DRAFT ENVIRONMENTAL IMPACT ASSESSMENT

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT REPORT:

The Proposed Gas to Power Powership Project at the Port of Ngqura within the Coega SEZ, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape

DFFE REF NO: 14/12/16/3/3/2/2005
A Project of Karpowership SA (PTY) Ltd)

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EXECUTIVE SUMMARY:
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1. Introduction

Karpowership SA (Pty) Ltd proposes a Gas to Power via Powership Project at the Port of Ngqura, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape.

Triplo4 Sustainable Solutions has been appointed to undertake the Scoping and Environmental Impact Reporting (S&EIR), also referred to as the EIA process required in terms of the National Environmental Management Act 107 of 1998, as amended (NEMA).

The proposed Gas to Power Powership Project at the Port of Ngqura has been formulated in response to the Request for Proposals (RFP) for technology agnostic New Generation Capacity under the Risk Mitigation IPP Procurement Programme (RMI4P) issued by the Department of Mineral Resources and Energy (DMRE) to alleviate the immediate and future capacity deficit as well as the limited, unreliable and poorly diversified provision of current power generating technology with its inherent adverse environmental and economic impacts. The "Risk Mitigation Power Purchase Procurement Programme (2000MW): National" has also been designated the status of a Strategic Integrated Project (SIP) under the Infrastructure Development Act, 23 of 2014 by the Presidential Infrastructure Coordinating Commission. SIPs are considered to be projects of significant economic or social importance to South Africa as a whole or regionally that give effect to the national infrastructure plan and for this reason, can be expeditiously implemented through the provisions of the enabling Act.

The Integrated Resource Plan (IRP) 2019 identifies the necessary generation mix of technologies to respond to the demand for electricity. Inherent in the planning process is the commitment to energy security, cost efficiency and effectiveness, and environmental sustainability. The RMI4P succeeded in attracting project proposals featuring a variety of technology combinations to provide dispatchable generation. These determinations facilitate the process of procuring the required electricity capacity. Preferred Bidder status in the RMI4P was awarded to eight projects on 18 March 2021 and three further projects on 1st June 2021, being:

- ACWA Power Projects DAO (Solar PV + BESS + Diesel Generator)
- Oya Energy (Solar PV + BESS + Diesel Generator + Onshore Wind)
- Umoyilanga Energy (Solar PV + BESS + Liquid Petroleum Gas (LPG) Generator + Onshore Wind)
- Two projects for Mulilo Total (Reciprocating Gas Engines + Solar PV) and (Solar PV + BESS + Diesel Generator))
- Three projects for Karpowership SA (Floating Modular Reciprocating Gas Engines with Heat Capture Steam Turbines)
- Three further Preferred Bidder projects were added on 1 June 2021 to Scatec (Solar PV + BESS).

The Gas to Power via Powership Project at the Port of Ngqura forms part of the solutions provided by the RMI4P preferred bidders that provide for a combination of a range of technologies that can be noted above.

Gas, as per the DMRE, has been identified as one of the most affordable and reliable forms of power. From the 11 preferred bidders, only 1 bidder's project bid a lower cost, confirming the affordability of the gas to power project as a fully dispatchable technology.

28 projects submitted bids in response to the RMI4P on 22 December 2020. Bids were assessed for compliance with qualification criteria and then assessed on lowest cost and committed economic development contributions. The Karpowership Port of Ngqura project was subsequently named as one of the 11 successful bids announced by the DMRE. Karpowership's project status, upon award as a preferred bidder for the RMI4P, became classified as a Strategic Integrated Project (SIP) and are to be managed within the requirements as set out in the Infrastructure Development Act 23 of 2014- Appendix 7.1

2. Governance Framework

NEMA prohibits a person from commencing a listed activity without environmental authorisation. The Project triggers several activities listed in the EIA Regulations Listing Notices 1, 2 and 3 of 2014 (as amended) ("**Listing Notices**"). The procedural requirements for such an application and associated EIA that needs to be undertaken, are prescribed by the EIA Regulations, 2014 promulgated under NEMA (as amended) ("**EIA Regulations**").

In addition, the Project triggers an activity listed under the National Environmental Management: Air Quality Act 39 of 2004 (NEMAQA) which requires an atmospheric emission licence (AEL). The same EIA process prescribed by the EIA Regulations is applied to the AEL application, with a number of additional requirements set out in NEMAQA and its Regulations.

The EIA Regulations outline two authorisation processes. Dependant on the type of activity that is proposed, either a Basic Assessment or a Scoping and Environmental Impact Assessment process is required to obtain Environmental Authorisation (EA).

Triplo4 has determined that proposed the Gas to Power via Powership Project at the Port of Ngqura triggered activities in Listing Notice 1-3 of the EIA Regulations.

Table 0-1: Listed Activities

Activity	**Summarised Description**
Listing Notice 1	
11	The development of facilities or infrastructure for the transmission and distribution of electricity— (i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or (ii) inside urban areas or industrial complexes with a capacity of 275 kilovolts or more.
12	The development of infrastructure or structures with a physical footprint of 100 square metres or more within a watercourse or within 32m of a watercourse.
15	The development of structures in the coastal public property where the development footprint is bigger than 50 square metres
17	Development in the sea or in an estuary or within the littoral active zone; in respect of infrastructure or structures with a development footprint of 50 square metres or more.
18	The planting of vegetation or placing of any material on dunes or exposed sand surfaces of more than 10 square metres, within the littoral active zone
19	The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.
19A	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from— (i) the seashore; (ii) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater; or (iii) the sea
27	The clearance of an area of 1 hectare or more, but less than 20 hectares of indigenous vegetation.
Listing Notice 2	

2	The development and related operation of facilities or infrastructure for the generation of electricity from a non-renewable resource where the electricity output is 20 megawatts or more.
4	The development and related operation of facilities or infrastructure, for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres
6	The development of facilities or infrastructure for any process or activity which requires a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent.
7	The development and related operation of facilities or infrastructure for the bulk transportation of dangerous goods— (i) in gas form, outside an industrial complex, using pipelines, exceeding 1 000 metres in length, with a throughput capacity of more than 700 tons per day; (ii) in liquid form, outside an industrial complex, using pipelines, exceeding 1 000 metres in length, with a throughput capacity of more than 50 cubic metres per day.
14	The development and related operation of— (ii) an anchored platform; or (iii) any other structure or infrastructure — on, below or along the sea bed.
Listing Notice 3 (Eastern Cape)	
10	The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres.
12	The clearance of an area of 300 square metres or more of indigenous vegetation within an identified geographical area.
14	The development of— (ii) infrastructure or structures with a physical footprint of 10 square metres or more; where such development occurs— (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse.

A Water Use Authorisation in terms of Section 21 of the National Water Act 36 of 1998 (NWA) is required from Department of Water and Sanitation.

3. Environmental Process

The EIA Regulations define the detailed approach to the S&EIR process, which consists of two phases: the Scoping Phase and the Impact Assessment Phase (the current phase).

A Scoping and Environmental Impact Reporting (S&EIR) process was conducted during 2020-2021, which is required for an EA, as per the timeline below:

- The Scoping Report, including the Plan of Study and approved Public Participation (PP) Plan for the EIA, was accepted by the Competent Authority (CA), namely the Department Forestry, Fisheries and the Environment (DFFE), on 06 January 2021.
- A Final EIA Report (EIAr) and Environmental Management Programme Report (EMPr) were submitted to the CA on the 26 April 2021. The CA refused the EA application and provided KSA with the Record of Refusal (RoR) on 23 June 2021.
- On 13 July 2021, KSA appealed the CA's refusal. On 1 August 2022, the Appeal Authority (the Minister of the DFFE) dismissed the appeal and exercised her powers in terms of Section 43(6) of NEMA. The application was remitted back to the CA, with the instruction to address various gaps and defects through a new EIAr and associated PPP, in order for the application to be considered by the CA.

The CA advised that an updated EIAr, addressing the various gaps in information, and subject to a Public Participation Process (PPP), must be submitted to the CA for reconsideration.

The key objectives of the EIA are to:

- Inform Interested and Affected Parties (I&APs) about the proposed Project and the EIA process followed;
- Obtain comments from I&APs (including the relevant authorities and the public) and ensure that all issues, concerns and queries raised are fully documented and addressed in the EIA Report;
- Identify and assess potential significant impacts associated with the proposed development;
- Formulate mitigation measures to avoid and/or minimise impacts and enhance benefits of the Project; and
- Produce a Final EIA Report which will provide all the necessary information for the Competent Authority to decide whether (and under what conditions) to authorise the proposed Project.

Figure 0-1: Overview of Project Site

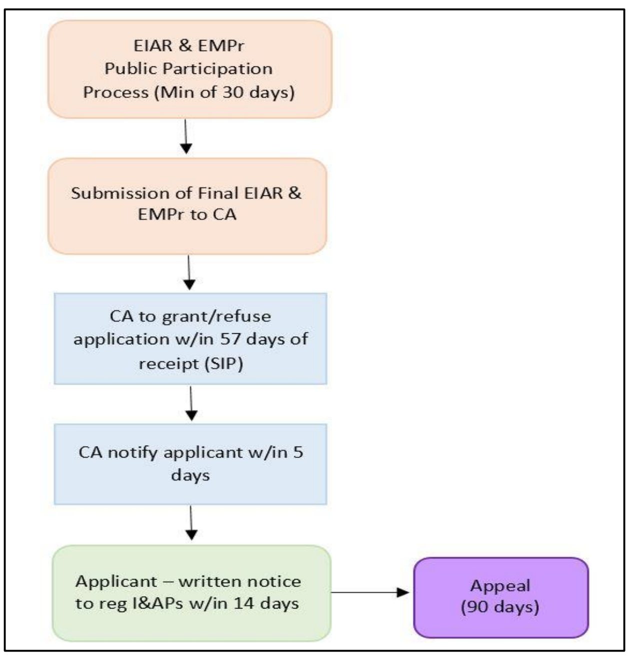

Figure 0-2: EIR Process

4. Description of the Site & Environment

The project is located in the Port of Ngqura. It is located within the Coega Special Economic Zone (SEZ) in the Nelson Mandela Bay Metropolitan Municipality (NMBM) in the Eastern Cape Province. The Coega SEZ, is managed by the Coega Development Corporation (CDC) and the Port of Ngqura forms part of the Coega Industrial Development Zone (IDZ), but falls under the jurisdiction of the Transnet National Ports Authority.

The Coega SEZ is located around the Port of Ngqura in order to promote business and industry that will benefit from direct access to the Port. As such it is anticipated that the area will develop as a strategic industrial zone. Whilst the majority of the SEZ remains undeveloped, the area immediately to the west of the Port is relatively well developed.

The proposed Powerships, FSRU, temporary LNGC and gas line, will be located in the Port of Ngqura under the jurisdiction of TNPA. While the transmission line is across Transnet properties as well as CDC properties currently used as a services servitude. The proposed Powership is located adjacent to the admin craft basin. The proposed FSRU is located at the base of the eastern breakwater and is seaward of the admin craft basin.

Figure 0-3: Overview of Port Site

Figure 0-4: Overview of Transmission Route

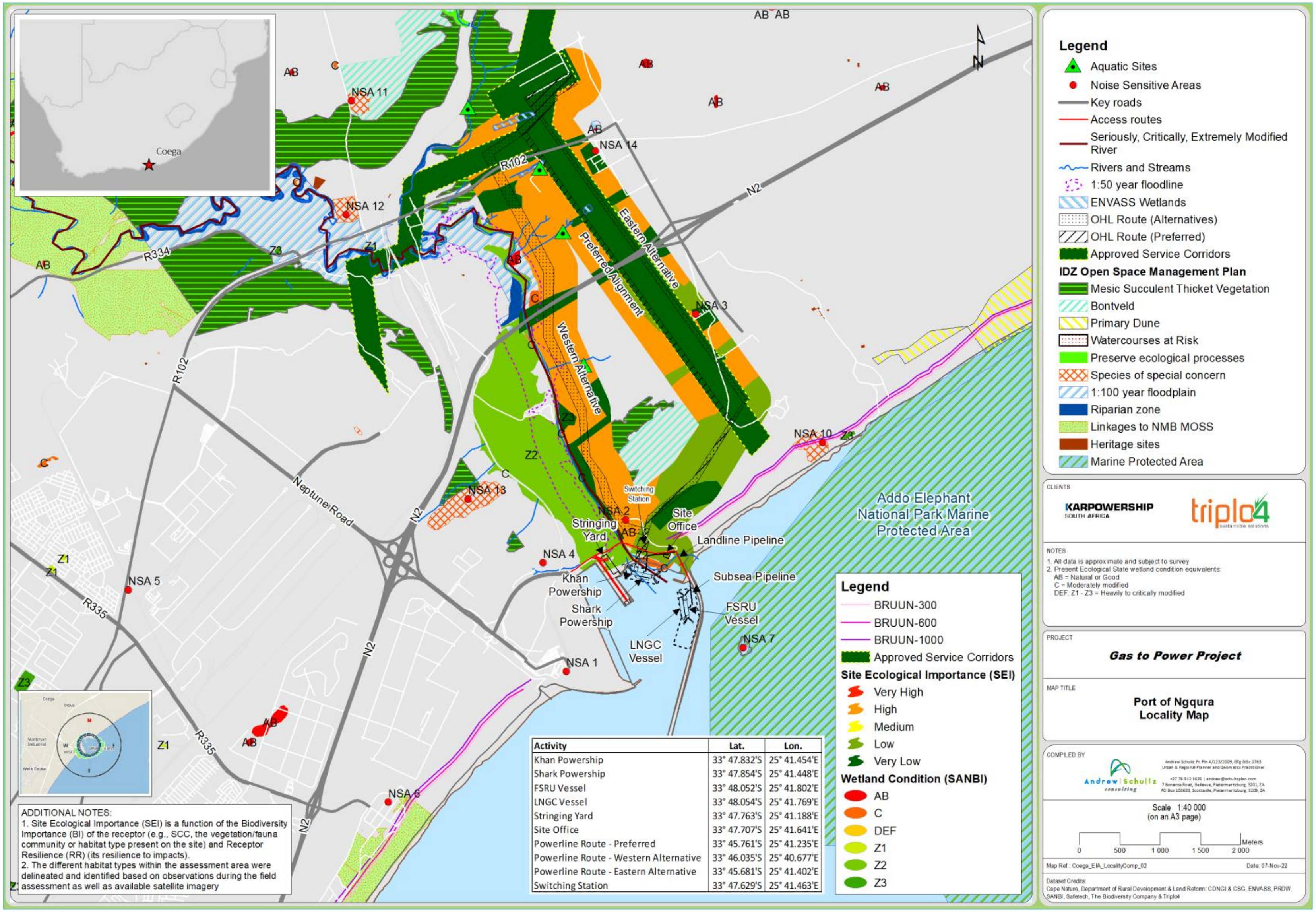

Figure 0-5: Overview of Project Locality – Gas to Power via Powership in Port of Ngqura

The most notable land uses adjacent to the project site are:

- Settlement areas: These include the coastal settlement areas of St George's Strand and Bluewater Bay.
- Undeveloped sections of the Coastal Plain: This area is relatively flat with generally low vegetation.
- Industrial sections of the Coastal Plain. This is comprised of the SEZ area immediately to the south west of the Port.
- The Port and Coastal Strip: The coastal strip can be differentiated from the rest of the coastal plain due to its proximity to the sea.

Two conservation areas are located in the vicinity of the project. The project site is situated outside Greater Addo Elephant National Park and the Bird Island Marine Protected Area (MPA) which includes Saint Croix and Jahleel Islands that are approximately 5km and 1km away respectively. In addition, the project is approximately 10 km to the south west is the Swartkops Valley Local Nature Reserve.

The NMBM is the second most populous municipality in the province after the O.R. Tambo District Municipality, although it has a significantly higher population density.

The current metro area population of Nelson Mandela Bay in 2022 is 1,281,000, a 1.1% increase from 2021. The metro area population of Nelson Mandela Bay in 2021 was 1,267,000, a 1.04% increase from 2020 (Macrotrends LLC, 2022).

5. Project Need and Desirability

The Karpowership project has arisen in response to the need to address the current energy crisis experienced in South Africa. It is in response to a bid issued by DMRE as part of the RMI4P. The RMI4P is to satisfy the short-term electricity supply gap, ease the current electricity supply constraints and reduce the wide-scale usage of diesel-based peaking electrical generators using alternative energy technologies ((Steenkamp & Weaver, 2022; DMRE, 2021a). The energy generated through the Karpowership project will contribute towards alleviating the loadshedding burden and resultant negative socio-economic impacts by providing much needed dispatchable energy, which can be provided at baseload, mid-merit and peaking.

The RMI4P, declared a Strategic Integrated Project, is an important response to the energy crisis, and in line with the mandate of the state to provide services that ensures socio-economic growth and well-being for the benefit of all of society. Karpowership's proposed project is in accordance with the IRP 2019 where provision has been made for gas in the energy mix. Powerships should not be considered a replacement of renewable energy, but rather a complementary technology to renewable energy, which supports the transition away from coal and a reduction in the negative environmental impacts associated with coal. Coupled with the urgent need to respond to the energy crisis Karpowership's project bring a solution where electricity can be dispatched on instruction when the energy supply is under strain.

In addition, the project will result in positive multiplier impacts on the local economy during both the construction and operational phases. Karpowership will play a positive role in the local economy through skills-, enterprise- and supplier development programmes. The direct, indirect, and induced economic impacts of the project on employment, income generation, new production and economic value will be positive. This will include skills development and capacity development towards the realisation of a just transition in South Africa. It is therefore anticipated that the Karpowership project will result in an overall positive socio-economic impact when considering the host of economic and environmental impacts.

It is worth reiterating that the Karpowership project is in an active port, and Coega Development Special Economic Zone, which is considered a key growth node catering specifically for the energy and maritime sectors.

However, a responsible and sustainable approach to the proposed project is still required, in line with the requirements of NEMA and the environmental management Acts Policies and Guidelines. In addition, a duty of care must be observed. Therefore, numerous multidisciplinary specialist impact assessments have been undertaken as part of the EIA process, integration of specialist findings was ensured and the application of a polycentric view to the impact assessment was applied. Negative and positive impacts have been identified, and as far as possible all negative impacts have been avoided or mitigated to reduce the impact, and further management recommendations provided for as per the EMPr. All Specialists supported the project and no fatal flaws were identified. The polycentric approach gave consideration to all relevant factors, inclusive of potential impacts that the proposed project could have on the local as well as the broader community. There is further opportunity for scientific research and monitoring programmes to inform adaptive management to the life cycle of this project, and for similar port-based projects. The Sustainability Specialist, based on Specaialists' inputs, independently assessed the project's geographical, physical, biological, social, economic and cultural aspect of the environment through the application of three methods that assisted with synthesizing and conceptualizing technical information for decision making purposes. The following conclusion was reached: *"I support that this project be granted the environmental authorisation, provided the necessary mitigation and management recommendations are upheld. The recommendations provided in this report offer further opportunity to reduce the negative impacts of this project on the environment and enhance the positive contributions and legacy that Karpowership SA can contribute to this community."*

6. Project Description

The Project entails the generation of electricity by two Powerships moored in the Port of Ngqura, fed with natural gas from a third ship, a Floating Storage & Regasification Unit (FSRU). The three ships will be moored in the port for the Project's anticipated 20-year lifespan. A Liquefied Natural Gas Carrier (LNGC) will bring in liquefied natural gas (LNG) and offload it to the FSRU approximately once every 20 to 30 days, dependent on power demand which is determined by the buyer, ESKOM. The FSRU stores the LNG onboard and turns the liquid form into gaseous form (Natural Gas) upon demand from the Powership (Regasification). Natural gas will be transferred from the FSRU to the Powerships via a subsea gas pipeline. The Project's design capacity is 540MW. Electricity will be generated on Powerships by 27 reciprocating engines, each having a heat input in excess of 10MW (design capacity of 18.32MW each at full capacity). Heat generated by operation of the reciprocating engines is captured, and that energy is used to create steam to drive three steam turbines that each have a heat input of circa 15.45MW. The contracted capacity of 450MW, which cannot be exceeded under the terms of the RMI4P, will be evacuated via a 132kV transmission line over a distance of approximately 7.4km, from the Port of Ngqura's tie-in point to the Eskom line, at a connection point (necessitating a new switching station located adjacent to Klub Road near Port Control) in proximity to the existing Dedisa Substation, which feeds electricity into the national grid.

7. Alternatives

The EIA Regulations, 2014 (as amended) require that all S&EIR processes must identify and describe feasible and reasonable alternatives. Numerous alternatives were identified and considered to date.

Table 0-2: Alternatives Screened Out

Alternative	Screened Out Reason
Transmission Route: approx. 180m away from the Port of Ngqura and heads in a north-westerly direction and adjacent to the transformed Ngqura River, thereafter a small stretch heads in an easterly direction and continues in a north-westerly direction prior to the Dedisa substation.	Potential impacts on watercourses were considered to be too detrimental to these systems, From an ecological perspective this route is also not favoured as it traverses some undisturbed thicket areas that form important habitats for fauna, many of which are themselves protected species.

The following alternatives were considered in the EIA:

7.1. Layout Alternatives

Marine:

Preferred Powership and Gas Pipeline Alternative 1: The proposed Powerships is located adjacent to the admin craft basin. The proposed FSRU is located at the base of the eastern breakwater and is seaward of the admin craft basin. Onshore gas pipeline is routed around the ACB admin buildings and across the dune field via the shore crossing and along the seabed to the location of the Powership PLEM.

Powership and Gas Pipeline Alternative 2: is considered less suitable from an engineering perspective, as the Powerships and the FSRU are located too close together and would be an issue in terms of navigational aspects. This option is to position the two Powerships closer to the liquid bulk terminal and the FSRU along the curved portion of the eastern breakwater. The gas pipeline connecting the FSRU to the Powerships will be routed along the edge of the existing eastern breakwater

Transmission:

Alternative 1 (Preferred): The electricity that is generated onboard the Powerships is converted by the on-board High Voltage substations (capacity of 110 – 170kV) will be evacuated by first connecting the two Powerships and then to land via a double circuit twin Tern conductor 132kV single transmission line route over a distance of approximately 7.4km, from the Powership to the Dedisa Substation. The transmission line is routed on the western side of the services servitude. A connection point (necessitating a new Saltpan 132kV on shore switching station) is required to feed the electricity into the national grid via the Dedisa Substation.

Alternative 2: Transmission line of approximately 7,4km will be routed on the eastern side of the services servitude and will interconnect the Powership to the National Grid utilising the existing Dedisa network via a new Saltpan 132kV on shore switching station.

7.2. Design Alternatives

The proposed transmission line can be constructed of either monopole or lattice steel construction, based on the final engineering design requirements, the topography and geotechnical survey results. As the extent of the lattices' footprint is much bigger and require more vegetation clearance than the monopoles, the monopoles are the preferred options.

7.3. Technology Alternatives: Fuel

The Powerships to be deployed will generate electricity using Wärtsilä engines running exclusively on natural gas. Wärtsilä conducts extensive research on the use of different fuel sources within its engines, improving and optimising their technology to future-proof and deliver leading efficiency. Wärtsilä have made significant progress on the possibility of using hydrogen gas to power with their engine technology; whilst it is already technically possible to utilise a mix of hydrogen with natural gas, this technology is in its infancy and is undergoing rigorous research and development for pure hydrogen operations, and outcomes of that research and development (R&D) are anticipated within the coming years.

7.4. No Go Alternative

The option of not implementing the activity, i.e. the "no-go" alternative, was considered. In respect of the Project, it would mean that the existing status quo would prevail. While the benefit of this option is that there will be no negative environmental or social impacts, there also would be no positive environmental or socio-economic benefits as well as deployment of cleaner turnkey energy technology in keeping with the South Africa's Just Energy Transition objectives.

Based on the findings of the independent specialist studies, the proposed project will not result in significant negative environmental or social impacts provided the mitigation measures recommended by the EAP and specialists, as contained in Section 7.5 of the draft EIA report and the EMPr are implemented. In fact, the proposed project will have positive environmental impacts due to mitigation measures involving ecological research and subsequent long-term improvements resulting from improved knowledge. Negative environmental impacts resulting from loadshedding, declining energy or the use of more environmentally harmful alternative fuel sources will also be prevented.

The highly significant positive socio-economic impacts will not be realised in the no-go scenario. A socially just transition for the poor and unskilled workforce and marginalised individuals and Government's target for a sustainable energy supply mix will also not occur in context of the Karpowership Project in Port of Ngqura. The lost benefit of having electricity derived from natural gas, reduces the stability and resilience of power grids, thereby reducing the energy transition towards facilitating rapid deployment of renewable energy sources. Dispatchable power to the national grid to meet existing as well as increased future electricity demand within the country will not be available to prevent the disastrous and devastating economic decline associated with loadshedding resulting from an ever increasing deficit of power. Continued loadshedding will negatively impact on the wellbeing of the majority of the SA population, on the economy as a whole as well as on local and international investor sentiments. Opportunities to stimulate the economy through employment, social development programmes, bursaries for education, other educational programmes, skills development programmes and procurement from local suppliers will be lost while the broader economic sectors such as industry, tourism, and entertainment will also face growth constraints. Moreover, individuals and especially the disadvantaged and marginalised, will have to face increasing risks to their livelihoods as well as reduced economic opportunities.

When the minimal potential environmental and socio-economic risk with mitigation is measured against the potential environmental and socio-economic benefits, there is simply no contest. The environmental benefits are significant and the social and economic benefits vastly outweigh the mitigated environmental and socio-economic impacts.

The no-go option is thus not consistent with the principles of sustainable development in relation to the provision of electricity which falls under the SDG 7: Affordable and Clean Energy and SDG 8: Decent Work and Economic Growth. It is thus the reasoned opinion of the EAP that the proposed 540MW Gas to Power Powership Project, should be authorised subject to the conditions proposed in Section 9, which include compliance with the EMPr. Hence the "no-go" alternative is not recommended.

8. Stakeholder Engagement

Stakeholder engagement is a key component of the S&EIR process and is being undertaken in accordance with the requirements of the EIA Regulations. Stakeholder engagement periods include the following:

- Initial notification and submission of the BID;
- Formal public comment period on the draft EIA Report

The key stakeholder engagement activities during the EIA processes are summarized in Section 5.

Table 0-3: Summary of Stakeholder Engagement Activities

Activity	**Date**
Initial Notification	
Advert, BID, Site Notices, Flyers, Leaflets, Radio Announcements	24 -28 October 2022
Consultation Meetings	24 October – 09 November 2022
Impact Assessment	
Draft EIAR Comment Period	10 November – 13 December 2022
Public & Virtual Meeting	25 November 2022

9. Assessment of Potential Impacts

9.1. Specialist Studies & Technical Reports

Specialist studies were undertaken to investigate key potential direct, indirect and cumulative impacts:

- Hydrology & 1:100 Year Floodline Assessment
- Aquatic Assessment
- Hydropedology Assessment
- Geohydrology Assessment
- Water Balance Assessment
- Wetland Delineation & Functionality Assessment
- Heritage & Palaeontology Assessment
- Terrestrial Biodiversity Assessment
- Avifauna Assessment
- Baseline Underwater Noise Report
- Underwater Noise Assessment Report
- Underwater Heritage Report
- Marine Ecology Assessment & Fisheries Impact Report
- Marine Avifaunal Assessment
- Estuarine and Coastal Assessment
- Traffic incl. Marine Assessment
- Thermal Plume Modelling Report
- Air Quality Impact Assessment
- Ambient Noise Impact Assessment
- Climate Change Impact Assessment
- Socio-Economic Impact Assessment
- Small Scale Fishers Specialist Engagement Report
- Sustainability Report
- Tourism Impact Assessment
- Visual Impact Assessment
- Major Hazard Installation Assessment
- Role of Gas in the Just Transition
- Cost implications Gas vs. Renewable forms of Energy

For all potentially significant impacts, the significance of the anticipated impact was rated without and with recommended mitigation measures in Table 0-4.

9.2. Impact Significance

The significance of potential impacts of the proposed Project was determined in order to assist decision-makers. The overall impact ratings, assuming mitigation measures (refer to Section 9.3.2) are effectively implemented, are:

- No significant or negligible impacts or risks were identified for specialist studies conducted in terms of traffic, marine traffic, major hazard installation, hydrology, geohydrology, hydropedology, aquatic, tourism and visual aspects.
- Impacts and risks of very low and/or low significance were identified for wetlands, archaeology, underwater archaeology, atmospheric emissions, terrestrial noise, tourism and visual impacts and socio-economic. Terrestrial biodiversity impacts ranged from very low to medium low.
- The overall impact of the Project on the Coega Estuary and coastal environment will be medium-low to low.
- Medium impacts were specified regarding the effects on the marine ecology in the receiving water body due to discharge of cooling water or increased noise and vibration levels and the effects of impacts on ecosystem services during the operational phase.
- Low to very high positive impacts were indicated for aspects related to the Tourism Industry and the socio-economic assessment indicated numerous positive impacts ranging from medium, medium-high to high positive.

A polycentric approach to the proposed project requires the holistic consideration of all relevant factors, inclusive of potential impacts that the proposed project could have on the local as well as the broader community. Section 2(4)(b) of NEMA states that *Environmental management must be <u>integrated,</u> acknowledging that all elements of the environment are linked and interrelated, and it must take into account the effects of decisions on all aspects of the environment and all people in* the *environment by pursuing the selection of the best practicable environmental option.* Sustainable development as per NEMA requires the integration of social, economic, and environmental factors in the planning, implementation, and evaluation of proposed projects, to ensure that development serves the needs of present and future generations.

The independent sustainability specialist assessment therefore considered both the positive and negative impacts of actual and potential impacts on the geographical, physical, biological, social, economic, and cultural aspects of the environment in a polycentric and holistic approach that:

- Acknowledges that this environment is a complex and dynamic system
- Acknowledges the interrelated socio-ecological and socio-economic relationships
- Identifies the risks and consequences of alternatives and options for mitigation of activities, to minimise negative impacts, maximise benefits, and promote compliance with the principles of environmental management as set out in Section 2 of NEMA.

Table 0-4 below summarises the impacts assessed in the EIA, including their significance before and after the implementation of essential mitigation measures.

Table 0-4: Summary of Impacts

Potential Impacts and Risk	Significance	
	Pre-Mitigation	**Post Mitigation**
Hydrology Impacts		
Disturbing vadose zone - excavations/construction activities.	Neutral/ Negligible	Neutral/ Negligible
Exposure of soils: sedimentation of the watercourses; soil compaction; and soil erosion.	Low – negative	Neutral/ Negligible
Surface water contamination and sedimentation	Low – negative	Neutral/ Negligible
Transmission line installation: backfilling may cause soil subsidence	Neutral/ Negligible	Neutral/ Negligible
Switching station spillages (incidents only)	Neutral/ Negligible	Neutral/ Negligible
Leakages from vehicles: transmission line maintenance	Neutral/ Negligible	Neutral/ Negligible
Aquatic Impacts		
No impacts		
Hydropedology Impacts		
Site preparation impacting on soil interflow processes, soil quality, soil structure and land capability	Neutral/ Negligible	Neutral/ Negligible

Disturbing vadose zone during soil excavations / infilling activities	Low – negative	Neutral/ Negligible
In-situ placement of new soils, altering existing soil-flow processes impacting on soil interflow processes, soil quality, soil structure and land capability	Low – negative	Neutral/ Negligible
Vegetation clearing & soil stockpiling	Low – negative	Neutral/ Negligible
Surface water (wetland) quality	Low – negative	Neutral/ Negligible
Soil quality	Low – negative	Neutral/ Negligible
Excavation will disturb soil interflow processes	Low – negative	Neutral/ Negligible
Oil & fuel spills impacting on soil quality	Low – negative	Neutral/ Negligible
Geohydrology Impacts		
Disturbing vadose zone during soil excavations / construction activities	Neutral/ Negligible	Neutral/ Negligible
Hydrocarbon contamination of the vadose zone (construction phase)	Low – negative	Neutral/ Negligible
Surface water contamination and sedimentation	Low – negative	Neutral/ Negligible
Impacts to downstream groundwater users	Neutral/ Negligible	Neutral impact. No mitigation required.
Perched water table dewatering	Neutral/ Negligible	Neutral/ Negligible
Hydrocarbon contamination of the vadose zone (operational phase)	Neutral/ Negligible	Neutral/ Negligible
Impacts to downstream groundwater users (operational phase)	Neutral/ Negligible	No monitoring is proposed. Impact probability is neutral.
Wetland		
Catchment modifications (land cover and surface runoff)	Low	Very Low
Water Quality (Pollution)	Low	Very Low

Archaeology Impacts		
No impacts.		
Palaeontology Impacts		
Loss of shells of other fossils during excavation of pylon foundations	Low	Very Low
Terrestrial Biodiversity Impacts (Transmission)		
Loss of strandveld (Preferred Alternative 1 and Alternative 2)	Medium-Low	Low
Loss of intact bontveld (Preferred Alternative 1)	Medium-High	Medium
Loss of intact bontveld (Alternative 2)	Medium-High	Medium-Low
Loss of degraded bontveld (Preferred Alternative 1 and Alternative 2)	Medium-Low	Low
Loss of Flora SCC (Preferred Alternative 1 and Alternative 2)	Medium-High	Low
Loss of Fauna SCC (Preferred Alternative 1 and Alternative 2)	Medium-Low	Low
Loss of biodiversity in general (Preferred Alternative 1 and Alternative 2)	Medium-High	Medium-Low
Ecosystem function and process (Preferred Alternative 1 and Alternative 2)	Medium-High	Medium-Low
Loss of strandveld (Preferred Alternative 1 and Alternative 2)	Medium	Low
Loss of intact bontveld (Preferred Alternative 1 and Alternative 2)	Medium	Low
Loss of degraded bontveld (Preferred Alternative 1 and Alternative 2)	Medium-Low	Low
Loss of Species of Special Concern and Biodiversity (Preferred Alternative 1 and Alternative 2)	Low	Very Low
Ecosystem function and process (Preferred Alternative 1 and Alternative 2)	Low	Very Low
Avifauna Impacts		

Physical disturbance by Site establishment, Powerships, FSRU, LNG Carrier, gas pipelines (Preferred Alternative 1)	Low	Low
Physical Disturbance by Site establishment, Powerships, FSRU, LNG Carrier, gas pipelines (Alternative 2)	Low	Very Low
Disturbance by atmospheric noise and light (Powerships, FSRU) (Preferred Alternative 1 and Alternative 2)	Medium-High	Medium
Emergency events (Powerships, FSRU, LNG Carrier, gas pipelines, gales, swells, flooding and marine traffic accidents) (Preferred Alternative 1 and Alternative 2)	Low	Very Low
Transmission lines: Habitat disturbance and fragmentation (Preferred Alternative 1 and Alternative 2)	Medium-Low	Very Low
Transmission lines: Collisions and electrocution (Preferred Alternative 1 and Alternative 2)	Medium - High	Low
Underwater Noise Impacts		
Impact of underwater noise on marine mammals and fish	Low	Very Low
Underwater Archaeology Impacts		
No impacts to underwater heritage resources		
Marine Ecology and Marine Avifauna Impacts		
The effects of increased noise levels from construction on the surrounding marine ecology – construction phase	Medium-Low	Low
The effects of increased noise levels from construction on the surrounding marine ecology – construction phase	Medium-Low	Medium-Low
The effects of construction impacts on ecosystem services– construction phase	Medium-Low	Medium-Low
The effects of the intake of cooling water on marine organisms in the surrounding water body – operational phase	Medium	Medium-Low
The effects of the discharge of cooling water on the marine ecology in the receiving water body– operational phase	Medium - High	Medium
The effects of increased noise and vibration levels on the surrounding marine ecology	Medium - High	Medium
The effects of the combined operational impacts on ecosystem services– operational phase	Medium	Medium
Coastal and Estuary Impacts		
Effect on habitat as a result of construction within the estuarine functional zone – Site Office	Medium-Low	Medium-Low
Effect on habitat as a result of construction within the estuarine functional zone – Gas Line Preferred Alternative 1 and Terminal Tower	Medium	Medium-Low
Effect on habitat as a result of construction within the estuarine functional zone - Gas Line Alternative 2	Neutral/ Negligible	Neutral/ Negligible
Effect on estuarine/beach fauna as a result of construction activities and noise – Site Office & Gas Line Alternative 2	Low	Low
Effect on estuarine/beach fauna as a result of construction activities and noise - Gas Line Preferred Alternative 1	Medium - High	Medium-Low
Effect on estuarine/beach fauna as a result of construction activities and noise - Terminal tower	Medium - High	Medium
Effect on terrestrial and estuarine avifauna as a result	Very Low	Very Low

of construction activities and noise (Powerships: Preferred Alternative 1 and Alternative 2)		
Effect of solid waste pollution & chemical pollution arising from construction related spills of hazardous substances	High	Medium-Low
Effect on estuarine and terrestrial avifauna due to collisions and electrocutions at the powerlines (Transmission: (Preferred & Alternative 2)	Medium	Low
Affect on terrestrial and estuarine avifauna due to atmospheric noise and light (Powerships: Preferred Alternative 1 and Alternative 2)	Medium	Medium-Low
Effect of cooling water discharge on estuarine/marine ecology (Powerships: Preferred Alternative 1 and Alternative 2)	Medium - High	Medium
Effect of underwater noise on marine ecology (Powerships: Preferred Alternative 1 and Alternative 2)	Medium - High	Medium
Effect on coastal/estuarine associated fauna and habitat destruction due to fires and explosion (Powerships: Preferred Alternative 1 and Alternative 2)	Very Low	Very Low
Effect on coastal/estuarine associated fauna and habitat destruction due to fires and explosion	High	Low
Effect on/of dynamic coastal processes (Transmission Preferred Alternative 1)	Low	Low
Effect on/of dynamic coastal processes (Site Office & Stringing Yard)	Low	Very Low

Effect on/of dynamic coastal processes (Gas Line Preferred Alternative 1)	Medium-Low	Low
Effect on/of dynamic coastal processes (Gas Line Alternative 2)	Low	Low
Atmospheric Impacts & Risks		
SO_2, NO_2, PM_{10}	Low	Low
Terrestrial Noise Impacts & Risks		
Noise impacts from construction & operational activities	Medium-Low	Low
Climate Change Impacts and Risks		
Contribution to climate change	Low (Positive)	Low (Positive)
Socio-Economic Impacts and Risks		
Temporary increase in the GDP and production of the national and local economies during construction	High (Positive)	High (Positive)
Temporary increase in employment in local and national economies	High (Positive)	High (Positive)
Contribution to skills development in the country and in the local economy	Medium-Low (Positive)	Medium (Positive)
Temporary improvement of the standard of living of the positively affected households	Medium (Positive)	Medium (Positive)
Temporary increase in government revenue	Medium (Positive)	Medium (Positive)
Temporary increase in social conflicts associated with the influx of construction workers and job seekers to the area and Added pressure on economic and social infrastructure during construction as a result of increase in local traffic and in migration of construction workers	Medium (Low)	Low
Impact on the sense of place experienced by the local community as a result of visual and noise effects that appear during the construction phase	Low	Low

Temporary increase in the GDP and production of the national and local economies during construction	High (Positive)	High (Positive)
Creation of sustainable employment positions nationally and locally	High (Positive)	High (Positive)
Skills development of permanently employed workers during operations phase	Medium (Low) (Positive)	Medium (Positive)
Improved standard of living for benefitting households	High (Positive)	High (Positive)
Sustainable increase in national and local government revenue	Medium-High (Positive)	Medium-High (Positive)
Provision of electricity for future development during operations phase	High (Positive)	High (Positive)
Local community and social development benefits derived from the project's operations	Medium (Positive)	Medium-High (Positive)
Impact on the sense of place experienced by the local community as a result of visual and noise effects that appear during the operational phase	Low	Low
Tourism Impacts and Risks		
Noise impacts on marine tourism activities	Low	N/A
Visual and noise impacts on tourism	Low	N/A
Electricity provision on the hospitality and tourism industry Nelson Mandela Bay	Very High (Positive)	Very High (Positive)
Energy and Industrial Tourism at Port of Nqgura	Low (Positive)	Low (Positive)
Traffic Impacts		
No impacts		
Visual Impacts		
Change the character and sense of place: of the landscape setting (Landscape Change); as seen from urban areas and particularly the coastal settlements of St George's Strand and Bluewater Bay; roads particularly the N2 the south east on the seaward side of the coastal dune close to of St George's Strand and Bluewater Bay Conservation areas including the Addo Elephant Park and the Swartkops Valley Local Nature Reserve operational, safety and security lighting of the facility at night on observers. (Powership, FSRU)	Low	N/A
Change the character and sense of place of the landscape setting (Landscape Change); urban areas and particularly the coastal settlements of St George's Strand and Bluewater Bay roads particularly the N2 south east on the seaward side of the coastal dune close to of St George's Strand and Bluewater Bay. (Transmission Line: (Preferred Alternative 1 & 2)	Low	Low
Major Hazard Installation Risks		
No impacts		
Marine Traffic Impacts and Risk		
No impacts		

9.3. Key Mitigations Measures

The mitigation hierarchy (avoid, reduce, rehabilitate and offset) was applied. Key design mitigation proposed to address impacts of the bypass are summarised below:

Avoid

- Screening out of Transmission Line Alternative 3:
- Detrimental to several watercourses and associated systems;
- Traverses some undisturbed thicket areas that form important habitats for fauna, many of which are themselves protected species.
- The gas pipeline alternative selected the route in relation to the Preferred Powership position. The

position of the Powerships as per Alternative 2 in relation to the shore is feasible but somewhat more challenging from a technical engineering perspective and potential risk is added to navigating vessels from running the evacuation line across the Admin Craft Basin entrance

- The preferred alternative transmission line based within the services servitude of the CDC and the CDC's preferred position. The services servitude within the industrial zoned area, as per environmental authorisation, provides for the establishing of inter alia a 132kV powerline. In addition, the alignment of the powerlines outside the protected Bonteveld Open Space System.
- The use of closed-loop water systems that exclude the use of biocides and chlorine and thus prevent any potential pollution within the marine environment.

Reduce

- The design of the Powerships provides for built-in noise mitigation e.g. double hull and anti-vibration mounts;
- Management of water intact velocities and placement of intake outside the benthic environment to reduce impacts within the marine ecosystem;
- Navigational simulations and TNPA agreements regarding FSRU and Powership positioning ensured the optimal location of the vessels to avoid marine traffic collisions and align with TNPA Port planning.
- Various measures were stipulated as per the EMPr for the construction and operational phase to reduce impacts.

Rehabilitate

Rehabilitation is stipulated for any areas disturbed during construction as per the measures provided in the EMPr. The EMPr also provides for the maintenance of areas to prevent degradations during the operational phase.

10. Conclusion

This draft EIAR Report identified and assessed the potential biophysical and socio-economic impacts associated with the Proposed Gas to Power Powership Project at the Port of Ngqura within Coega SEZ.

It is the opinion of the EIA project team, incorporating the signatories below, that all components of this application, including the EIR with attached independent specialist reports, EMPr, public participation process and supporting documentation, comply with the relevant guidelines and contain all the required information in terms of GN 982 to enable an informed decision by the competent authority.

It is the reasoned opinion of the EAP that the Gas to Power Powership project is acceptable, will not create unacceptable environmental impacts and can be reasonably authorised subject to the implementation of the mitigations and management measures set out in the EMPr. This opinion was reached with due consideration of:

- the independent specialist studies, with each and every specialist concluding their assessment with a supportive statement for the proposed development (i.e. no fatal flaws were identified),
- the independent contributions to the need and desirability,
- the impacts identified from a macro, micro, cumulative and polycentric (integrative) perspective in terms of the geographical, physical, biological, social, economic and cultural aspect of the environment,
- the potential to avoid or minimise negative impacts and maximise positive impacts through inter alia the socio-economic development plan and reduced loadshedding.

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List of Abbreviations

AHT Anchor Handling Tug
BID Background Information Document
BOG Boil Off Gas
CBAs Critical Biodiversity Areas
CWDP Coastal Waters Discharge Permit
dB Decibel
DAFF Department of Agriculture, Forestry and Fisheries
DEDEAT Department of Economic Development, Environmental Affairs and Tourism
DEFF Department of Environment, Forestry and Fisheries
DFFE Department of Fisheies, Forestry and Environment
DFP Development Framework Plan
DWA Department of Water Affairs
DWS Department of Water and Sanitation
DOT Department of Transnet
DWAF Department of Water Affairs and Forestry
EA Environmental Authorisation
EAP Environmental Assessment Practitioner
ECA Environment Conservation Act
EIA Environmental Impact Assessment
EIR Environmental Impact Report
EMP Environmental Management Plan
EMPr Environmental Management Programme
EMS Environmental Management Systems
G2P Gas to Power
GG Government Gazette
GN Government Notice
I&APs Interested and Affected Parties
IDP Integrated Development Plan
IDZ Industrial Development Zone
IEP Integrated Energy Planning
IPP Independent Power producer
IRT Issues and Response Trail
IUCN International Union for Conservation of Nature
MPA Marine Protected Area
NEMA National Environmental Management Act
NEM:AQA. National Environmental Management: Air Quality Act
NEM:BA National Environmental Management: Biodiversity Act
NEM:ICMA National Environmental Management: Integrated Coastal Management Act
NERSA National Energy Regulator South Africa
NGO Non-Governmental Organisations
NFEPA National Freshwater Ecosystems Priority Areas
NIRP National Integrated Resource Planning
NWA National Water Act
OCIMF Oil Companies International Marine Forum
PLEM Pipeline end manifold
PoS Plan of Study
PPP Public Participation Process
RMI4P Risk Mitigation Independent Power Producer Procurement Programme
SANBI South African National Biodiversity Institute
SANS South African National Standards
SCC Species of Conservation Concern
SDF Spatial Development Framework
SEA Strategic Environmental Assessment
SEZ Special Economic Zone
SIGTTO Society of International Gas Tanker and Terminal Operator
SIP Strategic Infrastructure Project
STS Ship to Ship
TOR Terms of Reference
TPNA Transnet National Ports Authority

THIS REPORT WAS COMPILED BY TRIPLO4 SUSTAINABLE SOLUTIONS (PTY) LTD IN TERMS OF APPENDIX 3 OF THE EIA REGULATIONS, 2014 (GNR 982 (AS AMENDED))

1 INTRODUCTION

1.1 Project Title

The Draft Environmental Impact Assessment Report for the Proposed Gas to Power Powership Project at the Port of Ngqura and Coega SEZ, Nelson Mandela Bay Metropolitan Municipality, Eastern Cape.

1.2 Background

1.2.1 RMI4P Context

The proposed Project has been formulated in response to the Request for Proposals (RFP) for up to 2,000MW of New Generation Capacity of dispatchable power from a range of technologies under the Risk Mitigation IPP Procurement Programme (RMI4P) issued by the Department of Mineral Resources and Energy (DMRE) to alleviate the immediate and future capacity deficit as well as the limited, unreliable and poorly diversified provision of power generating technology with its current adverse environmental and economic impacts.

Furthermore, emergency power is required urgently for South Africa's economic development and upliftment, primarily to provide reliable dispatchable power to the national grid to prevent load-shedding. The energy crisis has had a significant impact on the South African economy over the past 15 years and is anticipated to continue well into the future without an emergency risk response such as the RMI4P.

The RMI4P is different to the Renewable Energy Independent Power Producer Procurement Programme (REI4P) and the wider development of the electricity generation in South Africa in that it was established to address the current, and critical shortfall in electricity supply and and grid instability which has resulted in South Africa's energy crisis. The procurement thus seeks to address the short-term deficit in electricity supply, rather than determining the future energy mix. The RMI4P Request for Proposals (RFP) stipulates that all proposed projects must provide between 50 and 450 MW each of dispatchable power for a 20 year contract term, and that various stringent qualification criteria must be met including environmental, social and economic development, BBBEE, skills development, demonstration of financial and technical track record and capability and legal compliance. Bids were assessed by a panel of independent private sector experts for RFP qualification compliance, and then assessed with a weighting of 90% on bid price and 10% on Economic Development commitments made by the bidder.

The proposed Project offers 450 MW of dispatchable generation for a 20 year operational period. The 20 year term is as stipulated for all projects in accordance with the RFP and will be reflected in related Power Purchase Agreements (PPA).Projects under the RMI4P have been declared Strategic Integrated Projects (SIP) in terms of the Infrastructure Development Act 23 of 2014 by the Presidential Infrastructure Coordinating Commission Council on 24 July 2020 under SIP 20. Karpowership SA's Port of Ngqura project was announced by the DMRE on 18 March 2021 as one of the initial 8 successful bids (3 further projects were awarded Preferred Bidder status on 1 June 2021). The Project has been gazetted as a designated Strategic Integrated Project (SIP) by the SIP Steering Committee as set out in Government Gazette 43547, in accordance with the provisions of the Infrastructure Development Act 23 of 2014 (IDA) – Appendix 7.1 – SIP Confirmation Letter.

The Gas to Power Powership Project at the Port of Ngqura and Coega Special Economic Zone (SEZ) forms part of the dispatchable solutions provided by RMI4P Preferred Bidders via a range of technologies as indicated in the list of Preferred Bidders below. Gas, as per the DMRE, has been identified as one of the most affordable forms of power. 28 Projects submitted bids in response to the RMI4P RFP, from which 11 Preferred Bidders were selected. From those 11 preferred bidders, only 2 bidders (of which one was another Karpowership SA project) provided a marginally lower bid evaluation price (also included in the list of Preferred Bidders below, data from publicly available IPP Office communications), confirming the affordability of the gas to power Project.

Preferred Bidder	**Technology**	**Contracted Capacity**	**Evaluation Price MW/h**
ACWA Power Project DAO	Solar PV + BESS + Diesel Generator	150 MW	1,462.00
Karpowership SA Coega	Floating Modular Reciprocating Gas Engines with Heat Capture Steam Turbines	450 MW	1,468.87
Karpowership SA Richards Bay	Floating Modular Reciprocating Gas Engines with Heat Capture Steam Turbines	450 MW	1,496.03
Mulilo Total Hydra Storage	Solar PV + BESS + Diesel Generator	75 MW	1,515.97
Oya Energy Hybrid Facility	Solar PV + BESS + Diesel Generator + Onshore Wind	128 MW	1,550.34
Karpowership SA Saldanha	Floating Modular Reciprocating Gas Engines with Heat Capture Steam Turbines	320 MW	1,686.48
Umoyilanga Energy	Solar PV + BESS + Liquid Petroleum Gas (LPG) Generator + Onshore Wind	75 MW	1,721.64
Scatec Kenhardt 3	Solar PV + BESS	50 MW	1,884.56
Scatec Kenhardt 2	Solar PV + BESS	50 MW	1,884.61
Scatec Kenhardt 1	Solar PV + BESS	50 MW	1,884.64
Mulilo Total Coega	Reciprocating Gas Engines + Solar PV	197.76 MW	1,885.37

1.2.2 South African Energy Crisis

In the South African context, the failure to deliver stable electricity is a function of numerous factors including corruption, non-payment by citizens, public entities and private sector firms, demand inelasticity, misallocation of resources, lack of infrastructure maintenance, a stagnation in the demand for electrical energy in South Africa since 2007, and the inflexible construction programme marred with delays and cost over-runs (i.e., Medupi and Kusile) (Department of Public Enterprises, 2019).

In response to the South African energy crises, the National Development Plan (NDP) prioritised the need for energy infrastructure to be robust, extensive, and affordable to the meet the needs of industry, the commercial sector as well as households (DMRE, 2021).

Subsequently, the Integrated Resource Plan (IRP) 2019 identifies the necessary generation mix of technologies to respond to the demand for electricity. Inherent in the planning process is the commitment to energy security, cost efficiency and effectiveness, and environmental sustainability. The RMI4P succeeded in attracting project proposals featuring a variety of technology combinations. These determinations facilitate the process of procuring the required electricity capacity. The objective of the RMI4P is to satisfy the short-term electricity supply gap, ease the current electricity supply constraints and reduce the wide-scale usage of diesel-based peaking electrical generators using alternative energy technologies. RMI4P is part of an attempt by government to procure a net increase of more than 23 900 megawatts (MW) of energy over the next eight years (i.e., short term).

As South Africa increases its renewable energy capacity through further renewable energy bid windows, it is becoming apparent that dispatchable and flexible generation is required which is found in gas and lesser extent battery technology. The role of gas is indisputable in the just energy transition as it provides additional dispatchable capacity at scale that enables the large exploitation of renewable resources. With the likely demand profile for electricity in South Africa uncertain, the amount of generation required will remain unknown. However, for portions of generation that will be provided by variable sources, provision must be made for supplying all the generation from dispatchable resources in the times where the variable sources do not provide the required energy. Energy technologies are classified as dispatchable (gas, coal, nuclear, oil, hydro) or non-dispatchable (wind, solar). Both these technology groupings play an important role in meeting baseload and peaking demand and thereby ensuring security of supply. Natural gas can complement these non-dispatchable technologies by providing a dispatchable source of energy as a quick ramp up which will expedite the proliferation of renewable technologies in South Africa. Powerships should not be considered a replacement of renewable energy, but rather a complementary technology to renewable energy, which supports the transition away from coal.

1.2.3 Karpowership Overview

The applicant is Karpowership SA Pty Ltd, a South African company that is 49% owned by a Black Empowered Company and 51% owned by Karpowership, a member of Karadeniz Energy Group that owns, operates and builds Powerships (floating power plants). Since 2009, 36 Powerships have been completed to provide a total installed capacity of 6,000 MW globally, with additional Powerships either under construction or in the pipeline. Karpowership is operational in 14 locations across the world as per the Figure 1-1. Almost 1 GW of additional generation capacity is currently being commissioned in three more countries, with others at various stages of project development. Karpowership directly employs more than 2,600 people from 26 nationalities and has created more than 10,000 direct and indirect jobs around the world. The company has generated approximately 70 billion kilowatt hours of power around the world.

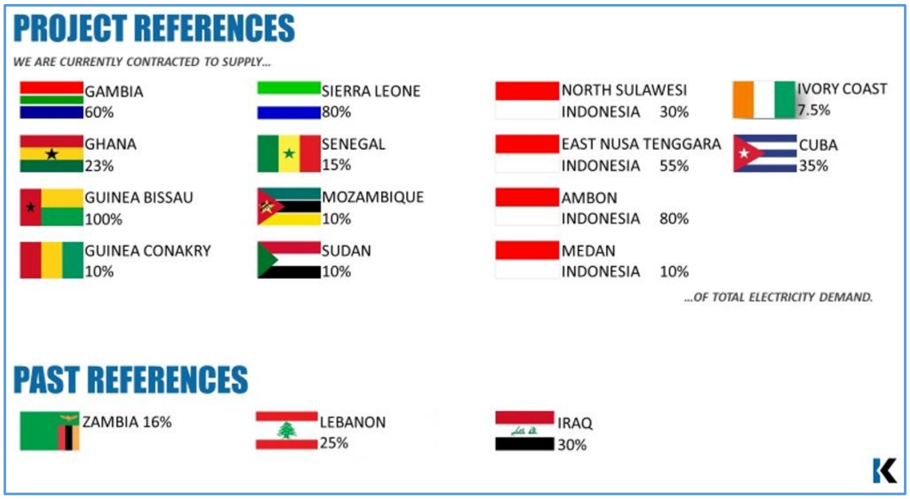


Figure 1-1: Karpowership's Project References

1.2.4 Summary of the Environmental Impact Assessment Process

Triplo4 Sustainable Solutions (Pty) Ltd has been appointed by Karpowership SA (Pty) Ltd (Karpowership) to undertake the environmental impact assessment (EIA) and manage the application for Environmental Authorisation as well the Atmospheric Emission Licence for the proposed Gas to Power Powership Project at the Port of Ngqura and Coega Special Economic Zone (SEZ), located within ward 53 of the Nelson Mandela Bay Metropolitan Municipality, Eastern Cape.

The Competent Authority responsible for evaluating and deciding on the application for environmental authorisation is the Department of Forestry, Fisheries and the Environment (DFFE): Integrated Environmental Authorisations Directorate. The same EIA will inform Karpowership's application for an atmospheric emission licence (AEL). The licensing authority for the AEL is DFFE Air Quality Authorisations which is a sub-directorate within Directorate of Climate Change and Air Quality Management. The respective landowners of the Port and surrounding SEZ are the Transnet National Ports Authority (TNPA) and the Coega Development Corporation (CDC).

A Scoping and Environmental Impact Reporting (S&EIR) process was conducted during 2020-2021 and the Environmental Authorisation was refused. The refusal was appealed by Karpowership SA (Pty) Ltd. The Minister dismissed the appeal and exercised her powers in terms of Section 43(6) of NEMA. The application was remitted back to the Component Authority (CA) to allow the applicant to address various gaps and defects through a new EIAr and associated Public Participation Process (PPP) for the application to be considered by the CA. As per pre-application meeting with the CA, it was agreed that the main components to be addressed comprise of Noise, Climate Change, Socio-Economic Assessment, Need and Desirability / Holistic Approach, Public Participation and Integration and Polycentric Approach to enhance the specialist studies.

