 Name of aerodrome: **Walvis Bay International Airport**
2.2 Total height of the proposed structure: **10 meters (32.8084 feet)**
2.3 Elevation of the site above mean sea level. **82 meters (269.029 feet)**
2.4 Distance between the proposed structure to the aerodrome reference point: **5.371 km (17621.391 feet)**
2.5 Geographical Coordinates of the proposed structure (WGS 84): **Point 1 - 0143767 E (14°37'6.70"E) 231235 S (23°1'23.55"S)** **Point 2 - 0143785 E (14°37'8.56"E) 231226 S (23°1'22.63"S)** **Point 3 - 01437110 E (14°37'11.05"E) 231269 S (23°1'26.93"S)** **Point 4 - 0143791E (14°37'9.19"E) 231279 S (23°1'27.85"S)**
2.6 Proposed start date and duration: **Construction activities for the proposed facility are anticipated to start in September 2026. Once construction is completed, the site should be commissioned between January 2027 – December 2028. The site is anticipated to be fully operational in January 2028. The facility will be a permanent facility.**

NAMIBIA CIVIL AVIATION AUTHORITY	
APPROVED	SIGNATURE
	DATE

2.7 Type of structure

☐ Crane ☒ Other

Description
Building

.....

.....

PART 3: SUPPORTING DOCUMENTS

3 1 Supporting Documents
Mark the appropriate block

☒ Map showing the location of the proposed structure
☒ Plan showing the total height of the structure
☐ Letter of authorisation if a consultant or third party is submitting the application on behalf of the project owner. (N/A)
☒ Operational information (operational hours, fixed/mobile, operators)
☐ Additional supporting document (specify)

Description
Operational information - General operations will take place daily from 07h00 am – 17h00 on weekdays (i.e., Monday - Friday). On Saturdays, operations will be conducted from 07h00 am – 13h00. On public holidays and Sundays, operations are limited, and the site is closed. However, due to the nature of O&G operations, treatment plants and similar operations require to be conducted 24 hours per day, 7 days per week schedule.

.....

.....

.....

NAMIBIA CIVIL AVIATION AUTHORITY	
APPROVED	SIGNATURE
	DATE

Namwaste (Pty) Ltd Namibia Obstacle Limitation Surfaces and Land Use Planning Assessment

ERF 160, FARM 38 WASTE PROCESS FACILITY

Renos Samaritis
NAMIBIA AIRPORTS COMPANY (WALVIS BAY INTERNATIONAL AIRPORT)

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Appendix B: NAC Application for permanent erection of structures - Form 032 7

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1 Introduction

Walvis Bay International Airport is tasked with ensuring that the defined airspace around aerodromes is maintained free from obstacles to permit the intended aeroplane operations at the aerodromes to be conducted safely and to prevent the aerodromes from becoming unusable due to the growth of obstacles around the aerodromes. This is achieved by establishing a series of obstacle limitation surfaces that define the limits to which objects may project into the airspace. In order to safeguard the airspace in and around Walvis Bay International Airport, Obstacle Limitation Surfaces (OLS) and subsequent OLS safeguarding charts are established. The OLS and safeguarding charts are based on the requirements of Namibian Civil Aviation Regulations (NAMCARs and CATs) 139 Subpart 11 and international regulations.

In addition to controlling the defined airspace around aerodromes, the airport also provides guidance on the safeguarding of aerodromes by controlling proposed developments in areas surrounding aerodromes. To safeguard, in terms of how it relates to aviation activities means, "a measure taken to protect someone or something or to prevent something undesirable" therefore airport safeguarding as referred to in this document refers to taking the measures necessary to ensure the safety of aircraft, and thereby the passengers and crews aboard them, while taking-off or landing, or while flying in the vicinity of an aerodrome.

2 Reference Documents

Namibian Civil Aviation Regulations 139 Subpart 11 and 139.01.34 & Technical Standards 139

International Civil Aviation Organization Annex 14, 9th edition, 2022, Chapter 4

International Civil Aviation Organization Airport Services Manual, Doc 9137, Part 6 Control of Obstacles – 2nd edition, 1983

International Civil Aviation Organization Airport Planning Manual, Part 2 Land Use and Environmental Control, 4th edition - 2018

International Civil Aviation Organization Doc 9674, World Geodetic System 1984 (WGS-84), 2nd edition, 2002

3 Application

Mr. T Provendier of Rent-A-Drum on behalf of Namwaste Windhoek (Pty) Ltd, submitted an application to Namibia Airports Company, Walvis Bay International Airport Manager, initially on Wednesday, 18 March 2026. The provided coordinates were incorrect, and the corrected version was resubmitted on Tuesday, 31 March 2026, following their initial application, attached as Appendix A.

These applications, Form 032 for permanent installation, are attached to this document as Appendix B, the purpose of which was to assess the proposed erection of a facility to construct a waste process plant on Erf 160, Farm 38 a facility located approximately 6km west of the Walvis Bay International Airport's Airport Reference Point (ARP).

The structure which is to be erected will be to the total height of no higher than 92m AMSL, at its highest point, above ground level, including elevation. The application(s) were submitted based on the corners of the proposed structure (east, west, north and south). The application was tested on the Geospatial Data Management System (GDMS) software, the outcome contained in Appendix D.

3.1 Information

- Application should be completed with all the relevant information and coordinates expressed in accurate WGS84 values, name of aerodrome, total height of the proposed structure, elevation of the site above mean sea level
- Plot the location of the proposed development on a suitable map.
- Measure the distance of the site from the aerodrome. If the site layout does not clearly indicate the exact location of the structure/development, use the part of the site nearest to the aerodrome.
- Determine the most critical, normally the highest, point of the proposed structure / development.
- Establish the prevailing surface or surfaces using OLS charts
- Calculate the height of the applicable obstacle limitation surface(s) at the site.
- Compare the height of the applicable obstacle limitation surface(s) at the site, with that of the maximum allowable development height, for residential areas of the proposed structures to determine if there is an infringement and by how much.
- Consideration of potential impact/hazards of: Land Use Planning, Bird strike Hazard, Wildlife attracting features, Lighting, Cranes (other tall structures), etc.

Important aspects to consider when conducting the assessment are height restrictions, landscaping in relation to water, and, by implication, wildlife management. Whether the development has any area(s) which fall within the take-off climb, approach or transitional surface, then such structures could cause a potential safety risk.

3.2 Assessment Phases

The airport will assess applications received by any property owner/investors, the local Municipality and any other temporary or permanent possible obstacle application, attached as Appendix A.

During the first phase, the documents will be assessed for completeness of required information in the required format and for accuracy. Applications are completed and attached as Appendix B.

The second phase is the processing phase, taking into consideration aerodrome OLS, surfaces which protect visual and instrument flight paths, visual and electronic aides, and the type of land use in relation to the OLS chart of FYWB attached as Appendix C.

The third and last phase is the following assessment phase, outcome-based on the GDMS software attached as Appendix D, where the airport will review the assessment and submit the application to the Namibia Civil Aviation Authority for approval for construction to commence, with a no-objection letter to the applicant.

The document following the assessment phases, from the airport perspective, is attached to this report as Appendix E.

3.3 OLS Assessment

Information used to conduct the assessment was, provided by the applicant Namwaste Windhoek (Pty) Ltd. The information used to undertake this assessment was provided by Mr. Provendier.

This information was then used to plot information into the Geospatial Data Management System. The required information and format of information are outlined on form Appendix 13 from the Aerodrome Manual – FYWB, Issue 1, 2022. The information is tested in relation to the OLS OLS /safeguarding chart, attached to this document as Appendix C, for Walvis Bay International Airport, to determine whether this proposed construction will infringe on the Obstacle Limitation Surfaces.

The obstacle applications, from Namwaste, are attached to this document as Appendix A, the applications for the erection of permanent structures by the airport are attached as Appendix B, against the established OLS chart attached as Appendix C. and the test result outcome is contained in Appendix D.

Since the development will be located outside Walvis Bay on Farm 38, south of the new D1984 highway, the process plant will affect the horizontal surface.

The assessment was conducted using an elevation of 82m above mean sea level (highest elevation) plus the total maximum structure height of 10m AGL. The total height of the structure, at its highest point, is therefore 92m (elevation 82 MASL + height of structure 10m). The proposed structure, therefore, does not infringe on affected OLS surfaces and, as such, it is permitted for construction in relation to the obstacle limitation surface.

3.4 Safeguarding Assessment

Important aspects taken into consideration for the purpose of safeguarding the aerodrome are:

- Land Use
- Lighting
- Tall Structures (cranes)
- Technical safeguarding (radiation)
- Noise
- Security
- Air Traffic Control line of sight
- Wildlife Hazard Management aspects (attractant features), particularly water.

Whether the development has any area(s) which fall within the take-off climb, approach or transitional surface, then such structures could cause a potential safety risk. All of which are discussed in further detail under safeguarding conditions.

4 Points of Consideration prior to Construction

Construction near airports was concerned largely with height control of possible hazards or obstacles to permit the intended aeroplane operations at the aerodromes to be conducted safely; however, further criteria should also be taken into consideration, as there is a need to control potentially conflicting activities, such as, but not limited to:

4.1 Conditions:

a) <u>Lighting:</u>
Namwaste should ensure that the proposed development does not include lighting that may dazzle or distract pilots or air traffic controllers on or in the vicinity of the aerodrome. Visual aids denoting obstacles require the erection of a red obstacle light, atop the top-most height of the structure, a warning or obstacle light.

b) <u>Tall Structures / Cranes:</u>
Namwaste should ensure that, when cranes are required on or in the vicinity of an aerodrome for the duration of the construction, if it extends to a height of more than 45m, the necessary applications are submitted to the Namibia Airports Company. Any other tall structures and buildings which may be anticipated following the initial assessment should also be communicated to the airport.

c) <u>Electrical Interference:</u> Activities that could cause electrical interference with radio communications and navigation aids.

d) Visibility Reduction: Namwaste should ensure consideration to limit the production of smoke, or any other substance, which may reduce visibility to approaching or departing aeroplanes, or aircraft using the aerodrome.

e) Technical Site Safeguarding (Telecommunications Facility):
Namwaste should ensure that the proposed development does not affect the performance of aeronautical systems (Airborne Radio, Navigation and surveillance aids) at or near an aerodrome. The siting of telecommunication or other radiating equipment can cause adverse electromagnetic interference to these systems. The proposal of any such infrastructural developments will have to be communicated to the NCAA ATS and/or ANS to ensure that this does not impact their electronic systems.

f) Land Use Planning:
Namwaste should ensure that during and after construction, their development does not attract wildlife and or birds to their process plant at Farm 38. Their waste should be managed appropriately to ensure that there is no wildlife attracting feature by means of the provision of food, water or shelter.

g) Water:
Namwaste should ensure that during and after construction, their development, particularly the two evaporation ponds, does not attract wildlife and or birds to their process plant at Farm 38. Their waste should be managed appropriately to ensure that there is no wildlife attracting feature by means of the provision of food, water or shelter.

5 Recommendation

Walvis Bay International Airport recommends that Namwaste take care in ensuring that the two evaporation ponds they are to construct does not attract wildlife and or birds to their process plant at Farm 38.

6 Conclusion

The Namibia Airports Company have assessed the application for the construction of a waste processing facility within the vicinity of Walvis Bay International Airport and found that the maximum allowable height to which any structure on this development may extend is 92m, taking into consideration the highlighted areas for consideration.

For the construction of any object higher than that, approval must be sought from the Executive Director of the Namibia Civil Aviation Authority.

The Namibia Airports Company would also like to point out to the applicant that, with the development of the area in question, they should take cognisance that the approval, if provided, has conditions, about covering of two water ponds and erection of obstruction lights atop the four corners assessed to ensure that the requirement for visual aids denoting obstacles is met.

7 Approval

Assessment By Chief Safety Officer Samantha Rence	Signature:	Date: 20/04/2026
Approved By Airport Manager Ms. Chrizelda N. George	Signature:	Date: 20/04/2026

Appendix B: NAC Application for permanent erection of structures - Form 032

NAMIBIA CIVIL AVIATION AUTHORITY
P. Bag 12003
Ausspannplatz, Windhoek,
Namibia

FSS-AGA-FORM-032
Application for erection of permanent structure within the vicinity of an aerodrome

PART 1. **Particulars of the Applicant**

1.1 Full Name: **Namibia Airports Company**
1.2 Trade Name: **Namibia Airports Company**
1.3 Full Business / Residential address. **154 Independence Avenue** **Sanlam** **5th Floor**
1.4 City/town: **Windhoek**
1.5 Postal address: **P.O. Box 23041, Windhoek** 1.6 Email address: **ulichb@airports.com.na**
1.7 Telephone Number: **+264 61 295 5000** 1.8 Telex or other contact (if any) **+264 61 295 5022**
1.9 Project owner / operator (if different from the applicant): **Namwaste (Pty) Ltd** **Sam Nujoma Drive (next to Tony Rust Race Track) Windhoek** **P.O. Box 30735, Windhoek, Namibia** **Namibia (Project Owner)**
1.10 The applicant declares hereby that the particular provided in the application are true in every respect Signature 7/5/26 Date

PART 2: Particulars of the Structure to be erected

All coordinates shall conform to World Geodetic System 1984(WGS-84) reference frame

2.1 Name of aerodrome: **Walvis Bay International Airport**
2.2 Total height of the proposed structure. **10m**
2.3 Elevation of the site above mean sea level: **82m**
2.4 Distance between the proposed structure to the aerodrome reference point: **5 526m**
2.5 Geographical Coordinates of the proposed structure (WGS 84): **23°01'23.55"S 14°37'06.70"E**
2.6 Proposed start date of construction: **September 2026**
2.7 Type of structure ☒ Building ☐ Power line, telephone line or overhead line ☐ Other Description: **Point 1 (West): 10m in total height, western part of the building structure at Erf160 of Farm 38**

PART 3: SUPPORTING DOCUMENTS

3.1 Supporting Documents
Mark the appropriate block

- [x] Map showing the location of the proposed structure
- [x] Plan showing the total height of the structure
- [ ] Letter of authorization if a consultant or third party is submitting the application on behalf of the project owner.
- [x] Additional supporting document (specify)

Description. **Geospatial Data Management System (GDMS) assessment report for Namwaste (Pty) Ltd and Client Application**

NAMIBIA CIVIL AVIATION AUTHORITY
P. Bag 12003
Ausspannplatz, Windhoek,
Namibia

FSS-AGA-FORM-032

Application for erection of permanent structure within the vicinity of an aerodrome

PART 1. **Particulars of the Applicant**

1.1 Full Name: **Namibia Airports Company**

1.2 Trade Name: **Namibia Airports Company**

1.3 Full Business / Residential address:

154 Independence Avenue
Sanlam
5th Floor

1.4 City/Town: **Windhoek**

1.5 Postal address: **P.O. Box 23061, Windhoek** 1.6 Email address: ulabb@airports.com.na

1.7 Telephone Number: **+264 61 295 5000** 1.8 Telex or other contact (if any) **+264 61 295 5022**

1.9 Project owner / operator (if different from the applicant):

Namwaste (Pty) Ltd
Sam Nujoma Drive (next to Tony Rust Race Track) Windhoek
P.O. Box 30735, Windhoek. Namibia
Namibia (Project Owner)

1.10 The applicant declares hereby that the particular provided in the application are true in every respect

Signature 7/5/26 Date

PART 2: Particulars of the Structure to be erected

All coordinates shall conform to World Geodetic System 1984(WGS-84) reference frame

2.1 Name of aerodrome: **Walvis Bay International Airport**

2.2 Total height of the proposed structure: **10m**

2.3 Elevation of the site above mean sea level: **62m**

2.4 Distance between the proposed structure to the aerodrome reference point: **5 476m**

2.5 Geographical Coordinates of the proposed structure (WGS 84): **23°01'22.63"S 14°37'08.56"E**

2.6 Proposed start date of construction: **September 2026**

2.7 Type of structure

☒ Building

☐ Power line, telephone line or overhead line

☐ Other

Description: **Point 2 (North): 10m in total height, western part of the structure at Erf160 of Farm 38**

PART 3: SUPPORTING DOCUMENTS

3.1 Supporting Documents
Mark the appropriate block

- [x] Map showing the location of the proposed structure
- [x] Plan showing the total height of the structure
- [ ] Letter of authorization if a consultant or third party is submitting the application on behalf of the project owner.
- [x] Additional supporting document (specify)

Description: **Geospatial Data Management Systems (GDMS) assessment report for Namwaste (Pty) Ltd and Client Application**

NAMIBIA CIVIL AVIATION AUTHORITY
P Bag 12003
Ausspannplatz, Windhoek,
Namibia

FSS-AGA-FORM-032
Application for erection of permanent structure within the vicinity of an aerodrome

PART 1. **Particulars of the Applicant**

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1.2 Trade Name: **Namibia Airports Company**
1.3 Full Business / Residential address: **154 Independence Avenue** **Sanlam** **5th Floor**
1.4 City/town. **Windhoek**
1.5 Postal address: **P.O. Box 23061, Windhoek** 1.6 Email address: uxabbiea@nacia.com.na
1.7 Telephone Number. **+264 61 295 5000** 1.8 Telex or other contact (if any) **+264 61 295 5022**
1.9 Project owner / operator (if different from the applicant): **Namwaste (Pty) Ltd** **Sam Nujoma Drive (next to Tony Rust Race Track) Windhoek** **P.O. Box 30735, Windhoek, Namibia** **Namibia (Project Owner)**
1.10 The applicant declares hereby that the particular provided in the application are true in every respect Signature 27/5/26 Date

PART 2: Particulars of the Structure to be erected

All coordinates shall conform to World Geodetic System 1984 (WGS-84) reference frame

2.1 Name of aerodrome: **Walvis Bay International Airport**
2.2 Total height of the proposed structure. **10m**
2.3 Elevation of the site above mean sea level: **62m**
2.4 Distance between the proposed structure to the aerodrome reference point: **5 557m**
2.5 Geographical Coordinates of the proposed structure (WGS 84): **23°01'26.93"S 14°37'11.05"E**
2.6 Proposed start date of construction: **September 2026**
2.7 Type of structure ☑ Building ☐ Power line, telephone line or overhead line ☐ Other Description: **Point 3 (East): 10m in total height, western part of structure of Erf160 of Farm 38**

PART 3: SUPPORTING DOCUMENTS

3.1 Supporting Documents
Mark the appropriate block

- ☒ Map showing the location of the proposed structure
- ☒ Plan showing the total height of the structure
- ☐ Letter of authorization if a consultant or third party is submitting the application on behalf of the project owner
- ☒ Additional supporting document (specify)

Description: **Geospatial Data Management System (GDMS) assessment report for Namwaste (Pty) Ltd and Client Application**

NAMIBIA CIVIL AVIATION AUTHORITY
P. Bag 12003
Ausspannplatz, Windhoek,
Namibia

FSS-AGA-FORM-032
Application for erection of permanent structure within the vicinity of an aerodrome

PART 1 **Particulars of the Applicant**

1.1 Full Name: **Namibia Airports Company**

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5th Floor

1.4 City/town: **Windhoek**

1.5 Postal address: **P.O. Box 23061, Windhoek** 1.6 Email address: uiaabb@airports.com.na

1.7 Telephone Number: **+264 61 295 5000** 1.8 Telex or other contact (if any) **+264 61 295 5022**

1.9 Project owner / operator (if different from the applicant):

Namwaste (Pty) Ltd
Sam Nujoma Drive (next to Tony Rust Race Track) Windhoek
P.O. Box 30735, Windhoek, Namibia
Namibia (Project Owner)

1.10 The applicant declares hereby that the particular provided in the application are true in every respect

Signature

7/5/26
Date

PART 2: Particulars of the Structure to be erected

All coordinates shall conform to World Geodetic System, 1984 (WGS-84) reference frame

2.1 Name of aerodrome: **Walvis Bay International Airport**

2.2 Total height of the proposed structure: **10m**

2.3 Elevation of the site above mean sea level: **62m**

2.4 Distance between the proposed structure to the aerodrome reference point: **5 607m**

2.5 Geographical Coordinates of the proposed structure (WGS 84): **23°01'27.85"S 14°37'09.19"E**

2.6 Proposed start date of construction: **September 2026**

2.7 Type of structure

☒ Building

☐ Power line, telephone line or overhead line

☐ Other

Description: **Point 4 (South): 10m in total height, western part of the structure of Erf160 of Farm 38**

PART 3: SUPPORTING DOCUMENTS

3.1 Supporting Documents
Mark the appropriate block

☒ Map showing the location of the proposed structure
☒ Plan showing the total height of the structure
☐ Letter of authorization if a consultant or third party is submitting the application on behalf of the project owner.
☒ Additional supporting document (specify)

Description: **Geospatial Data Management System (GDMS) assessment report for Nomwaste (Pty) Ltd and Client Application**

Appendix C: FYWB OLS Chart

FYWB - Walvis Bay, Namibia
Namibian Airports Company
Aerodrome Safeguarding - GDMS Report

Obstacle Penetration Summary

Generated by Walvis Bay Safety

Project: Namiweste
Description: Namiweste 26 March 2026

Obstacle Id	Obstacle Height (AMSL)	Infringed Surface	Penetrates (m)	Surface Maximum (AMSL)	Easting (WGS84)	Northing (WGS84)
Namiweste Point 1	92.00	Conical	No (47.88)	139.88	355838.06	7450906.90
Namiweste Point 2	92.00	Conical	No (45.81)	137.81	355880.59	7450926.05
Namiweste Point 3	92.00	Conical	No (51.32)	143.32	355983.68	7450864.88
Namiweste Point 4	92.00	Conical	No (53.35)	145.35	355911.15	7450775.79

26 March 2026

FYWB - Walvis Bay, Namibia
Aerodrome Safeguarding
Namibian Airports Company
walvisbay.safety@airports.com.na

Obstruction Information

Summary Report

Report generated by: Walvis Bay Safety

Reference:	Namwaste Point 1	Lit:	No		
Group:	Namwaste	Status:	Structure		
Description:	NWPoint1				
Easting:	355938.057	Northing:	7450905.899	Magnetic from ARP:	208.893°
Latitude:	23° 01' 23.5500" S	Longitude:	14° 37' 8.7000" E	Distance from ARP:	5526.485 m

Horizontal Extents	0.000 m
Ground level AMSL	82.000 m
Height of structure AGL	10.000 m
Height of structure AMSL	92.000 m

Penetration Information

Dsgn.	Surface.	Penetrates	Max. AMSL (m)	Max AGL (m)
Inner Horizontal	Conical	No (47.88)	139.88	57.88

26 March 2026

FYWB - Walvis Bay Namibia
Aerodrome Safeguarding
Namibian Airports Company
walvisbaysafety@airports.com.na

Obstruction Information

Summary Report

Report generated by Walvis Bay Safety

Reference:	Namwaste Point 2	Lit:	No
Group:	Namwaste	Status:	Structure
Description:	NWPoint2		

Easting:	355890.589	Northing:	7450936.079	Magnetic from ARP:	208.588°
Latitude:	23° 01' 22.6300" S	Longitude:	14° 37' 8.5600" E	Distance from ARP:	5475.644 m

Horizontal Extents:	0.000 m
Ground level AMSL:	82.000 m
Height of structure AGL:	10.000 m
Height of structure AMSL:	92.000 m

Penetration Information

Dsgn	Surface	Penetrates	Max. AMSL (m)	Max AGL (m)
Inner Horizontal	Conical	Yes (45.81)	137.81	55.81

26 March 2026

FYWB – Walvis Bay, Namibia
Aerodrome Safeguarding
Namibian Airports Company
walvisbaysafety@airports.com.na

Obstruction Information

Summary Report

Report generated by: Walvis Bay Safety

Reference	Namwaste Point 3	LIL	No
Group:	Namwaste	Status	Structure
Description:	NWPoint3		

Easting:	355963.683	Northing	7450804.875	Magnetic from ARP	207.257°
Latitude	23° 01' 26.9300" S	Longitude:	14° 37' 11.0500" E	Distance from ARP:	5557.375 m

Horizontal Extents:	0.000 m
Ground level AMSL:	82.000 m
Height of structure AGL	10.000 m
Height of structure AMSL:	92.000 m

Penetration Information

Dsgn.	Surface	Penetrates	Max. AMSL (m)	Max AGL (m)
Inner Horizontal	Conical	No (51.32)	143.32	61.32

FYWB - Walvis Bay, Namibia
Aerodrome Safeguarding
Namibian Airports Company
walvisbaysafety@airports.com.na

Obstruction Information

Summary Report

Report generated by: Walvis Bay Safety

Reference:	Namwaste Point 4	**Lit:**	No
Group:	Namwaste	**Status**	Structure
Description	NWPoint4		

Easting:	355011.151	Northing:	7450775.695	**Magnetic from ARP**	207.599°
Latitude:	23° 01' 27.8500" S	**Longitude:**	14° 37' 9.1900" E	Distance from ARP	5507.473 m

Horizontal Extents	0.000 m
Ground level AMSL	82.000 m
Height of structure AGL:	10.000 m
Height of structure AMSL:	92.000 m

Penetration Information

Dsgn.	**Surface.**	**Penetrates**	**Max. AMSL (m)**	**Max AGL (m)**
Inner Horizontal	Conical	No (63.35)	145.35	63.35

Appendix D: Namwaste GDMS Test Results

Appendix E: Assessment Phase Outcome

WALVIS BAY INTERNATIONAL AIRPORT - SAFETY

Telephone: (064) 271102/127 Fax. (064) 200164
E-mail: samantha@airports.co.n.na

[redacted]

Safeguarding Assessment: Appendix D

File reference: OLS/A4/DSC Farm Number: 038

2026/03/1

Aerodrome: Walvis Bay International Airport

Technical Site: ±6km west of the ARP

Application Received: 31 March 2026 Assessment Date: 20 April 2026 Reply By: C. George

Description:

Erection of a building for a waste process treatment facility to be constructed on Erf 160 at Farm 38 adjacent to the airport.

Type of Application: Full: X Initial/Outline ☐

1.	WGS84 Co-ordinates: Lalitude/Longitude	As per application
2.	Safeguarding Map colour Zone:	Blue
3.	Height of proposed structure above ground level:	10m
4.	Height of ground level at development location:	82m Elevation
5.	Overall maximum height of proposed structure:	92m (total structure)

Cross Reference(s) to previous case: Cleanergy Green Hydrogen facility, application of January 2023.

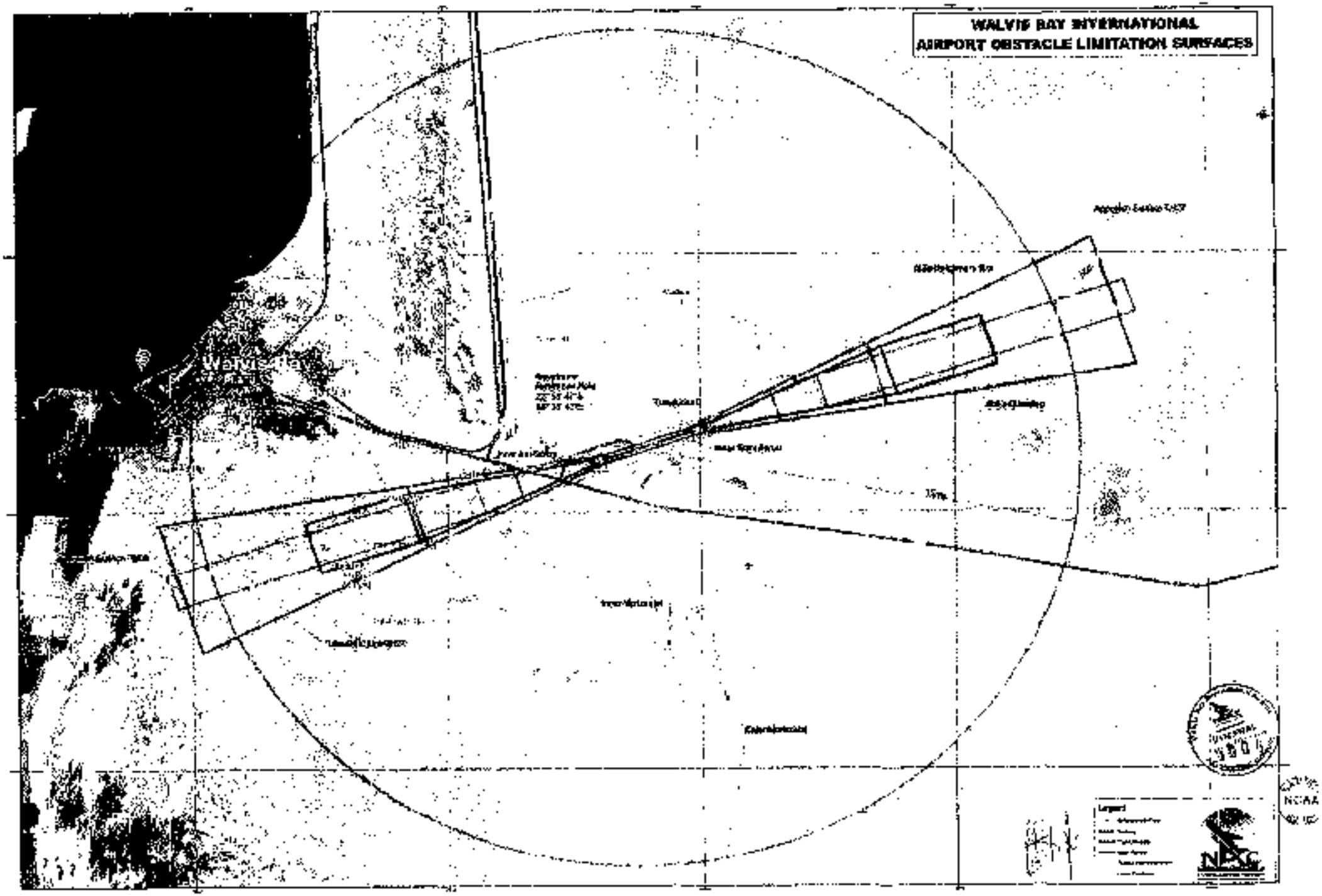
Comments:
- N/A

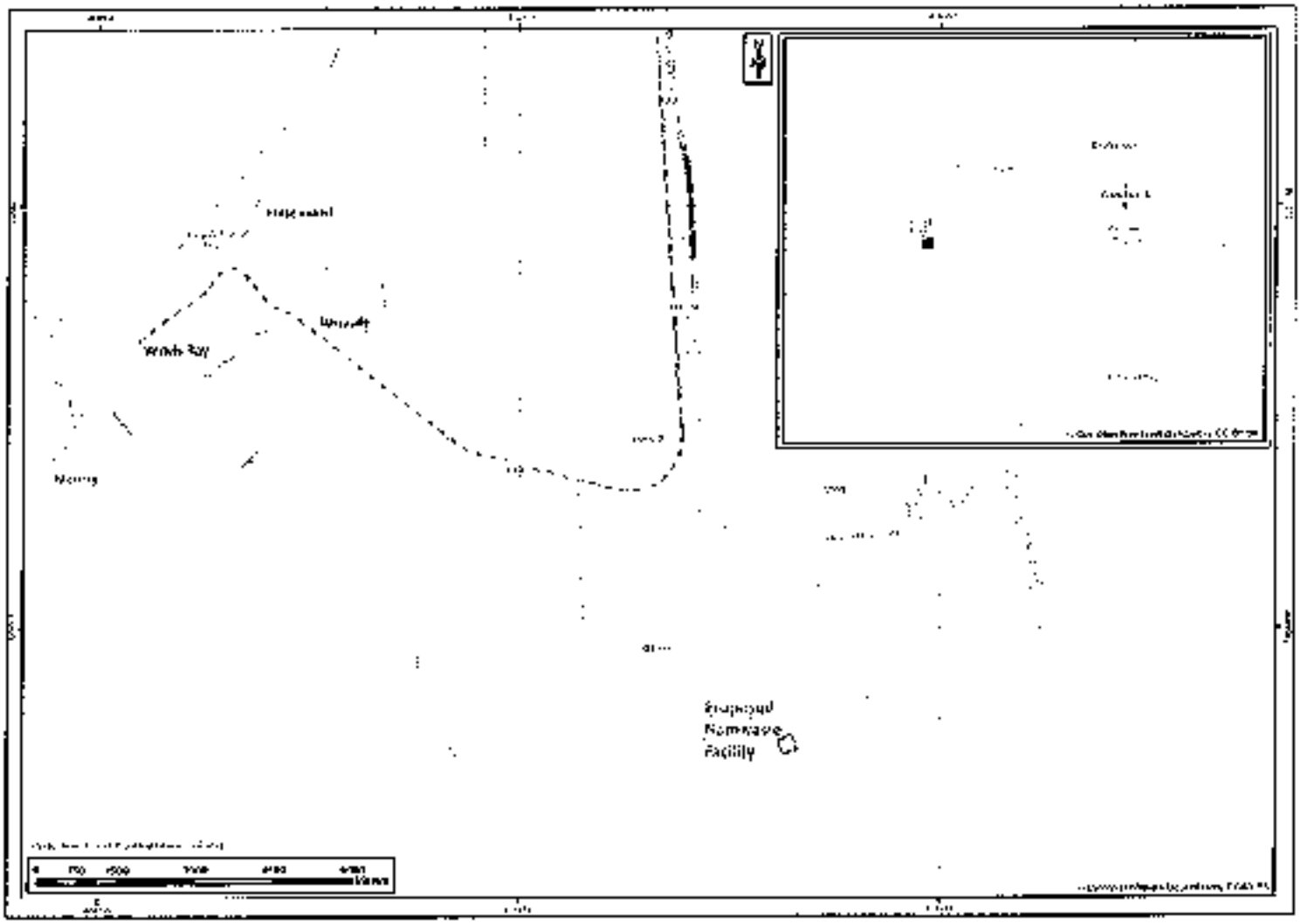
OBJECTION	☐	Signed	LETTER	☐
NO OBJECTION BUT WITH CONDITIONS	☒	Airport Manager: Walvis Bay	FAX:	☐
NO OBJECTIONS	☐	Date: 20/04/2026	PHONE:	☐
NCAA AWARE	☐		EMAIL:	☒

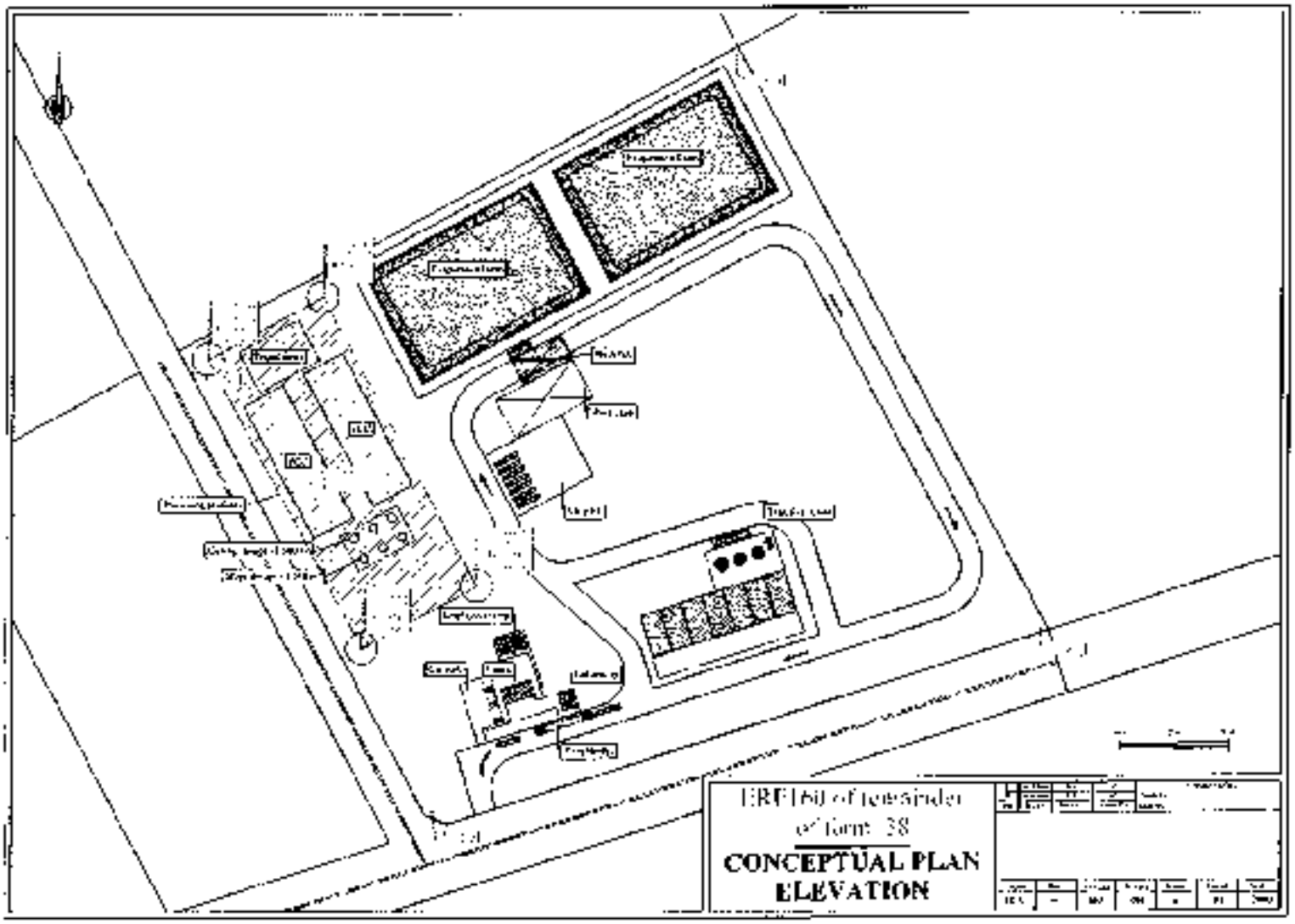
Condition:

There are no reflective lights or other signals which may dazzle or confuse pilots on departure and or approach-to-land at Walvis Bay International Airport. Obstruction light(s) are to be placed at the highest point of the structure, at each corner of the building for enhanced Aviation Safety

II Evaporated water ponds must be covered to ensure that wildlife and birds are not attracted to the water


WALVIS BAY INTERNATIONAL
AIRPORT OBSTACLE LIMITATION SURFACES
Walvis Bay
Legend
NCAA


Proposed
Nonhazardous
Facility


CONCEPTUAL PLAN
ELEVATION

ANNEXURE F – AIR QUALITY IMPACT ASSESSMENT

Walvis Bay Integrated Waste Management, Treatment, Transfer and Recovery Facility

Air Quality Impact Assessment Report

KP Consulting

J-SAF-50039

16-01-2026

Disclaimer

WKC Group* accepts no responsibility to any parties whatsoever, following the issue of the Document, for any matters arising outside the agreed scope of the work. This Document is issued in confidence to the Client and WKC has no responsibility to any third parties to whom this Document may be circulated, in part or in full, and any such parties rely on the contents of the report solely at their own risk.

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Approval & Revision Record

Project:	Walvis Bay Integrated Waste Management, Treatment, Transfer and Recovery Facility
Document Title:	Air Quality Impact Assessment Report
Client:	KP Consulting
Report Number:	J-SAF-50039

Rev	Date	Prepared	Reviewed	Approved
00	27-10-2025	Daniel du Plessis Environmental Scientist	Ashley Meyer Partner	Ashley Meyer Partner
01	29-10-2025	Daniel du Plessis Environmental Scientist	Ashley Meyer Partner	Ashley Meyer Partner
02	30-10-2025	Daniel du Plessis Environmental Scientist	Ashley Meyer Partner	Ashley Meyer Partner
03	16-01-2026	Daniel du Plessis Environmental Scientist	Ashley Meyer Partner	Ashley Meyer Partner
04	16-01-2026	Daniel du Plessis Environmental Scientist	Ashley Meyer Partner	Ashley Meyer Partner

Summary of Changes

Rev	Date	Nature of Revision
00	27-10-2025	Draft Version
01	29-10-2025	Issued for Review
02	30-10-2025	Issued for Review

03	16-01-2026	Issued for Review
04	16-01-2026	Issued for Submission

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Acronyms

General

3D	Three-Dimensional
ADM	Air Dispersion Modelling
AERMOD	American Meteorological Society/ Environmental Protection Agency Regulatory Model
DEA	Department of Environmental Affairs
EPA	Environmental Protection Agency
GLC	Ground Level Concentration
SR	Sensitive Receptor
UK	United Kingdom
US	United States
UTM	Universal Transverse Mercator
WKC	WKC Group (Pty) Limited
WRF	Weather Research and Forecasting

Chemical Formulae

CO	Carbon Monoxide
NO_2	Nitrogen Dioxide
NO_x	Oxides of Nitrogen
$PM_{2.5}$	Particulate Matter (diameter <2.5 µm)
PM_{10}	Particulate Matter (diameter <10 µm)
SO_2	Sulphur Dioxide

Metrics

%	Percentage
µg/m^3	Microgram per Cubic Metre
g/s	Grams per Second
kg	Kilograms
km	Kilometre
kW	Kilowatt

m	Metre
m^2	Squared Meters
m^3	Cubic Metres
mg/m^3	Milligram per Cubic Metre
MJ/kg	Megajoules per Kilogram
m/s	Metres per Second
ppm	Parts per Million

1 Introduction

This Air Dispersion Modelling (ADM) Report has been prepared on behalf of Knight Piésold (KP) Consulting, hereafter referred to as the 'Client', as part of the environmental permitting process that is being undertaken for the proposed Namwaste facility, hereafter referred to as the 'Project', which will be an integrated waste management, treatment, transfer, and recovery facility. The proposed Project will be located in Walvis Bay in the Erongo Region of Namibia, approximately 20 km from the Port entrance.

1.1 Study Objectives

The key objectives of this assessment are as follows:

- To undertake a review of the relevant ambient air quality standards in the context of the Department of Environmental Affairs (DEA) or in their absence, international guidelines as applicable, to provide a summary of the minimum standards that will need to be achieved in ambient air; and,
- To quantify and assess the potential impacts of the construction and operation phases of the planned facility with regards to ambient air quality considering the main air emissions sources.

Operational emissions and potential air quality impacts from the Project were modelled using AERMOD Version 13.0.0 and compared to the applicable ambient air quality standards (AAQS) and international guideline levels.

1.2 Scope of this Study Scope

This report presents the assessment of potential impacts associated with the construction and operation phases of the Project. The construction phase of the assessment was assessed qualitatively in accordance with the internationally recognised Institute of Air Quality Management (IAQM) Guidance on the assessment of dust from demolition and construction [1]. The operation phase emissions and associated impacts were modelled using the internationally recognised AERMOD air dispersion modelling software, and were assessed in isolation and cumulatively relative to the applicable standards / guideline values. The maximum modelled ground level concentrations (GLCs) at the nearest sensitive receptors (SRs) were compared directly with the assessment criteria detailed in Section 2.2.

2 Project Description

2.1 Project Overview

2.1.1 Project Background

Large crude oil and natural gas discoveries offshore Namibia in recent years has led to oil and gas exploration drilling activities being undertaken in the area. Associated drilling and production of oil and gas reserves offshore will generate significant quantities of solid and liquid, general and hazardous waste. Increased production of waste offshore Walvis Bay, existing commercial and industrial uses of the port and the lack of suitable industrial waste treatment facilities necessitate a private sector solution to manage the waste on-shore, both from off-shore activities and port activities.

The purpose of the Project is to fulfill that role by providing the relevant treatment facility as close as possible to the source of generation. The facility will largely be tailored to the specific needs of the offshore oil and gas exploration and production (E&P) industry. The E&P industry produces two specific waste streams (cuttings (~15% oil, 15% water & 70% solids (rock)) and slops (~10% oil, 80% water & 10% solids (rock)) in large quantities during drilling as well as a wide range of industrial waste such as used and redundant chemicals, chemical containers and paints in smaller quantities. General solid waste and medical waste is also generated by the personnel on the riggs. In addition, drilling fluids (mud and brine), which are used to aid the drilling of wells, become contaminated with hydrocarbons during the process and require treatment prior to reuse.

2.1.2 Project Activities Overview

Project activities will consist of waste management specific activities and supporting / ancillary activities common to industrial sites. Waste management specific activities which will take place on the site include:

- Treatment of cuttings and mud and recovery of hydrocarbons using either a Thermomechanical Cuttings Cleaner (TCC) or Thermal Desorption Unit (TDU);
- Treatment of slops in a slops treatment unit (mainly a centrifuge);
- Discharge of treated effluent into the municipal wastewater treatment works or evaporation ponds;
- Storage of cuttings and slops in suitable, bunded containment facilities;
- Temporary storage of waste (liquids and solids) in suitable, bunded containment facilities; and,
- Tank and skip washing.

Ancillary infrastructure and supporting activities required to conduct primary activities include:

- Truck depot and bin yard;
- Stormwater / run-off management infrastructure for collection and containment of any contaminated water;
- Effluent storage in ponds / dams for evaporation with surface area of 17,000 m^2 or discharge into the municipal wastewater treatment works;
- A plant / vehicle washing bay with contaminated runoff control;
- Laboratory to test and verify the classification of incoming and / or treated waste as required;
- Access road (~1.2 km) to the facility;
- Access control facilities including perimeter fencing;
- Weighbridges and control room;
- Fuel storage facilities with capacity of 23,000 litres;
- Water storage tank with a capacity of 200 m^3;
- Back-up generators – 5 x 500 kVA;
- Offices and other administrative buildings;
- Staff dining and ablution facilities
- Camp for ~50-100 employees;
- Workshop and stores;
- Weather station; and,
- Utility connections:
    - The facility will require a maximum electricity supply of 2,500 kVA – TCC + 750 kW Disc Stack centrifuge / Slops treatment process + 110 kW Enhanced Passive Evaporation process for use on site.
    - Water supply from municipal 25 m^3 per day.
    - Sewage management – package sewer plant.

2.1.3 Project Location

The project is located in the Southern part of Namibia, just outside the town of Lüderitz. The Project location is shown in a regional context in Figure 2-1 and the local perspective of the Project are given in Figure 2-2.

Figure 2-1 – Regional Perspective of the Project

Figure 2-2 – The Project in a Local Context

2.2 Sources and Pollutants of Concern

The primary sources considered in this impact assessment are the dedicated combustion sources. These include the following sources:

- TCC / TDU;
- Boiler, and
- Generators.

Combustion related pollutants that were considered in this assessment due to their known impact on the environment as well as human health and their potential to be released to the atmosphere include:

- **Nitrogen Oxides (represented by NO_2)**: Collective term for the group of pollutants, predominantly comprising nitrogen dioxide (NO_2) and nitric oxide (NO). NO_2 is toxic even at relatively low concentrations and can be readily formed from the oxidation of NO in the presence of atmospheric oxidants. Epidemiological studies have shown that symptoms of bronchitis in asthmatic children tend to increase in association with long term exposure to NO_2;
- **Particulate Matter (PM)**: Small particles of less than 10 micrometres in diameter (PM_{10} and $PM_{2.5}$) pose a health risk, as these particles can penetrate deep into the lungs, and may even enter the bloodstream. Exposure to such particles can result in effects to both the lungs and heart;
- **Sulphur Dioxide (SO_2)**: Short-term exposures to SO_2 can harm the human respiratory system and make breathing difficult. People with asthma, particularly children, are sensitive to these effects of SO_2. High concentrations of SO_2 in the air generally also lead to the formation of other sulfur oxides (SO_x) that can react with other compounds in the atmosphere to form PM.
- **Carbon Monoxide (CO)**: CO formed by the incomplete reaction of air with fuel and occurs primarily from emissions produced by fossil fuel–powered engines, including motor vehicles and non-road engines and vehicles (such as construction equipment and boats). CO can cause harmful health effects by reducing oxygen delivery to the body's organs and tissues.

Other potential sources and pollutants associated with the operation of the facility include fugitive emissions of VOC from various stages of the waste handling and processing, as well as fuel storage. However, all materials (liquid and waste) will be enclosed during transport, transfer, storage and processing; and where cuttings and sludge are treated by TCC or TDU, the purpose of the process is the desorption and capture of volatile compounds. Based on the Project description, and the implementation of best practice in accordance with the relevant IFC EHS guidelines including Guidance for upstream oil and gas, EHS guidance for waste Guidelines for Offshore Oil and Gas Development, impacts from fugitive VOCs have been screened from the quantitative ADM assessment.

3 Regulatory Framework

This section presents the relevant local and international air quality regulations and guidelines applicable to the Project.

3.1 National Legislation

In Namibia, there are no formally promulgated national ambient air quality standards. The country has historically applied the provisions of the South African Atmospheric Pollution Prevention Act (Act 45 of 1965), which addresses smoke, dust, noxious gases, and vehicle emissions. South Africa has since replaced this Act with the National Environmental Management: Air Quality Act (Act 39 of 2004), which introduced specific ambient air quality standards (AAQS) based on the South African National Standards.

Because Namibia has not adopted its own AAQS, it is common practice for air quality assessments in the country to refer to the South African AQA standards, supplemented where appropriate by World Health Organisation (WHO) or European Union (EU) limits to reflect international best practice. For the purpose of this assessment, the World Bank Group (WBG) International Finance Corporation (IFC) Environmental Health and Safety (EHS) guidelines and the referenced EU Directive AAQS have been use for the assessment of the Project.

3.2 International Guidelines

According to the IFC General EHS Guidelines [2], projects with significant sources of air emissions, and potential for significant impacts to ambient air quality, should prevent or minimise impacts by ensuring that:

- Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current WHO Air Quality Guidelines, or other internationally recognised guidelines such as the EU Directive [3];
- Emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards. As a general rule, this Guideline suggests 25% of the applicable air quality standards to allow additional, future sustainable development in the same airshed.

The IFC guidelines make reference to alternative international guidelines and standards such as the EU standards (European Council Directives [3]) that were recently update in 2024, providing interim targets in-line with the previous 2008 Directive, and providing new and revised targets for 2030, aligning more closely with the WHO Air Quality Guidelines [4]. For the purpose of this assessment, the EU Directive AAQS have been adopted as the applicable international AAQS aligning with the IFC General EHS guidelines for air quality [2].

Table 3-1 – EU Directive AAQS

Pollutant	Averaging Period	EU Directive 2024 AAQS			
		2026 Limit Values (µg/m³)	Allowable Exceedances	2030 Limit Values (µg/m³)	Allowable Exceedances
NO_2	1-hour	200	18	200	3
	24-hour	-	-	50	18
	Annual	40	-	20	-
SO_2	1-hour	350	24	350	3
	24-hour	125	3	50	18
	Annual	-	-	20	-
PM_{10}	24-hour	50	35	48	18
	Annual	40	-	20	-
$PM_{2.5}$	24-hour	-	-	25	18
	Annual	25	-	10	-
CO	8-hour	10,000	-	10,000	-
	24-hour	-	-	4,000	18

4 Baseline Ambient Air Quality

The baseline air quality of the Project site was established by means of a baseline air quality survey using a combination of passive and active sampling methods. Details of the baseline survey and results are covered in the following sections.

4.1 Methodology

4.1.1 Passive sampling – SO_2 and NO_2

Ambient concentrations of SO_2 and NO_2 were measured using passive samplers / diffusion tubes. Diffusion tubes are simple, cost-effective samplers that absorb target gases from the surrounding air over a fixed exposure period. The gases diffuse along the tube and are captured by a chemical absorbent specific to each pollutant. After exposure, the tubes are sealed and sent to an accredited laboratory for analysis, where the mass of pollutant collected is converted into an average ambient concentration over the sampling period.

4.1.2 Active Sampling – PM

Particulate matter (PM_{10} and $PM_{2.5}$) were measured continuously using an Osiris real-time dust monitor. The Osiris instrument operates on the principle of light scattering, where a laser beam passes through the sampled air stream and the intensity of light scattered by particles is proportional to their mass concentration. The monitor provides near-real-time measurements of airborne particulate matter and records data at high temporal resolution, allowing for the assessment of daily and short-term variations in dust levels.

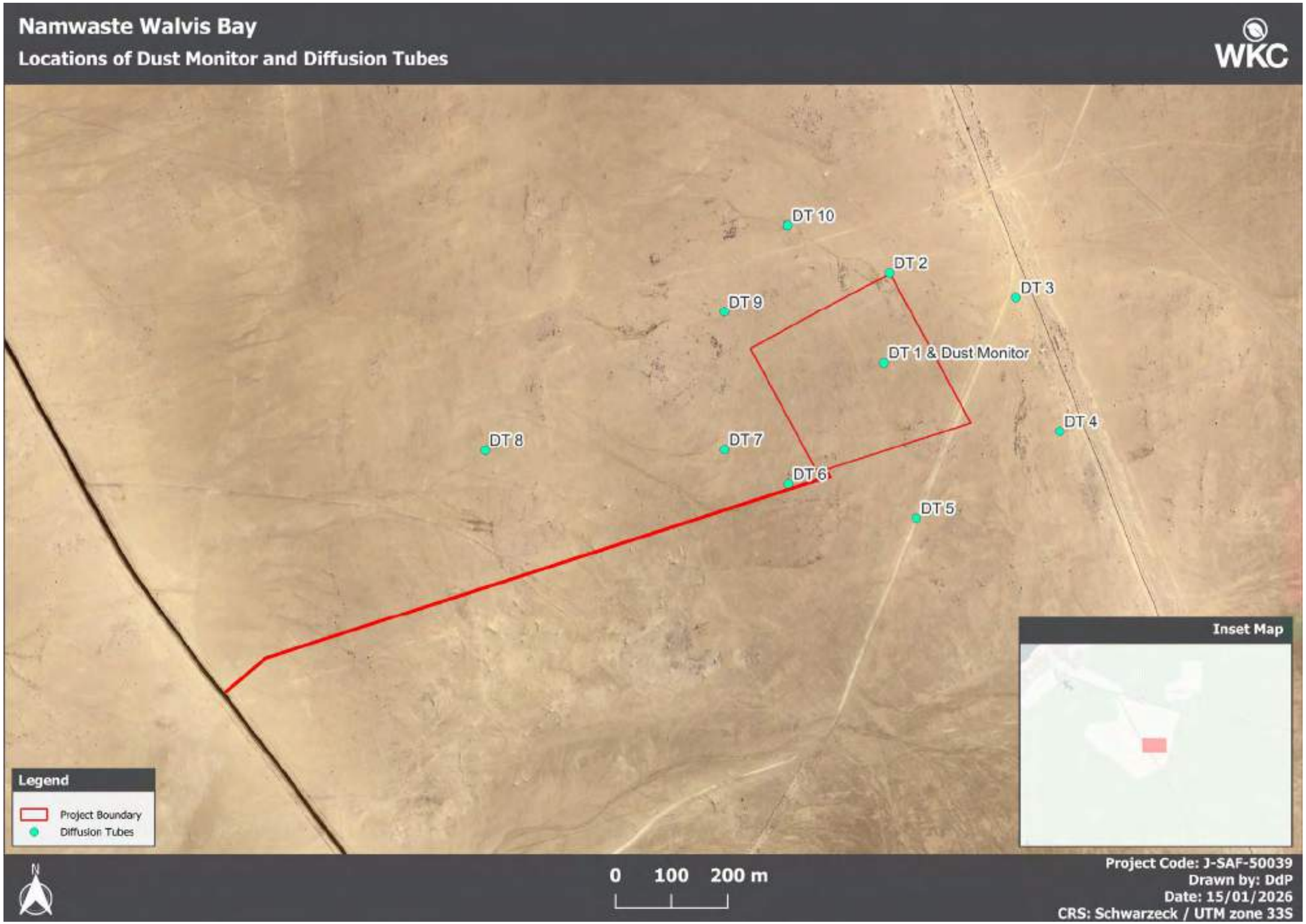
4.2 Survey Locations

The baseline passive sampling survey was undertaken from the 30th of April until the 30th of June, 2025. The passive samplers were deployed at various location on and around the Project site to determine the site specific and representative baseline air quality levels in immediate surrounding areas. The active sampler (Osiris dust monitor) was deployed on-site on the 30th of April for a period of approximately 7 hours to provide an indication of the short-term PM levels. A summary of the sampling locations including co-ordinates and deployment dates and times is provided in Table 4-1, and the sampling locations are presented in Figure 4-1. It should be noted that one of the 10 samplers (DT10) was not retrieved after the survey period likely due to damage or loss of the sampler during the exposure period.

Table 4-1 – Dust Monitor and Diffusion Tubes Locations and Monitoring Periods

Monitor ID	Co-ordinates		Date and Time Initiated	Date and Time Collected
	m E	m S		
Dust Monitor	461,149	7,453,847	10:57, 30/04/2024	16:42, 30/06/2024
DT 1	461,149	7,453,847	12:10, 30/04/2024	13:30, 06/06/2024
DT 2	461,159	7,454,008	12:15, 30/04/2024	13:25, 06/06/2024
DT 3	461,384	7,453,964	13:00, 30/04/2024	12:30, 06/06/2024
DT 4	461,462	7,453,725	13:00, 30/04/2024	12:38, 06/06/2024
DT 5	461,207	7,453,570	13:50, 30/04/2024	12:45, 06/06/2024
DT 6	460,979	7,453,631	14:15, 30/04/2024	13:00, 06/06/2024
DT 7	460,865	7,453,692	14:43, 30/04/2024	13:10, 06/06/2024
DT 8	460,438	7,453,691	15:14, 30/04/2024	13:40, 06/06/2024
DT 9	460,864	7,453,938	15:42, 30/04/2024	13:10, 06/06/2024
Note a: DT10 was not retrieved after the survey, likely due to damage or was otherwise removed.				

Figure 4-1 – Dust Monitor and Diffusion Tubes Locations



4.3 Baseline Survey Results

The survery monitoring results, including the passive sampler results (SO_2 and NO_2) are presented in Table 4-2, and the active sampler results (PM) are presented in Table 4-3.

Table 4-2 – Baseline Survey Results

ID	Long-term Concentration (µg/m³)	
	NO_2	SO_2
DT 1	1.4	2.5
DT 2	1.3	1.4
DT 3	1.3	0.7
DT 4	1.6	1.8
DT 5	1.1	1.3
DT 6	0.9	0.8
DT 7	1.2	5.5
DT 8	1.1	4.4
DT 9	1.3	3.7
Average	**1.2**	**2.4**
AAQS	**10 (annual)**	**40 (24-hour)**

Table 4-3 – Baseline Survey Results

ID	Short-term Concentration (µg/m³)	
	PM_{10}	$PM_{2.5}$
PM Sampling Location (DT1)	33.4	11.6
AAQS	**45 (24-hour)**	**15 (24-hour)**

The baseline monitoring results indicate low concentrations of SO_2 and NO_2, reflecting the absence of significant anthropogenic combustion sources in the area. This is consistent with the low population density, minimal traffic, and lack of nearby industrial or commercial activities.

In contrast, elevated levels of PM_{10} and $PM_{2.5}$ are characteristic of arid environments such as the Project area outside of Walvis Bay, where natural sources, including windblown dust, soil resuspension, and limited vegetation cover, are the dominant contributors.

Overall, the data suggests that particulate matter levels are primarily driven by natural processes, while combustion-related pollutants remain low due to the area's undeveloped nature.

4.4 Background Data Used for Cumulative Assessment

An important aspect of cumulative impact assessment entails combining modelled concentrations with monitored background concentrations to determine the potential cumulative ambient air quality impacts. The use of a single uniform monitored background contribution is the simplest approach to implement as it can be applied outside of the modelling system.

However, in determining a suitable background value for short-term periods it is acknowledged that use of the overall highest hourly background concentration is overly conservative in many cases, as the maximum process contribution and maximum background concentration may be separated both temporally and spatially, so that the addition of the two “worst case” concentrations together may not represent a likely event. In order to be able to provide a comparison of the short-term average regulatory standard in conjunction with short-term average model outputs, the approach advocated by the UK Environmental Agency has been adopted in [5]. When assessing short-term effects, it is reasonable to consider the maximum short-term modelled output in an additive context with a background concentration equal to two times (double) the long-term background value [5].

Background concentrations from the baseline survey for SO_2 and NO_2 are considered to be representative of long-term baseline levels and have been considered accordingly for the assessment. The recorded PM levels are considered more consistent with short-term PM levels. The resulting background concentrations used for the cumulative impact assessment is shown in Table 4-4.

Table 4-4 – Background Concentrations for Cumulative Assessment

Pollutant	Long-Term Concentration	Short-Term Concentration
SO_2	2.4	4.8
NO_2	1.2	2.4
PM_{10}	16.7	33.4
$PM_{2.5}$	5.8	11.6

Based on international guidance [5], pollutant contributions from a Project can be screened from an assessment when Project contributions are less than 10% of the short-term standard, and less than 1% of the long-term standard. Therefore, the cumulative assessment only considered pollutants for which Project contributions exceeded these thresholds.

5 Impact Assessment Methodology

The following sections provide an overview of the impact assessment criteria used for assessment of air quality impact intensities, as well as the applicable EIA impact assessment criteria for the assessment of overall impact significance.

5.1 Construction Phase Impact Assessment Methodology

The assessment of potential dust impacts during construction followed the approach outlined by the IAQM for the assessment of dust from demolition and construction activities [1]. The IAQM methodology provides a risk-based framework that considers the scale of activities, proximity of sensitive receptors, and local environmental conditions such as wind speed and surface characteristics.

Potential impacts are evaluated in terms of dust soiling and human health effects (via PM_{10} concentrations). The magnitude of dust emissions is determined for each activity phase (earthworks, construction, material handling, and vehicle movements), and combined with receptor sensitivity to derive an overall impact risk category (negligible, low, medium, or high). The assessment then informs the level of mitigation and management controls required to ensure that residual effects remain negligible or minor following the implementation of good practice measures. Due to the nature of the area, potential ecological impacts from dust, as well as potential dust soiling, have been screened from the assessment.

5.2 Construction Phase Impact Assessment Criteria

The relevant assessment criteria aspects as they pertain to the assessment of potential human health impacts are provided in the tables below (Table 5-1 Receptor Sensitivity Criteria, Table 5-2 Impact Magnitude Criteria and Table 5-3 Overall Dust Impact Matrix).

Table 5-1 – Receptor Sensitivity Criteria

Sensitivity of Receptor	Condition
High Sensitivity	• Locations where users can reasonably expect enjoyment of a high level of amenity; • Appearance, aesthetics or value of property would be diminished by soiling; or, • People / property would reasonably be expected to be present continuously, or at least regularly for extended periods, as part of the normal pattern of use of the land e.g. residential dwellings, museums, medium/long-term car parks, car showrooms.
Medium Sensitivity	• Locations where users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or, • Appearance, aesthetics or value of property could be diminished by soiling; or, • People or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land e.g. parks and places of work.
Low Sensitivity	• Enjoyment of amenity would not reasonably be expected; • Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or, • There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land e.g. playing fields, farmland (unless commercially sensitive horticultural), footpaths, short term car parks and roads.
Negligible Sensitivity	• Open desert or uninhabited areas with limited ecological sensitivity.

Table 5-2 – Construction Impact Magnitude Criteria

Magnitude of Impact	Condition
	Earthworks
Large	Total site area >110,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >6 m in height.
Medium	Total site area 18,000 m^2 – 110,000 m^2, moderately dusty soil type (e.g. silt), 5 – 10 heavy earth moving vehicles active at any one time, formation of bunds 3 m – 6 m in height.
Small	Total site area <18,000 m^2, soil type with large grain size (e.g. sand), <5 heavy earth moving vehicles active at any one time, formation of bunds <3 m in height.
	Construction
Large	Total building volume >75,000 m^3, on site concrete batching, sandblasting.
Medium	Total building volume 12,000 m^3 – 75,000 m^3, potentially dusty construction material (e.g. concrete), on site concrete batching.

Magnitude of Impact	Condition
Small	Total building volume <12,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber).
Track-out	
Large	>50 HDV (>3.5 t) outward movements [(a)] in any one day [(b)] potentially dusty surface material (e.g. high clay content), unpaved road length >100 m.
Medium	20-50 HDV (>3.5 t) outward movements [(a)] in any one day [(b)] moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m.
Small	<20 HDV (>3.5 t) outward movements [(a)] in any one day [(b)] surface material with low potential for dust release, unpaved road length <50 m.
Note a: A vehicle movement is a one-way journey i.e. from A to B, and excludes the return journey	
Note b: HDV movements during a construction project vary over its lifetime, and the number of movements is the maximum not the average	

Table 5-3 – Overall Risk Matrix for Dust Impacts

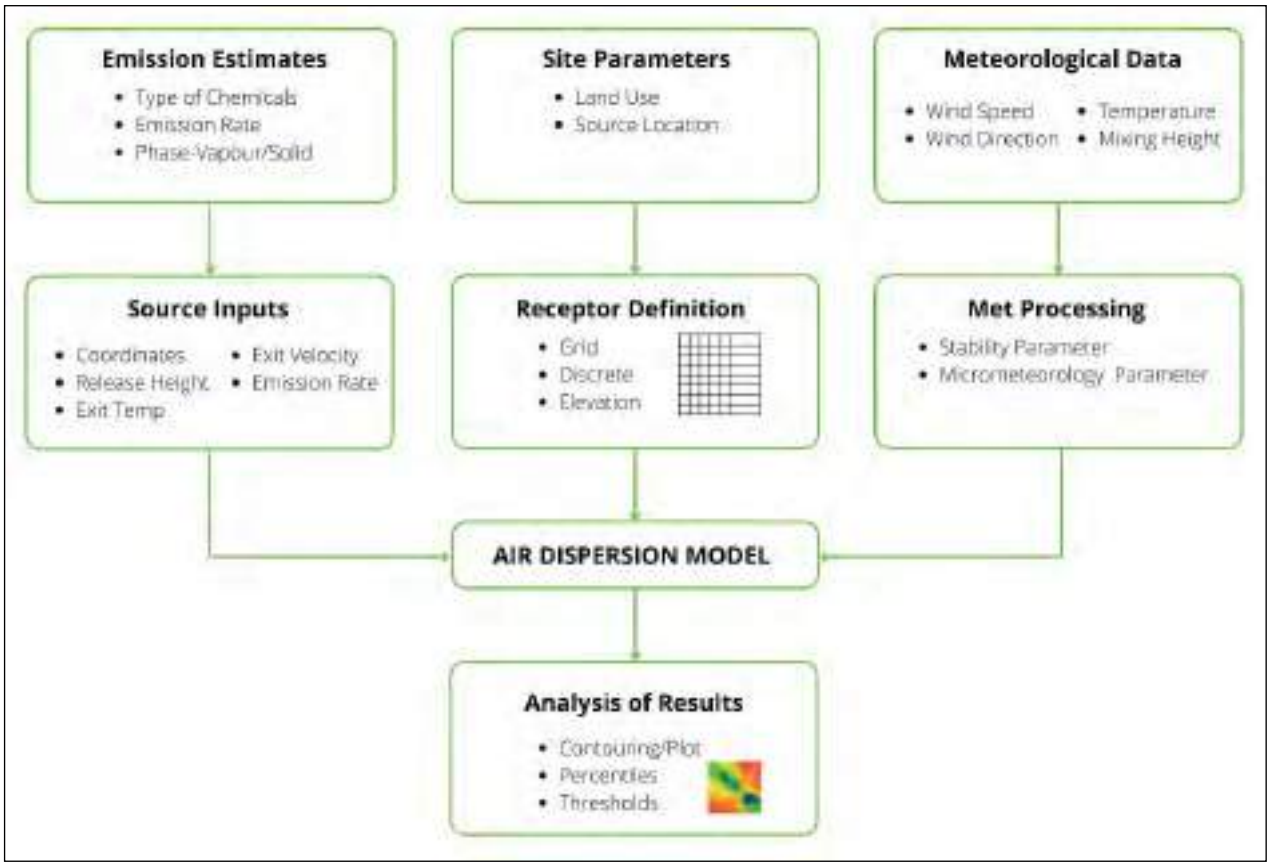
Sensitivity of Area	Dust Emission Magnitude [(a)]		
	Large	**Medium**	**Small**
High	High Risk (4 – High)	Medium Risk (3 – Moderate)	Low Risk (2 – Low)
Medium	Medium Risk (3 – Moderate)	Medium Risk (3 – Moderate)	Low Risk (2 – Low)
Low	Low Risk (2 – Low)	Low Risk (2 – Low)	Negligible (1 – Minor)
Note a: The impact intensity in accordance with the EIA impact assessment criteria is provided in brackets.			

5.3 Operation Phase Impact Assessment Methodology

In order to quantify and assess the potential operation air quality impacts, an air dispersion modelling assessment was carried out. Dispersion models compute ambient concentrations as a function of source configurations, emission strengths and meteorological characteristics, thus providing a useful tool to ascertain the spatial and temporal patterns in the GLCs arising from the given emission sources.

A general overview of the process typically involved in air dispersion modelling assessment is presented in Figure 5-1.

Figure 5-1 – Generic Process for Air Dispersion Modelling



Increasing reliance has been placed on concentration estimates from models as the primary basis for environmental and health impact assessments, risk assessments and emission control requirements. It is therefore important to carefully select and customise a dispersion model for the purpose.

Specifics pertaining to the model selection and all model input parameters, including meteorological data, terrain data, receptors, sources, etc. are described in detail in the following sections.

5.3.1 Summary of Model Settings and Approach

A summary of the model settings and inputs is presented in Table 5-4. Details of each of the model settings are provided in subsequent sections.

Table 5-4 – Model Parameters

Model Parameter	Details
Dispersion Model Versions	Lakes AERMOD Version 13.0.0
	US EPA AERMOD Model 24142
	AERMET 24142 (Meteorological Data Pre-processor for AERMOD)
Model Domain	50 km x 50 km modelling domain
Terrain	Global Shuttle Radar Topography Mission (SRTM-1) terrain (30m resolution)
Land Use	GLCC (Global Land Cover Characterisation) at 1 km resolution
Meteorological Data	3 years of Weather Research and Forecasting (WRF), 4 km grid spacing

Model Parameter	Details
Sensitive Receptors	A combination of sensitive receptors has been considered within close proximity to the Project.

5.3.2 Air Dispersion Modelling Software

In order to estimate the Ground Level Concentrations (GLCs) of each pollutant, an Atmospheric Dispersion Modelling (ADM) study was conducted using the latest version of the United States Environmental Protection Agency (US EPA) AERMOD software (Lakes AERMOD View, Version 13.0.0). AERMOD is a straight-line, steady-state Gaussian plume model designed to simulate pollutant dispersion over both rural and urban settings, in flat and complex terrain. It can account for surface and elevated releases from multiple source types (point, area, and volume), and calculates ground-level concentrations at defined receptor points.

Developed jointly by the US EPA and the American Meteorological Society under the Regulatory Model Improvement Committee (AERMIC), AERMOD represents a new generation of air quality models. It incorporates improved algorithms for convective and stable boundary layers, vertical wind and turbulence profiles, and temperature structure, resulting in more realistic characterization of atmospheric dispersion. A key advancement is its ability to construct vertical profiles of meteorological parameters, significantly improving the representation of vertical pollutant transport.

The AERMOD modelling system consists of two pre-processors:

- AERMET – the meteorological pre-processor, which computes boundary layer parameters and other required atmospheric inputs for AERMOD, using both on-site and off-site surface and upper-air data.
- AERMAP – the terrain pre-processor, which determines receptor elevations and effective hill heights from digital terrain data to account for topographic influences on dispersion.

Together, these modules allow AERMOD to incorporate detailed meteorology and site-specific topography, making it applicable to a wide range of environmental conditions and source configurations.

5.3.3 Sensitivity Analysis and Model Domain

Initial model runs were undertaken to determine the geographical extent of plume dispersion. This subsequently allowed the domain over which modelling was undertaken to be refined accordingly. This is deemed a sensitivity analysis and has been undertaken to determine the optimal grid layout for the model set up. During the process of model setup, the model needs to be optimised by appropriate refinement of the model grid while encompassing the limitations of processing power and the time required for modelling. After undertaking initial runs and determining the most probable locations for maximum pollutant GLCs, the modelling is refined until a point at which further refinement does not result in significant changes to the GLC value. Alternative grid spacings and resolutions have been tested and evaluated prior to selecting the final model domain.

Based on the outcomes of the sensitivity analysis, a combination of course and fine grids was selected to provide adequate receptor density. The final model domain consisted of two (2) cartesian grids of receptor points in addition to site boundary receptor points, as detailed in Table 5-5. The model setup is presented in Figure 5-2.

Table 5-5 – Model Domain Parameters

Model Domain	Grid Spacing (m)
Course Grid 50km x 50 km	1,000 m
Medium Grid, approximately 10 km x 10 km	250 m
Fine grid, approximately 10 km x 10 km	100 m
Boundary receptors	50 m spacing

5.3.4 Terrain

The terrain within the model domain including the elevation contours and associated colour scale is shown in Figure 5-3.

Figure 5-2 – Model Receptor Grid

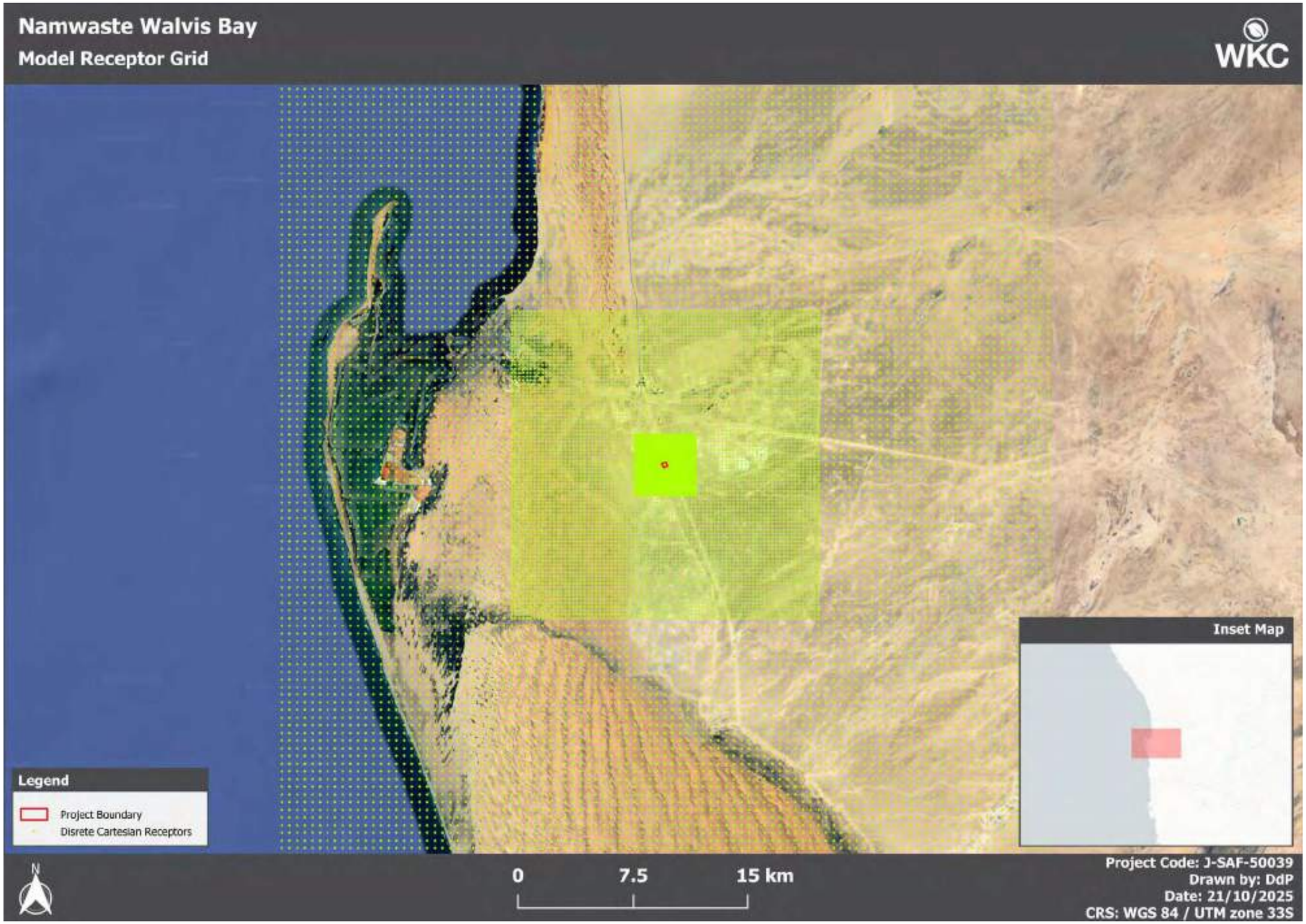


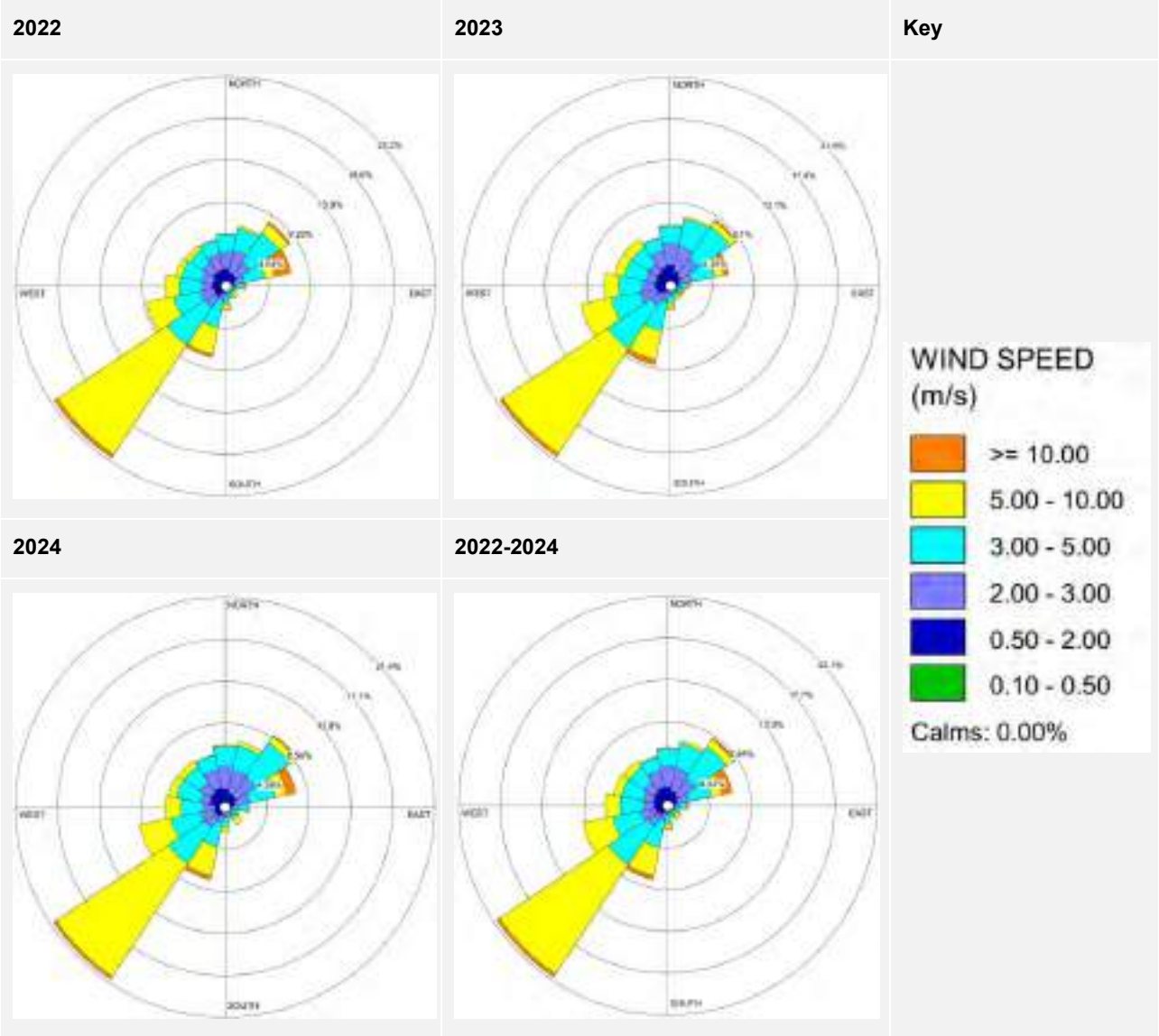
Figure 5-3 – Terrain Elevations within the Model Domain

5.3.5 Meteorological Data Summary

The Lakes WRPlot View programme was used to produce wind roses from the WRF meteorological data. The wind roses comprise 16 spokes, which represent the directions from which winds blew during a specific period and the colours indicate classes of wind speeds. The wind roses were created for each year between 2022 – 2024 to illustrate surface wind patterns at 10 m above ground level as detailed in Figure 5-4.

The wind roses indicate that winds predominantly originate from the southwest, accounting for approximately 22% of occurrences, with secondary contributions from the west-southwest and south-southwest directions. Wind speeds are generally moderate (5 – 10 m/s), with higher speeds occurring more frequently in the southwestern sector. Winds from other directions are relatively infrequent. This pattern suggests that air pollutant dispersion and transport at the site are primarily north-eastward.

Figure 5-4 – Annual Average Wind Roses (Blowing From)



5.3.6 Modelling Assumptions

The following assumptions have been made for the dispersion modelling assessment, and wherever possible, a conservative approach has been adopted:

- The emissions inventory has been compiled based upon data received from the client. In the absence of suitable design data, assumptions were made based on international best practice and the professional judgement of the team developing the study;
- No buildings were modelling in the study, which may have an influence on dispersion in the form of building downwash; and,
- The model selection for NO_x to NO_2 conversion was Ambient Ratio Method 2 (ARM2) with a variable conversion ratio of 0.5 – 0.9.

5.3.7 Model Uncertainty

Air quality models attempt to predict concentrations at a specific point and time based on “known” or measured values of various parameters input into the model, such as wind speed, temperature profiles, solar radiation. There are, however, variations in the “unknown” parameters that are not measured, as well as unresolved details of atmospheric turbulent flow. Variations in these “unknown” parameters can result in deviations of the predicted concentrations of the same event, even though the “known” parameters are fixed. As a result of the deviations of the “unknown” parameters, a “perfect” model may be able to predict an average of identical events well, while each repetition of that event will provide marginally different results. The statistics of these concentration residuals are termed ‘‘inherent’’ uncertainty of a model.

In addition, there are “reducible” uncertainties due to inaccuracies in the model, errors in input values and errors in the measured concentrations. “Reducible” uncertainties include inaccuracies in the input values of the known conditions (for example, poor quality or unrepresentative meteorological, geophysical and source emission data); errors in the measured concentrations that are used to compare with model predictions and inadequate model physics and formulation used to predict the concentrations. As the term indicates, “reducible” uncertainties can be controlled or minimised by collecting accurate input data, preparing the input files correctly, checking and re-checking for errors, correcting for unexpected model behaviour, ensuring that the errors in the measured data are minimised and applying better model physics.

With regards to the operational activities the confidence in model data is much higher, with emission estimates based on vendor data or legislated emission limits and therefore a much higher degree of confidence.

It is acknowledged that there will always be some error in any geophysical model, however notwithstanding the limitations and assumptions detailed, the structure of the modelling approach has been prepared in such a way as to minimise the total error.

5.4 Operation Phase Impact Assessment Criteria

The impact intensity criteria used to guide the prediction of air quality impact intensity was based on a combination of the DEFRA guidance [5] and the IFC General EHS Air Quality Guidelines [2] and is presented in Table 5-6.

Table 5-6 – Definition of Impact Intensity

Impact Intensity Category	Rating of Intensity	Ground Level Concentration as a Percentage of the AAQS	Description
Minor	1	Short-term concentrations <10% of the AAQS, and long-term concentrations less than 1% of the AAQS	Project contributions are considered to be negligible, and can be screened from cumulative impact assessments.
Low	2	<25% of the AAQS	Project contributions are considered to be low, meeting the IFC general EHS air quality guidelines for the prevention of significant deterioration to airsheds (PSD) (i.e. <25% of the AAQS)
Moderate	3	<50% of the AAQS	Project contributions are less than 50% of the applicable AAQS, but exceed the 25% PSD requirement of the IFC general EHS air quality guidelines
High	4	<100% of the AAQS	Project contributions are below the AAQS, but contribute to significantly to the airshed, with significant potential for cumulative exceedances of the AAQS.
Very High	5	>100% of the AAQS	Project contributions results in exceedances of the applicable AAQS

5.5 EIA Impact Assessment Criteria

The criteria for the assessment of air quality impacts arising at SRs from the operation and construction of the Project were assessed using the KP assessment criteria, which defines impact significance as the product of an impact's consequence and probability, where the consequence is the sum of the impact severity, reversibility, duration, and spatial extent.

The KP Impact Assessment Criteria used to guide the approach in determining the impact significance of air quality impacts from construction and operation is detailed in Appendix B.

6 Sensitive Receptors

The immediate area around the project site has a small number of commercial buildings, with some residential areas located further away to the northwest and northeast of the site location. The nearest identified potential SRs were considered in the assessment. The SRs together with their corresponding UTM coordinates are detailed in Table 6-1. A map showing the spatial location of the SRs in relation to the Project is shown in Figure 6-1.

Table 6-1 – Details of Identified SRs

SR ID	SR Description	Distance from Project (km)	UTM Co-ordinates		Site Classification
			m E	m S	
SR 1	Rooikop Town	5.3	464,718	7,457,954	Residential
SR 2	Walvis Bay	10.4	453,091	7,460,882	Residential

Figure 6-1 – Identified Sensitive Receptors

7 Construction Phase Impact Assessment

7.1 Construction Phase Overview

Fugitive dust emissions are expected to arise from a range of activities during the construction phase of the Project. These emissions will primarily result from the disturbance and movement of soil and other fine materials during site preparation and from vehicle activity across unpaved areas. The principal sources of dust generation are anticipated to include:

- Earthworks and site preparation, including excavation, grading, and material stockpiling;
- General construction activities, such as material handling, cutting, and onsite vehicle movement; and,
- Track-out, where dust is carried offsite by construction vehicles onto paved public roads.

The potential for dust impacts were assessed in accordance with the IAQM Guidance on the Assessment of Dust from Demolition and Construction [1], which provides a risk-based methodology for evaluating the likelihood and significance of construction-related dust impacts.

Past project experience of assessing the exhaust emissions from on-site and surrounding traffic suggests that these emissions are unlikely to significantly impact the local air quality and have therefore been screened out of this assessment [1].

7.2 Magnitude of Dust Impact

Based on the IAQM criteria, the impact magnitudes for earthworks, construction and track-out were 'Large', 'Medium' and 'Medium' respectively, as detailed in Table 7-1.

Table 7-1 – Construction Impact Magnitude Assessment

Phase / Activity	Magnitude of Impact	Condition
Earthworks	**Large**	Total site area >110,000 m^2, potentially dusty soil type (e.g. clay, which will be prone to suspension when dry due to small particle size), >10 heavy earth moving vehicles active at any one time, formation of bunds >6 m in height.
Construction	**Medium**	Total building volume 12,000 m^3 – 75,000 m^3, potentially dusty construction material (e.g. concrete), on site concrete batching.

Phase / Activity	Magnitude of Impact	Condition
Track-out	**Medium**	20 – 50 HDV (>3.5 t) outward movements in any one day moderately dusty surface material (e.g. high clay content), unpaved road length 50 m – 100 m.

7.3 Receptor Sensitivity

Based on the receptor sensitivity criteria, the nearby residential receptors are considered to have a 'High' sensitivity. When taking their proximity to the Project site, and baseline air quality into consideration, and density of receptors, the resulting sensitivity is 'Low' (Table 7-2).

Table 7-2 – Receptor Sensitivity Analysis

SR	Receptor Sensitivity Description	Baseline Air Quality	Distance (m)	Number of Receptor	Resulting Sensitivity
SR1 and SR2	High	>70% of standard	>5 km	>100	Low

7.4 Determination of Impact Intensity

Based on the impact magnitudes and the receptors sensitivities, the overall construction dust impact risks were evaluated to be 'Low'. This impact risk was mapped to the EIA impact assessment impact intensity of 'Low' (2) (Table 4-4).

Table 7-3 – Construction Phase Impact Intensity

SR	Classification	Sensitivity	Phase / Activity	Magnitude	Risk of Impact / Impact Intensity
SR1 and SR2	Residential	Low	Earthworks	Large	Low (2)
			Construction	Medium	Low (2)
			Track-out	Medium	Low (2)

7.5 Determination of Impact Significance

Based on the IAQM assessment methodology, the dust impact intensity for at all SR's is predicted to be '**Low**', which corresponds to a rating of '**2**'. The Reversibility, Duration and Spatial Extent are allocated a rating of '**1**', '**1**' and '**2**' respectively, which leads to a Consequence of '**6**' for all SRs. Given that the Probability is allocated a rating of '**1**', the Impact Significance is classified as '**Low**'.

Table 7-4 – Construction Phase Impact Assessment Summary

		Severity / Magnitude (M)	Reversibility (R)	Duration	Spatial Extent	Probability	Significance	Nature of Impact	
								+ / -	D / I / C
Construction Impacts Prior to Mitigation									
Increase in fugitive dust / PM_{10} emissions from earthworks, material handling, construction and track-out with the potential to impact on human health	Without Mitigation	**2**	**1**	**1**	**2**	**1**	**Low**	**(-)**	**D**
• Refer to the recommended mitigation measures section									
Construction Impacts Post-Mitigation									
Increase in fugitive dust / PM_{10} emissions from earthworks, material handling, construction and track-out with the potential to impact on human health	With Mitigation	**2**	**1**	**1**	**2**	**1**	**Low**	**(-)**	**D**

7.6 Typical Dust Control Measures

The IAQM guidance provides mitigation measures divided into general measures applicable to all site and measures applicable specifically to earthworks, construction and track-out, for consistency with the assessment methodology. The recommended mitigation measures are as follows:

Mitigation for all sites: Communications

- Display the name and contact details of person(s) account- able for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.
- Display the head or regional office contact information

Mitigation for all sites: Dust Management

- Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions (including these measures).

Site Management

- Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
- Record any exceptional incidents that cause dust and/or air emissions, either on- or off-site, and the action taken to resolve the situation in the log book.

Monitoring

- Undertake daily on-site and off-site inspection, where receptors (including roads) are nearby, to monitor dust, record inspection results.
- Carry out regular site inspections to monitor compliance with the DMP, record inspection results.
- Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.

Preparing and maintaining the site

- Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.
- Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
- Fully enclose site or specific operations where there is a high potential for dust production and the site is actives for an extensive period
- Avoid site runoff of water or mud.
- Keep site fencing, barriers and scaffolding clean using wet methods.
- Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below.

- Cover, seed or fence stockpiles to prevent wind whipping.

Operating vehicle/machinery and sustainable travel

- Ensure all vehicles switch off engines when stationary - no idling vehicles.
- Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.
- Impose and signpost a maximum-speed-limit of 15 mph / 25 km/h on surfaced and 10 mph / 15 km/h on un-surfaced haul roads and work areas.

Operations

- Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems.
- Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation, using non-potable water where possible and appropriate.
- Use enclosed chutes and conveyors and covered skips.
- Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
- Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.

Waste management

- Avoid bonfires and burning of waste materials

Measures Specific to Construction

- Avoid scabbling (roughening of concrete surfaces) if possible
- Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place.

Measures Specific to Track-out

- Use water-assisted dust sweeper(s) on the access and local roads, to remove, as necessary, any material tracked out of the site. This may require the sweeper being continuously in use.
- Avoid dry sweeping of large areas.
- Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.
- Record all inspections of haul routes and any subsequent action in a site logbook.
- Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).

8 Operations Phase Impact Assessment

This chapter covers the modelled sources, inputs and assessment outcomes for the operation phase of the Project in accordance with the EIA impact assessment methodology.

8.1 Identified Sources and Emissions Inventory

An emissions inventory was developed based on information provided by the Client during the preparation of this assessment. The inventory quantifies expected atmospheric emissions from key sources associated with the Project. These sources, along with their respective emission rates and characteristics, are detailed in Table 8-1. The following emission sources were included in the air dispersion modelling (ADM) study

- TCC / TDU;
- Boiler; and,
- Generators.

8.1.1 Modelling Scenarios

The air dispersion modelling assessment considered two scenarios including normal continuos operations of the TCC / TDU and the boiler, and a second intermittent or emergency scenario when the plant is running on back-up generators (i.e. all equipment items):

- Scenario 1: Normal Operations (TCC / TDU and boiler); and,
- Scenario 2: Emergency Operations (all source including generators).

8.1.2 Emissions Inventory

An emissions inventory was prepared to quantify the atmospheric emissions attributed to the key emission sources. The emission parameters are based on the data provided by the client in response to a data request.

The table that follows (Table 8-1) provides the model input data that were used in the assessment. Key emission characteristics associated with emission sources which affect dispersion of emissions include:

- Stack dimensions (m): Stack height and the vertical profile of the atmosphere can significantly affect dispersion of pollutants;
- Exit gas velocity (m/s): Gas velocity (correlated to stack diameter) provides plume momentum, influencing vertical (and horizontal) dispersion;
- Emission rate (g/s): Proportional to the associated GLCs of a particular pollutant (assuming conservation of mass within the dispersing plume). and,

- Exit gas temperature (K): Affects the buoyancy of the gas and thus the vertical dispersion of pollutants.

The operation of combustion sources will result in release of criteria pollutants (NO_2, PM_{10}, and SO_2 and CO).

Table 8-1 – Emission Inventory

Parameter	Unit	Value / Input			Comment / Reference
Source Type	-	**TCC / TDU**	**Boiler**	**Generator**	
Size	kW	2167.5	722.5	500	
Fuel Type	-	Diesel	Diesel	Diesel	
Efficiency	%	85	85	35	Assumption
No. of Sources	-	1	1	5	
Exhaust Parameters					
Stack height	m	6	8	6	Design Data / Client Data
Exit Velocity	m/s	15	15	25	Typical Data / Assumption
Exit Temperature	K	673.2	453.2	744.5	Typical Data / Generator Data Sheet [6]
Actual Volumetric Flow Rate	Am^3/s	2.16	0.41	1.52	Typical Data / Generator Data Sheet [6]
Fuel Flow Parameters					
Calorific Value	MJ/kg	42.5	42.5	42.5	Design Data / Client Data
Density	kg/L	0.837	0.837	0.837	Typical Data
Fuel Consumption Rate	kg/s	0.020	0.06	0.027	Calculated
Suphur Content	ppm	500	500	500	Typical Data / Assumption
Emission Factors					
NOx	-	74 mg/Nm^3 – IFC Emission Limit	0.0028 t/t E&P Emission Factor	3.2 g/hp-hour – CAT generator Datasheet	Representative emission limits (IFC) [2], emission factors (E&P Forum [7]), typical CAT Tier 3 generator specification data [6].
$PM_{10}/PM_{2.5}$	-	50 mg/Nm^3 – IFC Emission Limit	0.84 kg/m^3-diesel US EPA AP42 EF	0.028 g/hp-hour – CAT generator Datasheet	
SO_2	-	Based on Suphur content	Based on Suphur content	Based on Suphur content	
CO	-	0.007 t/t – E&P Emission Factor	0.007 t/t – E&P Emission Factor	0.5675 g/bh-hour – CAT generator Datasheet	
Emission Rates					
NOx	g/s	0.0648	0.0560	0.4768	Calculated
$PM_{10}/PM_{2.5}$	g/s	0.0438	0.0091	0.0042	Calculated
SO_2	g/s	0.0600	0.0200	0.0269	Calculated
CO	g/s	0.0420	0.0140	0.0846	Calculated

8.2 Modelling Results

Dispersion modelling results for each scenario are presented in the following sections. Selected isopleths are provided in Appendix A.

8.2.1 Maximum Project Contributions (Non-Sensitive Receptor)

Scenario 1 – Normal Operations

The modelled GLCs for Scenaio 1 were compared against the EU AAQS, both in isolation and cumulatively. Based on the findings of the assessment, when considered in isolation, modelled GLCs are not expected to exceed the relevant AAQS for any pollutants.

In terms of the internationally recognised guidelines for prevention of significant deterioration (PSD) of airsheds, the modelled GLCs for all pollutants are expected to be less than 25% of the WHO AAQS levels.

The results of the cumulative assessment indicate that no exceedances of the relevant AAQS are anticipated when the Project contributions are added to the existing baseline levels established in the baseline survey.

Scenario 2 – Back-up Power / Emergency Scenario

The modelled GLCs for Scenario 2 were assessed against the applicable EU AAQS, both in isolation and cumulatively. Under isolated conditions, GLCs for all pollutants are predicted to remain below the relevant AAQS.

In terms of PSD criteria, which recommend that individual project contributions remain below 25% of the applicable AAQS, all pollutants are within the guideline thresholds except for NO_2, which exceeds this threshold under the emergency operating scenario for both the 1-hour and 24-hour averaging periods.

Cumulative results, which account for existing baseline concentrations, indicate that no exceedances of the AAQS are expected for any pollutants, apart from NO_2, where short-term concentrations may exceed the applicable standard (particularly the 24-hour standard) near the project boundary.

It should be noted that these results represent maximum predicted concentrations within the modelling domain and are expected to occur near the Project boundary. Appendix A presents the corresponding isopleths showing the spatial distribution and variation of modelled GLCs.

Table 8-2 – Model Domain Maximum ADM Results for Scenario 1 – Normal Operations

Pollutant	Averaging Period	EU AAQS (µg/m³)	Modelled Results (µg/m³)	< Project Standard?	Projects % of Standard (%)	<25% of the Project Standard	Background Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Cumulative Result Compliant with Standard?
NO_2	1-hour	200	13.3	Yes	6.7%	Yes	4.8	18.1	Yes
	24-hour	50	2.3	Yes	4.6%	Yes	4.8	7.1	Yes
	Annual	20	1.0	Yes	5.2%	Yes	2.4	3.4	Yes
SO_2	1-hour	350	6.6	Yes	1.9%	Yes	2.4	9.0	Yes
	24-hour	50	1.5	Yes	3.0%	Yes	2.4	3.9	Yes
	Annual	20	0.7	Yes	3.6%	Yes	1.2	1.9	Yes
PM_{10}	24-hour	45	1.0	Yes	2.1%	Yes	33.4	34.4	Yes
	Annual	20	0.4	Yes	2.2%	Yes	16.7	17.1	Yes
$PM_{2.5}$	24-hour	25	1.0	Yes	3.8%	Yes	11.6	12.6	Yes
	Annual	10	0.4	Yes	4.5%	Yes	5.8	6.2	Yes
CO	8-hour	10,000	3.6	Yes	0.0%	Yes	0.0	3.6	Yes
	24-hour	4,000	1.1	Yes	0.0%	Yes	0.0	1.1	Yes

Table 8-3 – Model Domain Maximum ADM Results for Scenario 2 – Back-up Power / Emergency

Pollutant	Averaging Period	EU AAQS (µg/m³)	Modelled Results (µg/m³)	< Project Standard?	Projects % of Standard (%)	<25% of the Project Standard	Background Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Cumulative Result Compliant with Standard?
NO_2	1-hour	200	144.0	Yes	72.0%	No	4.8	148.8	Yes
	24-hour	50	46.2	Yes	92.3%	No	4.8	51.0	Yes
SO_2	1-hour	350	22.3	Yes	6.4%	Yes	2.4	24.7	Yes
	24-hour	50	4.5	Yes	9.1%	Yes	2.4	6.9	Yes
PM_{10}	24-hour	45	1.4	Yes	3.2%	Yes	33.4	34.8	Yes
$PM_{2.5}$	24-hour	25	1.4	Yes	5.7%	Yes	11.6	13.0	Yes
CO	8-hour	10,000	40.6	Yes	0.4%	Yes	0.0	40.6	Yes
	24-hour	4,000	10.7	Yes	0.3%	Yes	2.0	12.7	Yes

8.2.2 Project Contributions at Sensitive Receptors

Scenario 1 – Normal Operations

A review of the maximum model contributions at the identified SRs for each pollutant showed that there are no exceedances of the standards at all locations for all averaging periods. Additionally, the project is compliant with international PSD guidelines which states that a project should not contribute more than 25% of the applicable AAQS. The cumulative assessment indicated that no exceedances of the AAQS are anticipated at any of the SRs.

Scenario 2 – Back-up Power / Emergency Scenario

The dispersion modelling results show that maximum predicted ground-level concentrations at all identified SRs were below the applicable AAQS for all pollutants and averaging periods.

The assessment also demonstrated compliance with international PSD guidelines, which stipulate that project-related contributions should not exceed 25% of the applicable AAQS.

Cumulative impacts, including baseline air quality and other nearby emission sources, were also evaluated. The cumulative assessment indicated that no exceedances of the AAQS are expected at any SRs.

8.2.3 Determination of Impact Intensity

Scenario 1 – Normal Operations

In terms of the EIA impact assessment methodology, the low contributions expected for the normal operations of the Project are expected to be '**Minor**', where Project contributions are expected to be less than 1% of the AAQS for all pollutants. The SR impact intensity assessment is provided in Table 8-5.

Scenario 2 – Back-up Power / Emergency Scenario

In terms of the EIA impact assessment methodology, Project contributions during the back-up power scenario are expected to be '**Minor**' for SO_2, PM and CO. However, Project contributions of NO_2 at the SRs are expected to have an impact intensity ranging from '**Minor**' at SR2, to '**Low'** at SR1. Therefore, the maximum impact intensity for Scenario 2 (emergency operations) is '**Low**'. The SR impact intensity assessment is provided in Table 8-6.

8.2.4 Determination of Impact Significance

Scenario 1 – Normal Operations

Based on the EIA assessment methodology, the impact intensity for the operations phase (normal operations) at SR's is predicted to be '**Minor**', which corresponds to a rating of '**1**'. The Reversibility, Duration and Spatial Extent are allocated a rating of '**1**', '**4**' and '**2**' respectively, which leads to a Consequence of '**8**' for all SRs. Given that the Probability is allocated a rating of '**3**', the Impact Significance is classified as '**Low**'.

Scenario 2 – Back-up Power / Emergency Scenario

Based on the EIA assessment methodology, the impact intensity for the operations phase (normal operations) at SR's is predicted to be '**Low**', which corresponds to a rating of '**2**'. The Reversibility, Duration and Spatial Extent are allocated a rating of '**1**', '**1**' and '**2**' respectively, which leads to a Consequence of '**6**' for all SRs. Given that the Probability is allocated a rating of '**2**', the Impact Significance is classified as '**Low**'.

Table 8-4 – Operation Phase Impact Assessment Summary

		Severity / Magnitude (M)	Reversibility (R)	Duration	Spatial Extent	Probability	Significance	Nature of Impact	
								+ / -	D / I / C
Operation Phase AQ Impacts Prior to Mitigation									
Increase in criteria pollutant levels at SRs during normal operations due to diesel combustion and emissions from the TCC and boiler (i.e. increased emissions due to waste treatment operations)	Without Mitigation	1	1	4	2	3	Low	(-)	D
Increase in criteria pollutant levels at SRs during emergency / back-up power operations due to diesel combustion and emissions from generators, the TCC and boiler.	Without Mitigation	2	1	1	2	2	Low	(-)	D
Increase fugitive dust generation because of waste stream handling and logistics.	Without Mitigation	2	1	4	2	2	Low	(-)	D
Recommendations: Scenario 1 – Normal operations: • No specific mitigation measures are recommended. Best practice should be followed to minimise potential AQ impacts as far as possible Scenario 2 – Back-up power / emergency scenario • Use Low NO_x diesel generators (e.g. EPA Tier 4) to reduce NO_x emissions. • Increase stack heights to improve dispersion and reduce GLCs at SRs									
Operational Phase AQ Impacts Post-Mitigation									
Increase in criteria pollutant levels at SRs during normal operations due to diesel combustion and emissions from the TCC and boiler.	No Additional mitigation measures recommended	1	1	4	2	3	Low	(-)	D

		Severity / Magnitude (M)	Reversibility (R)	Duration	Spatial Extent	Probability	Significance	Nature of Impact	
								+ / -	D / I / C
Increase in criteria pollutant levels at SRs during emergency / back-up power due to diesel combustion and emissions from generators, the TCC and boiler.	With mitigation measures	2	1	1	2	2	Low	(-)	D
Increase fugitive dust generation because of waste stream handling and logistics	With mitigation measures	2	1	4	2	2	Low	(-)	D

Table 8-5 – SR Impact Intensity Assessment – Scenario 1

Pollutant	EU AAQS (µg/m³)	Modelled Results (µg/m³)	< Project Standard?	Projects % of Standard	<25% of the Project Standard	Background Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Cumulative Result Compliant with Standard?	Impact Intensity
NO2 1-hour Averaging Period									
SR1	200	1.4	Yes	0.7%	Yes	4.8	6.2	Yes	Minor
SR2	200	0.8	Yes	0.4%	Yes	4.8	5.6	Yes	Minor
NO2 24-hour Averaging Period									
SR1	50	0.1	Yes	0.1%	Yes	4.8	4.9	Yes	Minor
SR2	50	0.0	Yes	0.0%	Yes	4.8	4.8	Yes	Minor
NO_2 Annual Averaging Period									
SR1	20	0.0	Yes	0.1%	Yes	2.4	2.4	Yes	Minor
SR2	20	0.0	Yes	0.0%	Yes	2.4	2.4	Yes	Minor
SO2 1-hour Averaging Period									
SR1	350	0.9	Yes	0.3%	Yes	2.4	3.3	Yes	Minor
SR2	350	0.5	Yes	0.1%	Yes	2.4	2.9	Yes	Minor
SO2 24-hour Averaging Period									
SR1	50	0.0	Yes	0.1%	Yes	2.4	2.4	Yes	Minor
SR2	50	0.0	Yes	0.0%	Yes	2.4	2.4	Yes	Minor
SO_2 Annual Averaging Period									
SR1	20	0.0	Yes	0.0%	Yes	1.2	1.2	Yes	Minor
SR2	20	0.0	Yes	0.0%	Yes	1.2	1.2	Yes	Minor
PM_{10} 24-hour Averaging Period									
SR1	45	0.0	Yes	0.1%	Yes	33.4	33.4	Yes	Minor
SR2	45	0.0	Yes	0.0%	Yes	33.4	33.4	Yes	Minor
PM_{10} Annual Averaging Period									
SR1	20	0.0	Yes	0.0%	Yes	16.7	16.7	Yes	Minor
SR2	20	0.0	Yes	0.0%	Yes	16.7	16.7	Yes	Minor

Pollutant	EU AAQS (µg/m³)	Modelled Results (µg/m³)	< Project Standard?	Projects % of Standard	<25% of the Project Standard	Background Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Cumulative Result Compliant with Standard?	Impact Intensity
$PM_{2.5}$ 24-hour Averaging Period									
SR1	25	0.0	Yes	0.1%	Yes	11.6	11.6	Yes	Minor
SR2	25	0.0	Yes	0.0%	Yes	11.6	11.6	Yes	Minor
$PM_{2.5}$ Annual Averaging Period									
SR1	10	0.0	Yes	0.1%	Yes	5.8	5.8	Yes	Minor
SR2	10	0.0	Yes	0.0%	Yes	5.8	5.8	Yes	Minor
CO 8-hour Averaging Period									
SR1	10,000	0.2	Yes	0.0%	Yes	-	-	-	Minor
SR2	10,000	0.1	Yes	0.0%	Yes	-	-	-	Minor
CO 24-hour Averaging Period									
SR1	4,000	0.0	Yes	0.0%	Yes	-	-	-	Minor
SR2	4,000	0.0	Yes	0.0%	Yes	-	-	-	Minor

Table 8-6 – SR Impact Intensity Assessment – Scenario 2

Pollutant	EU AAQS (µg/m³)	Modelled Results (µg/m³)	< Project Standard?	Projects % of Standard	<25% of the Project Standard	Background Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Cumulative Result Compliant with Standard?	Impact Intensity
NO2 1-hour Averaging Period									
SR1	200	30.3	Yes	15.2%	Yes	4.8	35.1	Yes	Low
SR2	200	11.9	Yes	6.0%	Yes	4.8	16.7	Yes	Minor
NO2 24-hour Averaging Period									
SR1	50	1.2	Yes	2.4%	Yes	4.8	6.0	Yes	Minor
SR2	50	0.2	Yes	0.3%	Yes	4.8	5.0	Yes	Minor
NO_2 Annual Averaging Period									
SR1	20	0.3	Yes	1.4%	Yes	2.4	2.7	Yes	Low
SR2	20	0.0	Yes	0.2%	Yes	2.4	2.4	Yes	Minor
SO2 1-hour Averaging Period									
SR1	350	2.8	Yes	0.8%	Yes	2.4	5.2	Yes	Minor
SR2	350	1.2	Yes	0.3%	Yes	2.4	3.6	Yes	Minor
SO2 24-hour Averaging Period									
SR1	50	0.1	Yes	0.2%	Yes	2.4	2.5	Yes	Minor
SR2	50	0.0	Yes	0.0%	Yes	2.4	2.4	Yes	Minor
SO_2 Annual Averaging Period									
SR1	20	0.0	Yes	0.1%	Yes	1.2	1.2	Yes	Minor
SR2	20	0.0	Yes	0.0%	Yes	1.2	1.2	Yes	Minor
PM_{10} 24-hour Averaging Period									
SR1	45	0.0	Yes	0.1%	Yes	33.4	33.4	Yes	Minor
SR2	45	0.0	Yes	0.0%	Yes	33.4	33.4	Yes	Minor
PM_{10} Annual Averaging Period									
SR1	20	0.0	Yes	0.0%	Yes	16.7	16.7	Yes	Minor
SR2	20	0.0	Yes	0.0%	Yes	16.7	16.7	Yes	Minor
$PM_{2.5}$ 24-hour Averaging Period									

Pollutant	EU AAQS (µg/m³)	Modelled Results (µg/m³)	< Project Standard?	Projects % of Standard	<25% of the Project Standard	Background Concentration (µg/m³)	Cumulative Concentration (µg/m³)	Cumulative Result Compliant with Standard?	Impact Intensity
SR1	25	0.0	Yes	0.1%	Yes	11.6	11.6	Yes	Minor
SR2	25	0.0	Yes	0.0%	Yes	11.6	11.6	Yes	Minor
$PM_{2.5}$ Annual Averaging Period									
SR1	10	0.0	Yes	0.1%	Yes	5.8	5.8	Yes	Minor
SR2	10	0.0	Yes	0.0%	Yes	5.8	5.8	Yes	Minor
CO 8-hour Averaging Period									
SR1	10,000	1.8	Yes	0.0%	Yes	-	-	-	Minor
SR2	10,000	0.8	Yes	0.0%	Yes	-	-	-	Minor
CO 24-hour Averaging Period									
SR1	4,000	0.3	Yes	0.0%	Yes	-	-	-	Minor
SR2	4,000	0.0	Yes	0.0%	Yes	-	-	-	Minor

8.3 Mitigation Measures

The primary pollutant associated with the operation of diesel generators is NO_x. According to the US EPA AP 42 [8], NO_x formation occurs by two fundamentally different mechanisms. The predominant mechanism with internal combustion engines is thermal NO_x which arises from the thermal dissociation and subsequent reaction of nitrogen (N_2) and oxygen (O_2) molecules in the combustion air. Most thermal NO_x is formed in the high-temperature region of the flame from dissociated molecular nitrogen in the combustion air. The second mechanism, fuel NO_x, stems from the evolution and reaction of fuel-bound nitrogen compounds with oxygen. Gasoline, and most distillate oils have no chemically-bound fuel N_2 and essentially all NO_x formed is thermal NO_x.

8.3.1 Typical Mitigation Measures

To manage and reduce NO_x emissions from diesel generators, a range of mitigation strategies can be applied. Two of the most common methods include:

Use of Low-NO_x Diesel Generators: Advancements in engine design and emission controls have led to the classification of engines under non-road diesel emission standards, such as the US EPA Tier system:

- Tier 1 – Tier 3 engines represent earlier standards with moderate reductions in NO_x. Tier 3 emission factors were used in this ADM study.
- Tier 4 engines, introduced under more recent regulations, incorporate advanced emission control technologies. Tier 4 units achieve over 90% reduction in NO_x emissions compared to Tier 1, making them a preferred choice for mitigating impacts from generator sets.

Increased Stack Height

Increasing the exhaust stack height is a practical and often effective mitigation option. A taller stack promotes enhanced dispersion and plume rise, reducing ground-level concentrations of NO_2 and other pollutants. This is especially useful for mitigating short-term impacts at nearby receptors.

Stack height optimisation should be informed by air dispersion modelling, considering local terrain, meteorology, and receptor locations.

9 Conclusions

The air quality assessment evaluated the potential impacts associated with both the construction and operational phases of the Project.

During the construction phase, the primary emissions of concern are related to fugitive dust from earthworks, material handling, and vehicle movement. Based on the IAQM risk-based methodology [1], the overall dust impact risk across all sensitive receptors was determined to be 'Low', resulting in a 'Low' impact significance. Appropriate mitigation measures have been identified, based on the IAQM guidance, which are expected to effectively manage and minimise potential dust impacts.

For the operational phase, two scenarios were assessed using dispersion modelling: normal operations and emergency operations involving the use of diesel generators.

Under normal operations, modelled ground-level concentrations of all pollutants are predicted to remain below applicable AAQS at all locations, including at the nearest SRs. Project contributions also comply with internationally recognised PSD criteria, with pollutant levels below 25% of the applicable standards. The impact intensity and significance were classified as 'Low'.

Under the emergency or back-up power scenario, the operation of diesel generators results in elevated short-term emissions of NO_2. While the maximum predicted concentrations remain below AAQS at SRs for SO_2, PM and CO, model domain maxima may exceed the 24-hour NO_2 standard at the site boundary. However, at sensitive receptors, short-term NO_2 concentrations were found to exceed 10% of the standard at SR1, triggering a 'Low' impact intensity for 1-hour and annual averaging periods. The overall impact significance remains 'Low'.

In summary, the Project is not expected to result in significant air quality impacts during either the construction or operational phases, provided that recommended mitigation measures, particularly for dust and generator emissions, are implemented effectively.