This was undertaken through various measures, including the inclusion of additional information and considerations in expert report, weekly integration meetings held between various specialists to ensure consistent and open communication was held between the specialists, the identifying and conducting numerous stakeholder engagements and the special inclusion of reports which aimed at providing a holistic analysis of the benefits and detractions of the power project.

1.2.5 Project Summary

The project consists of three key parts: Liquefied Natural Gas, electricity generation and dispatch of electricity into the national power grid. Powerships are pre-constructed fully integrated floating power plants, with all necessary plant and equipment on board to allow the generation facility to plug directly into the grid, and for operations and maintenance to take place.

The Powership can be installed at a coastal site where there is an available substation for electrical connection and suitable marine conditions for berthing or mooring. Mooring will be followed by interconnection of the Powership to the national power grid. Finally, fuel connection takes place via pipeline and the electricity generated is evacuated via a transmission line to a substation on land. Refer to Figure 1-2 illustrating the concept:

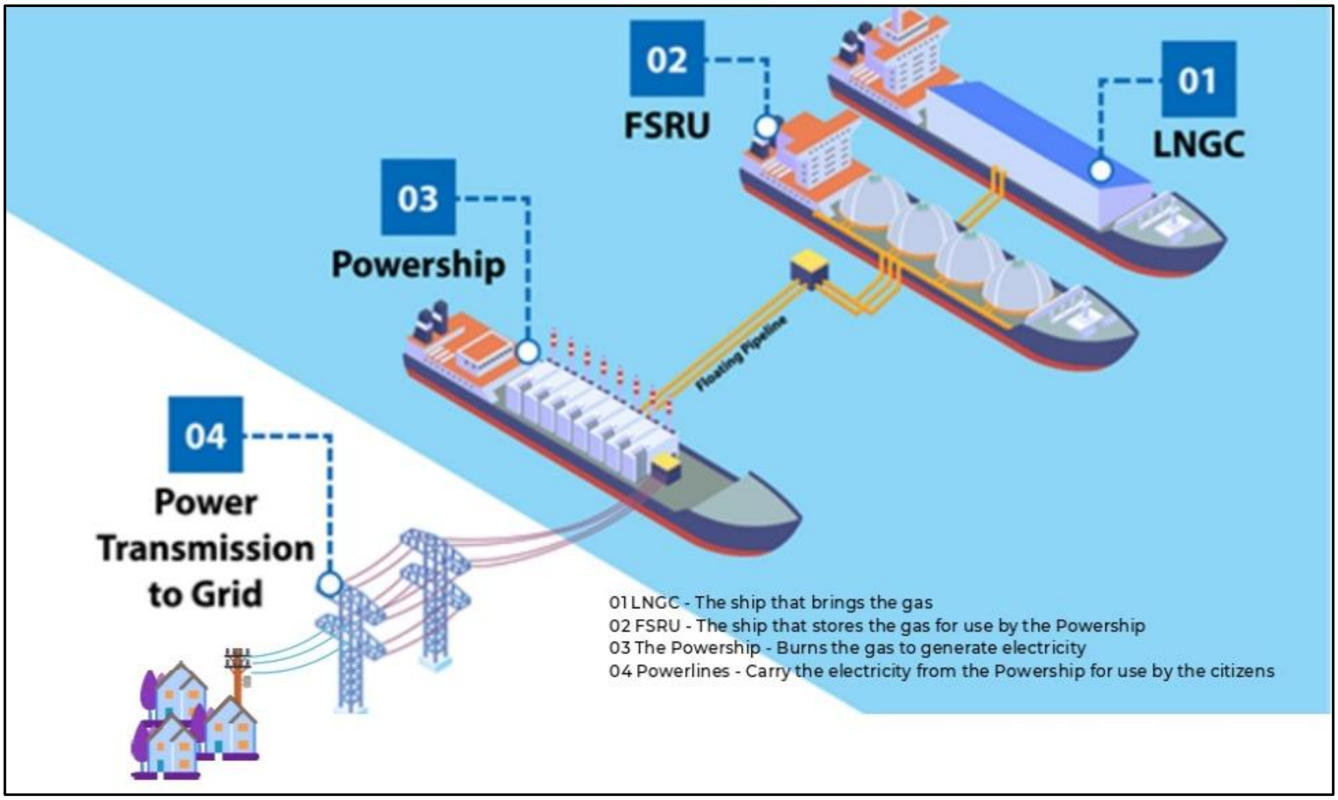


Figure 1-2: Conceptual image showing the Powership operations.

Karpowership proposes to moor two Powerships and Floating Storage Regasification Unit (FSRU), connected by a part sub-sea, part land-based gas pipeline in the Port of Ngqura to generate electricity which will be evacuated by means of a 132kV line. The Project's design capacity is 540MW. Electricity will be generated on Powerships by 27 reciprocating engines, each having a heat input in excess of 10MW (design capacity of 18.32MW each at full capacity). Heat generated by operation of the reciprocating engines is captured, and that energy is used to create steam to drive three steam turbines that each have a heat input of circa 15.45MW. The contracted capacity of 450MW, which will be measured at the Point of Utility Connection and cannot be exceeded under the terms of the RMI4P, will be evacuated via a 132kV transmission line over a distance of approximately 7.4km, from the Port of

Ngqura's tie-in point to the Eskom line, at a connection point (necessitating a new switching station) in proximity to the existing Dedisa Substation, which feeds electricity into the national grid. In addition, a LNG carrier shall periodically supply LNG to the FSRU (anticipated every 20 to 30 days depending on dispatch instructions for electricity generation) and will temporarily stay in the location within the Port (over a 1-to-2 day period) while offloading the LNG cargo.

The proposed technology for the production of electricity, incorporates the use of steam engines together with natural gas-fired reciprocating engines to improve the efficiency of energy generation through and steam engines. Construction is limited to transmission and gas supply lines as the ships are built internationally and arrive fully equipped in the Port ready for operation.

The proposed Port based activities (Powerships, FSRU, gas pipeline, temporary LNG carrier) are situated within the Port of Ngqura which is managed by Transnet Port National Authority (TNPA) and the Coega Development Corporation (CDC) and the proposed transmission line from the Port to the Eskom Dedisa substation traverses various properties owned by Transnet.

1.3 Summary of Environmental Authorisation Requirements

Prior to the commencement of the proposed Gas to Power Project at Port of Ngqura and Coega SEZ Project, the following key "environmental licences" are required from the following competent authorities, namely:

- Environmental authorisation from the Department of Forestry, Fisheries and the Environment (DFFE) in terms of the National Environmental Management Act 107 of 1998 (NEMA), the EIA Regulations, 2014 (as amended) and the EIA Regulations Listing Notices 1, 2 and 3 (as amended).
- An atmospheric emission licence (AEL) in terms of the National Environmental Management: Air Quality Act 39 of 2004) (NEM:AQA). The licensing authority is also DFFE Air Quality Authorisations which is a sub-directorate within Directorate of Climate Change and Air Quality Management. The AEL application has been submitted and is currently under assessment (Refer to Appendix H5).
- A General Authorisation (GA) from the Department of Water and Sanitation (DWS) in terms of the National Water Act 36 of 1998 (NWA) and the Water Use Licence Applications and Appeals Regulations, 2017. A General Authorisation (Register No: 28098406) was issued by DWS on 30 April 2021.

1.4 Purpose of this Report

EIA Regulations, Appendix 3.2: the objective of the environmental impact assessment process is to, "through a consultative process:

a) determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
b) describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the development footprint on the approved site as contemplated in the accepted scoping report;
c) identify the location of the development footprint within the approved site as contemplated in the accepted scoping report based on an impact and risk assessment process inclusive of cumulative impacts and a ranking

process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;

d) determine the –
   i. nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and
   ii. degree to which these impacts—
      aa) can be reversed;
      bb) may cause irreplaceable loss, of resources, and
      cc) can be avoided, managed or mitigated;
e) identify the most ideal location for the activity within the development footprint of the approved site as contemplated in the accepted scoping report based on the lowest level of environmental sensitivity identified during the assessment;
f) identify assess, and rank the impacts the activity will impose on the development footprint on the approved site as contemplated in the accepted scoping report through the life of the activity;
g) identify suitable measures to avoid, manage or mitigate identified impacts; and
h) identify residual risks that need to be managed and monitored.

The draft EIA Report documents the findings of the EIA as per the reporting requirements of the EIA Regulations, 2014, which is then made available to I&APs for public comment for a period of no less than 30 (thirty) days.

1.5 Independent Environmental Assessment Practitioner

EIA Regulations, Appendix 3. 3. (1) (a) An environmental impact assessment report must contain the information that is necessary for the competent authority to consider and come to a decision on the application, and must include— (a) details of—(i) the EAP who prepared the report; and (ii) the expertise of the EAP, including a curriculum vitae;

Please see Appendix E for EAP Declaration and full Curriculum Vitae.

Table 1-1: Independent EAP Details

EAP	Triplo4 Sustainable Solutions
EAP	Mrs. Hantie Plomp
Educational qualifications	Masters in Environmental Management
Professional Registrations	EAPASA; SACNASP; AP with GBCSA
Voluntary Memberships	IAIAsa; IWMSA; IODSA, WISA
Experience at environmental assessments (yrs.)	> 20 years
Postal Address	P.O. Box 6595 Zimbali, 4418
Telephone Number	032 946 3213
Cell Number	083 308 8003
Fax Number	032 946 0826
Email Address	coegaksa@triplo4.com

EAP	Triplo4 Sustainable Solutions
Assisted by:	Melissa Gopaul
Educational qualifications	Honours in Environmental Management
Professional Registrations	EAPASA; SACNASP
Voluntary Memberships	IAIAsa
Experience at environmental assessments (yrs.)	> 10 years
Assisted by:	Ms. Shanice Singh
Educational qualifications	Honours in Environmental Management
Professional Registrations	*EAPASA*
Voluntary Memberships	IAIAsa
Experience at environmental assessments (yrs.)	> 5 years
Assisted by:	Zayd Hoosen
Educational qualifications	MSc Environmental Sciences
Professional Registrations	SACNASP (*Pri.Sci.Nat*)
Voluntary Memberships	IAIAsa
Experience at environmental assessments (yrs.)	> 6 years

1.6 Specialist Studies

Specialist studies have been undertaken to inform the EIA process. The specialist studies involved the gathering of baseline data (desktop and site visit, where applicable) relevant to identifying and assessing environmental, socio-economic and heritage impacts that may occur as a result of the proposed project. Specialists have also recommended mitigation measures to minimise potential impacts or optimisation measures to enhance potential benefits as well as monitoring requirements, where necessary. These findings and recommendations have been incorporated into the assessment (Chapter 8) and the EMPr (Appendix 6). The methodologies and relevant protocols applied to each specialist study are described in the specialist reports attached as appendices (Appendix 9 and Appendix 7 – EMPr to this EIA. The specialists and technical experts who provided input to the EIA process are listed in the Table 1-2.

Table 1-2: Details of Specialist Assessments and Technical Team

COEGA SPECIALIST STUDIES, ASSESSMENTS AND TECHNICAL INFORMATION				
REPORT			SPECIALIST	CITATION
A TERRESTRIAL BIODIVERSITY & ECOSYSTEMS	A1	Hydrology Assessment	GCS (Pty) Ltd	A1 Hydro, Oct 2022
	A2	Aquatic Assessment	GCS (Pty) Ltd	A2 Aquatic, Oct 2022
	A3	Hydropedology Assessment	GCS (Pty) Ltd	A3 Hydropedology, Oct 2022
	A4	Geohydrological Assessment	GCS (Pty) Ltd	A4 Geohydro, Oct 2022

COEGA SPECIALIST STUDIES, ASSESSMENTS AND TECHNICAL INFORMATION				
REPORT			SPECIALIST	CITATION
	A5	Water Balance Assessment	GCS (Pty) Ltd	A5 Water Balance, November 2020
	A6	Wetland Delineation and Functional Assessment	ENVASS / Triplo4	A6 WDFA, Oct 2022
	A7	Archaeological Impact Assessment,	Agency for Cultural Resource Management	A7 HIA, Oct 2022
	A8	Terrestrial Ecological Assessment	The Biodiversity Company	A8 Terrestrial Ecology, Oct 2022
	A9	Terrestrial Avifauna Impact Assessment	Dr Paul Martin	A9 Terrestrial Avifauna, Nov 2022
B MARINE , COASTAL & ESTUARINE BIODIVERSITY & ECOSYSTEMS	B1	Baseline Underwater Noise Assessment	Subacoustech Environmental Ltd	B1 Baseline Underwater Noise, Nov 2021
	B2	Underwater Noise Assessment	Subacoustech Environmental Ltd	B2 Underwater Noise, Oct 2022
	B3	Underwater Heritage Compliance Letter	Contract Maritime Archaeologist	B3 Underwater Heritage, Oct 2022
	B4	Marine Ecology, Avifauna and Fisheries Assessment	Anchor Environmental	B4 Marine Ecology, Oct 2022
	B5	Coastal and Estuarine Impact Assessment	Coastwise Consulting & GroundTruth	B5 Coastal and Estuary, Oct 2022
C ATMOSPHERIC CONDITIONS	C1	Atmospheric Impact Assessment	uMoya-NILU Consulting (Pty) Ltd	C1 AIR, Oct 2022
	C2.1	SA Terrestrial Noise Assessment	Safetech	C2.1 Terrestrial Noise, Oct 2022
	C2.2	Ghana Airborne Noise Assessment	Subacoustech Environmental Ltd	C.2.2 Ghana Noise, Oct 2022
	C3	Climate Change Impact Assessment	Promethium Carbon	C3 CCIA, Oct 2022
D SOCIAL CONDITIONS AND RISKS	D1	Socio-Economic Impact Assessment	Afro Development Planning Pty Ltd	D1 SEIA, Nov 2022
	D1.1	Small Scale Fishers Engagement	Afro Development Planning Pty Ltd	D1.1 SFF, Oct 2022
	D1.2	Tourism Impact Research	3T Business Fusion	D1.2 Tourism, Nov 2022
	D1.3	Traffic and Transportation Evaluation	Fulcrum Development Consultants	D1.3 TTE, Oct 2022
	D2	Landscape and Visual Impact Assessment	Environmental Planning and Design	D2 VIA, Oct 2022
	D3	Major Hazard Risk Installation Assessment	Major Hazard Risk Consultants	D3 MHI, Sep 2022
	Independent Contributions to the Need and Desirability			
	8.1	Gas to Power Projects and the Just Energy Transition from Fossil Fuels in the South African Political Economy	Political Economy Southern Africa	

COEGA SPECIALIST STUDIES, ASSESSMENTS AND TECHNICAL INFORMATION				
REPORT			SPECIALIST	CITATION
	8.2	South Africa Country Specific Energy Security Assessment	Prof Lwazi Ngubevana	
	8.3	The Economic Impacts of Rolling Blackouts in South Africa	Afro Development Planning Pty Ltd	
	8.4	Sustainability Assessment	Afro Development Planning Pty Ltd	

1.7 EIA Report Requirements as per EIA Regulations 2014 (as amended)

Table 1-3 outlines the requirements of the Environmental Impact Assessment Report as per the EIA Regulations. According to Appendix 3 (1) "An environmental impact assessment report must contain the information that is necessary for the competent authority to consider and come to a decision on the application, and must include…" the information outlined in Table 1-3 below. This includes the information elicited through the Public Participation Process (PPP) prescribed by Regulations 39 to 44 of the EIA Regulations and described in Chapter 7 of the EIA Report.

Table 1-3: Prescribed contents of the Environmental Impact Assessment Report (Appendix 3 of the EIA Regulations, 2014).

Relevant section in GNR. 982	Requirement description	Relevant section in this report
(a) Details of-	(i) The EAP who prepared the report; and	Section 1.5
	(ii) The expertise of the EAP, including a curriculum vitae;	Appendix 4
(b) The location of the development footprint of the activity on the approved site as contemplated in the accepted scoping report, including -	(i) The 21-digit Surveyor General code of each cadastral land parcel;	Section 2.3
	(ii) Where available, the physical address and farm name;	
	(iii) Where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	
c) A plan which locates the proposed activity or activities applied for as well as the associated structures and infrastructure at an appropriate scale	(i) A linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or	Section 2.3 Appendix 1 Appendix 2
	(ii) On land where the property has not been defined, the coordinates within which the activity is to be undertaken;	
(d) A description of the scope of the	(i) All listed and specified activities triggered and being applied for;	Section 2.2
	(ii) A description of the activities to be undertaken,	Section 2.1

Relevant section in GNR. 982	Requirement description	Relevant section in this report
proposed activity, including	including associated structures and infrastructure;	
(e)	A description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context;	Section 4
(f)	A motivation for the need and desirability for the proposed development, including the need and desirability of the activity in the context of the preferred development footprint within the approved site as contemplated in the accepted scoping report	Section 8
(g)	motivation for the preferred development footprint within the approved site as contemplated in the accepted scoping report;	
(h) a full description of the process followed to reach the proposed development footprint within the approved site as contemplated in the accepted scoping report, including:	(i) details of the development footprint alternatives considered;	Section 3
	(ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;	Section 5 and Appendix 3 – Public Participation
	(iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;	Section 5 and Appendix 3 – Public Participation
	(iv) the environmental attributes associated with the development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	Section 6
	(v) the impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts— (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated;	Section 7.5
	(vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks;	Section 7.2
	(vii) positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be	Section 7.5

Relevant section in GNR. 982	Requirement description	Relevant section in this report
	affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;	
	(viii) the possible mitigation measures that could be applied and level of residual risk;	Section 7.5 and Appendix 6 - EMPr
	(ix) if no alternative development footprints for the activity were investigated, the motivation for not considering such; and	Not Applicable
	(x) a concluding statement indicating the location of the preferred alternative development footprint within the approved site as contemplated in the accepted scoping report	Section 9
(i) a full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred development footprint on the approved site as contemplated in the accepted scoping report through the life of the activity, including	(i) a description of all environmental issues and risks that were identified during the environmental impact assessment process; and	Section 7 and Appendix 9 – Specialist Studies
	(ii) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures	
(j) an assessment of each identified potentially significant impact and risk, including—	(i)cumulative impacts;	Section 7
	(ii) the nature, significance and consequences of the impact and risk;	
	(iii) the extent and duration of the impact and risk;	
	(iv) the probability of the impact and risk occurring;	
	(v) the degree to which the impact and risk can be reversed;	
	(vi) the degree to which the impact and risk may cause irreplaceable loss of resources; and	
	vii) the degree to which the impact and risk can be mitigated;	

Relevant section in GNR. 982	Requirement description	Relevant section in this report
(k)	where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report	Section 8
(l) an environmental impact statement which contains	(i) a summary of the key findings of the environmental impact assessment	Sections 7 and 9
	(ii) a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred development footprint on the approved site as contemplated in the accepted scoping report indicating any areas that should be avoided, including buffers; and	Appendix 1
	(iii) a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;	Section 7 and 9
(m)	based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation	Section 7.5
(n)	the final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment;	Section 9
(o)	any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;	Section 9
(p)	a description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;	Section 7.3
(q)	a reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;	Section 9
(r)	where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded and the post construction monitoring requirements finalised;	Not Applicable
(s) An undertaking under oath or	(i) The correctness of the information provided in the report;	Appendix 4

Relevant section in GNR. 982	Requirement description	Relevant section in this report
affirmation by the EAP in relation to -	(ii) The inclusion of comments and inputs from stakeholders and interested and affected parties; and	
	(iii) Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties;	
(t)	where applicable, details of any financial provision for the rehabilitation, closure, and ongoing post decommissioning management of negative environmental impacts	Not applicable
(u) an indication of any deviation from the approved scoping report, including the plan of study, including	(i) any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and	Section 7.4
	(ii) a motivation for the deviation	
(v)	any specific information that may be required by the competent authority; and	Appendix 5 - DFFE Correspondence
(w)	any other matters required in terms of section 24(4)(a) and (b) of the Act.	Not applicable
(2)	Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to an environmental impact assessment report the requirements as indicated in such notice will apply.	The methodologies and relevant protocols applied to each specialist study are described in the specialist reports - Appendix 9 to this EIA. Appendix 7 – Transmission Line EMPr.

1.8 Report Structure

The EIA Report has been structured as follows –

- Executive Summary
- Chapter 1: Introduction
  - Provides an introduction and background to the proposed project and outlines the purpose of this document.
- Chapter 2: Project Description
  - Provides a description of the proposed development, the properties on which the development is to be undertaken and the location of the development on the property. The technical details of the project are also provided in this Chapter.
- Chapter 3: Alternatives
- Chapter 4: Policy and Legislative Framework
  - Identifies all the legislation and guidelines that have been considered in the preparation of the EIR and project compliance.
- Chapter 5: Public Participation Process
  - Details the stakeholder engagement approach and summarises stakeholder comments that informed the impact assessment until date of release of the DEIR for public comments on 10 November 2022.
- Chapter 6: Description of the Environment
  - Provides a brief overview of the biophysical, heritage and socio-economic characteristics of the site and its environs that may be affected by the proposed development, compiled largely from published information, but supplemented by information from site visits.
- Chapter 7: Environmental Impact Assessment
  - Describes the specialist studies undertaken and assesses the potential impacts of the project utilising the impact assessment method.
- Chapter 8: Motivation, Need & Desirability
- Chapter 9: Concluding Statement and Recommendations
- Chapter 10: References Cites any texts referred to during preparation of this report.
- Appendices: Containing all supporting information, including specialist studies, public participation record and EMPr.

2 DESCRIPTION OF THE PROPOSED ACTIVITY

2014 EIA Regulations, Appendix 3 - 3(d) (ii) a description of the activities to be undertaken, including associated structures and infrastructure.

2.1 Description of the Activities to be Undertaken Including Associated Structure and Infrastructure

2.1.1 Overview

The Karpowership Project entails the generation of electricity by two Powerships moored in the Port of Ngqura, fueled with natural gas supplied from a third ship, a Floating Storage & Regasification Unit (FSRU). The three ships will be moored in the port for the Project's contracted 20 year lifespan (as per the RMI4P requirements- Appendix H3). A Liquefied Natural Gas Carrier (LNGC) will deliver Liquified Natural Gas (LNG) and offload it to the FSRU approximately once every 20 to 30 days, dependent on power demand which is determined by the buyer, ESKOM. The FSRU stores the LNG onboard and turns the liquid form into gaseous form (Natural Gas) upon demand from the Powership (Regasification). Natural gas will be transferred from the FSRU to the Powerships via a subsea and onshore gas pipeline. The Project's design capacity is 540MW and the contracted capacity will be 450MW of electricity to be supplied to the national grid, which will be measured at the Point of Utility Connection and cannot be exceeded under the terms of the RMI4P. Electricity will be generated on the two Powerships by 27 reciprocating engines, each having a heat input in excess of 10MW (design capacity of 18.32MW each at full capacity). Heat generated by operation of the reciprocating engines is captured, and that energy is used to create steam to drive three steam turbines that each have a heat input of circa 15.45MW.

The electricity that is generated is converted by the on-board High Voltage substation (capacity of 110 – 170kV) will be evacuated via a double circuit twin Tern conductor 132kV transmission line over a distance of approximately 7.4km, from the Powership to the Dedisa Substation. The transmission line is routed on the western side of the services servitude. A connection point (necessitating a new Saltpan 132kV on shore switching station) is required to feed the electricity into the national grid via the Dedisa Substation.

Alternatively, the transmission line approximately 7,4km will be routed on the eastern side of the services servitude and will interconnect the Powership to the National Grid utilising the existing Dedisa network via a new Saltpan 132kV on shore switching station.

There are two alternative transmission line routes from the Powership to the main transmission line routes described above – see Chapter **Error! Reference source not found.** for the assessment of these alternatives.

Refer to table of figures below, showing examples of Powership, an FSRU, transmission corridors and the project concept.

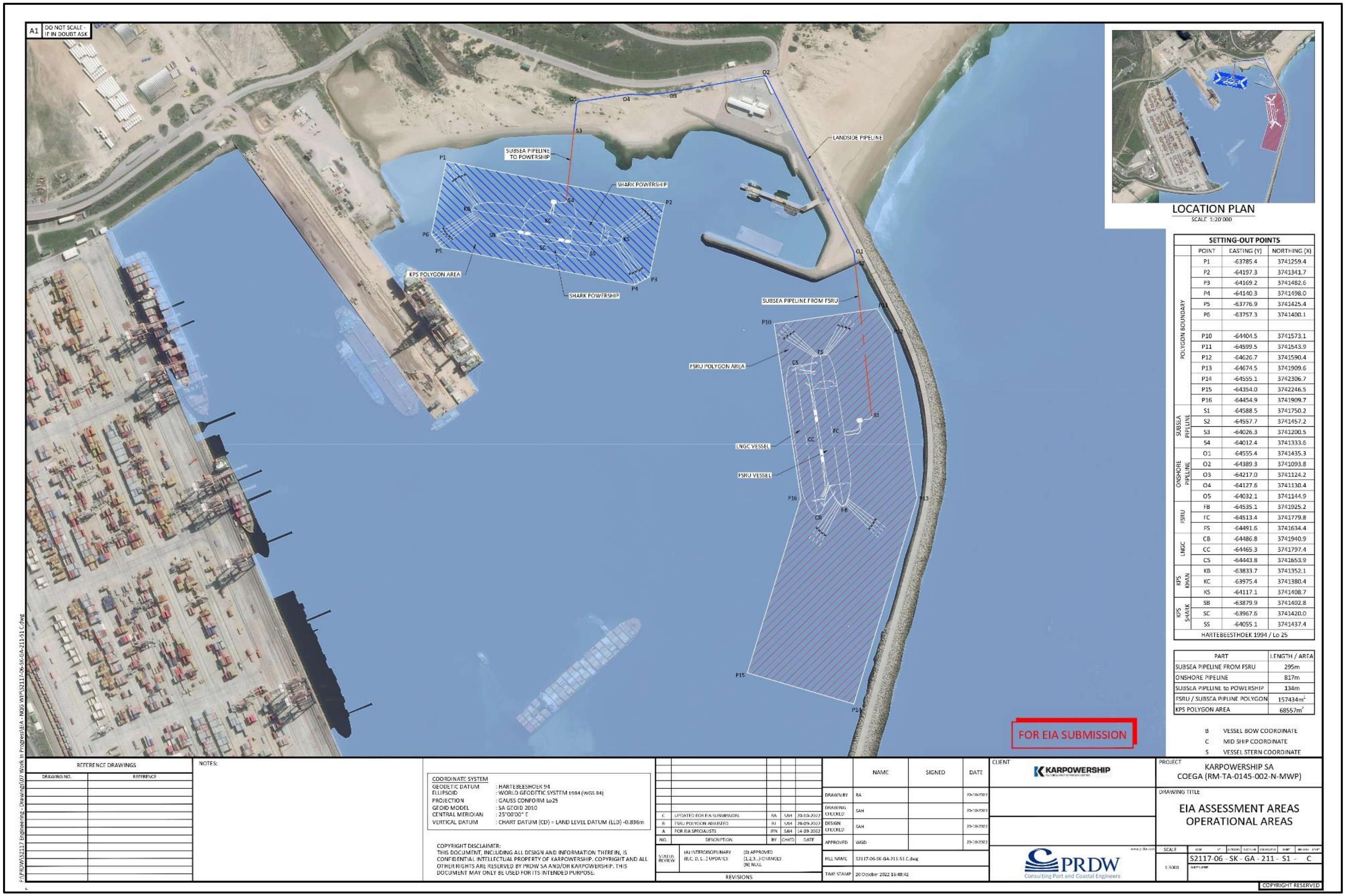


Figure 2-1: Overall Project Layout (Marine)

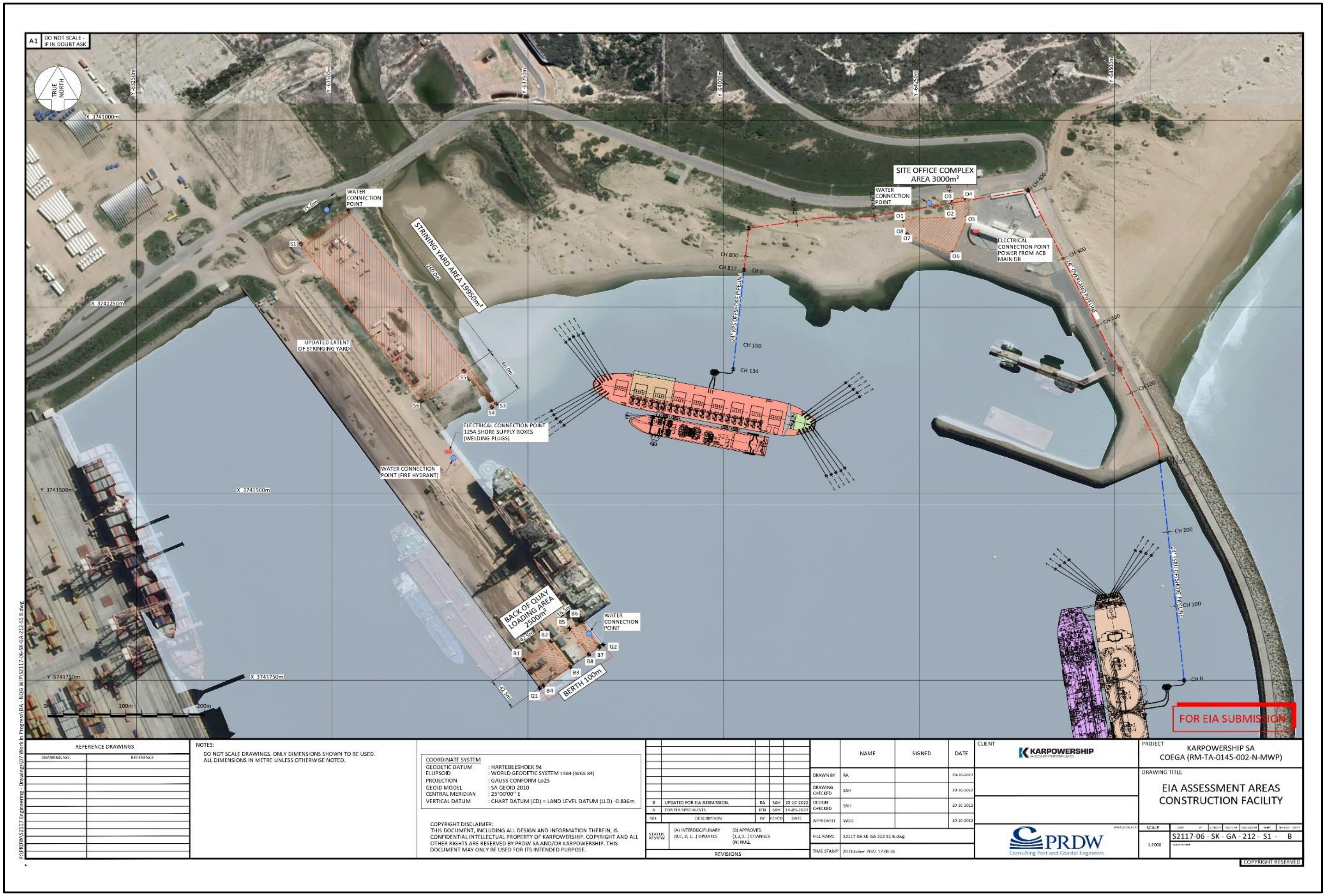


Figure 2-2: Overall Project Layout (Marine – Contractor Facilities)

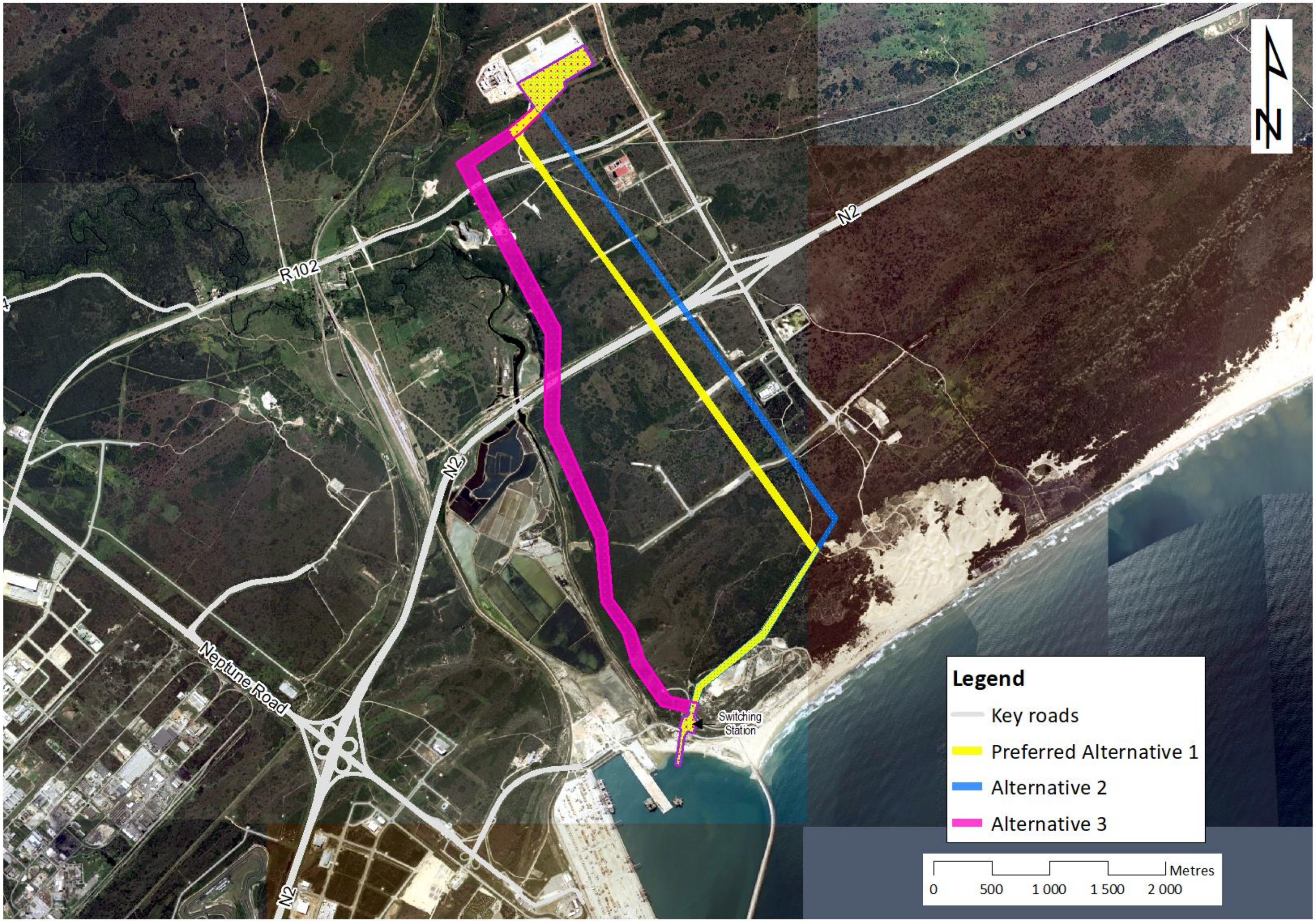
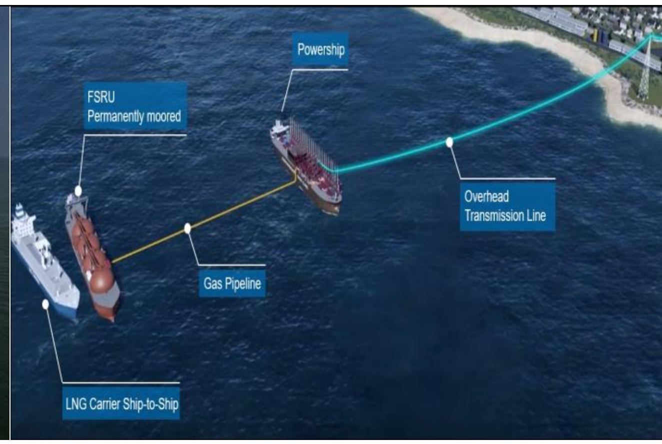


Figure 2-3: Overall Project Layout showing alternative corridors (Transmission)

Table 2-1: Images of Various Powerships

	
Image 1: Powership – Shark Class	Image 2: Powership – Khan Class
	
Image 3: Floating Storage & Regasification Unit (FSRU)	Image 4: Project Concept

The sub-chapters which follow attempt to provide various details related to the proposed activity, and its various components. Chapter 3, which follows, provides an assessment of the proposed activities, with a focus on alternatives.

2.1.2 Location

The proposed Powership, FSRU, temporary LNGC, gas line and contractor facilities, will be located in the Port of Ngqura under the jurisdiction of the Transnet National Port Authority (TNPA) (refer to Figure 2-1 & Figure 2-2). While the transmission line is across Transnet properties as well as Coega Development Corporation properties currently used for industrial activities (refer to Figure 2-3). The proposed Powership is located adjacent to the admin craft basin. The proposed FSRU is located at the base of the eastern breakwater and is seaward of the admin craft basin approximately 422m away from the shore.

Furthermore, the position of the Powerships, FSRU and gas pipeline has approved by TNPA having jurisdiction of all Port activities and infrastructure being established. An e-mail as received from TNPA, confirming that the drawings “are in order” and the technical team at the Port of Ngqura has “no further comments”. Refer to Appendix 7.6 – TNPA Correspondence.

Please refer to Chapter 2.3 for further detail on the project location and Chapter 3 for details on the alternatives considered which include two alternative Powership positions, the gas line route associated with each Powership position, alternative transmission line routes, connections and switching station position.

2.1.3 Berthing, Mooring of the Powerships and FSRU

Berthing and mooring will be conducted as per the Ports’ approved maintenance plans, procedures and requirements, and ships will be located where adequate depths exist and in acceptable positions to the port operator so as not to impact the safety of marine traffic and other port operations.

The operational requirements at the Port cannot accommodate the use of existing berthing infrastructure, and therefore the vessels will be positioned in unused areas of the Port and will utilise their own mooring system comprising catenary mooring chains and anchors on the seabed, which are designed to secure the vessels taking into consideration all local conditions. The Khan Class Powership and FSRU will use piled anchors. The Shark Powership is tied to the Khan vessel, therefore no mooring legs required. The Powership and FSRU will each have 16 mooring legs each consisting of a catenary mooring chain connected to an anchor pile with a padeye connector. The anchor piles will be installed using vibro piling to drive the casing to refusal and then the Reverse Circulation Drilling method (RCD) to drill the pile to depth. No marine structures are planned, and the mooring system for the vessels will be heavy chain lying on the seabed attached to anchor piles. The intention is to install the anchor piles such they are flush or below the surrounding seabed.

No dredging is envisaged for the mooring locations.

2.1.4 Gas Lines

A gas line is required between the FSRU and Powerships to ensure gas supply for power generation. The FSRU discharges gas via 2no flexible risers to the FSRU pipeline end manifold (PLEM) on the seabed next to the FSRU. The FSRU PLEM incorporates shutoff valves, an expansion spool and maintenance pigging connection. The gas is then transported from the FSRU PLEM via a 24” steel pipeline with 50mm concrete weight coating, installed on the seabed to the revetment crossing spool. The revetment crossing spool connects the subsea pipeline to the onshore 24” steel buried pipeline. The onshore pipeline is routed around the ACB admin buildings and across the dune field via the shore crossing and along the seabed to the location of the Powership PLEM positioned adjacent to the Powership. The Powership PLEM incorporates shutoff valves, pigging connection, an expansion spool and 2no 12” flexible risers delivering gas to the Khan Class Powership manifold – refer to Figure 2.4. The Shark Class Powership will be supplied with Natural Gas via the Khan Class Powership via flexible hoses.

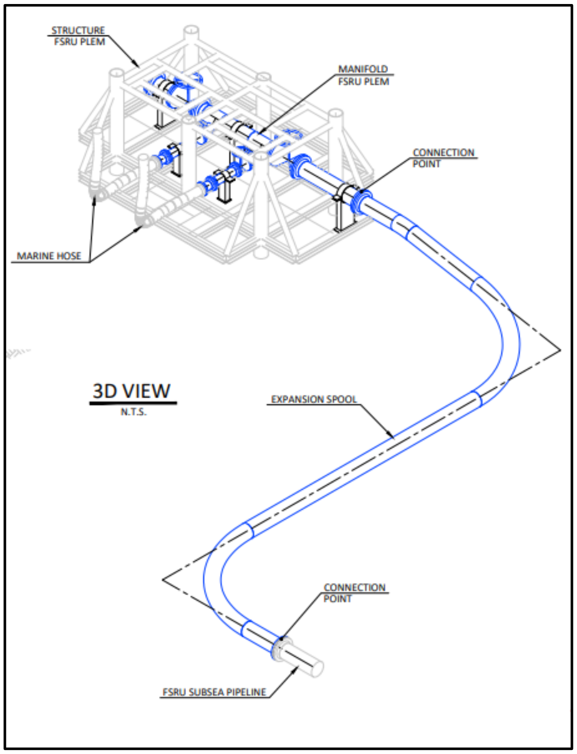


Figure 2-4: Typical PLEM and Tie-in Detail

For the gas pipeline, including the pipeline end manifolds (PLEM), there may need to be minor route rectification works along the subsea pipe route to flatten the route and limit the free span length of any section of the pipeline, to ensure it is well supported by the seabed. This will comprise flattening high spots or building up support under the pipe at low points. Due to the minor nature of this work, it will likely be undertaken by divers as the pipeline is installed.

It is anticipated that the subsea section of the pipeline will have a servitude of approximately 50m each side. The onshore buried section will require an anticipated servitude of 0.5 m each side.

The recommended routes authorised by the EIA process will be included in the commercial agreement to be entered into with Transnet National Port Authority (TNPA). Please to Appendix 10.10 for further details on this technical aspect.

2.1.5 Contractor Facilities

Three contractor facilities are proposed as follows:

- Stringing Yard

  The stringing yard is the area where the concrete pipes are laid down prior to installation. It will further accommodate a material laydown area as well as a concrete coating area within. The material laydown area will be used to store material that will be used during construction stage. The Stringing yard is situated on disturbed and compacted land between the finger jetty and the Coega River Mouth. The area is 19950m^2.
- Back of Quay Loading Area

The back of quay loading area and the load out berth are the sites that will be used to launch small boats that will be transporting staff and goods to ships. The loading area is positioned south of the fence line and the load out berth to the north. This facility is situated seaward end of the finger jetty (end of the eastern pier). The area is 2500m^2.

- Site Office Complex

  The geometry of the route to the Site Office will accommodate for cars and small trucks. This facility is situated on the beach environment adjacent to the Admin Craft Basin building. The area is 3000m^2.

2.1.6 Transmission Lines

The proposed transmission line will be constructed with either monopole or lattice steel construction based on the final engineering design requirements, the topography and geotechnical survey results. The available space will further influence the specific tower designs. The span lengths between towers will vary. Average spans lengths will be approximately 200m however based on the ground profile shorter spans of less than 100m or larger spans of greater than 300m can be constructed. As the extent of the lattices' footprint is much bigger and require more vegetation clearance than the monopoles, the monopoles are the preferred options.

There are two potential options being considered for connection from the Powership to the National Grid that will ultimately be dependent on Eskom's requirements:

- The electricity generated on the ship will be converted by the on-board High Voltage substation and transmitted along a double circuit Twin Tern conductor 132kV line. This new transmission line of approximately 7.4km routed along the western side of the services servitude and will interconnect the Powership to the National Grid utilising the existing Dedisa network via a new Saltpan 132kV on shore switching station. Approximately 35 towers are proposed within a 50 metre corridor which includes the 31m working servitude. The servitude, stretching approximately 7.4km from the Port to the existing Dedisa substation via a new 132kV on shore switching station located adjacent to Klub Road near Port Control, will have a width of 31m as per Eskom safety specifications.
- Alternatively, the electrcity generated on the ship will be converted by the on-board High Voltage substation and transmitted across a 132kV transmission line via a new 132kV on shore switching station to the existing Dedisa substation. A transmission line approximately 7,4km routed on the eastern side of the services servitude with a width of 31m as per Eskom safety specifications within a 50 metre corridor will be installed as part of the project from the Port of Ngqura to the existing Dedisa 132kv substation.

Both options traverse properties owned by the CDC. Each tower will cover a maximum footprint of 15m by 15m for steel lattice towers or 2.75m by 2.75m for monopoles which will necessitate the clearing of vegetation to allow for these structures to be erected.

Access will be via the existing servitude, therefore no additional access roads will be required to be constructed.

Routes options for the transmission lines are presented in the layout alternatives, section 3.2.3 of this report.

2.1.7 Switching Station

The electricity generated on the ship is required to be integrated into the Eskom National grid via a switching station. The location of the switching station is located on-shore adjacent to Klub Road near Port Control. The switching station is part of the Eskom self-build process and will be built by Karpowership and handed to Eskom for their ownership and operation. The switching station will facilitate the control of the incoming lines from the Powership and the outgoing lines to the Dedisa network.

The switching station will measure approximately 9775m^2 in size and will comprise of an incoming circuit for the lines from the ship, a busbar system to distribute the power and an outgoing circuit for the power to Eskom. The switching station further comprises of landing gantries, breakers, isolators, current transformers, voltage transformers and a control room for the monitoring, measurement and control of the power.

2.1.8 Operational Processes and Associated Measures

Powerships are equipped with cutting-edge modular medium speed reciprocating engine technology for generation, enabling reliable supply of electricity with minimal impacts from load profile and number of starts and stops. For all practical purposes, Powerships can maintain the same high efficiency even at partial loads by operation of a subset of the engines at full load and also offer the shortest response times for load variations. This modular technology and built-in redundancy allows that, even if one or more engines are taken off-line for any reason, it is most likely that the Powerships can continue operating and meeting the full contracted capacity requirements. The Powerships themselves have an effective operating lifespan of more than 25 years, more than covering the 20-year PPA provided for under the RMI4P.

Powerships store onboard all key spare parts that may be required to keep the generation running, essentially eliminating the risk of down-time caused by sourcing of necessary parts during the lifespan of a project, either related to routine maintenance or unplanned maintenance that may be required.

Another benefit of Karpowership over land-based solutions is that, in the highly unlikely event that a Powership falls completely out of commission, or if the buyer’s requirements change, vessels can be quickly replaced with another suitable Powership from Karpowership’s fleet to minimise any disruption to the power delivery.

2.1.8.1 Water Usage

The Powership uses seawater and potable water for cooling the reciprocating engines, condensers and other auxiliaries.

Part of the cooling seawater intake is processed into potable water through a vaporization process for steam generation (on-board water treatment unit) and non-process water consumption. In this way, seawater is primarily used for steam generation, make up water and for domestic use. Water supply for domestic use (cleaning, crew hygiene, etc.) is produced using the on-board water treatment unit whereby seawater is treated via freshwater generators and sea water reverse osmosis systems. Potable water for drinking purposes will be sourced as bottled water from local service providers. The Powerships have onboard sewage treatment units and oily bilge separators to be utilized while sailing, but the vessel will be moored for the duration of the Project and during this term wastewater disposal will be contracted to a licenced local service provider.

The Powership operates a once through cooling system, which abstracts seawater directly for cooling and then discharges it into the sea with no chemicals or other additives used. The total intake/outlet flow rates at 100% load are 8.49 m^3/s. The temperature of the discharged seawater (ΔT) ranges from 10.0 to 15.0°C. A smaller footprint of

ΔT is achieved when discharging at a depth 8 m below the water surface. The largest ΔT's are generally found at or near the surface, while the bottom is much less affected by the temperature change due to the buoyancy of the discharge. The thermal plume exceeds the 1°C ΔT guideline by 0.2°C. Nevertheless, the plume's absolute temperature did not exceed any of the biological thresholds assessed by the specialists. The conceptual process flow diagram (PFD) for the generation of electricity is shown in Figure 2-4 below.

Water supply for domestic use is produced using the onboard water treatment unit. Potable water for the crew will, where required, be provided by local suppliers. No bulk water supply will be necessary from the Nelson Mandela Bay Metropolitan Municipality. The Powership also has a sewage treatment unit and oily bilge separator to be utilized while sailing to the Port for installation. During the operational phase, the sewage will be taken off the vessels for treatment by a licensed service provider

The following volume of water required daily is anticipated:

- 300 litres of drinking water will be required for on-board utilisation.
- 20 000 litres for potable water will be required for on-board utilisation.
- 15000 litres technical water for continuous Steam Turbine Generators (STG) operation (5000 litres per STG) (processed from sea water intake); and;
- 25-30 litres of water per engine per day is required.

No chemicals whatsoever, including chlorine, are discharged with the cooling water. No biocides and no other additives are necessary to control bio-fouling in seawater pumping and temperature exchange systems.

Further details are captured in the Water Balance Report, attached as Appendix 9 A5.

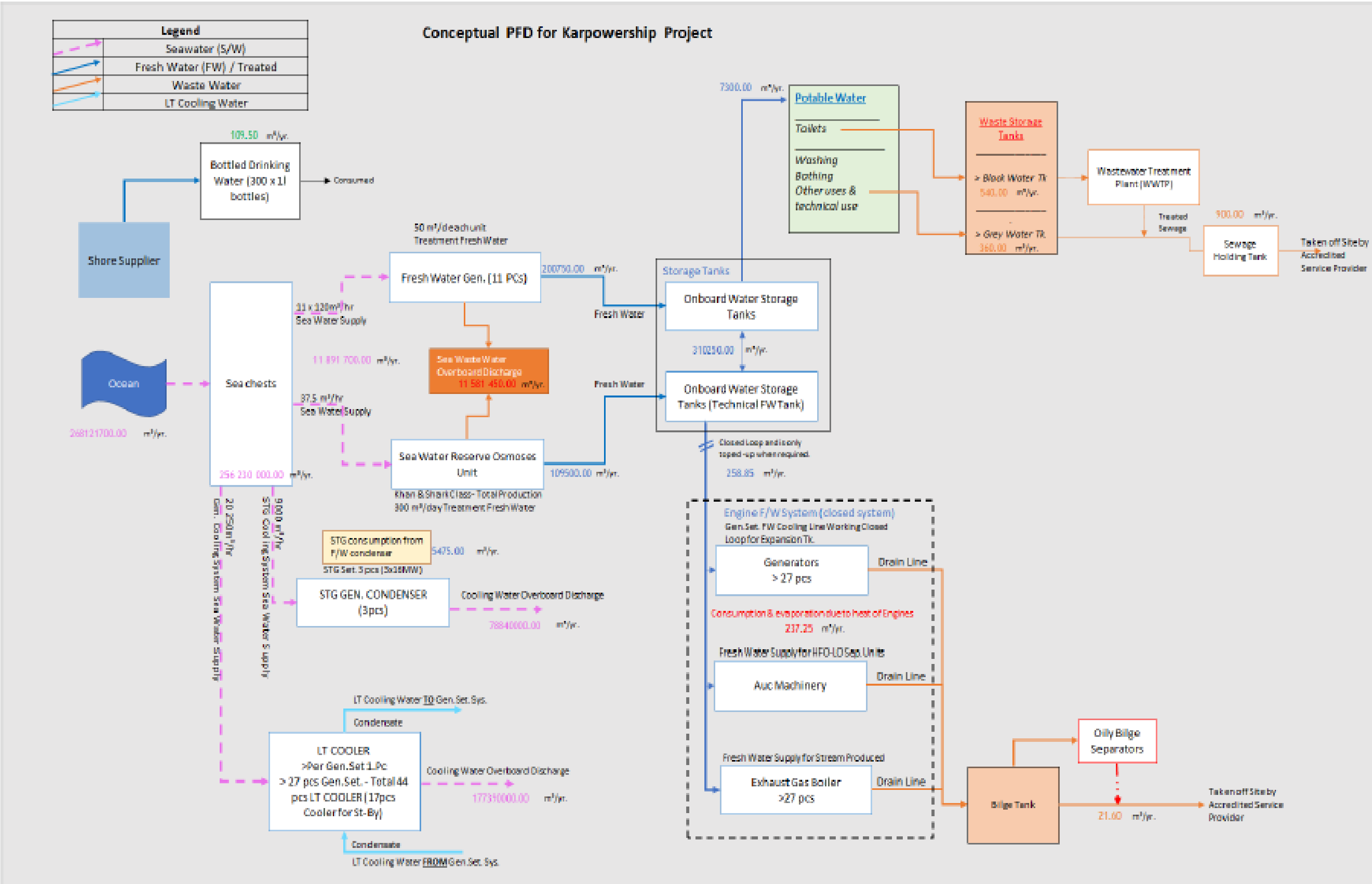


Figure 2-5: Conceptual Process Flow Diagram for the Project's operational Water Balance

2.1.8.2 Water Temperature

As above, the Powerships will use seawater for cooling the gen-sets and optionally processed for the steam turbine generators and fresh water uses. The total intake/outlet flow rates at 100% load are 8.49 m^3/s. The temperature of the discharged seawater (ΔT) ranges from 10.0 to 15.0°C within the Powerships process water. A smaller footprint of ΔT is achieved when discharging at a depth 8 m below the water surface. The largest ΔT's are generally found at or near the surface, while the bottom is much less affected by the temperature change due to the buoyancy of the discharge. The thermal plume exceeds the 1°C ΔT guideline by 0.2°C. Nevertheless, the plume's absolute temperature did not exceed any of the biological thresholds. No chemicals such as chlorine are discharged with the cooling water.

The dispersion of the resulting thermal plume depends on the flow rate, ΔT, discharge geometry, bathymetry, currents, winds and water column stratification.

A calibrated 3D hydrodynamic model was used to predict the extent of the thermal plume generated by the Powerships considered at Port of Ngqura running at 100% load.

The results show that a smaller footprint of ΔT is achieved when discharging at a deeper depth below the water surface. Discharging at a deeper depth allows the thermal plume to entrain colder sub-surface ambient water as it rises to the surface, reducing the temperature of the plume.

To reduce the risk of recirculation of the discharge back to the intakes, it is recommended that the discharge pipeline running down the vessel hull has a second elbow to discharge horizontally away from the vessel, and that the discharge pipes be positioned as far from the intakes as possible. Further details are captured in the Integrated Dispersion Modelling of Thermal Plumes Report, attached as Appendix 9D-10.2, and the Marine Ecology Report, attached as 9D-B4.

2.1.8.3 Risk and Possibility of Explosions

Safety performance is focused on risk and on the safe operation of the vessels as well as the containment of the LNG within the containment systems, including the pipeline. It is important to note that Powerships and FSRUs are operated by global leaders in a highly safety conscious industry, and that international best practices are adhered to at all times with respect to design, operations, procedures and training.

The gas lines between the FSRU and the Powerships are equipped with gas detectors in circuit which will identify any leak, so that the fuel gas can be immediately isolated and shut off, allowing the leak cause to be identified and the necessary repairs or replacements made. However, should there be a minor leakage of LNG, it will disperse quickly and rapidly rise into the atmosphere.

In the event of a lightning strike, the high conductivity of the large quantities of metal, with hundreds of square yards of hull in direct contact with the water, causes rapid dissipation of the electrical charge. The Powership, FSRU and LNG carriers are designed to meet stringent lightning protection standards required by the Ship Classification Society. FSRU operations are safeguarded through 100% containment with no LNG interface with the atmosphere. Lightning strikes are easily dissipated by the steel structures without affecting the normal operational aspects of the FSRU, however, in potential lightning situations, it is normal practice to cease STS (Ship-To-Ship) transfer operations if they are underway and make safe the transfer hoses through an inerting procedure and maintaining the cargo containment without oxygen.

Fire can be extinguished in the Powerships by means of various methods which include permanently installed systems in the Powerships that are able to fill the affected area with CO^2 or hot foam and portable extinguishing systems. Each chamber in the Powership is also equipped with fire detection and alarm equipment (fire detectors, manual call points, alarms, sounders, and bells) in order to detect & locate the origin of the fire.

In addition to using the fixed firefighting systems and portable firefighting equipment, personnel protection equipment is available and used throughout all areas of the Powership to ensure maximum protection from fire related accidents. Approved drawings on firefighting plans are located throughout the Powership in fireboxes and hung in different locations. In the event of fire drills or actual fire these plans are carried out rigorously.

2.1.8.4 Safety and Security Measures

Powership are equipped with advanced CCTV systems monitoring all areas, inside and out. To protect the Powership against unauthorized entry to the project site from land, the Powership site is surrounded by fencing and razor wire. A dedicated professional security team is responsible for monitoring and constantly patrolling the vessels to prevent any un-authorized entry or attacks. In addition, prior to deployment of the Powership to the operating location, an independent security risk assessor visits the location, meets local authorities (including port authorities and armed security forces) and provides detailed advice on any additional security measures that should be implemented before or during the operation over and above the proposed Security Plan specific to the project site.