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Appendix A – Selected Isopleths

Figure A-1 – Scenario 1: NO_2 1-Hourly Averaging Period

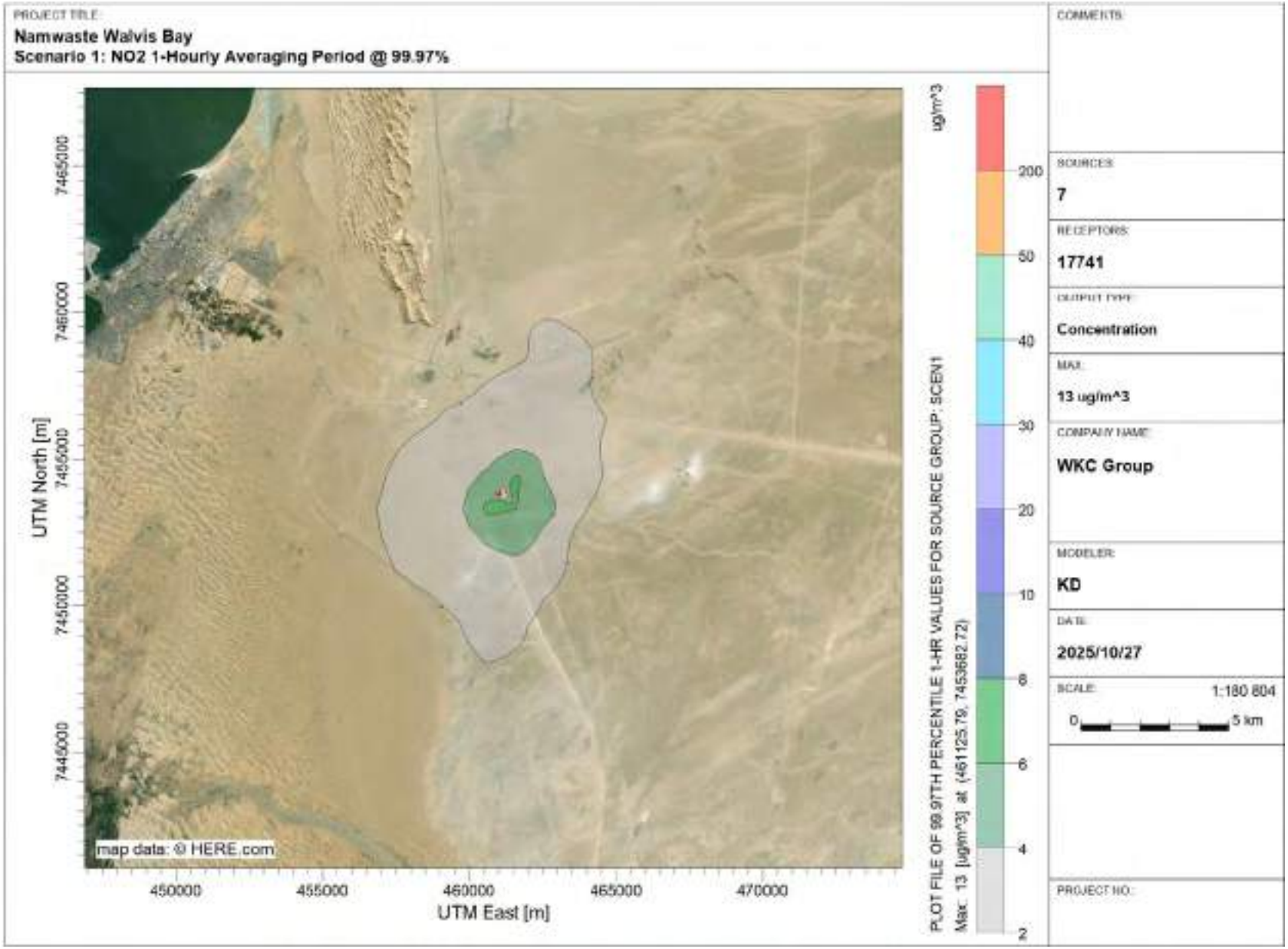


Figure A-2 – Scenario 1: NO_2 24-Hourly Averaging Period

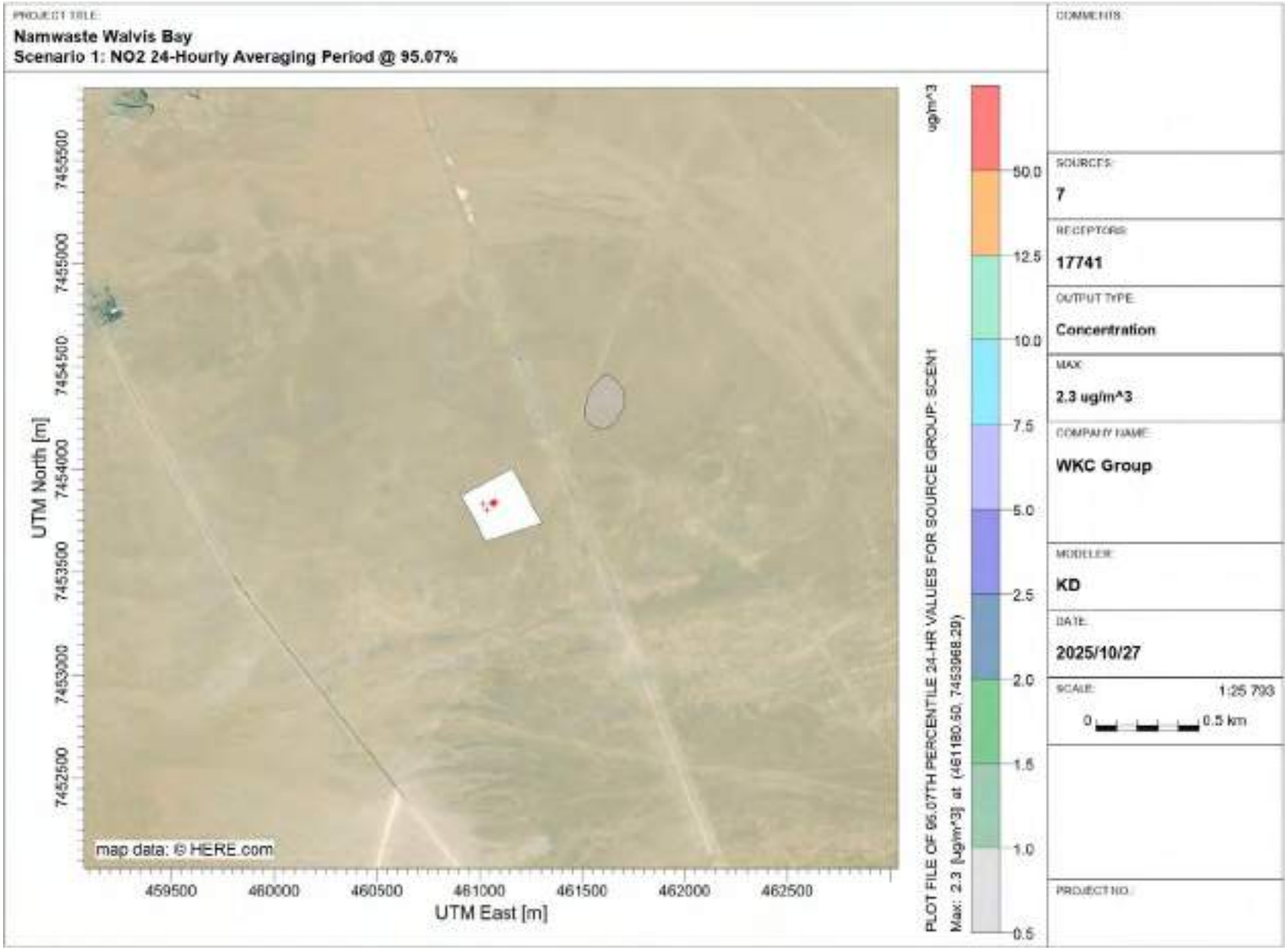


Figure A-3 – Scenario 1: NO_2 Annual Averaging Period

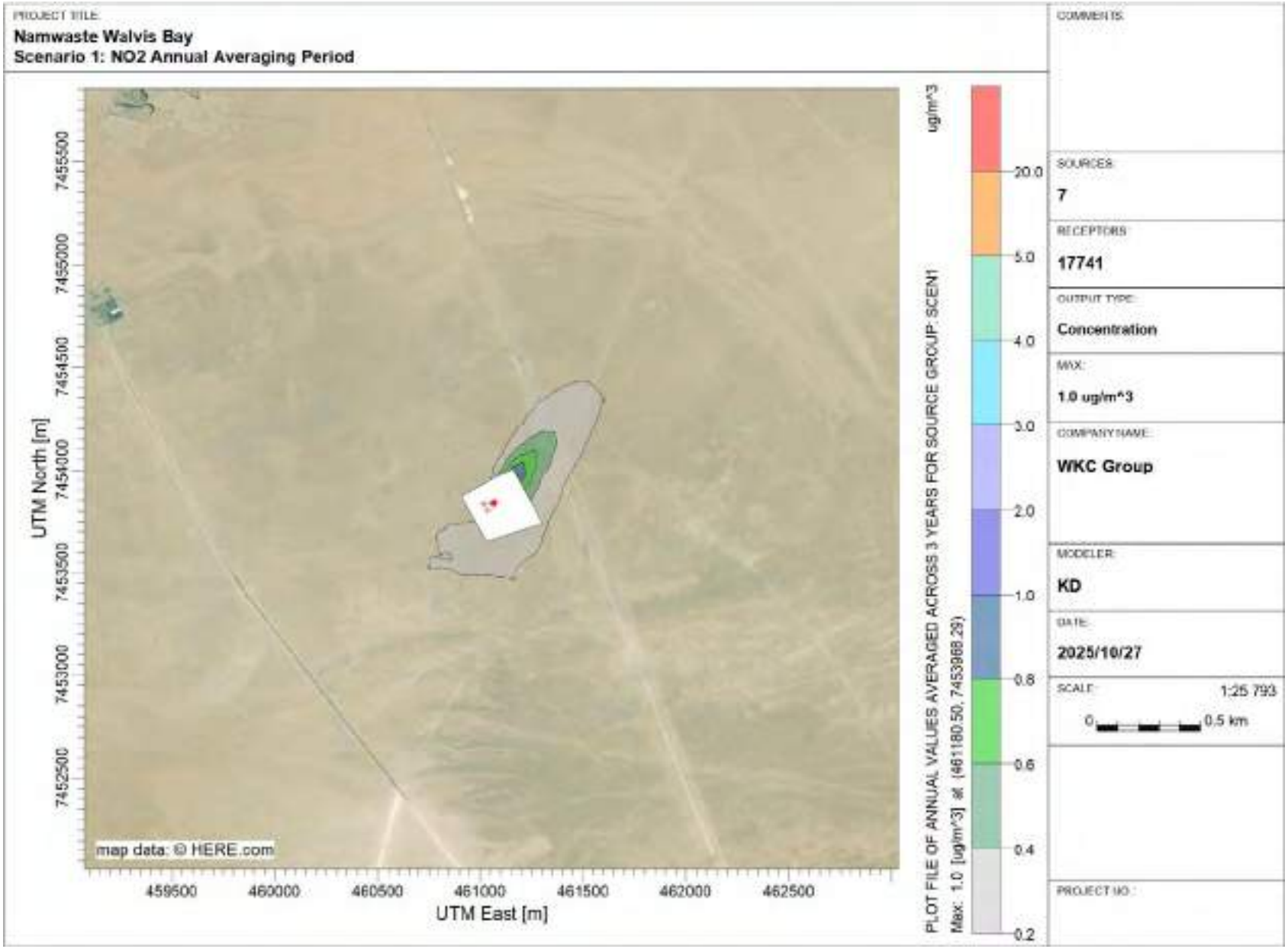


Figure A-4 – Scenario 2: NO_2 1-Hourly Averaging Period

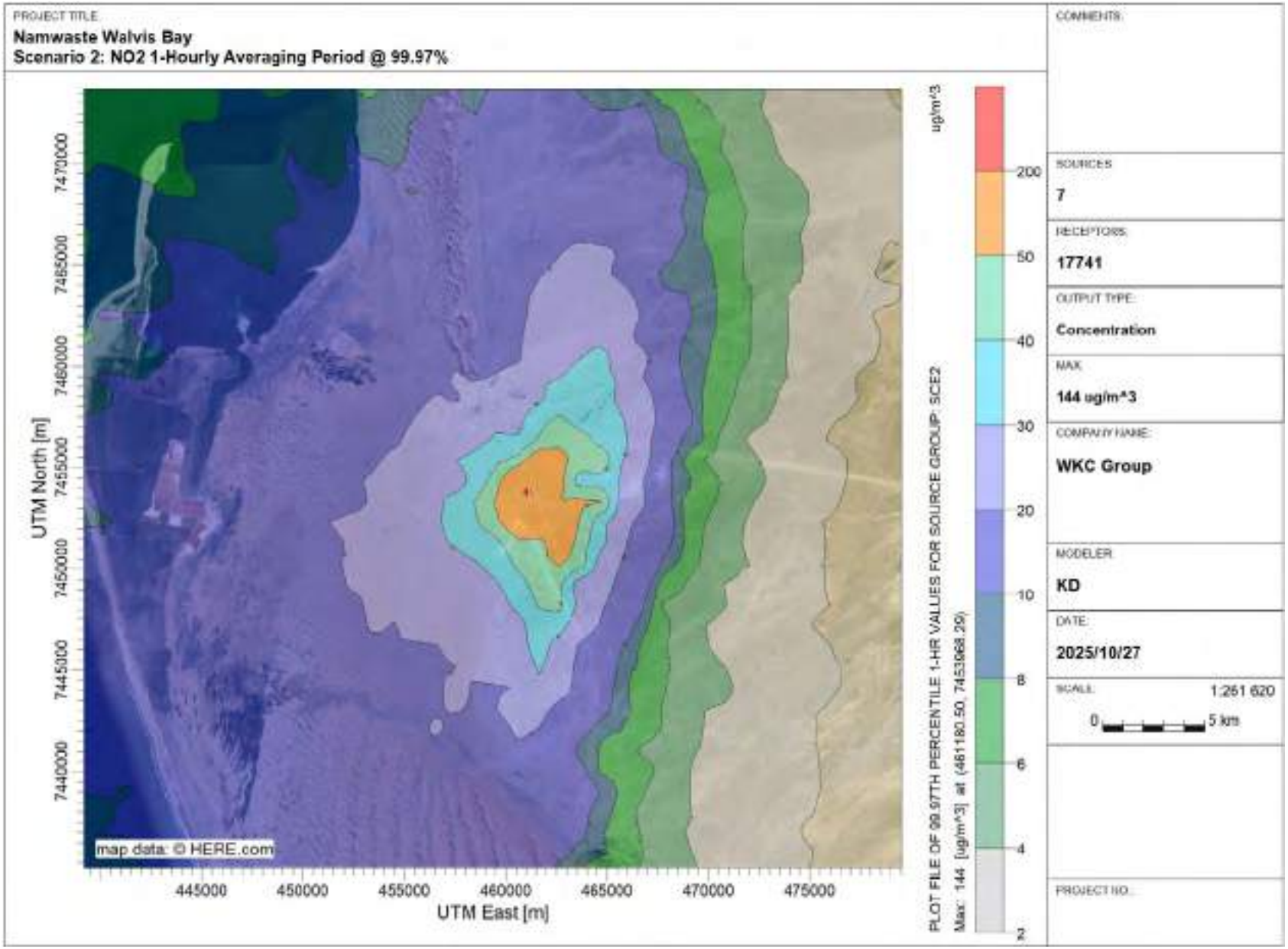


Figure A-5 – Scenario 2: NO_2 24-Hourly Averaging Period

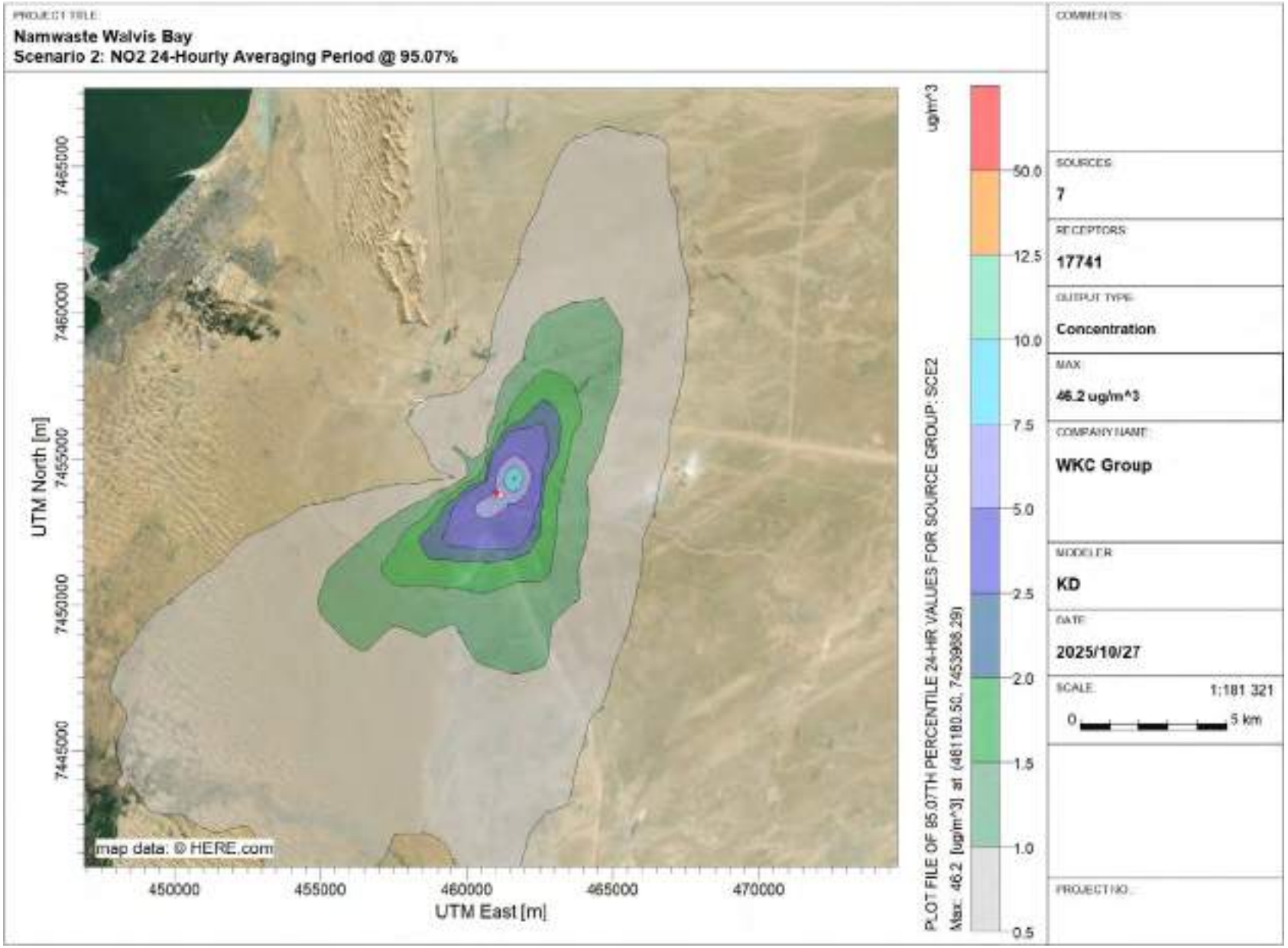
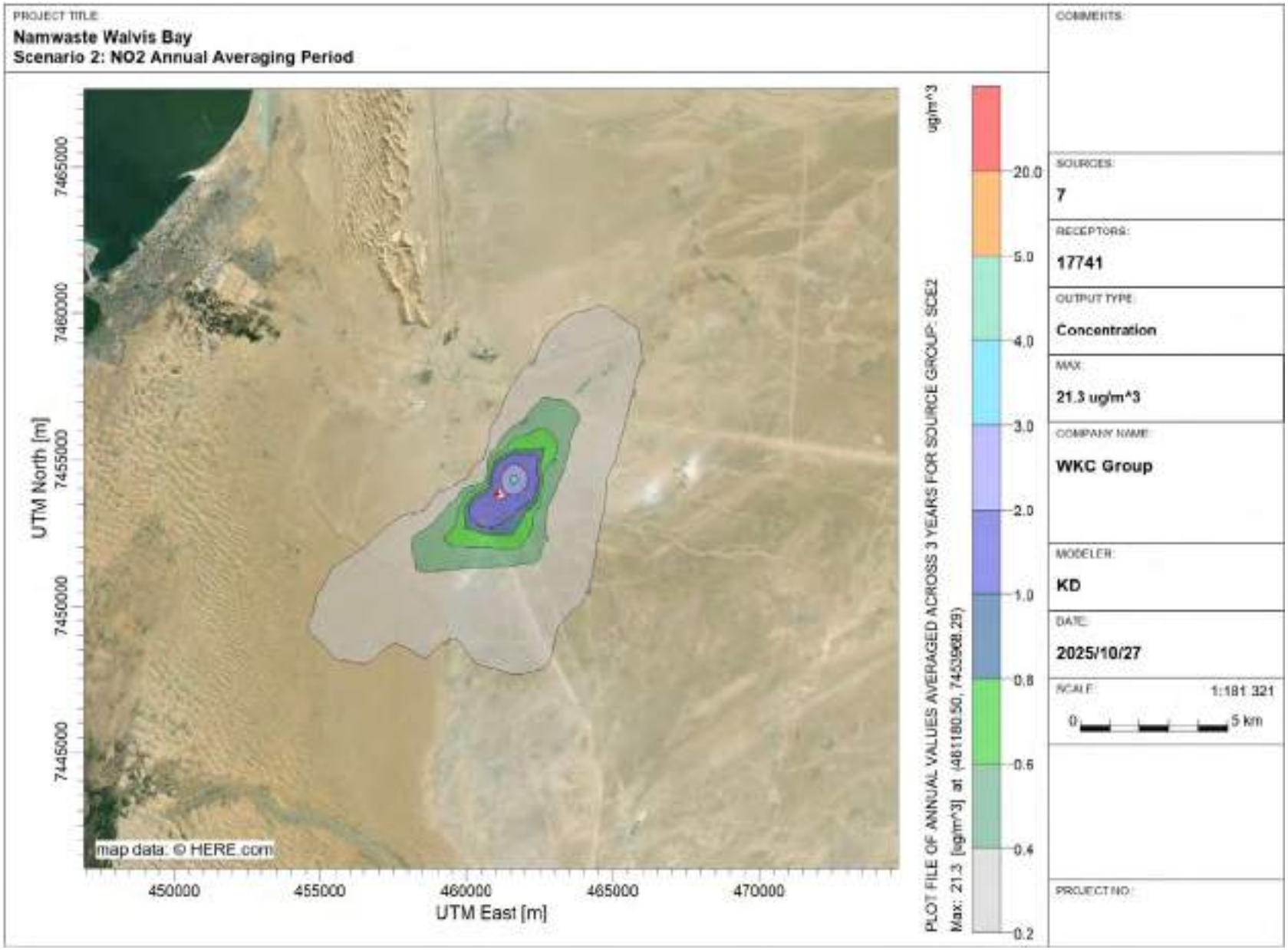


Figure A-6 – Scenario 2: NO_2 Annual Averaging Period



Appendix B – KP Impact Assessment Criteria

Nature of impact	
Term	**Definition**
Positive (+)	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative (-)	An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.
Direct impact (D)	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors (e.g. between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality).
Indirect impact (I)	Impacts that result from other activities that are encouraged to happen as a consequence of the Project (e.g. in-migration for employment placing a demand on resources).
Cumulative impact (C)	Impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the Project.

Ranking criteria				
Severity / magnitude (M)	**Reversibility (R)**	**Duration (D)**	**Spatial extent (S)**	**Probability (P)**
5 – Very high – The impact causes the characteristics of the receiving environment/ social receptor to be altered by a factor of 80 – 100 %	**5 – Irreversible** – *Environmental* - where natural functions or ecological processes are altered to the extent that it will permanently cease. *Social* - Those affected will not be able to adapt to changes and continue to maintain-pre impact livelihoods.	**5 – Permanent** - Impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.	**5 – International** - Impacts that affect internationally important resources such as areas protected by international conventions, international waters etc.	**5 – Definite** - The impact will occur.
4 – High – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 60 – 80 %		**4 – Long term** - impacts that will continue for the life of the Project, but ceases when the Project stops operating.	**4 – National** - Impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences.	**4 – High probability** – 80% likelihood that the impact will occur
3 – Moderate – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 40 – 60 %	**3 – Recoverable** *Environmental* - where the affected environment is altered but natural functions and ecological processes may continue or recover with human input. *Social* - Able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support or intervention.	**3 – Medium term** - Impacts are predicted to be of medium duration (5 – 15 years)	**3 – Regional** - Impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystem.	**3 – Medium probability** – 60% likelihood that the impact will occur
2 – Low – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 20 – 40 %		**2 – Short term** - Impacts are predicted to be of short duration (0 – 5 years)	**2 – Local** - Impacts that affect an area in a radius of 2 km around the site.	**2 – Low probability** - 40% likelihood that the impact will occur
1 – Minor – The impact causes very little change to the characteristics of the receiving environment/ social receptor and the alteration is less than 20 %	**1 – Reversible** *Environmental* - The impact affects the environment in such a way that natural functions and ecological processes are able to regenerate naturally. *Social* - People/ communities are able to adapt with relative ease and maintain pre-impact livelihoods.	**1 – Temporary -** Impacts are predicted to intermittent/ occasional over a short period.	**1 – Site only** - Impacts that are limited to the site boundaries.	**1 – Improbable** - 20% likelihood that the impact will occur

Consequence (severity + reversibility + duration + spatial scale) x Probability = Significance

Significance		
Score According to Impact Assessment Matrix	**Colour Scale Ratings**	
	Negative Ratings	**Positive Ratings**
Between 0 and 29 significance points indicate **Low Significance**	**Low**	**Low**
Between 30 and 59 significance points indicate **Moderate Significance**	**Moderate**	**Moderate**
60 to 100 significance points indicate **High Significance**	**High**	**High**

ANNEXURE G – NOISE IMPACT ASSESSMENT

Walvis Bay Integrated Waste Management, Treatment, Transfer and Recovery Facility

Noise Impact Assessment

Prepared for: Knight Piésold Consulting (Pty) Ltd

Ref.: J-SAF-50039

Date: 16-01-2026

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Acronyms

General

BS	British Standard
EHS	Environmental Health and Safety
EPC	Engineering Procurement and Construction
IFC	International Finance Corporation
ISO	International Organisation for Standardisation
KP	Knight Piésold Consulting
NIA	Noise Impact Assessment
NM	Noise Monitoring
SR	Sensitive Receptor
WKC	WKC Group (Pty) Ltd

Units of Measurement

%	Percentage
°C	Degrees Celsius
dB	Decibel
dB(A)	Decibel (A-weighted)
Hz	Hertz
kHz	Kilohertz
m	Meter
MW	Megawatt
MWp	Megawatt Peak
T	Tonne

1 Introduction

Knight Piésold Consulting (Pty) Ltd KP), hereafter referred to as the Client, has appointed WKC Group Pty Ltd (WKC) to undertake a Noise Impact Assessment (NIA) for a proposed Walvis Bay Integrated Waste Management, Treatment, Transfer and Recovery Facility (hereafter referred to as the 'Project'), which will be an integrated waste management, treatment, transfer, and recovery facility. The proposed Project will be located in Walvis Bay in the Erongo Region of Namibia, approximately 20 km from the Port entrance.

1.1. Study Objectives

The key objectives of the NIA assessment are:

- To undertake a review of the relevant national noise standards, or in their absence, internationally recognised noise standards and provide a summary of the minimum standards that will need to be achieved with respect to project noise emissions;
- To identify the key noise emissions associated with the Project through the development of a noise inventory;
- To quantify and assess the potential impacts of the construction and operations phase of the Project on the surrounding environment, and;
- If Required, to provide insight regarding general mitigation options with respect to noise level reductions to minimise potential impacts arising from project operations.

Potential operational noise impacts from the Project have been modelled using SoundPLAN© Version 9.0 and compared to the applicable standards.

1.2. Scope of Modelling Study

This report presents the findings of a predictive noise analysis of high noise-emitting equipment associated with the future construction and operation of the Project. Predicted noise levels at the nearest Sensitive Receptors (SRs) have been assessed in accordance with the assessment criteria detailed in Appendix C.

1.2.1. Construction Phase Assessment

The construction phase assessment was undertaken to predict the noise levels associated with construction activities for the Project which will result from:

- Site preparation; and,
- General construction site activities.

An assessment of predicted noise emission from construction activities in the area surrounding the Project site was carried out in accordance with BS5228-1 [1].

1.2.2. Operations Phase Assessment

The operations phase assessment was undertaken to predict noise levels associated with operational activities anticipated to arise from the continuous operation of high noise-emitting equipment and has been undertaken for both the daytime and night-time periods.

2 Project Description

2.1.1. Project Background

Large crude oil and natural gas discoveries offshore Namibia in recent years has led to oil and gas exploration drilling activities being undertaken in the area by various international energy groups. Associated drilling and production of oil and gas reserves offshore will generate significant quantities of solid and liquid, general and hazardous waste. Increased production of waste offshore Walvis Bay, existing commercial and industrial uses of the Port and the lack of suitable industrial waste treatment facilities necessitate a private sector solution to manage the waste on-shore, both from off-shore activities and port activities.

The purpose of the Project is to fulfill that role by providing the relevant treatment facility as close as possible to the source of generation. The facility will largely be tailored to the specific needs of the offshore oil and gas exploration and production (E&P) industry. The E&P industry produces two specific waste streams (cuttings (~15% oil, 15% water & 70% solids (rock)) and slops (~10% oil, 80% water & 10% solids (rock)) in large quantities during drilling as well as a wide range of industrial waste such as used and redundant chemicals, chemical containers and paints in smaller quantities. General solid waste and medical waste is also generated by the personnel on the riggs. In addition, drilling fluids (mud and brine), which are used to aid the drilling of wells, become contaminated with hydrocarbons during the process and require treatment prior to reuse.

2.1.2. Project Activities Overview

Project activities will consist of waste management specific activities and supporting / ancillary activities common to industrial sites. Waste management specific activities which will take place on the site include:

- Treatment of cuttings and mud and recovery of hydrocarbons using either a Thermomechanical Cuttings Cleaner (TCC) or Thermal Desorption Unit (TDU);
- Treatment of slops in a slops treatment unit (mainly a centrifuge);
- Discharge of treated effluent into the municipal wastewater treatment works or evaporation pond;
- Storage of cuttings and slops in suitable, bunded containment facilities;
- Temporary storage of waste (liquids and solids) in suitable, bunded containment facilities;
- Tank and skip washing.

Ancillary infrastructure and supporting activities required to conduct primary activities include:

- Truck depot and bin yard;
- Stormwater / run-off management infrastructure for collection and containment of any contaminated water;
- Effluent storage in ponds / dams for evaporation with surface area of 17,000 m^2 or discharge into the municipal wastewater treatment works;
- A plant / vehicle washing bay with contaminated runoff control;
- Laboratory to test and verify the classification of incoming and / or treated waste as required;
- Access road (~1.2 km) to the facility;
- Access control facilities including perimeter fencing;
- Weighbridges and control room;
- Fuel storage facilities with capacity of 23,000 litres;
- Water storage tank with a capacity of 200 m^3;
- Back-up generators – 5 x 500 kVA;
- Offices and other administrative buildings;
- Staff dining and ablution facilities;
- Camp for ~50-100 employees;
- Workshop and stores;
- Weather station; and,
- Utility connections:
    - The facility will require a maximum electricity supply of 2500 kVA – TCC + 750 kW Disc Stack centrifuge / Slops treatment process + 110 kW Enhanced Passive Evaporation process for use on site.
    - Water supply from municipal 25 m^3 per day.
    - Sewage management – package sewer plant.

2.2. Project Location

The project is located approximately 10 km to the Southeast of Walvis bay and is shown in a regional and local context below in Figure 2-1 and Figure 2-2 respectively.

Figure 2-1 – The Project Location in a Regional Context

Figure 2-2 – The Project Location in a Local Context

3 Regulatory Review

This section presents the national and international standards, guidance and Project specifications anticipated to be applicable to the assessment. In the absence of robust local noise standards, international best practice will be used to contextualise Project noise impacts with respect to the ambient noise environment.

3.1. Namibian Noise Control Regulations

The Local Authorities Act, 1992 (Act No. 23 of 1992) was brought into force on the 31 August 1992 by GN 118/1992 and defines the power, duties and functions of local authority councils and provides for incidental matters regarding the setting and implementation of local regulations within the country of Namibia. As a result, the authority of setting noise limits is designated to the local authority. To date the local regulations do not provide for specific noise limits on urban communities and industrial plants or facilities. In the absence of robust local noise standards, the quantitative assessment presented in this report will be based on noise limits defined within International Finance Corporation (IFC) General Guidelines [2], which constitute the application of International Best Practice.

3.2. International Guidance

3.2.1. IFC General Guidelines

The IFC General Environment, Health and Safety (EHS) guidelines for Noise Management state that the noise level guidelines should either be met, or alternatively the project shall not result in a maximum increase in background levels of 3 dB(A) at the nearest receptor location. The IFC maximum permissible noise levels for general environment are presented in Table 3-1.

Table 3-1 – Maximum Permissible Noise Levels for General Environment [3]

Classification of Receptor	Allowable Limits for Noise Levels (L_{Aeq}) (dB(A))	
	Day (7 a.m. – 10 p.m.)	Night (10 p.m. – 7 a.m.)
Residential, Institutional, Educational	55	45
Industrial, Commercial	70	70

3.2.2. Construction Noise Criteria

The IFC Guideline values are associated with “typical noise” for a given land use zoning. Construction activities are temporary in nature and therefore it can be argued that noise associated with construction activities are not considered to be typical or continuous for an extended period; therefore, the guideline values are not

specific to assessing construction noise. Due to the temporary nature of construction activities, it is not always relevant to compare noise levels generated during the construction period with allowable noise limits.

In the absence of national construction noise limits, the construction noise assessment has been carried out in accordance with internationally recognised construction noise guidelines of the Department of Environment & Climate Change New South Wales (NSW) [4]. The interim construction noise guidelines define a construction noise threshold margin of 10 dB above the background noise levels with a 75dB(A) upper limit for construction operations during standard hours. This is due to the temporary / short-term and transient nature of construction noise, as opposed to operational noise levels or conditions that are long-term (and therefore considered more significant). A noise level of L_{Aeq} 75 dB(A) represents the point above which there may be strong community reaction to noise and indicates a need to consider other feasible and reasonable ways to reduce noise, such as restricting the times of very noisy works to provide respite to affected residences.

3.2.3. ISO 1996-1-3 'Description and Measurement of Environmental Noise'

International Organisation for Standardisation (ISO) 1996-1-3 – 'Description and Measurement of Environmental Noise' [5] defines the basic quantities to be used for the description of noise in community environments and the basic procedures for the determination of these quantities. It also includes the methods for acquisition of data that enable specific noise situations to be checked for compliance with given noise limits.

3.2.4. ISO 9613 Acoustics – 'Attenuation of Sound during Propagation Outdoors' [6]

ISO 9613 Acoustics – 'Attenuation of Sound during Propagation Outdoors' [6] specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level (L_{Aeq}) under meteorological conditions favourable to propagation from sources of known sound emission.

4 Impact Assessment Methodology

The following sections provide an overview of the calculation methodology, the impact assessment criteria for the construction and operations phase of the Project.

4.1. Calculation Methodology

4.1.1. Calculation of Construction Noise

The calculation of construction noise was carried out in accordance with British Standard (BS) 5228:2014 'Noise and Vibration Control on Construction and Open Sites' [1]. The standard provides a comprehensive construction equipment inventory with associated noise levels, a construction noise calculation method, practical information on noise reduction measures, and promotes 'Best Practice Means' approach to control noise emissions during construction.

4.1.2. Calculation of Operational Noise

ISO 9613 Acoustics – Attenuation of Sound During Propagation Outdoors' [7] specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous L_{Aeq} under meteorological conditions favourable to propagation from sources of known sound emission.

SoundPLAN© 9.1 is an internationally recognised noise modelling software that adopts ISO 9613 and has been used to estimate the operational noise levels associated with the Project. This software allows for a spatially constructed model, incorporating noise emission parameters of the Project facilities/activities, and calculates sound propagation and attenuation by recognised methods in order to predict the levels of environmental noise at a distance from the modelled sources. The method predicts the L_{Aeq} under meteorological conditions favourable to propagation from sources of known sound emission.

4.2. Impact Assessment Criteria

4.2.1. Impact Assessment Criteria for Construction Phase

The impact assessment criteria presented in Table 4-1 is based on the NSW construction noise guidelines [4] and has been adapted in accordance with the KP assessment criteria and relates to the contributed noise level from the construction phase.

Table 4-1 – Construction Noise Impact Magnitude Assessment Criteria

Impact Intensity Category	Rating of Intensity	Increase in noise level above the noise limit	Description of Impact
Minor	**1**	0 dB(A)	The impact causes very little change to the characteristics of the receiving environment/

Impact Intensity Category	Rating of Intensity	Increase in noise level above the noise limit	Description of Impact
			social receptor and the alteration is less than 20%
Low	**2**	0 – 5 dB(A) above applicable noise limit	The impact alters the characteristics of the receiving environment/ social receptor by a factor of 20 – 40%
Moderate	**3**	5 – 10 dB(A) above applicable noise limit	The impact alters the characteristics of the receiving environment/ social receptor by a factor of 40 – 60%
High	**4**	>10 dB(A) above applicable noise limit	The impact alters the characteristics of the receiving environment/ social receptor by a factor of 60 – 80%
Very High	**5**	≥ 10 dB(A) above applicable noise limit and exceeding 75 dB(A)	The impact causes the characteristics of the receiving environment/ social receptor to be altered by a factor of 80 – 100%

4.2.2. Impact Assessment Criteria for Operational Phase

The impact assessment criteria presented in Table 4-2 is based on the IFC General EHS Guidelines for Noise Management [2] and the Institute of Acoustics (IoA) Noise Impact Assessment Guidelines [8] and has been adapted in accordance with the KP assessment criteria and relates to the contributed noise level and resulting change in noise levels at the SR during the operations phase.

Table 4-2 – Definition of Impact Intensity

Impact Intensity Category	Rating of Intensity	Change in Noise Level	Description
Minor	**1**	0 dB(A)	The impact causes very little change to the characteristics of the receiving environment/ social receptor and the alteration is less than 20%
Low	**2**	0.1 – 2.9 dB(A)	The impact alters the characteristics of the receiving environment/ social receptor by a factor of 20 – 40%
Moderate	**3**	3 – 4.9 dB(A)	The impact alters the characteristics of the receiving environment/ social receptor by a factor of 40 – 60%
High	**4**	5 – 10 dB(A)	The impact alters the characteristics of the receiving environment/ social receptor by a factor of 60 – 80%
Very High	**5**	> 10 dB(A)	The impact causes the characteristics of the receiving environment/ social receptor to be altered by a factor of 80 – 100%

4.2.3. Determination of Impact Significance

The impact significance arising at SRs was assessed using the KP assessment criteria, which define impact significance as the product of an impact's consequence and probability, where the consequence is the sum of the impact severity, reversibility, duration, and spatial extent.

The KP assessment criteria used to guide the approach in determining the impact significance of noise contributions from construction and operation is detailed in Appendix C.

5 Sensitive Receptors

The Project site is located in an area surrounded by mostly commercial districts with the town of Walvis Bay located 12 km to the North-West. The co-ordinates and description of the identified SR locations within a 10 km radius are shown in Table 5-1 below, and Figure 5-1 shows the location of the SRs in relation to the Project site.

Table 5-1 – Sensitive Receptor Details

SR ID	SR Description	UTM Co-ordinates*		Site Classification	IFC Noise Limits (dB(A))	
		m E	m S		Daytime	Night-Time
SR 1	Rooikop Town	464,718	7,457,954	Residential	55	45
SR 2	Walvis Bay	453,091	7,460,882	Residential	55	45
**UTM Co-Ordinates in ref system: WGS84 33S*						

Figure 5-1 – Sensitive Receptor Locations

6 Baseline Conditions

A baseline noise assessment was conducted on the 30th of April 2024, in order to determine the environmental noise characteristics at several noise monitoring (NM) locations in and around the Project site.

6.1. Noise Baseline Monitoring

A baseline noise survey was undertaken by WKC in accordance with best practice and ISO 1996-1-3 [5] at several locations in and around the Project site. The measurements were taken at a standard height of 1.5 metres and at a minimum of 3 metres away from any reflecting surfaces for a duration of 15 minutes at each location.

6.2. Equipment and Calibration

A Casella 'type 1' integrating sound level meter, together with a CEL-110/1 'type 1' field calibrator, was utilised for all measurements.

The selected sound level meter automatically logs environmental noise measurement parameters including L_{Aeq}, L_{Amax} and L_{Amin}.

The sound level meter was calibrated before and after each measurement using the field calibrator, subsequently ensuring any potential drift is attributed to each measurement location rather than all locations throughout the survey period. In addition, the sound level meter and field calibrator are factory calibrated by the certified bodies on an annual basis. A copy of the latest calibration certificates can be found in Appendix D of this report.

6.3. Noise Measurement Locations

Details of the measurement locations are summarised in

Table 6-1 and the measurement locations are illustrated in Figure 6-1. These locations were selected based on site inspection to ensure that the sound level meter was deployed in locations that would be representative of the project site and surrounding areas' acoustic environmental conditions.

Table 6-1 – Noise Measurement Locations and Period

NM ID	Date	15-Minute Measurements		UTM Co-ordinates*	
		Start Time	End Time	m E	m S
NM 1	30/04/2024	12:46	13:01	461376.3	7453970.6
NM 2	30/04/2024	13:11	13:26	461462.3	7453724.8
NM 3	30/04/2024	13:38	13:53	461206.5	7453570.4
NM 4	30/04/2024	14:08	14:23	460978.7	7453631.3
NM 5	30/04/2024	14:37	14:52	460864.7	7453692.5
NM 6	30/04/2024	15:05	15:20	460437.7	7453691.4
NM 7	30/04/2024	15:32	15:47	460864.0	7453938.5
NM 8	30/04/2024	14:56	16:11	460977.5	7454092.5
NM 9	30/04/2024	16:19	16:34	461148.5	7454000.7
NM 10	30/04/2024	16:46	17:01	461092.0	7453846.8

** WGS84 / UTM Zone 33S*

Figure 6-1 – Noise Measurement Locations

6.4. Results and Analysis

The ambient noise measurements recorded at all identified NM locations are shown in Table 6-2. The area around the Project site has been zoned for industrial purposes. The baseline noise levels have therefore been assessed against the IFC industrial noise limit of 70 dB(A).

Table 6-2 – Ambient Noise Survey Results

NM ID	Measured Noise Level dB(A)			Noise Limit (dB(A))	Limit Exceeded?	Description of Ambient Noise Source
	L_{Aeq}	L_{Amin}	L_{Amax}			
NM 1	53.7	36.1	66.6	70	No	The wind and distant vehicles.
NM 2	48.1	31.5	61.0	70	No	The wind and distant vehicles.
NM 3	50.7	37.3	63.6	70	No	The wind and distant vehicles.
NM 4	44.9	30.4	58.2	70	No	The wind and distant vehicles.
NM 5	55.5	39.5	64.0	70	No	The wind and distant vehicles.
NM 6	43.7	31.3	60.7	70	No	The wind and distant vehicles.
NM 7	55.0	37.0	72.7	70	No	The wind and distant vehicles.
NM 8	46.3	32.0	72.2	70	No	The wind and distant vehicles.
NM 9	46.6	32.4	68.8	70	No	The wind and distant vehicles.
NM 10	43.5	28.2	72.6	70	No	The wind and distant vehicles.

As can be seen in the results, all measurement locations are below the IFC noise limits. An average baseline noise level of 51.0 dB(A) has been calculated from all measurement locations and was used as a representative baseline noise level for the Project site and surrounding area.

7 Construction Phase Noise Impact Assessment

7.1. Construction Phase Overview

Noise emissions are expected during the construction of the Project due to the operation of various equipment and machinery. Key sources of noise during this phase include:

- Site preparation; and,
- General construction site activities.

The types and quantities of equipment anticipated for use throughout the different stages of construction have been provided by the Client. Based on this information, noise impacts during the construction phase have been assessed.

As construction activities are planned exclusively during daytime hours, this assessment considers compliance only with applicable daytime noise limits.

7.2. Equipment Noise Levels

Equipment noise levels for the various construction equipment items included in the assessment were obtained from BS 5228:2014 'Noise and Vibration Control on Construction and Open Sites' [1]. The noise levels used in the predictive assessment are summarised for each equipment item, and for each of the phases of construction in Table 7-1.

Table 7-1 – Estimated Construction Equipment Inventory

Sl No.	Equipment Item	Sound Level @ 10m (dB) – LA_{eq}	Reference
Site Preparation			
1	Tracked excavator	70	BS 5228-1 Table C.2
2	Tracked excavator	76	BS 5228-1 Table C.2
3	Wheeled loader	79	BS 5228-1 Table C.2
4	Lorry	80	BS 5228-1 Table C.2
5	Roller	78	BS 5228-1 Table C.2
6	Directional drill (generator)	77	BS 5228-1 Table C.2
7	Water pump	65	BS 5228-1 Table C.2
8	Grader	86	BS 5228-1 Table C.2
9	Water Tanker	81	BS 5228-1 Table C.2
General construction site activities			
10	Dumper	76	BS 5228-1 Table C.4
11	Large concrete mixer	76	BS 5228-1 Table C.4
12	Concrete mixer truck + truck mounted concrete pump + boom arm	78	BS 5228-1 Table C.4
13	Wheeled mobile crane	70	BS 5228-1 Table C.4
14	Tracked excavator	75	BS 5228-1 Table C.4
15	Core drill (electric)	85	BS 5228-1 Table C.4
16	Petrol hand-held circular saw	91	BS 5228-1 Table C.4
17	Circular bench saw (petrol-cutting concrete blocks)	85	BS 5228-1 Table C.4
18	Tractor (towing equipment)	80	BS 5228-1 Table C.4
19	Diesel generator	61	BS 5228-1 Table C.4
20	Diesel generator	66	BS 5228-1 Table C.4
21	Diesel generator	65	BS 5228-1 Table C.4
22	Water pump (diesel)	68	BS 5228-1 Table C.4
23	Dust suppression unit trailer	78	BS 5228-1 Table C.4
24	Angle grinder (grinding steel)	80	BS 5228-1 Table C.4

7.3. Determination of Impact Intensity

Construction noise levels have been calculated at specific distance intervals ranging from the development boundary to 1,000 m. The calculated noise levels for the Site Preparation phase are presented in Table 7-2 and the noise levels of the General Construction phase are presented in Table 7-3.

The predicted construction noise levels were calculated under the conservative assumption that one of each equipment item will be operating at full capacity at a singular point on the Project boundary closest to each SR, resulting in the highest potential construction noise level estimate for each SR.

Table 7-2 – Predicted Noise Emissions from Site Preparation

Distance from Project Boundary (m)	Noise Levels dB(A)
50	69.4
100	63.4
150	59.9
200	57.4
500	49.4
1000	43.4

Table 7-3 – Predicted Noise Emissions from General Construction Activities

Distance from Project Boundary (m)	Noise Levels dB(A)
50	73.7
100	67.7
150	64.2
200	61.7
500	53.7
1000	47.7

A review of the results in Table 7-3 shows that the noise from construction activities will be below the construction noise threshold of 70 dB(A) at approximately 80 m from the project boundary under worst-case construction activities. As there are no receptors within this distance from the project boundary the construction phase activities are not expected to generate noise levels that exceed applicable construction noise threshold at any of the assessed receptors. The discrete SR assessment is covered in the following section.

7.4. Construction Impact Assessment at SR's

General Construction was identified as the more significant construction phase (approximately 3-4 dB(A) louder than Site Preparation activities) and was therefore used as the representative construction phase to assess the impact magnitude at the SR's conservatively. The resulting impact intensities at the assessed SRs are presented in Table 7-4. Based on the results of the assessment the impact intensity as a result of construction activities is Minor.

Table 7-4 – Construction Noise Contribution and Impact Intensity at SRs

SR ID	Minimum Distance from Construction (km)	Total L_{Aeq} Contribution at Sensitive Receptor (dB(A))	Construction Noise Limit L_{Aeq} (dB(A)) [(a)]	Increase above Limit (dB(A))	Impact Intensity
SR1	5.3	33.2	70	-	*Minor*
SR2	10.5	27.3	70	-	*Minor*
Note a: the construction noise limit is set at 10dB above the applicable day-time noise limit for the area.					

7.5. Determination of Impact Significance

Based on the estimated construction noise levels, the Impact Intensity at all SR's is predicted to be *Minor*, which corresponds to a rating of '**1**'. The Reversibility, Duration and Spatial Extent are allocated a rating of '**1**', '**1**' and '**2**' respectively, which leads to a Consequence of '**5**' for all SRs. Given that the Probability is allocated a rating of '**3**', the Impact Significance is classified as '**Low**'. Upon the application of typical noise management measures outlined in Section 7.6, the Impact Intensity for these SRs is anticipated to remain the same and the Impact Significance remains the same based on the assessment criteria adopted for the study (refer Appendix C).

Table 7-5 – Construction Phase Impact Assessment Summary

		Severity / Magnitude (M)	Reversibility (R)	Duration	Spatial Extent	Probability	Significance	Nature of Impact	
								+ / -	D / I / C
Construction Impacts Prior to Mitigation									
Increase in noise emissions	Without Mitigation	**1**	**1**	**1**	2	**3**	**Low**	**(-)**	**D**

Recommendations:

Based on the construction phase noise impact assessment, the Project noise contributions are unlikely to result in significant impacts. However, in order to minimise the potential impact from the construction phase of the project, key noise control measures have been provided. Best practice construction noise control measures, as they are applicable to the construction phase, are provided to minimise noise from overall constructions activities.

Noise Control Guidelines – Controlling Noise Sources

Relevant construction noise control guidelines from the BS 5228 [9] are provided below.

General Mitigation Measures

- Avoid unnecessary revving of engines and switch off equipment when not required.
- Keep internal access routes well maintained and avoid steep gradients.
- Use rubber linings in, for example, chutes and dumpers to reduce impact noise.
- Minimise drop height of materials.
- Start-up plant and vehicles sequentially rather than all together.
- The movement of plant equipment onto and around the site should have regard to the normal operating hours of the site or surrounding environment.

	Severity / Magnitude (M)	Reversibility (R)	Duration	Spatial Extent	Probability	Significance	Nature of Impact	
							+ / -	D / I / C

- Audible reversing warning systems on mobile plant and vehicles should be of a type which, whilst ensuring that they give proper warning, have a minimum noise impact on persons outside sites. When reversing, mobile plant and vehicles should travel in a direction away from sensitive receptors whenever possible. Where practicable, alternative reversing warning systems should be employed to reduce the impact of noise outside sites.

Modification of Equipment

- Noise from equipment can often be reduced by modification or by the application of improved sound reduction methods, but this should only be carried out after consultation with the manufacturer (i.e., fitting a more effective exhaust silencer system or by designing an acoustic canopy to replace the normal engine cover).
- It might be possible in certain circumstances to substitute diesel engines with electric motors, thereby resulting in noise reduction.
- On-site generators supplying electricity for electric motors should be suitably enclosed and appropriately located.
- Noise caused by resonance of body panels and cover plates can be reduced by stiffening with additional ribs or by increasing the damping effect with a surface coating of special resonance damping material. Rattling noises can be controlled by tightening loose parts and by fixing resilient materials between the surfaces in contact; this is generally a maintenance issue. Impact noise during steel construction can be a nuisance. Direct metal-to-metal contact should be minimised where possible.

Enclosures

- As far as reasonably practicable, sources of significant noise should be enclosed. The extent to which this can be done depends on the nature of the machine or process to be enclosed and their ventilation requirements.

Use and Siting Equipment

- Equipment should always be used in accordance with manufacturers' instructions. Where possible, loading and unloading should also be carried out away from SRs.
- Where possible, machines such as cranes that might be in intermittent use should be shut down between work periods or should be throttled down to a minimum.

		Severity / Magnitude (M)	Reversibility (R)	Duration	Spatial Extent	Probability	Significance	Nature of Impact	
								+ / -	D / I / C

- Equipment from which the noise generated is known to be particularly directional should, wherever practicable, be orientated so that the noise is directed away from noise-sensitive areas.
- Acoustic covers to engines should be kept closed when the engines are in use and idling. If compressors are used, they should have effective acoustic enclosures and be designed to operate when their access panels are closed.
- Materials should be lowered whenever practicable and should not be dropped. The surfaces onto which the materials are being moved should be covered by resilient material.

Maintenance

- Provide regular and effective maintenance by trained personnel.

Other

- Conduct site inductions to cover the importance of noise control and available noise reduction measures.
- Establish and enforce site speed limits.
- Designate a grievance officer who is able to deal with concerns and establish a complaints response programme (this can form part of the grievance mechanism) to enable the identification and resolution of any noise related concerns at an early stage of the construction operations, as well as throughout the different phases of project development.

Construction Noise Impacts Post-Mitigation									
Increase in noise emissions	With Mitigation	**1**	**1**	**1**	2	**3**	**Low**	**(-)**	**D**

7.6. Typical Noise Management Measures

Based on the construction phase noise impact assessment, the Project noise contributions are unlikely to result in significant impacts. However, in order to minimise the potential impact from the construction phase of the project, key noise control measures have been provided. Best practice construction noise control measures, as they are applicable to the construction phase, are provided to minimise noise from overall constructions activities.

Noise Control Guidelines – Controlling Noise Sources

Relevant construction noise control guidelines from the BS 5228 [9] are provided below.

General Mitigation Measures

- Avoid unnecessary revving of engines and switch off equipment when not required.
- Keep internal access routes well maintained and avoid steep gradients.
- Use rubber linings in, for example, chutes and dumpers to reduce impact noise.
- Minimise drop height of materials.
- Start-up plant and vehicles sequentially rather than all together.
- The movement of plant equipment onto and around the site should have regard to the normal operating hours of the site or surrounding environment.
- Audible reversing warning systems on mobile plant and vehicles should be of a type which, whilst ensuring that they give proper warning, have a minimum noise impact on persons outside sites. When reversing, mobile plant and vehicles should travel in a direction away from sensitive receptors whenever possible. Where practicable, alternative reversing warning systems should be employed to reduce the impact of noise outside sites.

Modification of Equipment

- Noise from equipment can often be reduced by modification or by the application of improved sound reduction methods, but this should only be carried out after consultation with the manufacturer (i.e., fitting a more effective exhaust silencer system or by designing an acoustic canopy to replace the normal engine cover).
- It might be possible in certain circumstances to substitute diesel engines with electric motors, thereby resulting in noise reduction.
- On-site generators supplying electricity for electric motors should be suitably enclosed and appropriately located.
- Noise caused by resonance of body panels and cover plates can be reduced by stiffening with additional ribs or by increasing the damping effect with a surface coating of special resonance damping material. Rattling noises can be controlled by tightening loose parts and by fixing resilient materials between the surfaces in contact; this is generally a maintenance issue. Impact noise during steel construction can be a nuisance. Direct metal-to-metal contact should be minimised where possible.

Enclosures

- As far as reasonably practicable, sources of significant noise should be enclosed. The extent to which this can be done depends on the nature of the machine or process to be enclosed and their ventilation requirements.

Use and Siting Equipment

- Equipment should always be used in accordance with manufacturers' instructions. Where possible, loading and unloading should also be carried out away from SRs.
- Where possible, machines such as cranes that might be in intermittent use should be shut down between work periods or should be throttled down to a minimum.
- Equipment from which the noise generated is known to be particularly directional should, wherever practicable, be orientated so that the noise is directed away from noise-sensitive areas.
- Acoustic covers to engines should be kept closed when the engines are in use and idling. If compressors are used, they should have effective acoustic enclosures and be designed to operate when their access panels are closed.
- Materials should be lowered whenever practicable and should not be dropped. The surfaces onto which the materials are being moved should be covered by resilient material.

Maintenance

- Provide regular and effective maintenance by trained personnel.

Other

- Conduct site inductions to cover the importance of noise control and available noise reduction measures.
- Establish and enforce site speed limits.
- Designate a grievance officer who is able to deal with concerns and establish a complaints response programme (this can form part of the grievance mechanism) to enable the identification and resolution of any noise related concerns at an early stage of the construction operations, as well as throughout the different phases of project development.

8 Noise Model

In order to approximate the operational noise level, the internationally recognised noise modelling software 'SoundPLAN' was utilised.

The propagation methodology adopted, and the equations used within the SoundPLAN model are based on the ISO 9613 'Acoustics – Attenuation of Sound during Propagation Outdoors' (ISO, 1996) [10]. This document can be referred to for an in-depth description of the methodology SoundPLAN utilises for attenuation of sound and propagation outdoors.

ISO 9613 specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous L_{Aeq} under meteorological conditions favourable to propagation from sources of known sound emission. The source (or sources) may be moving or stationary and the model takes account of the following physical effects:

- Geometrical divergence.
- Atmospheric absorption.
- Ground effect.
- Reflection from surfaces; and,
- Screening by obstacles.

This method is applicable in practice to a great variety of noise sources and environments. It is applicable, directly or indirectly, to most situations concerning: industrial noise sources, and many other ground-based noise sources. A summary of noise model settings and standards are detailed in Table 8-1.

Table 8-1 – Model Settings

Model Parameter	Parameter Setting / Standard
Calculation Standard	(ISO) 9613 'Acoustics – Attenuation of Sound during Propagation Outdoors' (ISO, 1996)
Ground Absorption Coefficient	0.6
Maximum Order of Reflection	1
Reflection Loss by Obstacles and Barriers	Default: 1 dB
Calculation Grid Size	Project area calculations: 2 m resolution Surrounding Area calculations: 5 m resolution

8.1. Propagation of Sound Outdoors

The variables that affect sound propagation over ground away from a source have been the subject of much detailed investigation over the years. The principal factors influencing sound attenuation with distance from the source are:

- Geometrical spreading (this is the standard spherical wave divergence term which gives 6 dB reduction in noise level for each doubling of distance from point sources e.g. small motor, 3 dB for a line source e.g. piping);
- Source directivity;
- Atmospheric (molecular) absorption;
- Ground effects (different for hard/soft ground, and type of ground cover);
- Atmospheric wind temperature gradients (refraction);
- Source height;
- Atmospheric turbulence; and,
- Barrier effects (diffraction). A brief description of the above is given as follows.

The total attenuation due to all these factors except geometrical spreading and directivity is generally referred to as 'excess attenuation' and will vary with frequency. Because of these effects, a significant noise source may not be significant at, and beyond, the boundary and vice-versa. A noise source dominated by low frequency noise (with a long wavelength) is likely to travel a greater distance under the same excess attenuation factors to that of a noise source dominated with high frequency noise (with a shorter wavelength).

8.2. Meteorological and Ground Conditions

The most influential environmental condition on noise propagation is distance, the greater the distance between the noise source and the receiver the greater the noise reduction achieved. Typically for stationary sources (such as a refinery), a reduction of 6 dB(A) per doubling of distance is considered the norm.

The type of ground cover also influences noise propagation. Soft ground such as sand or agricultural land absorbs sound energy shortening the propagation path whereas hard ground such as compact soil or tarmac reflects the sound energy and thereby noise travels further. It has been assumed for this assessment that the ground cover will be soft outside of the Project boundary and hard within the Project boundary.

For noise propagation over short distances, climatic conditions do not have a significant effect, however over longer distance over 50 m wind becomes more influential. Downwind the level may increase by a few dB, depending on wind speed whereas on the upwind or side-wind the level can drop by 10 dB.

Temperature gradients create effects similar to those of wind gradients, except that they are uniform in all directions from the source. On a sunny day with no wind, temperature decreases with altitude, giving a noise shadow. (The result is the noise is taken up and away from the source and the ground). On a clear night, temperature may increase with altitude (temperature inversion) focusing sound towards the ground surface.

8.3. Equipment Review

Full details of the modelled industrial building / block sources can be found within the noise log in Appendix B.

8.3.1. Major Noise Sources

Major noise sources identified as part of this study include, but are not limited to:

- Pumps;
- Compressors;
- Fans; and,
- Transformers.

All noisy equipment items were modelled inside industrial buildings using the loudest item expected as the internal noise of the building. A summary of the number of the industrial buildings is given in Table 8-2 below. A complete detailed list of all equipment items included in the models can be seen in the noise log in Appendix B.

Table 8-2 – Number of Identified Noise Sources

Industrial Building	Source Type
Slops Treatment	Block Source / Industrial Building
TCC / TDU	Block Source / Industrial Building
Transformers	Point Source

8.4. Summary of Modelling Methodology and Key

The following sections provide an overview of the modelling methodology and some key assumptions applied for the modelling assessment. Wherever possible, a conservative approach has been taken.

8.4.1. Model Environment:

- Ground absorption was modelled at 0.6 for the surrounding area;
- Environmental objects that were deemed to be of significant influence on the screening of noise (including large tanks and buildings) were included in the noise model. Environmental object dimensions were based upon dimensions specified on the plot plans and cross sections as far as this information is available;
- Reasonable worst-case meteorological conditions were implicitly applied in accordance with ISO 9613-2, i.e., steady wind conditions blowing in each direction;
- The topography between noise source and the site boundary receptors is flat (in reality, the topography may undulate leading to attenuation of noise).

8.4.2. Source Layout and Geometry

- Equipment items were modelled at elevations of 1m.
- Noise sources were modelled as point or block sources.

8.4.3. Equipment and Noise Levels

- Noise modelling calculations were carried out for the eight octave bands centred between 63 hertz (Hz) and 8 kilo hertz (kHz);

- Equipment items were modelled at reasonable worst-case noise levels;
- Noise emission spectra were based on typical data from the SoundPLAN emissions library.
- Calculations were based on a steady-state operation with continuous duty cycles.

8.4.4. Noise Assessment

- The noise contour plots were calculated at an overall receiver height 1.5 m height.
- Project noise contribution at the project boundary was assessed in isolation against the relevant industrial area boundary noise limits of 70 dB(A).
- Project noise contributions at the identified SR locations were assessed both in isolation, and with consideration of background ambient noise levels obtained through quantitative survey, as detailed in Section 6. These contributions were assessed with respect to IFC residential, institutional, educational limits of 55 dB(A), or industrial and commercial limits of 70 dB(A) where applicable.
- The change in noise levels above the baseline noise level at receptors due to project operations was assessed in order to determine an operational impact magnitude.

9 Operations Phase Noise Impact Assessment

9.1. Noise Contour Maps

Noise contour maps were produced to visualise the noise level contributions of the Project in the area around the project site. Noise contour maps are shown in Appendix A and include the following:

- Figure A-1 – Project Area – Normal Operating Conditions.
- Figure A-2 – Surrounding Area – Normal Operating Conditions.

9.2. Boundary Noise Contribution

A site boundary noise assessment was carried out along the entire Project boundary to determine whether the Project will be in compliance with the site boundary noise limit.

The Project site is classified as “Industrial”; therefore, as per the limits specified in Section 3.2.1, the noise level should not exceed an L_{Aeq} of 70 dB(A) at the property boundary for daytime and night-time periods.

For the purposes of the assessment and modelling, point receptors were set up on the boundary line of the site. The locations of the modelled point receptors along the Project boundary are illustrated in Figure 9-1.

Figure 9-1 – Site Boundary Point Receiver Locations

Table 9-1 details the predicted noise level contribution from the Project equipment at the overall property boundary under normal operating conditions.

Table 9-1 – Project Site Boundary Noise Contribution

Receiver	Boundary Noise Level Contribution (dB(A))	Noise Limit (dB(A))	Limit Exceeded?
BP 1	56.7	70	No
BP 2	60.1	70	No
BP 3	64.3	70	No
BP 4	65.5	70	No
BP 5	63.4	70	No
BP 6	59.3	70	No
BP 7	59.0	70	No
BP 8	58.8	70	No
BP 9	56.1	70	No
BP 10	52.1	70	No
BP 11	51.5	70	No
BP 12	51.5	70	No
BP 13	51.4	70	No
BP 14	51.1	70	No
BP 15	50.7	70	No
BP 16	51.0	70	No
BP 17	50.2	70	No
BP 18	49.8	70	No
BP 19	51.5	70	No
BP 20	53.1	70	No
BP 21	54.9	70	No
BP 22	55.8	70	No
BP 23	56.6	70	No

The results in Table 9-1 above show that in isolation the project is expected to generate noise levels below the property boundary noise limit of 70 dB(A) at all boundary receptor points. The highest predicted noise contribution is at BP4, with a noise level of 65.5 dB(A), while the lowest predicted noise contributions is at BP18, with a noise level of 49.8 dB(A).

9.3. Sensitive Receptor Assessment

9.3.1. Project Contribution at Sensitive Receptors in Isolation

The project site is located in a remote area to the Southeast of Walvis Bay. The noise contributions of the project at the identified SRs were assessed against the IFC noise limits and are summarised in Table 9-2 below.

Table 9-2 – Model Results at Sensitive Receptors in Isolation

SR ID	Project Noise Contribution at SR (dB(A))	IFC Daytime Noise Limits (dB(A))	IFC Night-time Noise Limits (dB(A))	Exceedance of Daytime Limit?	Exceedance of Night-time Limit?
SR 1	18.6	55	45	No	No
SR 2	10.7	55	45	No	No

The noise contribution assessment shows that the Project's noise contributions are expected to be negligible, primarily as a result of the distance between the Project site and the nearest SRs.

9.3.2. Cumulative Assessment at Sensitive Receptors

A cumulative noise assessment was carried out for the assessed SRs in order to determine the potential impact intensity of Project's operation phase noise contributions. The outcomes of the cumulative assessment are summarised in Table 9-3 below.

Table 9-3 – Impact Intensity at Sensitive Receptors

SR ID	Project Noise Contribution at SR (dB(A))	Baseline Noise Level (dB(A))	Cumulative Noise Level (dB(A))	Change in Noise Level (dB(A))	Impact Intensity
SR 1	18.6	51.0	51.0	0	*Minor*
SR 2	10.7	51.0	51.0	0	*Minor*

Based on the cumulative assessment no change in background noise levels is anticipated at both receptors due to the negligible project noise contribution at these locations. Therefore, the impact intensity at all SRs is '*Minor'*.

9.3.3. Determination of Impact Significance

Based on the results of the cumulative assessment in Table 9-3, the Impact Intensity for assessed SR's was determined to be '***Minor'*** which corresponds to a rating of '**1**'. The Reversibility, Duration and Spatial Extent are allocated a rating of '**1**', '**4**' and '**2**' respectively, which leads to a Consequence of '**8**'. Given that the Probability is allocated a rating of '**3**', the Impact Significance is classified as '**Low**'.

Table 9-4 – Operations Phase Impact Assessment Summary

		Severity / Magnitude (M)	Reversibility (R)	Duration	Spatial Extant	Probability	Significance	Nature of Impact	
								+ / -	D / I / C
Operations Impacts									
Operational Noise Impacts Prior to Mitigation									
Noise generated by facility infrastructure and operations	Without Mitigation	**1**	**1**	**4**	**2**	**3**	**Low**	**(-)**	**D**
Recommendations: ▪ A comments and complaints register, accessible to members of public, should be implemented and maintained. Such a register would provide a formal framework within which to record any comments and complaints received, as well as to identify and action appropriate mitigation and/or remediation measures and allow for active dissemination regarding potential operational noise issues. The register should also include a means of recording and communicating the close-out of issues; ▪ Investigate noise complaints immediately and where warranted undertake monitoring and investigate corrective actions; ▪ Preference for low noise equipment during procurement and use of low noise equipment where possible; ▪ All equipment to be maintained in good working order and regularly inspected for unnecessarily loud noise emissions and replaced or repaired in such cases.									
Operational Noise Impacts Post-Mitigation									
Noise generated by facility infrastructure and operations	With Mitigation	**1**	**1**	**4**	**2**	**3**	**Low**	**(-)**	**D**

9.4. Typical Noise Management Measures

Several conservative assumptions were implicit in the modelling study and have resulted in a 'Low' impact significance. Despite the low impact rating a number of mitigation measures have been provided below and should be considered:

- A comments and complaints register, accessible to members of public, should be implemented and maintained. Such a register would provide a formal framework within which to record any comments and complaints received, as well as to identify and action appropriate mitigation and/or remediation measures and allow for active dissemination regarding potential operational noise issues. The register should also include a means of recording and communicating the close-out of issues;
- Investigate noise complaints immediately and where warranted undertake monitoring and investigate corrective actions;
- Preference for low noise equipment during procurement and use of low noise equipment;
- All equipment to be maintained in good working order and regularly inspected for unnecessarily loud noise emissions and replaced or repaired in such cases.

1 0 Conclusion and Recommendations

10.1. Scope of Project

A noise impact assessment was undertaken encompassing a baseline noise assessment and a predictive analysis of high noise-emitting equipment, for the proposed Walvis Bay Integrated Waste Management, Treatment, Transfer and Recovery Facility project, which would use a Rent-A-Drum system to collect waste, and treat multiple forms of waste and recyclables. The Project is located in Walvis Bay in the Erongo Region of Namibia.

10.2. Construction Noise Assessment

A construction noise impact assessment was conducted to determine the noise contribution anticipated from the following phases:

- Site preparation; and,
- General construction site activities.

Equipment noise levels for the various construction equipment items were obtained from BS-5228:2014 'Noise and Vibration Control on Construction and Open Sites' [1]. The assessment was used to determine Impact Intensity based on the criteria detailed in Appendix C.

Based on the construction phase assessment, the overall Impact Intensity for SRs is predicted to be *Minor* corresponding to an impact rating of '**1**'. The Reversibility, Duration and Spatial Extent are allocated a rating of '**1**', '**1**' and '**2**' leading to an Impact Consequence of '**5**' at the SRs. The Probability rating of the impact due to construction is given a rating of '**3**'. The overall Impact Significance due to Project construction is therefore anticipated to be '**Low**'.

10.3. Operations Noise Assessment

In order to estimate the operational noise level, the internationally recognised noise modelling software 'SoundPLAN' was utilised for the determination of Project noise contributions at both the Project boundary and offsite sensitive receptors.

10.3.1. Boundary Noise Assessment

A site boundary noise assessment was undertaken which resulted in modelled noise levels at the Project boundary ranging from 49.8 dB(A) to 65.5 dB(A). The limit of 70 dB(A) was calculated to have no exceedances at any of the assessed points along the plant boundary.

10.3.2. Sensitive Receptors Assessment

The operational noise assessment showed that noise contributions from the Project in isolation are not likely to exceed the IFC General EHS Noise Guideline levels for both the daytime and night-time periods.

Based on the results of the cumulative assessment, the impact Intensity for assessed SR's is determined to be Minor which corresponds to a rating of '**1**'. The Reversibility, Duration and Spatial Extent are allocated a rating of '**1**', '**4**' and '**2**' respectively, which leads to a Consequence of '**8**'. Given that the Probability is allocated a rating of '**3**', the Impact Significance is classified as '**Low**'.

References

[1] British Standards Institute (BSI), BS5228 - Noise and Vibration Control on Construction and Open Sites, London: BSI, 2014.

[2] International Finance Corporation (IFC), "Environmental, Health, and Safety (EHS) Guidelines - Noise Management," 2007.

[3] Environmental, Health, and Safety (EHS) Guidelines, *General EHS Guidelines: Environmental Noise Management,* 2007.

[4] Department of Environmental & Climate Change NSW, Interim Construction Noise Guideline, Sydney, 2009.

[5] International Organisation for Standardisation (ISO), *ISO1996-1-3 'Description and Measurement of Environmental Noise',* 2003.

[6] International Organisation for Standardisation (ISO), *ISO9613-2 'Acoustics – Attenuation of Sound During Propagation Outdoors',* 1996.

[7] International Organisation of Standards (ISO), *ISO 9613-2 Acoustics - Attentuation of Sound During Propgation Outdoors,* International Organisation of Standards (ISO), 1993.

[8] Institute of Acoustics (IoA), "IEMA/IoA Noise Impact Assessment Guidelines - Update," IoA, 2005.

[9] BSI British Standards, *BS 5228: 2009+A1: 2014 Code of practice for noise and vibration control on construction and open sites,* BSI British Standards, 2014.

[10] "International Organisation for Standardisation (ISO) 9613 'Acoustics - Attenuation of Sound During Propagation Outdoors' (ISO, 1996)".

Glossary

L_{Aeq} T: This is the continuous equivalent sound level. It is a widely used noise parameter that calculates a constant level of noise with the same energy content as the varying acoustic noise signal being measured. The letter “A” denotes that the A-weighting has been included and “eq” indicates that an equivalent level has been calculated. Hence, L_{Aeq} is the A-weighted equivalent continuous noise level. A-weighting is a filter incorporated into a sound level meter which when measuring noise replicates the sensitivity of human hearing.

LASN, T percentile levels: The level of A-weighted noise exceeded for N% of the measurement time. LAS90, T is often used as a measure of background noise in many standards and guidelines. The LAS90, T parameter would therefore represent the level exceeded for 90% of the measurement period, T. Likewise the LAS10, T would indicate the level exceeded for 10% of the measurement period, T indicating the higher noise levels measured.

Octave Band Analysis: To identify frequency components of a sound, there is octave band analysis in which frequencies are segmented into proportionate widths (octave bands) and analysed. The sound pressure level of a single octave band is called the "octave band level", while that analysed for 1/3 of the octave band is called a "1/3 octave band level". The frequency band in the octave band and 1/3 octave band is expressed as the centre frequency of that band. Using f1 and f2 as the upper and lower end frequencies of the band.

Sound Pressure Level (L_p): An acoustic measurement for the ratios of sound energy. Rated in decibels.

Sound Power Level (L_w): The Lw is a measure of the total airborne acoustic power generated by a noise source, expressed on a decibel scale referenced to a common standard (10-12 watts).

Decibel (dB): dB is a logarithmic unit of measurement that expresses the magnitude of a physical quantity (usually power or intensity) relative to a specified or implied reference level. Since it expresses a ratio of two quantities with the same unit, it is a dimensionless unit.

dB(A): The ‘A’ weighting network is very similar to the way in which the human ear responds to variations in sound pressure level as it places higher attenuation on the lower frequencies than on the mid to upper frequencies. It is applied to the decibel scale in order to account for how the human ear responds to changes in sound levels.

Appendix A – Noise Contour Plots

Noise contour maps shown in Appendix A are:

- Figure A-1 – Project Area – Normal Operating Conditions.
- Figure A-2 – Surrounding Area – Normal Operating Conditions.

Figure A-1 – Project Area – Normal Operating Conditions

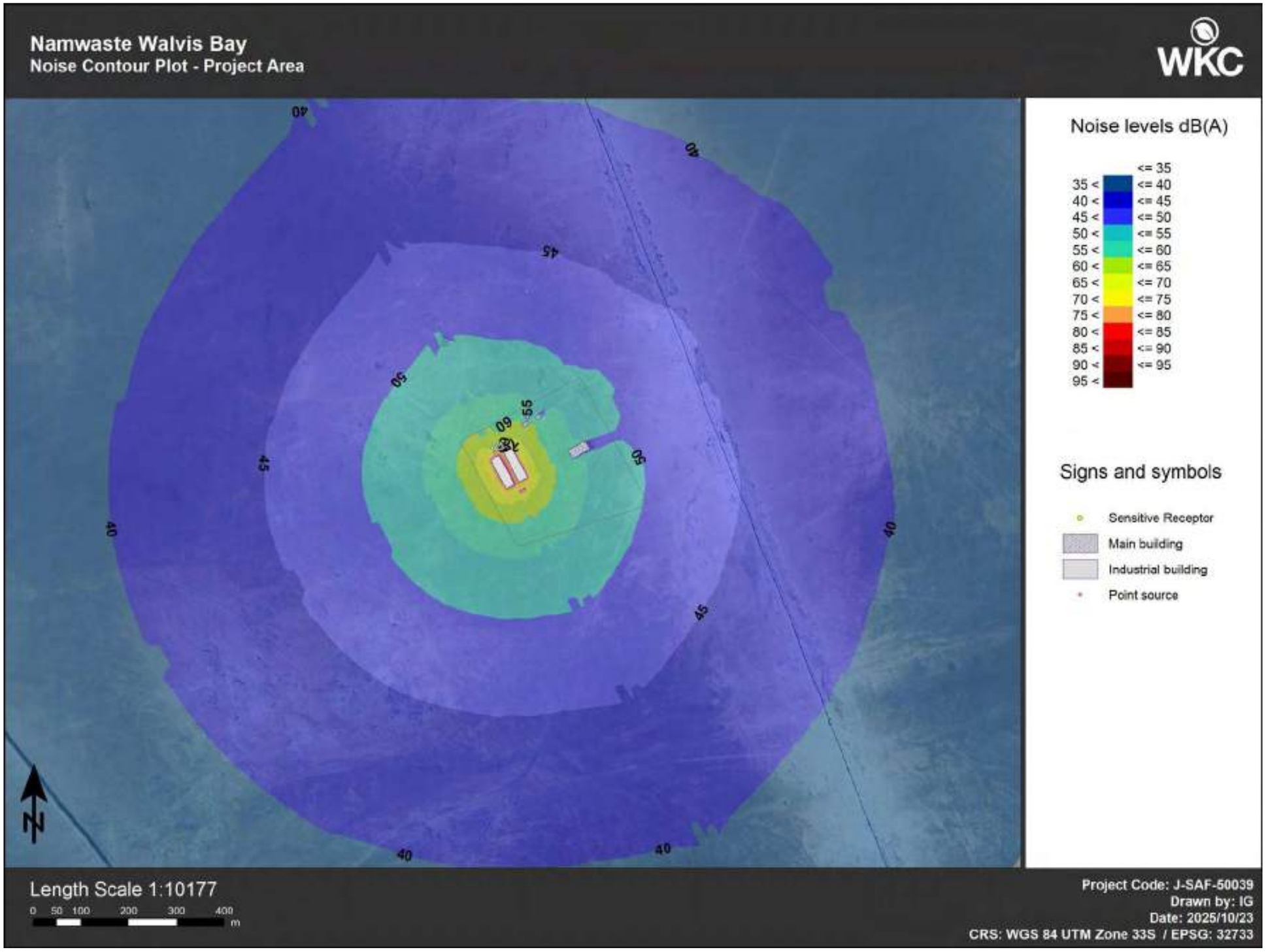
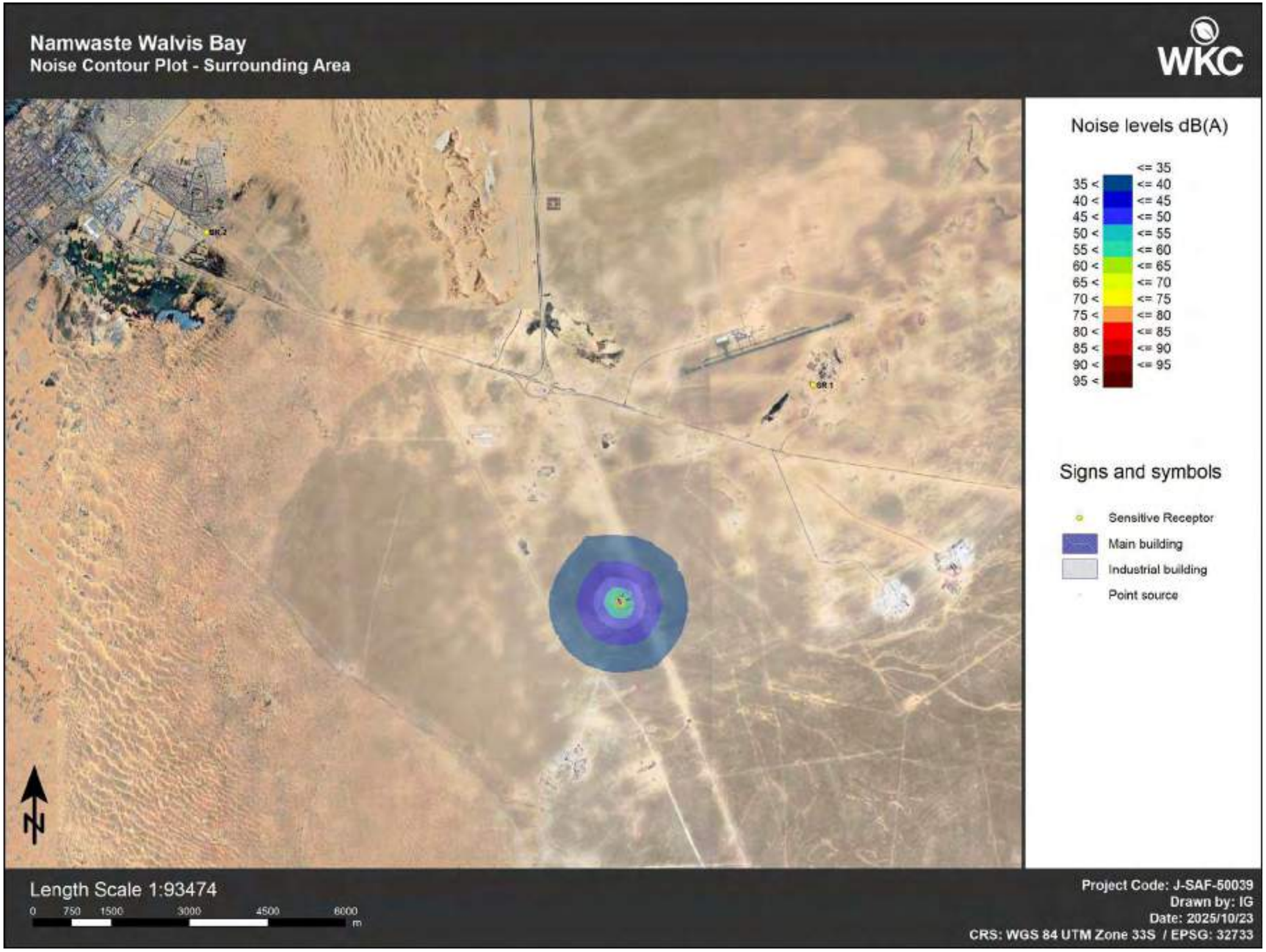


Figure A-2 – Surrounding Area – Normal Operating Conditions



Appendix B – Plant Equipment Noise Data Log

Table B-1 – Plant Equipment Noise Data Log

Building Name / Source	Source Type	Lw (dB(A))	Octave Band Central Frequency Spectrum Hz (dB(A))								Comment
			63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8kHz	
Slops Treatment	Block / Industrial Building	116.1	90.1	102.2	103.7	107.1	111.3	111.5	105.3	97.2	Assumed 85 dB(A) at 1m, Emission Spectrum from SoundPLAN Library
TCC / TDU	Block / Industrial Building	117.3	-	94.	100.0	106.6	111.5	108.0	108.9	112.7	Assumed 85 dB(A) at 1m, Emission Spectrum from SoundPLAN Library
Transformers	Point Source	74.9	51.3	63.4	65.9	71.3	68.5	64.7	59.5	50.4	Assumed 65 dB(A) at 1m, Emission Spectrum from ENC Ch11

Appendix C – KP Impact Assessment Criteria

Nature of impact	
Term	**Definition**
Positive (+)	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative (-)	An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.
Direct impact (D)	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors (e.g. between occupation of a site and the pre-existing habitats or between an effluent discharge and receiving water quality).
Indirect impact (I)	Impacts that result from other activities that are encouraged to happen as a consequence of the Project (e.g. in-migration for employment placing a demand on resources).
Cumulative impact (C)	Impacts that act together with other impacts (including those from concurrent or planned future third party activities) to affect the same resources and/or receptors as the Project.

Ranking criteria				
Severity / magnitude (M)	**Reversibility (R)**	**Duration (D)**	**Spatial extent (S)**	**Probability (P)**
5 – Very high – The impact causes the characteristics of the receiving environment/ social receptor to be altered by a factor of 80 – 100%	**5 – Irreversible** – *Environmental* - where natural functions or ecological processes are altered to the extent that it will permanently cease. *Social* - Those affected will not be able to adapt to changes and continue to maintain-pre impact livelihoods.	**5 – Permanent** - Impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.	**5 – International** - Impacts that affect internationally important resources such as areas protected by international conventions, international waters etc.	**5 – Definite** - The impact will occur.
4 – High – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 60 – 80%		**4 – Long term** - impacts that will continue for the life of the Project, but ceases when the Project stops operating.	**4 – National** - Impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences.	**4 – High probability** – 80% likelihood that the impact will occur
3 – Moderate – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 40 – 60%	**3 – Recoverable** *Environmental* - where the affected environment is altered but natural functions and ecological processes may continue or recover with human input. *Social* - Able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support or intervention.	**3 – Medium term** - Impacts are predicted to be of medium duration (5 – 15 years)	**3 – Regional** - Impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystem.	**3 – Medium probability** – 60% likelihood that the impact will occur u
2 – Low – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 20 – 40%		**2 – Short term** - Impacts are predicted to be of short duration (0 – 5 years)	**2 – Local** - Impacts that affect an area in a radius of 2 km around the site.	**2 – Low probability** - 40% likelihood that the impact will occur
1 – Minor – The impact causes very little change to the characteristics of the receiving environment/ social receptor and the alteration is less than 20%	**1 – Reversible** *Environmental* - The impact affects the environment in such a way that natural functions and ecological processes are able to regenerate naturally. *Social* - People/ communities are able to adapt with relative ease and maintain pre-impact livelihoods.	**1 – Temporary -** Impacts are predicted to intermittent/ occasional over a short period.	**1 – Site only** - Impacts that are limited to the site boundaries.	**1 – Improbable** - 20% likelihood that the impact will occur

Consequence (severity + reversibility + duration + spatial scale) x Probability = Significance

Significance		
Score According to Impact Assessment Matrix	**Colour Scale Ratings**	
	Negative Ratings	**Positive Ratings**
Between 0 and 29 significance points indicate **Low Significance**	**Low**	**Low**
Between 30 and 59 significance points indicate **Moderate Significance**	**Moderate**	**Moderate**
60 to 100 significance points indicate **High Significance**	**High**	**High**

Appendix D – Instrument Calibration Certificates

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Certificate of Calibration

ANSI National Accreditation Board (ANAB) is a member of the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Agreement (MRA). This arrangement allows for the mutual recognition of technical test and calibration data by the member accreditation bodies worldwide. For more information on the arrangement please consult www.ilac.org. The accuracies of all measurements were traceable to the SI (International System of Units) through NIST, NMISA, PTB or International Measuring Standards, unless otherwise noted. The uncertainties of measurement were estimated for a coverage factor of k=2 which approximates to a 95% confidence level.

American Standard Calibration Laboratory
Measurement Science Laboratory

Certificate No	LS1456	As Found/As Left	Rev 0	
Manufacturer	Casella			
Description	Sound Level Meter; Microphone			
Model No	CEL-490; CEL-496; CEL251			
Serial No	429016; 004010; 03483			
Plant No	None			
Calibrated for	WKC Group (Pty) Ltd			
Address	Not provided			
Temperature	23.7 °C ± 2 °C			
Relative humidity	64.2 % rh ± 5 % rh			
Barometric Pressure	856 mbar ± 5 mbar			
Date of calibration	24 January 2024			
Expiry date	23 January 2025	Issue Date	24 January 2024	
Calibrated by				

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Technical Signatory

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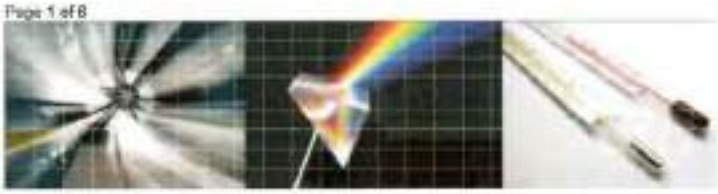

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Certificate No LS1469 As Found/As Left Rev 0

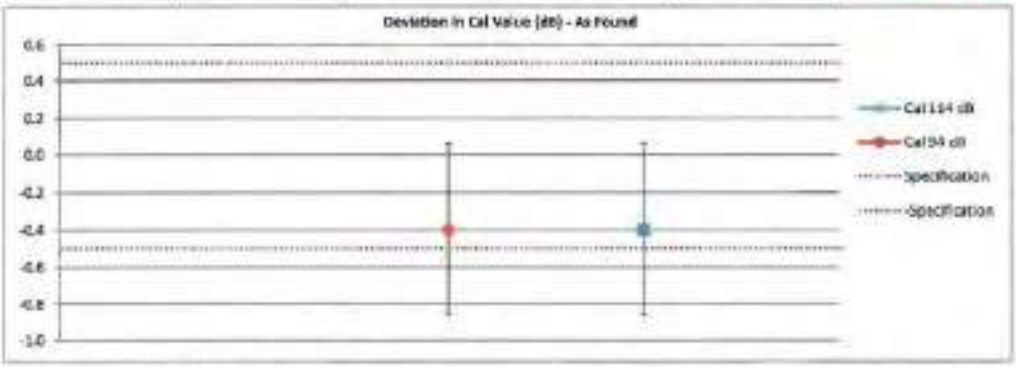
Standards and Equipment used

Description	Asset No	Cal due
Omnical Sound Level Calibrator	TS302	29 February 2024
Memory-Loc Barometer	TS088	13 November 2024

Procedure TS PL 021

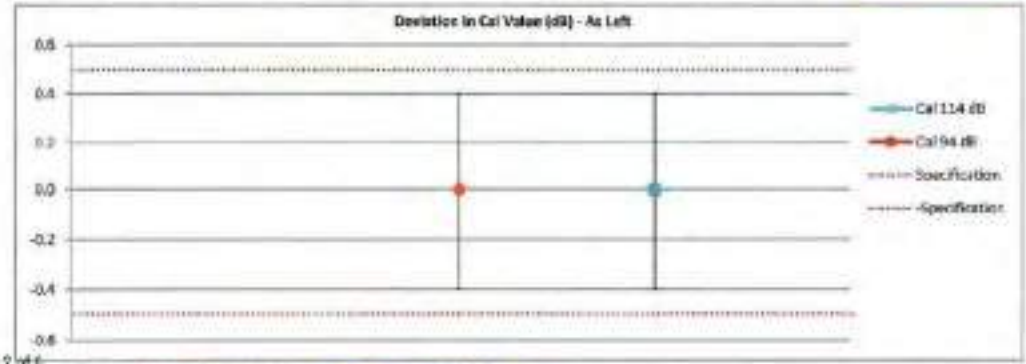
Results As Found

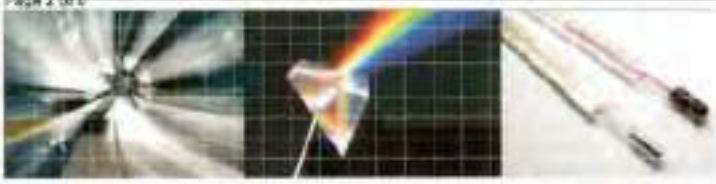
Input	Reported Value (dB)	Correction (dB)	Measurement Uncertainty (± dB)	Specification (± dB)	Conclusion
94 dB, 1 kHz	94.4	-0.4	0.5	0.5	Pass
114 dB, 1 kHz	114.4	-0.4	0.5	0.5	Pass



Results As Left

Input	Reported Value (dB)	Correction (dB)	Measurement Uncertainty (± dB)	Specification (± dB)	Conclusion
94 dB, 1 kHz	94.0	0.0	0.5	0.5	Pass
114 dB, 1 kHz	114.0	0.0	0.5	0.5	Pass





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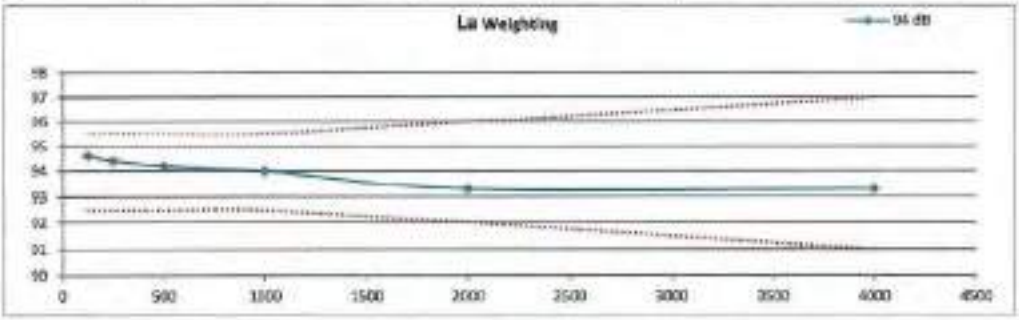
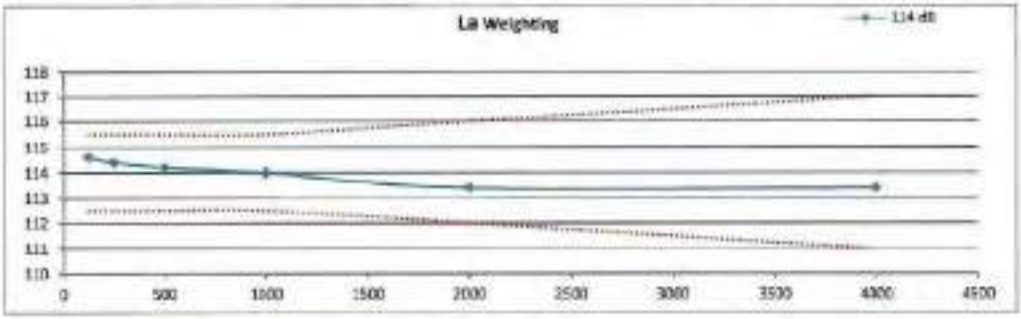
Frequency Weighting - Corrections have been applied according to IEC 61672:2013

Level Range	Weight	Response	Input	Reported Value (dB)	Measurement Uncertainty (± dB)	Specification (± dB)
0 - 140 dB	La	Slow	94 dB, 125 Hz	94.5	0.5	1.5
		Slow	94 dB, 250 Hz	94.4	0.5	1.5
		Slow	94 dB, 500 Hz	94.2	0.5	1.5
		Slow	94 dB, 1 kHz	94.0	0.5	1.5
		Slow	94 dB, 2 kHz	93.3	0.5	2.0
		Slow	94 dB, 4 kHz	93.3	0.6	3.0



Frequency Weighting - Corrections have been applied according to IEC 61672:2013

Level Range	Weight	Response	Input	Reported Value (dB)	Measurement Uncertainty (± dB)	Specification (± dB)
0 - 140 dB	La	Slow	114 dB, 125 Hz	114.5	0.4	1.5
		Slow	114 dB, 250 Hz	114.4	0.4	1.5
		Slow	114 dB, 500 Hz	114.2	0.4	1.5
		Slow	114 dB, 1 kHz	114.0	0.4	1.5
		Slow	114 dB, 2 kHz	113.4	0.4	2.0
		Slow	114 dB, 4 kHz	113.4	0.6	3.0



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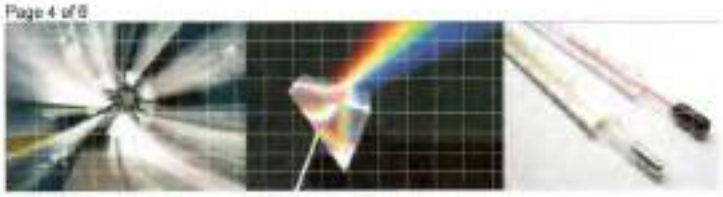
SPL Accuracy

Level Range	Weight	Response	Input	Reported Value (dB)	Measurement Uncertainty (± dB)	Specification (± dB)	Correction (dB)
0 - 140 dB	La	Fast	74 dB, 1 kHz	74.0	0.5	0.5	0.0
		Slow	74 dB, 1 kHz	74.0	0.5	0.5	0.0
		Impulse	74 dB, 1 kHz	74.0	0.5	0.5	0.0
	Lc	Fast	74 dB, 1 kHz	77.5	0.5	0.5	-3.5
		Slow	74 dB, 1 kHz	77.0	0.5	0.5	-3.0
		Impulse	74 dB, 1 kHz	77.5	0.5	0.5	-3.5
0 - 140 dB	La	Fast	84 dB, 1 kHz	84.0	0.5	0.5	0.0
		Slow	84 dB, 1 kHz	84.0	0.5	0.5	0.0
		Impulse	84 dB, 1 kHz	84.0	0.5	0.5	0.0
	Lc	Fast	84 dB, 1 kHz	84.5	0.5	0.5	-0.5
		Slow	84 dB, 1 kHz	84.5	0.5	0.5	-0.5
		Impulse	84 dB, 1 kHz	84.5	0.5	0.5	-0.5
0 - 140 dB	La	Fast	94 dB, 1 kHz	94.0	0.5	0.5	0.0
		Slow	94 dB, 1 kHz	94.0	0.5	0.5	0.0
		Impulse	94 dB, 1 kHz	94.0	0.5	0.5	0.0
	Lc	Fast	94 dB, 1 kHz	94.0	0.5	0.5	0.0
		Slow	94 dB, 1 kHz	94.0	0.5	0.5	0.0
		Impulse	94 dB, 1 kHz	94.0	0.5	0.5	0.0
0 - 140 dB	La	Fast	104 dB, 1 kHz	104.0	0.5	0.0	0.0
		Slow	104 dB, 1 kHz	104.0	0.5	0.0	0.0
		Impulse	104 dB, 1 kHz	104.0	0.5	0.0	0.0
	Lc	Fast	104 dB, 1 kHz	104.0	0.5	0.0	0.0
		Slow	104 dB, 1 kHz	104.0	0.5	0.0	0.0
		Impulse	104 dB, 1 kHz	104.0	0.5	0.0	0.0
0 - 140 dB	La	Fast	114 dB, 1 kHz	114.0	0.4	0.0	0.0
		Slow	114 dB, 1 kHz	114.0	0.4	0.0	0.0
		Impulse	114 dB, 1 kHz	114.0	0.4	0.0	0.0
	Lc	Fast	114 dB, 1 kHz	114.0	0.4	0.0	0.0
		Slow	114 dB, 1 kHz	114.0	0.4	0.0	0.0
		Impulse	114 dB, 1 kHz	114.0	0.4	0.0	0.0

Page 4 of 6



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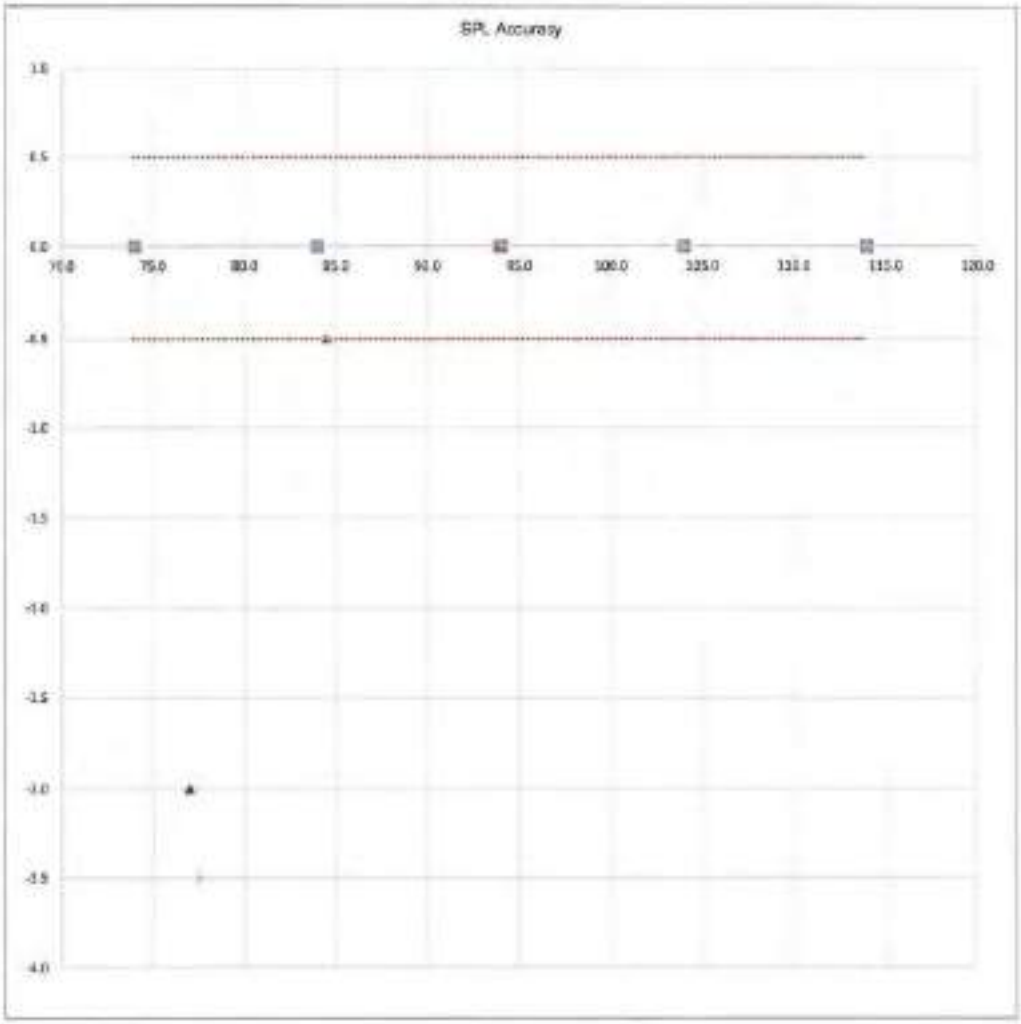

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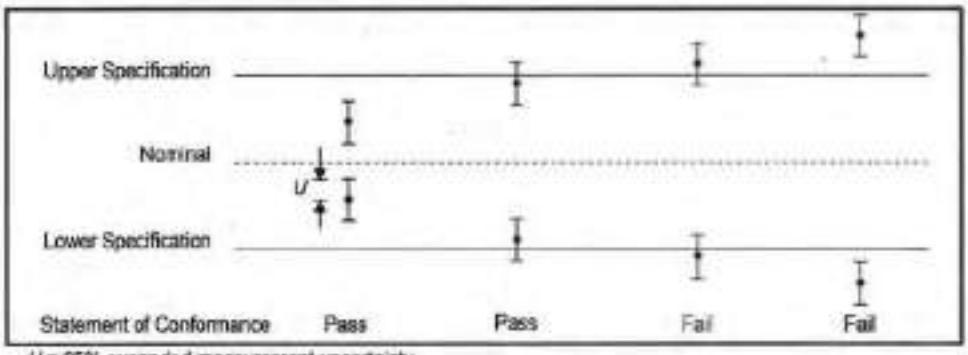
Compliance with Specifications - ILAC-G8:09/2019

The laboratory implements the shared risk approach as defined in ILAC-G8:09/2019, Section 4.2.1 - Binary Statement for Simple Acceptance Rule (w = 0) when making statements of conformity.

Statements of conformity are reported as:

Pass - the measured value is within the specification.
Fail - the measured value is outside the specification.



U = 95% expanded measurement uncertainty

Status	Instrument Received With Battery Cover Clip Broken.
Comments	The correction must be algebraically added to the UUT reading to obtain the correct value. Instrument Adjusted As Per Manufacturers Adjustment Procedure.

End of Calibration Data

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ANNEXURE H – HYDROGEOLOGY IMPACT ASSESSMENT

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WI306-00033/01-A
WI24-00243

PROPOSED WASTE MANAGEMENT FACILITY IN WALVIS BAY

HYDROGEOLOGY SPECIALIST STUDY

Rev	Description	Date
A	Issued in Final	01/15/2026

Knight Piésold CONSULTING

EXECUTIVE SUMMARY

Namwaste (Pty) Ltd appointed Knight Piésold Pty Ltd (KP) to undertake a groundwater field investigation for the proposed development of a Waste Management Facility in Walvis Bay, Erongo Region, Namibia. The groundwater investigation forms part of the Environmental Impact Assessment Report for the proposed waste management facility, which aims to obtain an Environmental Clearance Certificate for the waste facility's development.

The approach followed by KP included a geophysical survey to locate possible drilling targets, followed by air percussion drilling and the construction of three (3) monitoring boreholes (WBBH1, WBBH3, and WBBH4). The outcome of the drilling program produced two with seepage (WBBH12 and WBBH3), while WBBH4 was completely dry. The boreholes will be used to monitor any potential pollution plumes or aquifer contamination. If the contamination plume migrates off site, additional boreholes will be needed to intercept and abstract the contamination as the yields of the existing boreholes are too low to act as abstraction boreholes.

Groundwater samples from boreholes WBBH1 and WBBH3 and the seawater sample were collected at the end of the drilling phase. These samples were submitted to the laboratory for chemical analysis. When compared to the Namibian water quality standards as defined in the Namibian Water Act and Guidelines of 2013, the samples' element concentrations exceed the acceptable limits for sodium, potassium, magnesium, and sulphate. The concentrations exceed the acceptable limit for chloride, fluoride, and nitrate. The elevated concentrations of potassium and sulphate may relate to potential potash (Potassium Sulphate) deposits in the area, which are highly soluble and dissolve rapidly and entirely in water.

The groundwater samples also recorded an LSI value of >0, indicating that these samples are supersaturated with calcium carbonate, and scale forming will occur inside pipelines without suitable treatment.

The site is covered by a thin veneer of gypsisol (type of soil) and quaternary deposits comprising sand (alluvial/colluvial), underlain by fractured and folded gneiss lithologies. The geophysical survey results showed varying depths of weathering and delineated a NE-SW striking fault.

The weathered profile proved unsaturated based on the results of the drilling program and is not considered a sustainable aquifer. The main aquifer identified in this area is the fractured rock aquifer associated with the migmatites, where the groundwater is predominantly governed by secondary porosity formed by intrusion of the granites into the host rock, and flows through structures and fractures that act as preferential groundwater flow pathways.

Groundwater levels recorded in the boreholes drilled in this area range between 20.6 m in borehole WBBH1, where seepage was intercepted at approximately 50 m depth, suggesting confined conditions in the aquifer. No groundwater strikes were recorded in WBBH3, but slow seepage into the borehole caused the groundwater level to rise over time to 50.3 mbgl. No groundwater was intercepted in, or seeped into WBBH4. The groundwater flow is expected to follow this area's natural topography and drainage patterns and flow towards the Atlantic Ocean to the west-northwest. The flow will be directed through structures that act as preferential groundwater flow paths, likely taking advantage of the NW-SE thrust faults. The flow against the NE-SW trending fold axes will be limited, and flow will occur along the strike but will change direction when it flows along the NW-SE structure.

The aquifer around the NamWaste Waste Management site is classified as a **non-aquifer system** with a **low vulnerability**, according to the DWS classification system (1998). This is defined as an aquifer occurring in fractured or potentially fractured rocks that do not have a high primary permeability (Parsons, 1995).

A risk assessment identified medium to low risks to the groundwater resource by the facility, mainly in the form of seepage from waste storage and oil spillage from the transportation of waste. Mitigation measures must be implemented to ensure that impacts on the groundwater resource are minimised during the site's construction and operational phases. These measures include using suitable foundations with built-in seepage and run-off controls, installing oil and silt traps, and ensuring that spillage clean-up equipment is on hand. A monitoring plan must be implemented at the project site to ensure that any seepage from the proposed facilities is identified and managed.

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ABBREVIATIONS

CDT	Constant Discharge Test
m^3/hr	Cubic metres per hour
DAFU	Dissolved Air Flotation Unit
ERI	Electrical Resistivity Tomography
FAO	Food and Agriculture Organization of the United Nations
K	Hydraulic Conductivity
KP	Knight Piésold
L	Litres
mm	Millimetres
m/day	Metres per day
m/s	Metres per second
m^2/day	Metres squared per day
mm/yr	Millimetres per year
MRF	Material recovery facility
NATIS	National Administration Traffic Information System
S	Storage coefficient
T	Transmissivity
TCC	Thermo-mechanical cuttings cleaner

1.0 INTRODUCTION

1.1 PROJECT BACKGROUND

Rent-A-Drum (Pty) Ltd (Rent-A-Drum) has operated in the Namibian waste management sector for 36 years. The Rent-A-Drum Group was acquired by the Séché Environnement Group in 2023. The Séché Environnement Group owns a majority stake in the Rent-A-Drum Group, of which Namwaste (Pty) Ltd (Namwaste) is a subsidiary.

The Séché Environnement Group, an established French-owned company that has operated for 40 years and operates in 16 countries worldwide, is a major player in the circular economy and waste management, decontamination, and emergency environmental services sector. The Rent-A-Drum Group offers integrated waste management solutions and has an operational footprint in 6 of Namibia's 14 regions, serving over 2,000 customers and employing approximately 450 full-time staff members.

The project applicant is Namwaste (Pty) Ltd, established in 2023. The company aims to develop new Namibian industrial waste treatment and disposal facilities. These facilities will address the pressing shortage of solutions for Namibia's industrial and waste management, protect the environment, create employment opportunities and foster economic growth.

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

1.2 OBJECTIVE AND SCOPE OF WORK

The following tasks have been undertaken and included in this study to meet the objectives:

- Hydrocensus to identify groundwater users in the area as well as the hydrogeological features
- A geophysical survey to identify possible drilling targets for the monitoring boreholes.
- Drilling and construction of three (3) boreholes.
- Aquifer testing (pumping test) to evaluate hydraulic coefficients.
- Conducting a risk assessment to identify impacts and mitigations.
- Development of a conceptual groundwater model for the current hydrogeological conditions at the site.

2.0 SITE DESCRIPTION

2.1.1 PROJECT ACTIVITIES

The type of activities and waste planned to be treated or stored on the Walvis Bay site that are to be considered for groundwater impacts include:

- Treatment of cuttings and mud and recovery of hydrocarbons using a Thermo-mechanical Cuttings Cleaner (TCC) or a Thermal Desorption Unit (TDU);
- Treatment of slops in a slops treatment unit (mainly a centrifuge);
- Discharge of treated effluent into the evaporation ponds or the municipal wastewater treatment works; Storage of cuttings and slops in suitable, bunded containment facilities;
- Temporary storage of waste (solid and liquid) in suitable, bunded containment facilities;
- Tank and skip washing.

2.1.2 LAYOUT

The project will be comprised of an integrated waste management facility and yard tailored for the transfer and treatment of oil and gas waste, with the following ancillary infrastructure:

- Truck depot and bin yard
- Stormwater/run-off management infrastructure
- Evaporation ponds with a combined surface area of 17 000 m^2.
- Plant/Vehicle wash bay
- Analytical Laboratory
- Access road of approximately 1.2 km
- Access control facilities and perimeter fencing
- Weighbridges and control room
- Fuel storage facilities with a capacity of 23 000 litres
- NamPower connection point and backup generators
- Water connection point and water storage tank with a capacity of 200 m^3
- Camp for approximately 50 – 100 employees
- Offices and administrative buildings

Additional features include ablutions, accommodation camps, workshops, sewage management facilities, etc. The preliminary layout is indicated in Figure 2-1.

Figure 2-1: Namwaste Proposed Waste Facility

3.0 REGIONAL SETTING

3.1 LOCATION

Walvis Bay is a small port town on the Atlantic Ocean in the Erongo region of southern Namibia. Walvis Bay town is located just north of the Tropic of Capricorn in the Kuiseb River Delta and lies at the end of the TransNamib Railway to Windhoek, and on the B2 road. Besides being an export terminal for certain products, fishing and salt production are also of economic importance. The proposed site is located on Portion 160 of Remainder of Farm 38, ESE of Walvis Bay and approximately 20 km from the Port entrance. The nearest residential housing stands exist approximately 15 km WNW of the site. The area comprises a mix of exposed rock and sandy ground, with limited vegetation consistent with the surrounding landscape.

3.2 TOPOGRAPHY AND HYDROLOGY

The site is in a low-lying topographical area, generally flat and sloping towards the west. Tributaries drain the region from the Kuiseb River Basin System (Khuiseb Catchment), which follows the surface topography flowing westerly into the Atlantic Ocean. Satel Remote Topography Mission (SRTM) data show that the elevation ranges between 71 and 77 meters above mean sea level (mamsl).

No tributaries or drainage channels are found on and near the project site. Figure 3-1 below displays the project area's topography.

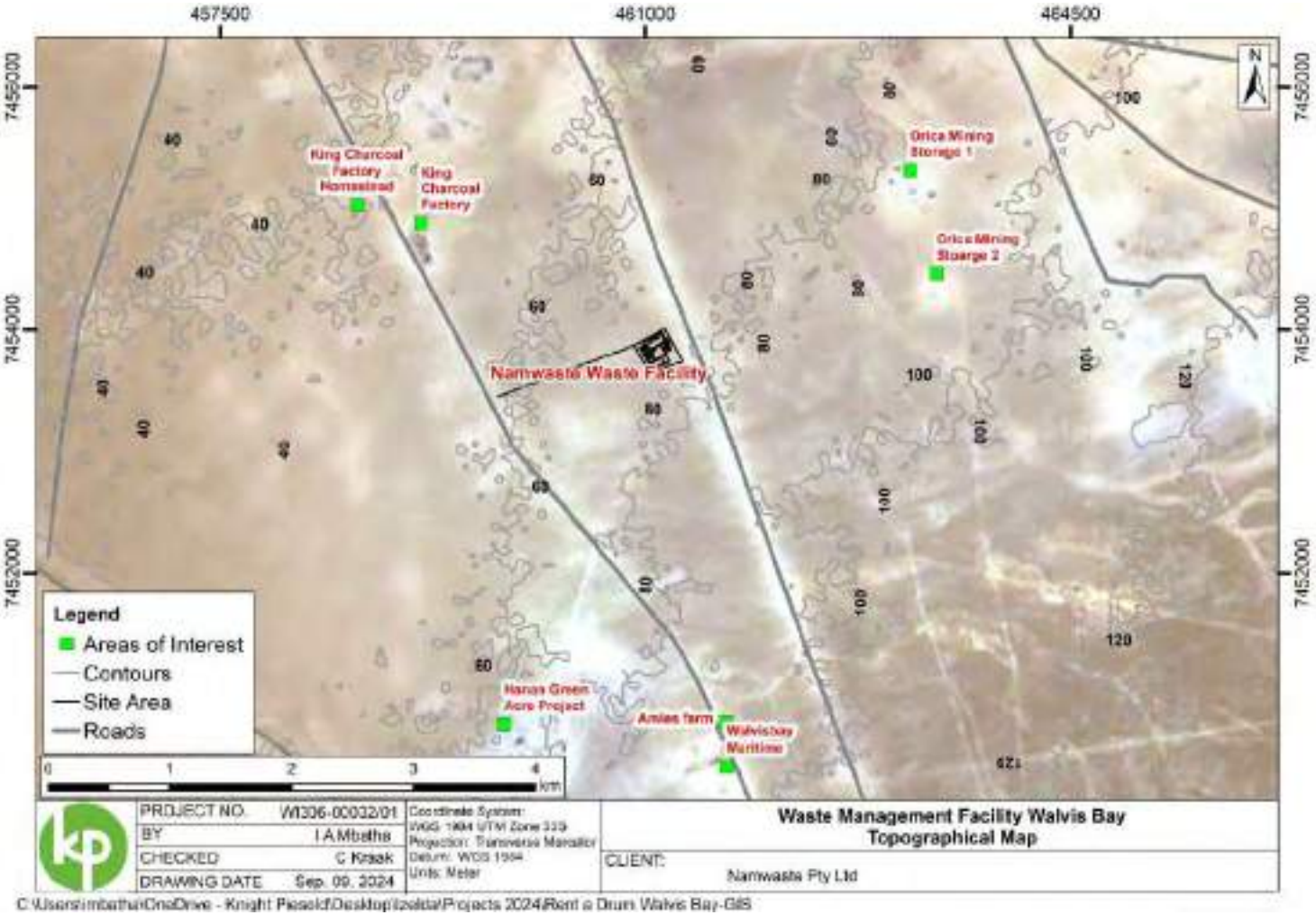


Figure 3-1: Topographical Map of the project area

3.3 VEGETATION

The specific project area exhibits minimal vegetation, and much of the surface is unvegetated. The local plant species primarily depend on fog for their water supply. The landscape is partly exposed rock and sandy lands with little established vegetation, typical of the surrounding environment.

3.4 CLIMATE

The climate of the central Namib Desert is characterised by predominant southwest winds originating from the quasi-stationary South Atlantic High off the southern Namibian coast. At Walvis Bay, the prevalent wind directions are from southwest to southeast almost 90% of the time. As a result of the cold Atlantic, temperatures close to the coast are moderate, the humidity is high and overcast days and foggy nights are standard. Climatically, this part is referred to as Cool Desert (ECC, 2021).

3.4.1 TEMPERATURES

Local climate information from 2018 to 2022 was retrieved from the Food and Agriculture Organization of the United Nations (FAO) Aquastat Climate information tool for this study. Figure 3-2 shows that the highest temperatures are observed between January and July 2024, while the lowest are from August to December 2024. On average, the warmest month is February, and the coolest month is August.

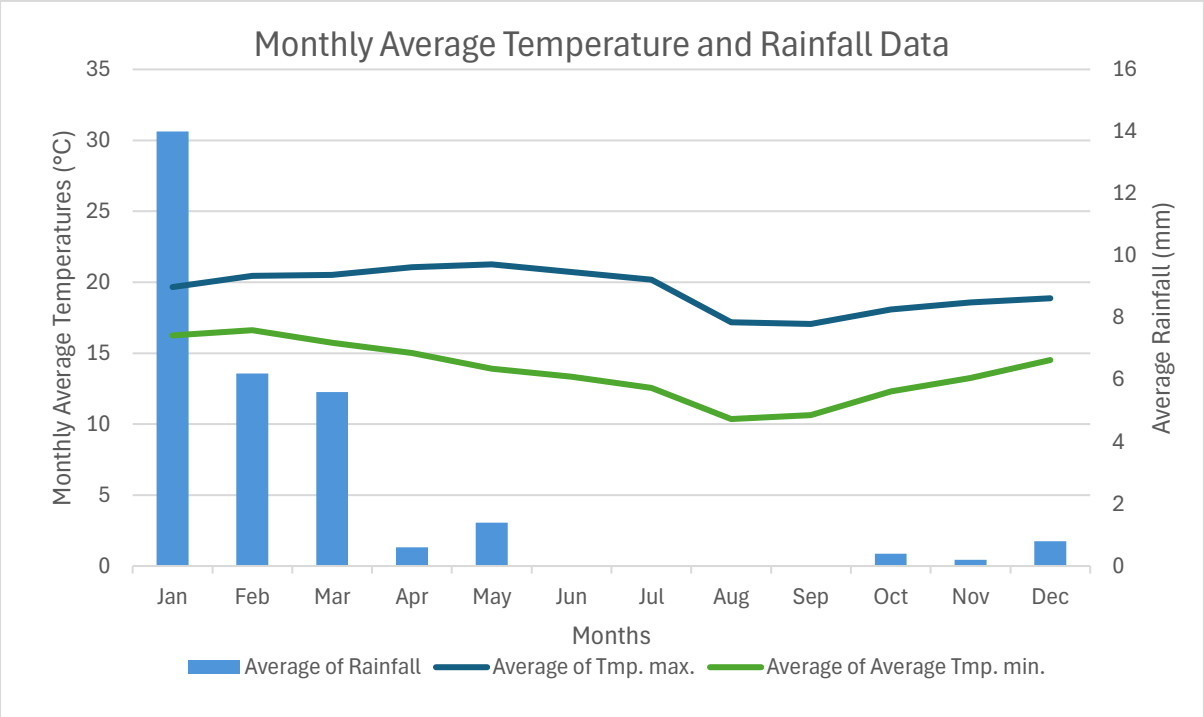


Figure 3-2: Monthly Rainfall and Temperature graph (FAO, 2018 to 2022)

3.4.2 RAINFALL AND EVAPOTRANSPIRATION

Walvis Bay is located in an area where rainfall follows seasonal trends, with the rainy season between January and March (see Figure 3-2). The rainfall and evapotranspiration data were obtained from the Food and Agriculture Organization of the United Nations (FAO) Aquastat Climate information tool for this study.

During the dry season (April to December), there is limited rainfall, with a maximum recorded value of 2 mm/yr. The rainy season (January to March) experiences precipitation levels ranging from 0 to 53 mm/yr. The average Mean Annual Precipitation (MAP) is 27 mm/yr, but can vary between dry and wet periods as indicated in Table 3-1.

The dry season's evapotranspiration ranges between 81 and 148 mm/m, and the wet season (Jan to March) ranges between 135 and 149 mm/m. The Mean Annual Evapotranspiration (MAE) is 1,326 mm/yr, with variations indicated in Table 3-1.

Based on this data, it is evident that there is a negative climatic water balance for the site. Drought conditions can last up to 7 years, resulting in little to no recharge to the region's aquifers. Therefore, groundwater use requires strict management.

Table 3-1: Rainfall and Evapotranspiration Averages between wet and dry seasons (FAO, 2018 to 2022)

Month	Avg. (2005)		Dry (2007)		Wet (2011)	
	Precipitation (mm)	EvapoT (mm)	Precipitation (mm)	EvapoT (mm)	Precipitation (mm)	EvapoT (mm)
Jan	2	149	1	148	53	124
Feb	8	136	2	126	24	125
Mar	3	135	1	144	5	130
Apr	7	92	0	120	19	104
May	1	81	0	135	7	89
Jun	1	73	0	90	0	82
Jul	0	142	0	139	1	123
Aug	1	80	0	111	3	93
Sep	1	102	0	112	1	113
Oct	2	121	1	128	1	128
Nov	1	135	1	144	2	134
Dec	1	148	2	138	2	142
Total	**27**	**1396**	**9**	**1534**	**116**	**1396**

4.0 GEOLOGY

4.1 GEOLOGY

Walvis Bay forms part of the central zone of the Damara Sequence (between 850 and 600 million years old). Schists, quartzites, meta-greywackes, marbles, and calc-silicates underlie this part of Namibia. These rocks have been intensely folded and have a local NNE/SSW strike. Part of the pre-Damaran basement, gneiss, and granite lithologies are quite common and intrude the Damara metasediments as outcrops. Karoo-age dolerite dykes also intrude on the Damara metasediments. Formations of the Damara Supergroup are covered by recent, shallow deposits of unconsolidated material, mainly of aeolian origin in the vicinity of Walvis Bay (Mendelsohn et al., 2002). These deposits form part of the central Namib sand sea. Bedrock is found at depths of more than 30m (Omamanya Geotechnical Consultants, 2020).