The same independent security advisors visit the vessels shortly after their arrival, immediately after mooring arrangements are completed, to follow up and assess actual operation of the security systems and team. Regular follow up visits and assessments continue, and adaptation of systems and protocols would be made if the project site security risk status is deemed by security advisors to have changed in the area over time.

In addition, a vessel can be moved relatively quickly in the event that South Africa becomes exposed to terrorist activities and the risk becomes severe. Access to these facilities are also more easily controlled than land-based facilities, by natural virtue of their position in the ocean.

In terms of Emergency Plans, the Major Hazard Installation (MHI) Risk Assessor had recommended that an Emergency Plan be developed and sent to the Nelson Mandela Metropolitan Disaster Management for them to comment and formulate action plans during the MHI application. The MHI application will be made to the District Municipality, and be assessed based on their disaster management capacity. This MHI application can only be made upon completion of the EIA process, once the EA has been granted (refer to the Major Hazard Installation Risk Assessment, Appendix 9D3). The attached procedures (Appendix 11) are examples of internally developed procedures utilised at Karpowership operations. Karpowership SA will develop and implement procedures aligned with relevant standards, legislative and key stakeholder (e.g. TNPA) requirements. These procedures will be updated as required throughout the full project lifespan to ensure the procedures remain current and applicable.

2.1.8.5 Occupation Health and Safety

Oxygen Twenty one undertook a comprehensive legal compliance review for KSA to comply with all legal requirements and applicable international norms and best practices that include the following but will not be limited to:

- Compensation for Occupational Injuries and Diseases Act 130 of 1993;
- Occupational Health and Safety Act 85, 1993 and all applicable regulations;
- Government Gazette Notice No 1235 – Code of Practice Inshore Diving;
- Basic Conditions of Employment Act 75, 1997;
- Maritime Occupational Safety Regulations, 1994, R 1904;
- SAMSA Acts, Regulations and Codes

A comprehensive HSEQ management manual which underpins the HSEQ Policy of Karadeniz Holding and Group Companies Management, was developed. The HSEQ management system is aligned to international norms and standards such as ISO9001 and ISO 45001. The policy of Karadeniz Holding and Group Companies Management and existing procedures or amendments thereof will be implemented where required for Karpowership SA. These will include but not be limited to:

- Emergency Response Plan
- Fire Safety Plan
- Fire Alarm System
- Tanks Integrated Management Plan
- House Keeping and Leak Emergency on Board
- Technical Periodic Inspection Procedure
- Fugitive Emissions Management Plan

Please refer to Appendix 11 - Policy & Procedures.

2.1.8.6 Lighting

The project is proposed within the operational Port and there is therefore an existing level of light associated with the Port activities. Lighting is critical for the safe and secure operations of the Powerships as well as the Port operation at nights. The lighting aspects of the project was considered to ensure appropriate management in accordance with the Port's requirements where navigational vessels must display lights as directed by the Harbour Master. Minimum illumination levels, expressed in lux, that would ensure a safe working environment as per SANS 10389-1: Exterior lighting, Part 1: Artificial lighting of exterior areas for work and safety and the OHS Act of South Africa will be applicable to reduce risks and ensure that accidents are prevented. Excessively light levels and colour differences, where the distinction of colours are critical to ensure tasks are performed safely, must also be avoided in terms of environmental pollution and disruption of Port shipping and guidance activities.

Light pollution is the alteration of natural light levels in the night environment by artificial lighting where it may cause environmental harm or nuisance. Light pollution may arise from:

- Glare from excessive brightness of a light source;
- Over-illumination;
- Light clutter from excessive grouping of light sources;
- Light trespass from the unwanted direct lighting of an area;

- High energy, short wavelength UV/violet/blue light that is strongly detected by wildlife; and
- Areas requiring lighting must not be over lit and lighting trespass must be avoided.

Lighting will be provided during the construction phase at the respective working areas to provide a safe working environment. All effort will be made to limit the illumination to effective and safe levels and reduce the timeframe of exposures where possible.

The Powership and FSRU lighting will be carefully arranged to minimise lighting pollution and lighting effects on the natural environment. Light intensity and light trespass will be reduced by:

- Mounting lighting fixtures as low as possible;
- Dimming lights where possible and turning off lights when areas are not in use or lighting is not required;
- Where fixed lighting may not adequate for ship operations, portable or temporary lighting will be used to ensure safe operations and navigation on the ship.
- Directing light to the task by reducing the mounting height, repositioning lighting fixtures and adjusting the angle of lighting;
- Using shields on lighting fixtures to prevent light spill outside the footprint area.

High energy, short wavelength UV/violet/blue light which may be detected by nocturnal species will be minimised and avoided at the side of the Powership facing the sensitive natural receptors.

2.1.8.7 Air Emissions & Filtration Systems

Natural Gas (NG) will be the fuel used for the generation of electricity in the proposed Karpowership Project. The pollutants that are emitted using this type of fuel include oxides of nitrogen (NOx), low sulphur dioxide (SO_2) and low particulate matter (PM_{10}) but in small quantities and within the thresholds allowed by South African law. This is fully disclosed in the AEL and is closely monitored during the lifetime of the project.

The Powerships' Charge Air Systems are designed and equipped with both wet and dry filtration systems, so that Powerships can continue to operate in extreme environments, including the locations where high levels of organic or inorganic dusts exist. Charge air filtering system day-to-day workmanship or its maintenance intervals may be affected by the pollutant intensity, but operations can continue. The Charge Air Filtering system has proved itself at other locations, for example at Guinea Conakry, where the Applicant is operating next to an iron ore exporting harbour.

2.1.8.8 Storage of Hazardous Goods

The LNG stored on the FSRU at any given time will not exceed 175 000m^3. The FSRU is made up of a series of pressurised containers. The storage of NG on the Powership is of small quantities and can be assumed as zero. The reason for this is because as the gas is produced it is used to produce electricity. Health and Safety protocols and requirements are ensured for the storage of hazardous goods such as small quantities of lubricating oil stored for equipment maintenance purposes.

2.1.8.9 Fueling of the Powership

The fuel is supplied to the Powership by a separate vessel, a FSRU, which stores the LNG and converts it to a gaseous state for delivery to the Powership through a gas pipeline on demand, based on the generation requirement. The FSRU has an overall length of approximately 300m with an approximate breadth of 50m and incorporates a series of pressurised containers and regassification equipment.

The FSRU is refuelled through vessels specially fitted for the purpose of carrying LNG – a Liquid Natural Gas Carrier or LNGC. Refuelling would be required approximately every 20 to 30 days, depending on the power generation demand from Eskom and output of the Powership. This LNGC will temporarily moor alongside the FSRU over a 1 to 2 day period, while offloading the LNG cargo via STS transfer to the FSRU. The LNG delivered by the LNGC will be sourced from the global market through the Project's contracted fuel supplier, Shell SA, and therefore does not form part of the Karpowership EIA.

The location of the LNGC, when re-fuelling, will be immediately adjacent to the FSRU. The LNGC will stay in this location within the Port only during the re-fuelling process which takes one to two days including all mooring, connection work, safety checks, offloading, disconnection, and preparation for safe transit out of the Port. The FSRU can hold enough LNG to allow the Project to operate for approximately 40 days; expected arrival dates of the LNG Carriers transporting the LNG from the overseas market will be aligned (taking account of the prevailing weather conditions) with the expected usage profile, whilst ensuring that sufficient reserves are maintained on the FSRU in case of any short notice delays. This contingency is to avoid interrupting the supply of LNG to the Powership and thus, to ensure continuously reliable power generation.

The ship-to-ship transfer of LNG will be managed in accordance with STS operation, the applied standard is Ship-to-Ship Transfer Guide (Liquefied Gases) - 2nd edition (OCIMF/SIGTTO) via trained personnel to ensure compliance to this standard and with all quality, health and safety requirements.

The FSRU regasifies the required amount of LNG and sends this to the Powership in gaseous form (NG) continuously on demand through a connecting pipeline. The FSRU is specifically designed, constructed and equipped to supply the fuel gas required, at the designated pressure and flow rates for the power generator engines installed on the Powerships.

For daily operations, standard port limits will apply. For LNG STS (ship-to-ship) operation, an approximate 250-300m meters radius from the STS manifold will be defined as no-go zone and 500 meters radius as controlled traffic zone.

Natural gas boil-off of LNG (Boil Off Gas (BOG)) on board the FSRU is not flared or vented. The BOG is used as fuel for the operation of the FSRU and if in excess, is prioritised for export to the Powership for use in the generation of electrical power. In the event that BOG is in excess of the base load demand, then arrangements are provided on-board the FSRU for this excess BOG to be burnt in a specialised internal process as a last resort so as to avoid any discharge of natural gas to the atmosphere. All BOG management shall be performed in accordance with operating procedures in the approved FSRU Barge Operating Manual. The FSRU has a chromatograph and a metering system from which the data recorded will be provided in real time and formally reported to the Powership in accordance with established procedures.

Under normal operations it is anticipated that the demand for gas will be significantly in excess of the natural boil off resulting in LNG being re-gasified for export to the Powerships for supply to the engines. The engines in operation drive the corresponding generator shaft to generate electricity, and the heat generated by the engines may be captured and used by additional steam turbines for increased efficiency. The electricity generated is transmitted through the overhead transmission line to the substation to the national grid.

For further detail on fuelling please refer to Appendix 11.

2.1.8.10 LNG Fuel Source

The Powership is designed to use Natural Gas, a cleaner burning fuel for the cost effective generation of power, as opposed to coal or diesel-fired power generation. Compared to coal, natural gas emits between 45 and 55% fewer greenhouse gas emissions and less than one-tenth of the air pollutants when used to generate electricity (Shell SA, Media Release, 2020).

Karpowership SA is partnering with Shell SA to supply LNG to the Projects. Shell is one of the global leaders in LNG supply. They are able to leverage economies of scale and their robust networks to secure LNG from the global market. There is a fuel supply management team in place and LNG procurement will be arranged based on COD date and demand during the Project terms. The gas will be sourced from Shell SA with relevant licenses and permissions for the supplier's full supply/value chain. The applicant has also indicated that they have received assurances from the LNG supplier that the gas will not be sourced from fracking.

According to Shell SA, "*Natural gas is the cleanest-burning hydrocarbon, producing around half the carbon dioxide (CO_2) and just one tenth of the air pollutants of coal when burnt to generate electricity. LNG is a clear, colourless and non-toxic liquid which forms when natural gas is cooled to -162ºC (-260ºF). The cooling process shrinks the volume of the gas 600 times, making it easier and safer to store and ship. In its liquid state, LNG is not explosive and cannot burn.*

If consumption remained at today's levels, there would be enough recoverable gas resources to last around 230 years. It is versatile. A gas-fired power station takes much less time to start and stop than a coal-fired plant. This flexibility makes natural gas a good partner to renewable energy sources like solar and wind power, which are only available when the sun shines and the wind blows." (https://www.shell.co.za/energy-and-innovation/natural-gas.html).

2.1.8.11 Global LNG Market

The market for Liquefied Natural Gas has existed since 1958 when the first tanker shipment of LNG took place from Lake Charles, USA bound for Canvey Island in the UK.

Today, more than 40 countries import LNG from 21 exporting nations around the world. Imports are dominated by the Asia Pacific region, with Japan, China and South Korea dominating demand.

On the supply side, Qatar has been the world's largest supplier of LNG for a number of years. However, both Australia and the USA are expected to surpass Qatar as the world's largest LNG suppliers since both nations have rapidly expanded their liquefaction capacity in recent years.

2.1.8.12 LNG Supply Sources

Given the complexity of different sources of LNG and different customers for LNG and the fact that demand for LNG in a country can change from year to year as well as within the market, this market is suited to very large and well prepared companies who can manage the complexity of changing import demand combined with the requirement to serve the customers' demands.

LNG Supply is a mature market with approximately 30 larger companies, capable of supplying LNG to the project. Shell SA was selected after a competitive selection process as they offered the best value for this Project. Any well–established company would have to supply LNG from within their total global portfolio. Therefore, the LNG will not be sourced from a dedicated source(s) continuously, but rather from the best fit supply location taking the market and logistics, in particular, into account at any given time also allowing the switch to indigenous or regional gas supply if it becomes available and feasible at any time in the project term. This global supply portfolio also adds to supply security, because if any shipping route or supply location becomes inaccessible, it can be substituted logistically.

The RMI4P also specifies termination clauses within the international LNG supply agreements, which can be executed if a suitable local or regional gas supply becomes available at any time through the Project term.

The market for the supply of LNG will continue to grow for the next 40 years, and therefore there is no risk associated with the physical supply of this fuel for the term of the project.

2.1.8.13 Waste Generation and Management

Due to daily activities and the Powership and FSRU will require regular maintenance and repairs which will produce waste. Approximately 75m^3 of sewage (black water) as well as grey water (washing and kitchen) will be generated monthly. All effluent and solid (general and hazardous) waste will be removed by authorised service providers in terms of legislation and TNPA and MARPOL requirements and will be treated and disposed of in authorised land-based treatment and disposal sites.

In terms of energy waste, Powerships operate with a lean waste philosophy. Every type of energy generated from the fuel is used in a specific way to reduce waste energy. While engines burn fuel, heat is ejected from the engines via exhaust gasses. In order to utilise this waste heat, Powerships use Exhaust Gas Boiler Equipment to convert waste heat to superheated steam which is redirected to the Steam Turbine Generators to generate electricity.

2.1.8.14 Hull Cleaning

Hull cleaning equipment to be used by Karpowership involves ‘Brushcart’ technology which is a diver-steered, hydraulically powered unit with twin / triple rotating discs that can be fitted with either brushes or blades, depending on the application. For niche areas, (fewer regular surfaces) shrouded hand tools and a containment box have been designed.

Each cleaning tool has a suction shroud that connects separately to the central, fully enclosed suction system through which debris is pumped to the surface support system for treatment. Extracted water and debris is then processed through a multi-staged, modular filtration and treatment system where the fouling debris and particles are removed, and then the filtrate passed through an automated UV disinfection unit. No chemical biofouling agents are used for the hull cleaning process.

2.1.9 Construction of the Powership, FSRU and LNG Carrier

The Powerships are assembled off-site and will be delivered fully equipped and functional to the Port of Ngqura. Powerships through their modular generation capability, allow for greater technical flexibility for load cycling and shedding. The Khan Class Powerships are approximately 289m in length with an approximate breadth of 45m and Shark Class Powerships are approximately 180m in length with an approximate breadth of 26m. The gas fuelled reciprocating engines for power generation allow a reliable supply of electricity with minimal impacts from load profile, number of start and stops and maintenance requirements. They are essentially ships which have been fitted with the necessary gas fuelled generation equipment, including reciprocating engines and heat capture steam turbines with high voltage substation with all applicable equipment to generate and transmit electricity to the grid from this Project.

2.1.10 Construction of the Gas Pipeline

2.1.10.1 Site Access

The gas pipeline is to be brought onto site in 18m lengths by road truck, concrete weight coated and welded together in a pipe stringing yard near the launch site. The trucks used to deliver the pipeline sections will therefore require road access to the stringing yard and laydown area.

2.1.10.2 Pipeline Assembly

Sufficient space for a temporary onshore stringing yard near the launch site will be required to assemble the pipeline. A previously disturbed area within the Port will be selected in order to reduce new impacts.

The selection of the site will only be finalised once a preferred marine contractor has been selected. At this stage it is estimated that an area of 260 m x 75 m would be required. The stringing yard will be set up to assemble three strings of varying lengths to make up the 492m of sub-sea pipeline. The total length of pipeline is approximately 1250m. A launchway will be constructed with rollers to transfer the pipeline from the stringing yard to the sea. The launchway will be constructed on the East side of the stringing yard continuing down the existing ramp into the sea. The launchway will consist of concrete or steel pedestals supporting rollers at approximately 10 to 20m centres, over which the pipeline will move, allowing the completed pipeline to be pulled into the sea. This area will be fully rehabilitated after the completion of the installation of the pipeline.

Figure 2-6: Typical Stringing Yard

Figure 2-7 Typical Launchway across beach

2.1.10.3 Pipeline Installation

The pipeline is to be installed by pulling it from the shore fitted with floatation units, towing it into position using tugs or workboats and lowering it onto the seabed. The pipeline is lowered with minimal disturbance to the seabed and weighted with a 50 mm thick concrete weight coating to ensure the on-bottom stability of the pipeline during operation. Although no dredging is required prior to installation of the pipeline, some seabed preparation in the form of levelling of high spots or placing of crushed stone founding material in low spots may be necessary prior to installing the pipeline.

Minor seabed preparation works are anticipated to receive the pipe and the PLEMs, with the intention to place both directly on the seabed. In cases where there may be a high point, some material might need to be moved to keep the PLEM level or the span lengths within limits.

Once the pipeline installation is complete, the laydown site will be rehabilitated to the topographical and environmental condition prior to the disturbance during the construction phase of this project.

The above methodology for the preferred proposal for the gas pipeline further detailed in **Appendix 10.10 Pipeline Methodology.** The methodology will also need to be approved by TNPA prior to construction start.

2.1.10.4 Pipeline Maintenance

The gas pipeline infrastructure is designed to require little to no maintenance during its design life. Furthermore, the maintenance of the gas pipeline will be managed by the Operation and Maintenance Contractor that will be appointed by Karpowership. Relevant design features include the following:

- the subsea pipeline will be protected with a factory applied external coating as well as sacrificial anodes;
- the external coating will be protected by a concrete weight coating which is designed to provide abrasion resistance, which is especially important during pipeline installation; and
- the pipeline is designed to remain stable on the seabed, thereby mitigating against seabed abrasion and material fatigue.

2.1.11 Socio-economic Commitments

The project is anticipated to make a notable contribution towards the national and local economy through commitments made in the Karpowership SA bid submissions. There will be a significant number of local employees for both the construction and operation period which will exceed the Economic Development criteria that must be reached under the terms of the RMI4P.

The Economic Development (ED) programme will be implemented over the ±12-month construction phase and the 20-year operations and maintenance phase of the projects.

The estimated budget for Socio-Economic Development (SED) is based on the commitment that was made at the Bid Stage of spending 1.28% of the Revenue generated during the 20-year operation period on Socio Economic Development initiatives.

At the time this equated to the following Rand values:

- **R567 923 133 -** **Projected for 20-year Power Purchase Agreement**
- **R28 396 156** **Projected per annum**
- **R2.37m** **Approx. per month projections**

Karpowership may allocate a maximum projected SED spend within the Eastern Cape Province of:

- **R141 980 783 -** **Projected for 20-year Power Purchase Agreement**
- **R7 099 039** **Projected per annum**
- **R591k** **Approx. per month projections**

This budget allocation will be triggered in instances where SED projects have been successfully implemented in the identified beneficiary communities. The extended provincial spend will be considered in order to prevent a migration from neighbouring communities into the beneficiary communities by people looking to access improved socio-economic circumstances, e.g., bursaries, educational programmes etc.

The following SED projects have been identified as priority areas within the NMBMM, and will be the first SED Projects to be rolled out:-

- Primary and secondary school focus on building educator and learner capacity in (Science, Technology, Engineering and Math) STEM;
- Scholarships/Bursary Programme
- Installation of Energy Efficient systems
- Environmental sustainability
- Support to Vulnerable Communities; and
- Sports and Recreation

As part of it Enterprise Development Programme (EDP), Karpowership will provide financial and non-financial support to Exempt Micro Enterprises (EMEs), these are entities with a turnover below R10 million, and/or Qualifying Small Enterprises (QSEs), businesses with a turnover above R10 million but below R50 million. Support will be focused on enterprises that have a minimum fifty-one percent (51%) shareholding by Black people, with emphasis on women and youth-owned businesses. – This criteria is aligned to compliance with the Broad-Based Black

Economic Empowerment Act 53 of 2003 and the subsequent promulgated Codes of Good Practice. All further amendments shall be adhered to by Karpowership during the life-cycle of the implementation period of each Project / Beneficiary Programme.

While the initial area of focus may be Karpowership' s supply chain, businesses that are supported under do not necessarily have to be part of the Karpowership value chain and could include a wide range of businesses, including the informal sector.

The overall projected budget allows for a preliminary Enterprise Development spend within the NMBMM area to be:

- **R227 169 252 -** **Projected for 20-year Power Purchase Agreement**
- **R11 358 462** **Projected per annum**

In addition, should the development needs require, Karpowership may allocate a maximum projected Enterprise Development spend within the Eastern Cape Province of:

- **R56 792 313** **Projected for 20-year Power Purchase Agreement**
- **R2 839 615** **Projected per annum**

Consideration for this projected Provincial spend will be in line with the sustainability of enterprises which have been established or developed within the Local Beneficiary Communities. For example, where a business has received beneficiation and now needs to expand its distribution chain or improve its supply chain from outside of the immediate communities.

Our strategy has further been defined to include the following focus areas:

- **Vendor Kiosks for SMME's;**
- **Tourism and Hospitality**
- **Youth Enterprise Development; and**
- **Enterprise Development short term funding**

The projected budget for Supplier Development initiatives within the NMBMM area is:

- **Approximate Projected Budget for the Construction Phase is R506k, to be split over 12 months**
- **Approximate Projected Budget is R1.1 million, projected as per annum, over the 20-year Power Purchase Agreement period (Operations Phase)**

Karpowership will implement a Skills Development Programme. Projected budget for Skills Development initiatives within the NMBMM area is:

1. In Compliance with the Broad Based Black Economic Empowerment Act 53 of 2003 and all subsequent amendments.

nt

Projected budget for Skills Development initiatives within the Eastern Cape Province shall be:

- **Approximate Projected Budget is R7 887 821 over the 20-year Power Purchase Agreement period (Operations Phase)**

- **Approximate Projected Budget is R394k, projected as per annum**

Karpowership recognises the importance Learnerships and Apprenticeships programmes. The Karpowership Academy, an in-house training institution will be establishment in South Africa also assist with Skills Development initiatives. Training and skills development will take place continually to ensure that adequate maintenance and operational related labour force is available within the immediate community

Please refer to Appendix 9 - D1 SEIA, Nov 2022 and Section 7.3.16 of this report for further details on the findings from the Socio-Economic Impact Assessment.

2.1.12 Timeframes

2.1.12.1 Contract Period

The Risk Mitigation IPP Procurement Programme was technology agnostic and required tenderers to provide solutions that would ensure dispatchable energy to the buyer (Eskom). The 11 Preferred bidders were declared Strategic Integrated Projects (SIP) in terms of the Infrastructure Development Act 23 of 2014 by the Presidential Infrastructure Coordinating Commission Council on 24 July 2020 under SIP 20. As per the requirements of the Risk Mitigation IPP Procurement Programme, all projects would be required to sign a 20-year Power Purchase Agreement (PPA) with Eskom.

The decommissioning of the existing coal fleet (due to end of design life) can provide space for a relatively different energy mix. It must be noted that, in the period preceding 2030, the system requirements are largely for incremental capacity addition (modular) and flexible technology, to complement the existing installed inflexible capacity (IRP, 2019). This is essentially what a system like the Karpowership fleet can provide, ship-based power generating and transmission of energy to land-based transmission connection points. This capacity can be modularly up-scaled on site with a very short lead time to meet additional requirements, should these be required at a later stage. The RFP limits the project to a delivered capacity of 450MW at the Point of Utility Connection.

2.1.12.2 Operating Hours

Under the PPA the operating hours depend entirely on dispatch instructions from the buyer (ESKOM), which can only be given between the hours of 05:00 and 21:30 (16.5 hours) on any given day throughout the year (i.e. it is not permitted to be operational for the remaining 7.5 hours).

Within these 16.5 operating hours per day (maximum), dispatch instructions in terms of required MW can range between 0MW – 450MW.

2.2 All Listed and Specified Activities Triggered in terms of NEMA and NEM: AQA

2014 EIA Regulations (as amended), Appendix 3 - 3(d) (i) all listed and specified activities triggered

The table below indicates activities that are deemed applicable to the proposed project, based on Triplo4's assessment and guidance sought from DFFE:

<u>NEMA</u>

Table 2-2: Applicable Listed Activities

LISTED NOTICES		
LISTING NOTICE 1		
Activity No.	Activity Description	Applicability
Activity 11	*The development of facilities or infrastructure for the transmission and distribution of electricity—* *(i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or* *(ii) inside urban areas or industrial complexes with a capacity of 275 kilovolts or more;* *excluding the development of bypass infrastructure for the transmission and distribution of electricity where such bypass infrastructure is —* *(a) temporarily required to allow for maintenance of existing infrastructure;* *(b) 2 kilometres or shorter in length;* *(c) within an existing transmission line servitude; and* *(d) will be removed within 18 months of the commencement of development.*	The power generated on the ship will be converted by the on-board High Voltage substation (110kV-170kV) and transmitted along the 132kV twin conductor overhead transmission line. A switching station will be required to facilitate the supply of electricity into the national grid. The transmission line and switching will be located within the boundaries of the Port of Ngqura (Transnet) and within the Coega Industrial Development Services Servitude and its capacity falls below the threshold of 275 kV.
Activity 12	*The development of—* *(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or* *(ii) infrastructure or structures with a physical footprint of 100 square metres or more;* *where such development occurs—* *(a) within a watercourse;* *(b) in front of a development setback; or* *(c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; —* *excluding—* *(dd) where such development occurs within an urban area;*	The preferred route of the transmission line on the Western side of the services servitude, the locations of the proposed switching station and the temporary laydown area for the gas pipeline installation, is within 32m of a watercourse. The FEPA wetland that is indicated on maps, no longer exists. These structures and infrastructure are proposed within the existing Port of Ngqura (Transnet) and within the Coega Industrial Development
Activity 15	*The development of structures in the coastal public property where the development footprint is bigger than 50 square metres, excluding—*	Structures in the coastal public property exceeding 50 square meters include the: gas pipeline,

LISTED NOTICES		
LISTING NOTICE 1		
Activity No.	Activity Description	Applicability
	(i) the development of structures within existing ports or harbours that will not increase the development footprint of the port or harbour; *(ii) the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies;* *(iii) the development of temporary structures within the beach zone where such structures will be removed within 6 weeks of the commencement of development and where coral or indigenous vegetation will not be cleared; or* *(iv) activities listed in activity 14 in Listing Notice 2 of 2014, in which case that activity applies.*	transmission line and the contractor facilities and mooring structures for the gas pipeline and transmission line installations. The development of these structures and infrastructure will occur within the Port of Ngqura. A part of the gas pipeline will be established overland to connect to the Powership. Activity 14 in Listing Notice 2 of 2014 is applied for in terms of the gas pipeline and mooring structures within the sea /along the seabed and thus can be excluded from this activity. The transmission line and temporary construction facilities are deemed to increase the development footprint of the port and thus are not excluded from this activity.
Activity 17	*Development—* *(i) in the sea;* *(ii) in an estuary;* *(iii) within the littoral active zone;* *(iv) in front of a development setback; or* *(v) if no development setback exists, within a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever is the greater;* *in respect of—* *(a) fixed or floating jetties and slipways;* *(b) tidal pools;* *(c) embankments;* *(d) rock revetments or stabilising structures including stabilising walls; or*	The Powerships and FSRU are not being developed. However, the mooring system, the gas pipeline, the proposed towers for the transmission line, the switching station and the temporary laydown area for the gas pipeline installation will cumulatively exceed a footprint of 50 square meters within the sea, and littoral active zone. In addition, these structures and infrastructure are proposed within the existing Port of Ngqura and Transnet property, which are

LISTED NOTICES		
LISTING NOTICE 1		
Activity No.	Activity Description	Applicability
	(e) infrastructure or structures with a development footprint of 50 square metres or more — *but excluding—* *(aa) the development of infrastructure and structures within existing ports or harbours that will not increase the development footprint of the port or harbour;* *(bb) where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies;* *(cc) the development of temporary infrastructure or structures where such structures will be removed within 6 weeks of the commencement of development and where coral or indigenous vegetation will not be cleared; or* *(dd) where such development occurs within an urban area.*	deemed to increase the development footprint of the port and thus are not excluded from this activity.
Activity 18	*The planting of vegetation or placing of any material on dunes or exposed sand surfaces of more than 10 square metres, within the littoral active zone, for the purpose of preventing the free movement of sand, erosion or accretion.*	Sections of the gas pipeline and transmission line, where it comes on shore, need to be stabilised to prevent erosion on the substrate where the pipeline and transmission line is established. Furthermore, rehabilitation for the land-based portion will be required. Although the area has already been transformed due to port activity, it will require the planting of vegetation on exposed sand surfaces of more than 10 square meters to ensure environmental management.
Activity 19	*The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse;*	The proposed transmission line, gas pipeline installation and the temporary construction facilities, the development will take place within a watercourse and will require the infilling or depositing of

LISTED NOTICES		
LISTING NOTICE 1		
Activity No.	Activity Description	Applicability
	but excluding where such infilling, depositing, dredging, excavation, removal or moving— (a) *will occur behind a development setback;* (b) *is for maintenance purposes undertaken in accordance with a maintenance management plan;* (c) *falls within the ambit of activity 21 in this Notice, in which case that activity applies;* (d) *occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or* (e) *where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.*	material of more than 10 cubic meters into, and the excavation, removal or moving of soil or sand of more than 10 cubic meters from a watercourse. These infrastructure and structures are deemed to increase the development footprint of the port and thus are not excluded from this activity.
Activity 19A	*The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from—* *(i) the seashore;* *(ii) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater; or* *(iii) the sea; —* *but excluding where such infilling, depositing , dredging, excavation, removal or moving—* (f) *will occur behind a development setback;* (g) *is for maintenance purposes undertaken in accordance with a maintenance management plan;* (h) *falls within the ambit of activity 21 in this Notice, in which case that activity applies;* (i) *occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or* *where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.*	The Powership mooring system, the gas pipeline, the erection of the towers for the transmission line, and the construction facilities for the gas pipeline installation will require the removal of more than 5 cubic metres of soil or sand from the littoral active zone, an estuary or a distance of 100 meters of an estuary, and the sea. Installation of the subsea as well as land based portions of the pipeline will require excavation, levelling infilling and compaction. These structures and infrastructure are deemed to increase the development footprint of the port and thus are not excluded from this activity.
Activity 27	*The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation,*	The proposed switching station and the temporary construction facilities will cumulatively require clearance

LISTED NOTICES		
LISTING NOTICE 1		
Activity No.	Activity Description	Applicability
	except where such clearance of indigenous vegetation is required for— *(i) the undertaking of a linear activity; or maintenance purposes undertaken in accordance with a maintenance management plan.*	of more than 1 hectare of indigenous vegetation. DEFF IQ desk has confirmed that the transmission line comprising of towers / pylons and 132kV lines is considered as a linear activity, and thus is excluded from this activity.

Activity No.	Activity Description	Applicability
LISTING NOTICE 2		
Activity 2	*The development and related operation of facilities or infrastructure for the generation of electricity from a non-renewable resource where the electricity output is 20 megawatts or more.*	The two Powerships and FSRU are assembled off-site and will be delivered fully equipped and ready to operate to the Port of Ngqura where they will be moored and linked via a gas pipeline. The Project's design capacity is 540MW and the contracted capacity will be 450MW of electricity to be supplied to the national grid. Electricity will be generated by 27 reciprocating engines, each having a heat input in excess of 10MW (design capacity of 18.32MW each at full capacity). Heat generated by operation of the reciprocating engines is captured, and that energy is used to create steam to drive three steam turbines that each have a heat input of circa 15.45MW. The gas pipeline from the FSRU to the Powerships and the transmission line from the Powerships to the switching station trigger separately listed activities, as does the need for an AEL which if issued, will regulate the

Activity No.	Activity Description	Applicability
LISTING NOTICE 2		
		atmospheric emissions during commissioning and operation of the project.
Activity 4	*The development and related operation of facilities or infrastructure, for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres*	Storage of LNG on the FSRU will exceed 500 cubic meters (maximum estimated storage is 175000 cubic meters at any given time.
Activity 6	*The development of facilities or infrastructure for any process or activity which requires a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent, excluding—* *(i) activities which are identified and included in Listing Notice 1 of 2014;* *(ii) activities which are included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies;* *(iii) the development of facilities or infrastructure for the treatment of effluent, polluted water, wastewater or sewage where such facilities have a daily throughput capacity of 2 000 cubic metres or less; or* *(iv) where the development is directly related to aquaculture facilities or infrastructure where the wastewater discharge capacity will not exceed 50 cubic metres per day.*	The engines used for electricity generation are a Listed Activity under GN 893 of 22 November 2013 (as amended) in terms of Section 21 of the NEM: AQA Sub-Category 1.5: Reciprocating Engines. In the case of the proposed project, the Powership will have a combined sum of 27 engines that each have a heat input capacity of more than 10MW. The three steam turbines have a heat input capacity of less than 50MW, but more than 10MW. These units are therefore declared Controlled Emitters and they will be regulated in terms of GN 831 of 1 November 2013 for Small Boilers.
Activity 7	*The development and related operation of facilities or infrastructure for the bulk transportation of dangerous goods—* *(i) in gas form, outside an industrial complex, using pipelines, exceeding 1 000 metres in length, with a throughput capacity of more than 700 tons per day;* *(ii) in liquid form, outside an industrial complex, using pipelines, exceeding 1 000 metres in length, with a throughput capacity of more than 50 cubic metres per day; or*	A subsea gas pipeline for transportation of gas in gas form is proposed, exceeding 1000 meters. As this activity is within the existing Port boundaries.

Activity No.	Activity Description	Applicability
LISTING NOTICE 2		
	(iii) in solid form, outside an industrial complex, using funiculars or conveyors with a throughput capacity of more than 50 tons per day.	
Activity 14	*The development and related operation of—* *(ii) an anchored platform; or* *(iii) any other structure or infrastructure —* *on, below or along the sea bed;* *excluding —* *(a) development of facilities, infrastructure or structures for aquaculture purposes; or* *(b) the development of temporary structures or infrastructure where such structures will be removed within 6 weeks of the commencement of development and where coral or indigenous vegetation will not be cleared.*	The ships will be anchored and moored in existing port operational areas utilising the vessel's anchoring system. The transmission of the NG gas will flow via a gas pipeline from the moored ship along the seabed to the main ship for processing. The subsea gas pipeline is proposed to be installed, operate and maintained along the toe of the existing dredged slopes between the floating storage regasification unit (FSRU) and Powership to ensure gas supply for power generation.

Activity No.	Activity Description	Applicability
LISTING NOTICE 3		
Activity 10	*The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres.* a***. Eastern Cape*** *i. Outside urban areas:* *(aa) A protected area identified in terms of NEMPAA, excluding conservancies;* *(ee) National Protected Area Expansion Strategy Focus areas;* *(ff) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;* *(gg) Sites or areas identified in terms of an international convention;*	The storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of more than 500 cubic metres. The FSRU with a storage capacity not exceeding 175 000 cubic metres of LNG at any time, will be situated approximately 500 metres from the shoreline, adjacent to the breakwater structure, within the Port of Ngqura will be situated further than 500m from the estuarine functional zone.

Activity No.	Activity Description	Applicability
LISTING NOTICE 3		
	(hh) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; *(ii) Core areas in biosphere reserves;* *(jj) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve;* *(kk) Areas seawards of the development setback line or within1 kilometre from the high-water mark of the sea if no such development setback line is determined;* *(ll) Areas on the watercourse side of the development setback line or within 100 metres from the edge of a watercourse where no such setback line has been determined;* *(mm)* *Within 500 metres of an estuarine functional zone, excluding areas falling behind the development setback line;* *(nn) In an estuarine functional zone, excluding areas falling behind the development setback line; or* *(oo) Within a watercourse; or* *ii. Inside urban areas:* *(aa) Areas zoned for use as public open space;* *(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose; or* *(cc)Within 500metres of an estuarine function zone excluding areas falling behind the development setback line.*	The Jahleel Island is approximately 1km away whereas the St Croix and Brenton Islands are situated approximately 6,5km away from the FSRU. These islands are situated within the Greater Addo National Elephant Park Marine Protected Area, which is situated immediately adjacent to the breakwater structure within the Port.
Activity 12	*The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.* ***Eastern Cape*** *i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area*	This activity will be triggered by the clearance of vegetation exceeding 300 square metres for the establishment of the transmission line towers and switching station, within the littoral active zone and 100 metres inland from the highwater mark of the sea and estuarine functional zone.

Activity No.	Activity Description	Applicability
LISTING NOTICE 3		
	that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; *ii.Within critical biodiversity areas identified in bioregional plans;* *iii.Within the littoral active zone or 100 metres inland from the high water mark of the sea, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas;* *iv.Outside urban areas, within 100 metres inland from an estuarine functional zone; or* *v.On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning.*	
Activity 14	*The development of—* *(i) dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 10 square metres; or* *(ii) infrastructure or structures with a physical footprint of 10 square metres or more;* *where such development occurs—* *(a) within a watercourse;* *(b) in front of a development setback; or* *(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse;* *excluding the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour.* *Eastern Cape* *i. Outside urban areas:* *(aa) A protected area identified in terms of NEMPAA, excluding conservancies;* *(bb) National Protected Area Expansion Strategy Focus areas;* *(cc) World Heritage Sites;* *(dd) Sensitive areas as identified in an environmental management framework as*	The proposed Infrastructure or structures with a footprint of more than 10 square meters will be developed within the Port of Ngqura and the CDC. The CDC's potentially preferred alignment of the transmission line will occur within 32m of a watercourse. These infrastructure and structures are deemed to increase the development footprint of the port and thus are not excluded from this activity

Activity No.	Activity Description	Applicability
LISTING NOTICE 3		
	contemplated in chapter 5 of the Act and as adopted by the competent authority; (ee) Sites or areas identified in terms of an international convention; (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (gg) Core areas in biosphere reserves; (hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; (ii) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined;	

<u>NEM:AQA</u>

In terms of Section 21 of the National Environmental Management: Air Quality Act, 2004 (NEM:AQA), the Minister published a 'list of activities which result in atmospheric emissions and which the Minister or MEC reasonably believes have or may have a significant detrimental effect on the environment, including health, social conditions, economic conditions, ecological conditions or cultural heritage'. The consequences of listing an activity are set out in Section 22:

'No person may ***without a provisional atmospheric emission licence or an atmospheric emission licence*** *conduct an activity—*

(a) listed on the national list anywhere in the Republic; or

(b) listed on the list applicable in a province anywhere in that province.'

Table 2-3: Applicable Listed Activities under NEM:AQA for the proposed Gas to Power Powership Project (GN 893 in GG No. 37054 of 22 November 2013, as amended).

Category of Listed Activity	**Sub-category of the Listed Activity**	**Application**
Category 1: Combustion Installations	Sub-category 1.5: Liquid and gas fuel stationary engines used for electricity generation	All installations with design capacity equal to or greater than 10 MW heat input per unit, based on the lower calorific value of the fuel use.

The applicability of this listed activity has been investigated by the EAP upon advice of the air quality specialist and will be confirmed in consultation with the licensing authority, also DFFE Air Quality Authorisations which is a sub-directorate within Directorate of Climate Change and Air Quality Management.

The minimum emission standards prescribed for Activity 1.5 are presented in Table 2-4 below:

Table 2-4: Minimum Emission Standards in mg/Nm3 for Subcategory 1.5: Reciprocating Engines (Gas Fired).

Substance or mixture of substances		MES for sub-category 1.5
Common name	**Chemical symbol**	**MES under normal conditions of 15% O_2, 273 Kelvin and 101.3 kPa**
Particulate matter	N/A	50
Oxides of nitrogen (Expressed NO_2)	NO_X	400
Sulphur dioxide	SO_2	N/A

2.3 Project Locality

2014 EIA Regulations, Appendix 3 - 3 (1) an environmental impact assessment report must include (b) the location of the development footprint of the activity on the approved site as contemplated in the accepted scoping report, including: (i) the 21 digit Surveyor General code of each cadastral land parcel; (ii) where available, the physical address and farm name; and (iii) where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties; (c) a plan which locates the proposed activity or activities applied for as well as the associated structures and infrastructure at an appropriate scale.

2.3.1 Location of the Activity

Table 2-5: Location of the Proposed Activity.

Description	Location of the Activity
Metropolitan Municipality	Nelson Mandela Bay Municipality (NMBM)
Municipal Ward	Ward 53 (borders Ward 60)
Area / Town / Village	Port of Ngqura and Coega Special Economic Zone, situated near Port Elizabeth
Property Description & 21 Digit SG Code	See Table 2-6 below

Table 2-6: Properties Description, the 21 SG codes and the Central Coordinates.

Property Description	21 SG CODES	CENTRAL GPS-COORDINATE	
		Longitude	Latitude
Erf 251 Coega	C07600230000025100000	25.690411	-33.795652
Erf 312 Coega	C07600230000031200000	25,6960670	-33,7877900

Remainder of Erf 252 Coega	C07600230000025200000	25,6944580	-33,7711600
Remainder of Erf 281 Coega	C07600230000028100000	25,6835390	-33,7585280
Remainder of Erf 275 Coega	C07600230000027500000	25,6789980	-33,7532740
Rem of Erf 276 Coega	C07600230000027600000	25.675593	-33.750389
Erf 329 Coega	C07600230000032900000	25.675109	-33.746749
Erf 356	C07600230000035600000	25.688591	-33.797403

Figures 2-8 below present the Locality Map which illustrates the following:

- Preferred Powerships position and FSRU;
- Preferred gas pipeline route,
- Preferred transmission route corridor and alternative corridors;
- Site access via existing access roads network from the N2 will be used to access the Powerships site;and
- Stringing yard and site offices.

2.3.2 Locality Plan of Activity (Marine & Transmission)

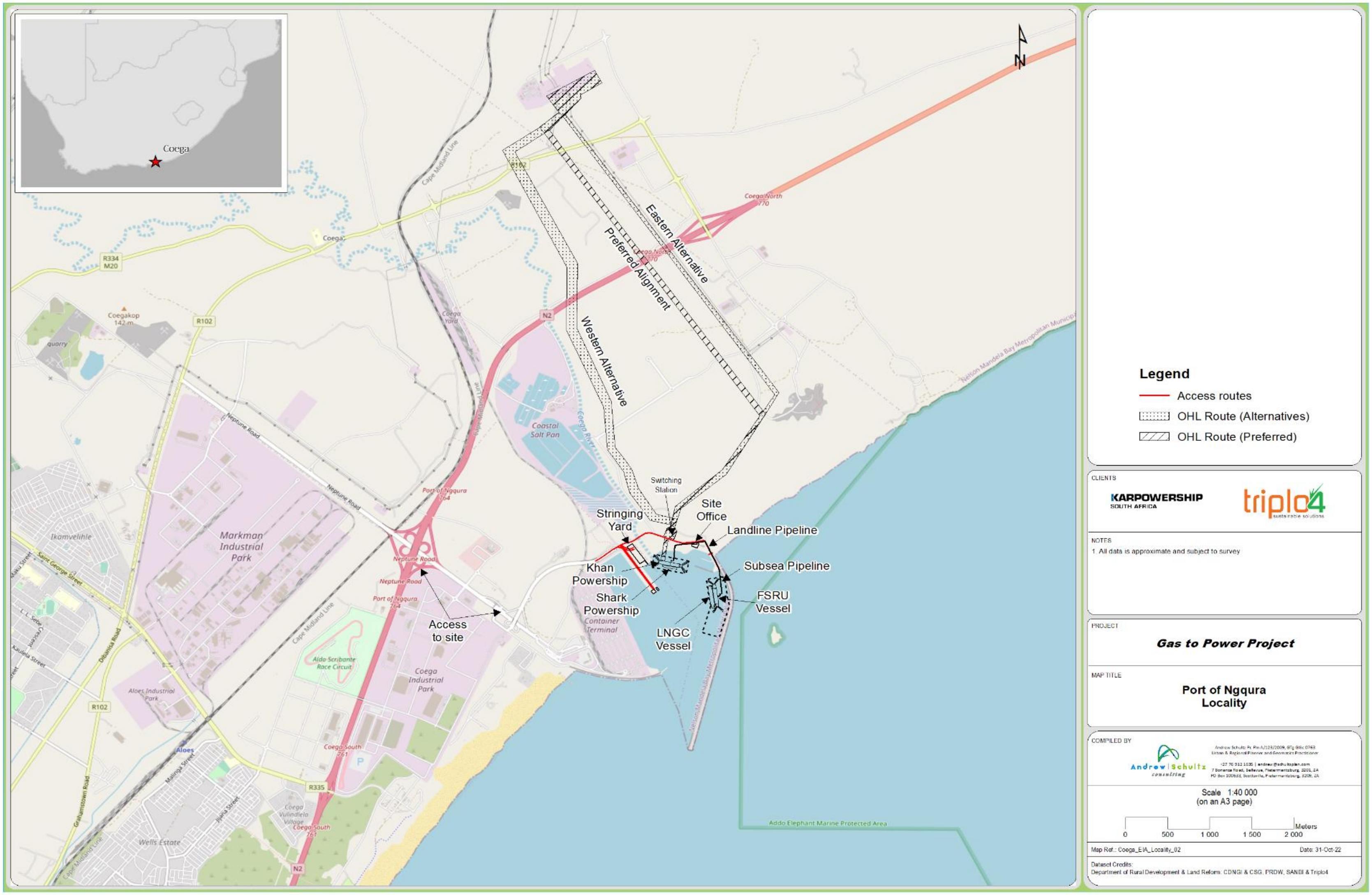


Figure 2-8: Locality Map (Marine & Transmission) – Refer to Appendix 1.1

3 ALTERNATIVES

The reasonability and feasibility of the alternatives have been considered in terms of Section 24O.

3.1 Approved site and Alternatives assessed in EIA

EIA Regulations, Appendix 3 - 3(h) a full description of the process followed to reach the proposed development footprint within the approved site as contemplated in the accepted scoping report, including: (i) details of the development footprint alternatives considered;

3.1.1 Port Site Selection

Three (3) Port sites were considered for the Eastern Cape Province, which were Port of East London, Port of Port Elizabeth and Port of Ngqura.

Port site selection was based on criteria such as adequate space for ship(s) positioning, delivering of gas via LNG carrier, adequate navigational routes, turning circles, size and depth of Ports; Port planning, existing facilities and infrastructure, available grid capacity and evacuation capacity.

Port of East London’s main focus on the local automotive industry and handles primarily industrial and agricultural cargoes. The Port located on the Buffalo River is spatially constrained and there is insufficient water depth, navigation area and berthing space to accommodate the project and fuel delivery vessels without significant dredging and modifications. The amount of grid strengthening required in order to evacuate the generated electricity to Eskom, was perceived as a high risk to the project.

The Port of Port Elizabeth was considered and evaluated as a potential site, however it was not selected as there was insufficient available grid capacity to accommodate the project size.

Port of Ngqura is planned to be the primary central Port and energy hub (provision of LNG) and the leader of technological innovation with the Port of Port Elizabeth providing complementary services. The Dedisa substation has sufficient available grid capacity to accommodate the project and the port has sufficient water depth making The Coega SEZ and Port of Ngqura the ideal location to meet the requirements for the proposed Powership Project, this is the preferred location, and no other sites within this region are suited for the Project.

3.1.2 Current Port Site Selection

Being a ship-based power generating operation (as opposed to land-based) with transmission of energy to land-based transmission connection points, only locations that provide infrastructure associated with the proposed technology were identified.

The bulk of the Project is to be located in the Port of Ngqura which is adjacent to the Coega Special Economic Zone, originally established as an Industrial Development Zone in 1999. It falls within the Nelson Mandela Bay Metropolitan Municipality (NMBM) in the Eastern Cape Province. The Coega SEZ, is managed by the Coega Development Corporation (CDC) and the Port of Ngqura, falls under the jurisdiction of by the Transnet National Ports Authority (TNPA).

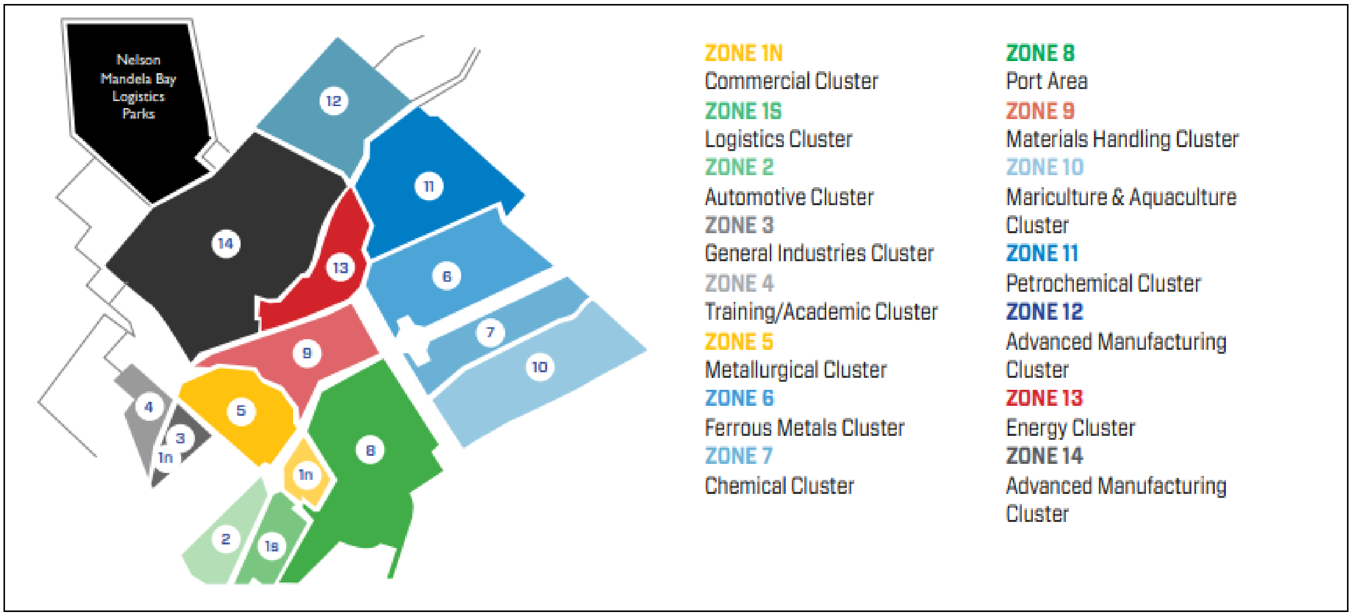


Figure 3-1: Coega SEZ Zones.

The Port and Coega SEZ create opportunities through clusters that facilitate synergy and supply chain integration. Zone 8 Port Area and Zone 13 – Energy Cluster enable the location of the proposed project as per the lay-out and provisions of the Energy Cluster.

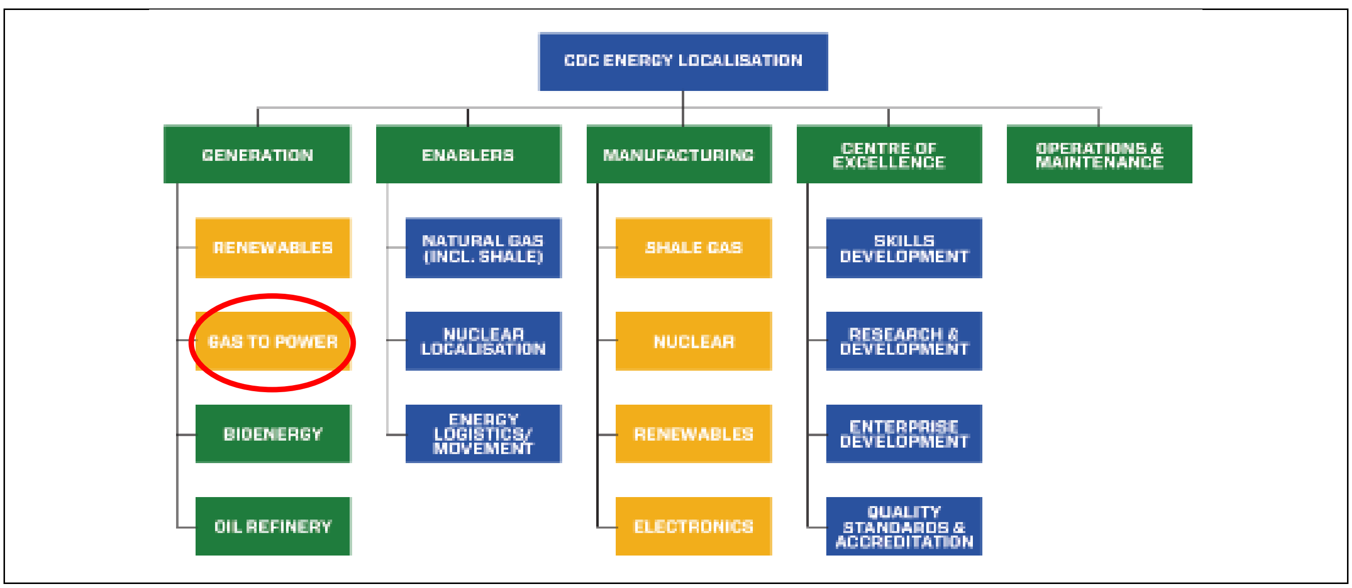


Figure 3-2: Coega IDZ Cluster Zones.

As the Coega SEZ and Ngqura Port meet the requirements for the proposed Powership Project, this is the preferred location, and no other sites within this region are proposed for this project. Other ports such as Port Elizabeth were considered and evaluated as a potential site, however it was not selected as there were navigational issues associated and for this reason the Port of Ngqura was considered.

The following alternatives have been assessed as part of the EIA.

3.2 Development footprint (layout) alternatives assessed in EIA

Table 3-1: Summary of Alternatives

Alternative	Description	Status	Key reasoning	Report Section
Site Alternatives within Eastern Cape Province	Port of East London,	Screened out	This not a feasible alternative.	Section 3.1.1
	Port of Elizabeth	Screened out	This not a feasible alternative.	Section 3.1.1
	Port of Ngqura	Assessed in EIA	This is a feasible and preferred alternative. Aligned with Port and CDC energy hub activities, sufficient depth and available grid infrastructure via existing CDC services servitude with connection to Dedisa Substation.	Section 3.1.2
Layout Alternative Powership	Alternative 1: Two Powerships adjacent to the admin craft basin and the FSRU along the eastern breakwater	Assessed in EIA	This is a feasible and preferred alternative.	Section 3.2.1
	Alternative 2: Two Powerships closer to the liquid bulk terminal and the FSRU along the curved portion of the eastern breakwater.	Assessed in EIA	This is a feasible alternative.	Section 3.2.1
Layout Alternative Gas Pipeline	Alternative 1: Onshore pipeline is routed around the ACB admin buildings and across the dune field via the shore crossing and along the seabed to the location of the Powership PLEM.	Assessed in EIA	This is a feasible and preferred alternative.	Section 3.2.2
	Alternative 2: Gas pipeline connecting the FSRU to the Powerships will be routed along the edge of the existing eastern breakwater	Assessed in EIA	This is a feasible alternative.	Section 3.2.2

Alternative	Description	Status	Key reasoning	Report Section
Layout Alternative: Transmission Lines	Alternative 1: Western alignment in the authorised services servitude	Assessed in EIA	This is a feasible and preferred alternative.	Section 3.2.3
	Alternative 2: Eastern alignment in the authorised services servitude	Assessed in EIA	This is a feasible alternative.	Section 3.2.3
	Alternative 3: north-westerly route which crosses several watercourses and adjacent to the transformed Ngqura River	Screened out	This not a feasible alternative. ▪ Detrimental to several watercourses and associated sytems; ▪ Traverses some undisturbed thicket areas that form important habitats for fauna, many of which are themselves protected species.	Section 3.2.3
Design Alternative: Transmission Lines	Lattice	Screened out	This is a feasible alternative but not preferred. ▪ larger excavations for their foundation; ▪ larger clearing of vegetation; ▪ Less visually appealing; ▪ higher vertical risk area to flying birds.	Section 3.2.4
	Monopole	Assessed in EIA	This is a feasible and preferred alternative.	Section 3.2.4
Technology Alternatives: Fuel	Natural Gas	Assessed in EIA	This is a feasible and preferred alternative.	Section 3.2.5
	Hydrogen	Not assessed in EIA	This is not a current feasible option, however, it is not an excluded option over the 20 years timeframe of the project. When commercially viable for implementation on the utility scale of the Project, the relevant environmental	Section 3.2.5

Alternative	Description	Status	Key reasoning	Report Section
			processes will be completed as required.	