According to the 1:250 000 geological map of Namibia, the geology overlying the project area consists of Damara Supergroup rocks that include the Nosib Group and the intrusive granites, the Salem Granite. Mapped lithologies underlying the sediments near the site comprise granite, quartzite, and marble.

Superficial deposits of sand, gravel, and calcrete cover the land surface. Limited granite outcrops occur on-site, but those within the project boundary show intact hard rock conditions or hard rock with signs of fracturing (ASST,2024).

Gypsisol soils overlie the project site. (Mendelsohn, et al., 2002) indicated that gypsisol soils are characterised by the accumulation of calcium sulphate, which is restricted to the arid areas of Central Namib. The calcium sulphate is dissolved from the rock and soil and then carried by percolating water beneath the surface, where it remains in various forms, such as powder, pebbles, stone, or gypsum crystals.

Table 4-1 below displays the lithology units near the project area.

Table 4-1: Lithology units in the vicinity of the project area (Namib Hydrosearch, 2022)

Lithology	Geology	Lithcode	Supergroup	Group	Formation
Granite	Biotite Granite	NgSAs			Salem Granite
Quartzite	Quartzite	Net	Damara	Nosib	Etusis
Marble	Calcsilicate	NKn	Damara	Nosib	Khan
Granite	Biotite Granite	NgSAs			Salem Granite
Marble	Calcsilicate	NKn	Damara	Nosib	Khan
Quartzite	Quartzite	Net	Damara	Nosib	Etusis

4.2 STRUCTURES

During the geophysical survey, several features that relate to faults and deep weathering were identified. Known regional structures, such as the Okahandja Lineament, were also targeted during the survey. The deep weathering profile throughout is underlain by granite bedrock. The interpreted fault structure identified during the geophysical survey strikes in a northwest-southeast direction.

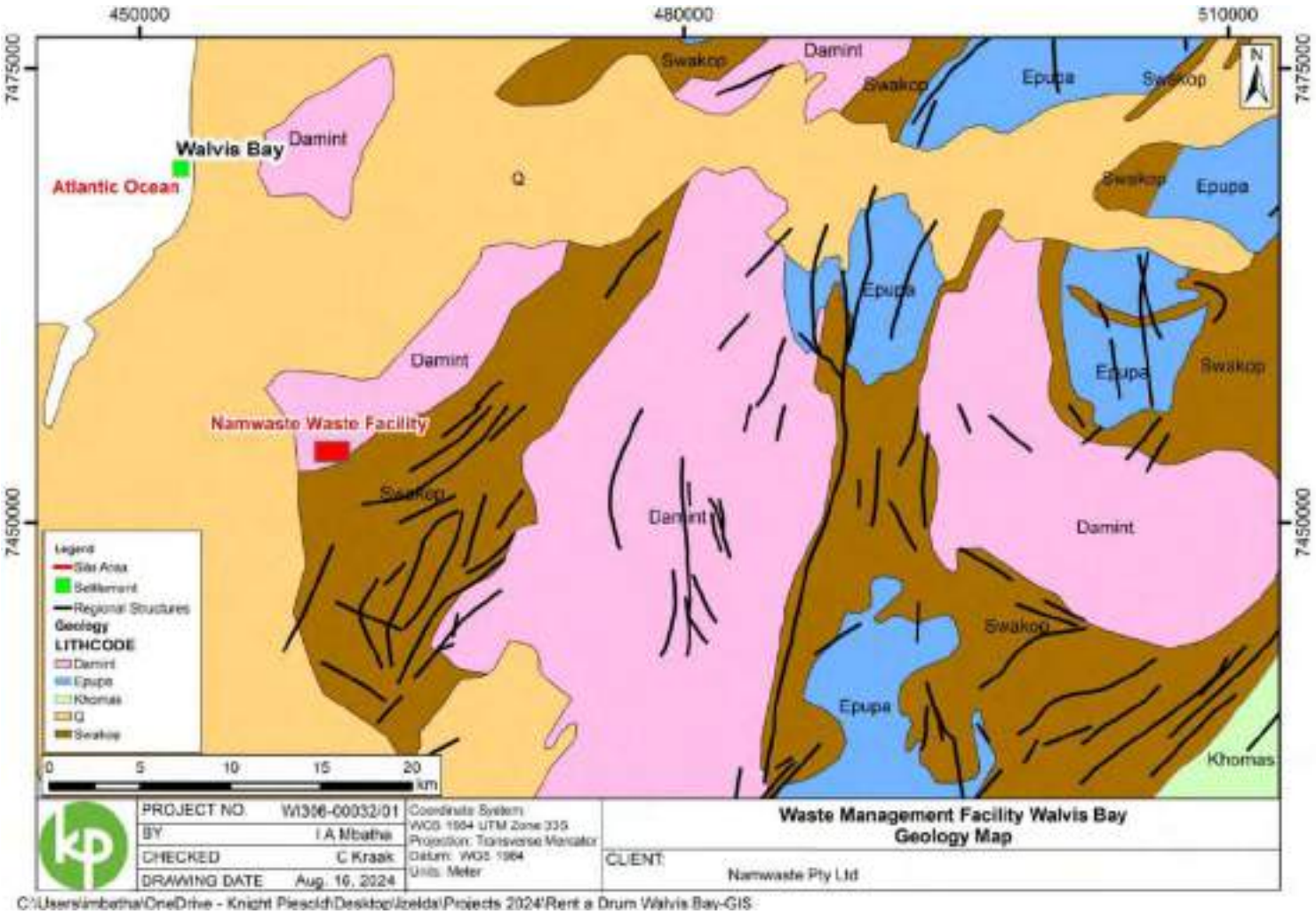


Figure 4-1: Geology Map of the project area.

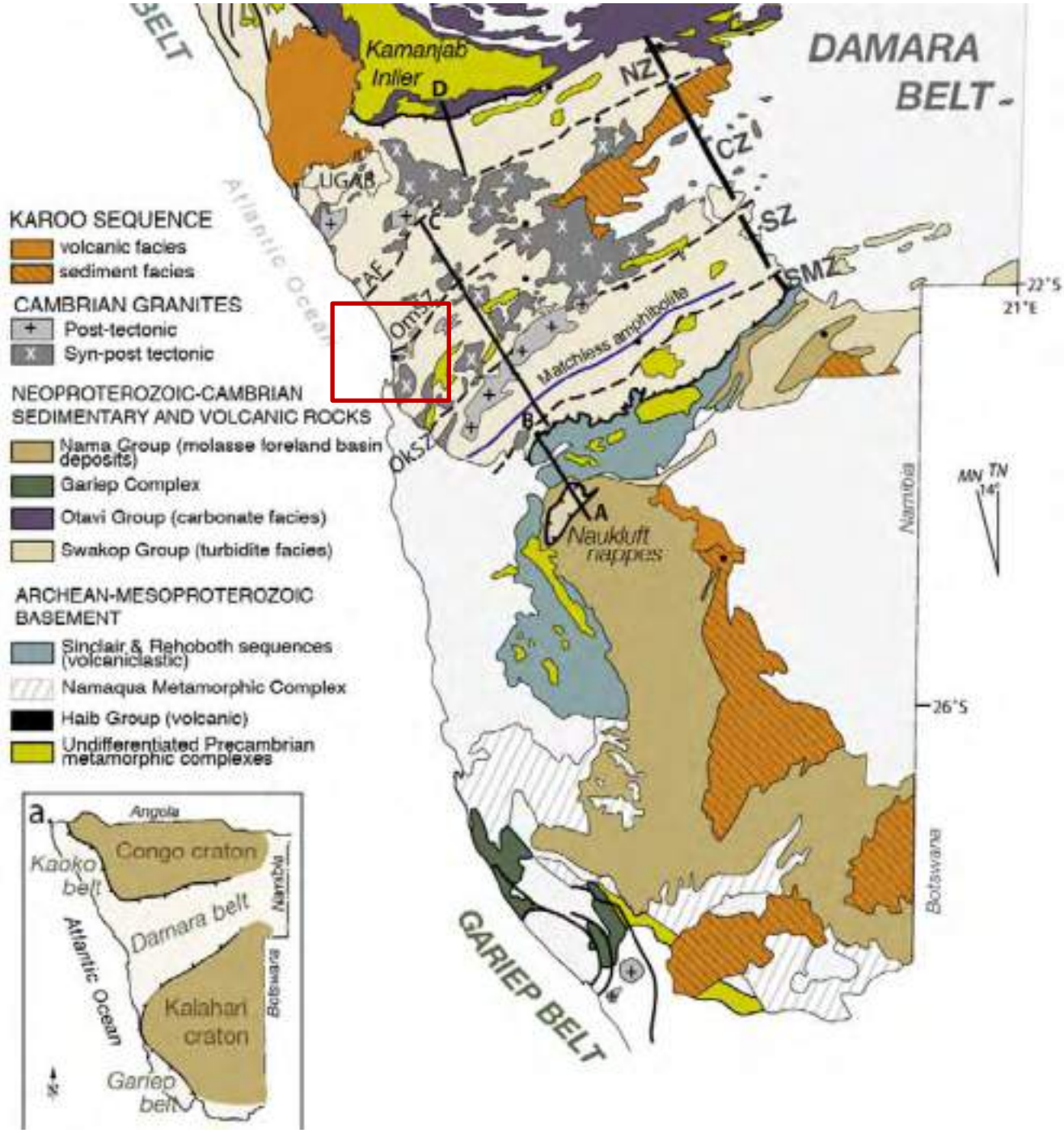


Figure 4-2: Geological Map of Namibia showing the Damara Belt (David & Ben, 2017).

5.0 FIELD INVESTIGATION

5.1 HYDROCENSUS

KP personnel conducted a comprehensive hydrocensus within a 5 km radius of the project area on the 18th and 19th of March 2024. The fieldwork encompassed identifying, surveying, and documenting borehole data within the radius of the project site, which is detailed in the Fieldwork Memo found in Annexure A. Additionally, it involved locating hydrology points, such as rivers and streams near the project area. The hydrocensus also involved identifying groundwater-related features within the proposed waste facility area.

All sites surveyed during the hydrocensus depend on water provided by the Namibian Water Corporation (NamWater) through a system of boreholes, reservoirs, and pipelines drawing from the lower Kuiseb River aquifers, located approximately 15 km from the site. No boreholes or surface water sources were found within 5 km of the project site, and no groundwater or surface water samples were collected during the hydrocensus.

5.2 GEOPHYSICAL SURVEY

Applied Scientific Services and Technologies (ASST) conducted the Electrical Resistivity Imaging (ERI) surveys from the 18th to the 20th of March 2024.

The results identified a northwest-southeast striking structure and several regions of deep weathering, which can be targeted for future monitoring of groundwater conditions on-site. Without any drill hole information during the reporting to establish a relationship between the resistivity data and the bedrock–regolith interface, the actual boundary and thickness of the weathering profile are currently unknown. It should be noted that a decrease in the resistivity values does not necessarily relate to softer soils but rather indicates an increase in minerals that causes an increase in the conductivity of the soils.

The attached field memo, Annexure A, provides the full geophysical report with the remaining sections.

5.3 GROUNDWATER BOREHOLES

Based on the geophysical survey results, three monitoring boreholes were drilled at the Walvis Bay Namwaste site. Deeper weathering areas and potential geological structures were targeted for drilling. A KP site hydrogeologist undertook drilling supervision, chip logging, and photography according to the Standard Operating Procedure (SOP) submitted to the client (Knight Piesold Consulting, 2024). The boreholes were primarily drilled using a ten-inch diameter hammer for roughly 18 m until the weathered zone was surpassed. Once fresh rock was intercepted, an eight-inch diameter hammer was used until the final depth was reached. When a water strike was intercepted, the blow yields were measured.

A summary of the drilling undertaken is presented in Table 5-1.

Table 5-1: Borehole Summary

Borehole ID	Coordinates		Dates drilled	Borehole Depth	Borehole Elevation	Water Strike	Blow Yield
	EAST UTM33S	SOUTH UTM33S		(mbs)	(m)	(mbs)	(m^3/hr)
WBBH1	461061	7453946	08th to 09th July 2024	60	80	Seepage at 50m	-
WBBH3	460993	7453778	11th to 12th July 2024	60	81	-	-
WBBH4	461221	7453849	12th to 13th July 2024	60	99	-	-

6.0 HYDROGEOLOGY

6.1 AQUIFER TYPES

The geology overlying the project area consists of Damara Supergroup rocks, including the Nosib Group and the intrusive granites, which are inherently impermeable with little or no primary porosity. Groundwater flow is predominantly in secondary features like faults and joints.

According to the Namibian hydrogeological zone map (Christelis & Struckmeier, 2011), the project is located within the hydrogeological zones with very low and limited groundwater potential. The low and limited groundwater potential can be explained by the low rainfall and the Namib Desert's aridity, which limits sufficient aquifer recharge.

The fractured zones are, however, poorer aquifers due to low connectivity between individual fractures and fracture apertures decreasing with depth. Fresh rock units are usually characterised by very low hydraulic conductivity.

6.2 GROUNDWATER LEVELS AND FLOW

A limited amount of hydrogeological research is available for the project area, and little information can be obtained from the GROWAS Borehole database. During the hydrocensus conducted by KP personnel from March 18th to 19th 2024, no boreholes were identified within the 5 km radius of the site. However, three boreholes were drilled during the drilling phase from the 08th of July to the 13th of July 2024. Groundwater strikes in were recorded during the drilling program:

- Borehole WBBH1 – Seepage was encountered at 50 m depth. Over time the groundwater level in the borehole rose to 20.3 mbgl.
- Borehole WBBH3 – No groundwater strikes were recorded. However, over time the seepage into the borehole occurred, and the depth to groundwater level was measured at 50.3 mbgl.
- Borehole WBBH4 – No groundwater strikes were recorded, and the borehole remained dry until KP personnel left the site.

The groundwater flow is expected to follow the natural topography and drainage patterns for this area, and flow towards the Atlantic Ocean to the west. The flow will be directed through structures, likely taking advantage of NW-SE thrust faults and the Okahandja Lineament.

6.3 GROUNDWATER USAGE

The town of Walvis Bay relies on groundwater extracted from the Kuiseb aquifer for their domestic and industrial use. NamWater abstracts groundwater from the shallow alluvial Kuiseb River sediments with high-capacity production boreholes at the Swartbank, Rooibank A, Rooibank B and Dorob wellfields. Presently, the entire water supply scheme is operated by NamWater (Integrated Water Resources Management Kuiseb River Basin, 1999).

There are no other identified groundwater users within the vicinity of the project area.

7.0 HYDROCHEMISTRY

Three water samples were collected at the end of the drilling phase. These included samples from boreholes WBBH1 and WBBH2 as well as a seawater sample, which were submitted to the Analytical Laboratory Services (Pty) Ltd for chemical analyses.

The results of the samples collected are reported in graphic format (Figure 7-1 to Figure 7-3) and summarised in Table 7-1. The results are compared to the water quality guidelines set in the Namibian Water Resource Management Act of 2013. As specified in Annexure 1 of the Act, the new water quality guidelines and standards for potable water only indicate limits as the ideal guidelines and acceptable standards. When the concentration of a parameter exceeds the standards set by the Water Resource Management Act, the values are highlighted in Table 7-1. The guideline values as set out in the Act are included in Figure 7-1 to Figure 7-3 for ease of reference.

7.1 MAJOR IONS AND PHYSICAL PARAMETERS

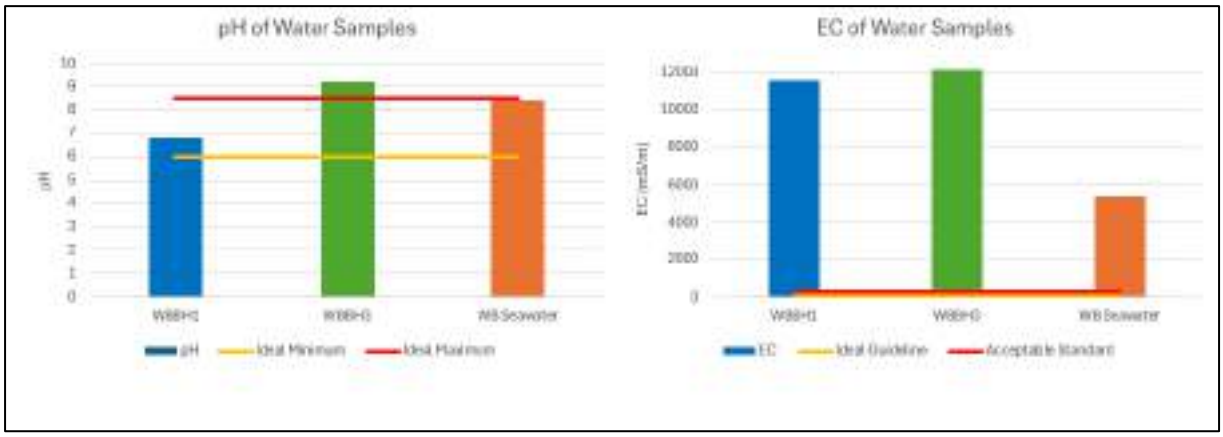
- When compared to the Namibian water quality standards, the pH ranges from neutral (6.8) to slightly alkaline (9.2) for the Walvis Bay Namwaste samples, as shown in Figure 7-1.
- The three samples' Electrical Conductivity (EC) values are 11 550, 12 110, and 5 350 milliSiemens per metre (mS/m). The acceptable standard for EC requires the sample to have an EC of less than 300 mS/m.
- 

Figure 7-1: pH-EC of Water Samples

- Figure 7-2 and Figure 7-3 show the concentrations of the major cations and anions in samples WBBH1, WBBH3 and the Seawater sample. All three samples exceed the acceptable standard set out for sodium (Na), potassium (K), magnesium (Mg) and calcium (Ca).The acceptable standards for Na, K, Mg and Ca are 300 mg/L, 100 mg/L, 70 mg/L and 150 mg/L, respectively. Weathering and dissolution of minerals like feldspar and calcite in rocks can increase these parameters' concentrations in groundwater. High concentrations of Mg and Ca can contribute to water hardness and thus lead to scale formation in pipelines.
- The measured concentrations fall above the acceptable standard for Chloride (Cl), Nitrate (NO_3) and Sulphate (SO_4). The concentrations for Chloride (Cl), Nitrate (NO_3) and Sulphate (SO_4) are

above the allowable limit, according to the standards set by the Water Resource Management Act. Elevated levels of these parameters can be due to mineral dissolution in rocks or saltwater intrusion. High nitrate concentrations within the project area could be due to high potassium nitrate concentrations from paleo lakes in an arid region.

The total and dissolved metals concentrations of the samples are measured in units of micrograms per litre (µg/L) and shown in Figure 7-1. Laboratory Results are included in Appendix B.

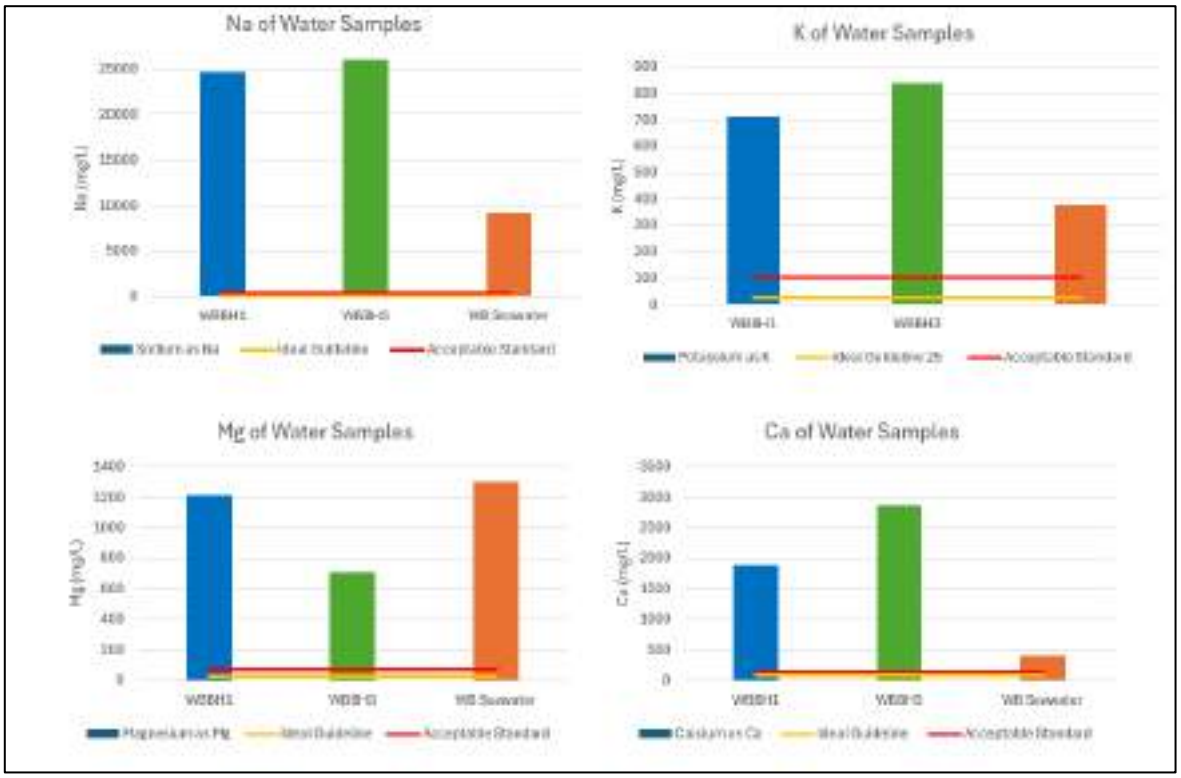


Figure 7-2: Major Cations of the Water Samples

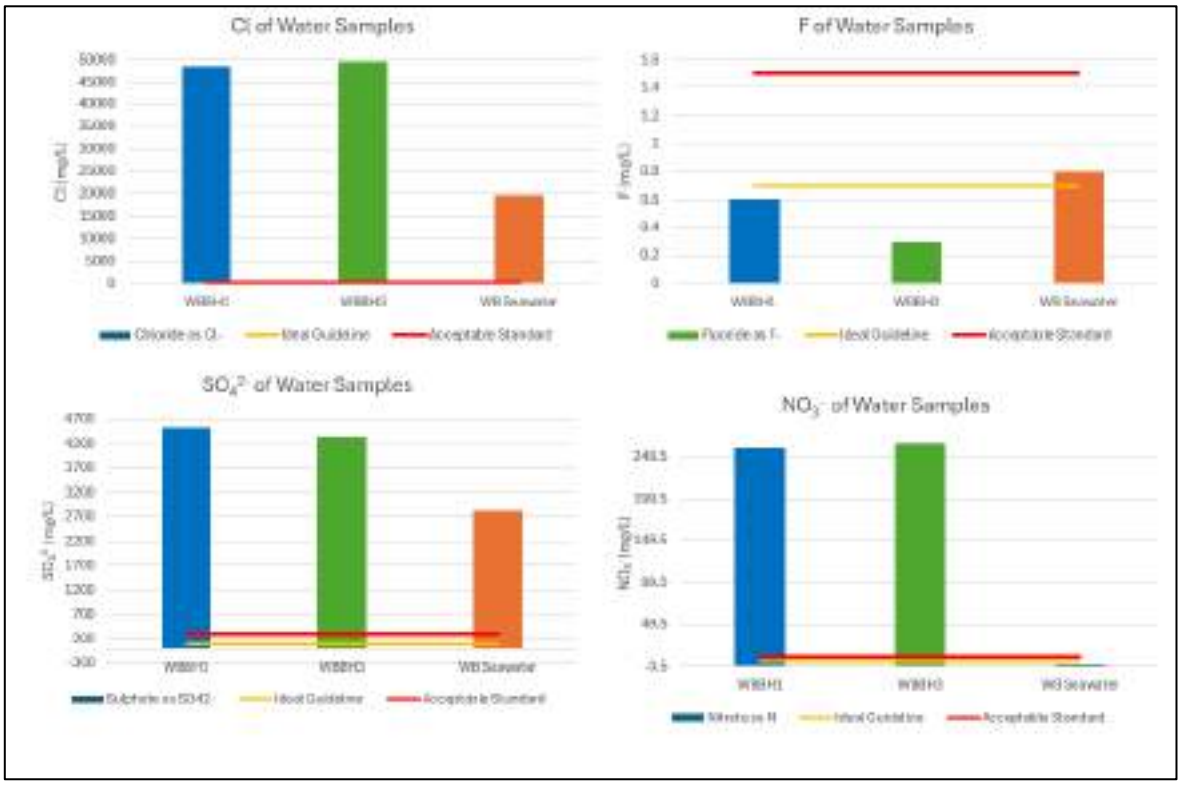


Figure 7-3: Major Anions of Water Samples

Table 7-1: Total and Dissolved Metal Concentrations of Water Samples

Parameter	Unit	Ideal Guideline	Acceptable Standard	WBBH1		WBBH3		WB Seawater	
				Total	Diss	Total	Diss	Total	Diss
Lithium as Li	µg/l			383	383	422	422	199	218
Beryllium as Be	µg/l	<2	<5	1.7	<1.0	1.9	1.8	1.5	1.4
Boron as B	mg/l	<0.3	<0.5	18.28	18.28	10.22	10.22	4.88	4.88
Strontium as Sr	mg/l			86.1	86.1	115.7	115.7	20.57	20.57
Zirconium as Zr	µg/l			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Molybdenum as Mo	µg/l			32	32	2.0	27	15	15
Cadmium as Cd	µg/l	<5	<10	3.0	3.0	<1.0	<1.0	<1.0	<1.0
Tin as Sn	µg/l	<100	<200	2.0	1.2	1.6	1.7	2.4	2.4
Antimony as Sb	µg/l	<5	<50	1.8	<1.0	<1.0	<1.0	<1.0	<1.0
Tellurium as Te	µg/l			<1.0	<1.0	1.6	<1.0	<1.0	<1.0
Barium as Ba	mg/l	0.5	<2	0.30	0.30	0.62	0.66	0.25	0.25
Lanthanum as La	µg/l			1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Tungsten as W	µg/l			29	24	26	22	26	23
Iridium as Ir	µg/l			1.5	<1.0	1.0	<1.0	<1.0	<1.0
Platinum as Pt	µg/l			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Parameter	Unit	Ideal Guideline	Acceptable Standard	WBBH1		WBBH3		WB Seawater	
				Total	Diss	Total	Diss	Total	Diss
Gold as Au	µg/l			57	<1.0	<1.0	<1.0	<1.0	<1.0
Mercury as Hg	µg/l	<1	<2	53	26	46	16	55	20
Thallium as Tl	µg/l	<5	<10	5.6	53	53	53	53	53
Lead as Pb	µg/l	<10	<50	<1.0	1.8	2.3	2.3	4.9	4.9
Bismuth as Bi	µg/l	<250	<500	11	<1.0	<1.0	<1.0	<1.0	<1.0
Thorium as Th	µg/l			11	7.9	8.6	7.8	8.2	7.9
Uranium as U	µg/l	<3	<15	495	495	150	28	33	33
Aluminium as Al	µg/l	<25	<100	264	156	164	164	229	173
Silicon as Si	mg/l			5.63	5.63	3.54	0.33	4.30	2.29
Phosphorus as P	mg/l			7.65	7.28	4.17	4.17	8.51	7.62
Sulphur as S	mg/l			1686	1686	1571	1571	1031	1027
Titanium as Ti	µg/l	<100	<300	722	722	1105	1105	195	195
Vanadium as V	µg/l	<100	<500	5.2	5.2	6.0	3.6	3.9	3.9
Chromium as Cr	µg/l	<50	<100	14	14	264	257	5.9	5.9
Manganese as Mn	µg/l	<50	<100	352	352	14	8.5	5.1	5.1
Iron as Fe	µg/l	<200	<300	131	131	236	13	225	27
Cobalt as Co	µg/l	<250	<500	2.1	1.5	<1.0	<1.0	<1.0	<1.0
Nickel as Ni	µg/l	<50	<150	10	6.9	8.0	4.3	4.6	4.6
Copper as Cu	µg/l	<500	<2000	237	225	231	203	444	203
Zinc as Zn	µg/l	<1000	<5000	110	110	39	39	196	88
Arsenic as As	µg/l	<10	<50	3.6	<1.0	2.8	2.6	5.0	1.8
Selenium as Se	µg/l	<10	<50	166	166	139	125	21	20
Ruthenium as Ru	µg/l			<1.0	<1.0	1.5	1.5	3.9	3.9
Rhodium as Rh	µg/l			2.8	2.8	3.8	3.8	2.9	2.9
Palladium as Pd	µg/l			<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Silver as Ag	µg/l			3.4	3.4	3.7	2.2	13	13

Note: Orange – Ideal Guideline; Red -Acceptable Standard

7.2 DIAGNOSTIC PLOTS

7.2.1 PIPER DIAGRAMS

The nature and change in water characteristics can best be illustrated using a Piper diagram. The Piper diagram is one of the most commonly used techniques to interpret groundwater chemistry data. This method entails plotting the major cations and anions on adjacent trilinear fields, with these points then extrapolating to a central diamond field. Here, the chemical character of water can be observed, and changes in the quality can be interpreted. The cation and anion plotting points are derived by computing the percentage equivalents for the Ca, Mg, Na, and anions Cl, SO_4, and HCO_3 diagnostic cations.

Different waters from different environments plot in diagnostic areas as described below:

- The upper half of the diamond typically contains water of dynamic regimes where ion exchange takes place and the water is relatively enriched in Mg/Ca Cl or Ca/Mg SO_4.
- The left-middle area typically indicates an area of recent recharge where little ion exchange has taken place since the recharge event occurred. Sodium chloride brines normally plot on the right-hand corner of the diamond shape.
- The lower triangle of this diamond shape suggests an area of older regimes.
- The top corner typically indicates water contaminated with gypsum (Anthropogenic and mine impacts).

The ratio of major cations and anions for Walvis Bay water samples is plotted on a Piper diagram (Figure 7-4). The following observations are made:

- All three samples (WBBH1, WBBH3, and WB Seawater) show similar dialogistic characterisations.
- Na cations and Cl anions dominate all three samples.
- All three samples plot on the right-hand corner of the diamond shape representing sodium chloride - brine water type. This is expected with the two boreholes being located close to the ocean where precipitation will be enriched in sodium chloride. The sodium chloride enriched rainfall will recharge into the aquifers, thereby increasing the concentrations in the groundwater. It should also be noted that the groundwater qualities can be impacted by saltwater intrusion from the ocean. The site is located approximately 15 km from the coast, and therefore, it is considered unlikely that the saltwater intrusion extends that far. This is supported by the lack of large-scale salt production activities around the site. The seawater sample is expected to be sodium chloride dominant.

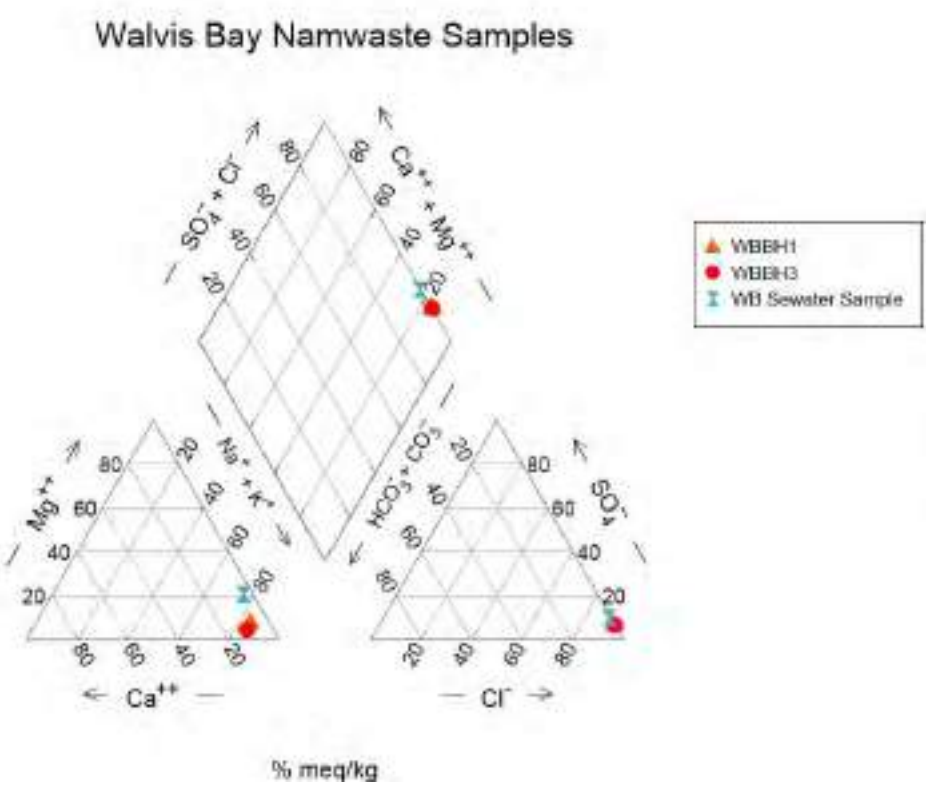


Figure 7-4: Piper Plot of Water Samples

7.3 ISOTOPE ANALYSIS

Water stable isotope analysis of deuterium (δ^2H) and oxygen ($\delta^{18}O$) is a scientific technique used to investigate the isotopic composition of water, which can reveal information about the water's source, history, and processes it has undergone. If a water sample has undergone evaporation, it becomes enriched with the heavier isotopes of deuterium and oxygen as the lighter molecules evaporate.

The Global Meteoric Water Line (GMWL) is a slope that is used to show the isotopic composition of hydrogen and oxygen isotope ratios in global precipitation and is plotted with the local meteoric water line (TLMWL) from Windhoek (Kudzai, et al., 2018). Results from the samples are plotted against these, and any deviation from the line indicates mixing or isotopic exchange with other sources (Castaňeda et al., 2012).

The water samples collected in the field included an additional sample bottle for isotope analysis. The three samples were submitted to iThemba Laboratory in South Africa for stable isotope analysis of deuterium (δ^2H) and oxygen ($\delta^{18}O$). A summary of the results is shown in Table 7-2 below. The $\delta^{18}O$ values of the samples ranged from+0.1‰ to -+1.50‰ while the δ^2H values ranged from -18.5‰ to -12.4‰ for the groundwater samples (WBBH1 and WBBH2) and +2.1‰ for the seawater. Laboratory analysis certificates are attached in Appendix C.

The results of the stable isotopes are plotted on the δ^2H vs $\delta^{18}O$ graph along with the GMWL and the TLMWL, as shown in Figure 7-5.

The following observations are noted:

- There is no active recharge within the groundwater samples.

- The groundwater is likely old, and there is interaction with rock rich in oxygen 18.

Table 7-2: Summary of the Results

Sample ID	Sample Description	δ^2H (‰)	$\delta^{18}O$ (‰)
WBBH1	2024/07/18	-18.5	+0.32
WBBH2	2024/07/18	-12.4	+1.50
Seawater Sample	2024/07/18	+2.1	+0.10

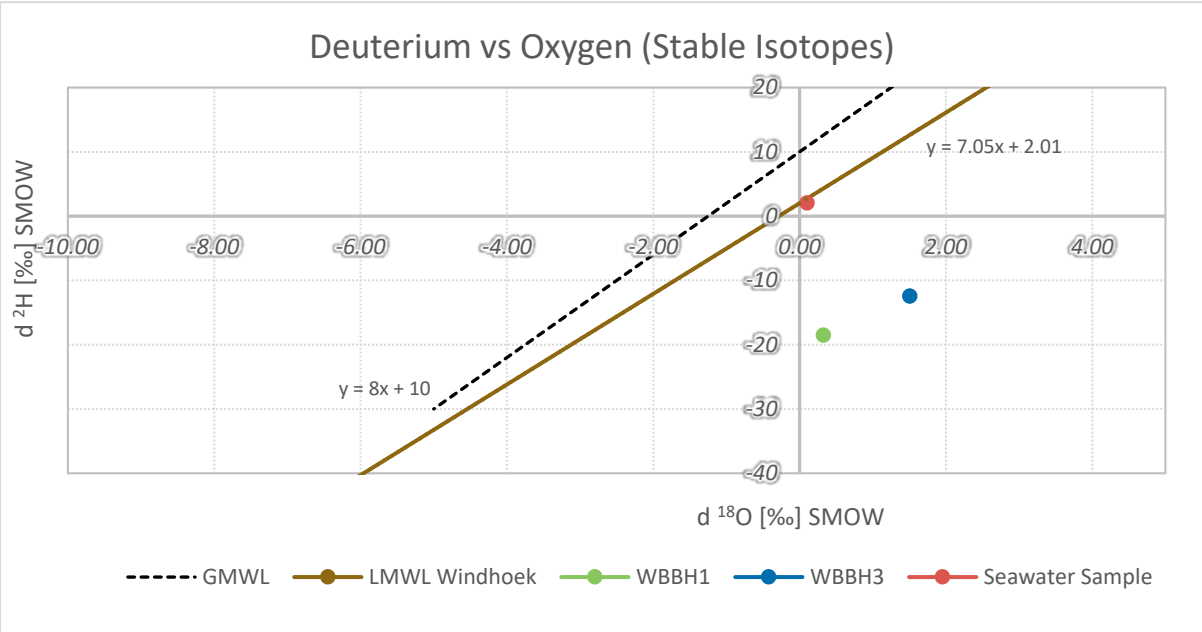


Figure 7-5: Isotope Plot for Walvis Bay Samples

7.4 LANGELIER SATURATION INDEX

The Langelier Saturation Index (LSI) is based on the study of carbonate equilibrium in water and is used as an indicator for the corrosivity of the water. The index is not related directly to corrosion but to calcium carbonate film or scale deposition. When no protective scale is formed, the water is considered aggressive, and corrosion can occur, whereas an excess of scale can also damage water systems (Langelier, 1946).

The LSI value is calculated using a sample's pH, alkalinity, calcium concentration, total dissolved solids, and water temperature (Larson & Buswell, 1942). The indications for the LSI are based on the following values:

LSI<0: Water is undersaturated with calcium carbonate. Undersaturated water tends to remove existing calcium carbonate protective coatings in pipelines and equipment.

LSI=0: Water is considered to be neutral—neither scale-forming nor scale-removing.

LSI>0: Water is supersaturated with calcium carbonate ($CaCO_3$), and scale forming may occur.

The samples taken at Walvis Bay have an LSI value of >0, indicating that these samples are supersaturated with calcium carbonate, and scale may likely form inside any pipelines (Table 7-3).

Considering the water quality assessment, using the water for processes or activities on site is not recommended.

Table 7-3: Walvis Bay water sample LSI Values.

BHID	pH	TDS (mg/L)	Ca (mg/L)	Hardness ($CaCO_3$) mg/L	Alkalinity ($CaCO_3$) mg/L	LSI
WBBH1	6.8	82,610	1885	9686	68	0.2
WBBH3	9.2	85,649	2863	10,064	75	2.8
WB Seawater	8.4	33,784	402	6365	115	1.4

0	0 to 0.5	0.5 to 2
Balanced but pitting corrosion possible	Slightly scale forming and corrosive	Scale forming but non-corrosive

8.0 AQUIFER CHARACTERISATION

8.1 AQUIFER CLASSIFICATION

The aquifer classification system used is the National Aquifer Classification System (Parsons, 1995). This flexible system can be linked to second classifications, such as a vulnerability or usage classification. (Parsons, 1995) suggests that aquifer classification is a valuable planning tool that can guide the management of groundwater issues. The South African Aquifer System Management Classification is presented by five major classes described in Table 8-1.

Table 8-1: Modified aquifer system management classification.

Aquifer Type	Description
Sole Source Aquifer System	An aquifer that is used to supply 50% or more of urban domestic water for a given area and for which there are no reasonably available alternative water sources.
Major Aquifer System	A high-yielding aquifer system of good-quality water.
Minor Aquifer System	A moderately yielding aquifer system of variable water quality.
Non-Aquifer System	A low to negligible-yielding aquifer system of moderate to poor water quality.
Special Aquifer System	An aquifer system designated as such by the South African Minister of Water and Sanitation, after due process.

The aquifer around the Walvis Bay Waste Management site is classified as a **non-aquifer system**, according to the National Aquifer Classification System. This is defined as an aquifer occurring in fractured or potentially fractured rocks that do not have a high primary permeability. The aquifer's extent is limited, and water quality is poor (Parsons, 1995).

8.2 GROUNDWATER VULNERABILITY

A second classification system was implemented to improve the decision-making, as the ability of an aquifer to yield water to a user is not adequately stated. The vulnerability of the aquifer to contamination was used to decide on the appropriate level of groundwater protection. Groundwater vulnerability was considered in terms of the DRASTIC assessment method of an aquifer's intrinsic vulnerability to contamination from the surface (Aller, Lehr, Petty, & Bennett, 1987). This method considers the factors listed in Table 8-2 which are the main aspects that control an aquifer's vulnerability to surface contamination.

Table 8-2: DRASTIC Assessment Factors

	Factor	Weights (W)	DRASTIC Rating (R)	Score
D	Depth to the water table	5	5	5
R	Recharge	4	1	9
A	Aquifer material	3	3	18
S	Soils	2	9	10
T	Topography and slope	1	10	10
I	Impact of the vadose (unsaturated) zone	5	4	20
C	Hydraulic conductivity	3	4	6
Total				**78**

Where an index is related to a degree of vulnerability.

Table 8-3: DRASTIC Calculated Vulnerability

DRASTIC Index	Vulnerability
> 155	High
155 – 100	Moderate
< 100	Low

The aquifer within the study area is calculated as having a DRASTIC index of 78 and is therefore classified as having a **"low" vulnerability** to contamination.

8.3 AQUIFER PROTECTION CLASSIFICATION

An aquifer classification system provides a framework and objective basis for identifying and setting appropriate levels of groundwater resource protection. This would facilitate the adoption of a policy of differentiated groundwater protection.

Table 8-4: Ratings for the Aquifer Quality Management Classification System

Aquifer Classification		Vulnerability	
Class	Points	Class	Points
Sole Source Aquifer System	6	Low	1
Major Aquifer System	4	Medium	2
Minor Aquifer System	2	High	3
Non-Aquifer System	0		
Special Aquifer System	0 - 6		

After rating the aquifer system management and vulnerability, the points are multiplied to obtain a Groundwater Quality Management (GQM) index (Table 8-5).

Table 8-5: Level of Groundwater Protection Required

GQM Index	Level of Protection
<1	Limited Protection
1 – 3	Low-Level Protection
4 – 6	Medium Level Protection
7 – 10	High-Level Protection
>10	Strictly Non-degradation

The above classification implies that the aquifer is considered a **non-aquifer system** with a **low vulnerability**. This, in turn, results in the aquifer having a **low susceptibility to contamination**. A **limited level of protection** to mitigate groundwater resource degradation is required.

9.0 HYDROGEOLOGICAL CONCEPTUAL MODEL

The conceptual hydrogeological model is shown in a cross-section (Figure 9-1) from northwest to southeast and includes the proposed site infrastructure. The site is in a topographical low-lying flat area sloping towards the west with an average gradient of 1:100. The annual precipitation in the region is extremely low, with areas receiving less than 27 mm/yr. Precipitation is often in the form of fog with very little ability to infiltrate into the underlying strata. Therefore, recharge to the regional aquifers is limited.

The site is covered by a thin veneer of gypsisol and quaternary deposits comprising sand (alluvial/colluvial), which is underlain by orthoclase-rich granite. The geophysical survey results showed varying depths of weathering and delineated a NNE-SSW trending structural feature that also resulted in a deeper weathering profile.

The weathered profile proved to be unsaturated based on the results from the drilling campaign and is not considered to be a sustainable aquifer. The primary aquifer identified in this area is the fractured rock aquifer associated with the granites, where the groundwater flow is predominantly governed by secondary porosity associated with fracturing of the host rock that occurred during intrusion of the granite.

Groundwater levels recorded in the boreholes drilled in this area range between 20.6 m in borehole WBBH1, and 50.3 m in borehole WBBH3. The groundwater strike in borehole WEBBH1 occurred at approximately 50 mbgl, therefore, the fact that the groundwater level in the borehole rose to 20.6 mbgl suggests that the aquifer is confined. Groundwater flow is towards the west-northwest of the project area, towards the Atlantic Ocean. The groundwater flow will be through structures that act as preferential groundwater flow pathways, likely taking advantage of NW-SE thrust faults. The flow against the NE-SW trending fold axes will be limited, and flow will divert along the strike until it intercepts a NW-SE striking structure.

The groundwater quality in the region is brackish, with high levels of TDS, EC, and Cl. When compared to the Namibian water quality standards specified in the 2013 National Water Act, all measured concentrations of the determinants exceed the acceptable limits for Sodium (Na), potassium (K), magnesium (Mg), and Sulphate (SO_4). The concentrations also exceed the acceptable limits for Chloride (Cl), Fluoride (F), and Nitrate (NO_3). The elevated concentrations of potassium and sulphate may relate to potential potash (Potassium Sulphate) deposits in the area, which are highly soluble and dissolve rapidly and entirely in water. The groundwater samples also recorded an LSI value of > 0, indicating that these samples are supersaturated with calcium carbonate, and scale forming will occur inside pipelines without suitable treatment.

The proposed infrastructure includes a stormwater/run-off management system, vehicle wash bay, fuel storage facilities, ablutions, sewage management, and administrative buildings, which could seep potential contaminants into the weathered unit and structures, which can eventually enter the deeper aquifer. Seepage from these facilities will seep through the weathered zone and be captured along the weathered-to-fresh rock interface, after which it will infiltrate through fractures to the deeper aquifer. Infiltration of precipitation is limited and would unlikely be the leading cause of the plume migration, and it would rely more on the seepage rate and flow from the point source.

Possible contaminants include hydrocarbons and sewage, and preventative measures should be implemented to mitigate any potential seepage and plume migration into the deeper aquifer, which can lead to the Atlantic Ocean through connected fractures. However, the rate of plume migration is expected to be slow and can be easily mitigated by suitable liners and appropriate bundling of storage facilities.

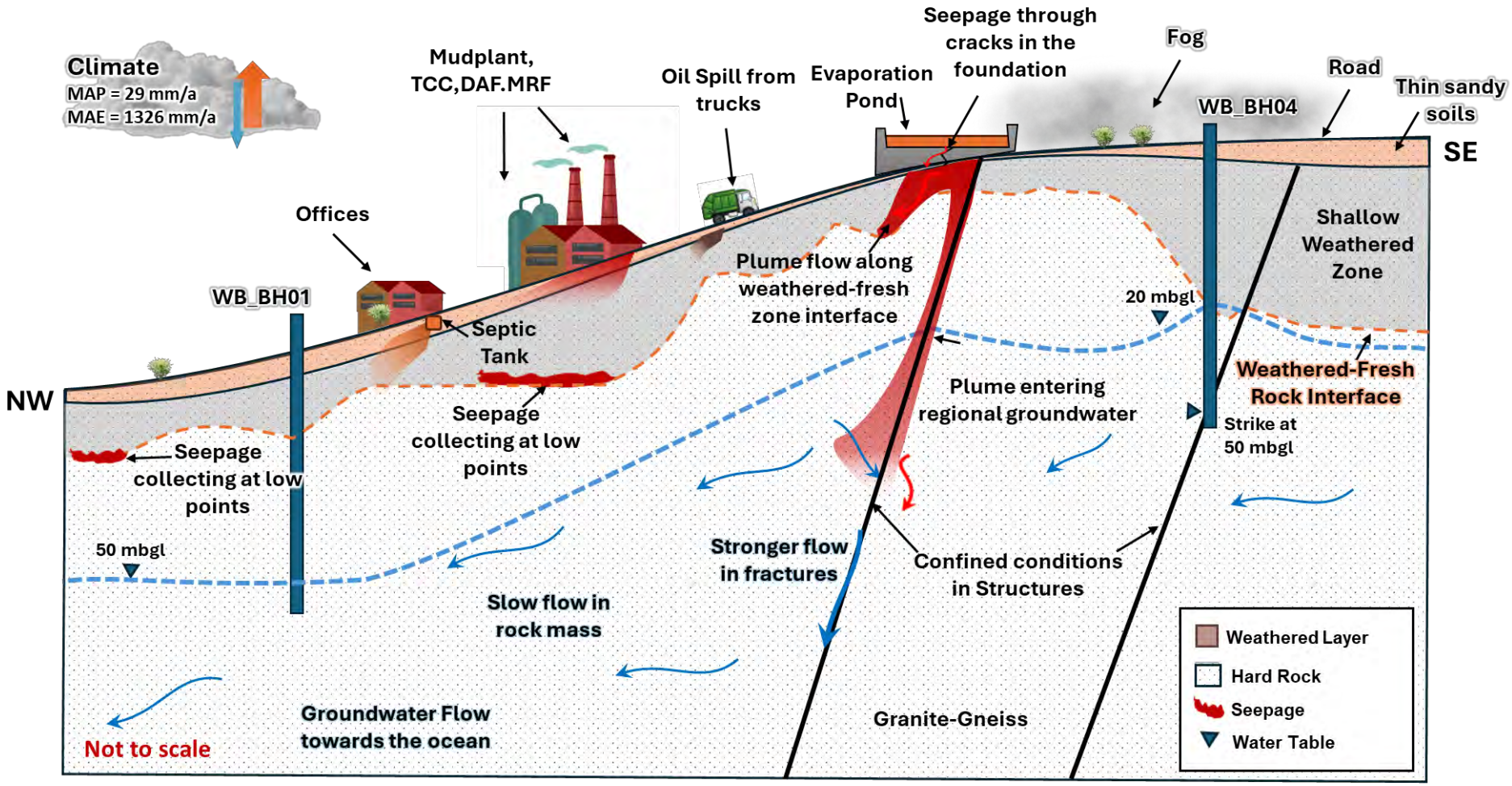


Figure 9-1: Walvis Base Waste Facility Conceptual Model.

10.0 RISK ASSESSMENT

10.1 DEFINING THE NATURE OF THE IMPACT

An impact is essentially any change to a resource or receptor brought about by the presence of the proposed project component or by the execution of a proposed project-related activity. The terminology used to define the nature of an impact is detailed in Table 10-1 below.

Table 10-1: Impact Nature

Term	Definition
Positive (+)	An impact that is considered to represent an improvement on the baseline or introduces a positive change.
Negative (-)	An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.
Direct impact (D)	Impacts that result from a direct interaction between a planned project activity and the receiving environment/receptors (e.g. between occupation of a site and the pre-existing habitats, or between an effluent discharge and receiving water quality).
Indirect impact (I)	Impacts that result from other activities that are encouraged to happen as a consequence of the Project (e.g. in-migration for employment placing a demand on resources).
Cumulative impact (C)	Impacts that act together with other impacts (including those from concurrent or planned future third-party activities) to affect the same resources and/or receptors as the Project.

10.2 ASSESSING SIGNIFICANCE

The Knight Piésold impact significance rating system is based on the following equation:

Significance of Environmental / Social Impact = consequence x probability

The consequence of an impact can be derived from the following factors:

Severity/magnitude – the degree of change brought about in the environment

Reversibility - the ability of the receptor to recover after an impact has occurred

Duration - how long the impact may be prevalent

Spatial extent - the physical area which could be affected by an impact.

The **severity, reversibility, duration, and spatial extent** are ranked using the criteria indicated in Table 10-2. Then, the overall consequence is determined by adding up the individual scores and multiplying them by the **overall probability** (the likelihood of such an impact occurring). Once a score has been determined, this is checked against the **significance** descriptions in Table 10-3.

Table 10-2: Ranking Criteria

Severity / magnitude (M)	Reversibility (R)	Duration (D)	Spatial extent (S)	Probability (P)
5 – Very high – The impact causes the characteristics of the receiving environment/ social receptor to be altered by a factor of 80 – 100 %	**5 – Irreversible** – *Environmental* - where natural functions or ecological processes are altered to the extent that it will permanently cease. *Social* - Those affected will not be able to adapt to changes and continue to maintain-pre impact livelihoods.	**5 – Permanent** - Impacts that cause a permanent change in the affected receptor or resource (e.g. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.	**5 – International** - Impacts that affect internationally important resources such as areas protected by international conventions, international waters etc.	**5 – Definite** - The impact will occur.
4 – High – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 60 – 80 %		**4 – Long term** - impacts that will continue for the life of the Project, but ceases when the Project stops operating.	**4 – National** - Impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences.	**4 – High probability** – 80% likelihood that the impact will occur
3 – Moderate – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 40 – 60 %	**3 – Recoverable** *Environmental* - where the affected environment is altered but natural functions and ecological processes may continue or recover with human input. *Social* - Able to adapt with some difficulty and maintain pre-impact	**3 – Medium term** - Impacts are predicted to be of medium duration (5 – 15 years)	**3 – Regional** - Impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystem.	**3 – Medium probability** – 60% likelihood that the impact will occur u

Severity / magnitude (M)	Reversibility (R)	Duration (D)	Spatial extent (S)	Probability (P)
	livelihoods but only with a degree of support or intervention.			
2 – Low – The impact alters the characteristics of the receiving environment/ social receptor by a factor of 20 – 40 %		**2 – Short term** - Impacts are predicted to be of short duration (0 – 5 years)	**2 – Local** - Impacts that affect an area in a radius of 2 km around the site.	**2 – Low probability** - 40% likelihood that the impact will occur
1 – Minor – The impact causes very little change to the characteristics of the receiving environment/ social receptor and the alteration is less than 20 %	**1 – Reversible** *Environmental* - The impact affects the environment in such a way that natural functions and ecological processes are able to regenerate naturally. *Social* - People/ communities are able to adapt with relative ease and maintain pre-impact livelihoods.	**1 – Temporary** - Impacts are predicted to intermittent/ occasional over a short period.	**1 – Site only** - Impacts that are limited to the site boundaries.	**1 – Improbable** - 20% likelihood that the impact will occur

Table 10-3: Significance Definitions

Score According to Impact Assessment Matrix	Significance Definitions	Colour Scale Ratings	
		Negative Ratings	Positive Ratings
Between 0 and 29 significance points indicate **Low Significance**	An impact of low significance is one where an effect will be experienced. However, the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value.	**Low**	**Low**
Between 30 and 59 significance points indicate **Moderate Significance**	An impact of moderate significance is one within accepted limits and standards. The impact on the receptor will be noticeable, and normal functioning will be altered, but the baseline condition will prevail, albeit in a modified state. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is As Low As Reasonably Practicable (ALARP). This does not necessarily mean that "moderate" impacts must be reduced to "low" impacts but that moderate impacts are managed effectively and efficiently not to exceed accepted standards.	**Moderate**	**Moderate**
60 to 100 significance points indicate **High Significance**	An impact of high significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resources/receptors. An impact with high significance will completely modify the baseline conditions. A goal of the ESIA process is to get to a position where the Project does not have any high negative residual impacts, certainly, not ones that would endure into the long term or extend over a large area. However, there may be high residual impacts for some aspects after all practicable mitigation options have been exhausted (i.e., ALARP has been applied). It is then the function of regulators and stakeholders to weigh such negative factors against the positive factors, such as employment, in deciding on the Project.	**High**	**High**

10.3 IMPACTS ON GROUNDWATER

The proposed waste facility will introduce several waste types into the area (Section 2.1.1). However, the facilities are proposed to be designed in such a way as to mitigate potential contaminants being introduced into the environment. Should these mitigation measures fail or not be implemented correctly, the following groundwater risks are noted:

10.3.1 CONSTRUCTION PHASE

Impacts on groundwater during the construction phase include the following:

- Groundwater contamination:
  - Spillage/leaking of hydrocarbons from construction vehicles.
- Groundwater Use:
  - Abstraction from the borehole may result in the lowering of the groundwater table.
  - Groundwater is used for dust suppression and vehicle cleaning. Due to the poor quality of the water and high salinity, soil conditions and existing vegetation may be negatively impacted.

10.3.2 OPERATIONAL PHASE

- Hazardous chemical spills can result in pollutants accumulating on the surface that could infiltrate into the underlying lithologies. Possible spills can occur from the following point sources:
  - Spillage from the waste storage facilities when being deposited.
  - Spillage from chemical use and storage for waste processing.
  - Should the vehicles not be well maintained, leaks and spills from vehicles on the property can occur.
  - Washing of the vehicles can collect and potentially spill fuel or oils into the environment from the wash bay.
- Leakage or seepage of contaminants:
  - Storage facility liners or hard standing that are not correctly designed or maintained can result in the seepage of pollutants into the underlying weathered rock; and
  - Sewage from ablution facilities may enter the environment from the sewage system.

The facility is considering the use of groundwater in the processing of waste. The following risks to the groundwater are noted:

- Reduction of the groundwater levels in the area.
- The pumping could encourage plume migration towards the abstraction well if contamination enters the deeper aquifer.

10.3.3 MITIGATION MEASURES

To ensure that impacts on the groundwater are mitigated during the construction and operational phase of the site, the following additional measures could be implemented:

- All hazardous substances must be handled according to the requirements of relevant legislation relating to the transport, storage, and use of the substances.
- Proper storage of chemicals and waste on hard standing in a bunded area is recommended.

- Ensure liners for the spill emergency storage are maintained in good working condition.
- Provide and maintain spillage clean-up kits.
- Any waste and spills must be cleaned up immediately.
- Drainage from each facility must be captured in lined stormwater systems and diverted to silt and oil traps before entering the stormwater dam.
- Vehicle storage, maintenance, and cleaning areas are to be on hard standing, and regular maintenance of vehicles must be implemented.
- Cleaning of oil/fuel leakage on vehicles and maintaining seals on the vehicle to prevent spillage.
- Areas should have lined drainage that prevents flow into the environment.
- Drainage must include silt and oil traps.
- Regularly clean drainage and traps and dispose of the material in a suitable waste facility.
- Ensure groundwater is abstracted at the rate and time cycle proposed within the sustainable yield.
- The monitoring network should be updated:
    - Groundwater monitoring must be done quarterly. During these monitoring runs groundwater must be collected for a full suite of chemical analysis, including:
        - General chemistry (pH, EC, TDS, alkalinity)
        - Major cations and anions.
        - Metals scan similar to that shown in Table 7-1.
    - Depth to groundwater level should be measured monthly.

If required, additional monitoring boreholes should be installed.

10.3.4 IMPACT ASSESSMENT

Table 10-4 summarises the possible groundwater impacts assessed before and after mitigation measures are put in place.

The identified impacts have a significance rating from medium to low, which can be reduced to low with the proposed mitigation measures.

Table 10-4: Assessing the identified impact of the project before and after mitigation.