3.2.1 Layout Alternatives: Powership Position within the Port

The Powerships and FSRU are to be moored in the waters within the Port of Ngqura. The operational requirements at the Port cannot accommodate the use of existing berthing infrastructure and therefore the vessels will be positioned in unused areas of the port and will utilise their own mooring system comprising catenary mooring chains and anchors. The key criteria for the mooring site requiring consideration are the size of the turning circle for the LNG carrier as well as the approach channel being shared with the container terminal, i.e. traffic in basin from container vessels, cargo vessels and tugs. The Powerships need to be located at of the approach channel entrance and outside the turning circle so as to not to impede vessel traffic movement in the Port. This will keep the safety exclusion zones required for the ship-to-ship transfer from the LNG to the FSRU. For daily operations, standard port limits will apply. For LNG STS (ship-to-ship) operation, an approximate 250-300m meters radius from the STS manifold will be defined as no-go zone and 500 meters radius as controlled traffic zone. These figures will be supported by an accredited association's report in this regard.

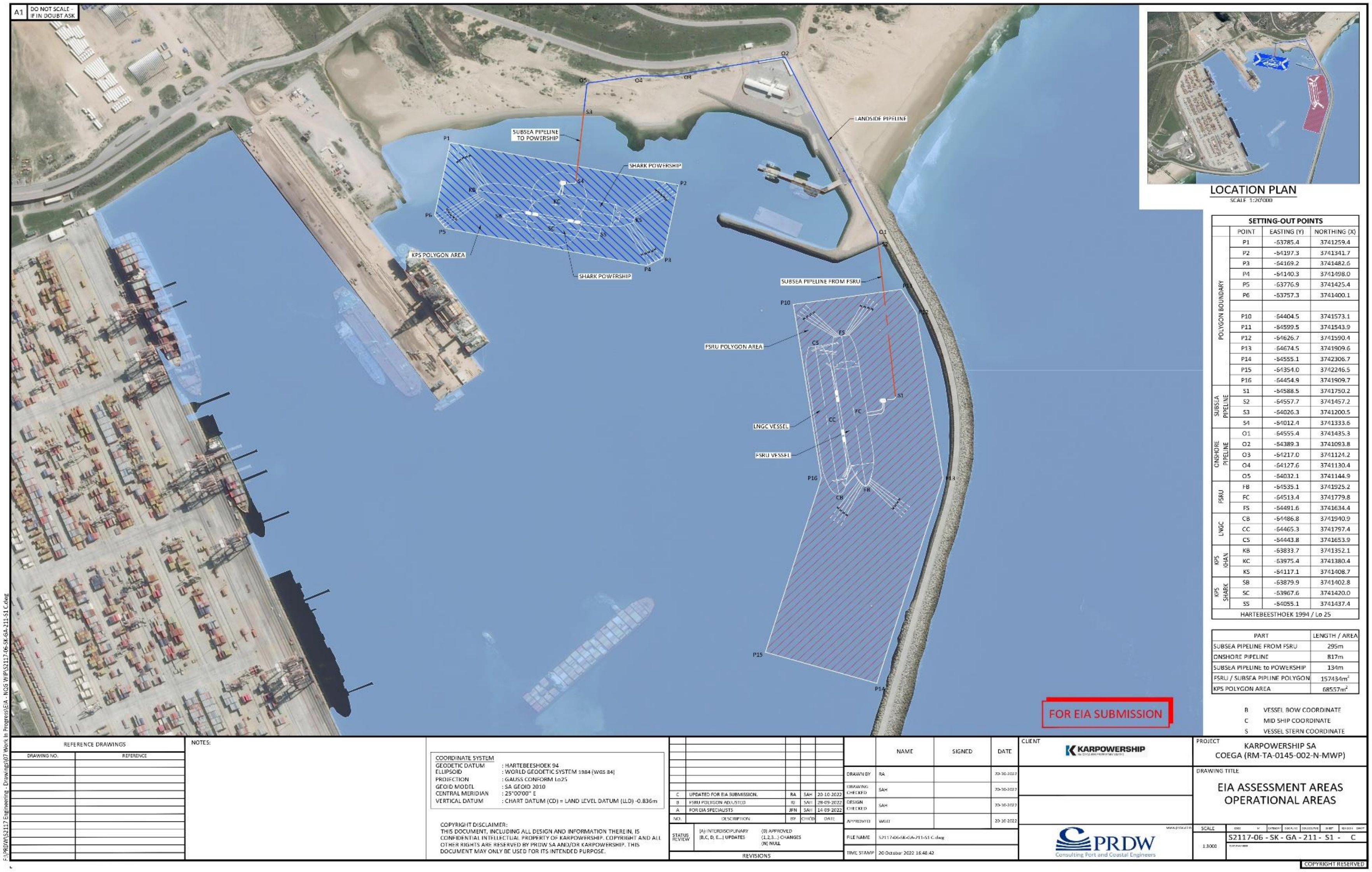
Figure 3-3: Powership mooring system.

The locations selected for the mooring of the FSRU and the Powerships are existing areas of the Port that are maintained at the advertised depth by the Port Authority. The depth of the water in which the ships will be positioned is approximately 14m. There are no technical or engineering concerns around the project site topography as the elevation changes and distances are minor and there are no notable high points or depressions on the route. The main risk for the project relates to the water depth but the Port maintained water depths are deemed sufficient for the project vessels and therefore no project specific dredging is required.

No dredging is required as the mooring locations are positioned in sufficient water depth to safely accommodate the moored vessels. In the process of identification of the potential sites, the existing cargo facilities and the Port's future short-term developments were avoided. The following alternatives were identified and are being assessed:

Alternative 1: is deemed the preferred option from an engineering perspective, as the Powerships and FSRU are not located close to each other and are positioned adjacent to the break bulk quay /multi-purpose terminal. This option is to position the two Powerships adjacent to the admin craft basin and the FSRU along the eastern breakwater. Alternative 1- is the preferred as it is in line with the FSRU in the port's long term FSRU berth position plans. Figures 3-4 below show the alternatives for the positioning of the Powerships. The preferred option above is situated in excess of approximately 1km from Jahleel Island. Refer to Appendix 1.5.

Alternative 2: is considered less suitable from an engineering perspective, as the Powerships and the FSRU are located too close together and would be an issue in terms of navigational aspects. This option is to position the two Powerships closer to the liquid bulk terminal and the FSRU along the curved portion of the eastern breakwater. Refer to Figure 3-5 and Appendix 1.6. The two alternatives, with the preferred position to be agreed with the Port and CDC, are illustrated in the two figures below:



SETTING-OUT POINTS			
	POINT	EASTING (Y)	NORTHING (X)
POLYGON BOUNDARY	P1	-63785.4	3741259.4
	P2	-64197.3	3741341.7
	P3	-64169.2	3741482.6
	P4	-64140.3	3741498.0
	P5	-63776.9	3741425.4
	P6	-63757.3	3741400.1
	P10	-64404.5	3741573.1
	P11	-64599.5	3741543.9
	P12	-64626.7	3741590.4
	P13	-64674.5	3741909.6
	P14	-64555.1	3742306.7
	P15	-64354.0	3742246.5
	P16	-64454.9	3741909.7
SUBSEA PIPELINE	S1	-64588.5	3741750.2
	S2	-64557.7	3741457.2
	S3	-64026.3	3741200.5
	S4	-64012.4	3741333.6
ONSHORE PIPELINE	O1	-64555.4	3741435.3
	O2	-64389.3	3741093.8
	O3	-64217.0	3741124.2
	O4	-64127.6	3741130.4
	O5	-64032.1	3741144.9
FSRU	FB	-64535.1	3741925.2
	FC	-64513.4	3741779.8
	FS	-64491.6	3741634.4
LNGC	CB	-64486.8	3741940.9
	CC	-64465.3	3741797.4
	CS	-64443.8	3741653.9
KPS KHAN	KB	-63833.7	3741352.1
	KC	-63975.4	3741380.4
	KS	-64117.1	3741408.7
KPS SHARK	SB	-63879.9	3741402.8
	SC	-63967.6	3741420.0
	SS	-64055.1	3741437.4
HARTEBEESTHOEK 1994 / Lo 25			

PART	LENGTH / AREA
SUBSEA PIPELINE FROM FSRU	295m
ONSHORE PIPELINE	817m
SUBSEA PIPELINE to POWERSHIP	134m
FSRU / SUBSEA PIPLINE POLYGON	157434m^2
KPS POLYGON AREA	68557m^2

Figure 3-4: Alternative 1 – Preferred: Powerships and FSRU position within the Port – Polygon points

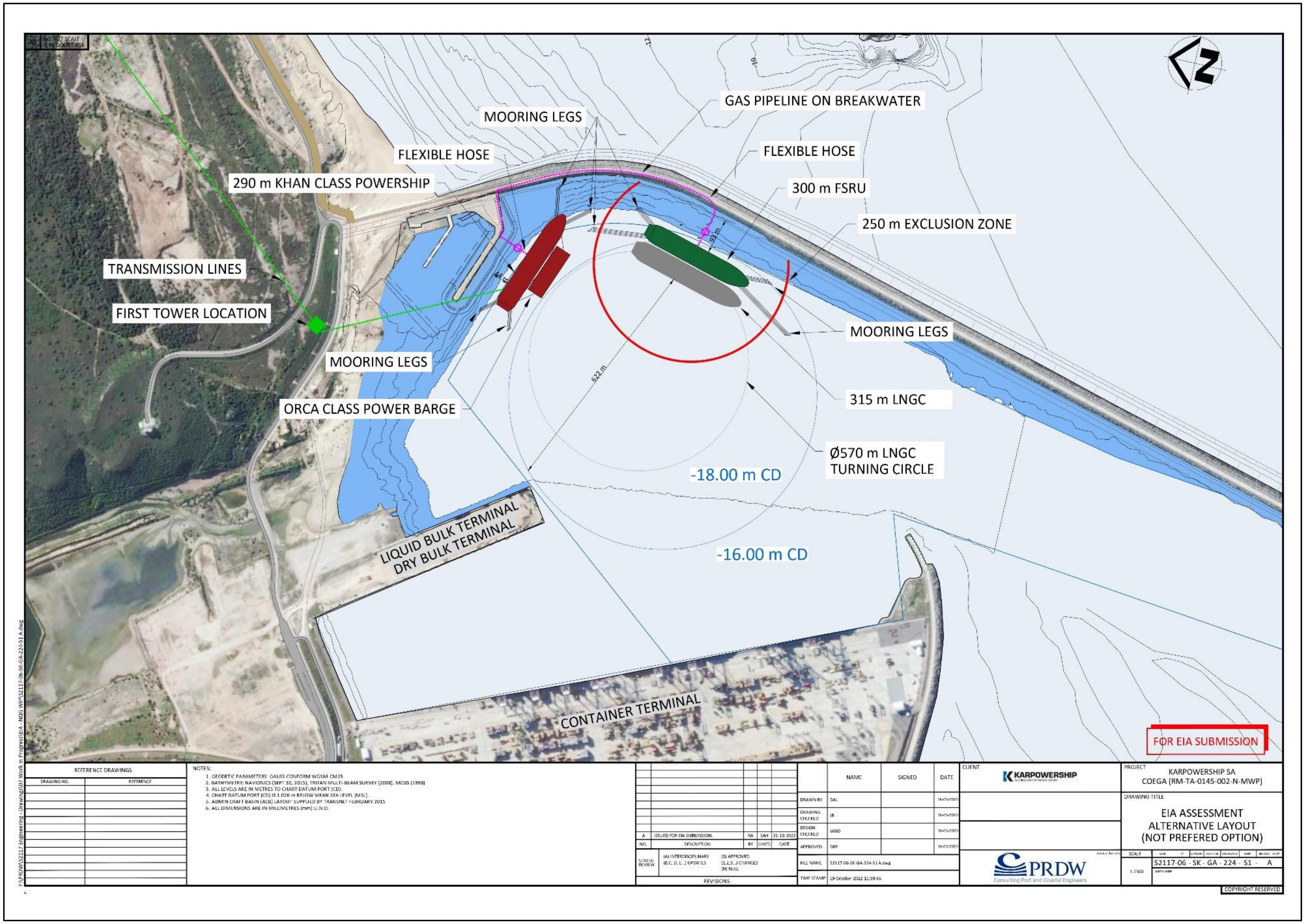


Figure 3-5: Alternative 2: position within the Port.

Table 3-2: Coordinates of Marine Powerships and FSRU – Preferred Alternative 1

SETTING-OUT POINTS		GPS (WGS84)(DEG)							
	POINT	Lng(°E) Deg Dec	Deg	Min	Sec	Lat(°N) Deg Dec	Deg	Min	Sec
POLYGON BOUNDARY	P1	25,688784	25	41	19,62	-33,796113	-33	47	46,01
	P2	25,693238	25	41	35,66	-33,796829	-33	47	48,59
	P3	25,692944	25	41	34,60	-33,798102	-33	47	53,17
	P4	25,692634	25	41	33,48	-33,798242	-33	47	53,67
	P5	25,688704	25	41	19,34	-33,797610	-33	47	51,40
	P6	25,688491	25	41	18,57	-33,797383	-33	47	50,58
	P10	25,695492	25	41	43,77	-33,798903	-33	47	56,05
	P11	25,697595	25	41	51,34	-33,798628	-33	47	55,06
	P12	25,697892	25	41	52,41	-33,799045	-33	47	56,56
	P13	25,698432	25	41	54,35	-33,801920	-33	48	6,91
	P14	25,697172	25	41	49,82	-33,805507	-33	48	19,83
	P15	25,694996	25	41	41,98	-33,804977	-33	48	17,92
	P16	25,696061	25	41	45,82	-33,801935	-33	48	6,96
FSRU	FB	25,696928	25	41	48,94	-33,802069	-33	48	7,45
	FC	25,696683	25	41	48,06	-33,800760	-33	48	2,74
	FS	25,696437	25	41	47,17	-33,799451	-33	47	58,02
LNGC	CB	25,696408	25	41	47,07	-33,802213	-33	48	7,97
	CC	25,696165	25	41	46,19	-33,800921	-33	48	3,32
	CS	25,695923	25	41	45,32	-33,799629	-33	47	58,66
KPS KHAN	KB	25,689313	25	41	21,53	-33,796946	-33	47	49,00
	KC	25,690845	25	41	27,04	-33,797192	-33	47	49,89
	KS	25,692377	25	41	32,56	-33,797439	-33	47	50,78
KPS SHARK	SB	25,689815	25	41	23,33	-33,797400	-33	47	50,64
	SC	25,690763	25	41	26,75	-33,797549	-33	47	51,18
	SS	25,691710	25	41	30,15	-33,797701	-33	47	51,72

Table 3-3: Sizes of Layout Preferred Alternative 1: Powerships, FSRU and LNGC Polygon

PART	AREA
FSRU / SUBSEA PIPELINE POLYGON	157434m^2
KPS POLYGON AREA	68557m^2

Table 3-4: Coordinates for the Powerships – Alternative 2

Powerships	GPS-COORDINATE	
	Longitude	Latitude
Powership Khan and Shark Classes	33°47'55.05"S	25° 41'40.04"E

3.2.2 Layout Alternatives: Gas Pipelines

A gas line is required between the FSRU and Powerships to ensure gas supply for power generation as the Powerships do not store any natural gas aboard.

The subsea pipeline from the FSRU will be installed on the seabed and through the existing revetment. The first leg of the overland pipeline will be installed on plinths above ground between the paved area of the admin craft basin and the crest of the breakwater.

The remainder of the overland pipeline will be trenched alongside the existing access road and crossing the existing entrance to the Admin Craft Basin. The subsea pipeline will be buried through the shore crossing and laid on the seabed connecting the overland pipeline to the Powerships. The horizontal and vertical alignment of the overland pipeline will take existing structures and services as well as safety aspects into consideration.

The gas pipeline connecting the FSRU to the Powerships will be routed along the edge of the existing eastern breakwater and will connect to the vessels via a flexible marine hose. The gas pipeline will likely be mounted on small footings requiring minor civil works to be constructed and installed. There are two proposed alternative routes for the gas pipeline, and these are directly influenced by the selected positions of the Powerships in relation to the position of the FSRU.

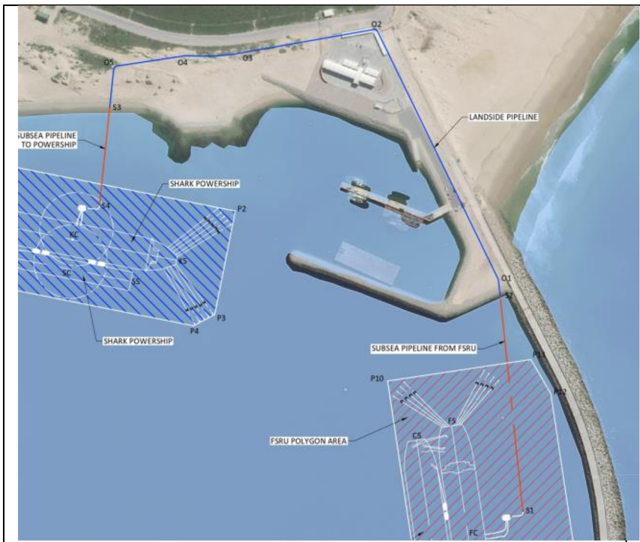


Figure 3-6: Gas pipeline route (Sub-sea - red line); (Onshore – Blue line) – Preferred Alternative 1

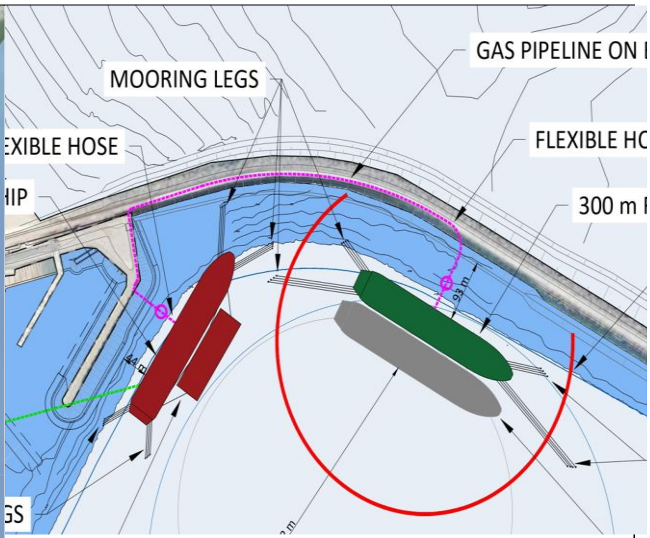


Figure 3-7: Gas pipeline (pink line) – Alternative 2

Alternative 1 of the gas pipeline route (Figure 3-6) is preferred from an engineering perspective, as it is in line with the preferred position (from an engineering design perspective) of the Powerships and the FSRU within the Port, positioning the Powerships in closer proximity to the land and the transmission line

(Powerships position – Alternative 1). From the FSRU, the gas pipeline is routed along the seabed then is taken onshore around the back of the admin craft basin to avoid crossing the basin entrance; the pipeline then crosses the beach onto the seabed to the Powerships. Refer to Appendix 1.5.

Table 3-5: Coordinates of Subsea and Onshore Pipeline – Preferred Alternative 1

SETTING-OUT POINTS		GPS (WGS84)(DEG)							
	POINT	Lng(°E) Deg Dec	Deg	Min	Sec	Lat(°N) Deg Dec	Deg	Min	Sec
SUBSEA PIPELINE	S1	25,697492	25	41	50,97	-33,800488	-33	48	1,76
	S2	25,697137	25	41	49,69	-33,797848	-33	47	52,25
	S3	25,691381	25	41	28,97	-33,795567	-33	47	44,04
	S4	25,691240	25	41	28,46	-33,796768	-33	47	48,36
ONSHORE PIPELINE	O1	25,697111	25	41	49,60	-33,797652	-33	47	51,55
	O2	25,695293	25	41	43,06	-33,794583	-33	47	40,50
	O3	25,693435	25	41	36,36	-33,794868	-33	47	41,52
	O4	25,692470	25	41	32,89	-33,794929	-33	47	41,74
	O5	25,691439	25	41	29,18	-33,795065	-33	47	42,23

Table 3-6: Sizes of Subsea and Onshore Pipeline

PART	LENGTH	DIAMETER	WORKING SERVITUDE
SUBSEA PIPELINE FROM FSRU	295m	24inch equivalent to approx. 60cm (600mm)	50m each side
ONSHORE PIPELINE	817m		0.5 m each side
SUBSEA PIPELINE to POWERSHIP	134m		50m each side

Alternative 2 of the gas pipeline route (Figure 3-7) is aligned to the second alternative of the Powerships positions (further from the shore) and the FSRU. Although this alternative presents a shorter gas pipeline, the position of the Powerships in relation to the shore is feasible but somewhat more challenging from a technical engineering perspective and potential risk is added to navigating vessels from running the evacuation line across the Admin Craft Basin entrance. For these reasons Alternative 2 is not strongly supported from an engineering and risk perspective therefore this alternative less feasible. Refer to Appendix 1.6.

Table 3-7: Coordinates of Subsea and Onshore Pipeline –Alternative 2

Subsea Gas pipeline	GPS-COORDINATE	
	Longitude	Latitude
Gas pipeline Route Alternative 2 - Start point	33°48'1.86"S	25°41'49.66"E
Gas pipeline Route Alternative 2 – End Point	33°47'53.77"S	25°41'36.68"E
Gas pipeline Route Alternative 2 – Mid way point	33°47'55.49"S	25°41'52.69"E

The proposed gas pipeline diameter is 24 inch, equivalent to approx. 60cm (600mm)). It is anticipated that the subsea section of the pipeline will have a servitude of approximately 50m each side. The onshore buried section will require an anticipated servitude of 0.5 m each side.

Contractors Facilities:

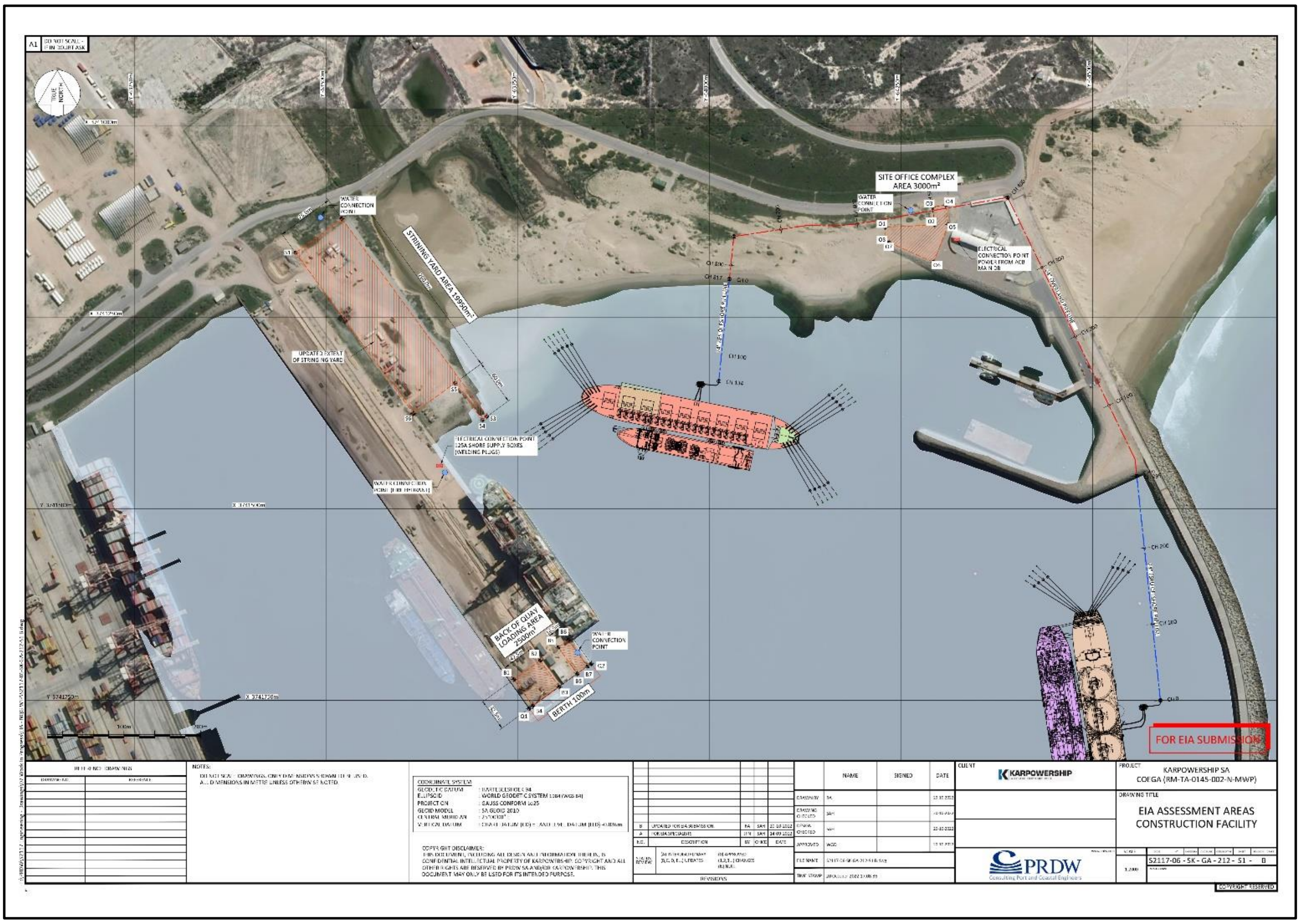


Figure 3-8: Contractors Facilities

Table 3-8: Coordinates of Contractors Facilties

Description	Location	Central Coordinates	Area (m^2)
Stringing Yard	On disturbed and compacted land between the finger jetty and the Coega River Mouth	33°47'46.02"S 25°41'11.20"E	19950
Back of Quay Loading Area	Seaward end of the finger jetty.	33°48'1.23"S 25°41'19.45"E	2500
Site Office Complex	On the beach environment adjacent to the Admin Craft Basin building.	33°47'42.34"S 25°41'38.64"E	3000

Refer to Appendix 1.8 - Construction Laydown Areas and Access Roads

3.2.3 Transmission Lines Alternatives

The electricity generated by the Powerships is converted by a high voltage substation on board the Powerships and transmitted along a 132kV double circuit twin Tern overhead transmission line, approximately 7.4 km in length from Port to the Dedisa Substation, situated within both the Coega SEZ and Transnet properties.

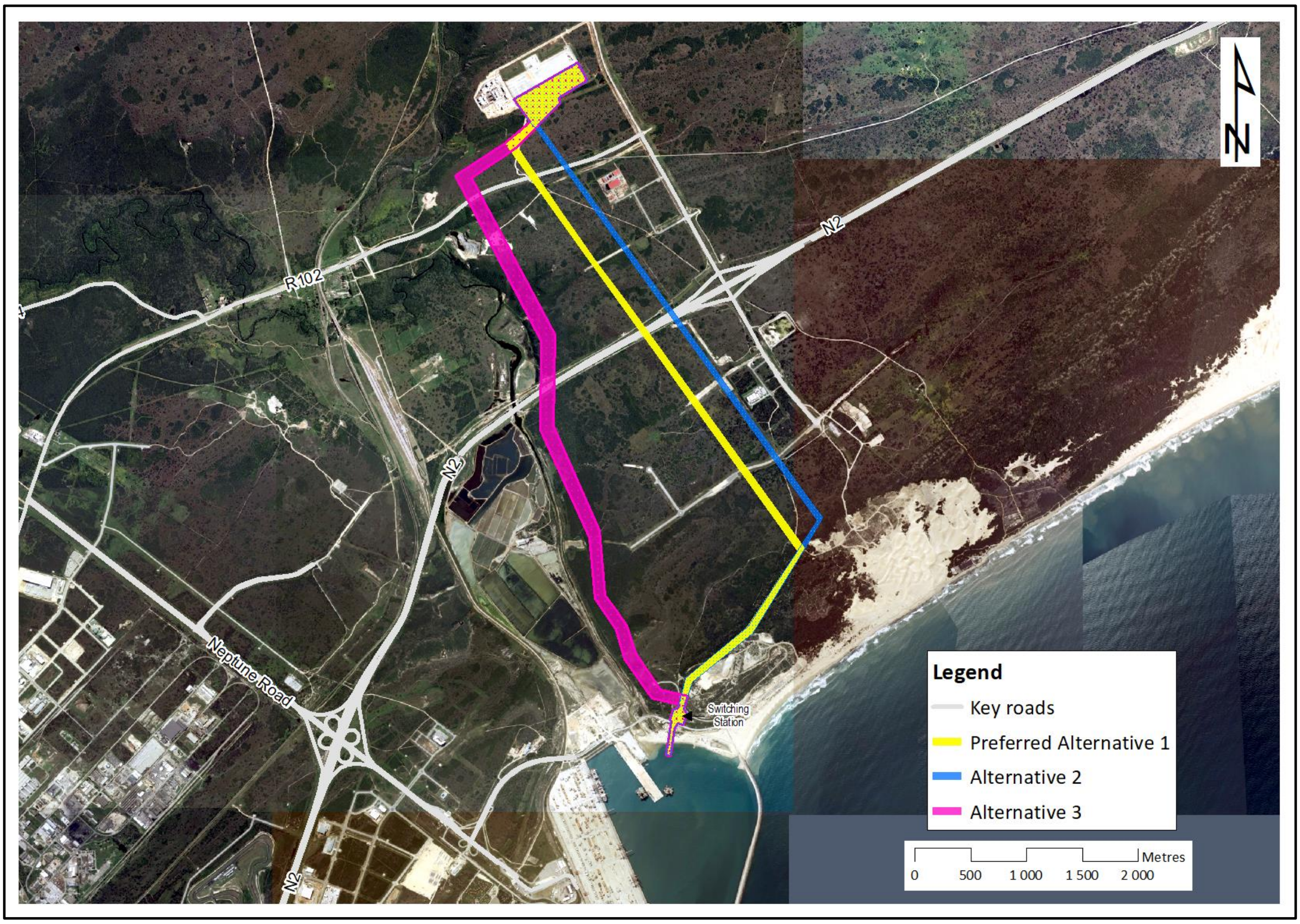


Figure 3-9: Power Evacuation Route Alternatives

As part of the draft EIA report 3 alternatives were considered. Refer to paragraphs below.

Preferred Alternative 1: The electricity that is generated is converted by the on-board High Voltage substation (capacity of 110 – 170kV) will be evacuated via a double circuit twin Tern conductor 132kV transmission line over a distance of approximately 7.4km, from the Port of Ngqura's tie-in point to the Eskom line which is routed on the western side of the services servitude, at a connection point (necessitating a new Saltpan 132kV on shore switching station located adjacent to Klub Road near Port Control in proximity to the existing Dedisa Substation, which feeds electricity into the national grid. This alternative has been indicated as the preferred as result of the following:

- Discussions with CDC have re-iterated that the preferred alignment (refer to Figure 3.9 and Appendix 1.7) to be located on the Western side of the services servitude.
- The CDC requirements i.e. establishment of the alignment on the Western Side is a feasible option and no fatal flaws are associated with this location, as the services servitude is an existing approved servitude for electrical services. Furthermore, two existing authorisations have been granted for this route- refer to Appendix 7.5 – Existing Environmental Authorisations.

The change will not impact the risks assessed as the route alignment is either outside the Specialist's area of assessment e.g. maritime, coastal or estuarine or the impacts assessed will remain the same due to similar topographical and environmental aspects e.g. hydrology – site remains outside the 1:100 year floodline.

Hydrology	The line is outside the 1:100year flood line. Moreover, flooding damage risk is estimated to be zero, based on the flood lines generated.
Geohydrology	No identified high geo-hydrological risks to not proceed with the development of the proposed transmission lines.
Hydropedology	No identified high hydropedological risks to not authorising the proposed transmission lines. The risks are considered low to neutral, and only small areas where pylons are erected will be disturbed.
Coastal and Estuary	No construction related impacts on the estuary are anticipated. As the majority of the infrastructure is proposed to be installed within the already access-controlled Coega IDZ and Port of Ngqura, no further change in coastal access is expected, as access is already restricted. Neither proposed locations of the transmission lines restrict access to the coast nor access routes to the coastline. Coastal access is therefore not highlighted as or rated as an impact.

There will be a slight increase in risk e.g. avifaunal. This can be mitigated and mitigations were provided.

Avifaunal	Powership Preferred Alternative 1. The impact of physical disturbance after mitigation is Low Transmission Preferred Alternative 1 (routed behind the Eastern Reclamation to the electrical services corridor) is the same after mitigation for collisions (Low) and habitat disturbance and fragmentation (Very Low). Alternative 1 is stand-alone prior to the electrical services corridor. Alternative 1 will be the first transmission line along the western boundary of the services corridor and closer to the top of the ridge above the Coega valley, making it slightly more vulnerable to collisions. It is recommended that for Alternatives 1 from the top of the Eastern Reclamation to Dedisa Sub-station, alternating black and white Spiral "pigtail" Bird Flight Diverters be installed on the earth wires as a mitigation measure. There will also be a little more dune thicket habitat loss and Bontveld fragmentation & loss inland of the N2, thus having the same habitat loss impact as Alternative 2.

There will potentially be an increased risk and higher impacts e.g. wetlands and ecological.

Wetland	The western alignment will indirectly impact upon two (2) riverine system and one (1) wetland system. There will be no direct impact to riverine or wetland systems. Thus, the wetland specialist is in support of this route.
Ecological	The majority of the CDC recommended route is located in areas of moderate to high sensitivity within the bontveld of the area. Some sections are located within disturbed vegetation, and these areas are of low sensitivity. However, it should be noted that the CDC recommended route is located to 300m to the west of the Alternative 2 within the same designated transmission line servitude, for which environmental authorisation has been granted. This route is thus considered an option with the preferred route as an alternative.

Alternative 2 Corridor:
Alternatively, the transmission line approximately 7,4km will be routed on the eastern side of the services servitude and will interconnect the Powership to the National Grid utilising the existing Dedisa network via a new Saltpan 132kV on shore switching station. From an engineering perspective, this route is feasible and there are no technical concerns. However, this alternative is least preferred due to the following:

- This route is not aligned with CDC's proposed plans.

Alternative 3 Corridor: The route begins approximately 180m away from the Port of Ngqura and heads in a north-westerly direction for most of the length of the route which crosses several watercourses and adjacent to the transformed Ngqura River, thereafter a small stretch heads in an easterly direction and finally continues in a north-westerly direction before reach its end point at the Dedisa substation. The length of this Powerline is approximately 6.67km in length. This alternative is not supported and has been screened out for the following reasons:

- According to the wetland specialist it was determined at a desktop level that the aforementioned route will be detrimental to several watercourses that it will traverse and in close proximity to the FEPA River (Coega River). Thus, the potential impacts on these watercourses were considered to be too detrimental to these systems, it was therefore the wetland specialist opinion that this route to be deemed unacceptable.
- From an ecological perspective this route is also not favoured as it traverses some undisturbed thicket areas that form important habitats for fauna, many of which are themselves protected species.

Table 3-9: Coordinates for the Transmission line, including alternatives.

Description		**GPS-COORDINATE**			
		Left		**Right**	
		Longitude	**Latitude**	**Longitude**	**Latitude**
Preferred Line Corridor Alternative 1 Length: 7,4km Approx. no. of Towers: 35 Corridor: 50m Working servitude: 31m	**Start**	25°41'22.72"E	33°47'48.58"S	25°41'24.36"E	33°47'48.70"S
	Bend 1	25°41'24.45"E	33°47'38.58"S	25°41'26.37"E	33°47'39.19"S
	Bend 2	25°41'29.21"E	33°47'26.13"S	25°41'31.79"E	33°47'27.18"S
	Bend 3	25°41'50.70"E	33°47'11.04"S	25°41'52.46"E	33°47'12.96"S
	Bend 4	25°42'7.84"E	33°46'48.91"S	25°42'10.51"E	33°46'48.06"S
	Bend 5	25°40'25.15"E	33°44'51.00"S	25°40'29.78"E	33°44'52.07"S
	Bend 6	25°40'40.37"E	33°44'40.70"S	25°40'44.19"E	33°44'39.20"S
	End	25°40'39.06"E	33°44'36.45"S	25°40'39.49"E	33°44'36.25"S
Alternative Line Corridor 2 Length: 7,4km Corridor: 50m Working servitude: 31m	**Start**	25°41'22.72"E	33°47'48.58"S	25°41'24.36"E	33°47'48.70"S
	Bend 1	25°41'24.45"E	33°47'38.58"S	25°41'26.37"E	33°47'39.19"S
	Bend 2	25°41'29.21"E	33°47'26.13"S	25°41'31.79"E	33°47'27.18"S
	Bend 3	25°41'50.70"E	33°47'11.04"S	25°41'52.46"E	33°47'12.96"S
	Bend 4	25°42'7.84"E	33°46'48.91"S	25°42'10.51"E	33°46'48.06"S
	Bend 5	25°42'14.71"E	33°46'40.15"S	25°42'16.77"E	33°46'39.18"S
	Bend 6	25°40'34.06"E	33°44'44.81"S	25°40'36.92"E	33°44'45.69"S
	Bend 7	25°40'40.37"E	33°44'40.70"S	25°40'44.19"E	33°44'39.20"S
	End	25°40'39.06"E	33°44'36.45"S	25°40'39.49"E	33°44'36.25"S
Alternative Line Corridor 3 Length: 6,67km	**Start**	25°41'22.72"E	33°47'48.58"S	25°41'24.36"E	33°47'48.70"S
	Middle	25°40'38.25"E	33°46'14.36"S	25°40'42.83"E	33°46'13.21"S
	End	25°40'39.06"E	33°44'36.45"S	25°40'39.49"E	33°44'36.25"S

A transmission line corridor will allow for technical construction requirements to be maintained on site, and the corridor was determined in consideration with sensitivities on site.

Saltpan Switching Station:

The electricity generated on the ship is required to be integrated into the Eskom National grid via a switching station. The location of the switching station is located on-shore adjacent to Klub Road near Port Control. The switching station is part of the Eskom self-build process and will be built by Karpowership and handed to Eskom for their ownership and operation. The switching station will facilitate the control of the incoming lines from the Powership and the outgoing lines to the Dedisa network.

The switching station will measure approximately 9775m^2 in size and will comprise of an incoming circuit for the lines from the ship, a busbar system to distribute the power and an outgoing circuit for the power to Eskom. The switching station further comprises of landing gantries, breakers, isolators, current transformers, voltage transformers and a control room for the monitoring, measurement and control of the power.

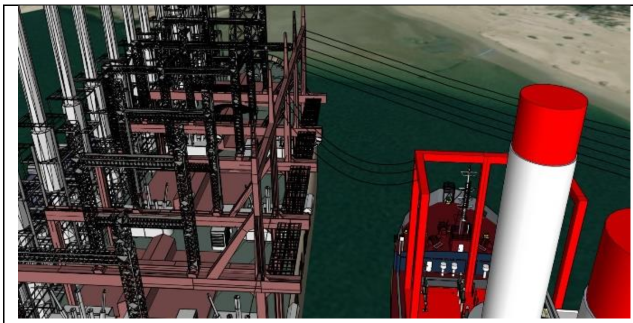
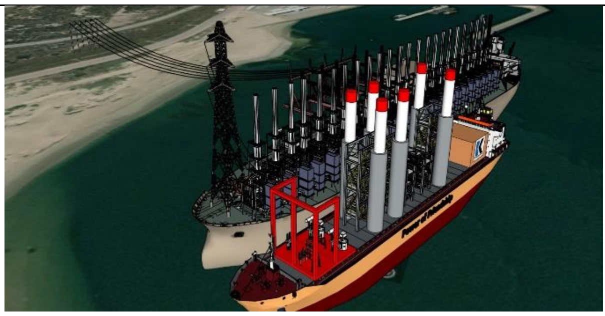
Table 3-10: Coordinates for the Switching Station

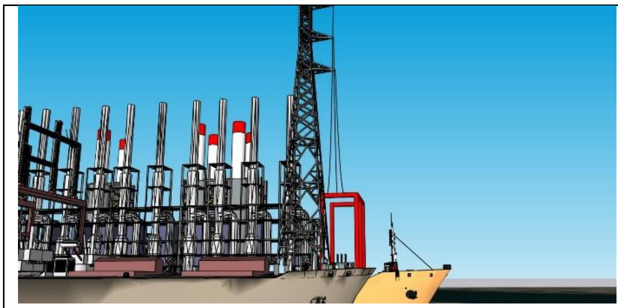
Saltpan Switching Station			
Corner	**Longitude**	**Latitude**	**Area**
1	25°41'24.05"E	33°47'38.40"S	9775m^2
2	25°41'25.09"E	33°47'35.44"S	
3	25°41'32.27"E	33°47'37.72"S	
4	25°41'31.14"E	33°47'40.50"S	
Midpoint	25°41'27.79"E	33°47'37.75"S	

Powerline between Ships

Power will be transferred from the Shark Class Powership to the Khan Class Powership via an overhead connection to the towers which are already existing on the Powerships. The overhead line will span approximately 50m between the ships. Please note that these images below are schematic, not to scale and for illustrative purposes only.

Table 3-11: Schematic Illustrations: Powerline between Ships

	
Khan to Shark bow – bow gantry 132kV interconnection	Khan to Shark bow – bow gantry 132kV interconnection and Starboard tower interconnection



Khan to shark 132kV interconnection side view

Shark to Khan 132kV interconnection option

Shark to Khan bow gantry to tower 132kV interconnection

3.2.4 Design Alternatives: Transmission Tower

The proposed transmission line can be constructed of either monopole or lattice steel construction, based on the final engineering design requirements, the topography and geotechnical survey results.

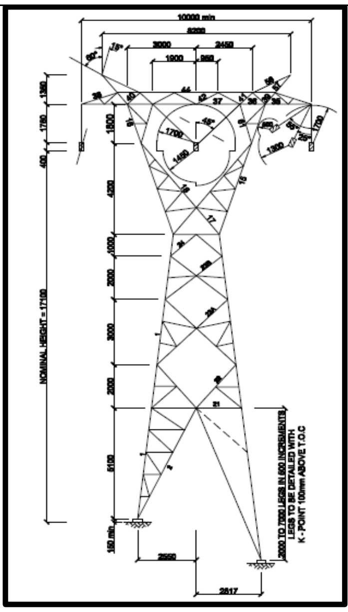


Figure 3-10: Typical 132kV single circuit lattice steel tower

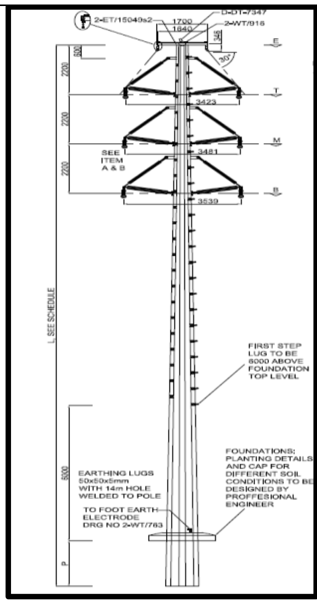


Figure 3-11: Typical 132kV Monopole Suspension

3.2.4.1 Lattice

The construction of lattice tower designs are least preferred due to the following:

- As the extent of the lattices' footprint is much bigger than the monopoles, the monopoles are the preferred options.
- Larger clearance of vegetation required;
- Higher vertical risk area to flying birds.
- Lattice towers are more costly and visually-intrusive than other tower types.

This alternative has been screened out and not assessed in the impact assessment.

3.2.4.2 Monopole

The construction of a monopole design is preferred based on the following:

- The footprint occupied by a monopole, compared to a lattice structure of the same capacity, is far less.
- Reduced clearance of vegetation required;
- As the number of components used in monopoles are much lesser than those used in lattice tower structures, the installation time is much lower.
- Due to its built-in flexibility and lower aerodynamic coefficient, poles are subject to lesser wind load as compared to the conventional tower structures.
- Occupying lesser space makes monopoles look aesthetically smarter.
- Since poles are more continuum-type structures, they offer more resistance to vandalism.

There are some disadvantages associated with the monopole design such as:

- Monopoles require heavy cranes for their deployment and installation.

3.2.5 Technology Alternatives: Fuel

3.2.5.1 Natural Gas (Preferred & Current)

The Powerships are designed to use Natural Gas, a cleaner burning fuel for the cost effective generation of power, as opposed to coal-fired power stations which are associated with significant air pollution as a result of the coal-fired combustion. Natural gas emits between 45% and 55% fewer greenhouse gas emissions and less than one-tenth of the air pollutants than coal when used to generate electricity (Shell SA, Media Release, 2020).

The use of natural gas to generate electricity, which is what the Powerships technology is designed to do, is the preferred alternative for power generation.

3.2.5.2 Hydrogen (Future)

The Powerships to be deployed will generate electricity using Wärtsilä engines running exclusively on natural gas. Wärtsilä conducts extensive research on the use of different fuel sources within its engines, improving and optimising their technology to future-proof and deliver leading efficiency. Wärtsilä have made significant progress on the possibility of using hydrogen gas to power with their engine technology; whilst it is already technically possible to utilise a mix of hydrogen with natural gas, this technology is in its infancy and is undergoing rigorous research and development for pure hydrogen operations, and outcomes of that R&D are anticipated within the coming years.

In the medium to longer term, green hydrogen or other sources of hydrogen may potentially be more environmentally suitable from a climate change perspective, especially when combined with carbon capture during production, but suitable safety precautions, including accidental release measures, will need to be developed due to hydrogen's hazard classification; hydrogen is an extremely flammable gas that also carries significant risk of explosion when heated. Karpowership's partnership with Wärtsilä is beneficial as the engine driven power plants would practically ease the transition from natural gas to hydrogen (or a mix of natural gas and hydrogen) if and when the option becomes commercially viable for implementation on the utility scale of the Project, to avoid any possibility of stranded assets, as technologies change and fossil fuels continue on the path of phase out. This future alternative will be investigated via a separate environmental process to assess all aspects that could impact on the environmental as well as socio-economic aspects with due consideration of the known risks, at an appropriate time when the feasibility of hydrogen fuelled power generation has sufficiently matured.

3.2.6 No-go option

The option of not implementing the Project, i.e. the "no-go" option, was considered as an alternative. In respect of the Project, it would mean that the existing status quo would prevail. While the benefit of this option is that there will be no negative environmental or social impacts, there will also not be any positive environmental or socio-economic benefits.

This alternative entails that the proposed gas-to-power facility would not become part of the RMI4P to provide dispatchable power to the national grid in order curtail the disastrous effects of loadshedding resulting in the down-wind spiralling effect on the economy and general decline of individual well-being. The opportunity to utilise gas as a cleaner, greener fuel in the just transition from coal and more polluting energy sources will remain unexplored.

The no-go alternative provides the baseline against which the other alternatives are assessed, taking into consideration both the micro and macro aspects related to the purpose of the project.

The project is proposed on the western side of the breakwater infrastructure within the active Port of Nqgura and the Coega Industrial Corporation which is earmarked and designated as an area for rapid economic development and industrialization. Further development and increased economic activity are keenly sought in the surrounding area. A number of energy related activities and port activities with possible expansions have already been planned for the future. The zonings relate to industry and commercial activities. The power evacuation is proposed within the existing servitude of the CDC where existing powerlines occur and further powerlines are planned as per the existing environmental authorisation.

The establishment of the no-go alternative as far as it relates to the powerline within the CDC servitude, is not realistic in the context of the existing infrastructure and authorised future infrastructure. The establishment of powerlines within the services servitudes has already been determined to be a preferred alternative to no development in the existing authorisation. There is however a small 132kV footprint area within the CDC area that will be situated outside the services servitude, but the lay-out for this section was planned within the approved operational footprint of the CDC and along existing infrastructure areas outside the protected Coega Open Space Bontveld.

Further ecological research (arising from long-term monitoring of the Project) is desperately needed to understand the reasons for the decline of the local penguin population, as well as to improve the management of marine protected areas. In addition, the Project will contribute to the prevention of environmental degradation in rural and poor / disadvantaged communities which would, in the absence of a reliable electricity supply, have to revert to the destruction of flora for cooking and heating purposes. This would impact negatively on air quality. Prolonged loadshedding will further exacerbate these impacts. Adequate electricity provision also reduces potential environmental pollution associated with, for instance, raw sewage pumpstation overflows, the inadequate treatment of sewage, and the generation of poor quality final effluent from sewage treatment works, which is discharged into freshwater systems and ultimately discharged into the ocean. Such discharges destroy both freshwater and marine ecosystems not only due their toxicity levels, but also due to high oxygen demand. Within the commercial and more affluent residential communities a more common method of dealing with loadshedding is by the operation of diesel generators. This too results in negative air quality impacts with accompanying increased sulphur dioxide, oxides of nitrogen and particulate matter levels as well as noise pollution. In contrast, the Project will result in insignificant sulphur dioxide and particulate matter levels which can be properly monitored and managed. It is only the very affluent households and businesses which can presently invest in solar power alternatives and therefore natural gas generated energy as a transitional and alternative fuel to coal and diesel, is preferred from an environmental perspective.

The following table presents the key Local and National considerations for the no-go option at the proposed Port of Nqgura:

Table 3-12: Local and National considerations for the no-go option

Considerations For the No-Go:	Considerations Against the No-Go
▪ Low risk to African Penguins in terms of the impacts on feeding and breeding grounds. ▪ Medium impacts to coastal and marine ecosystems will not occur. ▪ Low risks from ship-to ship transfer of LNG and NG will be avoided. ▪ Low visual impacts (due to shipping being aligned with the Port operations) will not occur. ▪ Climate change impacts originating from the generation of gas to power as per the proposed project will not occur. ▪ Medium-low impacts of the overhead transmission line between the ship and the Eastern reclamation will not occur. ▪ High socio-economic impacts from influx of people looking for work opportunities may not occur.	▪ Port operations as well as the CDC will continue to seek economic development and levels of impacts will occur irrespective of the presence or absence of the project due to the nature and intent of these facilities. ▪ Impacts to the environment will occur as a direct result of loadshedding and poverty resulting in the destruction of flora and uncontrolled release of fugitive emissions. ▪ Ambient and underwater noise impacts to Avifaunal at Jahleel Island will not occur from the generation of power at the Powership. ▪ Climate change and air quality impacts due to reliance on coal based power generation as well as the use of wood, paraffin or coal based fires for cooking and heating and diesel-powered generators to sustain business and individual households and living will continue. ▪ No additional dispatchable power will be generated and supplied to the National grid and loadshedding that could have been reduced will be present. ▪ The significant economic losses (approximately R1 billion rand for 1 day of loadshedding) will not be reduced (BusinessTech, 2022b). ▪ The opportunity through new technology gas to power electricity generation, that can pave the

Considerations For the No-Go:	Considerations Against the No-Go
	way to a just transition, aligned with South Africa needs as a developing country, will be lost. ▪ No direct skilled and unskilled employment opportunities will be created during the construction and operation phase. ▪ Opportunities for research to improve environmental understanding through dedicated and ongoing monitoring with continued and long term strategies to improve biodiversity will be lost. ▪ Socio-economic and enterprise development initiatives with the generation of new business and social upliftment will not be realised.

While the no-go alternative will not result in any direct negative environmental impacts from the gas-to power project, it will also not result in any positive indirect environmental benefits or direct and indirect socio-economic benefits. The status quo cannot be assumed to be environmental and socio-economically neutral as the micro and macro environmental and economic conditions will continue to result in both positive and negative impacts to the environment, economy and society regardless of whether the proposed project is developed or not.

In addition, the status quo may be unsustainable, if not simply unjust, and in this instance may prevent already marginalised communities from accessing power as the constrained national grid may fail and result in even more intense loadshedding. Alternatives such as generators or household / rooftop solar systems may not be financially viable and women and children will have to revert to practices of burning biomass and cooking over open fires to provide food for the family. Similarly, a reversion to the use of candles or paraffin sources would be necessary in order to do homework and participate in further education.

The no-go option will also not assist government in addressing its set target for a sustainable energy supply mix, nor will it assist in supplying the increasing electricity demand within the country. It will also not contribute further to the local economy by provide employment opportunities. Hence the “no-go” alternative is not the preferred alternative.

The highly significant positive socio-economic impacts will not be realised in the case of the no-go option, thereby impeding the socially just transition for the poor, the unskilled workforce and marginalised individuals, as well as retarding Government’s target for a sustainable energy supply mix. Further, dispatchable power to the national grid to meet existing as well as increased electricity demand within the country will not be available to prevent the inevitable catastrophic economic decline associated with loadshedding resulting from the widening electricity deficit. Continued loadshedding will negatively impact on the wellbeing of the majority of the SA population, on the economy as a whole as well as on local and international investor sentiments.
Opportunities to stimulate the economy through employment, social development programmes, bursaries for education, other educational programmes, skills development programmes and procurement from local suppliers will be lost while the broader economic sectors such as industry, tourism, and entertainment will also remain growth constrained. Moreover, individuals and especially the disadvantaged and marginalised will have to face increasing risk to their livelihoods and job security.

When the minimal potential environmental and socio-economic risk, with mitigation, is compared against the potential environmental and socio-economic benefits, there is simply no contest - the social and economic benefits vastly outweigh the mitigated environmental and socio-economic impacts.

The no-go option is thus inconsistent with the principle of sustainable development. It is thus the reasoned opinion of the EAP that the proposed 540MW Gas to Power Powership Project, should be authorised subject to the conditions proposed in Section 9 which include compliance with the EMPr. Hence the “no-go” alternative is not recommended.

4 POLICY AND LEGISLATIVE FRAMEWORK

4.1 NATIONAL REGULATORY FRAMEWORK

EIA Regulations, Appendix 3 - 3(1)- (e) a description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context.

The section below describes the policy and legislative context within which the proposed development is located, and how the proposed development complies with and responds to the legislation and policy context. In addition, specialists had considered and indicated relevant legislations, guidelines and policies in their respective studies.

4.1.1 National Legislation

The Constitution of the Republic of South Africa, 1996 ("**Constitution**") is the supreme law of the Republic. Any law or conduct inconsistent with it is unlawful and the obligations imposed by it must be fulfilled.

Chapter 2 of the Constitution contains the Bill of Rights, one of which is Section 24 which states:

- everyone has the right to an environment that is not harmful to their health or well-being; and

- The environment must be protected for benefit and use of present and future generations, through reasonable legislative and other measures that:
  - prevent pollution and ecological degradation;
  - promote conservation; and
  - secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

The NEMA does not prohibit development from taking place- rather it provides that projects must be sustainable and the impacts thereof must be assessed and minimised.

NEMA prohibits a person from commencing a listed activity without environmental authorisation. The Project triggers several activities listed in the EIA Regulations Listing Notices 1, 2 and 3 of 2014 (as amended) ("**Listing Notices**"). The procedural requirements for such an application and associated EIA that needs to be undertaken, are prescribed by the EIA Regulations, 2014 (as amended) ("**EIA Regulations**") and informed by guidelines published in terms of Section 24J of NEMA as well as applicable protocols and minimum information requirements.

In addition, the Project triggers an activity listed under the National Environmental Management: Air Quality Act 39 of 2004 (NEMAQA) which requires an atmospheric emission licence (AEL). The same EIA process prescribed by the EIA Regulations, 2014 needs to be applied to the AEL application, with a number of additional requirements set out in NEMAQA and its Regulations.

As part of the Environmental Impact Assessment ("**EIA**") process, Regulation 3(1)(e) of the EIA Regulations, 2014 (as amended) ("**EIA Regulations**") requires that a description of the policy and legislative context within which the development is proposed be reported on in the EIA Report, including an explanation of how the proposed development complies with and responds to such legislation and policy context. This includes an identification of applicable legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments. This section has been prepared to satisfy that requirement.

The below is a description of the national, provincial and local (municipal) policy and legislative landscape that must be considered and provides a brief explanation of how the proposed Project will address the legislative requirements.

National Environmental Management Act 107 of 1998

Legislation	**Section**	**Relates to**
National Environmental Management Act 107 of 1998	NEMA aims to provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state; to provide for certain aspects of the administration and enforcement of other environmental management laws; and to provide for matters connected therewith.	
	Section 2	Defines sustainable development and other principles that apply throughout South Africa to the actions of all organs of State that may significantly affect the environment.
	Chapter 5	Provides for integrated environmental management including the prohibition, restriction and control of activities which are likely to have a detrimental effect on the environment.
	Section 28	Contains the important "duty of care" which provides that the developer has a general duty to care to the environment to avoid environmental degradation and where such degradation cannot be avoided to minimise the impacts.
	Section 30	Deals with the control of emergency incidents, including the different types of incidents, persons responsible for the incidents and reporting procedures to the relevant authority.
Relevance to the Proposed Project, Compliance and Response:		
NEMA provides set requirements and thresholds which are created to give effect to the principles detailed in Section 2. NEMA prohibits a person from commencing a Listed Activity without an environmental authorisation. These Listed Activities are found in the EIA Regulations Listing Notices 1, 2 and 3 of 2014 (as amended) ("**Listing Notices**"). The Listing Notices describe the activities that require either a Basic Assessment (applies to activities in Listing Notices 1 and 3)), or Scoping and Environmental Impact Reporting ("**S&EIR**") (applies to activities in Listing Notice 2)). All listed activities that are triggered in the above listing notices need to be assessed in the assessment report – refer to Section 2.2. The proposed Project triggers several activities listed in the Listing Notices. The procedural requirements for such an application and associated EIA are prescribed by the EIA Regulations, 2014 (as amended)		

("**EIA Regulations**") and are further informed by Guidelines published in terms of Section 24J of NEMA as well as applicable protocols and minimum information requirements.
 	