Project activity or issue	Potential impact	Nature of impact		Significance before mitigation							Significance after mitigation as per EMP						
		+ / -	D/I/C	M	R	D	S	P	TOTAL	SP	M	R	D	S	P	Total	SP
Groundwater																	
Hazardous chemical spills (e.g. fuel)	Groundwater Contamination	-	D	2	3	4	2	3	33	**M**	2	3	4	2	2	22	**L**
Leakage or seepage of contaminants	Reduction in groundwater quality due to contaminated seepage or leakage	-	D	3	5	5	3	2	32	**M**	3	5	5	3	1	16	**L**
Abstraction of groundwater when required	Reduction of local groundwater levels through abstraction	-	D	3	1	4	3	3	33	**M**	3	1	4	3	2	22	**L**

10.4 MONITORING PLAN

KP recommends implementing a monitoring program at the project site to ensure that any seepage from the proposed facilities is identified and managed promptly. This program will help identify patterns, trends, or anomalies in water samples collected from boreholes drilled on site.

By monitoring on a quarterly basis, seasonal variability in the water samples can be assessed. This systematic approach will help understand the spatial variability in water chemistry throughout the project area and provide valuable insights into how seasonal changes may influence water quality.

The following steps are recommended:

- Establishing a regular schedule for groundwater sampling, typically quarterly, to track changes over time.
- Follow standardised procedures for purging and sampling to minimise contamination and ensure accurate results.
- Analysing samples for various parameters, including major ions, organic, hydrocarbons.
- Analysing collected data and reporting identified trends, potential contamination events, and compliance with regulatory standards.

Table 10-5: Proposed groundwater monitoring locations

Borehole ID	Coordinates		Borehole Depth	Borehole Elevation	Water Quality Monitoring Frequency	Water Level Monitoring Frequency
	X-UTM33S	Y-UTM33S	(m)	(mamsl)		
WBBH1	461061	7453946	60	80	Quarterly	Monthly
WBBH3	460993	7453778	60	81	Quarterly	Monthly
WBBH4	461221	7453849	60	99	Quarterly	Monthly

It should be noted, that although WBBH3 and WBBH4 were initially dry, the hydraulic conditions can change over time. In the case where the hydraulic head rises, these initially dry boreholes can be monitored.

11.0 CONCLUSION AND RECOMMENDATIONS

The geology overlying the project area consists of Damara Supergroup rocks, including the Nossib group and the intrusive granite, the Salem Granite.

The groundwater exploration assessment for the Namwaste Walvis Bay waste facility included a geophysical investigation that identified three targets for drilling groundwater boreholes. Two boreholes, WBBH1 and WBBH3, were drilled downstream of the project site, while borehole WBBH4 was drilled upstream from the site. According to the drilling results, a groundwater strike was recorded in borehole WBBH1 at ~50 m depth. Over time the groundwater level in the borehole rose to 20.6 mbgl. No groundwater strike was recorded in borehole WBBH3, but after a time, seepage accumulated in the borehole and the groundwater level was measured at 50.3 mbgl. Borehole WBBH4 was completely dry and no water accumulated in the borehole by the time the KP team left site.

The groundwater flow is expected to follow this area's natural topography and drainage patterns and flow towards the Atlantic Ocean to the west. The flow will likely be directed through structures, taking advantage of NW-SE striking structures.

The annual precipitation in the region is extremely low, with areas receiving less than 50 mm/yr. Precipitation is often in the form of fog, with very little infiltrating into the underlying strata. Therefore, recharge from rainfall to the regional aquifers is limited.

The water quality analysis indicated that some water quality parameters exceed the allowable levels per the Namibia Water Resource Management Act 2013.

The samples taken at Walvis Bay show that most samples have an LSI value of >0, indicating that these groundwater is supersaturated with calcium carbonate and scale forming may likely occur inside any pipelines.

Based on the study outcomes and results, KP would like to recommend the following:

- Water samples need to be collected and analysed on a quarterly basis for water quality monitoring.
- The water is unsuitable for drinking or processing without treatment. A desalination plant must be installed before it can be used.
- Due to the low yields of the installed boreholes (WBBH1, WBBH3, and WBBH4), additional abstraction boreholes will have to be installed if needed.
- Samples are to be collected during the dry season from groundwater and surface water for stable isotopes and tritium analysis to refine the recharge estimates to groundwater.

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13.0 CERTIFICATION

This report was prepared and reviewed by the undersigned.

Prepared:

Prepared, Jordyn Young, Cand.Sci.Nat
Title: Hydrogeologist

Reviewed:

Martiens Prinsloo, Pr.Sci.Nat
Title: Section Manager: Hydrogeology

Approval that this document adheres to Knight Piésold Quality Systems: MP

APPENDIX A

Field Memo 2024

MEMORANDUM

Date:	31 October 2024	**File No.:**	WI306-00033/01-A
		Cont. No.:	WI24-00225
To:	Thierry Provendier, Lise Steyn, Hulisani Netshisaulu, Virginia Tsele		
Copy To:	Camille Kraak. Lloyd Lynch		
From:	Izelda Mbatha		
Re:	**Waste Management Facility Walvis Bay Hydrogeological Field Memo**		

This report details the fieldwork undertaken from 8th July to 19th July 2024 for the groundwater study for the Namwaste Waste Management Facility at Walvis Bay.

ABBREVIATION

CDT	Constant Discharge Test
mamsl	Meters above mean sea level
CHD	Constant Head Test
T	Transmissivity
K	Hydraulic Conductivity
S	Storage coefficient
KP	Knight Piésold
L	Litres
mm	Millimetres
m/day	Metres per day
m/s	Metres per second
m^2/day	Metres squared per day
m^3/hr	Cubic metres per hour
mbs	Metres below surface
MAWLR	Ministry of Agriculture, Water and Land Reform
ORP	Oxidation-Reduction Potential

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1. INTRODUCTION

1.1 PROJECT BACKGROUND

Namwaste (Pty) Ltd appointed Knight Piésold Namibia Pty Ltd (KP) to undertake a groundwater field investigation for the proposed development of an oil and gas Waste Management Facility (WMF) in Walvis Bay, Namibia. This groundwater investigation forms part of the environmental scoping assessment for the proposed WMF to obtain an environmental clearance certificate.

Walvis Bay is a small port town on the Atlantic coast in the Erongo region of southern Namibia. Besides being an export terminal for certain products, there are small fishing and sealing industries and the diamond industry.

The proposed site is located on ERF 160 of Remainder of Farm 38, ESE of Walvis Bay and approximately 20 km from the Port entrance. The proposed site is approximately 78 133 m^2 (7.81 hectares) in extent (Figure 1-1).

The fieldwork at the Walvis Bay site was undertaken from the 08th to the 18th of July 2024.

1.2 OBJECTIVES

The study's objective is to obtain an understanding of the groundwater regime, to explore the availability of groundwater and to install groundwater monitoring boreholes with the key objectives summarized below:

- Conduct a hydrocensus and geophysical survey.
- Identify drilling positions for the groundwater monitoring boreholes.
- Borehole drilling and construction.
- Conduct a pumping test if a water strike(s) is intersected.
- Capture field measurements such as pH, electrical conductivity, dissolved oxygen, and oxidation-reduction potential ORP.

1.3 SCOPE OF WORK

The scope of work included a fieldwork program focusing on understanding the hydrogeological conditions of the site to identify the best locations for drilling monitoring boreholes. These boreholes may be used to monitor any potential seepage from the waste facility. If one of the monitoring boreholes is found to have a sufficiently high yield, it can be converted into a water supply borehole for the Namwaste facility, contingent upon approval from the Ministry of Agriculture, Water and Land Reform (MAWLR). The fieldwork included:

- Hydrocensus to identify groundwater users in the region as well as hydrogeological features/
- A geophysical survey to identify possible drilling targets for the monitoring boreholes.
- Drilling of three (3) monitoring boreholes.
- Aquifer testing (pump testing) to evaluate hydraulic coefficients.

1.4 BRIEF SITE DESCRIPTION

The site is in a topographical, low-lying, generally flat area sloping towards the west (Figure 1-1). The elevation is 77 meters above mean sea level (mamsl) in the southeastern corner, to 71 mamsl at its lowest along the western boundary (Google Earth Pro). The topographic interpretation of the area indicates that the direction of the groundwater near the project is inferred to flow toward the west.

The significant surface water bodies near the project site are the sea (approximately 16 km to the west) and the ephemeral Kuiseb River (approximately 13 km from the site) to the south.

Gypsisol soils overlie the project site. According to Mendelsohn et al. (2002), the gypsisol soils are characterized by the accumulation of calcium sulphate, which is common in the arid areas of Central Namib. The project area has little to no vegetation, with plants in the region relying heavily on fog as their water source. The vegetation within the project area includes Salsola shrubs and dune grass.

Figure 1-1: Site view and vegetation (looking west)

1.5 CLIMATE AND RAINFALL

The period's weather conditions were mainly cold in the morning, windy, and sunny during the day. No rainfall was recorded, and no delays were encountered due to adverse weather conditions. The highest temperatures were recorded on the 14th of July, 2024, with the lowest on the 08th of July, 2024. The maximum and minimum temperatures for the period covered are shown below in Figure 1-2.

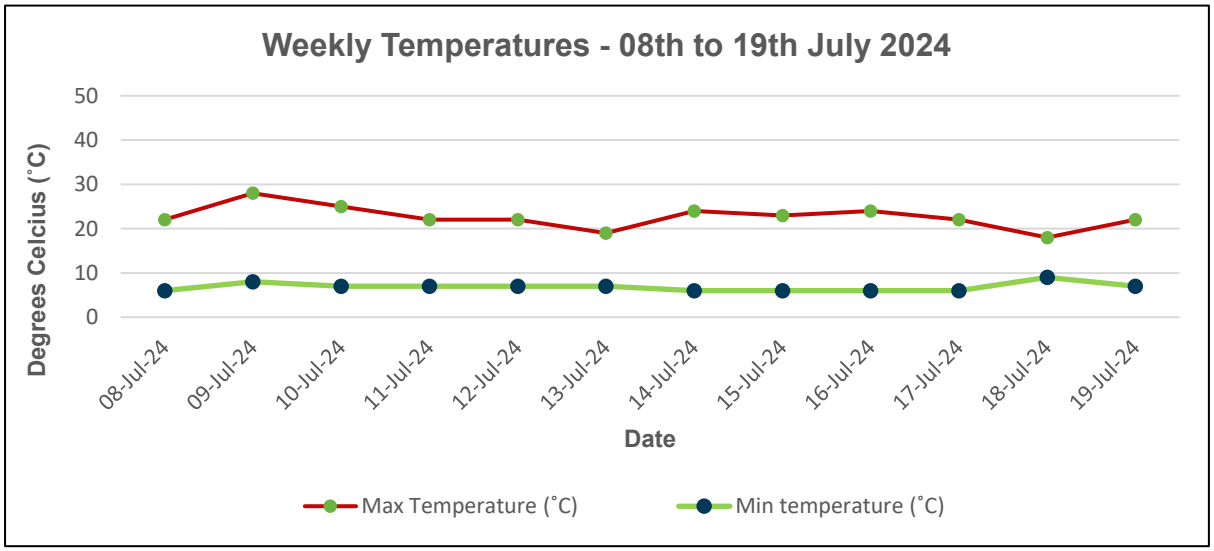

Figure 1-2: Walvis Bay Temperature (Accuweather.com, 2024)

2. SITE WORK

2.1 HYDROCENSUS

KP Personnel conducted a comprehensive Hydrocensus within a 5 km radius of the project area on the 18th of March and 19th of March 2024. The fieldwork included surveying borehole data, identifying surface features like rivers, and locating groundwater-related features within the waste facility area.

Table 2-1 provides information about these locations, and Figure 2-1 is a map of the places visited during the Hydrocensus.

All sites surveyed during the Hydrocensus depend on water provided by Namwater through a system of boreholes, reservoirs, and pipelines drawing from the lower Kuiseb River aquifers, located approximately 13 km from the site. No boreholes or surface water sources were found within 5 km of the project site, and no groundwater or surface water samples were collected during the Hydrocensus.

Table 2-1: Summary of Locations Visited during Hydrocensus

Location	Description	Coordinates	
		X	Y
B.C Stone	Quarry Manufacturing Company	458306	7456904
King Charcoal Factory	Factory	459155	7454876
Namwater Reservoir 1	Water Collection Reservoir	455894	7452490
Private Graden	Fruits and Vegetable Graden	460448	7448714
Walvis Bay Airport	Airport	463498	7458715
King Charcoal Factory Homestead	Factory	458628	7455023
Hanan Green Acre Project	Charcoal Manufacturing Project	459837	7450761
Walvis Bay Maritime	Maritime	461669	7450412
Orica Mining Storage 1	Storage Facility	463177	7455313
Orica Mining Storage 2	Storage Facility	463394	7454464
Amias farm	Private Owned Farm	461665	7450774

Figure 2-1: Sites visited during the Walvis Bay Hydrocensus

2.2 GEOPHYSICS

Applied Scientific Services and Technologies (ASST) conducted the Electrical Resistivity Imaging (ERI) surveys from the 18th to the 20th of March 2024. An ABEM 8-channel Terrameter LS2 system was used with four (No. 4) cables utilizing the roll-along method where necessary. The survey lines were proposed by ASST and consisted of a grid-like arrangement, which the KP Hydrogeologist approved (Geophysical Investigation at the proposed waste treatment facility site near Walvis Bay, 2024).

All ERI traverses were surveyed with stations spaced at ~5m intervals with a dipole-dipole configuration that delivers a depth of investigation of ~40m b.g.l. On the site, nine (9) traverses of 100 meters each were carried out using the ERI method.

The results identified a Northwest-Southeast structure and several regions of deep weathering, which can be targeted for future monitoring of groundwater conditions on-site (Figure 2-2). Without any drillhole information during the reporting to establish a relationship between the resistivity data and the bedrock–regolith interface, the actual boundary and thickness of the weathering profile are currently unknown. It should be noted that a decrease in the resistivity values does not necessarily relate to softer soils but rather indicates an increase in minerals that causes an increase in the conductivity of the soils.

The full geophysical report with the remaining sections is provided in Appendix A1.

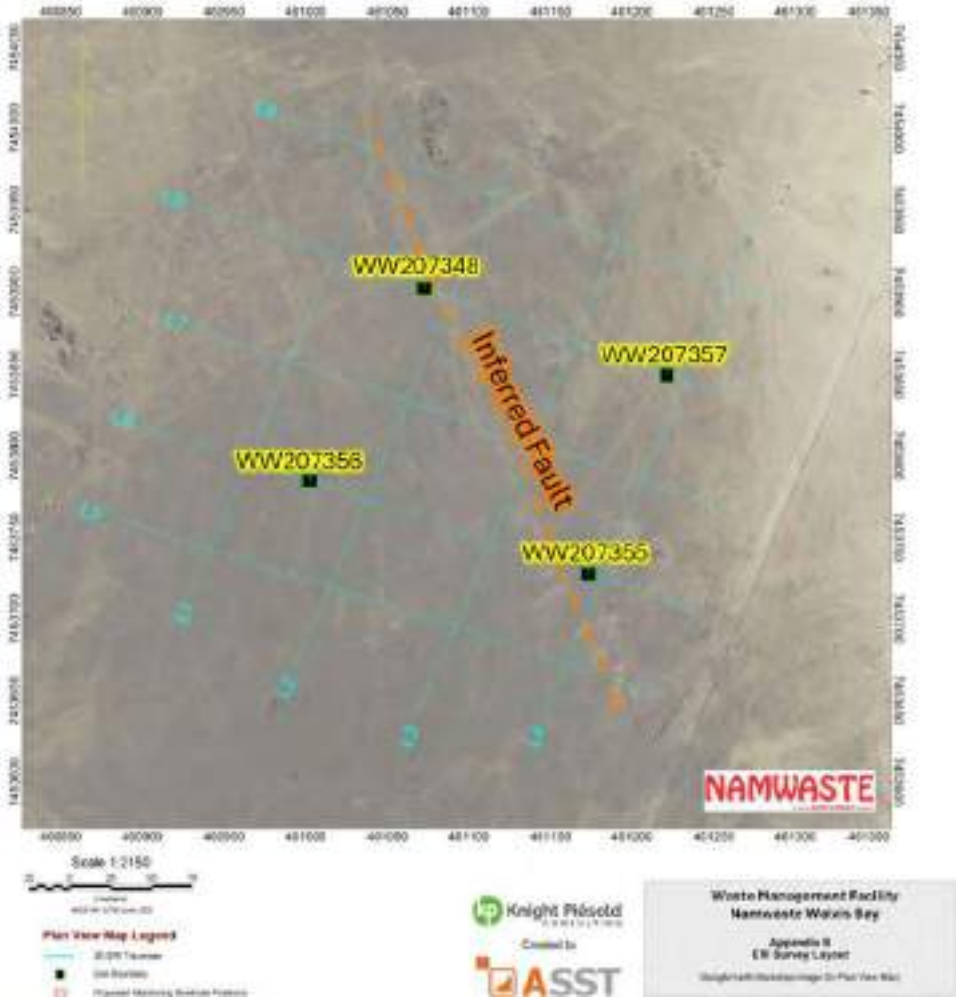

Figure 2-2: ERI Survey Layout (ASST,2024)

2.3 BOREHOLES

Ministry of Agriculture, Water and Land Reform (MAWLR) approved drilling four boreholes for monitoring purposes on portion 160 of the proposed portion A of the remainder of farm No.38, Walvis Bay district (correspondence in Appendix A2). Based on the geophysics results, four groundwater monitoring boreholes were sited. Three of these boreholes were drilled at the Namwaste site in Walvis Bay, while one borehole has been reserved for future drilling as it is not needed at this time. The drilling targeted areas of deep weathering and potential geological structures. A KP Site Hydrogeologist undertook drilling supervision, chip logging, and photography according to the provided Standard Operating Procedure (SOP) and as stated by the Ministry of Agriculture, Water and Land Reform (MAWLR) pre-approvals for drilling activities.

The boreholes were primarily drilled using a ten-inch diameter rod for roughly 18 m until the weathered zone was surpassed. Once fresh rock was intercepted, an eight-inch diameter rod was used until the final depth was reached. When a water strike was intercepted, the blow yields were measured.

The borehole logs and construction details are presented in Appendix A3. A summary of the drilling undertaken is presented in Table 2-2 and discussed in Sections 3.3.1 to 3.3.3. The location of the drilled boreholes is shown in Figure 2-3. Photographs of the drilling supervision can be found in Appendix A4, and photos of the chips can be found in Appendix A5.

It must be noted that the borehole plates for each borehole at the site currently show the original borehole numbering and do not include the WW ID number. It is recommended that the name plates be updated to include the assigned WW numbers.

Table 2-2: Borehole Summary

Borehole ID	Coordinates		Date drilled	Borehole Depth	Borehole Elevation	Water Strike	Blow Yield
	X-UTM33S	Y-UTM33S		(mbs)	(m)	(mbs)	(m^3/hr)
WW207348	461061	7453946	08th to 09th July 2024	60	80	Seepage at 50m	-
WW207356	460993	7453778	11th to 12th July 2024	60	81	-	-
WW207357	461221	7453849	12th to 13th July 2024	60	99	-	-
WW207355	461167	7453705	Reserved Borehole				

Figure 2-3: Drilled and Reserve Boreholes

2.3.1 BOREHOLE WW207348

- This borehole is located Alongside the Offices and Laboratories, downgradient along the proposed fault.
- The borehole targeted interpreted faults and deeper weathering profiles observed in the resistivity data.
- The borehole was drilled to a depth of 60m.
- The predominant strata encountered was granite.
- No water strike was encountered.
- Seepage was encountered at 50m but was not strong enough to obtain a blow yield.
- The rock condition was unstable; therefore, the borehole was fully cased to the final depth with slotted and solid UPVC Casing.

2.3.2 BOREHOLE WW207356

- This borehole is located downgradient of the DAF, TCC, Mud Plant, and Storage facilities.
- The borehole targeted deeper weathering profiles in the resistivity data.
- The borehole was drilled to a depth of 60 m.
- The predominant strata encountered was granite.
- No water strike was encountered.
- The rock condition was unstable; therefore, the borehole was fully cased to the final depth with slotted and solid uPVC casing.

2.3.3 BOREHOLE WW207357

- This borehole is located upgradient of the evaporation dam and truck parking site facilities.
- The borehole targeted deeper weathering profiles observed in the resistivity data.
- The borehole was drilled to a depth of 60m.
- The predominant strata encountered was granite.
- No water strike was encountered.
- The rock condition was unstable; therefore, the borehole was fully cased to the final depth with slotted and solid uPVC casing.

3. CLOSURE

The geophysical survey and borehole drilling conducted at the Walvis Bay Namwaste Project site was successful. The Final Report will incorporate and discuss the results.

Yours truly,
Knight Piésold Ltd.

Prepared: _____
Izelda Mbatha, Designation
Hydrogeologist

Reviewed: _____
Camille Kraak Pr. Sci. Nat.
Principal Hydrogeologist

Approval that this document adheres to Knight Piésold Quality Systems: CK

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APPENDIX A1

Geophysics Report

GEOPHYSICAL INVESTIGATIONS AT THE PROPOSED WASTE TREATMENT FACILITY SITE NEAR WALVIS BAY

Compiled by: Christiaan Mouton, Principal Geophysicist, BSc. (Hons) Geophysics, Pr.Sci.Nat.(400300/15)

Project Owner	Namwaste (Pty) Ltd
Project Managers / Hydrogeological Consultants	Knight Piésold Consulting (Pty) Ltd ("KP")

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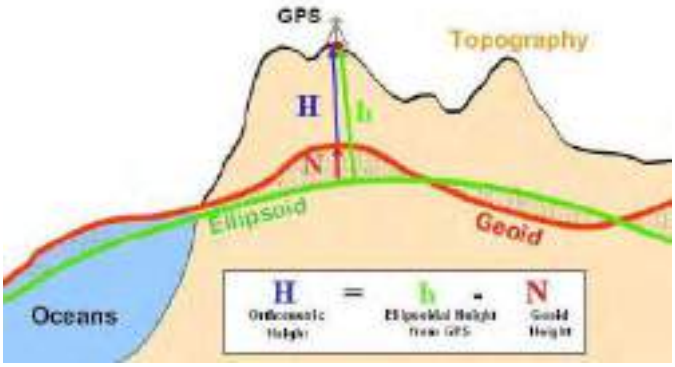
GLOSSARY

A glossary of scientific terms, abbreviations and units used in the main text of the report follows in the tables below.

Term / Abbreviation (Technical)	Description
Anomalies (geophysical datasets)	Areas where the geophysical data shows lower or higher values compared to what is measured for surrounding lithologies. Note that the colours used for presenting the data and have no meaning in terms of being an area of high or low risk.
b.g.l	Below Ground Level
Conductivity	Conductivity is the inverse of resistivity
Environment (lithological / geological)	Reference to lithological zones in the subsurface exhibiting similar geological composition and geophysical signature
ERI	Electrical Resistivity Imaging, a method to measure the electrical resistivity of soils and rocks with increasing depth.
Lineaments	Typically, a linear feature, such as a fault or dyke which is visible at the earth surface or in geophysical datasets which provided imaging of geological features in the subsurface
Resistivity	The resistivity of soils describes how much the soil resist the flow of applied electrical current. More resistive lithological units will resist the flow of current (e.g sand) whilst conductive units (e.g. shales and clay lenses or layers) will be more conductive. It is used to differentiate between geological units and soils conditions. Hard rock environments are usually more resistive whilst more porous rock is less resistive depending on whether pore spaced is filled with fluids which will decrease the bulk resistivity of the rock unit.

Term / Abbreviation (SI Units)	Unit
Electrical Conductivity (fluid)	Unit for EC is Siemens/meter (S/m) Milli-Siemens per meter (mS/m) 1mS/m = 0.001 Siemens/m or 1mS/cm = 100 mS/m
Resistivity	Unit for resistivity is Ohm-meter (Ohm.m) 1Ohm.m = 1S/m

Term / Abbreviation (General)	Description
Orthometric Height	Difference between ellipsoidal and geoidal height  *(source: http://www.geomobileinnovations.com)*

EXECUTIVE SUMMARY

Applied Scientific Services and Technologies CC ("ASST") was commissioned by Knight Piésold Consulting (Pty) Ltd ("KP") on behalf of Namwaste (Pty) Ltd Namibia to conduct geophysical surveys which forms part of the hydrological investigation of a proposed Waste Treatment Facility site south-east of Walvis Bay.

The objective with the geophysical investigation was to identify areas on site that can be targeted for boreholes to monitor groundwater quality over time.

The electrical resistivity surveys conducted at the proposed Waste Treatment Facility near Walvis Bay resulted in the identification of a Northwest-Southeast structure as well as several regions of deep weathering which can be targeted for future monitoring of groundwater conditions on site. Without any drillhole information available to establish a relationship between the resistivity data and the bedrock–regolith interface, the true boundary and thickness of the weathering profile is currently unknown. It should be noted that a decrease in the resistivity values not necessarily relate to softer soils but it is rather an indication of an increase in minerals that causes and increase in the conductivity of the soils.

Four monitoring drillhole positions were identified and positional information of these holes are provided in the report.

.

1. SCOPE OF WORK

Applied Scientific Services and Technologies CC ("ASST") was commissioned by Knight Piésold Consulting (Pty) Ltd ("KP") on behalf of Namwaste (Pty) Ltd Namibia to conduct geophysical surveys which forms part of the hydrological investigation of a proposed Waste Treatment Facility ("WTF") site south-east of Walvis Bay. The field work took place from the 18th until the 20th of March 2024.

The surveys were specifically aimed at siting three water monitoring boreholes that will be used for groundwater quality assessment.

Appendix B presents a map covering the project area with traverse layouts for the ERI surveys. Table 1-1 lists the geophysical survey technique, quantities and total distance covered as part of the investigation.

Table 1-1: List of techniques and quantities.

Geophysical Techniques	No. of traverses	Total distance surveyed (m)
Soil Electrical Resistivity Imaging (ERI)	9 lines	3310

2. INSTRUMENTATION & SURVEY CONFIGURATIONS

Since survey lines were not prepared by KP, ASST planned the ERI lines which was then submitted to KP for approval. With most of the site covered with windblown sediment and limited outcrop of what appears to be Monzonite Granite it is difficult to determine the exact strike of geological structures, hence the lines were orientated to best fit know regional structures such as the Okahandja Lineament. Traverses were planned both subparallel and at right angles to these structures.

All ERI traverses were surveyed with stations spaced at ~5m intervals with a dipole-dipole configuration that delivers a depth of investigation of ~ 40m b.g.l.

2.1 Electrical Resistivity Imaging

ASST conducted the ERI surveys using an ABEM 8 channel Terrameter LS2 system with four (No. 4) cables utilising the roll-along method where necessary. Table 2-1 lists the ERI instrumentation and acquisition parameters used during the survey.

Table 2-1: ERI instrumentation & acquisition parameters.

Transmitter / Receiver System	ABEM Terrameter LS2 8 channel system
Electrodes	Stainless Steel (rod: 10 mm diameter, 300 mm length)
Electrode spacing	~5m intervals depending on topography.
Number of electrodes	4 cables, 81 electrodes
Configuration (array)	2D Non-standard – Dipole-Dipole for 8 channel acquisitions.

2.2 Positioning

Positioning of all ERI electrodes were captured using a DGPS system capable of 5cm accuracy. All subsequent presentation of geophysical datasets was completed using the World Geodetic System 1984 (WGS84) in combination with the Universal Transverse Mercator (UTM) map projection system for assigning coordinates to locations. ASST uses the abbreviation "WUTM33" to indicate that the WGS84 datum and UTM zone 33 were applied. All heights were reduced to orthometric heights by calculating "N"- separation values for each position.

3. RESULTS AND INTERPRETATION

The results and interpretation of the geophysical surveys conducted for the DPMT are described in this section. A brief explanation of the ERI method is given in Appendix A. Table 3-1 lists all other appendices associated with the report.

Table 3-1: List of appendices applicable to the geophysical investigations conducted on site.

Appendix Number	Description
Appendix B	ERI survey location map
Appendices C1 – C9	2D Electrical Resistivity sections

3.1 Lithological description

In Special Publication No.11 of the Geological Society of South Africa (1983) titled "*Evolution of the Damara Orogen of South West Africa / Namibia*", it appears that the project area is situated in the Central Zone granite rocks and specifically consisting of either Syenogranite or Monzogranite. ASST has not conducted a separate desktop study and drawn information from this publication only.

Limited granite outcrops occur on site but those enveloped by the project boundary show intact hard rock conditions or hard rock with signs of fracturing. Hand drilling to install electrodes showed that the sediments that overlay the rocks can vary considerably and, in some areas, showed very soft, highly weathered material whilst the regolith layer can be as thin as a few centimetres in other areas.

3.2 Electrical Resistivity Imaging

ASST aimed to achieve a penetration depth of 40m using the Dipole-Dipole array which delivers better results in terms of mapping lateral variations in the electrical structure of the subterrain.

In general, data quality was good considering the fact that achieving electrical coupling in some areas was challenging as a result of large grain sands sediments covering the larger portion of the site with limited to no clay content in the composition of the sediments. This caused some noise in the data due to the less favourable coupling conditions which is critical for delivering high quality resistivity data. A mixture of saline water and Bentonite were used to retain moisture around the stainless-steel pins which in turn improves contact between pegs and soil.

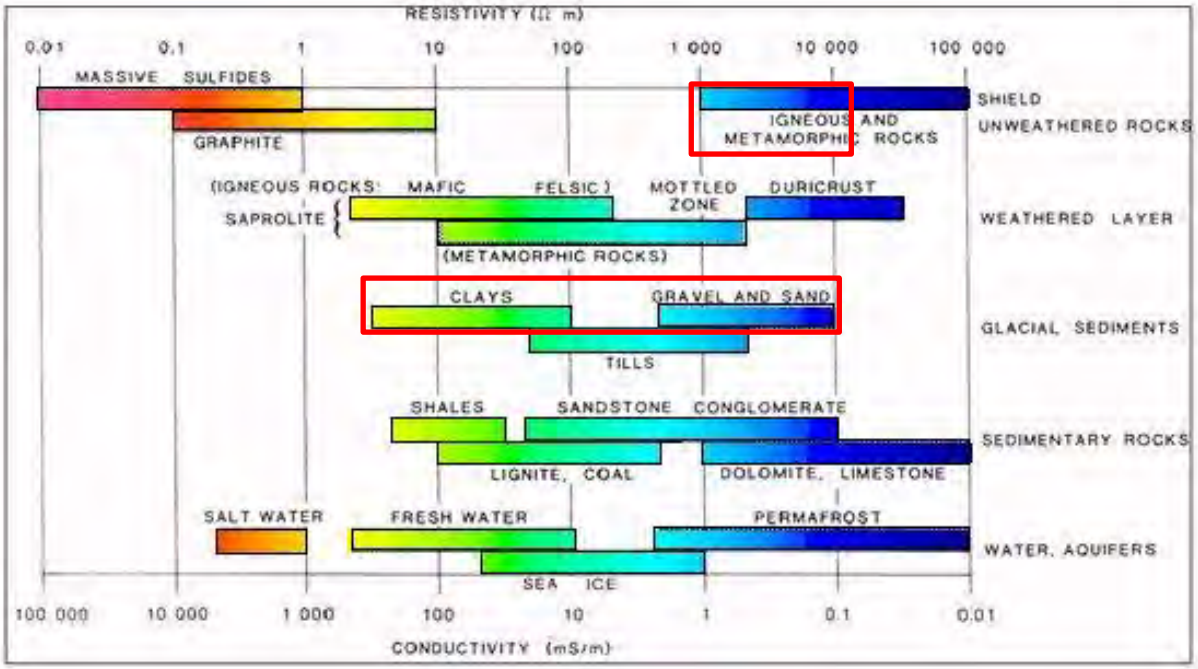
Resistivities across the ERI lines range between ~1.7 Ohm.m and ~12.4 kOhm.m, with a mean of ~288 Ohm.m. The low end of the range of resistivities observed correspond to values normally measured for sedimentary units such as clays and clayey sands and silts (See Figure 3-1). At the high end of the spectrum the resistivity values observed are typical for intrusive rocks such as Granite. Without any drilling to compare the ERI results with, the cause of the low resistivities observed in the data is unknown. However, it is likely that the weathered granite rocks (See symbols "WZ" notated on resistivity cross-sections) resulted in clay-rich sediments layers or troughs of deep weathering combined with clay minerals.

The 2D Resistivity models were imported to visualisation software (Geosoft Oasis Montaj) where the data was gridded, and 2D Resistivity cross-sections were created. Due to the large range in the data, the data for each line as shown on the 2D sections in Appendices C1 to C9 have been colour stretched to individual sections on a logarithmic scale of base 10 (e.g., a

value of 3 on the colour scale gives a resistivity of 10^3 = 1,000 Ohm.m, a value of 4 on the colour scale gives a resistivity of 10^4 = 10,000 Ohm.m etc.). This allows for detection of subtle changes in the make of the subsurface for individual sections. Contours were added which can be used to compare and possibly correlate lithological layering between lines and across the site.

The variation in, clay mineral content and porosity or fracturing can cause lower than expected resistivity values for this arid area, or preferential pathways for fluids respectively.

Figure 3-1: Bar plot of typical resistivities for different geologies (source: www.eoas.ubc.ca)



Several features believed to relate to faults or deep weathering troughs have been identified and indicated on individual sections. A total of four (No.4) possible drillhole positions have been identified for the purpose of monitoring holes.

The resistivity section of Line 1 (Appendix C1) suggests a weathering profile of ~10m thick. This profile is less prominent but visible on Lines 2 and 3 (Appendices C2 and C3) but appears to increase in thickens across Line 4. The five lines (Lines 5 to 9, Appendices C5 to C9), which have a Northwest-Southeast strike, show an increase in depth of the weathering profile along portions of the individual lines, specifically along the western boundary of the site. These features have been interpreted as weathering troughs and occur on both the western and eastern side of what appears to be a small, localised dome structure caused by the underlying bedrock.

This weathering profile throughout, is underlain by granite bedrock. An interpreted fault towards the northern end of Line 1 is also well-defined in the resistivity data for Line 9 as well as at the intersections of the other lines completed. It strikes in a Northwest-Southeast direction as indicated by the white dashed line (See three-dimensional view, Figure 3-2).

Figure 3-2: Three-dimensional display of ERI data for the Walvis Bay WTF with interpreted fault structure indicated with white dashed line.

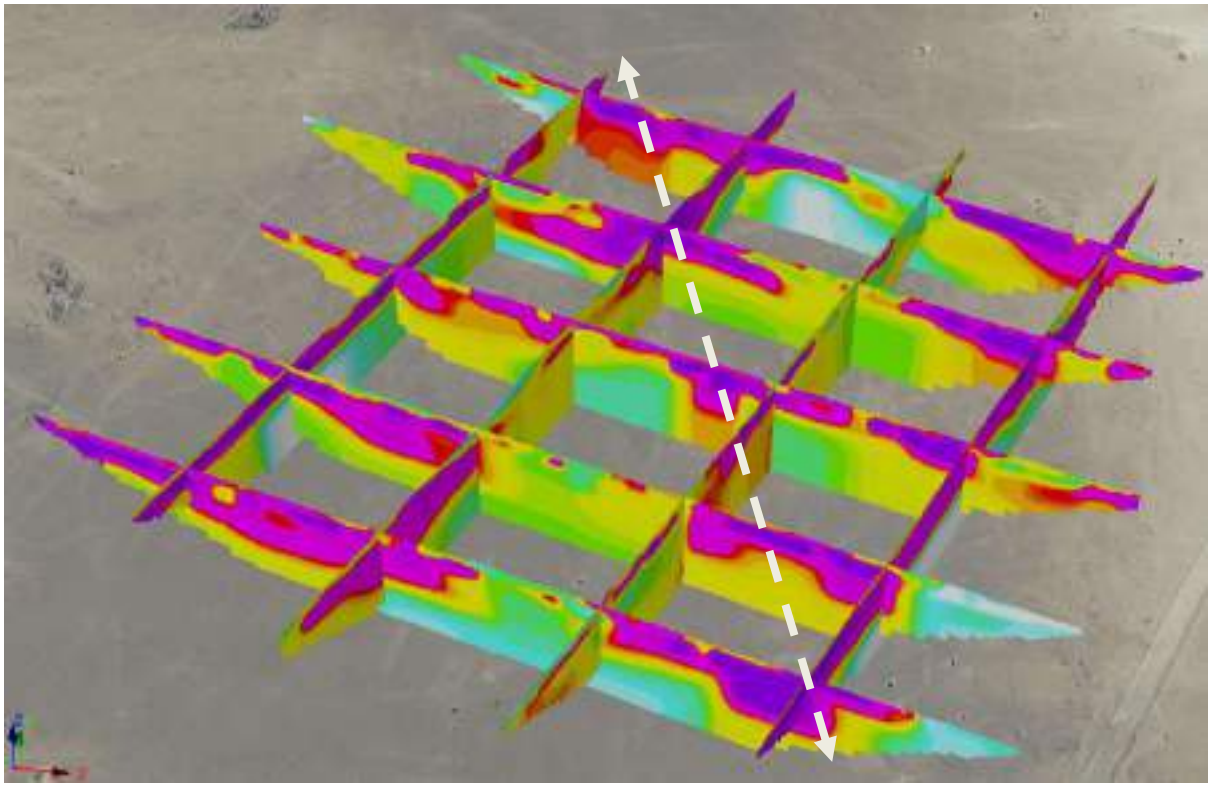


Table 3-2 provides a list of drillhole positions recommended for the proposed monitoring holes on site. Please note that these holes were decided and based on there vicinity to the interpreted fault and deeper weathering profiles observed in the resistivity data.

Table 3-2: List of Appendices for different datasets for the different geophysical techniques.

Hole ID	WUTM33_Easting	WUTM33_Northing
W8H101	461072	7453902
W8H102	461221	7453849
W6H103	461002	7453784
W6H104	461173	7453727

4. CONCLUSION

The electrical resistivity surveys conducted at the proposed Waste Treatment Facility near Walvis Bay resulted in the identification of a Northwest-Southeast structure as well as several regions of deep weathering which can be targeted for future monitoring of groundwater conditions on site. Without any drillhole information available to establish a relationship between the resistivity data and the bedrock–regolith interface, the true boundary and thickness of the weathering profile is currently unknown. It should be noted that a decrease in the resistivity values not necessarily relate to softer soils but it is rather an indication of an increase in minerals that causes and increase in the conductivity of the soils.

5. REFERENCES

Geological Society of South Africa. *Evolution of the Damara Orogen of South West Africa / Namibia. Special Publication No.1.* 1983.

DISCLAIMER

The interpretations contained in this report are based on the training and experience of the author and information acquired during the course of the investigation. As with all geophysical data, multiple interpretations are possible. The client is advised to consider information from all available sources prior to making a decision on how to proceed. ASST cannot be held responsible for errors or any consequences arising from the use of the information and ASST's liability to the Client for or in connection with any indirect, economic, special or consequential loss or damage as a result of the services provided by ASST will be limited to ASST rectifying any errors in the services in question. The Client indemnifies ASST from any liability it may have to the Client or any third party as a result of any information supplied to ASST by the Client or any of its agents, consultants, where such information and documentation is false, misleading or incomplete in a material respect.

The Client is not entitled to the report and/or any other documentation to be supplied by ASST and cannot rely on any such report or documentation, until all outstanding amounts are paid.

APPENDIX A: OVERVIEW OF GEOPHYSICAL METHODS

Appendix A provides technical information on the geophysical methods employed for the Walvis Bay WTF site investigations.

6. ELECTRICAL RESISTIVITY METHOD

The Electrical Resistivity (ER) method is based on the behaviour of the flow of direct current in the subsurface. Since the electrical source can be controlled, the depth of investigation can be controlled. For engineering purposes, the method delivers high resolution data similar to that of seismic refraction; therefore, the two methods often complement each other. However, the resistivity method is cheaper and more flexible in its application.

The two facets to the direct current (DC) method are as follows:

- Electrical soundings or Vertical Electrical Soundings (VES), whereby the electrical resistivity distribution (electrical structure of soils) with depth is investigated by progressively changing the depth of investigation. In this case the method is most effective in the presence of flat lying or gently dipping (dip <15) lithologies with extensive laterally homogeneous extent.
- Horizontal profiling on the other hand measures the lateral distribution of electrical resistivity at a specific depth of investigation which makes this method most effective when lateral changes in resistivity are large.

At least four electrodes are needed to carry out resistivity measurements, two current electrodes ("I" in Figure 6-1) through which current is passed into the soil and two potential electrodes ("V" in Figure 6-1) between which a potential difference due to the current is measured.

Electrical Resistivity Imaging (ERI) uses the same principles as the Electrical Resistivity method. ERI differs from the ER method in that it is a multi-electrode imaging technique which can be used to find vertical and lateral variations in the electrical structure of the subsurface.

Instead of using only four electrodes the complete electrode string consists of multiple electrode points (also referred to as take outs) which can be used both as current and potential electrodes. Similar to the VES method the ERI method employs a current source that injects electrical current into the earth through a pair of ground electrodes and the resulting potential field is measured along the ground surface using a second pair of electrodes. The transmitting

and receiving electrode pairs are referred to as dipoles. By varying the unit length of the dipoles as well as the distance between electrode pairs, the horizontal and vertical distribution of electrical properties at different depths can be recorded.

A number of electrode configurations can be applied during measurements some of which include Dipole–Dipole, Schlumberger, Wenner, Pole–Pole, Pole–Dipole, and the Square array. As mentioned previously each configuration has its own advantages and limitations.

Modern ERI equipment provides a fast-profiling method which sets it apart from traditional horizontal profiling and soundings techniques which are used to find the depths and resistivities of the geologic layers included in the half space beneath the centre of the sounding spread. Instruments that employ automated switching systems control switching to the relevant dipoles which allows for many different electrode spacings and locations to be recorded in a relatively short time. These integrated or volumetric resistivity measurements include contributions from all of the layers under the sounding site to the depth of investigation of the measurement. Unconstrained modelling of the data result in a two-dimensional resistivity section along the traverses surveyed. However, constrained modelling using existing borehole data can vastly improve modelling results.

The most common arrays in resistivity measurement techniques such as the Wenner and Schlumberger arrays employ all four electrodes symmetrically in a straight line. Other arrays more often used in mineral exploration include the Gradient array; where the potential electrodes are kept fixed and the current electrodes moved along lines parallel to the potential electrodes over an area where the primary electrical field is roughly uniform. Dipole–Dipole arrays are also commonly used where the distance between the current and potential dipoles is at least five times (×5) the dipole length. Variations of the dipole-dipole configurations include the Pole–Pole and Pole–Dipole arrays. Each configuration has its own limitations, advantages and disadvantages. For example, one configuration may be better to resolve lateral changes than others whilst another configuration may offer support or vertical resolution capabilities. Configuration setups for some of the most commonly used electrode arrays are illustrated in Figure 6-1.

Capabilities and Limitations

Proposed survey lines should avoid large underground metallic pipes, electric lines, grounded fences and overhead power lines.

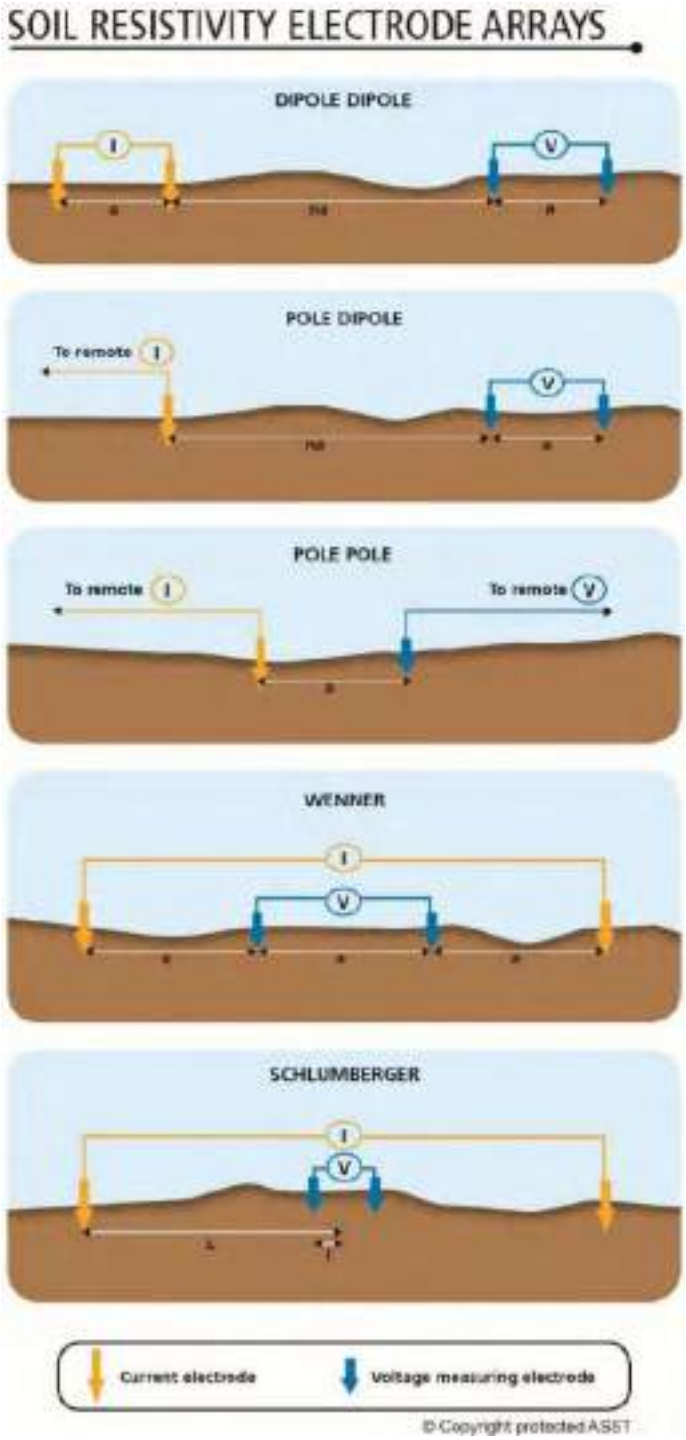
The depth of investigation is typically 20% of the total line length. However, resolution decreases rapidly with depth due to systematic widening of the dipoles. The highest resolution and most accurate depth conversion is provided in the upper 30% of the modelled section where the resolution is approximately 1/3 of the electrode spacing.

The method is labour intensive and in dry conditions saline water need to be poured around electrodes to allow better electrical contact between the electrodes and ground. The interpretation of resistivity soundings necessarily assumes that the subsurface is horizontally layered with no lateral variations in resistivity.

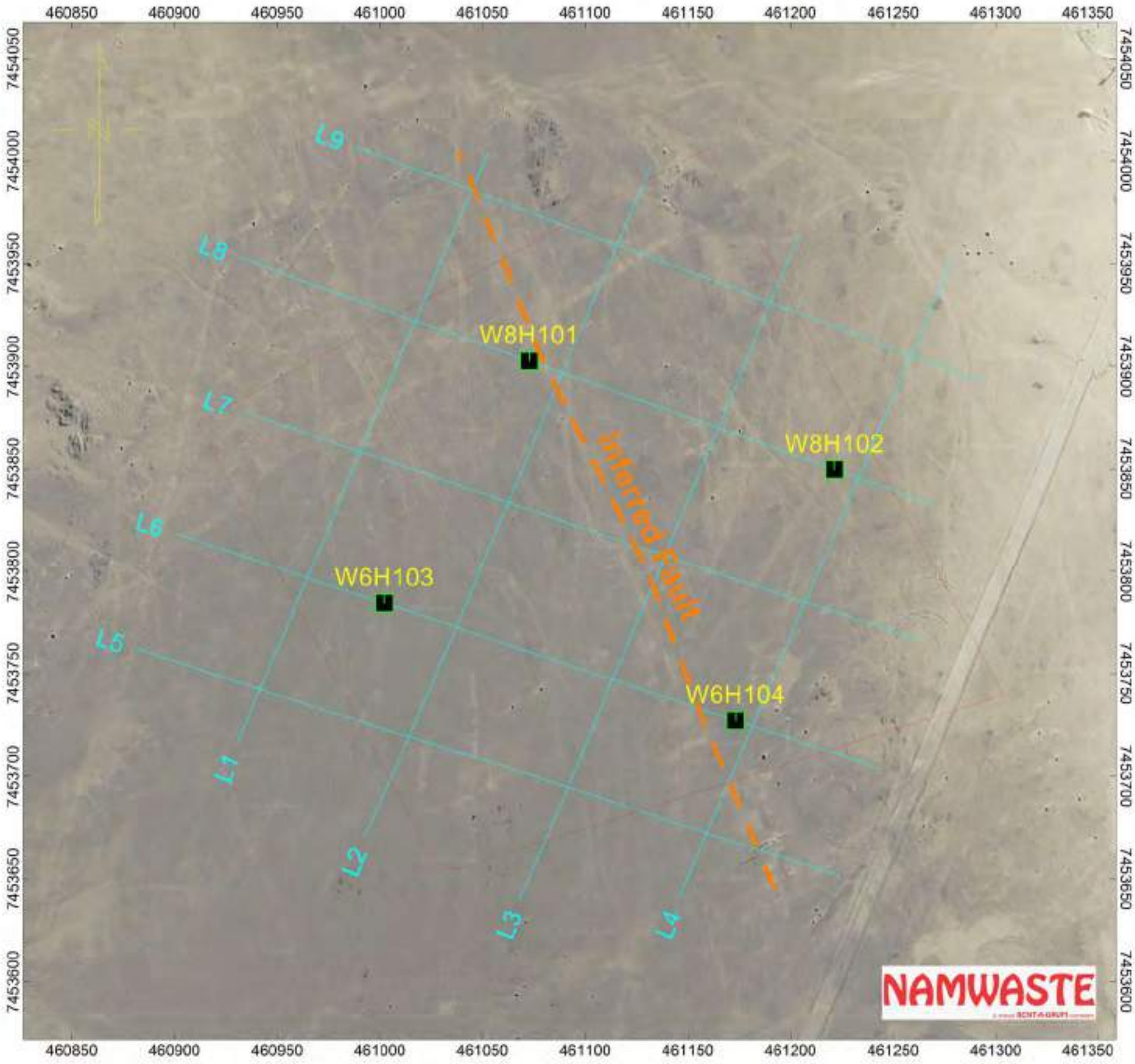
Amongst a variety of applications, typical examples of the applications of this technique include:

- determining the depths and resistivities of geologic layers,
- finding the water table,
- mapping contamination plumes, voids, fractures, faults, and other geologic features as well as archaeological investigations, and
- characterising landfills.

Figure 6-1: Illustration of different electrode configurations.



MAPS AND SECTIONS



Scale 1:2150

25 0 25 50 75

(meters)

WGS 84 / UTM zone 33S

Plan View Map Legend

- 2D ERI Traverses
- Site Boundary
- Proposed Monitoring Borehole Positions

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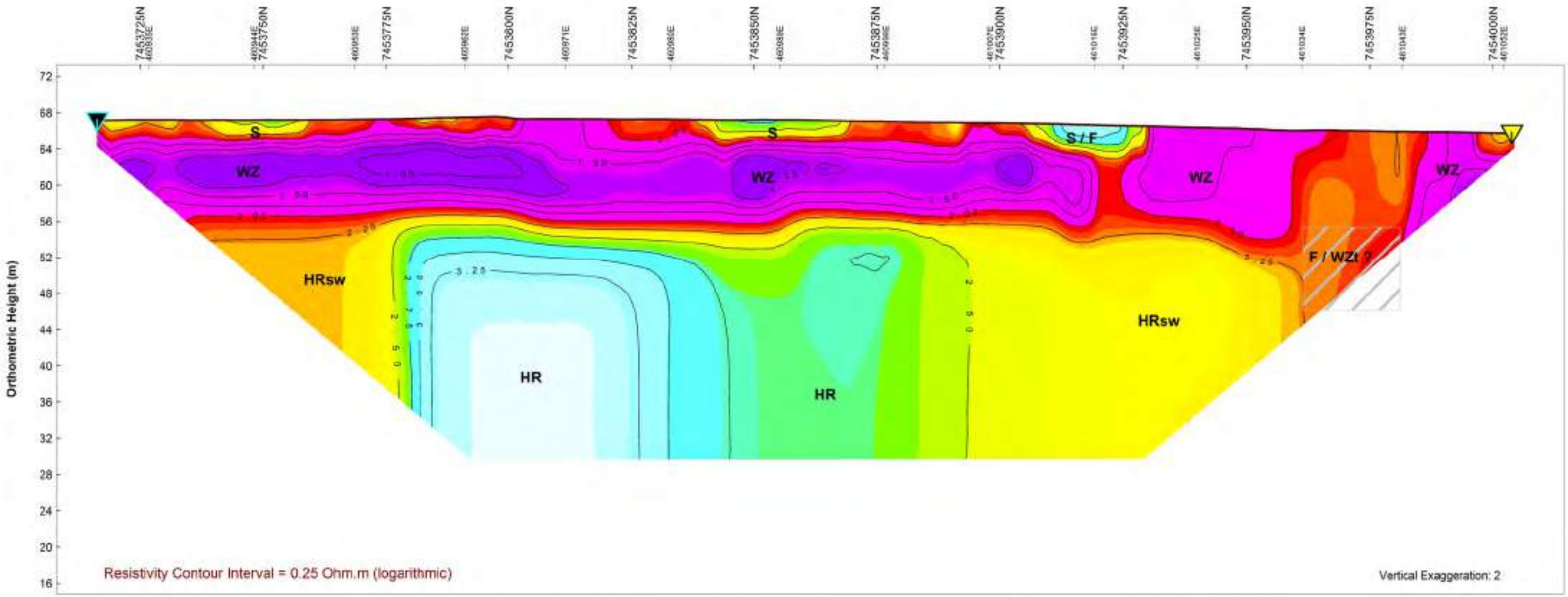
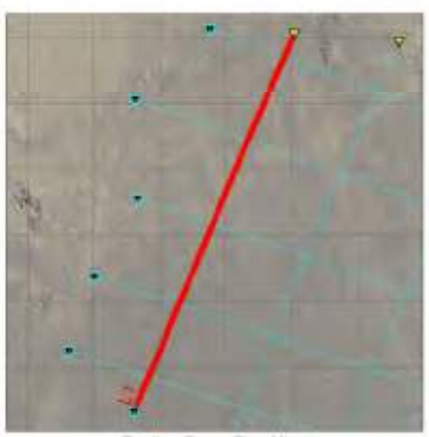
Appendix B
ERI Survey Layout

(Google Earth Backdrop Image On Plan View Map)

Modelled Soil Electrical Resistivity (WTFWB, Line 1)





Section Trace Plan View

Plan View Map Legend

- 2D ERI traverse
- Other 2D ERI traverses
- SOL (Start Of Line)
- EOL (End Of Line)

Section Interpretation

S = Shallow Resistive Surface Material

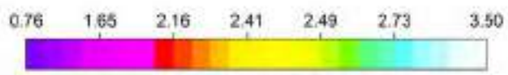
F = Granite Floater

WZ = Highly Weathered Rock / Weathered Material With Possibility Of Clay Material

HR = Unweathered Hardrock

HRsw = Slightly Weathered Rock

F / WZt ? = Inferred Faults / Deep Weathering Or Weathering Trough



Soil Electrical Resistivity
(Ohm.m - Logarithmic)

Scale 1:900

10 0 10 20 30

(metres)
WGS 84 / UTM zone 33S

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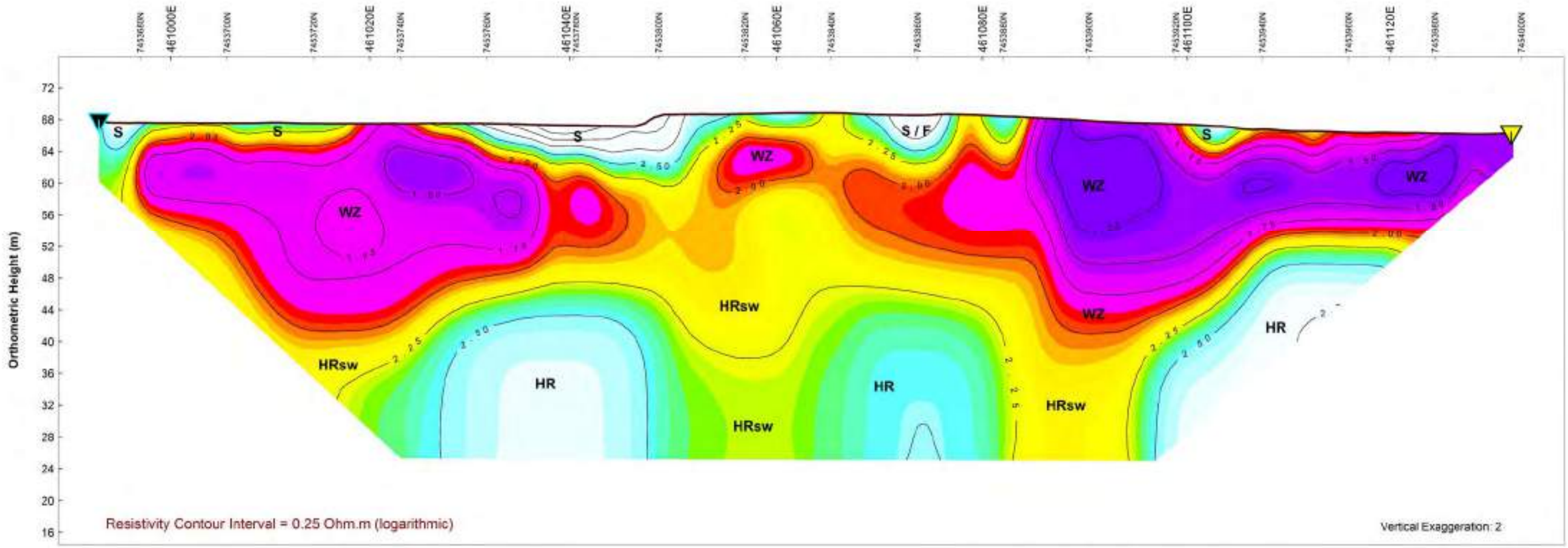
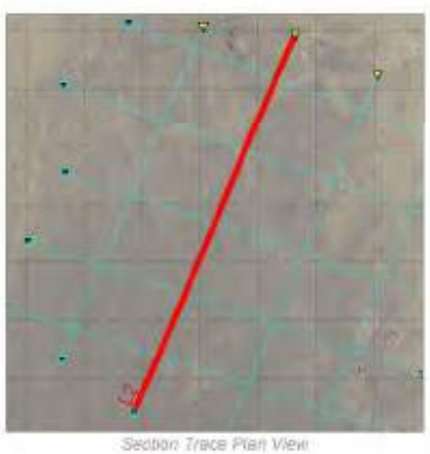
Appendix C1 - Soil Electrical Resistivity

(Google Earth Backdrop Image On Plan View Map)

Modelled Soil Electrical Resistivity (WTFWB, Line 2)





Section Trace Plan View

Plan View Map Legend

- 2D ERI traverse
- Other 2D ERI traverses
- SOL (Start Of Line)
- EOL (End Of Line)

Section Interpretation

S = Shallow Resistive Surface Material

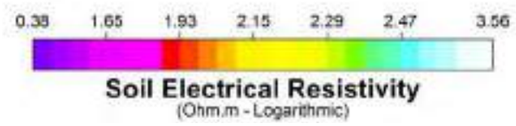
F = Granite Floater

WZ = Highly Weathered Rock / Weathered Material With Possibility Of Clay Material

HR = Unweathered Hardrock

HRsw = Slightly Weathered Rock

F / WZt ? = Inferred Faults / Deep Weathering Or Weathering Trough



Scale 1:1025

25 0 25

(meters)

WGS 84 / UTM zone 33S

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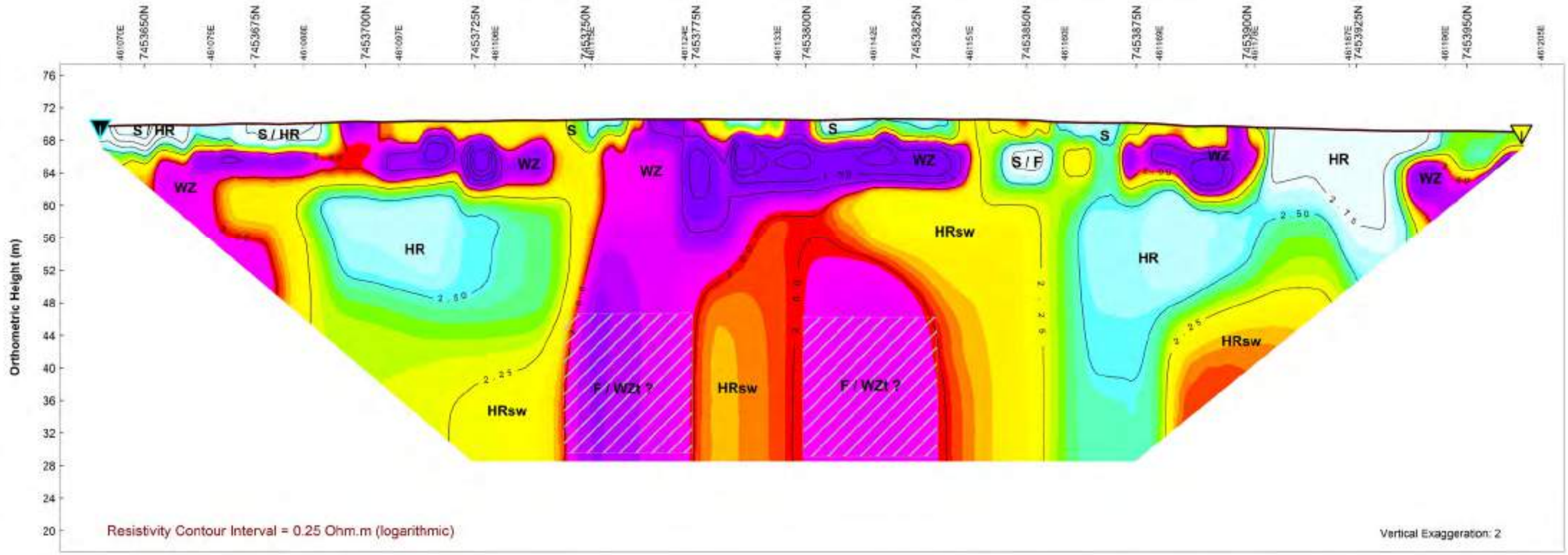
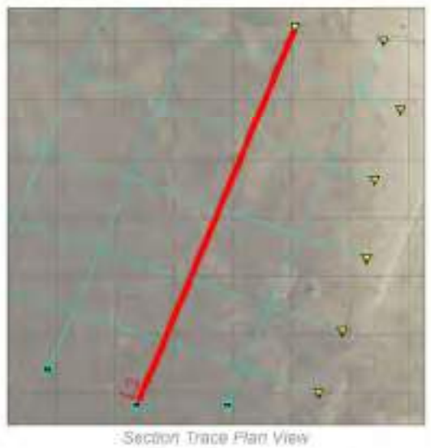
Appendix C2 - Soil Electrical Resistivity

(Google Earth Backdrop Image On Plan View Map)

Modelled Soil Electrical Resistivity (WTFWB, Line 3)





Section Trace Plan View

Plan View Map Legend

- 2D ERI traverse
- Other 2D ERI traverses
- SOL (Start Of Line)
- EOL (End Of Line)

Section Interpretation

S = Shallow Resistive Surface Material

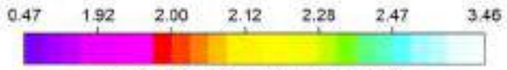
F = Granite Floater

WZ = Highly Weathered Rock / Weathered Material With Possibility Of Clay Material

HR = Unweathered Hardrock

HRsw = Slightly Weathered Rock

F / WZt ? = Inferred Faults / Deep Weathering Or Weathering Trough



Soil Electrical Resistivity
(Ohm.m - Logarithmic)

Scale 1:1000

10 0 10 20 30

(meters)

WGS 84 / UTM zone 33S

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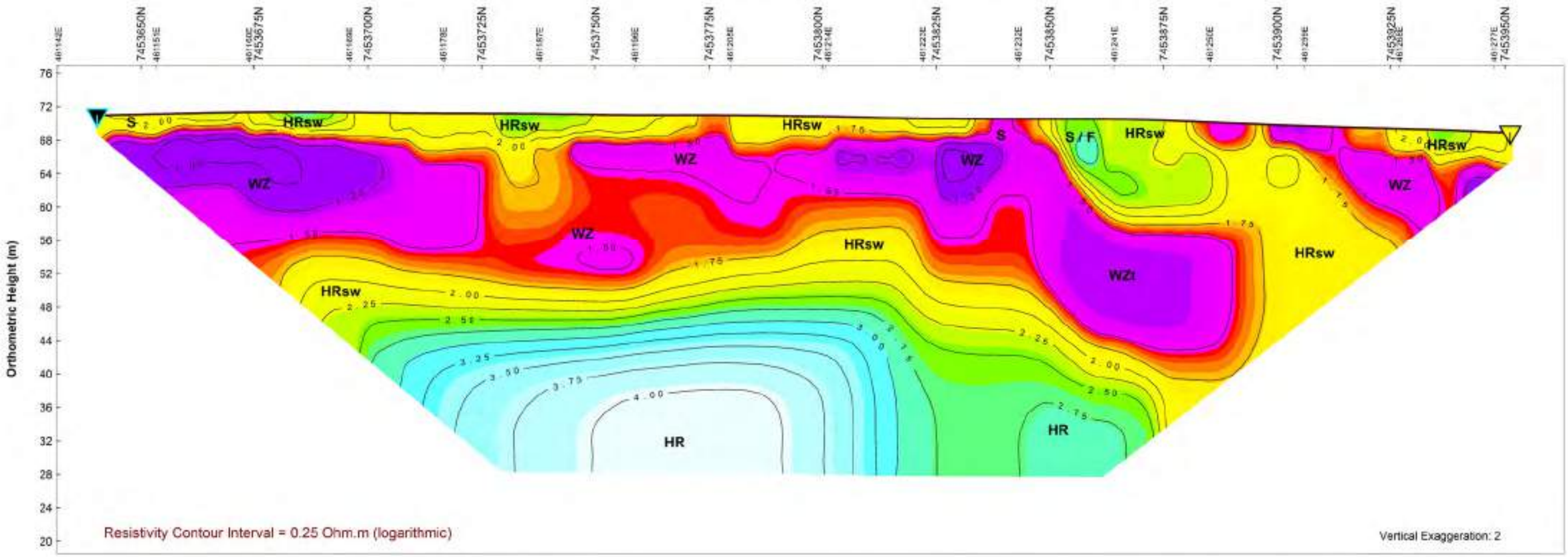
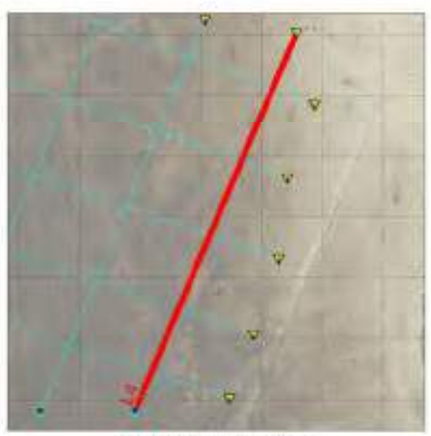
Appendix C3 - Soil Electrical Resistivity

(Google Earth Backdrop Image On Plan View Map)

Modelled Soil Electrical Resistivity (WTFWB, Line 4)




Section Trace Plan View

Plan View Map Legend

- 2D ERI traverse
- Other 2D ERI traverses
- SOL (Start Of Line)
- EOL (End Of Line)

Section Interpretation

S = Shallow Resistive Surface Material

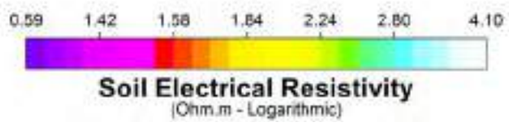
F = Granite Floater

WZ = Highly Weathered Rock / Weathered Material With Possibility Of Clay Material

HR = Unweathered Hardrock

HRsw = Slightly Weathered Rock

F / WZt ? = Inferred Faults / Deep Weathering Or Weathering Trough



Scale 1:975

(meters)

WGS 84 / UTM zone 33S

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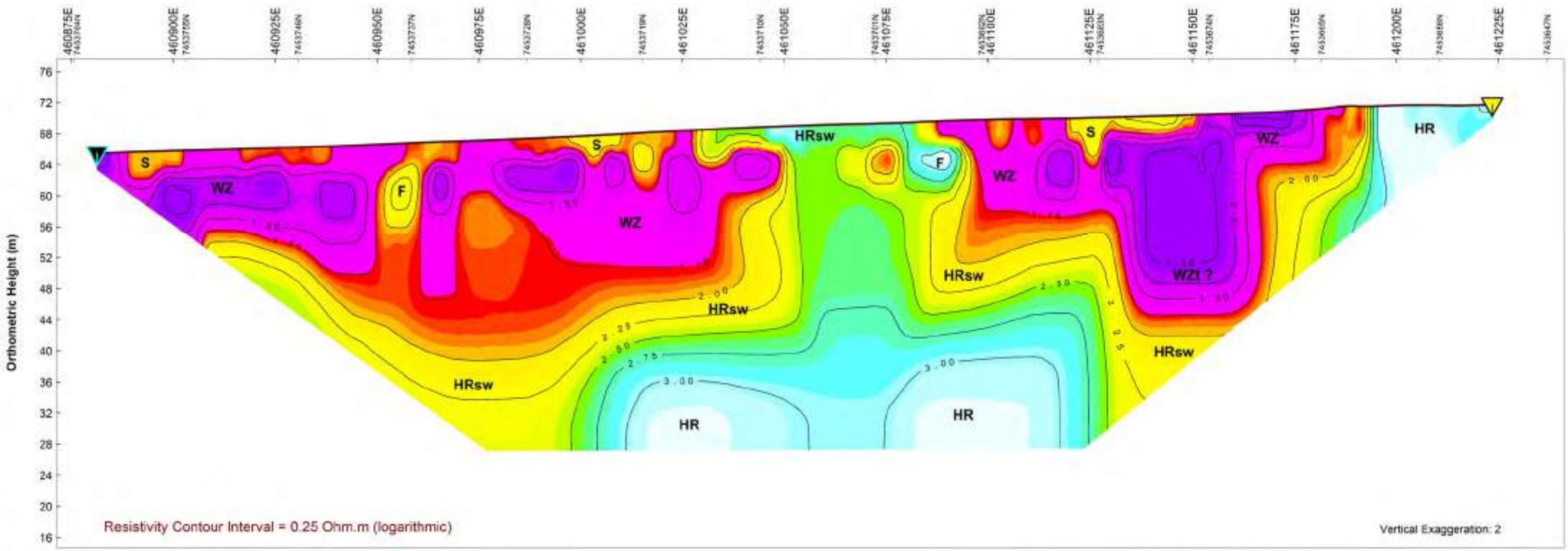
Appendix C4 - Soil Electrical Resistivity

(Google Earth Backdrop Image On Plan View Map)

Modelled Soil Electrical Resistivity (WTFWB, Line 5)



Section Trace Plan View

Plan View Map Legend

- 2D ERI traverse
- Other 2D ERI traverses
- SOL (Start Of Line)
- EOL (End Of Line)

Section Interpretation

S = Shallow Resistive Surface Material

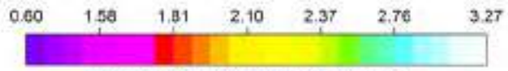
F = Granite Floater

WZ = Highly Weathered Rock / Weathered Material With Possibility Of Clay Material

HR = Unweathered Hardrock

HRsw = Slightly Weathered Rock

F / WZt ? = Inferred Faults / Deep Weathering Or Weathering Trough



Soil Electrical Resistivity
(Ohm.m - Logarithmic)

Scale 1:1050

25 0 25

(meters)

WGS 84 / UTM zone 33S

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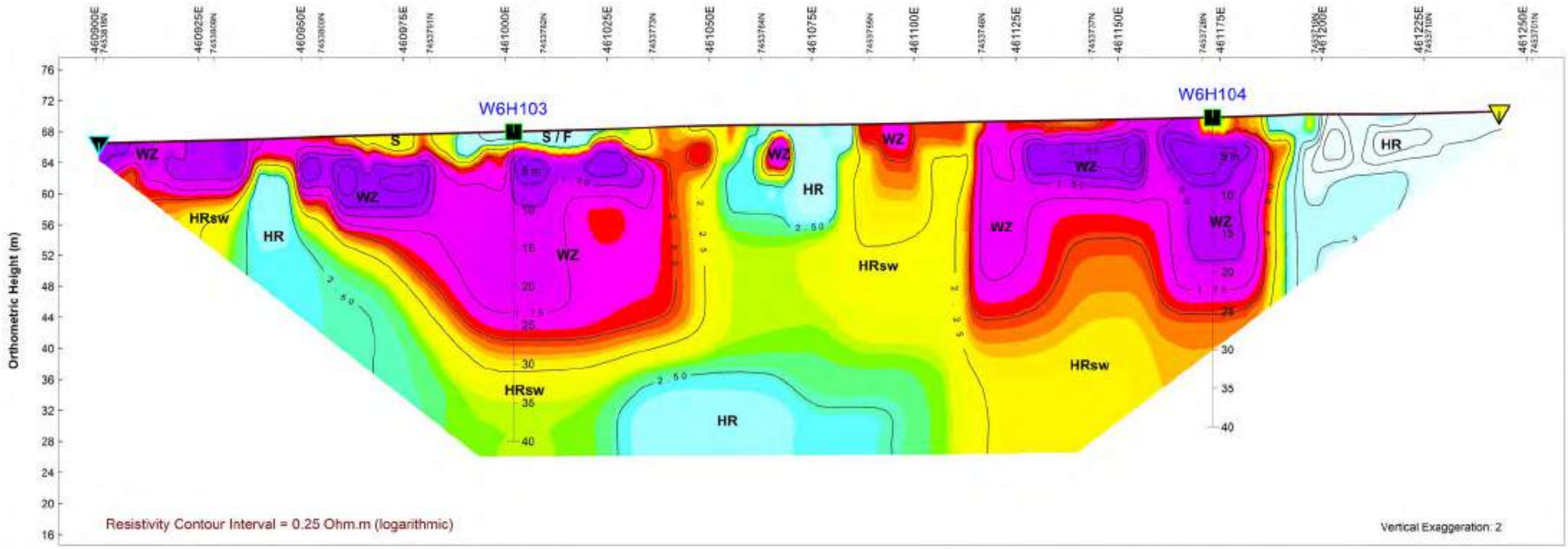
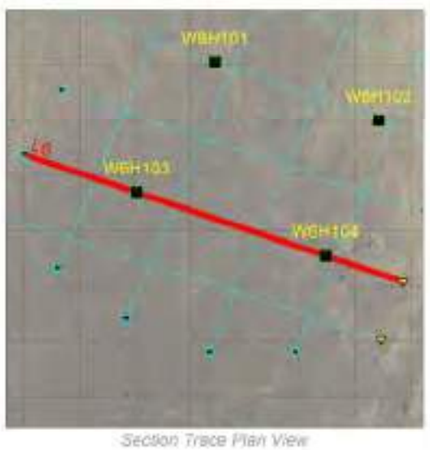
Appendix C5 - Soil Electrical Resistivity

(Google Earth Backdrop Image On Plan View Map)

Modelled Soil Electrical Resistivity (WTFWB, Line 6)





Section Trace Plan View

Plan View Map Legend

- 2D ERI traverse
- Other 2D ERI traverses
- SOL (Start Of Line)
- EOL (End Of Line)

Section Interpretation

S = Shallow Resistive Surface Material

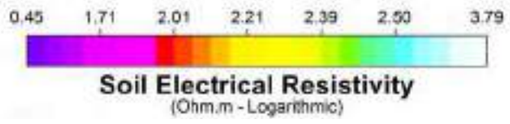
F = Granite Floater

WZ = Highly Weathered Rock / Weathered Material With Possibility Of Clay Material

HR = Unweathered Hardrock

HRsw = Slightly Weathered Rock

F / WZt ? = Inferred Faults / Deep Weathering Or Weathering Trough



Scale 1:1050

25 0 25

(meters)

WGS 84 / UTM zone 33S

NAMWASTE

Knight Piésold CONSULTING

Created by

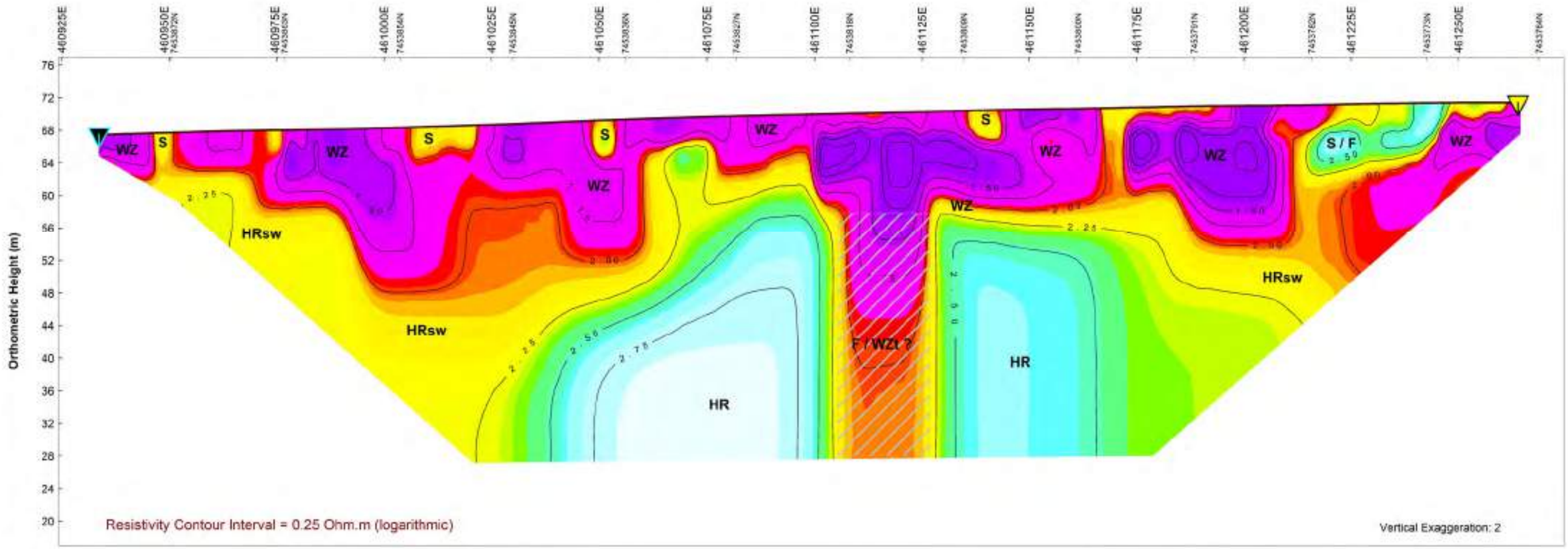
ASST

Waste Treatment Facility - Walvis Bay

Appendix C6 - Soil Electrical Resistivity

(Google Earth Backdrop Image On Plan View Map)

Modelled Soil Electrical Resistivity (WTFWB, Line 7)



Plan View Map Legend

- 2D ERI traverse
- Other 2D ERI traverses
- SOL (Start Of Line)
- EOL (End Of Line)

Section Interpretation

S = Shallow Resistive Surface Material

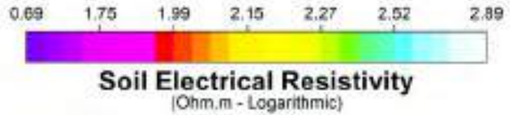
F = Granite Floater

WZ = Highly Weathered Rock / Weathered Material With Possibility Of Clay Material

HR = Unweathered Hardrock

HRsw = Slightly Weathered Rock

F / WZt ? = Inferred Faults / Deep Weathering Or Weathering Trough



Scale 1:1000

10 0 10 20 30

(meters)

WGS 84 / UTM zone 33S

NAMWASTE

Knight Piésold CONSULTING

Created by

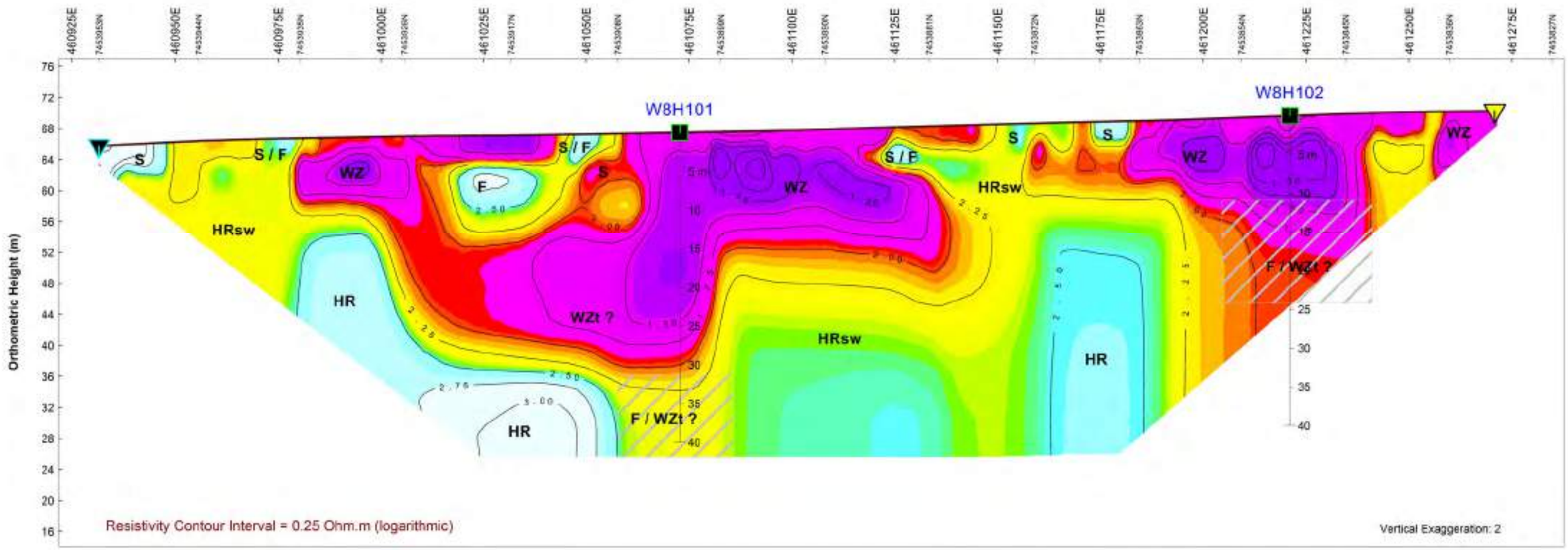
ASST

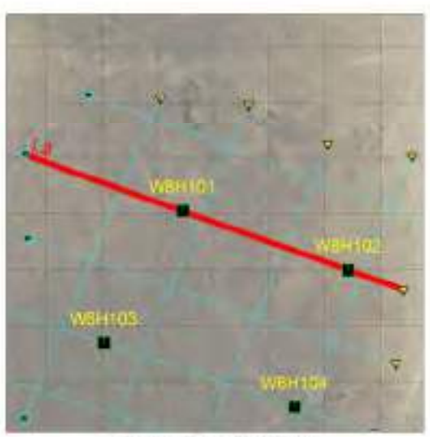
Waste Treatment Facility - Walvis Bay

Appendix C7 - Soil Electrical Resistivity

(Google Earth Backdrop Image On Plan View Map)

Modelled Soil Electrical Resistivity (WTFWB, Line 8)





Section Trace Plan View

Plan View Map Legend

- 2D ERI traverse
- Other 2D ERI traverses
- SOL (Start Of Line)
- EOL (End Of Line)

Section Interpretation

S = Shallow Resistive Surface Material

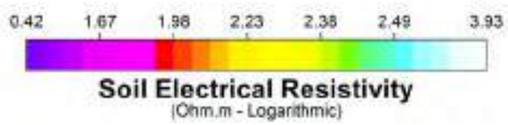
F = Granite Floater

WZ = Highly Weathered Rock / Weathered Material With Possibility Of Clay Material

HR = Unweathered Hardrock

HRsw = Slightly Weathered Rock

F / WZt ? = Inferred Faults / Deep Weathering Or Weathering Trough



Scale 1:1050

25 0 25

(meters)

WGS 84 / UTM zone 33S

NAMWASTE

Knight Piésold CONSULTING

Created by

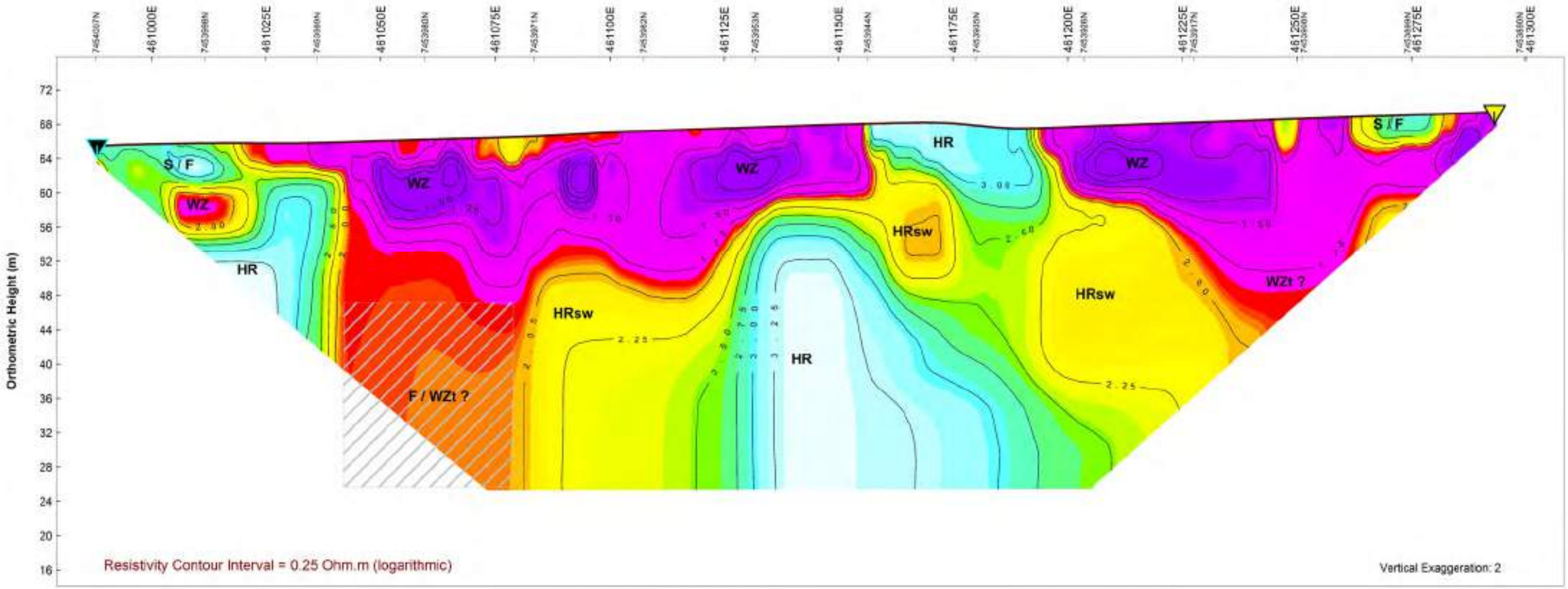
ASST

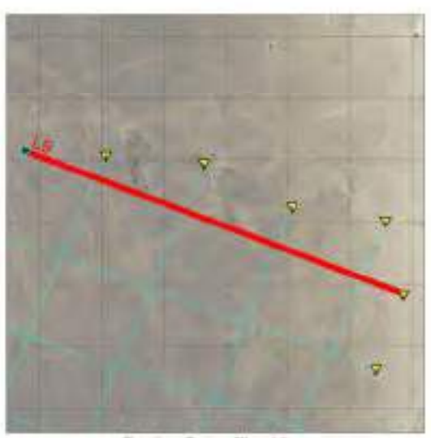
Waste Treatment Facility - Walvis Bay

Appendix C8 - Soil Electrical Resistivity

(Google Earth Backdrop Image On Plan View Map)

Modelled Soil Electrical Resistivity (WTFWB, Line 9)





Section Trace Plan View

Plan View Map Legend

- 2D ERI traverse
- Other 2D ERI traverses
- SOL (Start Of Line)
- EOL (End Of Line)

Section Interpretation

S = Shallow Resistive Surface Material

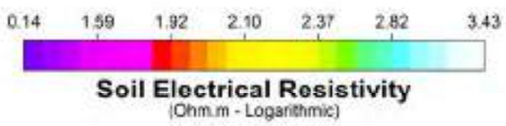
F = Granite Floater

WZ = Highly Weathered Rock / Weathered Material With Possibility Of Clay Material

HR = Unweathered Hardrock

HRsw = Slightly Weathered Rock

F / WZt ? = Inferred Faults / Deep Weathering Or Weathering Trough



Scale 1:950

10 0 10 20 30

(meters)

WGS 84 / UTM zone 33S

NAMWASTE

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Created by

ASST

Waste Treatment Facility - Walvis Bay

Appendix C9 - Soil Electrical Resistivity

(Google Earth Backdrop Image On Plan View Map)

APPENDIX A2

Drilling Activities Notification

Izelda Mbatha

From: Lloyd Lynch
Sent: Wednesday, 26 June 2024 09:25
To: James Mouton; Edward Godfried
Cc: Hulisani Netshisaulu; Camille Kraak; Lise Steyn; Thierry Provendier; Bertram Swartz
Subject: RE: Drilling activities notification
Attachments: 20240530_MAWLR_WVSB_Dirllind pre-permit.pdf

Good day James and Edward,

I trust you're both well.
I just wanted to notify you that the drilling at the Walvis Bay site is scheduled to commence on the 5th of July. Attached is the preapproval for reference.
The contractor who will undertake the drilling is Hammerstein, with supervision provided by Knight Piésold Consulting (Pty) Ltd, as undertaken for the Lüderitz site.

Kind Regards

Lloyd Lynch, Pr.Sci.Nat
Senior Environmental Scientist
Knight Piésold (Pty) Ltd.
T: +27 11 806 7111

From: Lloyd Lynch
Sent: Thursday, June 6, 2024 4:22 PM
To: James Mouton <James.Mouton@mawlr.gov.na>
Cc: Hulisani Netshisaulu <hulisanin@interwaste.co.za>; Camille Kraak <ckraak@knightpiesold.com>; Lise Steyn <l.steyn@interwaste.co.za>; Thierry Provendier <t.provendier@rent-a-drum.com.na>; Edward Godfried <edward.Godfried@mawlr.gov.na>; Bertram Swartz <Bertram.Swartz@mawlr.gov.na>
Subject: RE: Drilling activities notification

Good afternoon James,

Thanks for the prompt response, and for allowing us to begin drilling. We will ensure that technical details 2 – 5 are complied with during the drilling. The contractor who will undertake the drilling is Hammerstein, with supervision provided by Knight Piésold Consulting (Pty) Ltd.

We will ensure to inform Mr. Edward Godfried once drilling has been completed.

Looking forward to receiving the Walvis Bay pre-approval.

Have a fantastic day further.
Kind Regards

Lloyd Lynch, Pr.Sci.Nat
Senior Environmental Scientist
Knight Piésold (Pty) Ltd.
T: +27 11 806 7111

From: James Mouton <James.Mouton@mawlr.gov.na>
Sent: Thursday, June 6, 2024 3:50 PM
To: Lloyd Lynch <llynch@knightpiesold.com>
Cc: Hulisani Netshisaulu <hulisanin@interwaste.co.za>; Camille Kraak <ckraak@knightpiesold.com>; Lise Steyn <l.steyn@interwaste.co.za>; Thierry Provendier <t.provendier@rent-a-drum.com.na>; Edward Godfried <edward.Godfried@mawlr.gov.na>; Bertram Swartz <Bertram.Swartz@mawlr.gov.na>
Subject: Re: Drilling activities notification

[EXTERNAL EMAIL]

Good afternoon Mr Lynch

Your email was well received and noted. You can start with the drilling immediately, just make sure that you inform Mr Edward Godfried from our Geohydrology Division who the appointed contract driller is and immediately after drilling is completed. Just make sure that the technical conditions 2 to 5 are complied with during the drilling operation.

The pre approval for Walvis Bay should most properly be ready by tomorrow.

Kind Regards

James Norman Mouton
Administrative Officer
Division Water Law Administration
Directorate of Water Resources Management
Department of Water Affairs
Ministry of Agriculture, Water and Land Reform
Government Office Park, Luther Street, Windhoek, Namibia
Tel: +264 61 208 7228 / Cell: +264 81 7175888

From: Lloyd Lynch <llynch@knightpiesold.com>
Sent: Thursday, June 6, 2024 2:33:10 PM
To: James Mouton
Cc: Hulisani Netshisaulu; Camille Kraak; Lise Steyn; Thierry Provendier; Edward Godfried; Bertram Swartz
Subject: FW: Drilling activities notification

Good afternoon James,

Thanks for the quick call.
As discussed, the drilling at the Lüderitz project site is scheduled to commence on Monday the 10th of June.
Please could you confirm if we can proceed as scheduled?
We are still awaiting for the preapproval for Walvis Bay, but drilling at Walvis bay is scheduled for later this month.

Kind Regards

Lloyd Lynch, Pr.Sci.Nat
Senior Environmental Scientist
Knight Piésold (Pty) Ltd.
T: +27 11 806 7111

From: Lloyd Lynch
Sent: Thursday, June 6, 2024 2:07 PM
To: edward.godfried@mawlr.gov.na; Bertram.Swartz@mawlr.gov.na
Cc: Camille Kraak <ckraak@knightpiesold.com>; Hulisani Netshisaulu <hulisanin@interwaste.co.za>; Lise Steyn <l.steyn@interwaste.co.za>; Thierry Provendier <t.provendier@rent-a-drum.com.na>; Izelda Mbatha <imbatha@knightpiesold.com>
Subject: Drilling activities notification

Good day Edward and Bertram,

I trust you're both well.
We have just received pre-approvals to undertake drilling at two sites (Walvis Bay and Luderitz), as attached.
The appointed contractor for the drilling is Hammerstein, who will be mobilising this weekend to start drilling on Monday the 10th of June.
It came to our attention today that we need to inform you of our plans a week before drilling commences as part of the pre-approval requirements. Please advise whether we may continue as scheduled.

Kind Regards

Lloyd Lynch, Pr.Sci.Nat
Senior Environmental Scientist
Knight Piésold (Pty) Ltd.

T: +27 11 806 7111
1 Discovery Place, The Ridge, Sandhurst
Sandton | Gauteng | South Africa | 2196
twitter | linkedin | facebook

Knight Piésold CONSULTING

ISO 9001:2015 Certificate No: 212061140/5
ISO 14001:2015 Certificate No: 170414034/2
ISO 45001:2018 Certificate No: 271012066/3

This communication is confidential and subject to the legal disclaimer located at this link: Disclaimer.

REPUBLIC OF NAMIBIA

MINISTRY OF AGRICULTURE, WATER AND LAND REFORM

Tel.: (061) 2087228
Fax: (061) 2087697
Enquiries: Hamoratius Swartz
Email: Hamoratius.Swartz@mawlr.gov.na
Reference: PF General

Government Office Park
Private Bag 13193
WINDHOEK

30 May 2024

Mr Thierry Provendier
Namwaste (Pty) Ltd
P O Box 30735
Farm 38 Walvis Bay

Dear Mr Provendier

APPLICATION FOR A LICENCE FOR THE DRILLING OF FOUR (4) BOREHOLES FOR MONITORING PURPOSES ON PORTION 160 OF THE PROPOSED PORTION A OF THE REMAINDER OF FARM NO.38, WALVIS BAY DISTRICT, ERONGO REGION, NAMWASTE (PTY) LTD

1. Your application dated 07 May 2024 for a borehole license to drill four (4) boreholes to an approximate depth of 60 m for monitoring purposes was received.

2. This letter thus authorizes the drilling of four (4) boreholes for monitoring purposes on portion 160 of the proposed portion A of the remainder of Farm no 38 in the Walvis Bay District, as an interim arrangement while the licence is being processed.

3. The applicant is requested to comply with all conditions listed hereunder.

4. This pre-approval authorizes the drilling of four (4) boreholes identified as **WW207348, WW 207355, WW207356** and **WW207357** for the purpose mentioned above.

Accept the assurance of my highest consideration.

Yours sincerely

EXECUTIVE DIRECTOR
07 JUN 2024
Republic of Namibia

Ndiyakupi Nghituwamata (Ms)
Executive Director

APPLICATION FOR A LICENCE FOR THE DRILLING OF FOUR (4) BOREHOLES FOR MONITORING PURPOSES ON PORTION 160 OF THE PROPOSED PORTION A OF THE REMAINDER OF FARM NO.38, WALVIS BAY DISTRICT, ERONGO REGION, NAMWASTE (PTY) LTD

License conditions

This license authorizes the drilling of four boreholes identified as **WW207348**, **WW207355**, **WW207356** and **WW207357** for monitoring purposes as indicated on the farm planning map attached, subject to the following conditions:

1. If drilling is not completed within three years from the date of this license, this license automatically expires and application shall be made to the Executive Director for the issuing of a new license.
2. Where a borehole is drilled in a riverbed, no embankments shall be constructed around the borehole in the riverbed which could result in the river damming up or its normal flow being impeded.
3. All installations, reservoirs, pipes and taps shall be leak proof to prevent any spillage of water. The license holder shall take the necessary precautions to use the water on his property to the best advantage.
4. The Minister may amend a license issued under this Act to the extent necessary to prevent or rectify any significant adverse effect in relation to any matter mentioned in section 56 of this Act caused or likely to be caused by an activity carried out under the license.
5. The Minister may suspend or cancel a license issued under this Act, if the holder of the license:
   a) fails to comply with a condition to which the license is subject
   b) fails to comply with this Act or a directive given under this Act in connection with the license
   c) fails to commence with operations under the license within the period specified in the license;
   d) having commenced with such operations, discontinues operations under the license or fails to use the full quota allocated under the license for a continuous period of at least three years; or
   e) fails to pay any fee or charge payable in respect of the license
6. An authorized person may, at any reasonable time and without notice, enter any land or premises where activities under a license issued under this Act are carried on for the purpose of –
   a) inspecting any waterworks or the use of water or the discharge of wastewater effluent or waste; or
   b) Ascertaining whether this Act or the conditions of the license are being complied with.
7. The Minister shall not accept liability for damage or loss suffered by the license holder should the relevant source wane or run dry or the period of validity of the license not be extended or renewed.
8. Should the license holder not comply with any of the license conditions:
   a) the Minister may seal the borehole until the conditions are complied with;

b) the license holder may be held liable for any costs which the Minister may incur as a result thereof, and

c) the license holder shall be guilty of an offence and shall, on conviction, be liable to the penalties prescribed in Section 127 of the Water Resource Management Act, 2013 (Act 11 of 2013).

TECHNICAL DETAILS

1. At least one week before drilling commences, the license holder shall contact the Geohydrology Division: (Mr. Edward Godfried, 061-208 7105 or edward.godfried@mawlr.gov.na) at Windhoek indicating when drilling is to commence and who the appointed drilling contractor will be. As soon as the drilling operation is completed, the license holder shall inform the Geohydrology Division. Failure to do so will be seen in a serious light and punitive measures will be applied.

2. The drill cuttings shall be sampled every one meter during the entire drilling process of the four (4) boreholes by means of prescribed chip (drill cutting) trays and also each time the formation changes indicating on each chip tray the depths at which the sample was taken and the formation change occurred. A drilling record must be completed for each borehole, indicating the penetration rates and borehole completion reports must be fully completed and signed by the driller and supervising Hydro geologist.

3. If drilling is unsuccessful the surface steel casing shall be left in the borehole and a sanitary seal shall be tightly welded onto the top of the surface casing, with the borehole number scripted on it.

4. The drill chip samples, drilling record, borehole completion report, borehole development report, and test pumping data forms must be submitted to the Division of Water Law Administration (WLA).

5. The license holder shall seal the monitoring borehole in such a way that water level measurement and water sampling can be undertaken at the monitoring borehole.

6. This license is strictly for the drilling of a borehole for monitoring purposes. No abstraction of groundwater is permissible unless for water quality sampling purposes.

APPENDIX A3

Borehole Logs and Completion Certificates

BOREHOLE COMPLETION REPORT

2804

Applicant: Hammerstein Mining & Drilling	Borehole number: NB-BH1 WW207348
Farm:	Topo & well number:
District: Walvis Bay	Latitude:
Date commenced: 09/07/24	Longitud:
Date completed: 09/07/24	Collar height: m (not elevation)
GEOLOGY	Total depth from surface: m

From (m)	To(m)	Description
0	60	BH1
0-5		= Calcritic Granite
5-10		= Calcitized Residual Soil
10-60		= Granite

DIAMETER OF BOREHOLE

mm from		to	
mm from	0	to	18 M 10 Inch
mm from	18	to	60 M 8 Inch

First water strike:	50 m	Seepage
Second water strike:	m	
Third water strike:	m	
Water level:	m	
Yield:	m³/h	
Apparent quality of water:		
TDS when drilled:		

INITIAL CAPACITY TEST

Airlift yield:	
Pump yield:	
Yield in m³/h:	m³/h
Date:	
Duration:	

DRILLING COST

ITEM	N$
m drilled N$ per m	
Testing of borehole:	
CASING	
Plain: PVC ~~MS~~ length (m) Steel	18 m 10 inch
N$ per m:	
Perforated: 7 length (m)	
N$ per m:	
TOTAL COST:	

State whether the borehole is:

Successful:	Casing left in borehole: Y
Unsuccessful: Successful	Casing recovered:

DECLARATION BY DRILLER AND DRILLING INSPECTOR

I declare that the information supplied above is true and correct	I declare that the information supplied above is true and correct
Signature of driller:	Signature of drilling inspector:
Rank: Supervisor	Rank:
Date: 10/07/24	Date:
Place: Walvisbay (site)	Place:

John Meinert 2024-60740

Responsible Geohydrogeologist	Signature	Date
	Izabela Mbaatha	09/07/24

BOREHOLE COMPLETION REPORT

2805

Applicant: Hammerstein Mining & Drilling	Borehole number: ~~WB BH3~~ WW207356.
Farm: Walvisbay	Topo & well number:
District: Walvisbay	Latitude:
Date commenced: 11/07/24	Longitude:
Date completed: 11/07/24	Collar height: m (not elevation)
	Total depth from surface: m

GEOLOGY

From (m)	To(m)	Description
0	60	BH3
0-2 = Calcrete		
2-60 = Granite		

DIAMETER OF BOREHOLE

mm from		to
mm from	0	to 18 m (10 Inch)
mm from	18	to 60 m (8 Inch)

First water strike:	m
Second water strike:	m
Third water strike:	m
Water level:	m
Yield:	m³/h
Apparent quality of water:	
TDS when drilled:	

INITIAL CAPACITY TEST

Airlift yield:	
Pump yield:	
Yield in m³/m:	m³/h
Date:	
Duration:	

DRILLING COST

ITEM	N$
m drilled N$ per m	
Testing of borehole:	
CASING	
Plain: 11.5 length (m) 18 m (10 inch Steel)	
N$ per m:	
Perforated: 10 length (m)	
N$ per m:	
TOTAL COST:	

State whether the borehole is:

Successful: Successful	Casing left in borehole: Y
Unsuccessful:	Casing recovered:

DECLARATION BY DRILLER AND DRILLING INSPECTOR

I declare that the information supplied above is true and correct	I declare that the information supplied above is true and correct
Signature of driller:	Signature of drilling inspector:
Rank: Supervisor	Rank:
Date: 12/07/24	Date:
Place: Walvisbay Site	Place:

John Meinert 2024-00740

Responsible Geohydrogeologist — Izelda Mbartha — Signature — 11/07/24 — Date

BOREHOLE COMPLETION REPORT

2806

Applicant: Hammerstein Mining & Drilling	Borehole number: WB BH4 WW207357
Farm: Walvisbay	Topo & well number:
District: Walvisbay	Latitude:
Date commenced: 12/07/24	Longitud:
Date completed: 13/07/24	Collar height: m (not elevation)
GEOLOGY	Total depth from surface: m

From (m)	To(m)	Description
0	60	BH02

0 - 2 = Calcrete

2 - 60 = Granite

DIAMETER OF BOREHOLE

mm from		to
mm from	0	to 18 m (10 inch)
mm from	18	to 60m (8 inch)

First water strike:	m
Second water strike:	m
Third water strike:	m
Water level:	m
Yield:	m³/h
Apparent quality of water:	
TDS when drilled:	

INITIAL CAPACITY TEST

Airlift yield:	
Pump yield:	
Yield in m³/h:	m³/h
Date:	
Duration:	

DRILLING COST

ITEM		N$
m drilled N$	per m	
Testing of borehole:		
CASING		
Plain: 125	length (m) 18 m (10 Inch)	
N$ per m:		
Perforated: 9	length (m)	
N$ per m:		
TOTAL COST:		

State whether the borehole is:

Successful: Successful	Casing left in borehole: Y
Unsuccessful:	Casing recovered:

DECLARATION BY DRILLER AND DRILLING INSPECTOR

I declare that the information supplied above is true and correct	I declare that the information supplied above is true and correct
Signature of driller:	Signature of drilling inspector:
Rank: Supervisor	Rank:
Date: 13/07/24	Date:
Place: Walvisbay Site	Place:

Responsible Geohydrogeologist

Fjeldi Mbaatha — Signature

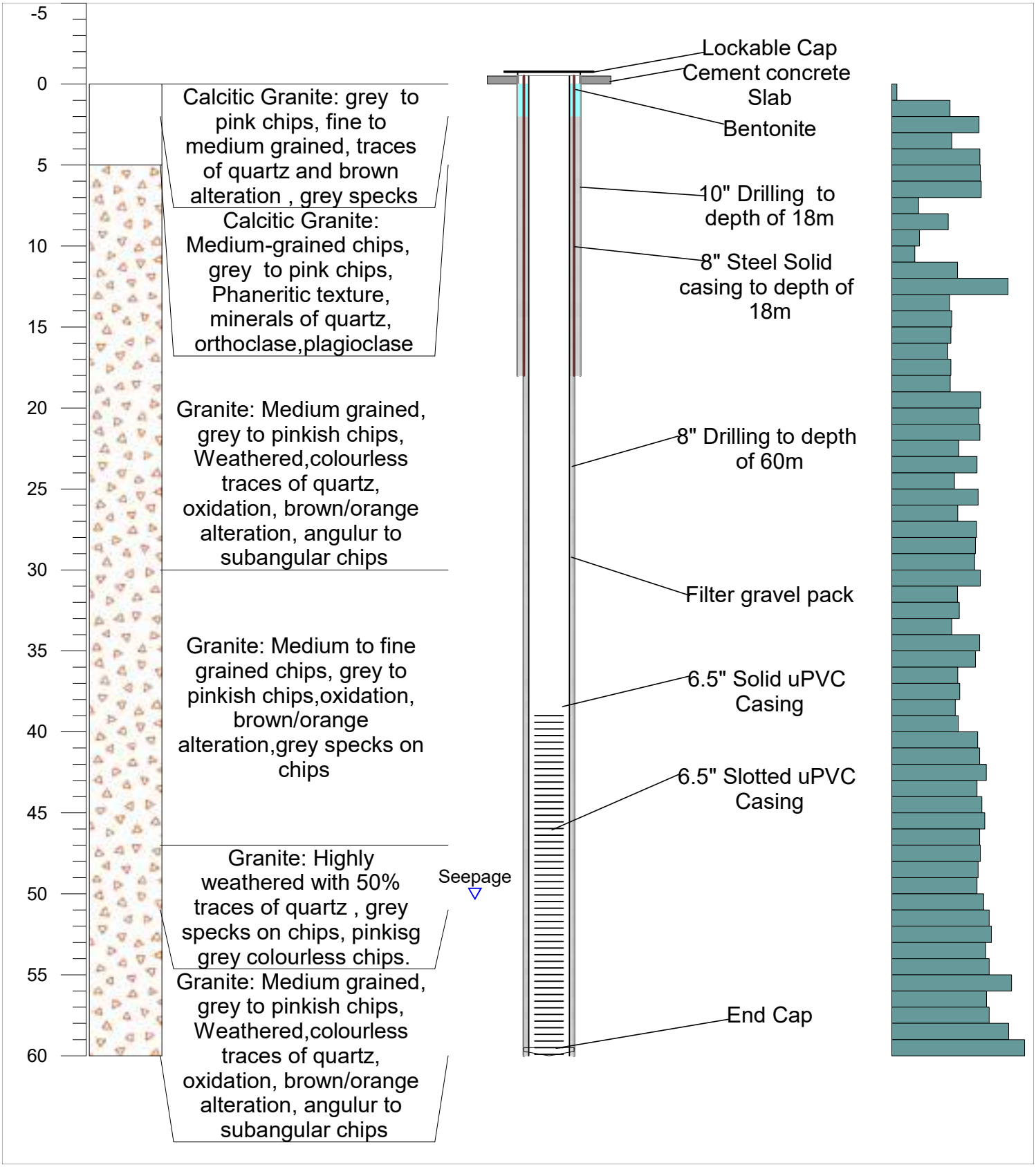
13/07/24 — Date

Knight Piésold CONSULTING

BOREHOLE NO.

WW207348

CLIENT:	Namwaste Pty Ltd	**COORD SYST.:**	WGS84 UTM 33S
PROJECT NO.:	WI306-00033/01	**LATITUDE:**	7453946 m
LOCATION:	Walvis Bay	**LONGITUDE:**	461061 m
DATE COMMENCED:	8/7/2024	**ELEVATION:**	80 m
DATE COMPLETED:	9/7/2024	**WATER STRIKE:**	50 mbs
DRILLED BY:	Hammerstein Drilling	**BLOW YIELD:**	NA m3/hr
LOGGED BY:	Izelda Mbatha	**AVERAGE TESTED YIELD:**	NA m3/hr



NOTES: Air Percussion drilling

Borehole was fully cased to depth of 60m.

No water strike was encountered. Seepage was encountered at depth of 50m.

Knight Piésold CONSULTING

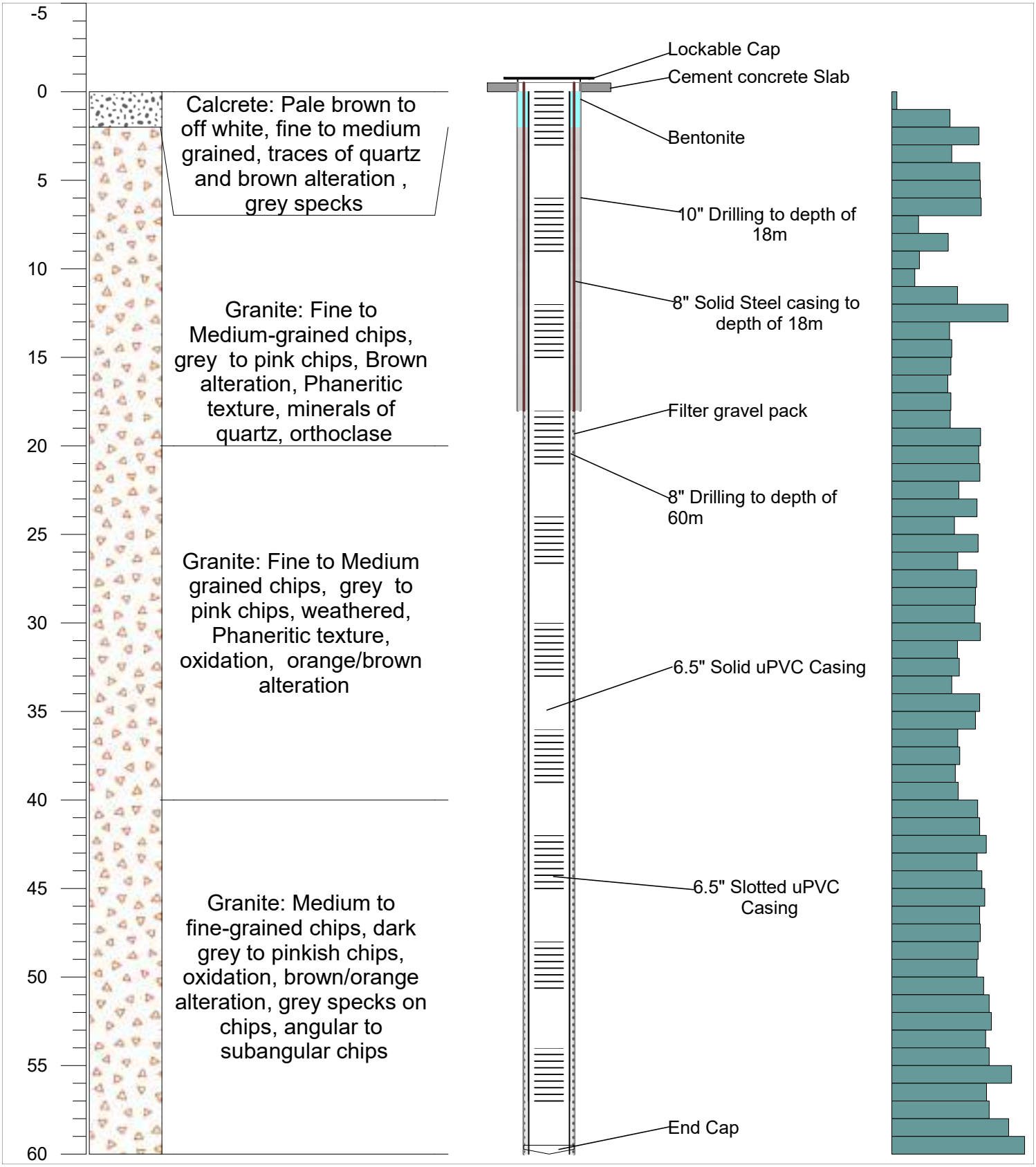
BOREHOLE NO.

WW207356

CLIENT:	Namwaste Pty Ltd	**COORD SYST.:**	WGS84 UTM 33S
PROJECT NO.:	WI306-00033/01	**LATITUDE:**	7453778 m
LOCATION:	Walvis Bay	**LONGITUDE:**	460993 m
DATE COMMENCED:	11/7/2024	**ELEVATION:**	81 m
DATE COMPLETED:	12/7/2024	**WATER STRIKE:**	NA mbs
DRILLED BY:	Hammerstein Drilling	**BLOW YIELD:**	NA m3/hr
LOGGED BY:	Izelda Mbatha	**AVERAGE TESTED YIELD:**	NA m3/hr

Penetration Rate (m/min)

0.4 1.4 2.4 3.4 4.4



NOTES: Air Percussion drilling

Borehole was fully cased to depth of 60m.

No water strike was encountered.

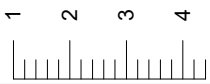
Knight Piésold CONSULTING

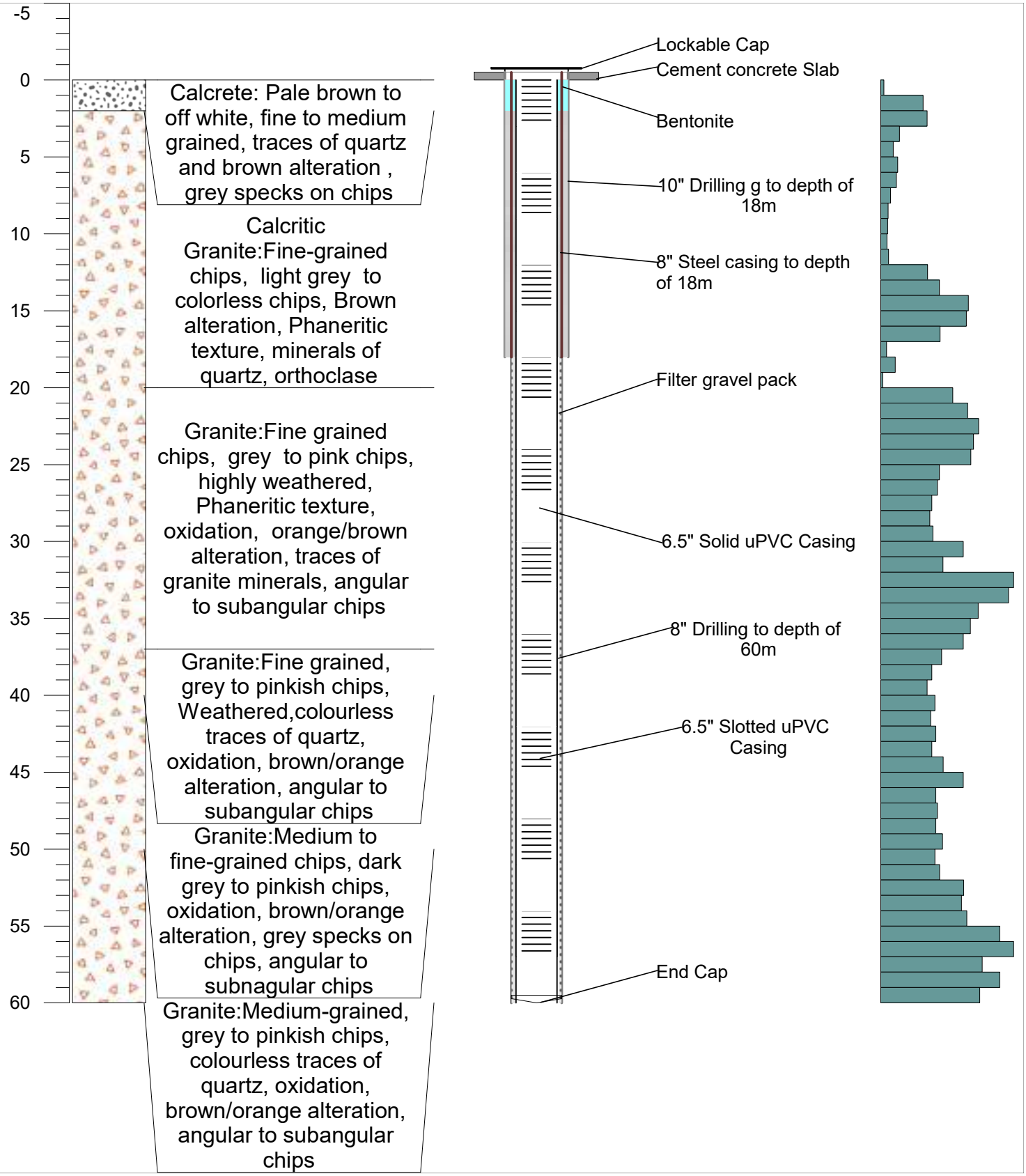
BOREHOLE NO.