Because the proposed Project triggers activities in Listing Notice 2, the application for an environmental authorisation is subject to the S&EIR process for all activities, including those listed under Listing Notice 1 and 3. As set out by Section 24C of the NEMA, the relevant competent authority for this activity is DFFE.
 	
Section 24J of NEMA prescribes that any Guidelines which are relevant, must be used to inform the environmental assessment of the proposed Project. The relevant Guidelines applied are:
Public Participation guideline in terms of NEMA EIA Regulations, Department of Environmental Affairs ("**DEA**") [1]
- (2017), Pretoria, South Africa.
  o This Guideline details and explains the minimum requirements for Public Participation ("**PP**") in an EIA process.
 	
- Guideline on Need and Desirability, DEA (2017), Pretoria, South Africa
  o This Guideline explains how Need and Desirability for a proposed project are detailed in an EIA.
The applicable protocols and minimum information requirements which have been applied to this Project include:
- Procedures for the assessment and minimum criteria for reporting on identified environmental themes when applying for environmental authorisation (GN320 in GG 43110 of 20 March 2020; and GN 1150 of GG 43855 of 30 October 2020).
  o These prescribe protocols in respect of specific environmental themes for the assessment of, as well as the minimum report content requirements on, the environmental impacts for activities requiring environmental authorisation.
The EIA process for this proposed Project complies with the requirements of NEMA, the EIA Regulations, the Procedures, and takes into account the Guidelines.
The Environmental Management Programme ("**EMPr**") details all practical steps to be taken to both reduce environmental and social impacts, but also all steps to mitigate any foreseen impacts.

National Environmental Management: Waste Act 59 of 2008 ("NEMWA") and its associated subordinate legislation

Legislation	**Section**	**Relates to**
National Environmental Management: Waste Act 59 of 2008	Sections 16 – 18, 21 – 27, 35 - 41, 60	Provides for general waste management measures; the remediation of contaminated land and reporting.
	Sections 19, 20, 43 – 59	Listed waste management activities, consequences and requirements for waste management licensing
Relevance to the Proposed Project, Compliance and Response:		

[1] Note, references to "Department of Environmental Affairs ("DEA"), or the Department of Environment, Forestry and Fisheries ("DEFF") are the erstwhile names of the current Department of Fisheries, Forestry and Environment ("DFFE").

A number of regulations and standards regulating waste management have been published under NEMWA and updated to Government Gazette 46602 dated 24 June 2022. including: ▪ List of waste management activities that have, or are likely to have, a detrimental effect on the environment, 2013 (as amended) ▪ National Waste Management Strategy, 2020 ▪ Waste Classification & Management Regulations, 2013 ▪ National Norms & Standards for the Assessment of Waste for Landfill Disposal, 2013 ▪ National Norms & Standards for Disposal of Waste to Landfill, 2013 ▪ National Norms and Standards for the Remediation of Contaminated Land and Soil Quality, 2014 The EMPr contains numerous impact assessment outcomes and actions that include waste management measures to ensure that: ▪ All reasonable measures must be taken to avoid the generation of waste and where such generation cannot be avoided, minimise the toxicity and amounts of waste that are generated; reduce, re-use, recycle and recover waste; where waste must be disposed of, ensure that the waste is treated and disposed of in an environmentally sound manner; ▪ Waste is managed in such a manner that it does not endanger human health or the environment or cause a nuisance through noise, odour or visual impacts; ▪ Any employee or any person is prevented from contravening this Act; and that the waste is prevented from being used for an unauthorised purpose; The proposed Project does not trigger any listed activities (under Categories A and B) of this Act and as such does not require a Waste Management Licence.

National Environmental Management: Air Quality Act 39 of 2004 ("NEMAQA") and its associated subordinate legislation

Legislation	Section	Relates to
National Environmental Management: Air Quality Act 39 of 2004	Provides for the protection of the environment by regulating air quality in order to prevent air pollution.	
	Sections 21, 22, 22A	Sections 21, 22, 22A
	Sections 23-25	Controlled emitters
	Section 32	Control of dust
	Section 34	Control of noise
	Section 35	Control of offensive odours
Relevance to the Proposed Project, compliance and response:		
A number of regulations and standards regulating air quality have been published under NEMAQA. including: ▪ National Ambient Air Quality Standards, 2009 ▪ National Ambient Air Quality Standard for Particulate Matter of Aerodynamic Diameter less than 2.5 micron metre (PM2.5), 2012 ▪ Declaration of a Small Boiler as a Controlled Emitter and Establishment of Emission Standards, 2013 ▪ National Dust Control Regulations, 2013 ▪ Listed Activities and Associated Minimum Emission Standards 2013 (amended)		

▪ Regulations regarding Air Dispersion Modelling, 2014 National Atmospheric Emission Reporting Regulations, 2015 ▪ National Atmospheric Emission Reporting Regulations, 2015 ▪ National Greenhouse Gas Emissions Reporting Regulations, 2016 (amended)Declaration of greenhouse gases as priority air pollutants, 2017 ▪ National Pollution Prevention Plans Regulations, 2017 (amended) (including the Regulations prescribing the format of the Atmospheric Impact Report (2013) and; ▪ Regulations regarding the phasing-out and management of ozone-depleting substances (2014); ▪ Amendments to the Regulations regarding the Phasing-Out and Management of Ozone Depleting Substances (2021) The proposed project requires an Atmospheric Emission Licence. The appointed specialist has applied the air dispersion modelling requirements in air quality specialist study and recommendations made therein will be carried through to the EMPr. GHG emission have also been assessed.

Carbon Tax Act 15 of 2019 and its associated subordinate legislation

Legislation	Section	Relates to
Carbon Tax Act 15 of 2019	Provides for the implementation of a taxation system for emitters of GHG's	
	Sections 2 - 6	Determining of tax, tax base and calculation thereof
	Section 18	Reporting
Relevance to the Proposed Project, Compliance and Response:		
As the proposed project will release GHG's and will require an Atmospheric Emission License, the proposed project will be subject to the Carbon Tax Act and its relevant Regulations.		

Marine Living Resources Act 18 of 1998

Legislation	Section	Relates to
Marine Living Resources Act (Act 18 of 1998) amended 2000	Regulates the utilization, conservation and management of marine living resources and the need to protect whole ecosystems, preserve marine biodiversity and minimize marine pollution.	
Relevance to the Proposed Project:		
The Act requires the sustainable utilisation of marine resources. Due to the project being located in the Port of Ngqura, all reasonable measures must be taken to avoid marine pollution that may affect marine living resources.		

Marine Living Resources Amendment Act 5 of 2014

Legislation	Section	Relates to
Marine Living Resources Amendment Act 5 of 2014	Amends the Marine Living Resources Act (1998), so as to insert, amend or delete certain definitions; to amplify the objectives and principles provided for in the MLRA (1998); to make provision for measures relating to small-scale fishing and for the powers and duties of the Minister in this regard; to effect technical amendments; and to provide for matters connected therewith.	
Relevance to the Proposed Project:		
This Amendment Act assists in defining and identifying important I&APs in the PPP.		

National Environmental Management: Integrated Coastal Management Act 24 of 2008

<table>
<tr><th>Legislation</th><th>Section</th><th>Relates to</th></tr>
<tr><td rowspan="4">National Environmental Management: Integrated Coastal Management Act 24 of 2008, as amended by Amended by the National Environmental Management: Integrated Coastal Management Amendment Act, No. 36 of 2014</td><td>Section 2</td><td>Provides for the preservation, protection and enhancement of the status of coastal public property, and secure equitable access to the opportunities and benefits of coastal public property.</td></tr>
<tr><td>Section 13</td><td>Persons right of reasonable access to coastal public property as well as the entitlement to use and enjoy coastal public property.</td></tr>
<tr><td>Section 58</td><td>Duty to avoid causing adverse effects on coastal environment</td></tr>
<tr><td>Section 69</td><td>Stipulate requirements for permits to discharge effluent that originates from a source on land into coastal waters.</td></tr>
<tr><td colspan="3">Relevance to the Proposed Project, Compliance and Response:</td></tr>
<tr><td colspan="3">The discharge of cooled water from the Powership operations is from the moored Powerships into the sea, i.e. there is no discharge from land-based activities, and therefore a coastal waters discharge permit is not required.
Measures to protect the coastal environment by mitigating impacts and responding to emergency incidents are contained in the EMPr.
Further, discharge temperatures will conform to the current guideline, the South African Water Quality Guidelines for Coastal Marine Waters, Volume 1, Natural Environment and Mariculture Use (2018), i.e. the impact of the discharge temperatures must be assessed and impacts on receptors defined in the EIA</td></tr>
</table>

National Water Act 36 of 1998

<table>
<tr><th>Legislation</th><th>Section</th><th>Relates to</th></tr>
<tr><td rowspan="4">National Water Act 36 of 1998</td><td colspan="2">Regulates the protection, use, development, conservation, management and control of fresh water resources.</td></tr>
<tr><td>Section 19</td><td>Prevention and remedying the effects of pollution</td></tr>
<tr><td>Section 20</td><td>Control of emergency incidents</td></tr>
<tr><td>Section 21</td><td>Permissible water use, including discharge & abstraction and development within 500m of a watercourse (including wetlands).</td></tr>
<tr><td colspan="3">Relevance to the Proposed Project, Compliance and Response:</td></tr>
<tr><td colspan="3">The Department of Water and Sanitation has confirmed that the water uses associated with the project fall under General Authorisation and therefore a water use licence is not required. A General Authorisation (Register No: 28098406) was issued on the 30 April 2021.

Measures to protect water resources by mitigating impacts and responding to emergency incidents are contained in the EMPr.</td></tr>
</table>

National Forest Act 84 of 1998

Legislation	Section	Relates to

National Forest Act 84 of 1998	Section 12	Provides for protection, control and licencing for cutting, disturbing, damaging or destroying protected trees
Relevance to the Proposed Project, Compliance and Response:		
If any protected trees in terms of this Act occur on site, the developer will require a licence from the DFFE to perform any of the above-listed activities. The CDC has a permit from DFFE for the removal of protected trees in all developable land within the SEZ. This permit is renewed annually.		

National Environmental Management: Biodiversity Act 10 of 2004

Legislation	Section	Relates to
National Environmental Management: Biodiversity Act 10 of 2004: Threatened or Protected Species Regulations and lists (2007 & 2017 (marine)); Alien and Invasive Species Regulations and lists (2020)	Provides for the management and conservation of biodiversity, protection of species and ecosystems, and sustainable use of indigenous biological resources, including threatened and protected species and ecosystems, and invasive and alien species	
Relevance to the Proposed Project, Compliance and Response		
The EIA, including specialist studies and the EMPr identifies impacts and contains mitigation measures to: ▪ avoid or minimise impacts on protected and threatened ecosystems and species to protect biodiversity; ▪ Identify permit requirements without which protected species may not be removed or damaged; ▪ Keep the proposed site and transmission routes clear of alien and invasive vegetation using appropriate means.		

National Environmental Management: Protected Areas Act 31 of 2004

Legislation	Section	Relates to
National Environmental Management: Protected Areas Act (31 of 2004)	Provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. Promotes sustainable utilisation of protected areas for the benefit of people, in a manner that would preserve the ecological character of such areas.	
Relevance to the Proposed Project, Compliance and Response		
The gas pipeline connecting the FSRU to the Powerships will be routed along the edge of the existing eastern breakwater and will connect to the vessels via a flexible marine hose. This location is approximately 1km away from the Jahleel Island. The breakwater will act as a natural buffer to operations occurring at the Port in relation to the island.		

National Environmental Management: Protected Areas Act (31 of 2004) - Strategy on Buffer Zones for National Parks (106 of 2012)

Legislation	Section	Relates to
National Environmental Management: Protected Areas Act (31 of 2004) -	Defines buffer zones to protect important areas of high value for biodiversity and/or to society where these extend beyond the boundary of	

Strategy on Buffer Zones for National Parks (106 of 2012)	the Protected Area; and stipulate legal requirements for developments within formally established buffer zone.
Relevance to the Proposed Project, Compliance and Response	
The strategy states that all development in a formally established buffer zone that requires an environmental authorisation in terms of the NEMA, will be subject to an environmental impact assessment. The proposed project is situated within the Port of Ngqura, approximately 5 km from the Addo Elephant National Park Marine Protected Area and the sensitive marine and estuarine habitats therein.	

National Heritage Resources Act 25 of 1999

Legislation	Section	Relates to
National Heritage Resources Act (No 25 of 1999) and regulations	Section 34	No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority.
	Section 35	No person may, without a permit issued by the responsible heritage resources authority destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or paleontological site.
	Section 36	No person may, without a permit issued by the South African Heritage Resource Agency (SAHRA) or a provincial heritage resources authority destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority. “Grave” is widely defined in the Act to include the contents, headstone or other marker of such a place, and any other structure on or associated with such place.
	Section 38	This section provides for Heritage Impact Assessments (HIAs), which are not already covered under the ECA. Where they are covered under the ECA the provincial heritage resources authorities must be notified of a proposed project and must be consulted during the HIA process. The Heritage Impact Assessment (HIA) will be approved by the authorising body of the provincial directorate of environmental affairs, which is required to take the provincial heritage resources authorities’ comments into account prior to making a decision on the HIA.
Relevance to the Proposed Project, Compliance and Response:		
▪ No person may alter or demolish any structure or part of a structure, which is older than 60 years or disturb any archaeological or paleontological site or grave older than 60 years without a permit issued by the relevant provincial heritage resources authority. ▪ No person may, without a permit issued by the responsible heritage resources authority destroy, damage, excavate, alter or deface archaeological or historically significant sites.		

▪ Cultural and palaeontological impact assessments have been included as specialist studies in the EIA and any permits required will need to be obtained from the provincial heritage authority.

Conservation of Agricultural Resources Act 43 of 1983

Legislation	Section	Relates to
Conservation of Agricultural Resources Act 43 of 1983 and Regulations	Prohibition and control of weeds and invader plant species	
	Control measures for erosion	
Relevance to the Proposed Project, compliance and response:		
There are no applicable permit or licence requirements, however cognisance of these requirements is to be taken during vegetation clearance and the maintenance of the existing servitudes, for the entire duration of the project lifecycle. Provision for control of invasive species and soil erosion are contained in the EMPr.		

Marine Pollution (Control and Civil Liability) Act 6 of 1981

Legislation	Section	Relates to
Marine Pollution (Control and Civil Liability) Act 6 of 1981	S24 requires a pollution safety certificate for the operation of an offshore installation from the South African Marine Safety Authority (SAMSA)	
Relevance to the Proposed Project, Compliance and Response		
No pollution certificate is required for the proposed project, however SAMSA requires a risk assessment to be conducted for approval.		

National Ports Act 12 of 2005

Legislation	Relates to
National Ports Act (12 of 2005)	Provide for the establishment of the National Ports Authority and the Ports Regulator; to provide the administration of certain ports by the National Ports Authority; and to provide for matters connect therewith.
	Prescribes that the National Ports Authority is to prepare and periodically update a Port Development Framework Plan (PDFP) for each port. The creation of new capacity in the ports' system results from the implementation of the Port Development Framework Plans.
Relevance to the Proposed Project, Compliance and Response	
TNPA is required by the Act to promote economic development of the Port. Further, a balance between environmental protection and economic development must be achieved. The compatibility of the Project with Port planning is required.	

Occupational Health and Safety Act 85 of 1993

Legislation	Section	Relates to
Occupational Health and Safety Act 85 of 1993 and Regulations	Section 8	General duties of employers to their employees
	Section 9	General duties of employers and self-employed persons to persons other than their employees
Relevance to the Proposed Project, compliance and response:		
The developer must be mindful of the obligations contained in the OHSA and mitigate any potential impacts. Hazardous Chemical Substances and Major Hazardous Installations are regulated under the Act.		

The associated requirements have been considered by the risk assessment specialist. Recommendations will be included in the EMPr

Hazardous Substances Act 15 of 1973

Legislation	**Section**	**Relates to**
Hazardous Substances Act 15 of 1973, as amended by the Hazardous Substances Amendment Act 53 of 1992	Provides for the definition, classification, use, operation, modification, disposal or dumping of hazardous substances	
Relevance to the Proposed Project, Compliance and Response		
Provision is made in the EMPr to: ▪ Manage the hazardous substances in such a manner that it does not endanger human health or the environment. ▪ Prevent hazardous substances from being used for an unauthorised purpose.		

SANS 10103 (Noise Standard)

Legislation	**Section**	**Relates to**
SANS 10103 (Noise Regulations)	The measurement and rating of environmental noise with respect to annoyance and to speech communication, as well as the categories for community responses to excess environmental noise.	
Relevance to the Proposed Project, Compliance and Response		
The ambient noise level guidelines in SANS 10103:2008 must be complied with Provision is made in the EMPr to manage the Noise Impacts during in the construction and operational phases.		

National Road Traffic Act 93 of 1996

Legislation	**Section**	**Relates to**
National Road Traffic Act (No 93 of 1996)	Provides for controlling transport of dangerous goods, hazardous substances and general road safety	
Relevance to the Proposed Project, Compliance and Response		
The requirements stipulated in the NRTA will need to be complied with during the construction and operational phases of the proposed project and included in the EMPr.		

Infrastructure Development Act 23 of 2014

Legislation	**Section**	**Relates to**
Infrastructure Development Act 23 of 2014 ("**the IDA**")	▪ To provide for the facilitation and co-ordination of public infrastructure development which is of significant economic or social importance to the Republic; ▪ to ensure that infrastructure development in the Republic is given priority in planning, approval and implementation; ▪ to ensure that the development goals of the state are promoted through infrastructure development;	

	▪ to improve the management of such infrastructure during all life-cycle phases, including planning, approval, implementation and operations; and ▪ to provide for matters incidental thereto.

Relevance to the Proposed Project, Compliance and Response

The IDA's main aim is to speed up the delivery and implementation of nationally important social and economic infrastructure by designating priority projects as strategic infrastructure projects ("**SIP's**"). The Projects are declared and Gazetted SIP's in **Section 8(1)(a)** read with **Section 7(1)** of the IDA.

Section 7(1)(b) states:

"(1) A project or group of projects qualifies as a strategic integrated project for the purposes of this Act if-

(b) it complies with any of the following criteria:

(i) It would be of significant economic or social importance to the Republic.

(ii) it would contribute substantially to any national strategy or policy relating to infrastructure development; or

(iii) it is above a certain monetary value determined by the Commission; and

(c) the Commission has included the project in the national infrastructure plan and has, in terms of section 8, designated the project as a strategic integrated project."

When considering whether to grant an environmental authorisation for the Projects, the DFFE must consider the socio-economic advantages of the Project, the fact that the Project is a declared SIP as well as ramifications for the IPP projects list on a national level against any significant environmental impacts.

Section 2(4)(i) of the NEMA states:

"The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in light of such consideration and assessment."

Further at (l):

"There must be inter-governmental co-ordination and harmonisation of policies, legislation and actions relating to the environment."

Similarly any other government authority considering the Project, must give consideration to these factors.

Section 8(4)(a) of the IDA further provides that:

"Every organ of state must ensure that its future planning or implementation of infrastructure or its future spatial planning and land use is not in conflict with any strategic integrated project implemented in terms of this Act."

This designation means that the State has recognised the project as vital to the South African economy, which must therefore be taken into account when considering the need and desirability of the Project and

the Environmental Authorisation of the Project. The status of the Project as a SIP also means that other projects must consider the cumulative impacts of their projects in relation to these Projects (giving due preference and weighting to the SIP project status) and that organs of state must factor SIP projects into their future planning.

Civil Aviation Act 13 of 2009

Legislation	Section	Relates to
Civil Aviation Act 13 of 2009	▪ Obstacle approval will be necessary for objects above select height.	
Relevance to the Proposed Project, Compliance and Response		
The proposed project will require consent from the SACAA for infrastructure above 60 meters tall.		

4.1.2 Provincial Legislation and Planning

Table 4-1: Applicable Provincial Plans, Strategies and Programmes.

Legislation	Relates to
Eastern Cape Vision 2030 – Provincial Development Plan (2014)	Outlines goals, visions, key objectives and strategic actions related to equitable economy, education, empowerment and health for rural and economic developments, including the protection of environment assets and natural resources.
Eastern Cape Environmental Implementation Plan (2021)	This is a five year plan prepared in accordance with Section 11 of NEMA and is aimed at detailing the specific activities the department will undertake to manage potential negative impacts of its programmes, policies and plans. It also sets targets and timelines to implement the identified activities.
Eastern Cape Coastal Management Programme (2014)	The Eastern Cape Coastal Management Programme, dated 2013, was developed to meet provincial obligations as stipulated in the ICM Act. The provincial programme (hereafter the Eastern Cape PCMP) situates the importance of integrated coastal management in promoting and achieving sustainable coastal development in the Eastern Cape
Eastern Cape Climate Response Strategy (2011)	The Eastern Cape Climate Change Response Strategy is the only pertinent provincial climate change document in respect of the proposed project. Similar to the Western Cape Climate Response Strategy, this strategy does not act as a regulatory document. Instead, the strategy acts as a high-level policy document that provides some guidelines for developing appropriate adaptation and mitigation responses and contextualises these guidelines within: i) the context of projected climate change impacts in the Eastern Cape; and ii) the development priorities within the Eastern Cape.
Eastern Cape Biodiversity Conservation Plan (ECBCP) (2017)	The Eastern Cape Biodiversity Conservation Plan identifies areas within the Eastern Cape that require conservation, and supplies land use guidelines for the province based on conservation values (Berliner et al 2007). This spatial biodiversity conservation plan looks at the province and defines areas of conservation value based on large numbers of threatened species, large numbers of species or ecosystems or ecological processes that are crucial for the long-term persistence of biodiversity.

Subtropical Thicket Ecosystem Programme (STEP) (2009)	The Subtropical Thicket Ecosystem Programme or STEP is a bioregional programme for the area where thicket is the dominant vegetation type, predominantly in the Eastern Cape (Pierce & Mader 2006). The function of STEP is to promote the sustainable management of the biodiversity of the region, as much of it is under pressure from poorly planned development. STEP can be used to identify areas that are crucial to conservation and areas that can withstand some development. It provides land use guidelines for each conservation status as well as for other natural areas and for corridor, to prevent fragmentation (Pierce & Mader 2006).

4.1.3 Local Legislation and Planning

Table 4-2: Applicable– Regional and Local Planning Frameworks.

Legislation	Relates to
Nelson Mandela Bay Municipal (NMBM) Integrated Waste Management Plan (2016 – 2020)	Defines the vision, objectives and targets for the provision of solid waste management services, including all aspects of waste management from waste generation to waste reduction, recycling, treatment and disposal in order to reduce waste to landfill.
NMBM Integrated Development Plan (2022/23 – 2026/27) (2022)	Serves as a strategic action and informs and guides all relevant planning, management, budgeting and decision-making processes within the institution.
NMBM Spatial Development Framework (2015)	Includes power production, inclusive of investments in the energy sector, with the purpose of feeding into the electrical grid, with the focus on renewable energy, peaking power generation capacity, and other key areas within the energy cluster.
Nelson Mandela Bay Coastal Management Programme (draft) (2015)	The Nelson Mandela Bay Municipality (NMBM) Municipal CMP, updated in 2015, is proposed as an implementation-based program focussing on three broad priority areas, namely: natural resource management; coastal pollution and coastal development, with the latter including broad coastal management objectives, management recommendations and implementation strategies. The NMBM coastal zone is divided into 20 segments with the Port of Ngqura included in segment 2. Coastal development is assessed strategically according to management areas, however the Coega IDZ and Port of Ngqura are excluded as the NMBM does not undertake maintenance activities within these areas (CEN, 2015).
Coega Open Space Management Plan (2014) and Coega IDZ Development Framework (2006)	Provides an overall development strategy for the Coega IDZ, including environmentally sensitive planning approach for linear infrastructure.
NMBM Fire Safety By-Law (2007)	Certificate for use, handling and storage of flammable substances prohibited in certain circumstances.

4.2 INTERNATIONAL AGREEMENTS

South Africa is a party to several international agreements which regulate the marine environment and the protection of marine resources:

- International Convention for the Prevention of Pollution from Ships - MARPOL 73/78
    - The MARPOL Convention regulates pollution from ships – accidental pollution and pollution from the general operations associated with shipping; Preserves the marine environment by eliminating pollution from harmful substances. Ships sailing under the flag of a country that has entered into the MARPOL convention are expected to comply with the regulations. The MARPOL Convention was ratified by South Africa in 1985,
- Convention on Biological Diversity - 1992-1995
    - This treaty has three main goals, namely: conservation of biodiversity; sustainable use of biodiversity; and the fair and equitable sharing of the benefits arising from the use of genetic resources
- International Convention on Civil Liability for Oil Pollution Damage, 1969
    - International maritime treaty adopted to ensure that adequate compensation would be available where oil pollution damage was caused by maritime casualties involving oil tankers
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter ("**London Convention**") - 1972-1978
    - This Convention's objective is to promote the effective control of all sources of marine pollution and to take all practicable steps to prevent pollution of the sea by dumping of wastes and other matter.
- Protocol to the 1972 Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter ("**London Protocol**") - 1996-1998
    - The London Protocol updates and is intended to replace the London Convention. The London Protocol prohibits all wastes, except for those identified on the "reverse list". These improvements to the London Convention further ensure that the few materials that are permitted for ocean disposal are carefully evaluated and will not pose a danger to human health or the environment and that there are not more feasible alternatives for their reuse or disposal.
- United Nations Convention on the Law of the Sea (UNCLOS) - 1982-1997
    - UNCLOS lays down a comprehensive regime of law and order in the world's oceans and seas establishing rules governing all uses of the oceans and their resources.
- International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties - 1969-1986
    - The Convention affirms the right of a coastal State to take such measures on the high seas as may be necessary to prevent, mitigate or eliminate danger to its coastline or related interests from pollution by oil or the threat thereof, following upon a maritime casualty.
- Protocol relating to intervention on the high seas in cases of pollution by substances other than oil - 1973-1997

  - The Protocol relating to Intervention on the High Seas in Cases of Marine Pollution by Substances other than Oil was adopted to extend the provisions of the 1969 Convention referred to above.
  - The list of hazardous substances covered by Protocol was amended and extended in 1991, 1996 and 2002.

- International Convention for the Safety of Life at Sea - 1974-1980
  - This Convention aims to specify minimum standards for the construction, equipment, and operation of ships, compatible with their safety.
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) – 1979
  - This Convention is a treaty under the mandate of the United Nations Environment Programme. It provides a global platform for the conservation and sustainable use of migratory animals and their habitats.
- International Whaling Commission's (IWC) Resolution 2018-4
  - The Resolution on Anthropogenic and Underwater Noise requires effective remediation of noise impacts when cost effective solutions are available.
- Agreement on the Conservation of African-Eurasian Migratory Waterbirds, or African-Eurasian Waterbird Agreement (AEWA)
- Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention) – 1998
  - This Convention was created to empower the role of citizens and civil society organisations in environmental matters and is founded on the principles of participative democracy.
  - The Convention establishes a number of rights to the individuals and civil society organizations with regard to the environment. The Parties to the Convention are required to make the necessary provisions so that public authorities, at a national, regional or local level, will contribute to these rights to become effective.
- United Nations Framework Convention on Climate Change (1992)
  - The UNFCCC is a global commitment by countries to cooperatively find solutions to limit the global average temperature increase.
- The Paris Agreement (2015)
  - The Paris Agreement establishes a global goal on adaptation – of enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change in the context of the temperature goal of the Agreement.

Also of relevance to the Project is the Framework Convention on Climate Change, 1992 and the Paris Agreement. This is discussed in more detail under Section 8.

5 PUBLIC PARTICIPATION PROCESS (PPP)

EIA Regulations, Appendix 3: 3(1) (h) (ii) details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs; (iii) a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them.

5.1 BACKGROUND

The EIA Regulations provide the requirements and framework in terms of which PPP for an EIA process must take place, including projects declared as a Strategic Integrated Project ("SIP") as contemplated in the Infrastructure Development Act 23 of 2014. The PPP, as undertaken in accordance with the Public Participation Plan by DFFE, for the Scoping Phase was approved.

Triplo4 undertook an enhanced PPP for the EIA Phase, by procuring the services of an Independent Public Participation specialist as well as Independent Service providers to distribute and manage the PPP notifications and the Virtual Meeting. The PPP was undertaken in a manner to promote equitable and effective participation, and specifically participation by vulnerable and disadvantaged persons and in accordance with Chapter 6 of the EIA Regulations, Regulations 39, 40, 41, 42, 43, 44 and 45 and the relevant Public Participation Guideline.
This chapter is divided in the following manner:

- Summary of the PPP during the Scoping Phase in 2020 to provide a complete overview of PPP undertaken for the application;
- Summary of Enhanced PPP Approach with
    - Actions taken before the public comment period of the DEIR;
    - Actions taken during public comment period of the DEIR

Table 5-1: Summary of PPP actions during the Scoping Phase

Item	Date	Stakeholders	Actions
1.	2020/09/15	DFFE	EAP submitted first draft of PPP to DFFE.
2.	2020/09/17	DFFE	EAP pre-application meeting with DFFE (Regulation 8 of EIA Regulations). DFFE communicated comments on PPP during meeting for the EAP to revise PPP.
3.	2020/09/18	DFFE	EAP submitted amended PPP to DFFE.
4.	2020/09/21	DFFE	**DFFE approved amended PPP.**

5.	2020/09/21 22 & 23	General	Advertisements in Herald Newspaper in three languages (English, Afrikaans and isiXhosa) on 22 September 2020 and Advertisements in Daily Dispatch Newspapers in three languages (English, Afrikaans and isiXhosa); English- published on 21 September 2020, Afrikaans and isiXhosa published on 23 September 2020 – requests for I&APs to register (3 day campaign). Three A2 site notices were placed on 21 September 2020 within close proximity to the site area, in English, Afrikaans and isiXhosa and were placed prominently, as per agreement with landowners at: - Location 1: the electronic noticeboard on CDC main building; - Location 2: site entrance to the Port Registration Office; and - Location 3: at the Port entrance. A5 sized-posters ("flyers") were also placed on 21 and 22 September 2020 with consultation with the Councillors at: - Eyethu Fishing (Pty) Ltd; - Cllr Offices (Ward 53): 31736, Buthelezi Street, Kamvelihle, Motherwell; and - Cllr Offices (Ward 60): Corner of Sityhotyholweni Street and Jijana Street, Wells Estate.
6.	2020/09/22	General	Background Information Document ("**BID**") and Notice of Application ("**NOA**") with an invitation to register were distributed to relevant Stakeholders and I&APs; emailed in three languages (English, Afrikaans and isiXhosa) to identified Stakeholders and I&APs on 2020/09/21, including landowners, the municipal ward councillor, the Ratepayers Association; Department of Mineral Resources & Energy (DMRE), Eskom, Department of Water and Sanitation, Department of Forest, Fisheries and the Environment (DFFE), Local Municipality, South African Heritage Resource Agency (SAHRA), South Africa Maritime Safety Authority (SAMSA), National Energy Regulator of South Africa (NERSA), South African National Roads Agency (SANRAL), Eastern Cape Provincial Heritage Resources Authority (ECPHRA), Eastern Cape Parks and Tourism Agency, Department of Economic Development, Environmental Affairs and Tourism (DEDEAT): Cacadu Region, Department of Agriculture, Forestry and Fisheries, Department of Environmental Affairs (DEA) Oceans and Coasts. The opportunity to register as an I&AP for this project was not limited to an end date enabling I&AP's to register throughout the process.
7.	2020/10/06	General	EAP distributed the Draft Scoping Report for comment until 6 November 2020. Hard copies were delivered to and available at:

			- Cllr Offices: Corner of Sityhotyholweni Street and Jijana Street, Wells Estate; - Triplo4 Ballito Offices: Suite 5, The Circle, Douglas Crowe Drive, Ballito; and Electronic copies were made available via: - Emails to registered I&AP's with a Google Drive Link to access the relevant documentation; - Triplo4 Website: www.triplo4.com.
8.	2020/10/13	General	Online Public Meetings/Webinars held 10h00–12h00 and 18h00–19h30
9.	2020/10/16	General	Online Public Meeting/Webinar held as continuation of morning meeting held on 13 October 2020 which was cut short (due to technical issues). Meeting held 10h00–12h00 For all Online Public Meetings on 13 and 16 October 2020, the specialists presented independently on their specialised area and also responded to I&AP's queries raised after the specialist's presentation. In a few instances where the specialist was unavailable to present, a voiceover was prepared.
10.	2020/11/06	General	Period for receiving public comments closed. From the BID until the submission of the Final Scoping and Plan of Study ("**PoS**") to DFFE, comments and Responses Report was compiled and responses submitted to I&APs. No requests for extensions on providing comments on the Draft Scoping Report were received.
11.	2020/11/17	General	Submission of Final Scoping and PoS to DFFE.
12.	2021/01/06	DFFE	**Scoping Report and PoS accepted by DFFE.**

Table 5.2 below lists the main issues raised during the commenting period on the draft Scoping Report that were to be addressed in the EIA phase (as relevant). This report addressed these aspects through the specialists' reports, technical reports and the various descriptions as per relevant chapters of this reports, as summaries below.

Table 5-2: Summary the main issues raised during the commenting period on the draft Scoping Report addressed EIA Phase

MAIN ISSUES RAISED DURING SCOPING PHASE TO BE ADDRESSED IN THE EIA PHASE	SECTIONS ADDRESSING THESE ISSUES IN THE EIAR
Source LNG	Chapter 2
Air Pollution	Chapters 6 and 7

MAIN ISSUES RAISED DURING SCOPING PHASE TO BE ADDRESSED IN THE EIA PHASE	SECTIONS ADDRESSING THESE ISSUES IN THE EIAR
	Appendix 9
Visual Impact	Chapters 6 and 7 Appendix 9
Noise Impact	Chapters 6 and 7 Appendix 9
Thermal Plume Modelling	Chapter 2 Appendix 10
Gas pipeline installation and modelling	Appendix 10
Vessel Traffic	Appendix 10
Waste Management	Chapter 2 Appendix 6
Safety and Security Risks	Chapters 2 and 7 Appendix 9
Coastal, Estuary and Climate Change incl GHG	Chapters 2 and 7 Appendices 6 and 9
Transmission Alignment	Chapters 2 and 3 Appendix 10
Leakage / spill risk from gas pipeline	Chapters 2, 3 and 7 Appendix 9
Socio-economic	Chapters 6, 7 and 8 Appendix 9
Public Participation	Chapter 5 Appendices 3 and 9
Cumulative Impacts	Chapter 7 Appendix 9
Ecological	Chapter 7 Appendix 9
Marine Ecology and Avifauna	Chapter 7 Appendix 9
Heritage	Chapter 7 Appendix 9
Alternatives	Chapters 3 and 7
Risk of bad weather preventing refuelling	Chapter 2
Mixing Zone	Chapter 7 Appendices 9 and 10
Lifespan of Project	Chapter 2
Municipality’s Disaster Management Capacity	Chapter 2 Appendix 9
Abstraction and Discharge of Water	Chapter 2

5.2 ACTIONS TAKEN BEFORE THE PUBLIC COMMENT PERIOD (2022)

5.2.1 Meeting with DFFE

On 24 August 2022 an in-person authority consultation meeting was held between Triplo4 Sustainable Solutions, Karpowership SA and DFFE, confirming the approach to the EIA phase as well as the timeframe for the process.

5.2.2 Identifying and creating initial I&AP database

Potential stakeholders were identified in a number of ways to ensure a detailed I&AP database. These included:

- Use of the existing I&AP database compiled from the Scoping as well as initial EIA phase.
- Online searches were conducted from Government, Academic, NGOs and Other applications in the public domain, as well as media sources, to augment and expand the existing database based on brainstorming exercises and further probes to identify stakeholders;
- Potential I&AP's identified as a result of Karpowership's engagements with stakeholders;
- The database also includes stakeholders and I&AP's that have emanated from electronic and print media reports, and engagements with Government Departments;
- Established lists from any other databases were utilized to augment the existing database;
- Officials and NGOs were approached for lists of names;
- Karpowership appointed Community Liaison Officers to further engage with the community and identify key stakeholders especially those from the rural, marginalized communities, **the poor, tribal communities and councils and the inadequately resourced;**
- During the socio-economic Impact Assessment, engagements with businesses and the Small Scale Fishers informed the database;
- Landowners, the Municipalities, NGO's and forums were contacted and requested to refer and forward all relevant details of stakeholders / I&AP's to the EAP for inclusion or to forward the notifications to I&AP's to allow inclusion via registration.

The database consisted of two main components, namely potential I&AP's with e-mail addresses and those with only cellphone numbers. At the time of submitting the I&AP notification and invitation to register, a total of approx. 600 emails were submitted. In addition to 94 SMSs for Coega.

5.2.3 Developing and updating of I&AP database

The comprehensive database of I&APs, which includes authorities, different spheres of government (national, provincial and local), stakeholders, landowners, traditional authorities, social group, NGOs, businesses and chambers, education and research institutions, interest groups, small-scale fishers and members of the general public, was compiled based on the approach above. This database was updated throughout the PPP process that commenced on 24 October 2022 and registered I&AP's and referrals from I&APs responding to the communications for participation, were added.

Triplo4 investigated "soft" and "hard" bounces from email notifications as well as the "unsubscribe" lists, where possible and updated the database continually throughout the PPP process.

5.2.4 Language Selection

The Public Participation considered, as part of appropriate participation methods, the language requirements for the posting of notices, newspaper and radio advertisements, flyers and information brochure and communication at the public meetings.

While the official Eastern Cape Provincial Language Policy is explicitly applicable only to state departments, this policy was used to confirm the official provincial languages, in this case being English, Afrikaans, isiXhosa, Sesotho. This policy was consulted to ensure that the PPP conducted was inclusive of the official provincial languages and therefore the communication methods to announce the project and provide information of participation included: English, Afrikaans, isiXhosa, Sesotho. In addition, the Background Information Document (BID) was provided in isiZulu.

5.2.5 Capacity Building

Capacity building, which forms part of the public participation process, is seen as an ongoing, multi-pronged approach to improve the abilities and skill of marginalised, vulnerable and previously disadvantaged groups to understand the proposed project. By utilising capacity building and participatory techniques, marginalised, vulnerable and previously disadvantaged groups are better equipped to meaningfully contribute to engagements and the wider public participation process. Capacity building therefore is an approach to PP which seeks to involve communities and people who do not have access to resources or have not been afforded the opportunity to higher levels of education. Steps were taken to take information to the I&APs personally via door-to-door distribution and in-person discussions and at a level more understandable for the relevant I&AP. This is done with the goal of promoting equitable and effective participation across different sectors and communities in society. KSA undertook various steps in addition to the formal PP arranged by the EAP, in order to commence fostering relationships with I&APs and to further add to the steps with capacity building:

5.2.5.1 Small-ScaleFisher (SSF) Workshops

Being a marginalized group, a workshops was held with small scale fishers to explain the aspects of the project and obtain viewpoints of how the project may impact on fishing and the fishing community. This engagement was specifically to ensure that SSFs had an appropriate opportunity to express their views and concerns regarding the project. Taxi’s were arranged to transport the SSF to the meeting held at the Masakhisizwe Hall, Daku, Kwazakhele, on the 28th September 2022 from 14:00 to 16:00.

In summary, it was acknowledged the benefits of the project to the community and to South Africa as a whole. Concerns were related to impact to fish populations, noise pollution and water temperature fluctuations, loss of sustainable livelihoods and subsistence associated with the ocean economy. Furthermore, desire was shown for Karpowership SA to recruit from the local community, and to invest in community upliftment projects and programmes.

It was established that the SSF were not directly affected as no fishing was conducted in the immediate vicinity of the project. Please refer to Appendix 9 D. 1.1 – SSF Report.

5.2.5.2 Community Liaison Officers (CLO)

Karpowership employed a male and female CLO to engage with the community, organise arrangements for the community to attend the SSF workshop and Public Meetings, and clarify information where possible or alternatively, refer queries to Triplo4. The CLOs were appointed in in early 2022

Karpowership SA provided the following for inclusion in terms of capacity building: *"Karpowership is committed to building robust and open channels of communication with social and business communities which are located in the vicinity of the Powership. To this end, KPS employed Community Liaison Officers (CLOs) for the purpose of fostering relationships with different sectors of society and facilitating the building of open communication channels to ensure KPS receives feedback and input from societal representatives.*

Engagement with I&APs is not restricted to the 'formal' public comment period on the Draft Environmental Impact Assessment Report. Consequently, steps were taken prior to this phase in order to ensure as many potential I&APs were informed of the proposed Gas to Power project and therefore more people were able to engage with the EAP during the formal public comment period.

It is important to highlight that the steps taken were not done solely for the sake of the EIA PPP, but to assist Karpowership with the identification of community issues and needs and the development of the Economic Development Plan as well as to create the foundation for continued engagement with stakeholders during the operational period of the project. The following is an extract of engagements:

- *Engagements with different businesses including Volkswagen Group SA; Aspen Pharmacare SA; Goodyear SA; Borbet and the Nelson Mandela Business Chamber;*
- *Various engagements with ward councillors from the Nelson Mandela Metropolitan Bay area, including Wards 54, 55, 56, 59, and 23;*
- *Engagements with the Southern African Foundation for the Conservation of Coastal Birds (SANCOBB); the Wildlife and Environment Society of South Africa (WESSA) and a Hloumani Nande Environmental ambassador;*
- *Engagements with the Nelson Mandela University and representatives from JV Women in Action;*
- *Engagements with community representatives from Motherwell;*
- *Engagements with a representative from the BASA Movement;*
- *Engagements with representatives from NAFCOC."*

5.2.5.3 Information Booklet

Capacity building requires that information is disseminated to I&APs at a level at which they can understand and from which they can extract value. To address this, KPS designed and distributed an 'Information Booklet', which aimed to provide information regarding the project in a format and at a level which was easily accessible to I&Aps who were not formally educated. The booklet provided by Karpowership comprised of the following sections:

- Background of the Company;
- Project concept – How do Powerships work and how is power generated;
- How Powerships engage with the Natural Environment
- Benefits of the Powership technology to mitigate South Africa's energy crisis
- The Just Energy transition and how Powerships play a role through the use of natural gas as a cleaner, source of energy
- Project locations of the proposed projects

- Health and Safety associated with Powerships' operations
- Plans for community investment and job creation as part of mandatory requirements
- Types of support to local fishing communities
- Frequently asked questions to assist the community to understand issues potentially in the public domain
- Public participation in the process of environmental authorisation.

1000 booklets were printed in English. These will be distributed at the public in-person meetings for the 3 proposed projects (i.e. at Richards Bay, Saldanha Bay and Coega). Refer to Appendix 3.6.

5.2.5.4 Information Leaflet

An Information leaflet was developed and distributed with the reminder e-mail notification of the public participation and registration notices as well as more than 79 000 "knock-and-drop" notices that were delivered to individual properties as per the external distribution services provider, Vibrant Direct. The English leaflet, translated in isiXhosa, Sesotho and Afrikaans, comprised of information on the project, specialist aspects being assessed, the importance of public participation and how to engage in the process for the project.

5.2.5.5 Pre-consultation engagement

Meetings were held with key stakeholders to provide opportunity for open communication on the proposed project, referrals of key stakeholders to include in the database and preliminary comments and clarification.

- Coega Development Corporation
- DFFE: Sustainable Aquaculture Management (final minutes pending).

Refer to Appendix 3.7 for final minutes of the meeting with Coega Development Corporation. Final minutes for the meeting with the DFFE: Sustainable Aquaculture Management will be appended to the final EIAr.

In addition, attempts for pre-consultation engagements were made with the following key stakeholders, at the time of going to print, no responses were received to carry out the requested engagement:

- Nelson Mandela Bay Metropolitan Municipality;
- ESKOM.

5.2.6 Additional Resources

5.2.6.1 External PP Facilitator / Expert

An Independent and experienced PP facilitator, Wakhiwe, was appointed to manage the in-person as well as virtual meeting facilitation. The facilitator had full access to the e-mail account to review comments and responses as well as notices and engagements with stakeholders and registered I&AP's.

Refer to Appendix 3.11.1 for information on the service provider.

5.2.6.2 Online-platform Specialists

Independent on-line platform specialists, WAHM, was appointed to set-up and manage the e-mail and SMS notifications via the MailerLite platform. The virtual meeting will also be managed via the AirMeet program and registration for this meeting will also be managed by WAHM as well as the compilation of the minutes.

5.2.6.3 Dedicated e-mail and cellphone contact details

A dedicated e-mail address coegaksa@triplo4.com was created. The purpose of the address was to ensure project specific e-mails be attended to in an efficient and effective manner as well as independent scrutiny by the Independent Service Providers. The dedicated cellphone number also ensured that calls could be identified as project specific calls and engagements ensured in accordance thereof.

5.2.7 Notification of PPP and Registration

Numerous notification methods were undertaken, consisting of the following:

5.2.7.1 Direct Notification to I&AP Database

A notification letter (in 4 languages) and background information documents (in 5 languages) were distributed on the 24 October 2022 to all identified I&APs by WAHM using the MailerLite programme with a dedicated e-mail address, as per the comprehensive I&APs database. The notification letter and the BID contain a brief description of the project, and the EIA and PP processes, and include an invitation register as an I&AP.

Refer to copy of:

- PPP Notification letter – Appendix 3.2;
- Background Information Document (BID) – Appendix 3.8;
- Proof of circulation of the notification letter and BID and statistics– Appendix 3.3

A Correction Notice was circulated on the 26th October 2022 to advise that an error occurred in the notification dated 24 October 2022 **in isiXhosa** regarding the venue for the public participation meeting to be held on 25 November 2022. The correct venue for the public participation is **Raymond Mhlaba Sport Centre, 34 Ramra St, Motherwell, Gqeberha. Coordinates – (33°48'47.22"S, 25°35'30.20"E).** Please note that the correct address was displayed in English, Afrikaans and Sesotho versions, circulated at the same time.

A reminder e-mail containing the notification letter, background information document and capacity building leaflet in the four languages was distributed by WAHM on 02 November 2022 via the MailerLite application to all I&AP's that had not unsubscribed from the mailing list. The purpose was to remind potential I&AP's to register for the PP meetings and submit comments as per the BID.

An SMS was submitted to potential I&AP's using the MailerLite platform. This SMS with characters not to exceed 169 character count, was submitted to potential I&AP's where only a cellphone number was available. Please refer to the statistics – Appendix 3.3.

All I&APs that registered were acknowledged and included in the database.

5.2.7.2 Newspaper ads (local and national)

Advertisements were placed in 3 local newspapers and in 3 national newspapers, in 4 languages, as summarised in table 5-3 below. The adverts contain the proposed project scope of works, location, project details, the dates and locations for review of the draft EIA Report, the dates and locations of the public meetings, as well as details of EAP and contacts to register and submit comments.

The advertisements were placed within the newspaper body where possible (as per individual newspaper) to improve visibility.

Table 5-3: Summary of newspapers advertisements

Local Newspapers	Language	Date of Publication
PE Express	English, Afrikaans, isiXhosa, Sesotho	26 October 2022
Herald	English, Afrikaans, isiXhosa, Sesotho	24 October 2022
Daily Dispatch	English, Afrikaans, isiXhosa, Sesotho	24 October 2022
Isolezwe lesiXhosa	IsiXhosa	27 October 2022
National Newspapers	**Language**	**Date of Publication**
Sunday Times	English	30 October 2022
Rapport	Afrikaans	30 October 2022
Ilanga	IsiZulu& IsiXhosa	24 October 2022

A Correction Notice was advertised (refer to Table 5-4) to advise that an error occurred in the notification dated 24 October 2022 **in isiXhosa** regarding the venue for the public participation meeting to be held on 25 November 2022. The correct venue for the public participation is **Raymond Mhlaba Sport Centre, 34 Ramra St, Motherwell, Gqeberha. Coordinates – (33°48'47.22"S, 25°35'30.20"E).** Please note that the correct address was displayed in English, Afrikaans and Sesotho versions, circulated at the same time.

Table 5-4: Summary of Correction Notice of the Newspapers Advertisements

Local Newspapers	Language	Date of Publication
PE Express	isiXhosa	02 November 2022
Herald	isiXhosa	27 October 2022
Daily Dispatch	isiXhosa	27 October 2022
National Newspapers	**Language**	**Date of Publication**
Ilanga	IsiXhosa	27 October 2022

Refer to copy of:

- Advertisements, providing the displayed detail – Appendix 3.4
- Proof of publications - Appendix 3.5

5.2.7.3 Radio Announcements

The PP Guidelines provides for different means to reach a wider audience. It is important to note that these methods are suggestions and do not amount to mandatory requirements for PPP. Further, there is no proof that these methods are inherently the best techniques to reach a wider audience. Such methods suggested by the PP Guidelines include: “announcing the PPP on a local radio station in a local language, at an appropriate time”. It was recognised that the radio announcements may assist those with reading disability and the visually impaired.

Announcements to inform the local communities were read in selected local radio stations, in 2 languages, during the various dates and slots, as describe in Table 5-5 below. The announcements were read by the show hosts. The announcements were focused on informing the public of the project, the dates and locations for the public meetings, the public locations to review the draft EIA Report, as well as the EAP contact details to obtain further information.

The radio stations were selected based on their reach within the project and surrounding areas, community and language preferred listeners and direction provided by the CLOs that live within the community and understand the societal dynamics.

Table 5-5: Summary of Radio announcements

Radio station	Language	Date and time
Nkqubela Radio (Community Radio)	IsiXhosa	**24/10/2022,** 2 slots per day, at 06:57 a.m. and 16:57 p.m, before the news slot.
Algoa FM	English	**24/10/2022,** 2 slots per day, at 5:52 a.m. and 7:26 p.m.
Umhlobo Wenene	IsiXhosa	**24/10/2022,** 1 slot per day, at 15:51, before the news slot.

5.2.7.3.1 *Selected Radio Stations*

The following present the profiles of the selected radio stations:

- **Nkqubela Radio Nkqubela Community Radio Station** is based in KwaDwesi Township at the Ziyabuya Centre in the Nelson Mandela Bay. The station was granted its broadcasting licence in 2003 and started to be on Air 2004, May the 8th. The transmission radius of the station is 100km (including Kirkwood, Jeffery's Bay and the outskirts of Nelson Mandela Bay). The broadcast languages are predominantly Xhosa 60 %, English 30% and Afrikaans 10%.
- **Algoa FM** Greater numbers of Eastern Cape and Garden Route listeners are tuning in to their regional radio station, according to the latest Radio Audience Measurement Survey (RAMS) release.Algoa FM broadcasts from the Wild Coast to Mossel Bay, and inland throughout the Eastern Cape. According to the RAMS research, Algoa FM's total past seven day audience has grown from 680 000 to 774 000 in just under a year.
- **Umhlobo Wenene** is a Public Broadcasting Service (PBS) radio station which broadcasts exclusively in isiXhosa, providing compelling and distinctive programming that not only entertains but also empowers South African citizens. Umhlobo Wenene FM is the 2nd biggest African language radio station and the second most loved radio brand in the country Umhlobo Wenene FM has a rich history and heritage that has built the station to what it is today (since 1960), and is still evolving. The station has developed such close relationships with its listeners to an extent that it was only natural to name it Umhlobo Wenene FM (after Radio Xhosa) - as it is viewed by listeners as a true friend. The station has the widest reach imaginable, being the only national ALS broadcasting in 7 provinces with easy access in all major metropolis in the country. The majority of Umhlobo Wenene FM's listeners (80%) reside in the Eastern and Western Cape, with the rest spread across the entire country.

Refer to copy of:

- Radio announcements' scripts - Appendix 3.4;
- Proof of announcements - Appendix 3.5

5.2.7.4 Government Gazette Advertisement

Although the Applicant was amenable to the placement of notices in the Government Gazette, due to the timeline of the EIA process as well as the process and timeframe required for the placement of a notice, this avenue was not deemed ideal and was not further pursued.

5.2.7.5 *Specific approaches to existing community structures, committees and leaders*

Specific engagements were held between the Applicant's Business Developer and the CLOs with the Business Community as per Section 5.2.5.2 depicted in Italics, to create an understanding for the project and for concerns and comments from these stakeholders to be recorded and internalised by the Applicant.

In addition Triplo4 identified community structures, committees and leaders with memberships and submitted a dedicated letter requesting these stakeholders to either provide contact details (considering compliance with POPIA) or alternatively disseminate the notification for registration and participation to their members via their internal databases. These included:

- Green Connection;
- Centre for Environmental Rights
- Ocean not Oil
- All Rise Attorneys for Climate and the Environment
- East Cape Conservation Association
- Ground Work
- Organization undoing Tax Abuse
- West Coast Bird Club Conservation
- Anti-Gas Alliance
- Bird Life South Africa
- Center of Environmental Rights
- Eastern Cape Environmental Network
- National Association for Clean Air (NACA)
- WESSA KZN
- Young Women in Business
- Frack Free SA
- Southern African Foundation for the Conservation of Coastal Birds (SANCCOB)
- WESSA Algoa Bay
- West Coast Bird Club – Conservation
- WESSA Southern KZN
- Black Women in Sustainable Development
- Chief Christine Williams of Hamcumqua Cape Khoi Royal House
- Coastal Links
- Cochoqua Tribal House
- Coega community leader
- Khoi group and chairperson of Saldanha Black Business council

- Nelson Mandela Bay Ratepayers association
- South Africa Gas Development Corporation (SOC) Ltd
- SACCI (South African Chamber of Commerce & Industry)

Refer to Appendix 3.3 for copies of the letter submitted via the dedicated e-mail address.

5.2.7.6 Site Notices and Flyers

Over 20 locations were strategically selected along the site area, for the display of site notices (over 100 site notices), as well placements of public notices flyers, including the leaflets, as described in section 5.2.5.4 (over 250 copies distributed). These locations were selected upon engagement with the local Community Liaison Officers (CLOs), to ensure wide reach. These notices were distributed in 4 languages, i.e. English, Afrikaans, Sesotho and isiXhosa. The site notices were printed in size A2 and the public notices flyers in A5.

Over 250 flyers and leaflets were placed at the selected sites.

Refer to copy of:

- List and maps of selected locations for site notices and public notices flyers – Appendix 3.2
- Site notices, providing the displayed detail - Appendix 3.2;
- Photographs as proof of site notices displayed - Appendix 3.3;
- Public notices flyers (including the leaflets), providing the displayed detail - Appendix 3.2;
- Photographs as proof of public notices flyers placed - Appendix 3.2.

5.2.7.7 Enhanced Notification Methods

In an effort to further reach and notify marginalised communities, a “knock and drop” initiative was carried out, and a pack containing flyers and leaflets (in 4 languages) were distributed by Vibrant Direct, the professional service provider, to over 79 000 households (refer to Table 5-6 below). These areas were strategically selected by the distribution company, based on their data and experience in reaching these marginalised and potentially vulnerable communities, as well as consultation with the Communities Liaison Officers, and their familiarity with the area.

The flyers contain the same content as the adverts and site notices, and in addition, contain the leaflets (as per section 5.2.5.4). Refer to Section 5.2.7.6 for information regarding the public notice flyers.

The leaflets were designed with the purpose to build capacity to better understand of the essence of the project, using simple terms and images, in all 4 languages. As per arrangement with the service provider, the following distributions with approximate numbers were made:

Table 5-6: Locations for “knock and drop” distribution

Location	Household Count
iBhayi	9 250
Motherwell	32 114
Colchester	720
Gelvandale	1 500
Missionvale	1 100

Ezinyoka	1 280
New Brighton	13 121
Kwa Zakhele	22 292
Joe Slovo	1 560
Total	**79 247**

Refer to copy of:

- List of selected locations for distribution of the flyers and leaflets – Appendix 3.2;
- Public notices flyers, providing the displayed detail - Appendix 3.2;
- Leaflets, providing the displayed detail - Appendix 3.2;
- Proof of distribution of the flyers and leaflets – Appendix 3.3;
- Proof of competence of the distribution company – Appendix 3.11.3.

5.2.8 Specific Focus Group Engagements

Various specific focus group engagements were initiated. These included:

Please refer to Section 5.2.5.1 and the SFF workshop summary as per the independent Socio-Economic Specialist Assessment Report.

In addition, please refer to the minutes of the meetings as per Section 5.2.5.5 regarding the specific focus group engagements with:

- CDC;
- DFFE: Sustainable Aquaculture Management. The minutes of the meeting is yet to be finalised.

Final minutes of pre-consultation meetings with DFFE: Sustainable Aquaculture Management will be appended to the Final EIA Report.

5.2.9 Additional Media Coverage

As result of the media coverage and notifications to the stakeholders, wide spread awareness of the project as well as details of the public participation was additionally made available to the public. This included various organisations placing notices on their websites:

Table 5-7: Summary of additional coverage

Stakeholder/Organisation	Published/Uploaded Date	Description /content
Weskus Sakekamer – Business Chamber	27 October 2022	Individual Referral Letter (Section 5.2.7.5)
The re-launching of the EIA phase has been widely advertised in the media. Please refer to Appendix 3.10 for a list of articles noted by Triplo4.		

Triplo4 also placed the BID in all 4 languages on its website, should any person becoming aware of the project visit the website for information. Refer to Appendix 3.10.

5.2.10 Summary of main issues raised during the notification period (24 October – 07 November 2022)

Table 5.8 below lists the main issues raised during the notification period of the EIA phase (as relevant). This report addressed these aspects through the specialists' reports, technical reports and the various concerns as per relevant chapters of this reports, as summaries below.

Table 5-8: Summary the main issues raised during the Notification Period of the EIA Phase

MAIN ISSUES RAISED	SECTIONS ADDRESSING THESE ISSUES IN THE EIAR
Biodiversity of Algoa Bay Marine Protected Area, with the inclusion of offshore islands	Section 7.5.7 - 7.3.8 Section 7.3.11 and 7.5.12 Appendix 9 - B4 Marine Ecology, Oct 2022 Appendix 9 - A9 Terrestrial Avifauna, Nov 2022 Appendix 9 - A8 Terrestrial Ecology, Oct 2022 Appendix 9 - B5 Coastal and Estuary, Oct 2022
Renewable energy movement	Section 1 Section 8 Appendix 9 -8.1 Appendix 9 -8.2
Pollution of the rivers	Section 7.5.1 – 7.5.4 Appendix 9 - A1 Hydro, Oct 2022 Appendix 9 - A2 Aquatic, Oct 2022 Appendix 9 - A3 Hydropedology, Oct 2022 Appendix 9 - A4 Geohydro, Oct 2022
Increase release of CO2 and methane into the atmosphere	Section 6.1.5 Section 7.3.13 Appendix 9 - C1 AIR, Oct 2022 Appendix 9 - C3 CCIA, Oct 2022
Powerships, FSRU, Gas Pipeline positioning	Section 2.3 Appendix 7.6 – TNPA Correspondence
Responses to Triplo4 requests for pre-consultation engagement (key stakeholders).	Triplo4 had set up pre-consultation meetings, and minutes were distributed after the meetings. Refer to Appendix 3.7 for details of pre-consultation engagements
Requests to register as I&APs following the Notification of Application (NOA) letters and distribution of the Background Information Documents (BIDs).	Registration requests were noted and the contacts were added to the I&APs database.

5.3 ACTIONS TAKEN DURING THE PUBLIC COMMENT PERIOD (2022)

5.3.1 Public Meeting

Independent public participation specialists have been appointed to facilitate the public participation process. The meetings will be chaired by the independent PPP facilitators, and presentations will be made by key specialists and project representatives. Measures were put in place to ensure that all I&APs and Stakeholders are provided with a reasonable opportunity to participate.

Two meeting time options with three hour timeframes are offered - a morning session (during working hours 10:00 to 13:00) and an evening session (after working hours 17:00 – 20:00). The same information will be provided at both sessions and registered I&APs will receive the minutes of both sessions. Transportation will be provided, where required, to ensure accessibility to the selected venue.

The meetings will be conducted in English, and independent interpreters have been appointed to attend both meetings, where any question and/or response raised by the attendees will be translated in the following languages (if and as required):

- isiZulu
- Afrikaans
- isiXhosa
- Sesotho
- Sign Language

These capacity building measures, various methods of distribution and engagements together with the languages for communication, the selection of the venue within / within close proximity of the project as well as availability of arranged transport was selected to ensure that rural or historically disadvantaged communities or people with special needs (e.g., illiteracy, disability or any other disadvantage) be included in the PPP.

Questions or comments may be submitted in advance of these meetings, and during the virtual meetings, attendees will be given the opportunity to raise questions via a Q&A function. Detailed on the meetings and dates are captured in Table 5-9 below.

Table 5-9: Public meetings details

Meeting	Venue Address and Coordinates	Date	Time
In person	Raymond Mhlaba Sport Centre, 34 Ramra St, Motherwell, Gqeberha Coordinates – 33°48'47.22"S, 25°35'30.20"E	**25 Nov 2022**	**10am-1pm**
Virtual	The registration link will be emailed to all previously & newly registered I&AP's.	**25 Nov 2022**	**5pm-8pm**

5.3.2 Receiving and responding to comments received on the DEIR

The 30 day comment period is extended to 33 days, and no extensions will be provided thereafter.

The draft EIA Report is made available for review for a period of 33 days **(10 November 2022 – 13 December 2022)** and hard copies will be placed at the following venues, as advertised:

- Cllr Offices (Ward 53): (Physical Address: 33175 Nkwenkwezi Street, Kamvelihle, Motherwell);
- Cllr Offices (Ward 60): (Physical Address: Corner of Sityhotyholweni Street and Jijana Street, Wells Estate);
- North End Library: (Physical Address: 12 Mount Road Mount Croix North End);

These venues were selected in consultation with the Ward Cllrs, local CLOs and their engagement with the Ward Cllrs.

A hard copy of the Draft EIAR can also be found at Triplo4's Ballito Office: Physical Address: Douglas Crowe Drive, The Circle, Suite 5, Ballito.

In addition, electronic copies of the draft EIA Report can be accessed in the following manners:

- accessing the Triplo4 website, www.triplo4.com, which will take the reader to a link to access to Draft EIAR and;
- A link to the relevant GoogleDrive online platform will be emailed to all registered I&APs to access the Draft EIAR.

5.4 ACTIONS TAKEN AFTER THE PUBLIC COMMENT PERIOD (2022-2023)

5.4.1 Comments and Responses Trail Report

Once the comment period for the draft EIA Report has concluded, the Comments and Response Trail Report will be updated to record all the comments received and responses provided during the EIA process, and submitted to DFFE with the final EIA Report.

Issues raised will be summarised in the report.

5.4.2 Notification of Outcome of CA Decision

All registered Interested and Affected Parties will be notified within 14 days of DFFE's decision on the Application for Environmental Authorisation.

6 DESCRIPTION OF THE ENVIRONMENT

EIA Regulations, Appendix 3- 3 (1)- (h) (iv) the environmental attributes associated with the development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;

6.1 BIOPHYSICAL ENVIRONMENT

6.1.1 Regional Setting and Topography

The Eastern Cape Province is situated on the south-eastern coastline in South Africa. The proposed development falls under the jurisdiction of the Nelson Mandela Bay Metropolitan Municipality (NMBM) and Transnet National Ports Authority (TNPA) in the Eastern Cape Province. NMBM is one of eight metropolitan municipalities in South Africa. NMBM is located on the shores of Algoa Bay in the Eastern Cape Province and comprises the City of Port Elizabeth, the nearby towns of Uitenhage and Despatch, and the surrounding rural area.

The proposed transmission situated within the existing authorised services servitude of Coega Development Corporation (CDC) Special Economic Zone (SEZ). The proposed Powerships, FSRU, temporary LNGC and gas line is situated in the Port of Nqgura.

The Port has been fully developed as a typical busy National Port operating 24 hours per day. The area surrounding the facility is an export/import National Port and is within a developed Port industrial land. The topography is sloped towards a steep hill from the quays.

The site is situated in Quaternary Catchment M30B of the Mzimvubu-Tsitsikamma (DWS, 2016) Water Management Area (WMA 7). Four (4) sub-catchments were delineated for the project area and describe the natural drainage of the area (i.e. the proposed transmission line crosses several drainage lines). The site is bound to the west by the Coega River (approx. 1.5 km downstream). Several non-perennial (ephemeral) streams drain the site (with the preferred transmission line route falling outside these streams).

6.1.2 Landform and Eco-Region

The proposed development falls into the South Eastern Coastal Belt (20) Level 1 Ecoregion (Kleynhans *et al.*, 2005). Level 1 ecoregions are derived primarily from terrain and vegetation, along with altitude, rainfall, runoff variability, air temperature, geology and soil. This region can predominantly be broken down into the following characteristics:

- Mean annual precipitation: Moderate to high.
- Coefficient of variation of annual precipitation: Low to moderate.
- Drainage density: Low to medium.
- Stream frequency: Low/medium to medium/high in limited areas.
- Slopes <5%: >80% but significant areas <20%.
- Median annual simulated runoff: Moderate to very high.
- Mean annual temperature: Moderate to moderately hot.

Table 6-1: Detailed characteristics of the South Eastern Coastal Belt (20) Level 1 Eco-region

Main Attributes	Description
Terrain Morphology: Broad division (dominant types in bold) (Primary)	Plains; Low Relief (limited); Plains Moderate Relief; Closed Hills; Mountains; Moderate and High Relief
Vegetation types (dominant types in bold) (Secondary)	Dune Thicket; Mesic Succulent Thicket; Valley Thicket; Xeric Succulent Thicket Coastal Grassland; Eastern Thorn Bushveld; Grassy Fynbos (limited); Mountain Fynbos; South and South West Coast Renosterveld; Afromontane Forest;
Altitude (above mean sea level – a.m.s.l)	0-500; 500-1300 limited
MAP (mm)	300 to 1000
Coefficient of Variation (% of annual precipitation)	<20 to 40
Rainfall concentration index	<15 to 30
Rainfall seasonality	All year to very late summer, to winter
Mean annual temp. (°C)	12 to 20
Mean daily max. temp. (°C): February	22 to 30
Mean daily max. temp. (°C): July	12 to 22
Mean daily min. temp. (°C): February	10 to 18
Mean daily min temp. (°C): July	2 to 10
Median annual simulated runoff (mm) for quaternary catchment	10 to >250

(ENVASS Triplo4 - Wetland Delineation and Functional Assessment, 2022)

6.1.3 Regional Climatic Conditions

The climate change projections for the Project indicate that the median annual mean ambient temperatures are likely to increase by 0.1-0.3˚C by 2030 and 0.4-1.0˚C by 2050 (with significant annual variability) under different climate scenarios.

Mean annual precipitation is likely increase in the short-term from recent amounts to the historical mean (since 1980). By 2050 precipitation is likely to be below the near-historical mean but is very dependent on the SSP trajectory and will be highly variable between now and 2050. The projected shifts are likely to further influence the regions' risks to droughts and fires in the future (Table 6-2). Such climatic changes could impact on the Project in terms of its core operations, value chain and broader socio-economic and natural environment. The current and future changes in climate for the Project at Ngqura Port, are summarised in the table below.

Table 6-2: Current and future climate projections - Project at Ngqura Port - Nelson Mandela Bay Metropolitan Municipality. Data sources: Copernicus Climate Change Service (C3S), & Green Book Risk Profile Tool.

		Projected change by 2040-2059 (median year 2050) relative to baseline		
Climate change impact	**Current/Near-historical**	**SSP1**	**SSP2**	**SSP5**
Mean annual temperature	18.1 ±0.3˚C; slight increasing trend	Increase of 0.2-0.8°C	Increase of 0.1-0.9°C	Increase of 0.2-1.0°C
Very Hot Days	0.2 days/year (mean)	Not available	Increase by 0-6 days/year (mean increase of 2.6 days per year)	Increase by 0-7 days per year (mean increase of 4 days per year)
Mean annual precipitation	502 ±107 mm/year; decreasing trend	Mean increase of ±95 mm/year	Mean increase of ±90 mm/year	Mean increase of ±110 mm/year
Extreme Rainfall Days	1.5 days/ year	Not available	Negligible change (<0.5 days)	Increase of ±2.2 days per year.
Drought Risk	Low to moderate drought risk	Not available		Extreme risk of increase in drought conditions per decade compared to baseline
Coastal flooding risk	Very high risk	Not available		Extreme risk
Fire Risk	Possible	Not available		Medium risk

(Promethium – Climate Change Impact Assessment, 2022)

6.1.4 Local Climatic Conditions

Local air and sea temperatures are measured at Port of Ngqura. The monthly maximum mean and minimum values of the air and sea temperatures are shown graphically below:

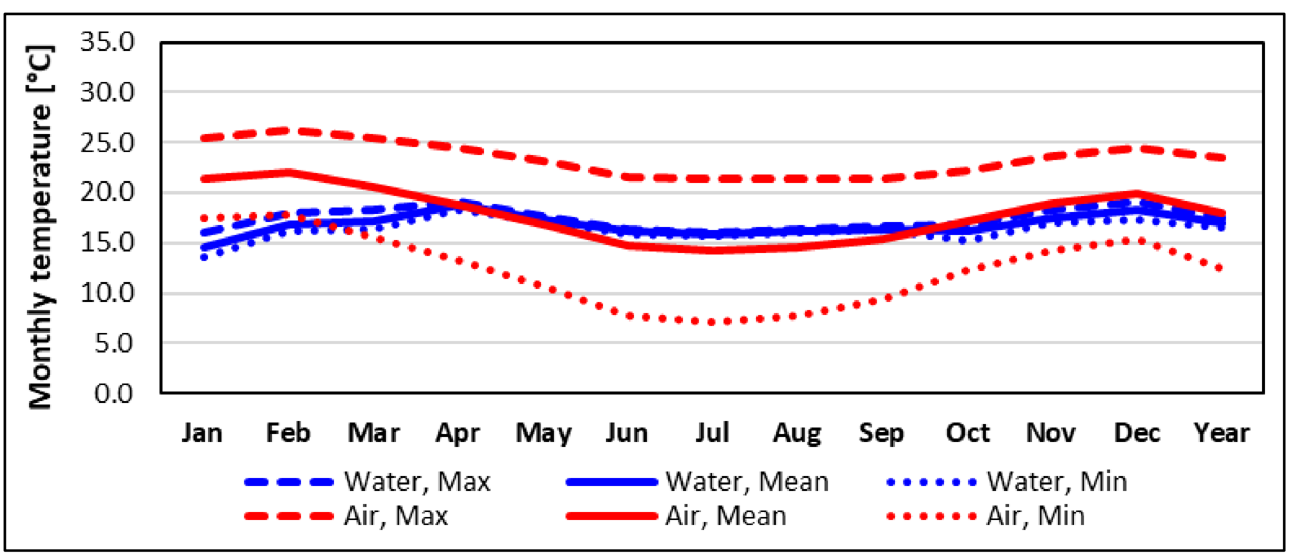
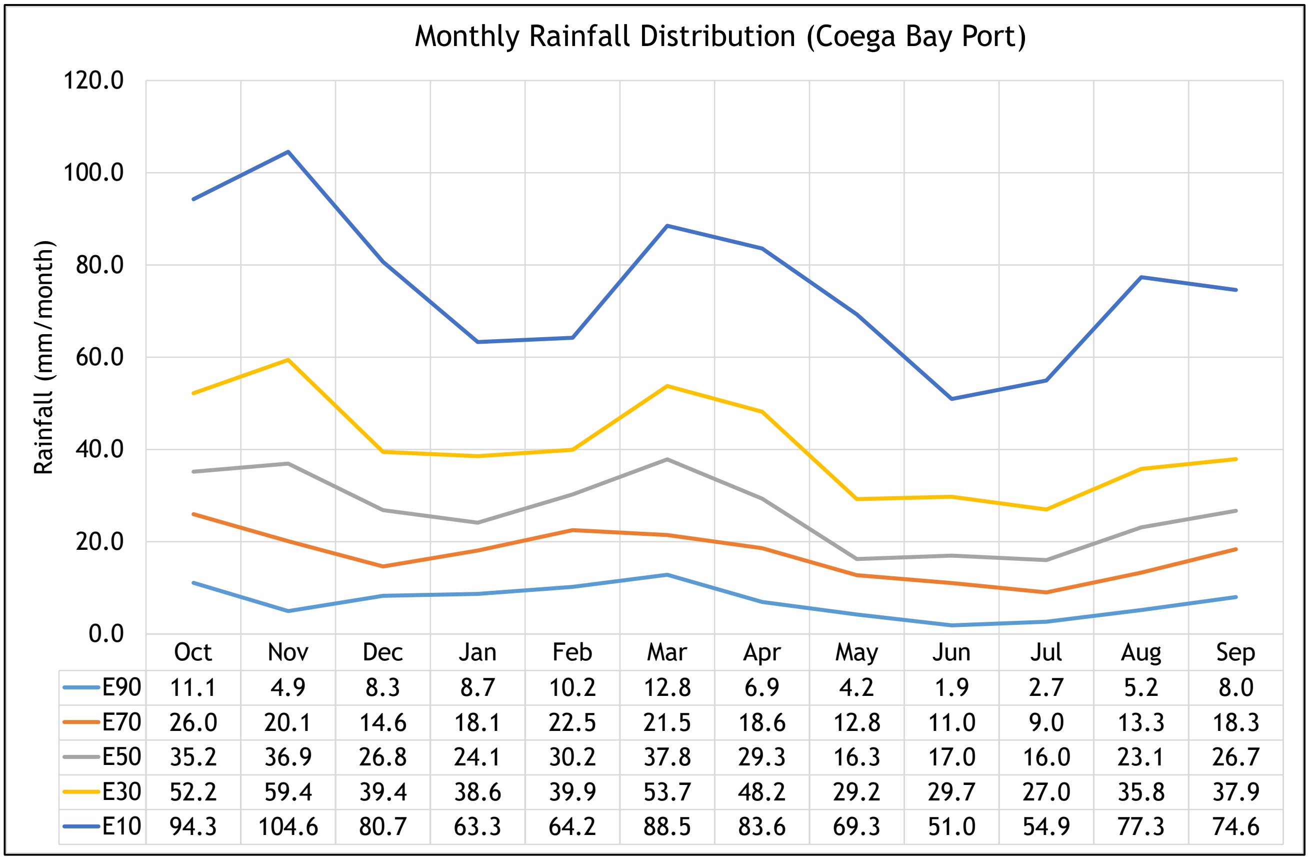


Figure 6-1: Monthly air and sea temperatures measured at Port of Ngqura.

Mean Annual Precipitation (MAP) and Mean Annual Evaporation (MAE) for the study area, obtained from WR2012, are 434 mm and 1 550 mm, respectively. Since evaporation is significantly higher than rainfall, there will be a net loss of water from the surface. The catchment falls within a summer rainfall area where peak rainfall occurs in November.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
E90	11.1	4.9	8.3	8.7	10.2	12.8	6.9	4.2	1.9	2.7	5.2	8.0
E70	26.0	20.1	14.6	18.1	22.5	21.5	18.6	12.8	11.0	9.0	13.3	18.3
E50	35.2	36.9	26.8	24.1	30.2	37.8	29.3	16.3	17.0	16.0	23.1	26.7
E30	52.2	59.4	39.4	38.6	39.9	53.7	48.2	29.2	29.7	27.0	35.8	37.9
E10	94.3	104.6	80.7	63.3	64.2	88.5	83.6	69.3	51.0	54.9	77.3	74.6

Figure 6-2: Monthly rainfall evaporation distribution for the M30B quaternary catchment

(GCS- Hydrology Assessment, 2022)

Prevailing wind tends to follow the coastline and the prevailing winds in the Port Elizabeth area are west-southwesterlies and east-northeasterlies. The airport at Port Elizabeth is the most climatologically representative of the sites and is well exposed to the prevailing synoptic-scale winds, showing a high frequency of winds from the sector west to southwest (more than 50% of all winds). These are also the strongest winds. There is some occurrence of wind from the northeast and east at this site. The annual average wind speed here is 5.7 m/s. The winds at Amsterdamplein, Motherwell and Saltworks also indicate the occurrence of reasonably strong west to southwesterly synoptic scale winds. At Amsterdamplein, winds are fairly, equally spread from the southwest, southeast, northwest, north and north-northeast, with an average wind speed of 4 m/s. At Motherwell, winds are predominantly from the northwest to southwest and east-southeast, with an average wind speed of 3.4 m/s. At Saltworks, winds are mainly from the west-northwest to southwest, north and east, also with an average wind speed of 3.4 m/s. (refer to Figure 4-3 – Wind Roses for Port Elizabeth Airport, Amsterdamplein, Motherwell and Saltworks).

The poorest atmospheric dispersion conditions occur with inversion conditions and calm or light winds. Greater surface cooling in winter is conducive to the formation of surface temperature inversions and a shallow mixing layer, particularly at night. Pollutants that are released into the inversion layer are typically trapped between the surface and the top of the inversion. Under light wind conditions, pollutants will tend to accumulate. It is under these conditions for May to July when the highest ground level concentrations of pollutants may be expected in the area.

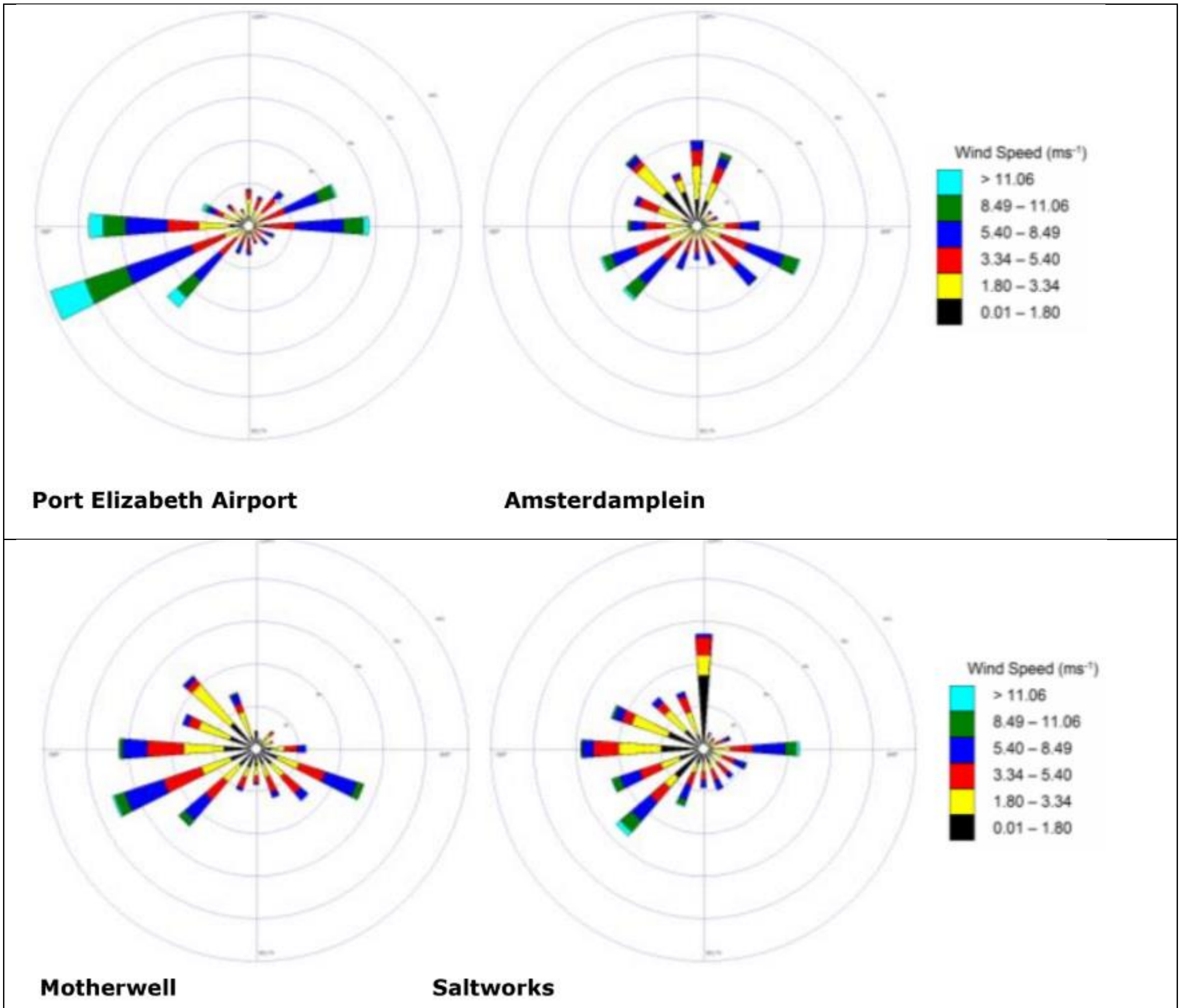


Figure 6-3: Figure Annual wind roses for Port Elizabeth Airport, Amsterdamplein, Motherwell and Saltworks for 2009-2011. Arcs represent 5% frequency intervals.

(uMoya-Nilu - Atmospheric Impact Report., 2022)

6.1.5 Ambient Air Quality

The status of ambient air quality in the Coega SEZ is described here using data from the Saltworks monitoring site. Monitoring data provides accurate measurements at a single point which may not be representative of the entire area of interest.

Ambient monitoring data for 2017 to 2019 at Saltworks is analysed for SO_2, NO_2, and PM_{10}. A relatively coherent dataset was available for the Saltworks site for August 2017 to December 2019. Monitored SO_2 data show ambient levels for the monitoring period, with no exceedances of NAAQS. Monitored NO2 concentrations are elevated with higher concentrations observed in winter (i.e., June to August). Monitored PM10 concentrations are elevated year-round with no exceedances of NAAQS. An estimated background concentration of 10 µg/m3 is observed, increasing in late winter and early spring. This is consistent with inputs from regional biomass burning. An increasing annual trend can also be observed and is suggestive of additional air quality management needs in the area.

Table 6-3: Annual Average Monitored Concentrations

Year	SO_2	NO_2	PM_{10}
	NAAQS 50 µg/m3	**NAAQS 40 µg/m3**	**NAAQS 40 µg/m3**
2017	3.3	8.5	14.8
2018	4.4	9.1	20.9
2019	1.6	10.7	26.6

(uMoya-Nilu - Atmospheric Impact Report., 2022)

6.1.6 Storms and Storm-Related Weather Impacts

Ngqura Bay are storms associated with frontal systems primarily occurring in winter low pressure systems such as cut-off lows that can bring widespread rain. Ngqura Port is vulnerable to cut-off lows developing and the flat topography of the coastline of Algoa Bay mean there is a very high coastal flooding risk during extreme rainfall and storm events and predicted to increase to extreme levels in the future.

Peak wave height during storms appears have increased and with an increase in storm activity in the future, there is a possibility if increased storm surges in the future, but substantially more data and research are required.

At the Ngqura Port, a combination of sea level rise, tides and storm surges appear likely to impact the Port itself and the area south-west of the Port (St George’s Strand) (Figure 6-4). Coastal infrastructure including those associated with harbours and Port will require increased maintenance to withstand increased storm surges. The coastal flooding risk for Algoa Bay as a whole, including Ngqura Port, is classified as very high, increasing to an extreme risk.

Figure 6-4: Area impacted (in pink) at and around the Ngqura Port by a 1 m rise in water level through combinations of sea level rise, tides, and storm surge. Source: https://coastal.climatecentral.org/.

At Ngqura Port, surface sea water pH has declined from roughly 8.14 to 8.09. By 2050, pH is predicted to be ~0.2 lower than a baseline of 1950 along the east coast of southern Africa under Shared Socio-economic Pathways (SSP5). Change of this magnitude and based on a trend of historical data poses a low risk the project and associated infrastructure.

Data from the [South African] Hydrographic Office shows that mean sea level at Ngqura Port has increased by ±7.6 cm (19.0 mm y-1) between 1978 and 2018 based on a linear trend. According to IPCC AR6 projections, sea level around Ngqura Port is expected rise by 11-39 cm (from a 1995-2014 mean) by 2050 under different SSPs (Figure 6-5) with the earliest expected 1 m rise (from a 1995-2015 mean) by ca. 2090 under SSP5-8.5.

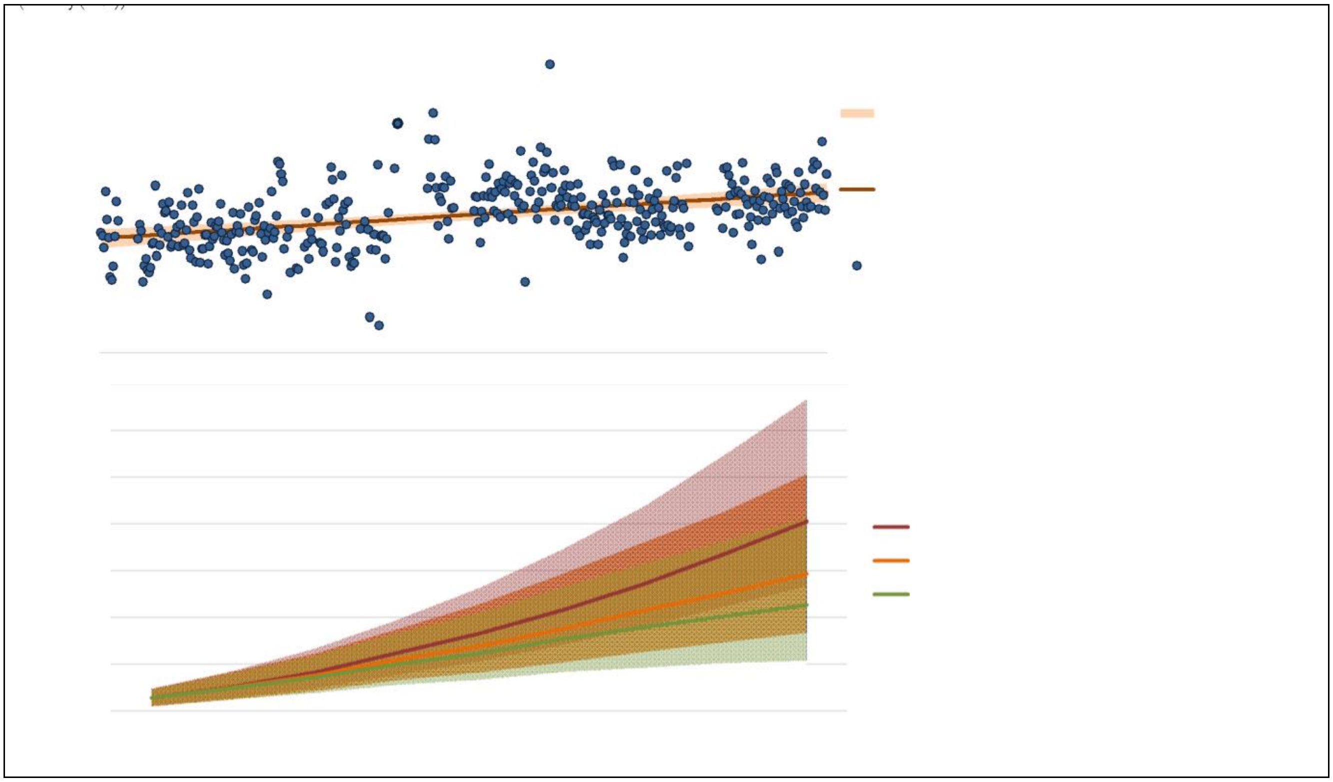


Figure 6-5: Measured monthly sea level at Ngqura Port from 1978 to 2018. Data source: SAN Hydrographic Office (top) and sea level rise projections under SSPs 1, 2 and 5. Data source: IPCC AR6.[17] (bottom).

The rise in sea level is not likely to have a material impact on the project during its lifetime. Increases in sea level amplify storm surges during extreme weather events. Increased sea level will result in greater water depth which positively influences wave energy, thus increasing the potential impacts on wave damage during storms and periods of sustained high winds.

Mean SST at Ngqura Port has increased by ±1.05˚C since 1900, with a decadal mean of 20.55˚C at present. By 2030 the temperature is could reach 21.3˚C (21.1-21.6˚C depending on SSP) and 22˚C by the late 2040s (despite a consistent drop towards the end of the 2040s in all SSPs) (Figure 6-6).

SST increases up to 2040 are unlikely to have a material impact on the operations of the project and the associated risk to the project is thus deemed to be very low. The primary impacts of SST changes are on marine biota, with widespread coral (Anthozoa) bleaching being the most well-known impacts of increased sea temperatures. Migration patterns and timing, fish spawning and plankton blooms have also been affected by changes to sea temperatures.

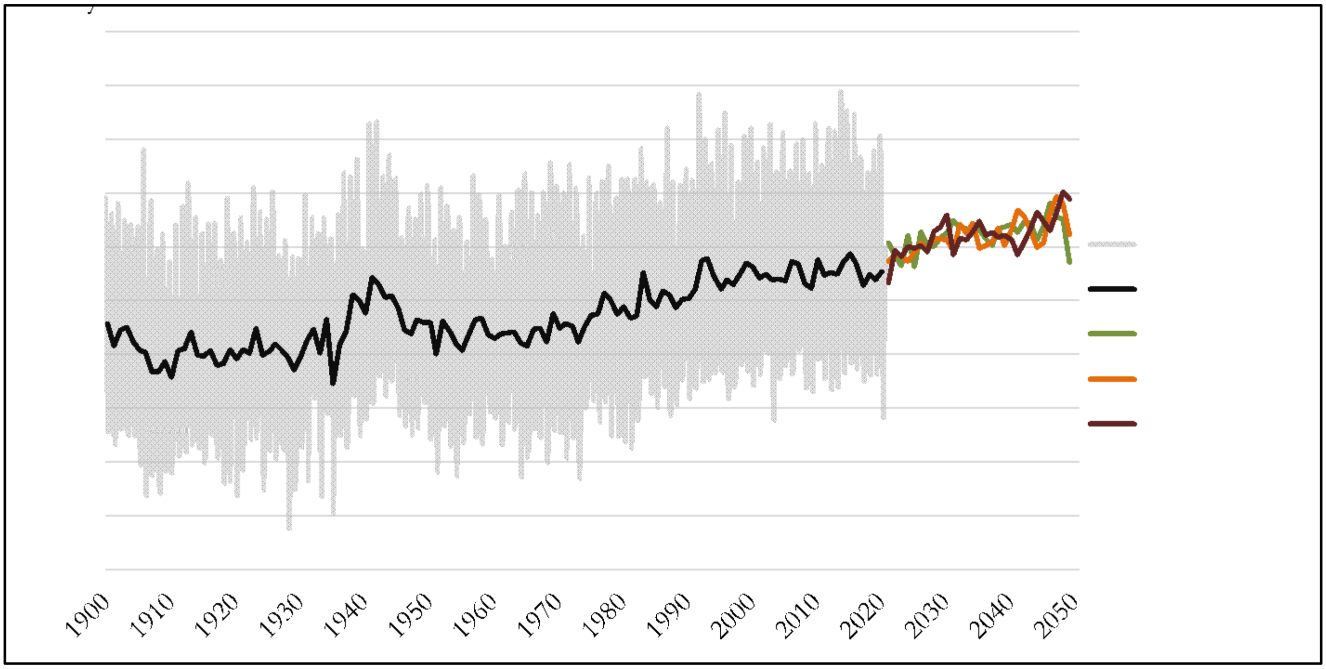


Figure 6-6: Historical mean sea surface temperature for Ngqura Port since 1900 and projected sea surface temperature up until 2050 under SSPs 1,2 and 5. Data sources: HadISST (historical), CMIP6 (future).

(Promethium Carbon - Climate Change Impact Assessment, 2022)

6.1.7 Terrestrial and Underwater Noise

6.1.7.1 Terrestrial

The noise sensitive areas (NSAs) have been identified and illustrated in Table 6-4 and Figure 6-7. The distances are calculated based on the noise source in relation to the noise sensitive area.

Table 6-4: Location of Noise Sensitive Areas.

#	Noise Sensitive Area	Latitude	Longitude	Distance to Project Location (m)
NSA 1	TPT Offices	33°48’29.5” S	25°40’49.1” E	1450
NSA 2	NPA Offices	33°47’27.3” S	25°41’18.2” E	1100
NSA 3	Cerebos Offices	33°46’2.8” S	25°41’52.7” E	3595
NSA 4	CDC Offices	33°47’46.7” S	25°40’37.9” E	1535
NSA 5	Motherwell Township	33°47’58.1” S	25°37’19.5” E	6605
NSA 6	St Georges Houses	33°49’22.1” S	25°39’25.4” E	4190
NSA 7	Jahleel Island	33°48’21.9” S	25°42’16.5” E	1175

NSA 8	St Croix Island	33°47’57.6” S	25°46’1.9” E	6905
NSA 9	Brenton Island	33°49’3.3” S	25°45’52.4” E	6950
NSA 10	Damara Tern Colony	33°46’59.5” S	25°42’51.8” E	2820
NSA 11	Rare Butterfly Habitat 1	33°44’40.2” S	25°39’5.5” E	7300
NSA 12	Rare Butterfly Habitat 2	33°45’26.9” S	25°39’2.5” E	6190
NSA 13	Rare Butterfly Habitat 3	33°47’20.0” S	25°40’3.7” E	2705

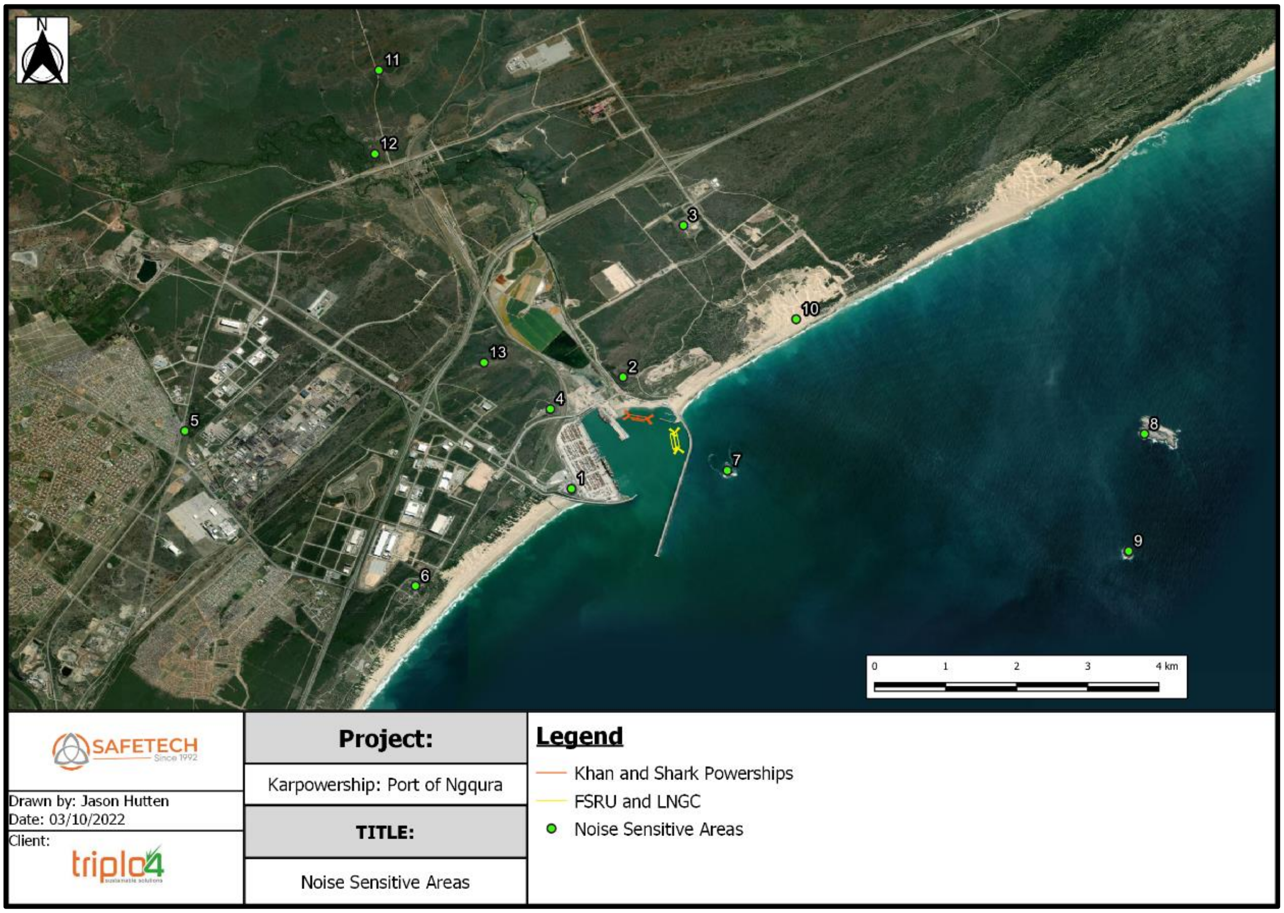


Figure 6-7: Noise Sensitive Areas.

The most sensitive areas from a noise perspective will be the staff and contractors within the Port of Ngqura, Jahleel Island and the Damara Tern Colony.

The other sensitive areas are too far away from the noise source to be of concern due to the attenuation of noise by distance. Access to Jahleel Island was not possible, therefore long-term measurements were taken at the harbour wall, which is close to the location of the proposed project. This point is a proxy for Jahleel Island as it is far enough from the current Port of Ngqura activities to approximate the residual noise.’

Given the strong winds experienced during the field study, it is highly possible that, on a calm day or night, the ambient noise level will fall below the SANS 10103:2008 night-time limit of 60 dB(A) for industrial districts or 50 dB(A) for natural areas.

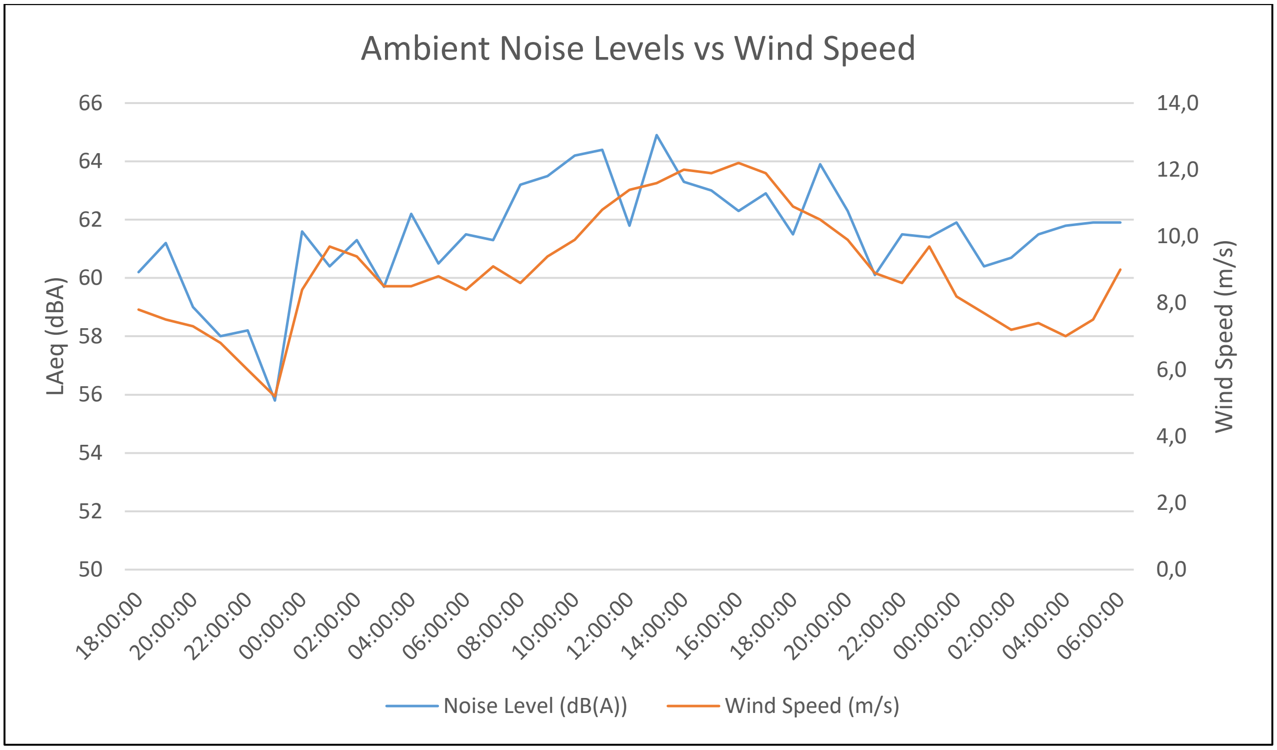


Figure 6-8: Ambient Noise Levels vs Wind Speed

The most applicable standard for planning purposes used in this study is SANS 10103:2008 which provides typical rating levels for noise in various types of districts. Ideally, in such areas one does not want to experience any anthropogenic noise pollution. SANS 10103:2008 provides typical rating levels for noise in various types of districts, as described in Table 6-5 below.

Table 6-5: Typical rating level for noise in various district types.

Type of District	Equivalent Continuous Rating Level, LReq.T for Noise					
	Outdoors (dB(A))			Indoors, with open windows (dB(A))		
	Day-night	Daytime	Night-time	Day-night	Daytime	Night-time
Rural Districts	45	45	35	35	35	25
Suburban districts with little road traffic	50	50	40	40	40	30
Urban districts	55	55	45	45	45	35
Urban districts with one or more of the following: Workshops; business premises and main roads	60	60	50	50	50	40

Type of District	Equivalent Continuous Rating Level, LReq.T for Noise					
	Outdoors (dB(A))			Indoors, with open windows (dB(A))		
	Day-night	Daytime	Night-time	Day-night	Daytime	Night-time
Central business districts	65	65	55	55	55	45
Industrial districts	70	70	60	60	60	50

These rating levels can thus be seen as the target levels for any noise emissions from a nearby industrial noise source. As can be seen from the residual noise monitoring results, the current residual noise is not exceeding the recommended day/night rating levels of industrial districts during high wind periods. It is however highly likely that the residual will be below the SANS 10103:2008 rating limit for industrial areas during calm conditions. The highlighted red font are the rating limits applicable to this project in the Port of Ngqura (Industrial Districts).

6.1.7.2 Underwater Noise

***6.1.7.2.1** Underwater Noise – Ghana*

The Karadeniz Powership Osman Khan is a 470 MW capacity Khan class Powership currently installed in Sekondi Naval Base, Ghana. The Powership features 24 gas powered engines, each engine capable of producing 18.3 MW of electricity. The underwater noise survey was undertaken to measure the in-water noise produced by operational plant onboard the Powership, selected for its similarity with those proposed to be deployed (sister ship) in South Africa. Based on the maximum power output of the Osman Khan (470 MW), the harbour design and technical parameters considered, this Powership is of the same design class to study, in order to determine relevant noise information for the South African Project.

***6.1.7.2.2** Baseline Underwater Noise – Port of Nqgura*

The monitoring was undertaken using a high-sensitivity hydrophone suitable for the measurement of background noise levels in this environment. The transducer used at the static monitor was a low-noise OceanSonics icListen RB9 digital hydrophone. This measurement station sampled on a 15-minute duty cycle over a period of 48 hours, sufficient to capture a variation over complete tidal cycles and any influence from the movement of bulk carrier ships and any other small craft passing nearby, such as tugs. The static monitor was installed at approximately 10:20 on 9th November 2021 and retrieved at 10:20 on 11th November 2021.

A series of spot measurements were taken at positions around Port of Ngqura harbour, as well as samples outside the sheltered area towards Jahleel Island to provide a representative sample of the noise levels throughout the wider area. The location of each measurement is shown in Figure 4-9. The locations are provided as an approximate position rather than a precise point on the map, as there was always some drift in position during the measurements.

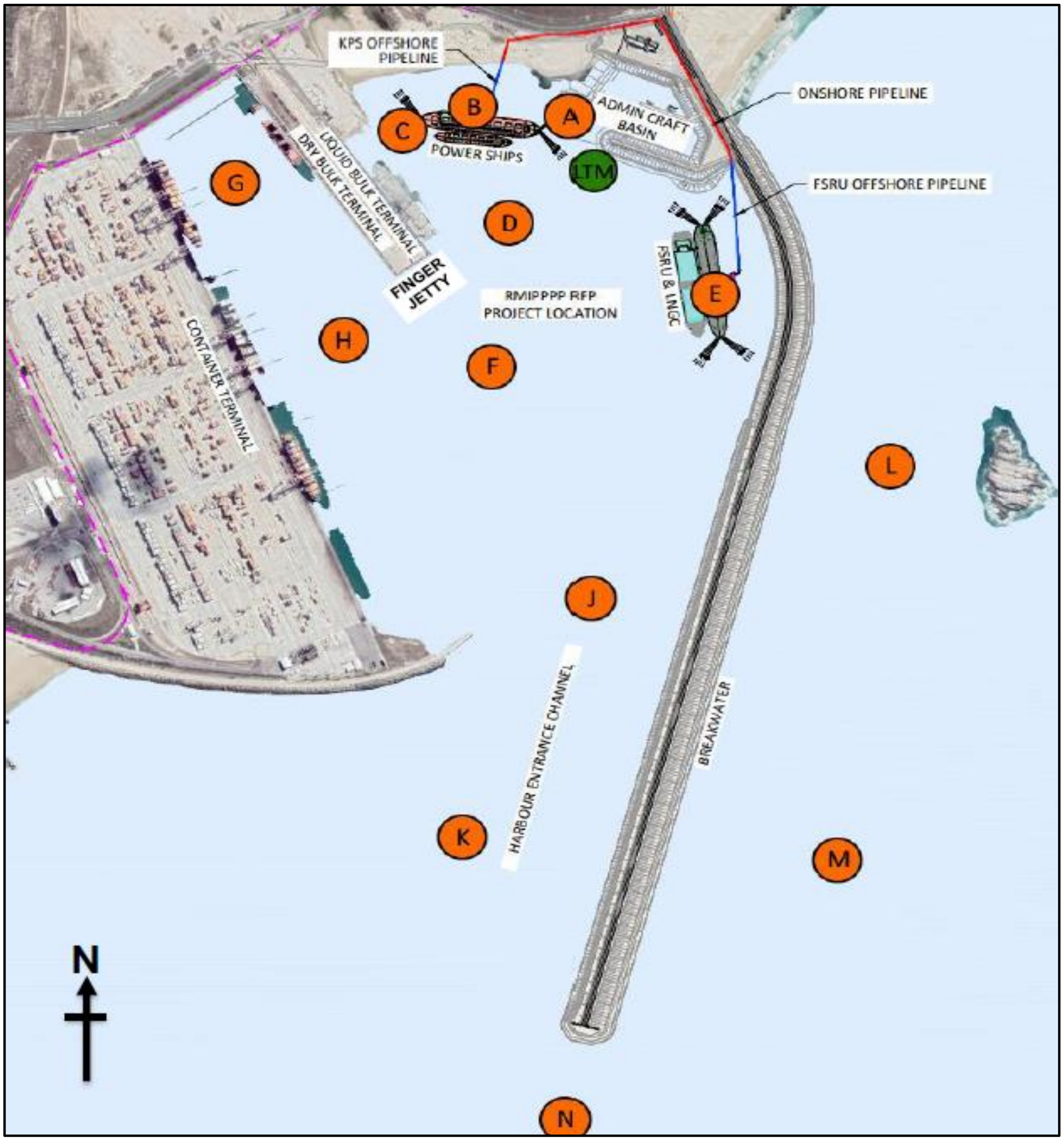


Figure 6-9: Measurement locations in Port of Ngqura, Coega SEZ. The static monitor location is labelled "LTM"

6.1.7.2.3 Underwater Noise – Port of Nqgura

In the Port of Ngqura, the largest Powership is capable of operating at up to 416 MW with 21 engines (Khan class), next to a second smaller Powership capable of operating at up to 125 MW with 6 engines (Shark class). For the larger ship, the noise level from the Powership in Ghana operating at 420 MW will be used. This will be combined with the measurements in Ghana at 250 MW power output, divided by two, which is equivalent to a reduction in noise of approximately 3 dB [i.e. 10*log(2)].

All calculated noise levels are based on the distance of each source to the relevant receiver position. Attenuations are based on the measurements in Ghana directly where available or using the best fit from the measurements at 420 MW (approximately 14.log(R) geometric attenuation).

All decibel noise values are combined with simple logarithmic addition, where the contributing noise added to the baseline noise equals the total combined levels, e.g. (by the Powership) 126.0 dB + 133.9 dB = 134.5 dB.

6.1.8 Geology and Soils

According to 3324 Port Elizabeth-1:250 000 Geological map series (DMEA, 1991) the local geology at the site is characterised by quaternary sands and sandy consolidated sediments associated with the Sondagsriver Group, associated with the Port of Ngqura (refer to Figure 6-10). Refer to Appendix 9-A4 - Geohydrological Assessment and Appendix 10.8 Geotechnical Review.

The soil textures within the study area range from sandy clay in the watercourses to sandy in the catchment areas. The entire study area is recorded to contain soils that display characteristics associated with C class soils (Schultze et al., 2010). These soils are calculated to exhibit a moderately high runoff potential with a slow infiltration rate and restrictive permeability. According to Schultze (1992), soils within the C class have a moderate erosion potential factor of 0.46, indicating that these soils exhibit a moderate level of sand content, are not entirely easily detachable but can encourage high rates of surface runoff, dependent on the surface roughness of the area.

The Algoa Basin is the most complex half-graben basin, with fully developed graben structures, horst blocks and diagonal faults (Coega and Commando Kraal Faults) cutting the horsts (Lourens, 2013). The Sundays River Formation overlies the Kirkwood Formation and attains a maximum thickness of approximately 1 863 m consisting of grey clays, siltstone and sandstone. The sandstones of the Sundays River Formation are fine-to medium-grained and less porous and permeable than the sandstones of the Kirkwood Formation. According to the Land types of South Africa database (ARC, 2006), the soils in the area predominantly consist of Mispah, Clovelly and Hutton soil forms, associated with the Fc369 land type.

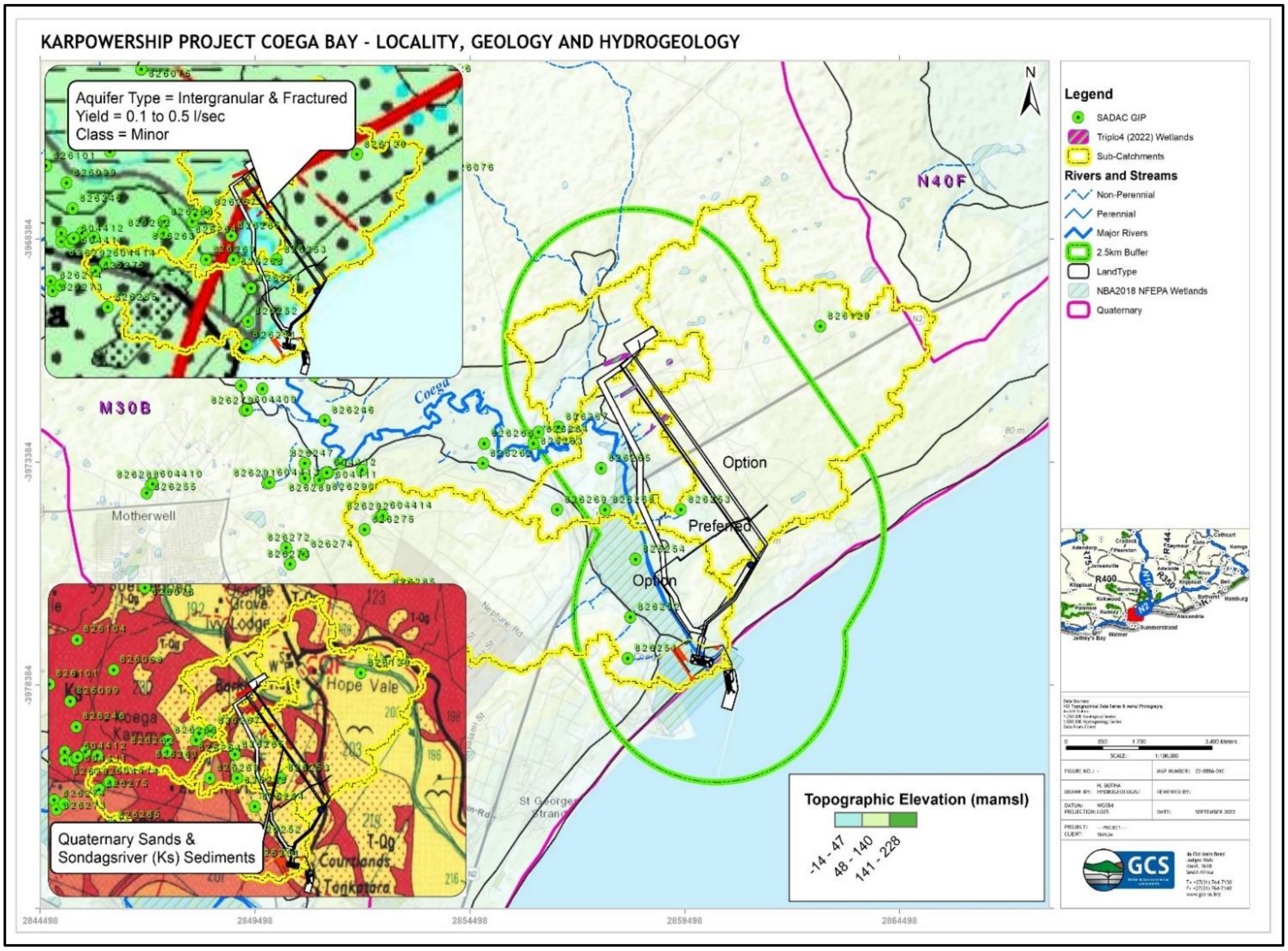


Figure 6-10: Site locality, local geology and hydrogeology.