WW207357

CLIENT:	Namwaste Pty Ltd	**COORD SYST.:**	WGS84 UTM 33S
PROJECT NO.:	WI306-00033/01	**LATITUDE:**	7453849 m
LOCATION:	Walvis Bay	**LONGITUDE:**	461221 m
DATE COMMENCED:	12/7/2024	**ELEVATION:**	77 m
DATE COMPLETED:	13/7/2024	**WATER STRIKE:**	NA mbs
DRILLED BY:	Hammerstein Drilling	**BLOW YIELD:**	NA m3/hr
LOGGED BY:	Izelda Mbatha	**AVERAGE TESTED YIELD:**	NA m3/hr

Penetration Rate (m/min)





NOTES: Air Percussion drilling

Borehole was fully cased to depth of 60m.

No water strike was encountered.

APPENDIX A4

Photography

Plate 1: Drilling in Progress at WW207348 (WBBH1)

Plate 2: Borehole WW207348 (WBBH1)

Plate 3: Drilling in Progress at WW207356 (WBBH3)

Plate 4: Borehole WW207356 (WBBH3)

Plate 5: Drilling in Progress at WW207357 (WBBH4)

Plate 6: Borehole WW207357 (WBBH4)

APPENDIX A5

Chip Samples

Plate 7: Chip Samples WW207348 (WBBH1)

Plate 8: Chip Samples WW207356 (WBBH3)

Plate 9: Chip Samples WW207357 (WBBH4)

APPENDIX B

Analytical Laboratory Water Quality Results

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P. O. Box 86782, Windhoek, Namibia

TEST REPORT I241509/1

To: **Knight Piesold Consulting**
P.O.Box 86062
Windhoek

Date received: 29/Jul/24
Date analysed: 30 July - 14 August 2024
Date reported: 16/Aug/24

Attn: Izelda Mbatha
e-mail: imbatha@knoghtpiesold.com
Tel: 061-307 297

Client Reference no.: Verbal
Quotation no.: QUA-81150
Lab Reference: I241509
Enquiries: Ms Helena P. Daniel

Sample details	Water
Location of sampling point	Walvis Bay
Description of sampling point	WB BH1
Date of sampling	2024/07/18; 10h35
Test item number	I241509/1

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**6.8**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**11550**	**mS/m**	D	150	300	400	
Turbidity	**8.0**	**NTU**	C	1	5	10	
Total Dissolved Solids (calc.)	**82610**	**mg/l**					6000
P-Alkalinity as $CaCO_3$	**<10**	**mg/l**					
Total Alkalinity as $CaCO_3$	**68**	**mg/l**					
Bicarbonate as HCO_3^-	**83**	**mg/l**					
Carbonate as CO_3^{2-}	**0**	**mg/l**					
Total Hardness as $CaCO_3$	**9686**	**mg/l**	D	300	650	1300	
Ca-Hardness as $CaCO_3$	**4707**	**mg/l**	D	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**4979**	**mg/l**	D	290	420	840	2057
Chloride as Cl^-	**48389**	**mg/l**	D	250	600	1200	1500-3000
Fluoride as F^-	**0.6**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**4611**	**mg/l**	D	200	600	1200	1000
Nitrate as N	**260**	**mg/l**	D	10	20	40	100
Nitrite as N	**0.43**	**mg/l**					10
ortho-Phosphate as PO_4	**0.18**	**mg/l**					
Sodium as Na	**24610**	**mg/l**	D	100	400	800	2000
Potassium as K	**713**	**mg/l**	C	200	400	800	
Magnesium as Mg	**1209**	**mg/l**	D	70	100	200	500
Calcium as Ca	**1885**	**mg/l**	D	150	200	400	1000
Manganese as Mn	**0.43**	**mg/l**	B	0.05	1.0	2.0	10
Iron as Fe	**<0.01**	**mg/l**	A	0.1	1.0	2.0	10
Copper as Cu	**0.40**	**mg/l**	A	0.5	1.0	2.0	
Zinc as Zn	**0.53**	**mg/l**					
Stability pH, at 25°C	**6.6**						
Langelier Index	**0.2**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**6.4**	scaling		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**1075.1**	increasing corrosive tendency		Applies to water in the pH range 7-8 which also contains dissolved oxygen ratios <0.2 no corrosive properties ratios >0.2 increasing corrosive tendency			

Approved Technical Signatory
Ms. Helena Daniel

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Tel: 061-307 297

Client Reference no.: Verbal
Quotation no.: QUA-81150
Lab Reference: I241509
Enquiries: Ms Helena P. Daniel

Sample details	Water
Location of sampling point	Walvis Bay
Description of sampling point	WB BH1
Date of sampling	2024/07/18; 10h35
Test item number	I241509/1

Parameter	Total Metals Value	Units		Total Metals Value	Units
Lithium as Li	**383**	µg/l	**Uranium as U**	**495**	µg/l
Beryllium as Be	**1.7**	µg/l	**Aluminium as Al [1)]**	**264**	µg/l
Boron as B [1)]	**18280**	µg/l	**Silicon as Si [1)]**	**5635**	µg/l
Strontium as Sr [1)]	**86100**	µg/l	**Phosphorous as P [1)]**	**7658**	µg/l
Zirconium as Zr	**<1.0**	µg/l	**Sulphur as S [1)]**	**1686000**	µg/l
Molybdenum as Mo	**32**	µg/l	**Titanium as Ti**	**722**	µg/l
Cadmium as Cd	**3.0**	µg/l	**Vanadium as V**	**5.2**	µg/l
Tin as Sn	**2.0**	µg/l	**Chromium as Cr**	**14**	µg/l
Antimony as Sb	**1.8**	µg/l	**Manganese as Mn**	**352**	µg/l
Tellurium as Te	**<1.0**	µg/l	**Iron as Fe**	**131**	µg/l
Barium as Ba	**306**	µg/l	**Cobalt as Co**	**2.1**	µg/l
Lanthanum as La [2)]	**1.0**	µg/l	**Nickel as Ni**	**10**	µg/l
Tungsten as W	**29**	µg/l	**Copper as Cu**	**237**	µg/l
Iridium as Ir [2)]	**1.5**	µg/l	**Zinc as Zn**	**110**	µg/l
Platinum as Pt [2)]	**<1.0**	µg/l	**Arsenic as As**	**3.6**	µg/l
Gold as Au	**<1.0**	µg/l	**Selenium as Se**	**166**	µg/l
Mercury as Hg	**57**	µg/l	**Ruthenium as Ru [2)]**	**<1.0**	µg/l
Thallium as Tl	**53**	µg/l	**Rhodium as Rh [2)]**	**2.8**	µg/l
Lead as Pb	**5.6**	µg/l	**Palladium as Pd [2)]**	**<1.0**	µg/l
Bismuth as Bi [2)]	**<1.0**	µg/l	**Silver as Ag**	**3.4**	µg/l
Thorium as Th	**11**	µg/l			

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e-mail: imbatha@knoghtpiesold.com
Tel: 061-307 297

Client Reference no.: Verbal
Quotation no.: QUA-81150
Lab Reference: I241509
Enquiries: Ms Helena P. Daniel

Sample details	Water
Location of sampling point	Walvis Bay
Description of sampling point	WB BH1
Date of sampling	2024/07/18; 10h35
Test item number	I241509/1

Parameter	Dissolved Metals Value	Units		Dissolved Metals Value	Units
Lithium as Li	**383**	µg/l	**Uranium as U**	**495**	µg/l
Beryllium as Be	**<1.0**	µg/l	**Aluminium as Al [1)]**	**156**	µg/l
Boron as B [1)]	**18280**	µg/l	**Silicon as Si [1)]**	**5635**	µg/l
Strontium as Sr [1)]	**86100**	µg/l	**Phosphorous as P [1)]**	**7282**	µg/l
Zirconium as Zr	**<1.0**	µg/l	**Sulphur as S [1)]**	**1686000**	µg/l
Molybdenum as Mo	**32**	µg/l	**Titanium as Ti**	**722**	µg/l
Cadmium as Cd	**3.0**	µg/l	**Vanadium as V**	**5.2**	µg/l
Tin as Sn	**1.2**	µg/l	**Chromium as Cr**	**14**	µg/l
Antimony as Sb	**<1.0**	µg/l	**Manganese as Mn**	**352**	µg/l
Tellurium as Te	**<1.0**	µg/l	**Iron as Fe**	**131**	µg/l
Barium as Ba	**306**	µg/l	**Cobalt as Co**	**1.5**	µg/l
Lanthanum as La [2)]	**<1.0**	µg/l	**Nickel as Ni**	**6.9**	µg/l
Tungsten as W	**24**	µg/l	**Copper as Cu**	**225**	µg/l
Iridium as Ir [2)]	**<1.0**	µg/l	**Zinc as Zn**	**110**	µg/l
Platinum as Pt [2)]	**<1.0**	µg/l	**Arsenic as As**	**<1.0**	µg/l
Gold as Au	**<1.0**	µg/l	**Selenium as Se**	**166**	µg/l
Mercury as Hg	**26**	µg/l	**Ruthenium as Ru [2)]**	**<1.0**	µg/l
Thallium as Tl	**53**	µg/l	**Rhodium as Rh [2)]**	**2.8**	µg/l
Lead as Pb	**1.8**	µg/l	**Palladium as Pd [2)]**	**<1.0**	µg/l
Bismuth as Bi [2)]	**<1.0**	µg/l	**Silver as Ag**	**3.4**	µg/l
Thorium as Th	**7.9**	µg/l			

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TEST REPORT I241509/1

Remark: Overall classification of water, considering only constituents that have been tested for:
Group D: high risk or water unsuitable for human consumption

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
The highest group assigned to any of the constituents determines the classification of the water as a whole.
Group A: excellent quality water
Group B: good quality water
Group C: low risk water
Group D: high risk or water unsuitable for human consumption

Ideally water should be either Group A or Group B. If water is classified as Group C, the situation is not yet critical, but attention should be given to those constituents over the Group B limit. If however, the water is classified as Group D urgent and immediate attention is required to reduce the levels of the problem constituents in the water to suitable levels.

Sample acceptance: Sample was collected in bottles provided by the laboratory.
Sample was suitable for testing

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TEST REPORT I241509/1

Assessment of water quality for human consumption

Naturally occurring chemicals that are of health significance in drinking water
Fluoride: Exposure to high levels of fluoride, which occurs naturally, can lead to mottling of teeth and, in severe cases, crippling skeletal fluorosis.
0-1.0 mg/l fluoride: no adverse health effects or tooth damage occurs

Chemicals from agricultural activities that are of health significance in drinking water
Nitrate and nitrite: In water it has been associated with methaemoglobinaemia, especially in bottle-fed infants
>20 mg/l nitrate as N: methemoglobinaemia occurs in infants. Occurrence of mucous membrane irritation in adults

Some of the naturally occurring chemicals which occur in drinking water at concentrations below those at which toxic effects may occur.
Chloride: high concentrations of chloride give a salty taste to water. Concentrations in excess of 250 mg/l are increasingly likely to be detected by taste.
Hardness: Depending on the interaction of other factors, such as, pH and alkalinity, water with a hardness above approximately 200 mg/l may cause scale deposition in the pipe work and tanks. On heating, hard waters form deposits of calcium carbonate scale.
pH: Optimum pH 6.5-8.
pH does not exert direct health effects, but may exert indirect health effects via metal solubility.
Sodium: The average taste threshold for sodium is about 200 mg/l.
Sulphate: It is generally considered that the taste impairment is minimal at levels below 250 mg/l.
Magnesium: The average taste threshold for magnesium is about 70 mg/l
Total dissolved solids: The palatability of water with a TDS level of less than 600 mg/l is generally considered to be good; drinking water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/l.

Turbidity is a measure of the light-scattering ability of water and is indicative of the concentration of suspended matter in water.
Microorganisms are often associated with turbidity, hence low turbidity minimises the potential for transmission of infectious diseases. Turbidity also affects the aesthetic quality of water.
Turbidity in water is caused by the presence of suspended matter which usually consists of a mixture of inorganic matter, such as clay and soil particles and organic matter.
Turbidity may also be associated with the presence of inorganic ions such as manganese(II) and iron(II).
The consumption of turbid water *per se* does not have any direct health effects, but associated effects due to microbial contamination or the ingestion of substances bound to particulate matter, do.
Aesthetic effects (appearance, taste, odour) of turbidity can be mitigated or removed by decantation or by filtration (or by both), accelerated, if necessary, by previous aeration

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TEST REPORT I241509/2

To: **Knight Piesold Consulting**
P.O.Box 86062
Windhoek

Date received: 29/Jul/24
Date analysed: 30 July - 14 August 2024
Date reported: 16/Aug/24

Attn: Izelda Mbatha
e-mail: imbatha@knoghtpiesold.com
Tel: 061-307 297

Client Reference no.: Verbal
Quotation no.: QUA-81150
Lab Reference: I241509
Enquiries: Ms Helena P. Daniel

Sample details	Water
Location of sampling point	Walvis Bay
Description of sampling point	WB BH3
Date of sampling	2024/08/18; 10h08
Test item number	I241509/2

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**9.2**		B	6-9	5.5-9.5	4-11	
Electrical Conductivity	**12110**	**mS/m**	D	150	300	400	
Turbidity	**97**	**NTU**	D	1	5	10	
Total Dissolved Solids (calc.)	**85649**	**mg/l**					6000
P-Alkalinity as $CaCO_3$	**5**	**mg/l**					
Total Alkalinity as $CaCO_3$	**75**	**mg/l**					
Bicarbonate as HCO_3^-	**79**	**mg/l**					
Carbonate as CO_3^{2-}	**6**	**mg/l**					
Total Hardness as $CaCO_3$	**10064**	**mg/l**	D	300	650	1300	
Ca-Hardness as $CaCO_3$	**7149**	**mg/l**	D	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**2916**	**mg/l**	D	290	420	840	2057
Chloride as Cl^-	**49630**	**mg/l**	D	250	600	1200	1500-3000
Fluoride as F^-	**0.3**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**4335**	**mg/l**	D	200	600	1200	1000
Nitrate as N	**266**	**mg/l**	D	10	20	40	100
Nitrite as N	**0.18**	**mg/l**					10
ortho-Phosphate as PO_4	**0.43**	**mg/l**					
Sodium as Na	**26050**	**mg/l**	D	100	400	800	2000
Potassium as K	**839**	**mg/l**	D	200	400	800	
Magnesium as Mg	**708**	**mg/l**	D	70	100	200	500
Calcium as Ca	**2863**	**mg/l**	D	150	200	400	1000
Manganese as Mn	**0.10**	**mg/l**	B	0.05	1.0	2.0	10
Iron as Fe	**<0.01**	**mg/l**	A	0.1	1.0	2.0	10
Copper as Cu	**0.67**	**mg/l**	B	0.5	1.0	2.0	
Zinc as Zn	**0.61**	**mg/l**					
Stability pH, at 25°C	**6.4**						
Langelier Index	**2.8**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**3.5**	scaling		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**994.3**	increasing corrosive tendency		Applies to water in the pH range 7-8 which also contains dissolved oxygen ratios <0.2 no corrosive properties ratios >0.2 increasing corrosive tendency			

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Enquiries: Ms Helena P. Daniel

Sample details	Water
Location of sampling point	Walvis Bay
Description of sampling point	WB BH3
Date of sampling	2024/08/18; 10h08
Test item number	I241509/2

Parameter	Total Metals Value	Units		Total Metals Value	Units
Lithium as Li	**422**	µg/l	**Uranium as U**	**150**	µg/l
Beryllium as Be	**1.9**	µg/l	**Aluminium as Al [1)]**	**164**	µg/l
Boron as B [1)]	**10220**	µg/l	**Silicon as Si [1)]**	**3540**	µg/l
Strontium as Sr [1)]	**115700**	µg/l	**Phosphorous as P [1)]**	**4178**	µg/l
Zirconium as Zr	**<1.0**	µg/l	**Sulphur as S [1)]**	**1571000**	µg/l
Molybdenum as Mo	**28**	µg/l	**Titanium as Ti**	**1105**	µg/l
Cadmium as Cd	**<1.0**	µg/l	**Vanadium as V**	**6.0**	µg/l
Tin as Sn	**2.0**	µg/l	**Chromium as Cr**	**264**	µg/l
Antimony as Sb	**<1.0**	µg/l	**Manganese as Mn**	**14**	µg/l
Tellurium as Te	**1.6**	µg/l	**Iron as Fe**	**236**	µg/l
Barium as Ba	**626**	µg/l	**Cobalt as Co**	**<1.0**	µg/l
Lanthanum as La [2)]	**<1.0**	µg/l	**Nickel as Ni**	**8.0**	µg/l
Tungsten as W	**26**	µg/l	**Copper as Cu**	**231**	µg/l
Iridium as Ir [2)]	**1.0**	µg/l	**Zinc as Zn**	**39**	µg/l
Platinum as Pt [2)]	**<1.0**	µg/l	**Arsenic as As**	**2.8**	µg/l
Gold as Au	**<1.0**	µg/l	**Selenium as Se**	**139**	µg/l
Mercury as Hg	**46**	µg/l	**Ruthenium as Ru [2)]**	**1.5**	µg/l
Thallium as Tl	**53**	µg/l	**Rhodium as Rh [2)]**	**3.8**	µg/l
Lead as Pb	**2.3**	µg/l	**Palladium as Pd [2)]**	**<1.0**	µg/l
Bismuth as Bi [2)]	**<1.0**	µg/l	**Silver as Ag**	**3.7**	µg/l
Thorium as Th	**8.6**	µg/l			

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Date reported: 16/Aug/24

Attn: Izelda Mbatha
e-mail: imbatha@knoghtpiesold.com
Tel: 061-307 297

Client Reference no.: Verbal
Quotation no.: QUA-81150
Lab Reference: I241509
Enquiries: Ms Helena P. Daniel

Sample details	Water
Location of sampling point	Walvis Bay
Description of sampling point	WB BH3
Date of sampling	2024/08/18; 10h08
Test item number	I241509/2

Parameter	Dissolved Metals Value	Units		Dissolved Metals Value	Units
Lithium as Li	**422**	µg/l	**Uranium as U**	**28**	µg/l
Beryllium as Be	**1.8**	µg/l	**Aluminium as Al [1)]**	**164**	µg/l
Boron as B [1)]	**10220**	µg/l	**Silicon as Si [1)]**	**332**	µg/l
Strontium as Sr [1)]	**115700**	µg/l	**Phosphorous as P [1)]**	**4178**	µg/l
Zirconium as Zr	**<1.0**	µg/l	**Sulphur as S [1)]**	**1571000**	µg/l
Molybdenum as Mo	**27**	µg/l	**Titanium as Ti**	**1105**	µg/l
Cadmium as Cd	**<1.0**	µg/l	**Vanadium as V**	**3.6**	µg/l
Tin as Sn	**1.7**	µg/l	**Chromium as Cr**	**257**	µg/l
Antimony as Sb	**<1.0**	µg/l	**Manganese as Mn**	**8.5**	µg/l
Tellurium as Te	**<1.0**	µg/l	**Iron as Fe**	**13**	µg/l
Barium as Ba	**660**	µg/l	**Cobalt as Co**	**<1.0**	µg/l
Lanthanum as La [2)]	**<1.0**	µg/l	**Nickel as Ni**	**4.3**	µg/l
Tungsten as W	**22**	µg/l	**Copper as Cu**	**203**	µg/l
Iridium as Ir [2)]	**<1.0**	µg/l	**Zinc as Zn**	**39**	µg/l
Platinum as Pt [2)]	**<1.0**	µg/l	**Arsenic as As**	**2.6**	µg/l
Gold as Au	**<1.0**	µg/l	**Selenium as Se**	**125**	µg/l
Mercury as Hg	**16**	µg/l	**Ruthenium as Ru [2)]**	**1.5**	µg/l
Thallium as Tl	**53**	µg/l	**Rhodium as Rh [2)]**	**3.8**	µg/l
Lead as Pb	**2.3**	µg/l	**Palladium as Pd [2)]**	**<1.0**	µg/l
Bismuth as Bi [2)]	**<1.0**	µg/l	**Silver as Ag**	**2.2**	µg/l
Thorium as Th	**7.8**	µg/l			

Approved Technical Signatory
Ms. Helena Daniel

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P. O. Box 86782, Windhoek, Namibia

TEST REPORT I241509/2

Remark: Overall classification of water, considering only constituents that have been tested for:
Group D: high risk or water unsuitable for human consumption

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
The highest group assigned to any of the constituents determines the classification of the water as a whole.
Group A: excellent quality water
Group B: good quality water
Group C: low risk water
Group D: high risk or water unsuitable for human consumption

Ideally water should be either Group A or Group B. If water is classified as Group C, the situation is not yet critical, but attention should be given to those constituents over the Group B limit. If however, the water is classified as Group D urgent and immediate attention is required to reduce the levels of the problem constituents in the water to suitable levels.

Sample acceptance: Sample was collected in bottles provided by the laboratory.
Sample was suitable for testing

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TEST REPORT I241509/2

Assessment of water quality for human consumption

Naturally occurring chemicals that are of health significance in drinking water
Fluoride: Exposure to high levels of fluoride, which occurs naturally, can lead to mottling of teeth and, in severe cases, crippling skeletal fluorosis.
0-1.0 mg/l fluoride: no adverse health effects or tooth damage occurs

Chemicals from agricultural activities that are of health significance in drinking water
Nitrate and nitrite: In water it has been associated with methaemoglobinaemia, especially in bottle-fed infants
>20 mg/l nitrate as N: methemoglobinaemia occurs in infants. Occurrence of mucous membrane irritation in adults

Some of the naturally occurring chemicals which occur in drinking water at concentrations below those at which toxic effects may occur.
Chloride: high concentrations of chloride give a salty taste to water. Concentrations in excess of 250 mg/l are increasingly likely to be detected by taste.
Hardness: Depending on the interaction of other factors, such as, pH and alkalinity, water with a hardness above approximately 200 mg/l may cause scale deposition in the pipe work and tanks. On heating, hard waters form deposits of calcium carbonate scale.
pH: Optimum pH 6.5-8.
pH does not exert direct health effects, but may exert indirect health effects via metal solubility.
Sodium: The average taste threshold for sodium is about 200 mg/l.
Sulphate: It is generally considered that the taste impairment is minimal at levels below 250 mg/l.
Magnesium: The average taste threshold for magnesium is about 70 mg/l
Total dissolved solids: The palatability of water with a TDS level of less than 600 mg/l is generally considered to be good; drinking water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/l.

Turbidity is a measure of the light-scattering ability of water and is indicative of the concentration of suspended matter in water.
Microorganisms are often associated with turbidity, hence low turbidity minimises the potential for transmission of infectious diseases. Turbidity also affects the aesthetic quality of water.
Turbidity in water is caused by the presence of suspended matter which usually consists of a mixture of inorganic matter, such as clay and soil particles and organic matter.
Turbidity may also be associated with the presence of inorganic ions such as manganese(II) and iron(II).
The consumption of turbid water *per se* does not have any direct health effects, but associated effects due to microbial contamination or the ingestion of substances bound to particulate matter, do.
Aesthetic effects (appearance, taste, odour) of turbidity can be mitigated or removed by decantation or by filtration (or by both), accelerated, if necessary, by previous aeration

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TEST REPORT I241509/3

To: **Knight Piesold Consulting**
P.O.Box 86062
Windhoek

Date received: 29/Jul/24
Date analysed: 30 July - 14 August 2024
Date reported: 16/Aug/24

Attn: Izelda Mbatha
e-mail: imbatha@knoghtpiesold.com
Tel: 061-307 297

Client Reference no.: Verbal
Quotation no.: QUA-81150
Lab Reference: I241509
Enquiries: Ms Helena P. Daniel

Sample details	Water
Location of sampling point	Walvis Bay
Description of sampling point	WB Seawater sample
Date of sampling	2024/07/18;11h15
Test item number	I241509/3

				Recommended maximum limits			
				Human consumption			Livestock
Parameter	**Value**	**Units**	**Classification**	**Group A**	**Group B**	**Group C**	**watering**
p H	**8.4**		A	6-9	5.5-9.5	4-11	
Electrical Conductivity	**5350**	**mS/m**	D	150	300	400	
Turbidity	**14**	**NTU**	D	1	5	10	
Total Dissolved Solids (calc.)	**33784**	**mg/l**					6000
P-Alkalinity as $CaCO_3$	**<10**	**mg/l**					
Total Alkalinity as $CaCO_3$	**115**	**mg/l**					
Bicarbonate as HCO_3^-	**140**	**mg/l**					
Carbonate as CO_3^{2-}	**0**	**mg/l**					
Total Hardness as $CaCO_3$	**6365**	**mg/l**	D	300	650	1300	
Ca-Hardness as $CaCO_3$	**1004**	**mg/l**	D	375	500	1000	2500
Mg-Hardness as $CaCO_3$	**5362**	**mg/l**	D	290	420	840	2057
Chloride as Cl^-	**19604**	**mg/l**	D	250	600	1200	1500-3000
Fluoride as F^-	**0.8**	**mg/l**	A	1.5	2.0	3.0	2.0-6.0
Sulphate as SO_4^{2-}	**2816**	**mg/l**	D	200	600	1200	1000
Nitrate as N	**0.3**	**mg/l**	A	10	20	40	100
Nitrite as N	**0.01**	**mg/l**					10
ortho-Phosphate as PO_4	**0.43**	**mg/l**					
Sodium as Na	**9211**	**mg/l**	D	100	400	800	2000
Potassium as K	**378**	**mg/l**	B	200	400	800	
Magnesium as Mg	**1302**	**mg/l**	D	70	100	200	500
Calcium as Ca	**402**	**mg/l**	D	150	200	400	1000
Manganese as Mn	**0.05**	**mg/l**	A	0.05	1.0	2.0	10
Iron as Fe	**<0.01**	**mg/l**	A	0.1	1.0	2.0	10
Copper as Cu	**0.39**	**mg/l**	A	0.5	1.0	2.0	
Zinc as Zn	**0.38**	**mg/l**					
Stability pH, at 25°C	**7.0**						
Langelier Index	**1.4**	scaling		>0=scaling, <0=corrosive, 0=stable			
Ryznar Index	**5.6**	scaling		<6.5=scaling, >7,5=corrosive, ≥6.5 and ≤7.5=stable			
Corrosivity ratio	**266.1**	increasing corrosive tendency		Applies to water in the pH range 7-8 which also contains dissolved oxygen ratios <0.2 no corrosive properties ratios >0.2 increasing corrosive tendency			

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TEST REPORT I241509/3

To: **Knight Piesold Consulting**
P.O.Box 86062
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Date received: 29/Jul/24
Date analysed: 30 July - 14 August 2024
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Attn: Izelda Mbatha
e-mail: imbatha@knoghtpiesold.com
Tel: 061-307 297

Client Reference no.: Verbal
Quotation no.: QUA-81150
Lab Reference: I241509
Enquiries: Ms Helena P. Daniel

Sample details	Water
Location of sampling point	Walvis Bay
Description of sampling point	WB Seawater sample
Date of sampling	2024/07/18;11h15
Test item number	I241509/3

Parameter	Total Metals Value	Units		Total Metals Value	Units
Lithium as Li	**199**	µg/l	**Uranium as U**	**33**	µg/l
Beryllium as Be	**1.5**	µg/l	**Aluminium as Al [1)]**	**229**	µg/l
Boron as B [1)]	**4885**	µg/l	**Silicon as Si [1)]**	**4302**	µg/l
Strontium as Sr [1)]	**20570**	µg/l	**Phosphorous as P [1)]**	**8513**	µg/l
Zirconium as Zr	**<1.0**	µg/l	**Sulphur as S [1)]**	**1031000**	µg/l
Molybdenum as Mo	**15**	µg/l	**Titanium as Ti**	**195**	µg/l
Cadmium as Cd	**<1.0**	µg/l	**Vanadium as V**	**3.9**	µg/l
Tin as Sn	**2.4**	µg/l	**Chromium as Cr**	**5.9**	µg/l
Antimony as Sb	**<1.0**	µg/l	**Manganese as Mn**	**5.1**	µg/l
Tellurium as Te	**<1.0**	µg/l	**Iron as Fe**	**225**	µg/l
Barium as Ba	**258**	µg/l	**Cobalt as Co**	**<1.0**	µg/l
Lanthanum as La [2)]	**<1.0**	µg/l	**Nickel as Ni**	**4.6**	µg/l
Tungsten as W	**26**	µg/l	**Copper as Cu**	**444**	µg/l
Iridium as Ir [2)]	**<1.0**	µg/l	**Zinc as Zn**	**196**	µg/l
Platinum as Pt [2)]	**<1.0**	µg/l	**Arsenic as As**	**5.0**	µg/l
Gold as Au	**<1.0**	µg/l	**Selenium as Se**	**21**	µg/l
Mercury as Hg	**55**	µg/l	**Ruthenium as Ru [2)]**	**3.9**	µg/l
Thallium as Tl	**53**	µg/l	**Rhodium as Rh [2)]**	**2.9**	µg/l
Lead as Pb	**4.9**	µg/l	**Palladium as Pd [2)]**	**<1.0**	µg/l
Bismuth as Bi [2)]	**<1.0**	µg/l	**Silver as Ag**	**13**	µg/l
Thorium as Th	**8.2**	µg/l			

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Client Reference no.: Verbal
Quotation no.: QUA-81150
Lab Reference: I241509
Enquiries: Ms Helena P. Daniel

Sample details	Water
Location of sampling point	Walvis Bay
Description of sampling point	WB Seawater sample
Date of sampling	2024/07/18;11h15
Test item number	I241509/3

Parameter	Dissolved Metals Value	Units		Dissolved Metals Value	Units
Lithium as Li	**218**	µg/l	**Uranium as U**	**33**	µg/l
Beryllium as Be	**1.4**	µg/l	**Aluminium as Al [1)]**	**173**	µg/l
Boron as B [1)]	**4885**	µg/l	**Silicon as Si [1)]**	**2295**	µg/l
Strontium as Sr [1)]	**20570**	µg/l	**Phosphorous as P [1)]**	**7620**	µg/l
Zirconium as Zr	**<1.0**	µg/l	**Sulphur as S [1)]**	**1027000**	µg/l
Molybdenum as Mo	**15**	µg/l	**Titanium as Ti**	**195**	µg/l
Cadmium as Cd	**<1.0**	µg/l	**Vanadium as V**	**3.9**	µg/l
Tin as Sn	**2.4**	µg/l	**Chromium as Cr**	**5.9**	µg/l
Antimony as Sb	**<1.0**	µg/l	**Manganese as Mn**	**5.1**	µg/l
Tellurium as Te	**<1.0**	µg/l	**Iron as Fe**	**27**	µg/l
Barium as Ba	**258**	µg/l	**Cobalt as Co**	**<1.0**	µg/l
Lanthanum as La [2)]	**<1.0**	µg/l	**Nickel as Ni**	**4.6**	µg/l
Tungsten as W	**23**	µg/l	**Copper as Cu**	**203**	µg/l
Iridium as Ir [2)]	**<1.0**	µg/l	**Zinc as Zn**	**88**	µg/l
Platinum as Pt [2)]	**<1.0**	µg/l	**Arsenic as As**	**1.8**	µg/l
Gold as Au	**<1.0**	µg/l	**Selenium as Se**	**20**	µg/l
Mercury as Hg	**20**	µg/l	**Ruthenium as Ru [2)]**	**3.9**	µg/l
Thallium as Tl	**53**	µg/l	**Rhodium as Rh [2)]**	**2.9**	µg/l
Lead as Pb	**4.9**	µg/l	**Palladium as Pd [2)]**	**<1.0**	µg/l
Bismuth as Bi [2)]	**<1.0**	µg/l	**Silver as Ag**	**13**	µg/l
Thorium as Th	**7.9**	µg/l			

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TEST REPORT I241509/3

Remark: Overall classification of water, considering only constituents that have been tested for:
Group D: high risk or water unsuitable for human consumption

Interpretation based on guidelines for the evaluation of drinking water for human consumption, DWA, Namibia, April 1988 and South African Water Quality Guidelines Volume 5: Agricultural water use: Livestock watering, Second Edition, 1996

For practical reasons, the guidelines are divided into four groups.
The highest group assigned to any of the constituents determines the classification of the water as a whole.
Group A: excellent quality water
Group B: good quality water
Group C: low risk water
Group D: high risk or water unsuitable for human consumption

Ideally water should be either Group A or Group B. If water is classified as Group C, the situation is not yet critical, but attention should be given to those constituents over the Group B limit. If however, the water is classified as Group D urgent and immediate attention is required to reduce the levels of the problem constituents in the water to suitable levels.

Sample acceptance: Sample was collected in bottles provided by the laboratory.
Sample was suitable for testing

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TEST REPORT I241509/3

Assessment of water quality for human consumption

Naturally occurring chemicals that are of health significance in drinking water
Fluoride: Exposure to high levels of fluoride, which occurs naturally, can lead to mottling of teeth and, in severe cases, crippling skeletal fluorosis.
0-1.0 mg/l fluoride: no adverse health effects or tooth damage occurs

Chemicals from agricultural activities that are of health significance in drinking water
Nitrate and nitrite: In water it has been associated with methaemoglobinaemia, especially in bottle-fed infants
>20 mg/l nitrate as N: methemoglobinaemia occurs in infants. Occurrence of mucous membrane irritation in adults

Some of the naturally occurring chemicals which occur in drinking water at concentrations below those at which toxic effects may occur.
Chloride: high concentrations of chloride give a salty taste to water. Concentrations in excess of 250 mg/l are increasingly likely to be detected by taste.
Hardness: Depending on the interaction of other factors, such as, pH and alkalinity, water with a hardness above approximately 200 mg/l may cause scale deposition in the pipe work and tanks. On heating, hard waters form deposits of calcium carbonate scale.
pH: Optimum pH 6.5-8.
pH does not exert direct health effects, but may exert indirect health effects via metal solubility.
Sodium: The average taste threshold for sodium is about 200 mg/l.
Sulphate: It is generally considered that the taste impairment is minimal at levels below 250 mg/l.
Magnesium: The average taste threshold for magnesium is about 70 mg/l
Total dissolved solids: The palatability of water with a TDS level of less than 600 mg/l is generally considered to be good; drinking water becomes significantly and increasingly unpalatable at TDS levels greater than about 1000 mg/l.

Turbidity is a measure of the light-scattering ability of water and is indicative of the concentration of suspended matter in water.
Microorganisms are often associated with turbidity, hence low turbidity minimises the potential for transmission of infectious diseases. Turbidity also affects the aesthetic quality of water.
Turbidity in water is caused by the presence of suspended matter which usually consists of a mixture of inorganic matter, such as clay and soil particles and organic matter.
Turbidity may also be associated with the presence of inorganic ions such as manganese(II) and iron(II).
The consumption of turbid water *per se* does not have any direct health effects, but associated effects due to microbial contamination or the ingestion of substances bound to particulate matter, do.
Aesthetic effects (appearance, taste, odour) of turbidity can be mitigated or removed by decantation or by filtration (or by both), accelerated, if necessary, by previous aeration

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Summary of test methods - Water Quality

Determinant	Unit		Technique	Method reference
Absorbed oxygen	mg/l	O_2	titrimetric	SANS 5220:2005
Acidity	mg/l	$CaCO_3$	titrimetric	AWWA 2310 B
Alkalinity	mg/l	$CaCO_3$	titrimetric	AWWA 2320 B
Ammonium	mg/l	N	colorimetric	AWWA 4500-NH_3 F / modified Berthelot
Bicarbonate & Carbonate	mg/l	$CaCO_3$	by calculation	
Biological oxygen demand, 5-day	mg/l	O_2	electrometric	AWWA 5210 B
Biological oxygen demand, carbonacious	mg/l	O_2	electrometric	AWWA 5210 B
Bromide & Iodide	mg/l	Br^-	iodometric	P. Höfer
Chloride	mg/l	Cl^-	argentometric	AWWA 4500-Cl^- B
Chlorine, free and total	mg/l	Cl_2	colorimetric	AWWA 4500-Cl G
Chlorophyll a	µg/L		spectrophotometric	ISO 10260:1992 E
Chemical oxygen demand	mg/l	O_2	colorimetric	AWWA 5220 D
Colour	Pt		colorimetric	AWWA Pt-Co-2120 B
Cyanide	mg/l	CN	colorimetric	AWWA 4500-CN E
Density	mg/l	g/ml	gravimetric	METH W 016
Dissolved oxygen	mg/l	O_2	electrometric	AWWA 4550-O G
Electrical conductivity	mS/m		electrometric	AWWA 2510 B
Fat, oil & grease	mg/l		extraction/gavimetric	AWWA 5520 B
Fixed and volatile solids, ignited at 550°C	mg/l		gravimetric	AWWA 2540 E
Fluoride	mg/l	F^-	electrometric	AWWA 4500-F C
Hardness	mg/l	$CaCO_3$	by calculation	AWWA 2340 B
Hexavalent chromium	mg/l	Cr	colorimetric	AWWA 3500-Cr B
Hydrolysable phosphates	mg/l	P	digestion, PO4	AWWA 4500-P B.2 + E
Kjeldahl nitrogen	mg/l	N	by calculation	
Molybdosilicate	mg/l	SiO_2	colorimetric	AWWA 4500-Si C
Nitrate	mg/l	N	colorimetric	Spectroquant / AWWA 4500-NO_3 E
Nitrite	mg/l	N	colorimetric	AWWA 4500-NO2 B
Oxidation reduction potential (Redox)	mV		electrometric	AWWA 2580 B
pH			electrometric	AWWA 4500-H^+ B
Phenols	mg/l	Phenol	colorimetric	ASTM D1783-01, B
Reactive phosphorous	mg/l	PO_4	colorimetric	AWWA 4500-P E
Settable solids	mg/l		gravimetric	AWWA 2540 F
Sulfide	mg/l	S^{2-}	colorimetric	AWWA 4500-S^{2-} D
Sulfite	mg/l	SO_3^{2-}	iodometric	AWWA 4500-SO_3^{2-} B
Sulphate	mg/l	SO_4	nephelometric / colorimetric	AWWA 4500-SO4 E / F
Total dissolved solids	mg/l		gravimetric	AWWA 2540 C
Total nitrogen	mg/l	N	digestion, NO3	EN ISO 11905-1:1997
Total phosphorous	mg/l	P	digestion, PO4	AWWA 4500-P B.5 + E
Total solids	mg/l		gravimetric	AWWA 2540 B
Total suspended solids	mg/l		gravimetric	AWWA 2540 D
Turbidity	NTU		nephelometric	AWWA 2130 B
UV absorbing organic constituents at 254nm	cm^{-1}		colorimetric	AWWA 5910 B

Aluminium	mg/l	Al	ICP-OES	AWWA ICP-3500-Al C
Antimony	mg/l	Sb	ICP-OES	AWWA ICP-3500-Sb C
Arsenic	mg/l	As	ICP-OES	AWWA ICP-3500-As D
Barium	mg/l	Ba	ICP-OES	AWWA ICP-3500-Ba C
Beryllium	mg/l	B	ICP-OES	AWWA ICP-3500-Be
Bismuth	mg/l	Bi	ICP-OES	AWWA ICP-3500-Bi
Boron	mg/l	B	ICP-OES	AWWA ICP-3500-B D
Cadmium	mg/l	Cd	ICP-OES	AWWA ICP-3500-Cd C

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Calcium	mg/l	Ca	ICP-OES	AWWA ICP-3500-Ca C
Chromium (total)	mg/l	Cr	ICP-OES	AWWA ICP-3500-Cr C
Cobalt	mg/l	Co	ICP-OES	AWWA ICP-3500-Co C
Copper	mg/l	Cu	ICP-OES	AWWA ICP-3500-Cu C
Gold	mg/l	Au	ICP-OES	AWWA ICP-3500-Au
Iron	mg/l	Fe	ICP-OES	AWWA ICP-3500-Fe C
Lead	mg/l	Pb	ICP-OES	AWWA ICP-3500-Pb C
Lithium	mg/l	Li	ICP-OES	AWWA ICP-3500-Li C
Magnesium	mg/l	Mg	ICP-OES	AWWA ICP-3500-Mg C
Manganese	mg/l	Mn	ICP-OES	AWWA ICP-3500-Mn C
Mercury	mg/l	Hg	ICP-OES	AWWA ICP-3500-Hg
Molybdenum	mg/l	Mo	ICP-OES	AWWA ICP-3500-Mo C
Nickel	mg/l	Ni	ICP-OES	AWWA ICP-3500-Ni C
Potassium	mg/l	K	ICP-OES	AWWA ICP-3500-K C
Rubidium	mg/l	Rb	ICP-OES	ICP-OES
Selenium	mg/l	Se	ICP-OES	AWWA ICP-3500-Se I
Silica	mg/l	Si	ICP-OES	ICP-OES
Silver	mg/l	Ag	ICP-OES	AWWA ICP-3500-Ag
Sodium	mg/l	Na	ICP-OES	AWWA ICP-3500-Na C
Strontium	mg/l	Sr	ICP-OES	AWWA ICP-3500-Sr C
Thallium	mg/l	Th	ICP-OES	AWWA ICP-3500-Tl C
Tellurium	mg/l	Te	ICP-OES	AWWA ICP-3500-Te
Tin	mg/l	Sn	ICP-OES	AWWA ICP-3500-Sn
Titanium	mg/l	Ti	ICP-OES	AWWA ICP-3500-Ti
Uranium	mg/l	U	ICP-OES	AWWA ICP-3500-U
Vanadium	mg/l	V	ICP-OES	AWWA ICP-3500-V C
Zinc	mg/l	Zn	ICP-OES	AWWA ICP-3500-Zn C

Lower reporting limit
These are estimated values only; accurate lower levels of detection (LLDs) (measurement as part of a method) and method detection levels (MDLs) (measurement for the whole method) still have to be established
Given the varied matrices submitted to the laboratory and divers quality needs method and/or reagent blanks, performance evaluation samples and duplicate results may be included to assist in appropriate use of laboratory data.

All submitted samples are initially run undiluted unless sample dilutions are required in order to reduce or eliminate known matrix / interference effects. When an analyte concentration exceeds the calibration or linear range, the sample is re-analysed after appropriate dilution. The analyst will use the least dilution necessary to bring the analyte within the range. In both cases, a loss of sensitivity is experienced. All sample dilutions result in an increase in the lower reporting limit by a factor equal to the dilution. The less than symbol "<" is used for qualified data below the lower reporting limit.

APPENDIX C

Isotope Analysis Results

ANNEXURE I – CULTURAL HERITAGE IMPACT ASSESSMENT

J. & J. Kinahan
Namib Desert Archaeological Survey
P.O. Box 22407
Windhoek
Namibia

12 March 2024

Knight Piésold Consulting (Pty) Ltd
P.O. Box 86062
Eros
Windhoek
Namibia

For attention: Lloyd Lynch

PHASE 2 ARCHAEOLOGICAL ASSESSMENT OF PROPOSED WASTE TREATMENT FACILITY, FARM 36, WALVIS BAY, ERONGO REGION, NAMIBIA

DECLARATION

We hereby declare that we:

(a) have knowledge of and experience in conducting archaeological assessments, including knowledge of Namibian legislation, specifically the National Heritage Act (27 of 2004), as well as regulations and guidelines that have relevance to the proposed activity;

(b) perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;

(c) comply with the aforementioned Act, relevant regulations, guidelines and other applicable laws.

We also declare that we have no interests or involvement in:

(i) the financial or other affairs of either the applicant or his consultant

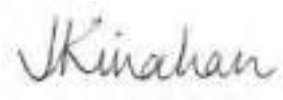
(ii) the decision-making structures of the National Heritage Council of Namibia.

Note: The purpose of this report is to guide the client in gaining consent under the National Heritage Act (27 of 2004) to proceed with development activities at specific locations as defined herein.

The report must always be quoted in full, and not in part, summary or précis form.

The report may not be distributed or used for any other purpose by the client, the National Heritage Council of Namibia or any other party and remains the copyright of the author.

John Kinahan, Archaeologist



Jill Kinahan, Archaeologist

EXECUTIVE SUMMARY

A field survey of the proposed waste treatment facility located on Farm 38, Walvis Bay, Erongo Region, Namibia revealed no archaeological sites. The area is considered to be of no archaeological Significance and it is recommended that the proposed waste treatment facility located on Farm 38, Walvis Bay be given consent under the National Heritage Act (27 of 2004) to proceed with development.

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Introduction: Knight Piésold (Pty) Ltd is carrying out an environmental impact assessment of a proposed waste facility to be established on Farm 38, Walvis Bay, in the Erongo Region of Namibia. The assessment is being carried out in compliance with the Environmental Management Act (7 of 2007), subject to the Environmental Impact Assessment Regulations (Govt Notice 30 of 2012). Archaeological remains in Namibia are protected under the National Heritage Act (27 of 2004) and National Heritage Regulations (Government Notice 106 of 2005) and require the issuance of a letter of consent from the National Heritage Council of Namibia. Knight Piésold (Pty) Ltd has engaged the undersigned J. & J. Kinahan, archaeologists, to carry out an archaeological assessment of the proposed waste facility project site.

Archaeological assessment relies on the indicative value of surface finds recorded in the course of field survey. Field survey results are augmented wherever possible by inference from the results of surveys and excavations carried out in the course of previous work in the same general area as the proposed project, as well as other sources such as historical documentation. Based on these data, it is possible to predict the likely occurrence of further archaeological sites with some accuracy, and to present a general statement of the local archaeological site distribution and its sensitivity. This report presents a Phase 2 assessment of the project a field survey carried out on 22nd and 23rd February 2024.

Legal requirements: The principal instrument of legal protection for archaeological/heritage resources in Namibia is the National Heritage Act (27 of 2004). Part V Section 46 of the Act prohibits removal, damage, alteration or excavation of heritage sites or remains. Section 48 *ff* sets out the procedure for application and granting of permits such as might be required in the event of damage to a protected site occurring as an inevitable result of development. Section 51 (3) sets out the requirements for impact assessment. Heritage sites or remains are defined in Part 1, Definitions 1, as "any remains of human habitation or occupation that are 50 or more years old …".

It is important to be aware that no specific regulations or operating guidelines have been formulated for the implementation of the National Heritage Act in respect of archaeological assessment. However, archaeological impact assessment of large projects has become accepted practice in Namibia during the last 25 years, especially where project proponents need also to consider international guidelines. In cases where international guidelines are applicable, those of the IFC, specifically Guidance Note 8: Cultural

heritage, are most appropriate. Of these guidelines, those relating to project screening, baseline survey and mitigation are the most relevant.

Archaeological impact assessment in Namibia may also take place under the rubric of the Environmental Management Act (7 of 2007) which specifically includes anthropogenic elements in its definition of environment. The list of activities that may not be undertaken without Environmental Clearance Certificate: Environmental Management Act, 2007 (Govt Notice 29 of 2012), and the Environmental Impact Assessment Regulations: Environmental Management Act, 2007 (Govt Notice 30 of 2012) also apply to the management of impacts on archaeological sites and remains whether these are considered in detail by the environmental assessment or not.

Previous archaeological surveys: The Walvis Bay area is extremely rich in archaeological sites, although most of these date to within the last three hundred years and are concentrated within the !Khuiseb Delta (see Figure 1). These sites provide a unique material record of trading relations between indigenous pastoral communities and visiting European ships.[1] The density of archaeological sites decreases sharply within 10km of the delta[2] and large parts of the area inland of Walvis Bay which is currently under industrial development have few archaeological sites of any significance. In addition much of this area was in the past used as a training ground for the South African Defence Force and the desert terrain was extensively disturbed by tanks and other tracked vehicles and the use of live artillery fire in training exercises.

[1] Kinahan, J.H.A. 2000. *Cattle for Beads: The archaeology of historical contact and trade on the Namib coast.* Uppsala University: Studies in African Archaeology 17; Kinahan, J. 2014. Cattle paths and the choreography of late pre-colonial contact and trade on the Namib Desert coast. *South African Archaeological Bulletin* 69: 96–102; Kinahan, J. 2019. The Origins and Spread of Pastoralism in Southern Africa. *Oxford Research Encyclopedia, African History* (oxfordre.com/africanhistory). Oxford University Press.

[2] Kinahan, J. 2008. Archaeological reconnaissance of EPL 3516 & 3518. QRS Job 93, commissioned by Cheetah Mineral Exploration (Pty) Ltd.; Kinahan, J. 2008. Archaeological Survey of EPL 3498, Erongo Region. QRS Job 92, commissioned by Reptile Uranium; Kinahan, J. 2011. Archaeological field survey and assessment of the Sandpiper phosphate project, Walvis Bay. QRS Job 146, commissioned by EnviroDynamics.

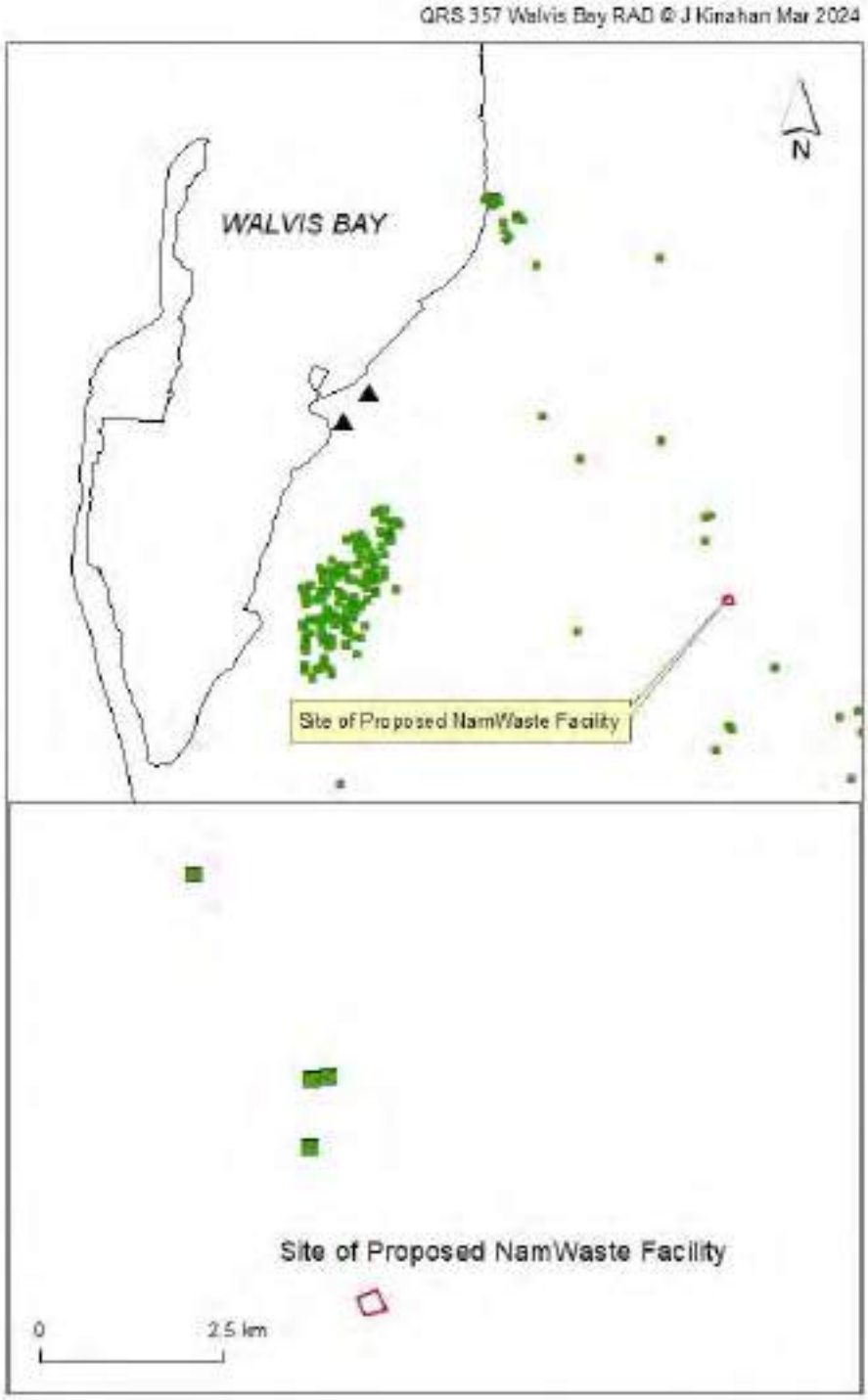

Figure 1: The proposed waste facility on Farm 38, Walvis Bay, in relation to known archaeological sites (green squares) and proclaimed National Monuments (black triangles).

Archaeological survey of the proposed waste facility site: The detailed survey of the proposed waste facility site covered both the project site and some adjacent ground. The survey was carried out as a series of parallel foot transects spaced according to the surface archaeological visibility. Archaeological sites if found are logged with hand-held GPS and documented according to standard criteria of affinity, size and general condition. Sites are individually ranked according to their archaeological Significance and Vulnerability, following standard criteria as set out in Table 1.

Table 1: Significance and Vulnerability Ranking of archaeological sites

SIGNIFICANCE RANKING

0 no archaeological significance

1 disturbed or secondary context, without diagnostic material

2 isolated minor find in undisturbed primary context, with diagnostic material

3 archaeological site forming part of an identifiable local distribution or group

4 multi-component site, or central site with high research potential

5 major archaeological site containing unique evidence of high regional significance

VULNERABILITY RANKING

0 not vulnerable

1 no threat posed by current or proposed development activities

2 low or indirect threat from possible consequences of development (e.g. soil erosion)

3 probable threat from inadvertent disturbance due to proximity of development

4 high likelihood of partial disturbance or destruction due to close proximity of development

5 direct and certain threat of major disturbance or total destruction

Archaeological survey of the proposed waste facility site : The area of the proposed waste facility Farm 38, Walvis Bay and its surroundings form a featureless plain comprising Neogene age Rooikop gravels partly overlain by a lag of disaggregated Gobabeb gravels. [3] There is no vegetation cover and the soil is highly saline. The area has been extensively disturbed by vehicle traffic. No archaeological features were observed.

Impact assessment: Field assessment following the ranking criteria set out in Table 1, showed that the survey area Significance value of 0, indicating "no archaeological significance". In terms of the Knight Piésold Impact Assessment Methodology, the waste facility footprint would be subject to direct impact in the course of construction. However, given the absence of archaeological sites the Significance score would be a **low negative**.

Conclusions and recommendations: The proposed waste facility Farm 38, Walvis Bay and its surroundings, are heavily disturbed by previous developments. The waste facility site is therefore considered a brownfield site and of no significance in terms of archaeological remains. It is recommended that consent should be given under the National Heritage Act (27 of 2004) for the proposed waste facility in Benguela Extension 3, Lüderitz project to proceed.

[3] Ward, J.D. 1987. *The Cenozoic succession in the Kuiseb valley, central Namib Desert*. Geological Survey of SWA/Namibia, Memoir 9.

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E-mail: info@nhc-nam.org

CONSENT

(Section 55(9) of the National Heritage Act, 2004 (Act No. 27 of 2004) Consent is hereby given to:

1st April 2026

Consent Number No: 42/2026/45

Name of applicant: Namwaste (Pty) Ltd

(Title and full name of the applicant)

Address of applicant: P.O Box 30735,Pionierspark, Windhoek

(Address of the applicant and of the applying institution (if applicable)

For: Establishment of a waste management facility.

(Type of Activity applied for)

Of: None

(Description of Heritage Resources)

From: The proposed project is located within Farm 38, Walvis Bay, Erongo Region.

(Description of the site, location as in the application)

Council Members: Ms. Una Ferreira (Chairperson), Dr. Kennedy Kariseb (Vice-Chairperson), Ms. Getrude Xawes, Mr. Beatus Amadhila, Dr. Emma Hailengi, Mr. Hannu Shipena, Mr. Mzingisi Gqweda (Ex-Officio), Mr. Manfred !Gaeb (Ex-Officio), Ms. Erica Ndalikokule (Ex-Officio)

Consent Number No: 41/2026/44

In accordance with Progress Report submitted for the proposed establishment of a waste management facility, Erongo Region. Namibia.

Permit application date: 26/01/2026

(Specify relevant documentation and Permit application date)

The following conditions (imposed in terms of section 55(9) of the Act.) apply to this permit:

a) Monitoring and evaluation inspection will be carried out on the area during the course of the year

b) Failure to adhere to the conditions will attract fines or imprisonment or the retraction of the consent as per the National Heritage Act no 27 of 2004

c) As per Section 55 (9) (a) the activity authorized by this consent be supervised by a person with appropriate professional qualifications or experience

d) The proponent should take caution approaches together with the compliance and of the Chance Find Procedure.

e) The consent holder is to report back to the National Heritage Council every six (6) months on compliance with the conditions of this consent.

f) This consent does not exempt the holder from any conditions that may be imposed by owners, hosts or any other relevant authorities in consultation with NHC who have a stake in the project area.

g) NHC shall not be liable for any losses, damages or injuries to persons or properties as a result of any activities related to this permit.

h) This Consent is subject to the provisions of the National Heritage Act (Act 27 of 2004). Should any of the conditions contained herein conflict with the Act, the provisions of the Act as per section 55 (10) shall prevail

i) This consent is renewable, upon submission of an application at least two months before the current permit lapses.

Council Members: Ms. Joa Ferreira (Chairperson), Dr. Kennedy Kanseti (Vice-Chairperson), Ms. Getrude Xawes, Mr. Beatus Amachila, Dr. Emma Hallongo, Mr. Fanuel Shipena, Mr. Mzingisi Gqweda (Ex-Officio), Mr. Manfred Klaeb (Ex-Officio), Ms. Erica Nealickulu (Ex-Officio)

Consent Number No: 41/2026/44

This Consent will be valid from 01st April 2026 to 31st March 2027.

Erica M.P. Ndalikokule

Director: National Heritage Council of Namibia

National Heritage Council of Namibia
Office of the Director
01 APR 2026
Private Bag 12043
Ausspannplatz
Windhoek, Namibia

Council Members: Ms. Una Ferreira (Chairperson), Dr. Kennedy Kariseb (Vice-Chairperson), Ms. Gertrude Xawes, Mr. Beatus Amadhila, Dr. Emma Haiango, Mr. Hennu Shidena, Mr. Mzingisi Gowede (Ex-Officio), Mr. Manfred !Gaeb (Ex-Officio), Ms. Erica Ndalikokule (Ex-Officio)