6.1.9 Water Resources

6.1.9.1 Groundwater

Literature suggests that the electrical conductivity (EC) for the rivers and streams associated with the project area and underlying aquifer generally ranges between 70 – 350 milli Siemens/meter (mS/m) and the pH ranges from 5 to 8. This indicates that water is generally suitable for domestic and recreational use (DWAF, 1996b); (DWAF, 2003) and (King, et al., 1998).

The aquifers underlying the site consist out of unconsolidated and consolidated sand, underlain by competent rock (sandstone) of the Uitenhage Series. The aquifer has a low to medium hydraulic conductivity (K-value) and porosity (n-value). The aquifer present is classified as a Minor Aquifer system (Parsons, 1995). Hence, the aquifer is not targeted for groundwater production. Two (2) aquifer systems are present:

- An unconfined aquifer associated with the unconsolidated sands; and
- A confined and fractured aquifer network associated with deeper and older Uitenhage Series.

The aquifer underlying the terrestrial portion of the site can be considered a low yielding aquifer (King, Maritz, & and Jonck, 1998), with reported yields ranging from 0.1 to 0.5 l/sec (Class-B2 aquifer). According to DWAF (2006), the groundwater depth on a quaternary scale is in the order of 25.8 mbgl. WRC (2015) and NGA (2015) data suggest that the groundwater table ranges from 1 to 26 mbgl, for the sub-catchment associated with the development site (refer to Figure 6-11). Shallower groundwater levels will typically be associated with low lying areas surrounding the Coega River, or areas where clay lenses occur (i.e. perched groundwater). Literature further suggests that the groundwater table mimics the surface topography. The site is situated in Quaternary Catchment M30B of the Mzimvubu-Tsitsikamma (DWS, 2016) Water Management Area (WMA).

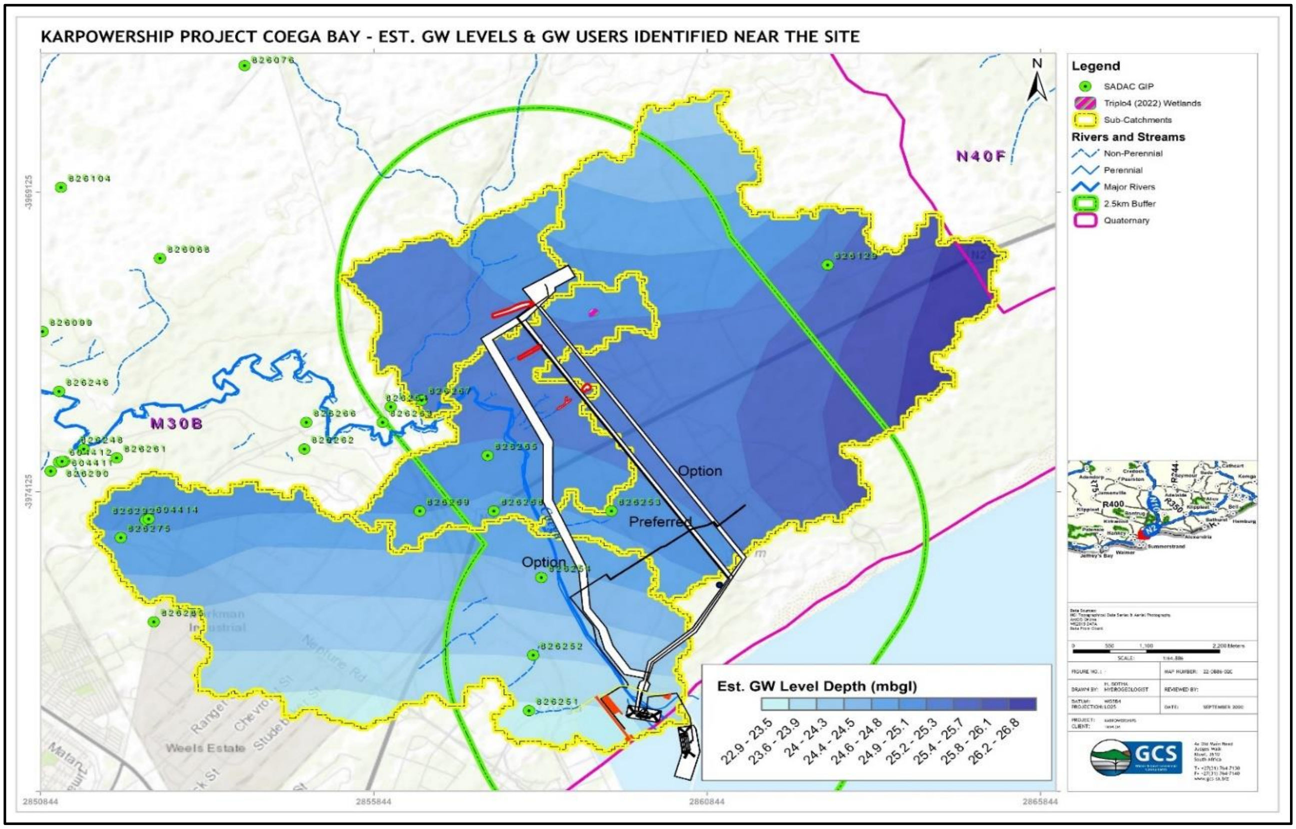


Figure 6-11: Estimated Groundwater Levels & Groundwater Users.

(GCS- Geohydrological Assessment, 2022)

According to National Groundwater Archive (NGA) and SADAC GIP borehole data for the project area, eight (8) groundwater users within a 2.5 km radius of the proposed transmission line. Assuming a median aquifer yield of 0.1 l/sec, an existing use in the order of 43.2 m³/day is assumed (GCS- Geohydrological Assessment, 2020).

6.1.9.2 Water Management Areas

The site is situated in Quaternary Catchment M30B of the Mzimvubu-Tsitsikamma (DWS, 2016) Water Management Area (WMA 7).

Four (4) sub-catchments were delineated for the project area, and describes the natural drainage of the area (i.e. the proposed transmission crosses several drainage lines). The site is bound to the west by the Coega River (approx. 1.5 km downstream). Several non-perennial (ephemeral) streams drain the site (with the preferred transmission line route falling outside these streams). Elevations on the site typically range from 0 to 60 metres above mean sea level (mamsl).

The aforementioned WMA is drained by several parallel rivers which flow in an easterly direction and eventually discharge into the Indian Ocean. The rivers which contribute to the highest flow within this WMA are the Fish, Kowie, Boesmans, Sundays, Gamtoos, Kromme, Tsitsikamma and Groot rivers with several smaller coastal rivers that feed the aforementioned larger rivers (Net el al., 2011). Refer to Figure 6.12 below.

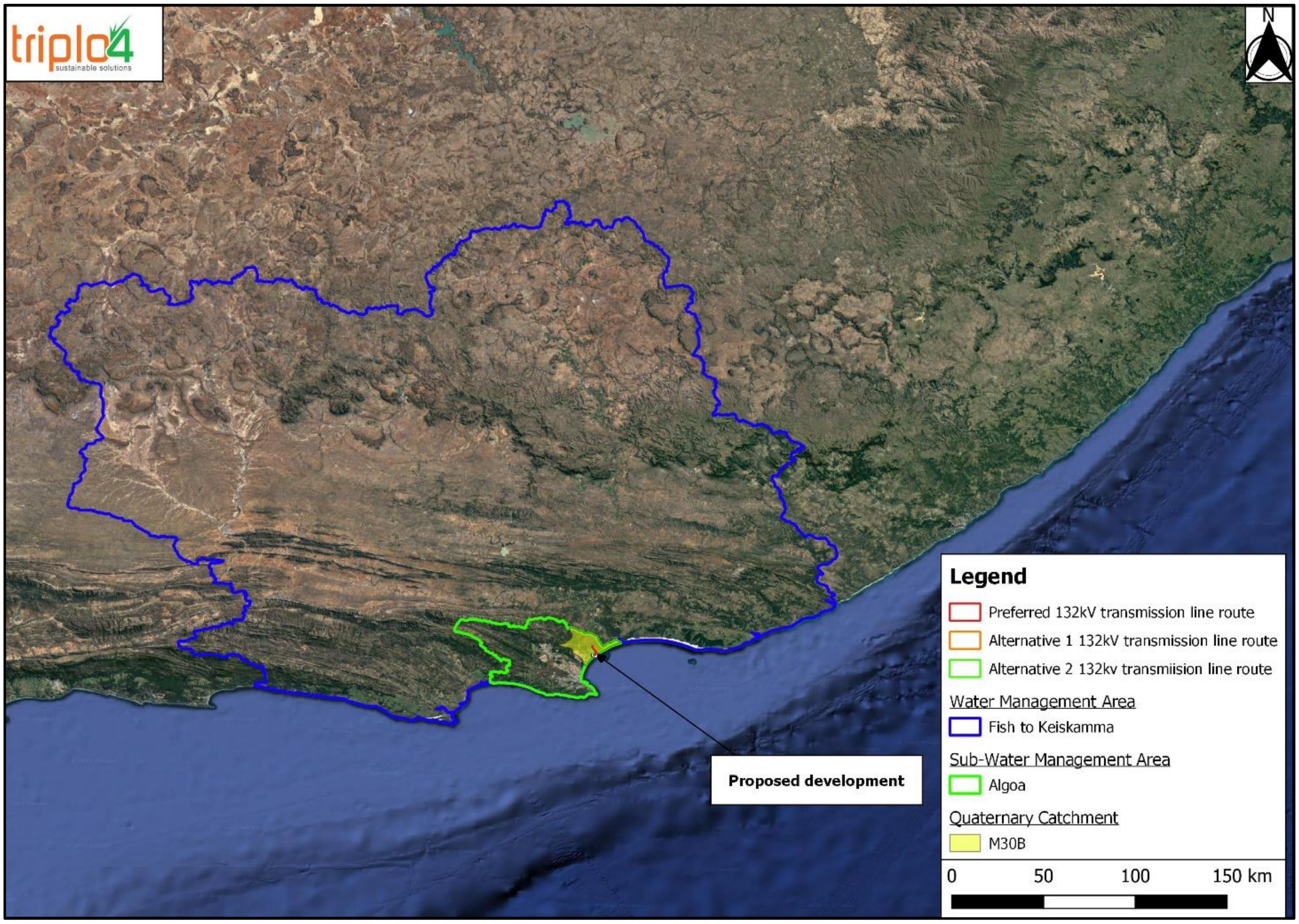


Figure 6-12: Map of the WMA, sub-WMA and Quaternary Catchment that fall within the proposed development.

6.1.9.3 Wetlands and Watercourses

The National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) are a selection of rivers, wetlands and estuaries which have been identified as systems of strategic importance to the hydrological functioning of South Africa. These systems have been identified using scientific methodologies as well as consensus amongst researchers, government entities and the general public (Nel *et al*., 2011).

According to the NFEPA dataset, historically a FEPA natural valley floor wetland would have been at risk as a result of the proposed development at a desktop level (Nel et al., 2011). However, due to the construction of the Ngqura Port, the aforementioned wetland does not exist anymore and it is currently dredged Port area. Furthermore, the desktop delineated FEPA Estuary is approximately 200m away from the starting point of the Alternative Route 1, whereas a natural bench is approximately 480m away from the end connection point (Dedisa Substation), in an easterly direction from the Dedisa Substation. The aforementioned wetlands were considered to not be at risk. Refer to Figure 6-13 and the Wetland Assessment in Appendix 9-A6.

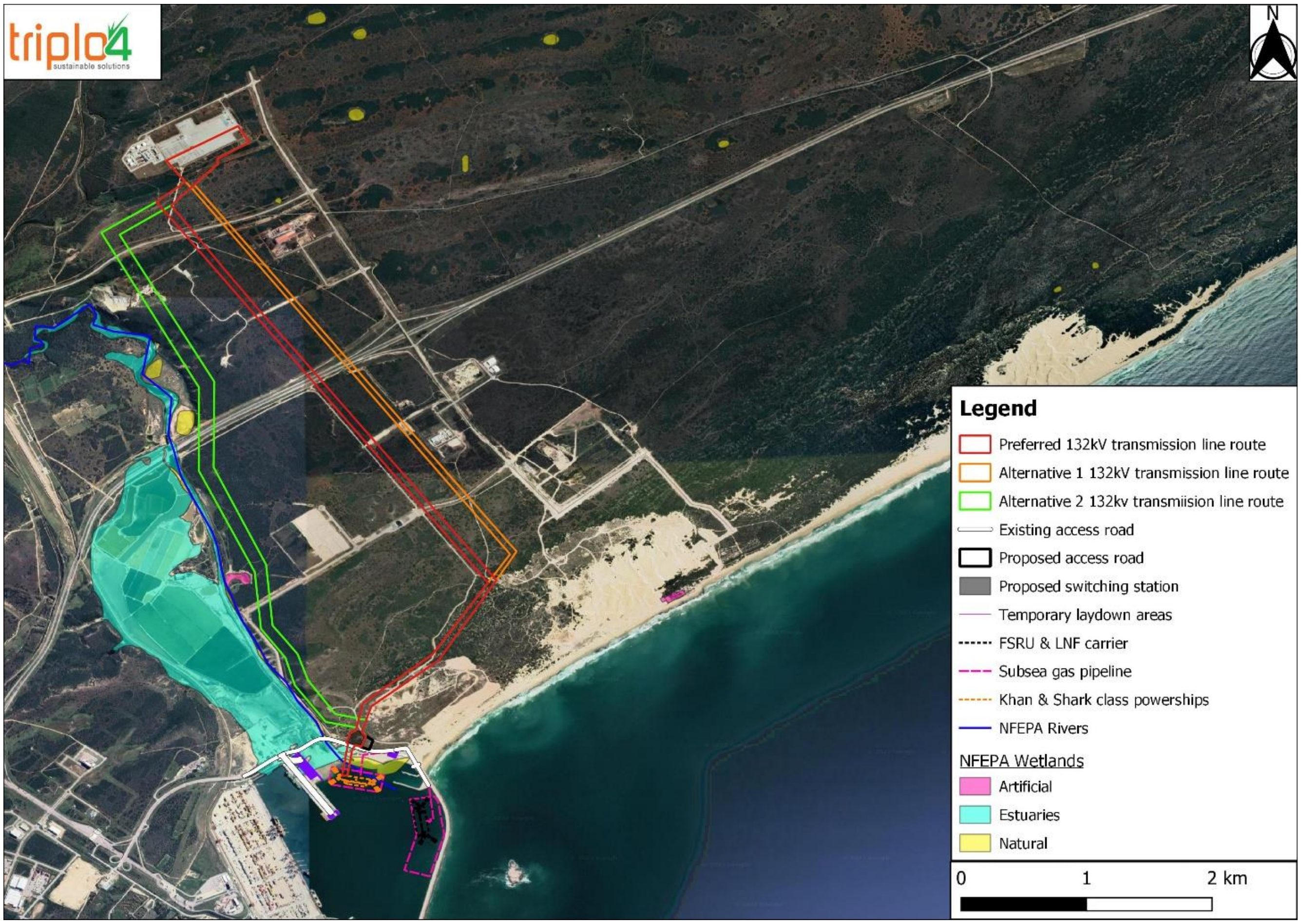


Figure 6-13: Map of the FEPA Rivers and Wetland in relation to the proposed development, from the NFEPA dataset.

Wetland Delineation

The watercourses within the study area were identified at a desktop level, classified and delineated in-field and subsequently mapped utilising GIS (QGIS 2.14 and Google™ Earth Pro) and available spatial data. Figure 6.14 below demonstrate the delineated watercourses identified within the study area during the field assessment.

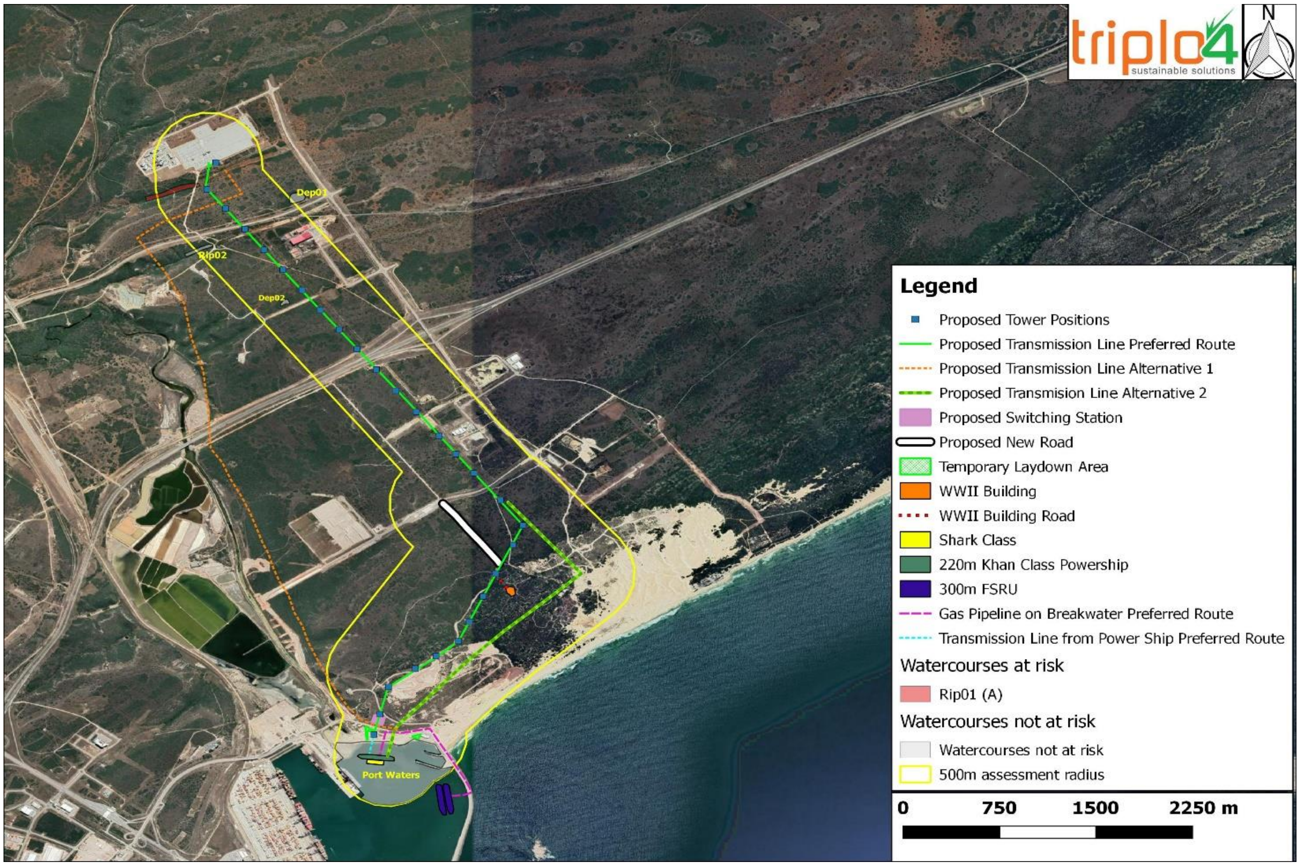


Figure 6-14: Map representing the watercourses within the study area and 500m assessment radius.

6.1.9.4 Aquatic Environment

Desktop information was obtained from DWAF (2013), for the sub quaternary reach (SQR) (M30A-08796) on the Coega River system, which may potentially be affected by the proposed development. The reach spans 72.92 km. The reach is heavily affected by canalization of the river, weirs, roads and bridges which significantly impacted on the instream habitat, water flow, habitat continuity in respect of aquatic invertebrates and fish. Riparian areas have been impacted by agriculture and alien plant infestation. In the lower reaches the estuary has been impacted by salt works, affecting physico-chemical conditions (water quality). Please refer to Table 6-6.

Table 6-6: Present Ecological Status for the Coega River SQR M30A-08796.

Synopsis for SQR M30A-08796 (Coega River)					
Present Ecological State		**Ecological Importance**		**Ecological Sensitivity**	
D (Largely Modified)		**High**		**Very High**	
Variable	**Status**	**Variable**	**Status**	**Variable**	**Status**
Modifications to Instream Habitat Continuity	Large	Fish species per sub quaternary catchment	12	Fish Physicochemical sensitivity description	High
Modifications to Riparian/Wetland Zone Continuity	Serious	Invertebrate taxa per sub	13	Fish No-flow sensitivity description	High

		quaternary catchment			
Modifications to Riparian/Wetland Zones	Serious	Habitat Diversity Class	Very High	Invertebrate Physicochemical sensitivity	High
Potential instream Modifications	Large	Instream Migration Link Class	Moderate	Invertebrate velocity sensitivity	Very High
Potential Flow Modifications	Moderate	Riparian-Wetland Zone Migration Link	Low	Stream size sensitive to modified flow/water level changes description	High
Potential Physicochemical Modifications	Large	Instream Habitat Integrity Class	Moderate	Riparian-wetland Vegetation intolerance to water level changes description	Low

(GCS- Preliminary Aquatic Assessment, 2022)

6.1.10 Fauna and Flora

6.1.10.1 Vegetation types

According to Mucina and Rutherford, there are four vegetation types: Sundays Thicket (AT 6), Coega Bontveld (AT 7), Algoa Dune Strandveld (AZs 1) and Cape Seashore Vegetation (AZd 3). In this case, the vegetation mapped by Mucina and Rutherford (2018) is true to the vegetation on the ground. The Coega OSMP also increases the detail of the mapping of the area of mesic succulent thicket and, to a lesser extent, bontveld of the site.

Sundays Thicket occurs on undulating plains and low mountains and foothills forming a dense thicket with trees, shrubs and succulents common, with a number of spinescent species as well as lianas. The local abundance of *Portulacaria afra* increases and the relative abundance of woody species present decreases with increasing aridity. This vegetation is Least Threatened with a conservation target of 19% and some both statutorily and privately conserved. Threats include cultivation and urban development as well as grazing by livestock. Thicker degraded through livestock grazing resembles a secondary thornveld or grassland, dominated by weedy or invasive species.

Coega Bontveld is restricted to the northeast of Port Elizabeth just inland of Algoa Bay, mainly around Coega. It occurs on moderately undulating plains and comprises a mosaic of low thicket (2 – 3m) bushclumps and open areas. The species present are a mix of Fynbos, Grassland and Karoo elements. A large number of succulent species occur in this vegetation type which has a conservation target of 19% with 10% statutorily conserved. The vegetation type has been lost to cultivation and urban development and the presence of the Coega IDZ is a serious threat.

Algoa Dune Strandveld occurs in a narrow coastal strip from the Tsitsikamma River mouth to the Sundays River mouth. It is comprised of a tall (up to 5m) dense thickets on dunes mainly outside the influence of salt spray and dominated by stunted trees and spinescent shrubs, lianas and with a sparse herbaceous and grassy understory. Algoa Dune Strandveld is Least Threatened with a conservation target of 20% and about 4% statutorily conserved. Over 10% has been transformed for cultivation, urban development and roads. Alien invasive species such as Acacia longifolia are problematic.

Cape Seashore Vegetation comprises beaches, coastal dunes, dune slacks and coastal cliffs of open grassy herbaceous and to some extent also dwarf shrubby (sometimes succulent) vegetation, often dominated by a single pioneer species. This vegetation type is Least Threatened, with a conservation target of 20% and almost half of the area statutorily conserved. About 2% has been transformed primarily by urban development.

Species of Conservation Concern (SCC) recorded from the site include over 35 species of succulent, many of which are protected. There is also a presence of (over 20 individuals) population of Euphorbia obesa. Aliens occur throughout the site, primarily due to disturbance occurring as part of the Industrial Development of the area. Some recorded species include Opuntia ficus-indica and Acacia longifolia (Terrestrial Ecological Assessment, 2022).

One of the large vegetation units present on the site is Coega Bontveld, this consists of a mixture of short, woody shrubland with interspersed dense bushclumps. Aloe ferox populations are common and extensive throughout this vegetation type. These denser bushclumps consist of typical thicket tree species that are also found in the dune strandveld. Some sections of the bontveld have been degraded particularly sections adjacent to all the roads as well as areas previously used in construction currently used for dumping areas.

Succulent Thicket occurs along the steeper valley slopes in the study area. This is the most sensitive vegetation type present and is rich in a diverse succulent species including species such as *Euphorbia meloformis* (Listed as Near threatened, SANBI, Raimondo et al. 2014).

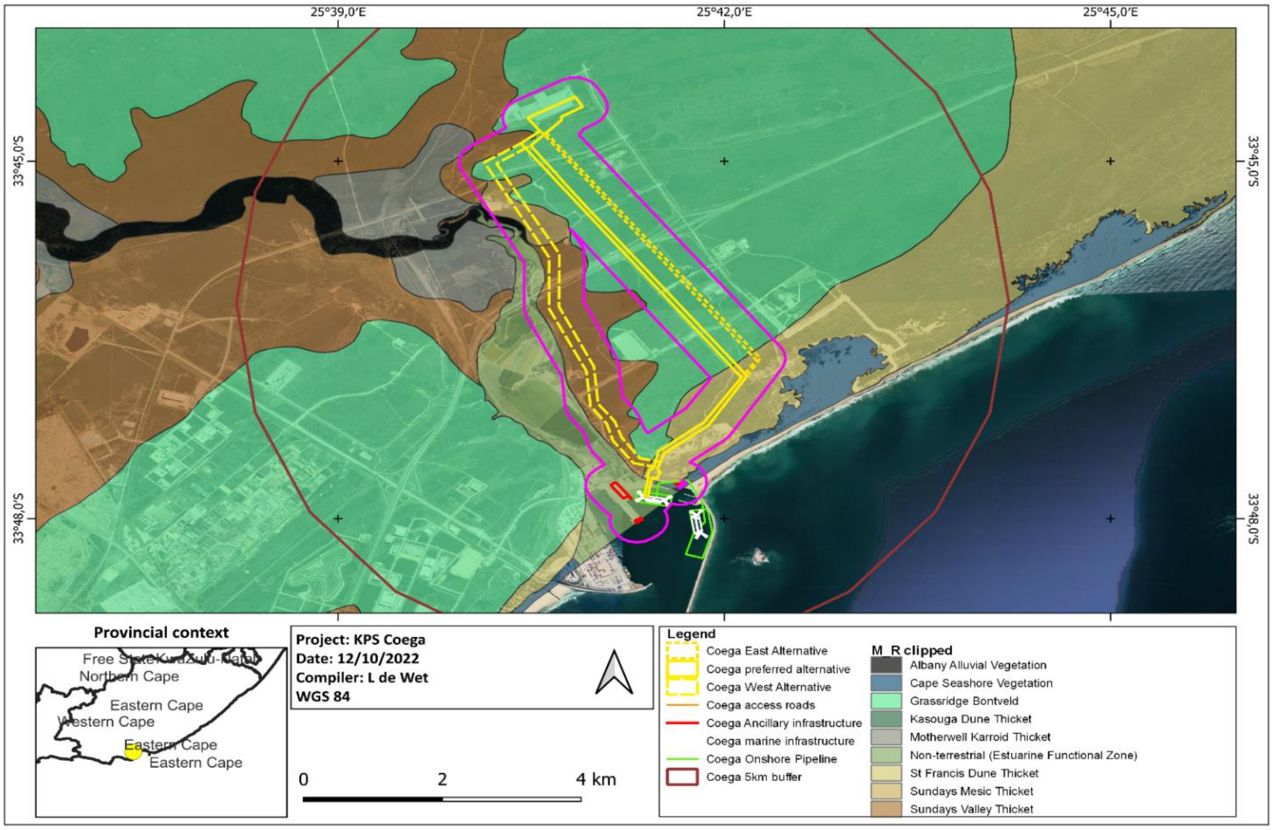


Figure 6-15: National Vegetation Map (Mucina & Rutherford, 2018)

6.1.10.2 Critical Biodiversity Areas (CBAs)

According to the Eastern Cape Biodiversity Conservations Plan (ECBCP), the study site is located primarily within an Ecological Support Areas (ESA) 1. This, according to guidelines, falls within Biodiversity Management Classes (BLMC 2): Near Natural Landscapes and should be managed to maintain biodiversity in near natural state with minimal loss of ecosystem integrity with no transformation of natural habitat permitted.

The study area is located outside of any Threatened Ecosystems but Albany Alluvial Vegetation, an Endangered ecosystem is located within 5km of the site. The closest protected area is the Addo Elephant National Park Marine Protected Area which includes islands (St Croix and Bird Island) off the coast less than 5km away from the study site. The St Croix group, consisting of Jahleel Island just off the Ngqura breakwater and Brenton Island on the seaward side.

Table 6-7: Criteria used to map CBAs and other categories in the ECBCP.

Category	Code	Features used to define categories
Protected Areas:		
Protected Area 1	PA1	Statutory protected areas. They include all national parks and provincial nature reserves.
Protected Area 2	PA2	Non-statutory protected areas: municipal and private conservation areas.
Terrestrial Critical Biodiversity Areas		

Category	Code	Features used to define categories
Terrestrial CBA 1	T1	Critically endangered vegetation types (ecosystems) identified through ECBCP the systematic conservation assessment
		Critically endangered vegetation types from STEP
		Critically endangered forest patches in terms of the National Forest Assessment
		Areas essential for meeting biodiversity targets for biodiversity features (SA vegetation types, expert mapping priority areas)
		KZN systematic conservation planning priorities
		Forest clusters identified as critical in the forestry planning process.
Terrestrial CBA 2	T2	Endangered vegetation types identified through the ECBCP systematic conservation assessment
		Endangered vegetation types from STEP
		Endangered forest patches in terms of the National Forest Assessment
		All expert-mapped areas less than 25 000ha in size (includes expert data from this project, STEP birds, SKEP, Wild Coast, Pondoland and marine studies)
		All other forest clusters (includes 500m buffers)
		1km coastal buffer strip
	C1	Ecological corridors identified in other studies (e.g. from STEP, Wild Coast, Pondoland, WMA 12 AEA, etc.) and corridors mapped by experts.
	C2	Ecological corridors identified by the ECBCP using an integrated corridor design for the whole province.

Table 6-8: Terrestrial BLMCs in relation to CBAs

CBA Map category	Code	BLMC	
Protected Areas	PA1	BLMC 1	Natural landscapes
	PA2		
Terrestrial CBA 1 (not degraded)	T1		
Terrestrial CBA 1 (degraded)	T1	BLMC 2	Near-natural landscapes
Terrestrial CBA 2	T2		
	C1		
	C2		
Other Natural Areas	ONA T3 ONA	BLMC 3	Functional landscapes
Transformed Areas	TF	BLMC 4	Transformed landscapes

6.1.10.3 Fauna

The Animal Demography Unit (ADU) data were interrogated to produce a list of each group of fauna for the Quarter Degree Square (QDS) into which the study site falls, and a list of recorded species for each group produced. The study area is known to house various faunal species, some of which are of conservation importance. Species expected include those that are likely to make use of the habitats present on site including thicket, mesic thicket and bontveld. Although fragmented due to the nature of an IDZ and associated continual disturbance, the Coega IDZ does hold suitable habitat for numerous faunal species. There are highly likely to be several of these species on site (especially mammals and reptiles) due to the large areas of intact vegetation on site.

There are several Species of Special Concern (SCC) that are expected for the site. That is, they have been recorded from the same QDS into which the site falls. This does not necessarily mean that these species will occur on site, however, some may occur. The likelihood of occurrence is assessed for each of the conservation important (Red Listed Critically Endangered and Endangered species) species.

6.1.10.4 Avifauna

6.1.10.5 Protected Areas and Important Bird and Biodiversity Areas

There are three Global Important Bird and Biodiversity Areas (IBAs) close to the Coega SEZ (Marnewick et al. 2015). These are areas that regularly hold significant numbers of globally threatened bird species or are of importance to species with restricted ranges:

- Woody Cape Section: Addo Elephant National Park. This IBA starts at the Sundays River 17 km E of the Port of Ngqura and stretches 60 km E to Cannon Rocks. It includes the Alexandria Coastal Dunefield and grassland inland of the dunefield and Alexandria Forest. Of consequence to this project is that the dune system between the Port of Ngqura and Sundays River is an extension of the Alexandria dunefield. Trigger species for the IBA that are also found in the gas to power project area include Damara Terns and African Black Oystercatchers in the mobile dune areas, Denham's Bustard and Secretarybird in the grassland whilst the dune thicket supports a variety of Southern African endemic species including Knysna Woodpecker, Cape Bulbul, Olive Bush-Shrike.
- Algoa Bay Islands: Addo Elephant National Park. This IBA includes Jahleel, Brenton and St Croix Islands located 750m SE, 6.6km SE and 6.5km E respectively of the proposed positions of the FSRU in the Port of Ngqura and the Bird Island complex located at the eastern end of Algoa Bay offshore of Woody Cape. St Croix Island has an important breeding colony of African Penguins Spheniscus demersus. Other endangered species that breed on the Algoa Bay Islands include Cape Gannet (Bird Island), Cape Cormorant and Roseate Tern. Of consequence to the gas to power project is that impacts that extend beyond the Port of Ngqura into the marine environment may impact on the IBA.
- Swartkops Estuary, Redhouse and Chatty Saltpans. This IBA is 10km SW of the Port of Ngqura. Important for its coastal wetlands, this IBA has many species that also occur on the Coega Saltpans and estuary and there is some movement of birds between these localities.

The closest terrestrial Protected Areas of consequence to the gas to power project are the portions of AENP that form part of the Woody Cape Section. The Algoa Bay Islands are part of the AENP and Jahleel Island is located 530m from the Eastern Breakwater of the Port of Ngqura. The AENP Marine Protected Area (MPA) gazetted on 23 May 2019 covers much of Algoa Bay east of the Port of Ngqura below the high water mark. At its closest point the MPA is 166m from the Ngqura breakwater.

6.1.10.6 Biodiversity Plans and Bird Habitats

The Coega OSMP is the primary environmental planning tool to guide development proposals within the Coega SEZ (CDC 2014). The OSMP showing the Critical Biodiversity Areas (CBA) within the Project Area of Influence

(PAOI). Important bird habitats and bird flyways. The vegetation types in this account follow the classification in Mucina & Rutherford (2006).

Port of Ngqura

The Port of Ngqura provides a sheltered coastal environment with artificial reefs (the breakwaters and concrete dolos) along an otherwise high energy sandy coastline and it is an important habitat for both juvenile and adult fish (Dicken 2010). While the marine waters of the Port are utilized as a feeding area by coastal bird species such as cormorants (Phalacrocoracidae), including the Endangered Cape Cormorant, gulls and terns (Laridae), including the Critically Endangered Damara Tern (mostly during January/February), the density of feeding birds is generally similar or only marginally greater than in the adjacent coastal areas.

A Kelp Gull colony (424 pairs in 2021) breeds between September and January next to the Western Breakwater near the Port entrance. This colony has relocated from their former nesting area on the Coega Saltpans. Within the Port of Ngqura, all that remains of the original coastal habitat is a 500m stretch of Sandy Beach and hummock dunes between the Coega River mouth and the Admin Craft Basin. The preferred location for the Powerships (Alternative 1) is adjacent to this area. Approximately 11 pairs of Kelp Gulls (2021) and 1-2 pairs of African Oystercatchers breed in this area. The mouth of the Coega Estuary provides a sheltered roosting area for several bird species, including Damara Terns (especially during January / February) and upto 36 African Oystercatchers. A few estuarine species (waders - Charadrii, gulls and terns - Laridae and herons - Ardeidae) feed here. Future authorized developments are planned that will transform all of the existing estuary mouth and adjacent sandy beach habitat.

Upstream of the mouth, the Coega River has been canalized with earth berms along the eastern edge of its floodplain to separate it from the adjacent Coega Saltpans. There is usually little water flow in the estuary and it is very saline due to the adjacent saltpans. It supports <10% of the bird numbers using the Coega Floodplain while the adjacent artificial saltpans support >90% of the bird population on the floodplain (Morant 2013). The Coega Saltpans are very important for waterbirds with median counts of 1244 birds of 41 species (Morant 2013) and a maximum count of 5485 birds (Pers.Obs. CWAC).

The Port of Ngqura and the Coega Estuary and Saltpans are not classified as a CBA in the NMB Bioregional Plan or Coega OSMP as they are earmarked for future Port developments. There is a busy bird flyway along the coast and up the Coega Valley.

Terrestrial Areas

North of the Admin Craft Basin and proposed mooring sites for the Powerships is a large disturbed area called the Eastern Reclamation – an area used to stockpile cut and fill material during Port construction projects.

The vegetation between the Eastern Reclamation and the Dedisa Sub-station is predominantly Coega Bontveld. It occurs on shallow soils overlying limestone and consists of scattered clumps of thicket in a matrix of grassland and shrubs characteristic of fynbos, succulent karoo and grassland vegetation types (Mucina & Rutherford 2006). In disturbed areas it is easily invaded by alien Rooikrans Acacia cyclops.

Sundays Valley Thicket occurs on clay soils on the steep sides of the Coega Valley and along drainage lines. It forms a dense thicket of often spiny shrubs, trees and succulents including Aloes (Mucina & Rutherford, Stewart et.al 2004; SRK 2010).

An area of Coega Bontveld in good condition north of the Eastern Reclamation and the Sundays Valley Thicket on the eastern side of the Coega Valley are demarcated as CBAs in the Coega OSMP. Another small (10ha) CBA protecting a small colony of Damara Terns is located in a mobile dunefield 2.2km north east of the Port of Ngqura.

The Management Guidelines for CBAs require them to be protected from development. Linear services (e.g. power lines) must follow identified Service Corridors and if this is not possible special mitigation and rehabilitation will be required (CDC 2014). The proposed Alternative 3 route for the overhead transmission line passes through Thicket CBA for most of the route between the Port and R102.

Coega Bontveld is important habitat for several large Species of Conservation Concern, especially Secretarybird, Blue Crane and Denham's Bustard within the PAOI, all of which are known to use the Bontveld CBA. The Blue Cranes frequently roost at a stormwater attenuation pond near the N2.

North-east of the Eastern Reclamation is the inland edge of the vegetated dune system where the vegetation is classified as Algoa Dune Strandveld with small trees such as Dune Crow-berry Searsia crenata, Candlewood Pterocelastrus tricuspidatus and White Milkwood Sideroxylon inerme (Mucina & Rutherford 2006, Stewart et.al 2004; SRK 2010). Alternatives 1 and 2 of the overhead transmission line pass through a short section of this vegetation type that is in good condition. Several endemic bird species are found in the vegetated dunes and in the Thicket vegetation, with Knysna Woodpecker being the only Species of Conservation Concern.

6.1.10.7 Bird Populations

Bird species that are known to regularly occur within the Project Area of Influence, between St Croix Island and Dedisa Sub-station, including the Coega Saltpans.The list comprises of 200 bird species, including 21 Species of Conservation Concern listed in one of the threat categories in the South African Red Data Book – Birds (Taylor et al. 2015) or IUCN Red List. An additional 47 species are listed in Appendix II of the Convention on the Conservation of Migratory Species and / or Annexure 2 of the African-Eurasian Waterbird Agreement.

In pentad 3345_2540 that includes most of the PAOI, 218 species have been recorded on 140 full protocol bird atlas cards between 2009 and 2022. No additional Species of Special Concern to those listed in Appendix B (Appendix 9- A9) were recorded on atlas cards (SABAP).

Most of the species that are endemic or near-endemic to southern Africa are found in Terrestrial habitats. Of the 35 endemic species 16 occur in the Thicket vegetation, 11 in Bontveld and open terrestrial habitats, 6 in marine and coastal environments and 2 in saltpan and wetland habitats

Of the 21 Species of Conservation Concern, six species are associated with the marine and coastal environments, seven with the saltpans and wetlands, seven with Bontveld and open terrestrial habitats and one with the Thicket habitat.

6.1.11 Estuarine and Marine Environment

6.1.11.1 Estuarine Environment

The Port of Ngqura was developed at the mouth of the Coega Estuary (33°47'43.58", 25°41'16.47"E) and commenced operations in 2009. The estuary itself has seen extensive modifications and environmental degradation from its natural condition due to its historical conversion into a commercial saltworks, and consequently very little natural estuarine habitat remains (Plates 1 to 6). The estuary and the old Coega Saltworks Facility are located on land that falls within the Port of Ngqura and within the IDZ (CSIR, 2015a). The facility was vacated in 2008 and in 2015, a Basic Assessment process was undertaken for the demolition of the facility and associated unused infrastructure and structures within the Port boundaries (CSIR, 2015a). The long-term Port Development Framework Plan (cited in CSIR, 2015a) provides for the future development and expansion (dredging/excavating, deepening and widening) of the Port up the Coega Estuary channel, as far as the N2 road bridge, with the remaining upper reaches of the system discharging directly into the harbour environment.

The proposed project will be located at/ in close proximity to the Coega Estuary mouth on the east side of the jetty.

<u>Coastal Environment</u>

The Port of Ngqura in the Coega area is a relatively modern port and is the only Port in South Africa to have been subjected to environmental legislation throughout its design, construction and operational phases. The broader area has been subjected to substantial beach erosion in the past, largely due to intentional vegetation of headland bypass dunes at Cape Recife with alien invasive species historically, and by the construction of a sewage works within the dune field. Sediment management aspects were therefore at the forefront of the environmental agenda when the Port was designed and authorised (Petterson, 2019).

Ngqura effectively blocks the natural eastward littoral drift causing severe sediment accretion to the west of the Port and beach erosion to the east. Beyond the beach impact, dune fields fed by windblown sand from the beaches also exhibit sedimentary changes. In the long term, accretion on the western end of the Port will increase along the wall until sediment is bypassed and fills the harbour mouth by wave transport, with sediment supply to the dune field that would naturally run behind/through the Port building up until the Port was bypassed. Maintenance of this Port therefore requires constant removal of dune sands and constant dredging of the harbour mouth.

A condition of the environmental authorisation for construction of the Port was for a sediment pump system to be installed that mimic littoral drift. A minimum of 240 000 tonnes of sediment is therefore moved per annum via the pump system from the western side of the Port to the eastern side thereby mimicking littoral drift (Petterson, 2019). The proposed infrastructure falls within the Port area that is entirely cut off from littoral drift.

<u>Estuarine Delineation</u>

In the context of the Coega Estuary, little remains of the natural connectivity between the critically modified core estuarine area due to the Coega Saltworks and the critically modified coastline as a result of the Port development. The inclusion of a ‘default’ surf zone in the EFZ is thus not representative of the modern state of the system, with hydrological connectivity spatially and temporally restricted to the mouth dynamics.

Figure 6-16: Geographical boundaries of the Coega estuarine functional zone as delineated by the 5m topographical contour in red, and the 10m topographical contour and marine extension in blue (Image source: Google Earth, 2021). Components of the Gas to Power project indicated in yellow (vessels, pipelines and transmission line corridors) and orange (contractor facilities)

<u>Catchment Characteristics, Surrounding Land-use and Vegetation types</u>

The catchment of the Coega River is predominantly undeveloped and rural in nature, with agriculture activities occurring along the river course. Along the coastal strip, the landscape is highly modified as a result of the historical development of the Coega Saltworks and expansive clearing of natural vegetation for agriculture, the more recent port development, and active development projects taking place within the Coega IDZ. A wind-farm currently consisting of two turbines, and the La Farge Quarry are located eastwards of the estuary, above the N2.

At a regional level, the biodiversity of the NMBM is particularly rich in comparison to other parts of South Africa, as it is located within two globally recognised biodiversity hotspots, namely, the Cape Floristic Region and the Maputaland- Pondoland-Albany Centre of Endemism. The NMBM also contains five of South Africa's nine biomes (SRK, 2014a). The Coega Estuary and its surrounds is located within the Albany Thicket Biome.

At a catchment level, the dominant vegetation comprises Sundays Valley Thicket, with Sundays Doringveld and Motherwell Karroid associated with the Coega River valley (SRK, 2014b; SANBI, 2018). These vegetation types also characterise the upper reaches of the Coega Estuary, with pockets of dense alien vegetation. Much of the Coega Estuary is surrounded by Sundays Valley Thicket and Grass Ridge Bontveld further afield. Along the coastline, Algoa/ St Francis Dune Thicket and Cape Seashore Vegetation occur on either side of the port and estuary mouth (SANBI, 2018; SRK, 2014b). The Coega Estuary, the drainage lines that flow into the upper reaches, the thicket vegetation along the eastern margin, and much of the landscape to the west, is classified as primary Critical Biodiversity Areas (CBA1) and that to the east is classified as secondary Critical Biodiversity Areas (CBA2), for the most part (SRK, 2014b).

The topography of the area is variable comprising the incised Coega River channel, the level floodplain, which is occupied by the Coega Saltworks, palaeodune ridges located to the west of the estuary and recent dunes along the coastline. Several deeply incised drainage lines enter into the upper reaches along the eastern margin as well as along the western margin below the N2 road bridge.

Estuarine Type and Functioning

Prior to the 2018 NBA, the estuaries of South Africa were classified into five general types based on various attributes (Whitfield, 1992), and the Coega Estuary was classified as a temporarily open/closed estuary. More recently, the estuarine typologies were revised and South Africa's estuaries have now been reclassified into 12 estuarine types. The Coega Estuary has been reclassified as a large temporarily closed estuary (TCE) within the Warm Temperate coastal biogeographic region (Van Niekerk et al., 2019; Van Niekerk et al., 2020). The main characteristics of large TCEs are provided in Table 6-9.

Table 6-9: Characteristics of Large Temporarily Closed estuaries (Van Niekerk et al., 2019).

Attribute	Description
Estuarine area (ha)	> 15
% time open to the sea	>50
Geomorphology	Linear/funnel with highly restricted outlet
Maximum water level determined by	Mouth state
Average tidal range (m)	0.25 – 0.5
Typical salinity range	0 – 60
Mixing process	Tidal/riverine/wind/seepage
Sediment stability	Mobile (breaching and floods)
Mean Annual Runoff ($x10^6$ m^3)	1 – 280

The size of the EFZ is approximately 270 ha, covering a length of approximately 2.9 km, with 2.3 ha of open water habitat (Van Niekerk et al., 2019). Natural processes within the Coega system have been severely modified by development in the EFZ. The main characteristic of a TCE is the formation of a sand bar, or berm, at the mouth that blocks off connection with the sea for varying amounts of time during the year. Closure of the Coega mouth is more a product of the ephemeral fluvial input and human modification, than marine sediment processes. The estuary is closed for more than 75% of the year (CSIR, 2015b). Mixing processes are induced by riverine flow and wind. Marine exchange is extremely limited given the highly developed and restricted mouth, and thus tidal amplitude is minimal during open mouth conditions.

Overall, the dynamics of the estuary have been critically altered by through flow modifications (affecting the duration of low flows), canalisation and stabilisation of the estuary mouth through the Port development (CSIR, 2015a).

Estuarine Habitat and Vegetation Types

Based on the area of natural remaining habitat, relative to the size of the EFZ, approximately 90 % of the EFZ is developed and completely transformed. This is as a result of the saltworks, roads and bridges, canalisation of the river, and catchment degradation (CSIR, 2015b).

Of the remaining 10 % of natural habitat, approximately 26.3 ha of estuarine habitat remains, including five habitat types, namely supratidal salt marsh, submerged macrophytes (Zostera capensis), reeds and sedges, open water habitat, and sand/mud banks (Table 5) (CES, 2000; Adams, Fernandes and Riddin, 2019; Van Niekerk, J. B. Adams, et al., 2019). The tidal zonation of existing salt marsh community is less distinct than found in more pristine estuaries as a result of the severe modifications, and thus areal coverage of intertidal saltmarsh is inconclusive. Key plant species recorded in the Coega Estuary and the habitat type in which they typically occur are listed in Table 6. Aside from habitat transformation, the absence of extensive salt marsh areas is likely attributed to the narrow intertidal zone, the steepness of the banks and trampling by cattle (CES, 2000). Although artificial, the constructed salt pans of the Saltworks Facility are considered to form part of, and contribute to, the estuarine and wetland environment (CSIR, 2015b). Several macroalgae species have also been recorded in the system in the intertidal zone including Cladophora sp. and Enteromorpha sp. indicative of high nutrient enrichment, low flow, and fluctuating salinities (CSIR, 2013).

Overall, the vegetation characteristics of the system have been altered by flow modification, mouth state and water levels, changes in the salinity regime, physical habitat degradation and destruction, as well as invasive alien vegetation (CSIR, 2015b). The latter occurs in isolated areas throughout the EFZ; nine species have been recorded (J. B. Adams et al., 2019).

Birds:

The Coega saltpans are reportedly one of the most important wetlands in the Eastern Cape Province for waterbird species, particularly for salt-tolerant species (CES, 2001; CSIR, 2013). The estuary is utilised as a feeding ground and roosting area by large numbers of palaearctic waders during the austral summer (CES, 2001).

The estuary mouth and the stretch of sandy beach with hummock dunes extending to the port's eastern breakwater, are also acknowledged as important habitat for birds, especially the Endangered Damara Tern (Sterna balaenarum), African Black Oystercatcher (Haematopus moquini) (CSIR, 2013), and Kelp gulls (Larus dominicanus) (Martin, 2022). Other bird groups that utilise the estuary mouth for feeding include waders (Charadrii), gulls and terns (Laridae) and herons (Ardeidae) (Martin, 2022). In terms of bird movements, there is a busy flyway between the coastline and the Coega valley and saltpans (Martin, 2022).

Martin (2022) reports that 199 bird species have been recorded within and around the project area, which includes the Algoa Bay Islands (Jahleel, St Croix and Bird Island group). Twenty species are of conservation concern, and a further 47 species are listed as migratory species of concern. Of the 20 species of conservation concern, six are associated with the marine and coastal environments and seven with the saltpans and wetlands (Martin, 2022). There are also 34 endemic species in the project area, six of these occur within the marine and coastal environments and two in the saltpans and wetland areas (Martin, 2022). An important mention is the small colony of Critically Endangered Damara Tern (Sterna balaenarum) (4 pairs), located 2.2km north-east of the port, which utilise the port as a feeding and roosting area, particularly during summer (Martin, 2022). They have also been noted feeding in the saltpans (Martin, 2022).

Apart from the above, the overall state of the Coega Estuary bird community is regarded as poor in comparison to its natural reference state, due to the same disturbances mentioned above for the fish and invertebrate communities (CSIR, 2015b)

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It is also important to note, that there are three globally Important Bird Areas (IBAs) in proximity to the Coega Estuary, namely the Swartkops Estuary and salt pans located 10 km to the south west, the Alexandria Coastal Belt located 18 km to the north east, and the Algoa Bay Islands (St Croix and Bird Island group) immediately offshore of the Port of Ngqura, included as part of the Greater Addo National Elephant Park Marine Protected Area (MPA) (CSIR, 2013; PRISM EMS, 2018). Species from these areas have the potential to utilise the Coega Estuary periodically whilst moving between these areas or during their migrations.

Health Status

According to the 2018 National Biodiversity Assessment (NBA) (Van Niekerk et al., 2019), the Present Ecological State (PES) of the Coega Estuary is a Category E, that is, a severely/critically modified system characterised by the extensive loss of natural habitat, biota and basic ecosystem functions and processes (Van Niekerk, Taljaard, et al., 2019). Consequently, the Coega system is classified as Critically Endangered in the Nelson Mandela Bay Municipality Conservation Assessment and Plan (cited in CSIR, 2013). Refer to Table 6.10 below.

Table 6-10: CBA Descriptions (ECBCP: SANBI, 2007).

COMPONENT	CATEGORY
Hydrology	D
Hydrodynamics and mouth condition	F
Water quality	D
Physical habitat alteration	F
Habitat health score	E
Microalgae	D
Macrophytes	F
Invertebrates	F
Fish	F
Birds	E
Biotic health score	E
PRESENT ECOLOGICAL STATE (PES)	E
2018 CONDITION STATUS	SEVERELY/CRITICALLY MODIFIED

Biodiversity and Conservation Importance

Turpie et al. (2002) first prioritised South African estuaries based on their conservation importance derived from various factors including size, type, biogeographical zone, habitat and biodiversity (plants, invertebrates, fish and birds). The subsequent prioritisation (Turpie & Clark, 2007) ranked the Coega estuarine system as the 140th most important estuary out of 256 systems in South Africa.

The system is currently rated as being of 'low to average biodiversity importance', and is not a nationally important fish nursery area. The Coega Estuary is, therefore, not among the priority estuaries identified as requiring formal protection in order to conserve South Africa estuarine biodiversity (van Niekerk, Turpie and Lamberth, 2019). Nonetheless, the Port of Ngqura is located adjacent to the Algoa to Amathole Ecological or Biologically Significant Marine Area (EBSA) (Van Niekerk, J. B. Adams, et al., 2019) and conservation assets of the Greater Addo National Elephant Park MPA, and thus activities within the port could affect the MPA.

Recommended Ecological Category

The Recommended Ecological Category (REC), or desired state, signifies the level of protection assigned to an estuary (generally from a flow perspective). The REC takes into account the estuary biodiversity importance and its conservation importance (protected area status).

The REC for the Coega Estuary remains as a category E (severely modified). Thus, management interventions must aim toward maintaining this state (as a minimum), and preventing further ecological degradation.

Activities to improve the health and productivity of the system system include (van Niekerk et al., 2019b):

- Restoring/protecting base flow;
- Rehabilitating riparian areas and wetlands; and
- Investigating the eradication of alien fish species.

6.1.11.2 Marine Environment

Algoa Bay is a large log-spiral bay (Rust 1991), anchored by rocky headlands at Cape Recife in the south-east and Woody Cape in the northeast. The Bay is relatively shallow, mostly <50 m in depth, and the seabed is generally sandy but has portions of exposed bedrock.

Biogeographically, Algoa Bay occurs within the warm temperate Agulhas Shelf Ecoregion (Sink et al., 2019). The ecoregion is characterised by many South African endemic marine species, with Algoa Bay being home to the highest percentage of endemic marine invertebrates and seaweeds (Sink et al. 2019). The Bay hosts many diverse habitat types with their associated fauna, including rocky shores, sandy shores, estuaries, subtidal reefs and offshore soft sediments. Several islands also occur in Algoa Bay which provides vital breeding habitat for seabirds and seals. Bird Island supports the largest breeding colony of Cape gannets (*Morus capensis*) in the world, while African penguins (*Spheniscus demersus*) and roseate terns (*Sterna dougallii*) also use the island for breeding. St Croix Island Group (comprising St Croix, Jahleel and Brenton Islands) supports a large (560 pairs) breeding colony of African penguins.

In 2005, the Bird Island group and the St Croix Island group were proclaimed as part of the Greater Addo Elephant National Park and the Bird Island Marine Protected Area (MPA) was established in 2013. In 2019, the Addo Elephant

National Park MPA was gazetted to expand on the original Bird Island MPA. The Addo Elephant National Park MPA incorporates the 1200 km2 area extending from the port's eastern breakwater to Cannon Rocks in the west and includes the Sundays River Estuary. Most of the islands do not occur within the proposed FPP development's immediate area, but Jahleel Island occurs much closer, 1 km from the proposed FSRU location. The proposed development also occurs within the Algoa to Amathole Ecologically or Biologically Significant Marine Area (EBSA).

6.1.11.2.1 *Local Oceanography and Hydrodynamics*

The local hydrodynamics of Algoa Bay is influenced by the warm Agulhas Current's presence bringing warm subtropical waters and deeper central water into the region (Schumann 1987). Although the current exerts large scale forcing functions in the wider Algoa Bay region, near the Port of Ngqura, this influence may be limited to modifying water masses, seawater temperatures and water column stratification (CSIR 2002).

Currents measured in shallow waters near the Port of Ngqura appear to be predominantly wind-driven, as they respond rapidly to wind conditions (CSIR 2002). Wave-driven currents (either south-west or north-east), dominate the nearshore zone adjacent to the Port of Ngqura. Under high wave conditions, these nearshore currents are of a significant magnitude. Modelling studies (CSIR 2002) indicated that the Port of Ngqura obstructs the alongshore flow somewhat and results in a zone to the north-east of the eastern breakwater that is at times quiescent or a zone of persistent re-circulation. A recirculation zone exists to the south-west of the Port of Ngqura (CSIR 2002). A rough characterisation of surface and near-seabed current speeds from modelling studies (CSIR 2002) indicate that the maximum simulated surface and near-bed current velocities in the port are approximately <0.1 m/s, while peak current speeds in the nearshore zone may exceed 0.6 m/s on occasion.

In the area adjacent to the Port of Ngqura, waves mainly come from the south-south-east and east-south-east sector due to the refraction effects on southerly and south-westerly ocean waves around Cape Recife (CSIR 2002). Waves may also approach from an easterly direction; these are weakly refracted and consequently retain high wave energy and may cause damage coastal structures and ships (CSIR 2002). Tides around South Africa are classified as semidiurnal microtidal, a dominant M2 tide (i.e., two high tides and two low tides per day). Spring- neap tide variation is significant. Tide ranges vary from as little as 0.5 m during neap tides to over 2 m at spring tides (South African Navy Tide Tables).

Meteorological influences, mainly wind, may result in longer-period water level variations. Coastal trapped waves along the south coast have amplitudes that, on occasion, are more than 0.5 m (Schumann and Brink, 1990). Consequently, net water level variations in Algoa Bay are a combination of wind and wave set-up and tidal variations and trough activity of the coastally trapped waves (Goschen et al., 2012). Offshore current variability associated with the Agulhas Current may result in slow (periods of 20 days or more) and relatively small water level variations (CSIR 2002).

6.1.11.2.2 *Port Water Quality*

The Council for Scientific and Industrial Research (CSIR) conducted a long-term marine environmental monitoring campaign in June (winter) 2016, February (summer) and July (winter) 2017 and January (summer) at stations surrounding and within the Port of Ngqura depicted in Figure 6-17.

Figure 6-17: Aerial view of the Port of Ngqura showing the positions where the CSIR monitored water quality from 2016 to 2018 (Source: CSIR 2017). FPP will be located near stations 15 & Y2.

Table 6-11: Summary of Water Quality Measurement Recorded for the Port

Parameter	Description
Temperature	Based on the overall measurements from the CSIR surveys of surface and bottom temperatures within the port (CSIR 2017, 2018), water column temperatures in winter ranged between 15.4 and 16.4°C and between 20.3 and 22.6°C in summer where water temperature generally decreased through the water column. In a previous water quality survey conducted by the CSIR, surface and bottom temperatures within the port fell to approximately 14.6°C during winter and 18°C in bottom waters during summer (CSIR 2012). At stations Y2 and 15 in the proposed FPP facility (Figure 4-18), temperatures were between 15.5 and 16.4°C in winter and 21.5 and 22.6°C in summer (CSIR 2017, 2018).
Salinity	In winter at the surface and bottom waters indicated that salinity ranged between 35 and 35.4 PSU, whilst in summer, it ranged between 34.5 and 35.5 PSU (CSIR 2017, 2018). Considering the Coega River discharges freshwater into the Port of Ngqura, the water column's salinity in parts of the port can be expected to fall below 33 PSU during high rainfall/river flow (CSIR, 2018). Lower salinities at the site are likely attributable to freshwater input from the Coega River, considering the site's position and the fact that river was flowing into the port at the time of the monitoring. Although the inflow did not have a distinct influence on the salinity of the water column in the remainder of the Port, surface salinities were slightly lower than those at the bottom, indicating some effect during that survey (CSIR 2012).

pH	The water column's pH in the port varied minimally through the water column, with values ranging between 7.6 and 8.2 in winter and 8 and 8.2 in summer (CSIR 2017, 2018). Bottom pH values were slightly lower than those recorded at the surface, more notably in summer. The pH of surface waters is usually higher than that of near bottom waters because of solar radiation.
Dissolved Oxygen	Dissolved oxygen concentrations in the port decreased progressively through the water column. Concentrations in winter ranged between 7.6 and 8.9 mg/L whilst saturation was between 94.6 and 111.2%. Lower dissolved oxygen concentrations and saturation (<5 mg/L and at about 60%) have been observed in the bottom water of the port during summer (CSIR 2012), reported being likely attributable to a lack of ventilation of bottom waters by oxygen-rich surface waters, due to the stable water column.
Turbidity	Turbidity in the port's surface water is generally low and tends to increase in the lower part of the water column, although still relatively low. During winter, turbidity ranged from 1.4 and 14.8 NTU, whilst in summer, values were generally lower and ranged between 0 and 13.1 NTU. High bottom turbidity values recorded during the 2017 summer survey were likely due to a wide-scale phenomenon rather than port associated activity, as high values were also observed at sites in the marine environment.
Nutrients	The significant nitrogen and phosphorus sources in the Ngqura Port area are from sewage, stormwater containing soil, industrial discharges, and rainfall (IECM 2005). During the 2017 winter and 2018 summer surveys, surface concentrations near the Port of Ngqura in the winter survey were moderate at all stations but low in the summer survey.

6.1.11.2.3 *Local Sediment Characteristics*

The particle size of sediments occurring in the greater Algoa Bay area is strongly influenced by wave energy and circulation patterns. Sediment in the port was classified as sandy-mud and mud. Coarse material was poorly represented in the port (CSIR 2018).

Given the association between fine sediment particles and organic matter, previous research by the CSIR resulted in the development of a linear regression model, with associated 99% prediction limits, estimating the baseline relationship between the percentage of mud and the Total Organic Content (TOC) of sediment in the Port of Ngqura (i.e., before any significant anthropogenic activity and contamination). Enrichment (calculated as the ratio between the TOC in the sediment sample of interest and predicted by the baseline model upper prediction limit for the same mud fraction) at both of these sites was between one and two times higher than that expected in the baseline sediment.

All trace metal concentrations were below the probable effect concentrations as stipulated by the BCLME (CSIR 2006).

6.1.11.2.4 Marine Ecology

The baseline focuses on the marine ecology occurring below the high-water mark, thus focuses on receptors in the water column, in and on the seabed, and the local avifauna, assessed at the local scale within the Port of Ngqura, but also includes local islands (Jahleel, St Croix and Bird Islands) important for avifauna breeding.

Marine ecosystems comprise a range of habitats, each supporting a characteristic biological community. The Port's important habitats include the subtidal benthic zone, the water body itself, and the artificial surfaces that mimic intertidal and shallow subtidal rocky shorelines.

Intertidal and Shallow Subtidal Habitats

The Port of Ngqura was developed in the estuary mouth of the Coega River. The estuary itself is characterised by narrow salt marshes with little distinct zonation due to the narrow intertidal region and the steep riverbanks (CES 2000).

The breakwaters in the Port of Ngqura offer a hard substrata habitat that mimics intertidal and shallow subtidal rocky shorelines and contrasts the soft sediment habitat associated with the sandy beaches that extensively occur adjacent to the Port (Dicken 2010). In an earlier study, Klages et al. (2006) indicated that the harbour structures supported invertebrate species typical of the region, including brown mussel *Perna perna,* rock oyster *Striostrea margaritacea* and barnacles *Tetraclita* spp. and *Chthamalus* spp.*,* as well as attached epiphytic and filamentous algae.

Sandy beaches characterise the intertidal and coastal region outside the harbour with relatively high wave activity (McLachlan,1983). Molluscs, primarily *Bullia* sp, *Donax serra* and *Donax sordidus* along with mysid shrimp dominate the macrofauna in these regions (CSIR 2013).

Subtidal Benthic Macrofauna

Monitoring surveys conducted from 2004 to 2006 in the Port of Ngqura found relatively impoverished macrofaunal communities (9 specimens per 0.25m2) that were not taxonomically distinct from the biological community in sediments adjacent to the harbour. Communities were dominated by polychaetes and crustaceans (Klages et al., 2006). Some changes in community structure were reported over the monitoring period. These were attributed in part to construction activities but were also likely due to natural variation (CSIR 2013).

Recent monitoring surveys conducted in 2016 and 2017, indicated the benthic macrofauna in the Port and surrounds represented an array of taxa typical of estuarine and marine environments in the warm temperate Agulhas Ecoregion (CSIR 2017, 2017). Findings were similar to the 2004 to 2006 surveys in which macrofauna in the Port during both the 2016 and 2017 surveys predominantly comprised annelid worms and brachyuran crabs. Sites outside of the Port) were generally more diverse, where amphipods and other small crustaceans were also found.

While disparity was found between the benthic communities occurring in the Port and the surrounding marine environment, for the most part, analyses did not indicate the presence of an abundance of pollution or disturbance tolerant taxa within the former. This is to be expected considering that, during both the 2016 and 2017 surveys, no large-scale contamination of the water or sediment was found. Therefore, the differences in community composition and lower diversity within the Port were not attributed to anthropogenic activities and rather are likely due to hydrodynamic factors and related differences in sediment particle size and total organic content.

During the 2017 survey, near the admin craft basin and the proposed FSRU location, macrofaunal abundance was highest of any of the sites sampled (1 803 individuals.m^{-2}). A large proportion of these individuals were small deposit-feeding polychaetes that are generally more opportunistic in nature and can proliferate in disturbed environments. These individuals' occurrence at this site may reflect the disturbance associated with the construction of the admin craft basin. It may indicate that the benthic environment near the proposed development location is disturbed (CSIR 2018).

Plankton

Algoa Bay is nutrient-limited, and thus, phytoplankton biomass and production are generally low, with high variability driven by upwelling events. In a study by Klages et al. (2006), chlorophyll-a concentrations (indicative of phytoplankton biomass) in the vicinity of the Port of Ngqura were found to range between 2 and 4 µg/L. The Coega River is considered an essential contributor of nutrients to the shallow subtidal zone as elevated phytoplankton biomasses have been recorded adjacent to the river mouth (CSIR 2012).

Approximately 124 phytoplankton taxa have been identified in Algoa Bay, in waters within and surrounding the Port of Ngqura, with most of these being diatoms or dinoflagellates (Klages et al. 2006; Mbambo 2014). Common diatoms found include species from the genera *Thalassiosira, Chaetoceros, Leptocylindrus* and *Thalassionema.* Species of the genera *Gonyaulax, Protoperidinium* and *Peridinium* were the most common dinoflagellates. It is expected that many of these species groups occur in the Port water body.

Accumulations of the diatom *Anaulus australis* occur in the surf zone and the eastern sector of Algoa Bay, mainly northeast of the Sundays River mouth. Blooms occur near and within the Port of Ngqura, although not in the extreme concentrations found further east (du Preez 1996). *Anaulus* may account for more than 95% of the total algal production (Campbell and Bate 1988), and consequently, this species is a critical component of nearshore food webs in the area.

Zooplankton

The zooplankton assemblage within Algoa Bay is dominated by copepods (*Calanus agulhensis, Neocalanus gracilis, Nannocalanus minor, Centropages* spp.), but chaetognaths, euphausiids and a variety of small gelatinous forms, including ctenophoran comb jellies, also occur (Klages et al. 2006; Dali 2010). These organisms are widely distributed throughout the Indian Ocean (Dali, 2010). In shallower waters within the surf zone, swarming mysids (*Gastrosaccus* spp. and *Mesopodopsi* spp.) are abundant, and the prawn *Macropetasma africana* is associated with *Anaulus* swarms (Romer 1986). While there is a high spatial and temporal variability in zooplankton abundance and biomass in Algoa Bay, these species groups are expected to occur within the Port of Ngqura.

Ichthyoplankton

The nearshore environment of Algoa Bay is favourable for the accumulation of ichthyoplankton. Beckley (1986) identified larvae of 25 families of teleosts at several nearshore stations in Algoa Bay, with gobies (Gobiidae spp.), anchovy (Engraulidae spp.) and sardines (Clupeid spp.) being dominant. Similarly, Pattrick and Strydom (2014) identified larval fishes from 34 families in nearshore waters of the Bay with anchovies dominating the catch. Other species found include tonguefish (Cynoglossidae spp.), sea breams (Sparidae spp.) and soles (Soleidae spp.). Many of these species are essential in the surrounding commercial fisheries. In the monitoring study conducted by Klages et al. (2006) in waters within and surrounding the Port of Ngqura, high densities of fish eggs were recorded, but the numbers of fish larvae were low.

Fish and Elasmobranchs

More than 70 fish species inhabit Algoa Bay comprising species endemic to South African coastal waters and fish with wider distributions. None of these species have distributions limited to the Algoa Bay area, i.e., they cannot be considered as rare and/or endangered or having narrow habitat preferences. Commonly occurring species include southern mullet (*Chelon richardsonii*), blacktail (*Diplodus capensis*), sand (*Lithognathus mormyrus*) and white steenbras (*Lithognathus* lithognathus), olive rock grunter (*Pomadasys olivaceus*), white stumpnose (*Rhabdosargus globiceps*), and strepie (*Sarpa salpa*). Leervis (*Lichia amia*), elf (*Pomatomus saltatrix*) and dusky kob (*Argyrosomus japonicus*) are present seasonally. Sharks, e.g., bronze whaler (*Carcharhinus brachyurus*), dusky shark (*Carcharhinus obscurus*), lesser sandshark (*Rhinobatos annulatus*) and rays, e.g., blue stingray (*Dasyatis chrysonota*) and eagle ray (*Myliobatis aquila*) are encountered in the region along with many other species (Heemstra and Heemstra 2004). Pilchard (*Sardinops sagax*), anchovy (*Engraulis encrasicolus*) and red-eye round herring (*Etrumeus whiteheadi)* also occur in Algoa Bay and are important food resources for their common predators, e.g., piscivorous seabirds, dolphins etc.

The intertidal and shallow subtidal habitat formed by the extensive breakwaters in the Port of Ngqura can alter the abundance, distribution and diversity of fish species in the marine environment. A survey by Dicken (2010) found that the Port water body itself supports a highly diverse fish species assemblage ranging from mainly herbivorous or omnivorous strepie (*Sarpa salpa*) and cape stumpnose (*Rhabdosargus holubi*) to predators such as dusky kob (*Argyrosomus japonicus*), garrick (*Lichia amia*), ragged tooth (*Carcharias taurus*) and dusky shark (*Carcharhinus obscurus*). Sampling yielded 4 559 fish with 47 species distributed in 27 families. The most abundant species were dusky kob (25.5%), elf (*Pomatomus saltatrix,* 24.9%), garrick (17.7%) and dusky sharks (10.7%). Records were typical of Eastern Cape estuarine and shore-fisheries. Almost all of the individuals caught for the most commonly caught elasmobranch (*C. obscurus*) and teleost species (*A. japonicus*) were juveniles (100% and 99.6% respectively). This and subsequent analyses (Dicken 2011) demonstrated that the Port functions as an important nursery area for many fish species and is an important habitat and activity zone for juvenile and neonate dusky shark. This is likely due to the relatively calm and sheltered environment provided by the Port compared to the surrounding coastline. For adult specimens, the area also acts as a refuge from recreational fisheries. Of the 47 fish species recorded, 30 species (64%) were considered to be marine while 17 of the species (36%) were considered to have some dependency on estuarine habitats during their life history.

This is based classification proposed by Whitfield (2019). Most estuarine dependent species encountered in the Port are partially (category II, euryhaline marine species which breed at sea with their juveniles showing varying degrees of dependence on estuaries as part of their life cycle) dependent on the estuary. Most estuary-dependent species enter the estuary as larvae or post larvae (Whitfield & Marais 1999; Harris & Cyrus 1994, 1995, 1996; Harris *et al.* 1999) and once the estuarine dependent phase is complete, they leave the estuary for the marine environment where they become available to marine fisheries, and upon maturity contribute to the spawning stock (Wallace 1975). This supports the finding that most species recorded were juveniles.

Three distinct habitat types within the port were identified (dolosse, quay wall and sandy beach), with each of these diverse hosting communities. The dolosse occurring along the edge of the eastern breakwater and in the vicinity of the proposed FSRU location hosted the highest number of fish species and the most diverse community.

Dicken (2011) also highlighted the unexpected abundance and diversity of shark species in the Port. These included bronze whalers (*Carcharhinus brachyurus*), hammerheads (*Sphyrna* spp.), various catsharks (Scyliorhinidae spp.), dusky sharks and gully sharks (*Triakis megalopterus*). The dusky and gully sharks were the most common chondrichthyans. In the 2010 study, one white shark (*Carcharodon carcharias*), three whale sharks (*Rhincodon typus*) and one manta ray *(Manta birostris*) were also identified in the Port.

More recently, an acoustic receiver has been deployed in the Port of Ngqura, at -33.80017 °S, 25.69835 °E since February 2013 (ATAP 2022). This receiver is rolled over annually (receiver retrieved and a new receiver deployed in its place) and was last retrieved in January 2022. Overall, 92 individual animals of 15 species have been detected between February 2013 and January 2022, together amassing more than 81 000 detections. Prominent species detected include leervis and ragged tooth shark, with 23 and 27 individuals being recorded in the port, respectively. The top three species in terms of numbers of detections include smoothhound shark *Mustelus mustelus* (~35 000 detections), leervis (20 000+ detections) and ragged tooth shark (10 000+ detections). Lesser represented species include smooth hammerhead *Sphyrna zygaena* (2 detections), white shark (3 detections) and common eagle ray *Myliobatis aquila* (16 detections). At least one green turtle, rehabilitated by Bayworld and subsequently released, has also been detected spending time in the port, highlighting its importance as a sheltered habitat used by various species as refuge. These results support earlier presence records from the Port.

The percentage of detections recorded for all species per season also fluctuates, highlighting the port to be an important habitat for multiple species particularly during summer (December to February) and spring (September to November). Of particular interest for this report is the presence of two soniferous (sound-producing) species - the sciaenid (drum) dusky kob *Argyrosomus japonicus* and haemulid (grunt) spotted grunter *Pomadasys commersonnii*. While the number of individuals recorded differs, as well as different timings of tagging, detection data revealed the port to be important to both species during the warmer summer months (December to March). Anecdotal reports suggest these species, and others, including Santer *Cheimerius nufar*, are resident inside the Port of Ngqura all year round.

<u>Megafauna</u>

In a study analysing the spatial and temporal habitat preference of cetaceans in Algoa Bay, six species were recorded between June 2008 and May 2011 (Melly et al. 2017). These included the Indo-Pacific bottlenose dolphin (*Tursiops aduncus),* the Indian Ocean humpback dolphin *(Sousa plumbea*), the long-beaked common dolphin *(Delphinus capensis)* and the Bryde's whale (*Balaenoptera brydei*), which were observed year-round, and the southern right whale (*Eubalaena australis*) and the humpback whale (*Megaptera novaeangliae)* which were observed from May to December.

The Indo-Pacific bottlenose dolphin was the most commonly seen species, where individuals were observed throughout the shallower areas of the Bay in waters from 8 to 20 m deep. Most observations were in the south-west of the Bay. However, some were observed in the vicinity of the Port of Ngqura. The Indian Ocean humpback dolphin was also observed in shallower waters. According to Wooldridge et al. (1997), before port construction, the Coega

River mouth's surf zone and around the St Croix Islands were a vital foraging area for the species. However, during the most recent survey by Melly et al. (2017), Indian Ocean humpback dolphins were seldom present near designated anthropogenically modified areas including near the Port of Ngqura. Due to declining population trends worldwide, this species is listed as an 'Endangered' by the IUCN in the Red List of Threatened species (IUCN 2022). Their possible occurrence within the Port, however, cannot be discounted. Several sightings of southern right whales and Bryde's whales were recorded in shallow waters near the Port of Ngqura, with some of these occurring in ship anchoring areas within the Port. Mother-calf southern right whale pairs were observed inshore of St Croix Island. Several marine mammals thus utilise the area surrounding and perhaps within the Port of Ngqura.

Cape fur seals (Arctocephalus pusillus) breed on the Islands within Algoa Bay, and may, on occasion, occur within the Port of Ngqura. Black Rocks, an island complex 1.6 km due west of Bird Island, is the most easterly Cape fur seal breeding colony in southern Africa, with a population of approximately 2 000 seals (Kirkman et al. 2007). The Cape fur seal *Arctocephalus pusillus pusillus* is the only pinniped (aquatic, fin-footed mammal) indigenous to southern Africa and is the primary prey species of the great white shark, *Carcharodon carcharias* (Kirkman et al. 2007). As a result, the inshore waters surrounding the islands of Algoa Bay are frequented by great white sharks during the winter when white sharks hunt juvenile seals (Dicken, Smale & Booth 2013).

Mating occurs off the coast of Natal after which near-term pregnant females ragged-tooth shark (*Carcharias taurus*) move towards the cooler waters of the Eastern Cape, where they give birth around September (Dicken et al. 2006). Algoa Bay provides shelter for juveniles of the species in the form of nursery areas.

The giant leatherback (*Dermochelys coriacea*), the loggerhead (*Caretta caretta*) and the hawksbill turtle (*Eretmochelys imbricata*) have all been recorded feeding in Algoa Bay (CES 2001). Their occurrence in the Port of Ngqura is possible; however, it is not likely.

<u>Alien and Invasive Species</u>

After habitat destruction, non-indigenous species are considered the greatest cause for loss of biological diversity (Vitousek et al. 1997). For this reason, Ports, marinas, and important conservation hotspots in the vicinity of these areas should be surveyed for introduced species regularly. During a Port survey conducted by Anchor Environmental Consultants in 2012 (Anchor 2013), a total of 13 fish species belonging to nine families was collected in beach seine and gill nets. All fish species collected were found to be indigenous to South Africa, and one (the Southern African mullet *Chelon richardsonii*) is endemic. Of the wider species found within the Port of Ngqura, 8% of the 83 invertebrate species surveyed were confirmed alien introductions, including the barnacle *Balanus glandula*, the isopod *Dynamene bidentata* and the ascidian *Styela plicata* (Laird et al. 2013).

6.1.11.2.5 Local Ecosystem Services

The area within the Port itself provides several essential supporting services. Most obviously, it hosts an area in which commercial transport is significant, and so conflict with other activities needs to be considered by the Port Authority.

Marine user groups can be broadly defined as recreational or commercial. Recreational marine activities that are most likely to be affected by the proposed development include recreational boat (skiboat) fishing, recreational scuba diving and yacht sailing. Other recreational marine activities such as open water swimming, surfing, surf skiing, kayaking, as well as wind and kite surfing that may be affected are also considered.

Several commercial marine activities take place within the broader Algoa Bay region; these include shipping, marine ecotourism, and a range of commercial fisheries.

Recreational Users:

Recreational marine activities that may be affected by the Powership in the Port of Ngqura include shore-based fishing, recreational scuba diving, beach utilisation, motorised water sports and non-motorised water sports.

Motorised water sports include jet skiing, water skiing and tubing; while non-motorised recreational marine activities include sunbathing, open water swimming, surfing, stand up paddle boarding, sailing, kayaking, and kite surfing. Recreational swimming beaches within close proximity to the Port of Ngqura include Joorst Park (1 km), St George's Strand (2.5 km), Wells Estate (4 km), Bluewater Bay (7 km) and New Brighton (12 km) all situated to the south of the harbour.

Recreational ski boat fishing effort to the south-west of the Port of Ngqura is considered 'low', while effort to the northeast was found to be higher. The increase to the north-east is likely due to shallow reef surrounding the offshore islands in this area.

Commercial Users:

A number of commercial marine activities take place within the broader Algoa Bay region including commercial shipping, mining (oil and gas), marine ecotourism (whale and shark watching), and a range of commercial fisheries. Commercial fishing around the Port of Ngqura is quite low. No trawling is allowed within the confines of Algoa Bay inshore of a line extending from Cape Recife to Woody Cape. No fishing at all is permitted in the Bird Island Marine Protected area. Five commercial fisheries currently operate within Algoa Bay and may potentially be affected by the proposed project. These are the small pelagic, traditional linefish, squid jigging, shark longline and small-scale fisheries.

- Small Pelagic: The small pelagic fishery in South Africa originated in St Helena Bay on the west coast, originally targeting sardine or pilchard *Sardinops sagax* and horse mackerel *Trachurus trachurus capensis* (Sauer et al. 2003). The fishery is managed through quota allocations in the form of Total Allowable Catches (TACs) for adult sardine, anchovy, and sardine by-catch. Pilchard is the only targeted species in Algoa Bay, with some incidental by-catch of horse mackerel and chub mackerel, as well as maasbanker *Trachurus trachurus*. terms of average annual effort and catch, the Port of Ngqura lies within reporting grid blocks that account for a very small proportion of the national catch and effort (1-5 hauls per year), but approximately 12% of the Eastern Cape annual average. The fishery is still concentrated on the west coast, it has spread to the south coast, centered around Mossel Bay and Port Elizabeth. About 4-5 boats are based in Port Elizabeth and 1-2 in Port St Francis, but the Mossel Bay boats occasionally move eastwards to fish in the Algoa Bay area. Thus, there can be up to 10 boats operating in Algoa Bay at one time.
- Squid Jigging: The fishery is currently regulated by means of Total Applied Effort (TAE), which limits the number of vessels and crew. Fishing decisions are subject to the MPAs at Sardinia, Bird Island and Tsitsikamma, closed seasons, and range is restricted by the South African Maritime Safety Authority (SAMSA) regulations to 40 NM or 200 NM limit. Algoa Bay is important for commercial (and recreational)

caches of squid, a valuable fishery within the South African context. Squid spawn in Algoa Bay throughout the year but with apparent peaks in the spring/summer period. There are a minimum of 26 individual spawning sites in Algoa Bay. The area offshore of the Port of Ngqura overlaps with a squid fishing ground which accounts for nearly 1% of average annual fishing effort.

- Small-Scale Fisheries: Small-scale fishing in South Africa has been considered to include various fishing methods targeting more than 30 species (Griffiths and Branch 1997) from a range of habitats (Branch et al. 2002, Clark et al. 2002). Although small-scale fisheries contribute less than 1% to South Africa's GDP, they play an important role in the provision of protein and employment for an estimated 136 coastal communities distributed along South Africa's 3 000 km coastline. The extent and spread of small-scale fishers covers the four provinces with coastlines, especially the Western Cape, where fishing has been an important source of protein among the coastal communities since the 1700s (Isaacs 2013). Small-scale fishers are found both in urban and rural coastal areas.

  The dominant activity on the east coast is the harvesting of intertidal and subtidal invertebrates including mussels, oysters, redbait and limpets, crabs, and octopus as well as fishes (Hockey and Bosman 1986, Kyle et al. 1997, Clark et al. 2002). High value resources such as rock lobsters, oysters and abalone are also caught by this sector although these resources are usually sold.

  In 2002, the subsistence sector was estimated to include 29 000 participants of which the majority (75%) were found on the east coast in KwaZulu-Natal and the former Transkei (Clark et al. 2002). Of the estimated 30 000 small-scale fishers active along the South African coastline, and 85% of them harvest linefish (Clark et al. 2002). Currently, the small-scale fishing sector will be given priority in the subsequent Linefish Rights-allocation process. Furthermore, the number of recreational angling permits may have to be limited in order to accommodate the newly established small-scale fisheries sector so as not to compromise resource sustainability. Various species have been set aside for the small-scale fishing sector. Some have already been allocated to the existing small-scale fishing co-operatives in other coastal provinces as part of the 2021 Fishing Rights Allocation Process. Many species allocated to the small-scale "baskets" are primary targets of the commercial and recreational linefish sectors, and these shared resources must be carefully monitored given the increased fishing pressure expected.

  The Small-Scale Fisheries Policy proposes that certain areas on the coast be prioritized and demarcated as small-scale fishing areas. In some areas access rights could be reserved exclusively for use by small-scale fishers. A basket of species may be harvested or caught within particular designated zones. The basket allocated to the small-scale community based legal entity will depend on quantity of the marine living resources available in the total allowable catch (TAC), zonal allocations and total allowable effort (TAE). The Port of Ngqura is currently located in 'Basket Area D – Tsitsikamma to the Pondoland MPA', which has 138 different resources marked for potential exploitation by small-scale fishers. There are a number of identified small-scale fishing communities in the region of the Port of Ngqura who may access earmarked coastal and marine resources within Algoa Bay.
- Aquaculture and Mariculture: DFFE intends for the ADZ to accommodate finfish as well as bivalve culture (oysters/mussels) within a combination of precincts namely, Algoa 1, Algoa 6 and Algoa 7 precincts. A number of mariculture activities have occurred in Algoa Bay and at the Port Elizabeth harbour, these included both finfish and bivalve aquaculture. However, there is presently only one sea-based aquaculture

company in operation in the Bay. Zwembesi Farms (Pty) Ltd (Knysna Oyster Company) has been operating in Algoa Bay since 1998 and is one of the oldest and largest oyster producers in South Africa, currently producing 100 tonnes annually on 13 ha (pers. comm. Simon Burton – Knysna Oyster Company 2019). The farm falls within the southern portion of the proposed ADZ Algoa 6 (PE Harbour) site. Zwembesi currently leases 6% of the Algoa 6 precinct (i.e., 27.7 ha) and intends to produce 140 t in 2019 on 15 ha. Zwembesi is expected to produce over 200 t per year on 27.5 ha. No other sea-based aquaculture activities currently occur in Algoa Bay.

If the Environmental Authorization for the ADZ is granted (currently in the appeals phase) finfish farming will be undertaken in the Algoa 7 precinct which located to the southeast of the Port of Ngqura at the border of the Addo MPA.

The environmental authorisation for the development of a land-based aquaculture development zone (ADZ) in the Coega Industrial Development Zone was granted in 2018. The EIA application considered a variety of species groups including marine fish (such as dusky kob *Argyrosomus japonicus*, Yellowtail *Seriola lalandi* Natal stumpnose *Rhabdosargus sarba*, White stumpnose *Rhabdosargus globiceps*, Spotted grunter *Pomadasys commersonnii*), marine invertebrates (including east and west coast rock lobster, abalone *Haliotis midae*, sea urchin *Tripneustes gratilla*, and scallops *Pectin sulcicostatus*) as well as a variet of freshwater species (Nile tilapia *Oreochromis niloticus*, Mozambique tilapia *Oreochromis mossambicus*, Sharptooth catfish *Clarias gariepinus*, rainbow trout *Oncorhynchus mykiss*) (Aquatic Ecosystem Services 2017a).

- Algoa 7 (Ngqura Harbour site): In 2020, authorisation was granted to establish a sea-based Aquaculture Development Zone (ADZ) in Algoa Bay. The ADZ comprises three precincts, one of which, Algoa 7, is located approximately 3 km offshore, 2.5 km from the entrance to the Port of Ngqura. Algoa 7 is approved for the farming of indigenous finfish only (Anchor 2019; TNPA 2020).

  The Ngqura fin fish farm focused on a range of fish including kob and yellowtail. Algoa 7 is not expected to impact significantly on shipping traffic. This site lies adjacent to the recently promulgated Addo MPA and a precautionary as well as risk adverse approach should be applied as the operation of an aquaculture farm is in direct conflict with conservation goals of the MPA.

6.2 CULTURAL AND NATURAL HERITAGE

6.2.1 Terrestrial Heritage

More than 17 Archaeological Impact Assessments (or AIAs) have been undertaken within the Coega IDZ (Binneman 2010a, b, c, 2008, 1999,1994; Binneman & Webley 1996, 1997a, b; Kaplan 2008, 2007a, b; Van Schalkwyk & Wahl 2006, Webley 2007a, b). The, majority of these unpublished reports and notes were found on the South Africa Heritage Resources Information System (or SAHRIS). One or two reports were sourced independently. The archaeologist also consulted with Ms. Celeste Booth, archaeologist at the Albany Museum in Makhanda (Grahamstown).

The most comprehensive survey of the Coega IDZ was conducted by the archaeologist Dr Johan Binneman of the Albany Museum in Grahamstown (Binneman 2010a), which included Zones 1-4, 6, 7, 9, & 10-13. Binneman

(2010a:3) brief was `to conduct a survey of possible archaeological sites in the Coega Industrial Development Zone and to establish the range and importance of the heritage sites/materials, the potential impact of the development on these and to make recommendations to minimize possible damage to these sites'.

According to Binneman (2010), large numbers of LSA shell middens were recorded in Zone 10 at the coast, while dispersed scatters of MSA tools of low archaeological significance were recorded further inland, behind the backdune area in Zone 7, and on exposed cobbles and gravels in Zone 6 and Zone 11 north of the N2.

Bush clearing for a road in Zone 7 exposed a thin layer of dune sand and dispersed scatters of marine shellfish, bone fragments, stone tools and pottery, while construction of the road exposed a few MSA tools. According to Binneman (2010), Zone 7 and Zone 10 are considered `the most sensitive' zones within the entire Coega IDZ, while Zone 11 and Zone 6 are considered `the least sensitive.

Tellingly, all the AIAs undertaken to date within the Coega IDZ confirm the early observations made by Binneman (2010a). These observations were further confirmed by Kaplan (2020), where small numbers of MSA tools were recorded during an AIA of the Eastern Route of the proposed 132Kv transmission line.

6.2.2 Palaeontology

The transmission corridor will cross a variety of lithotypes:

- Alexandria Formation (Ta)
- Bluewater Bay Formation (T-Qg)
- Modern Aeolian Sand (Qw)

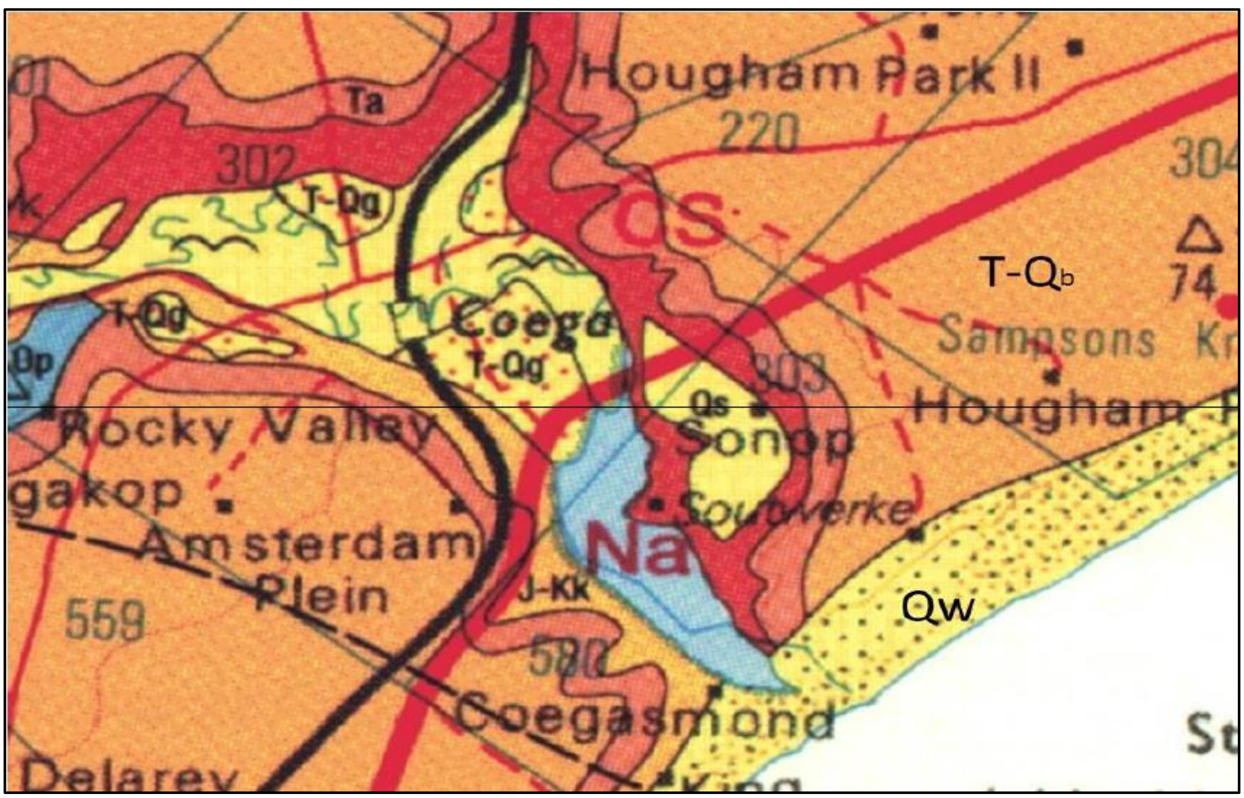


Figure 6-18: Extract from the Port Elizabeth 3324 1:250 000 Geological Map.

Alexandria Formation (Ta): This limestone-rich unit has an average thickness of 7-10m. It is of Tertiary age and composed of carbonaceous sandstone, shelly limestone and conglomerate. Sandstones are found in the upper section. These are horizontal, planar, or trough crossbedded. This unit was deposited in shoreface, foreshore or estuarine environments (Almond, 2010).

- Bluewater Bay Formation (T-Qb): This is an alluvial sheet composed of gravel and sand.
- Alluvium (Qw): This is a contemporary river sand deposit.
- Some of the lithotypes are rated high in palaeosensitivity as per Figure 6.19.

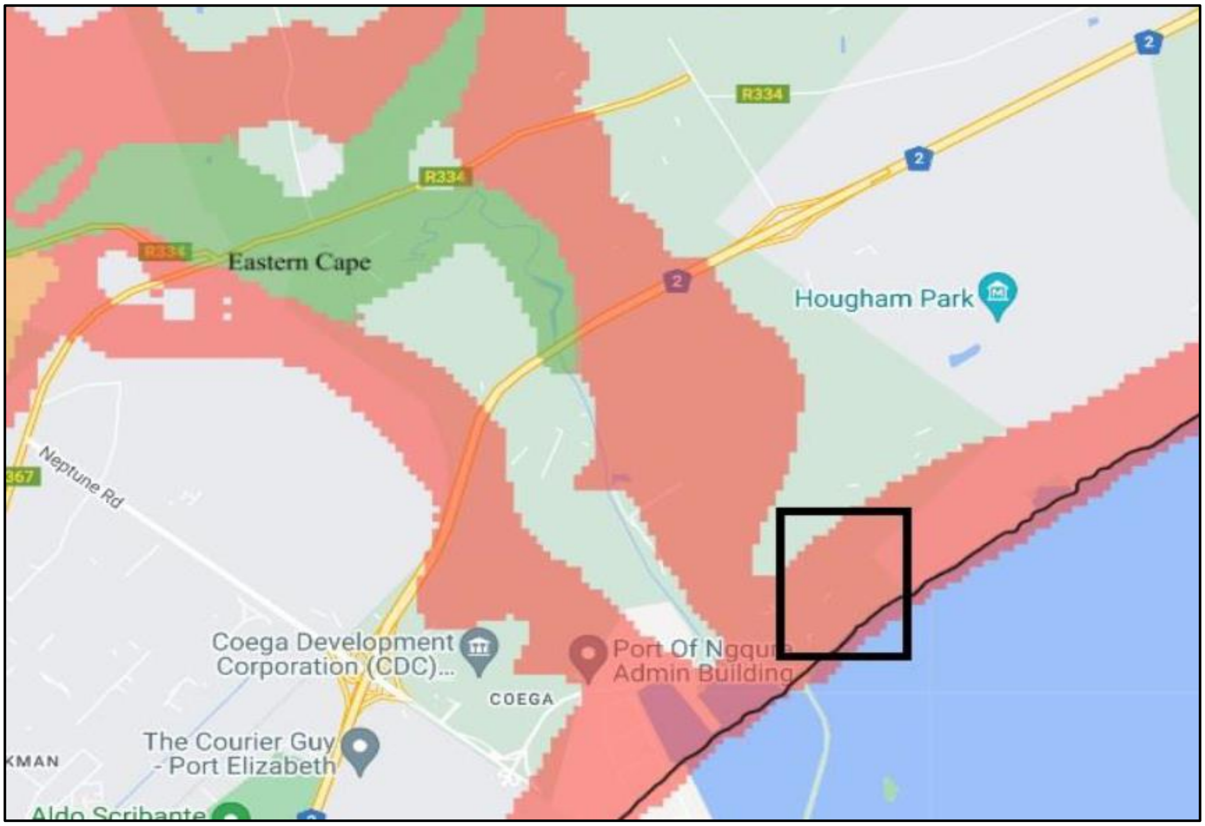


Figure 6-19: Palaeosensitivity of rocks in the proposed Residue Storage Extension area. The approximate palaeosensitive area (Alexandria Formation) to be traversed by the proposed power line is boxed. Most of the area is not palaeosensitive.

6.2.3 Maritime and Underwater Cultural Heritage (MUCH)

The County of Pembroke was originally wrecked near North End Beach in 1902. It was refloated and repairs were attempted. Eventually, in 1904, it was towed towards the Coega River and released. It drifted into the Coega River Mouth. In 2004 during the development of the Port of Ngqura, the wreck was discovered and subsequently removed.

Figure 6-20: Coega River Mouth in 2003 prior to development of the Port of Ngqura (Google Earth 2003)

Figure 6-21: Port of Ngqura original shoreline, County of Pembroke position and proposed pipelines (Google Earth 2022)

The area for the pipelines is near to where the County of Pembroke was found. Figure 6.20 shows the area prior to construction in 2003. Figure 6-21 shows the port with the original shoreline marked, where the County of Pembroke shipwreck was found, as well as the Impact Zone of the proposed Powership project. The findings of the MUCH specialist indicated that:

- These areas for the laying of the pipeline had already been extensively dredged far below the historic ground level and concluded that it is extremely unlikely that any heritage resources remain.
- The presence of unknown wooden wreckage lying in the inshore area of the proposed pipeline must be monitored by an archaeologist during excavations for the pipeline.

6.3 LANDSCAPE AND VISUAL ENVIRONMENT

The study area is comprised of the coastal plain. It is generally flat with limited undulations and ridgelines. A large dune cordon generally runs along the coastline which effectively screens views from areas immediately inland.

The Port of Ngqura is located within the Coega Special Economic Zone (SEZ). SEZs are geographically designated areas set aside for specifically targeted economic activities. The Coega SEZ is located around the Port of Ngqura in order to promote business and industry that will benefit from direct access to the Port. As such it is anticipated that the area will develop as a strategic industrial zone. Whilst the majority of the SEZ remains undeveloped, the area immediately to the west of the Port is relatively well developed. The area within which the power line is proposed has however been developed with road infrastructure.

Settlement in the area includes the Metropolitan area of Port Elizabeth as well as coastal settlement areas of St George’s Strand and Bluewater Bay that are located approximately 2.6km and 7km to the south west of the Port respectively (Environmental Planning and Design, 2022).

6.3.1 Landscape Character Areas (LCAs) - (Environmental Planning and Design, 2022).

- Settlement areas. These include the coastal settlement areas of St George's Strand and Bluewater Bay. They are generally inward-looking drawing little character influence from external areas. External views along the coast are also generally blocked by the coastal dune.
- Undeveloped sections of the Coastal Plain. This area is relatively flat with generally low vegetation which largely includes undeveloped sections of the Coega SEZ. Whist these areas are currently undeveloped, it is planned that industrial development will extend over much of this area.
- Industrial sections of the Coastal Plain. This is comprised of the SEZ area immediately to the south west of the Port.
- The Port and coastal strip. The coastal strip can be differentiated from the rest of the coastal plain due to its proximity to the sea. It is obviously different from adjacent industrial areas due to the scale of equipment and structures. Cranes and gantries are highly obvious from a distance. The beach runs north and south of the Port mouth abutting directly onto container storage on the southern side and ship mooring berths on the northern side.

6.4 SOCIO-ECONOMIC AND TOURISM CONDITIONS

6.4.1 Socio-Economic Aspects

The area falls within the Nelson Mandela Bay Metro Municipality. The Municipality encompasses towns, as well as the Coega Industrial Development Zone, situated near Port Elizabeth. The Nelson Mandela Bay Metro Municipality covers an area of 1 959 km^2. This makes it the smallest municipality in the Eastern Cape, accounting for only 1.2% of the total surface area of the Eastern Cape.

The largest town within the NMBMM is Gqeberha (previously Port Elizabeth) which is the administrative centre of the municipality, while the communities directly surround the Coega IDZ are Motherwell, Wells Estate, Bluewater Bay, and St Georges Strand. Other small towns in the area are: Uitenhage, Despatch, and Colchester. The urban areas are typical of the spatial patterns of towns throughout South Africa, namely that they are segregated by economic classes and reside in clusters. The Municipality is divided into 60 administrative wards. See below image indicating major settlements within Nelson Mandela Bay Municipality.

Figure 6-22: Major settlements within the Nelson Mandel Bay Municipality.

<u>Population, Income and Employment Profile</u>

The NMBM falls within the Eastern Cape and collectively accounts for 18.0% of the population, and 19.7% of the households in the province. The NMBM is the second most populous municipality in the province after the O.R. Tambo District Municipality, although it has a significantly higher population density. Population growth between 2009 and 2019 was 0.7% year-on-year for the NMBM which compared favourably to the Eastern Cape (0.2%) but was lower that the South Arica rate (1.5%) over the same period.

Table 6-12: Overview of the primary & secondary study areas population structure

Indicator	NMBMM	Eastern Cape	South Africa
Area (km^2)	1 959	168 966	1 220 813
Population	1 207 487	6 712 276	58 775 022
Number of households	336 495	1 706 942	16 366 369
Population density (km^2)	616.4	39.7	48.1
Average household size	3.6	3.9	3.6
Annual population growth (2009-2019)	0.7%	0.2%	1.5%
Average monthly household income	R24 979.3	R15 471.96	R24 627.43

(Afro Development Planning, 2022)

The NMBM has a higher average monthly household income than both the Eastern Cape and South Africa, however poverty still remains endemic in the NMBM, with a higher portion of households earning no income (15.7%) compared to the Eastern Cape (15%), and the country (14.8%). Table 6-13 demonstrates that the unemployment rate in NMBMM is lower than the provincial rate, but is slightly higher than the national rate at the time which statistics were compiled. A significant indicator is that the labour force participation rate in NMBMM is higher than both the provincial, and national rates, however these rates would have changed due to Covid-19's negative shocks to the economy, and with the unemployment rate likely to be higher.

Table 6-13: Employment profile of the study areas.

Indicator	NMBMM	Eastern Cape	South Africa
Employed	366 876	1 233 947	16 259 787
Unemployment rate	29.9%	34.2%	28.8%
Not economically active	281 846	2 068 978	15 516 188
Labour force participation rate	65%	47.5%	59.5%

(Urban-Econ, 2021)

The relatively low unemployment rate and higher labour force participation relative to the provincial averages further suggests that the NMBM is subject to inward migration from other parts of the Eastern Cape due to the greater number of actual and perceived employment opportunities available within the local municipality.

Education Profile

The level of education provision within an area is one of the main determinants when it comes to a locations ability to achieve long-term, positive economic growth. The provision of education alone, however, does not ensure that this growth will occur. Equally important is ensuring that this education provision is of a sufficient quality to meet both the communities and the broader economy's needs.

Table 6-14: Level of educational attainment in study areas in 2019.

Indicator	NMBMM	Eastern Cape	South Africa
No schooling	3.8%	11.2%	9%
Some primary	10%	17.8%	12.3%
Completed primary	5.1%	6.3%	4.7%
Some secondary	41.4%	36.6%	34.2%
Matric	28.3%	19.3%	27.9%
Tertiary	11.4%	8.7%	12%

(Urban-Econ, 2021)

It is evident from Table 6.14 that the skill level of the population, as measured by educational attainment, is notably better in the NMBM than in the rest of the Eastern Cape.

There has also been a marginal improvement in educational attainment since 2009 when only 10.3% of NMBM's population had attained some form of tertiary qualification.

It is evident from Table 6.14, unlike the rest of the Eastern Cape, the NMBM was characterised by high levels of educational attainment, with 11.4% of the population having attainted some form of tertiary qualification in 2019. This is also well above the provincial and likely attributable to the presence of Nelson Mandela University within the municipality as well as several other tertiary colleges. Despite this, almost three fifths (60.3%) of the population of NMBM has not completed high school, lower than the Eastern Cape (72.0%) and similar to the national (60.1%) figure. These levels of educational attainment suggest the need for interventions that targeted low and semi-skilled individuals.

Access to Basic Services

National legislation as well as a municipality's basic services policy recognises the need to prioritise access to basic services (water, sanitation, refuse removal and electricity) to all residents of an area, but particularly the poor and indigent households. The intention of this legislation and policies are to ensure that households enjoy a decent standard of living in line with the requirements of national legislation.

Table 6-15: Access to minimum basic services in 2019.

Indicator	NMBMM	Eastern Cape	South Africa
Total number of households	336 495	1 706 942	16 366 369
Water	96.3%	68%	85.6%
Electricity	90.2%	75.1%	84.9%
Sanitation	89.1%	46.4%	63.5%
Refuse removal	91.4%	44%	64.9%

(Urban-Econ, 2021)

In 2019, 96.3% of households in the NMBM had access to piped water, well above the provincial average of 68.0%. Accordingly, only 1 144 households in NMBM were dependent on either boreholes or natural sources, such as dams, rivers and streams as their primary water source. The high level of access can be attributed to the emphasis that the municipal government has placed on expanding access in low-income areas. It should be noted that this figure does not speak to the quality and reliability of this access.

Electricity access is exceptionally high in NMBM. This was evident by the fact that most (90.2%) households in the municipality use electricity as their primary means of lighting. This level of access is higher than both the provincial and national figures. The NMBM, however, has only increased access to electricity at an average annual rate of 1.9% between 2009 and 2019 compared to a rate 2.5% for the rest of the Eastern Cape.

Flush and chemical toilets are the most widely used sanitation type in the respective area, with the majority of households in the NMBM (89.1%), having access to this minimum national sanitation standard in 2019. Over the last ten years, the NMBM has made positive strides in improving access to sanitation. Between 2009 and 2019, the number of households that either had no access to sanitation or were dependant on pit and bucket latrines decreased at an average annual rate of 2.7%.

Approximately 91.4% of households in the NMBM have periodic refuse removal services provided by the municipal authority. This was notably higher than the 44.0% of households for the rest of the Eastern Cape. Accordingly, only

18 377 households (5.5%) in the NMBM had either no refuse removal services (7 314 households; 2.2%) or were dependant on their own refuse dump (11 063 households; 3.3%). Despite this high level of access, the number of households in the NMBM dependant on a communal refuse dump rose by 2.7% year-on-year between 2009 and 2019.

Gross Value

The NMBMM accounted for 38.5% of the Eastern Cape economy's gross value added (GVA), exemplifying the important role which the municipality plays in the Eastern Cape's economy. It is important to note however that over the 10-year period the NMBMM saw lower growth in the overall GVA than both the Eastern Cape, and South Africa. This is likely due to the municipality having a fairly established and developed economy relative to the rest of the Eastern Cape, and is reflected by the fact that Gqeberha is the largest city in the Eastern Cape.

Table 6-16: ***Gross Value add of the Primary, Secondary, and Tertiary Impact Areas (Billions of Rands)***

Indicator	NMBMM	Eastern Cape	South Africa
Total GVA - 2009	R133.39	R338.89	R4 369.557
Total GVA - 2019	R149.62	R387.56	R5 166.316
Growth over 10 years	11.46%	13.39%	16.71%

(Urban-Econ, 2021)

The economic profile of the immediate affected area, namely the areas of Motherwell, Wells Estate, Bluewater Bay, and St Georges Strand, are described in Table 6-17 below, while Figure 6 23: shows where these settlements are located. From Table 6-17 Motherwell, and Wells Estate are low-income areas which have less than half, and less than a quarter of the average monthly household income of NMBMM, and are therefore comparatively poorer areas. By comparison Bluewater Bay, and St Georges strand are significantly more affluent, particularly Bluewater Bay which has an average monthly household income which is just over 3.5 times that of the municipal average.

Table 6-17: Household monthly incomes of four largest residential areas within close proximity to proposed location of Powerships

Indicator	Value
Motherwell monthly household income	R9 795.7
Wells Estate monthly household income	R6 987.61
Bluewater Bay monthly household income	R89 254.71
St Georges Strand monthly household income	R30 027.34

(Urban-Econ, 2021)

Figure 6-23: Residential settlements surrounding proposed Powership location

It is important to consider the profile of the current and potential future businesses which may exist around the Powerships in the Coega IDZ, as such Figure 6-24 provides a map of the IDZ and the respective zones.

Figure 6-24: Coega IDZ Zones

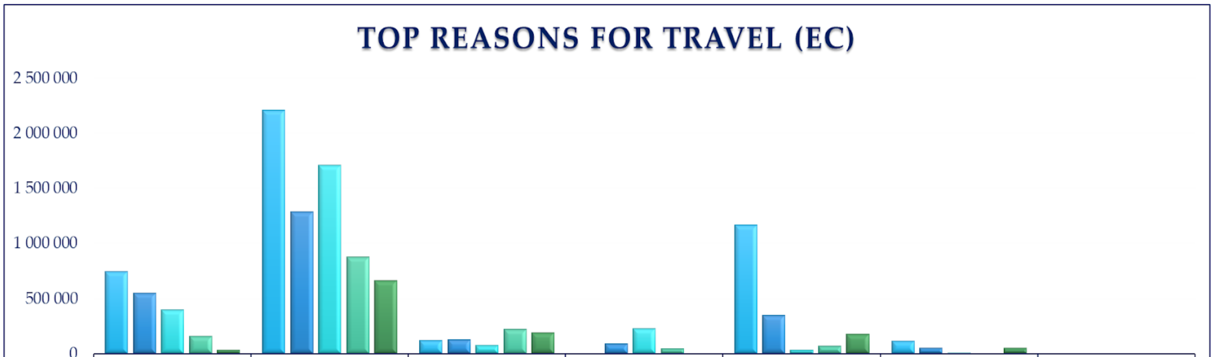
6.4.2 Tourism

The area falls within the Critical Biodiversity Area and near the Addo Elephant National Park Marine Protected Area and the Algoa to Amathole Ecologically or Biologically Significant Marine Area (EBSA). The Algoa Bay has also received status as one of the world's four Whale Heritage Sites. Addo Elephant National Marine Protected Area, including St Croix Island, is located within 5km, and Jaheel Island is located within 530m. The Addo Elephant Important Bird Area (IBA) is within 5km. Globally and Regionally Endangered African Penguin (*Spheniscus demersus*), are located in Jaheel Island, located 530m of the breakwater of Port of Ngqura, (supporting 1.3 -1.7% of global and SA population).

The 1200 km^2 MPA protects a wide range of ecosystems, including sandy beaches, rocky shores, reefs, an estuary and islands. Protection of the estuary and reefs are important for the recovery of valuable fisheries resources such as abalone and kob. The MPA increases the Big Five - found within the Addo Elephant National Park - to the Big Seven through the protection of great white sharks and whales (brydes, minke, Southern right Whale, humpback and right). The MPA protects important feeding areas for the 9,000 pairs of endangered African penguins breeding at St Croix Island and the 60,000 pairs of endangered Cape gannets breeding at Bird Island. Being close to the city, the MPA facilitates nature-based tourism, maintains attraction for marine ecotourism, and serves as an outdoor classroom for educational activities.

Located within the buffer zone of the park is the deep-water port of Ngqura, which lies 20 km northeast of Port Elizabeth South Africa's 8th and latest commercial port development, situated at the mouth of the Coega River in Algoa Bay. An industrial Commercial zone (ICZ), known as the Coega ICZ, has been developed over the 12,000 ha site in the area including the river and port, with a 4,500 ha core development immediately identified. The ICZ serves as a primary location for new industrial development for export driven industries (AENP Management Plan 2015- 2025).

In 2021, tourism arrivals to the Eastern Cape (EC) were led by travellers in the *Visit their friends and relatives (VRF)* segment. Despite the impact of COVID on visitor numbers, the province recorded an increase of 71,5% year-on-year increase between 2020 and 2021. In addition, visitors in the *Holiday* segment increased by 36% year-on-year. The increase in visitors in both segments could be attributed to intermittent lifting of COVID-19 lockdown restrictions during 2020 and 2021.



	Holiday	VFR	MICE	Medical	Religious	Education/training	Other
2021	745 956	2 206 862	122 179	0	1 171 205	116 994	0
2020	548 905	1 286 706	128 890	91 203	349 943	50 876	0
2019	396 794	1 711 764	75 890	230 865	35 913	2 916	0
2018	162 142	876 982	224 249	47 730	69 579	0	0
2017	33 441	667 013	192 121	0	175 802	49 286	0

2021 2020 2019 2018 2017

Figure 6-25: Top reasons for travel (EC)

<u>Nggura Port / Port Elizabeth Tourism Trends</u>

The Ngqura Port is located in Port Elizabeth (recently renamed Gqeberha) within the Nelson Mandela Bay Metro Municipality (NMBMM). The number of trips by tourists visiting Nelson Mandela Bay Metropolitan Municipality from other regions in South Africa has decreased at an average annual rate of -5.97% from 2009 (783 000) to 2019 (423 000).

The tourists visiting from other countries decreased at an average annual growth rate of 2.70% (from 92 100 in 2009 to 120 000).

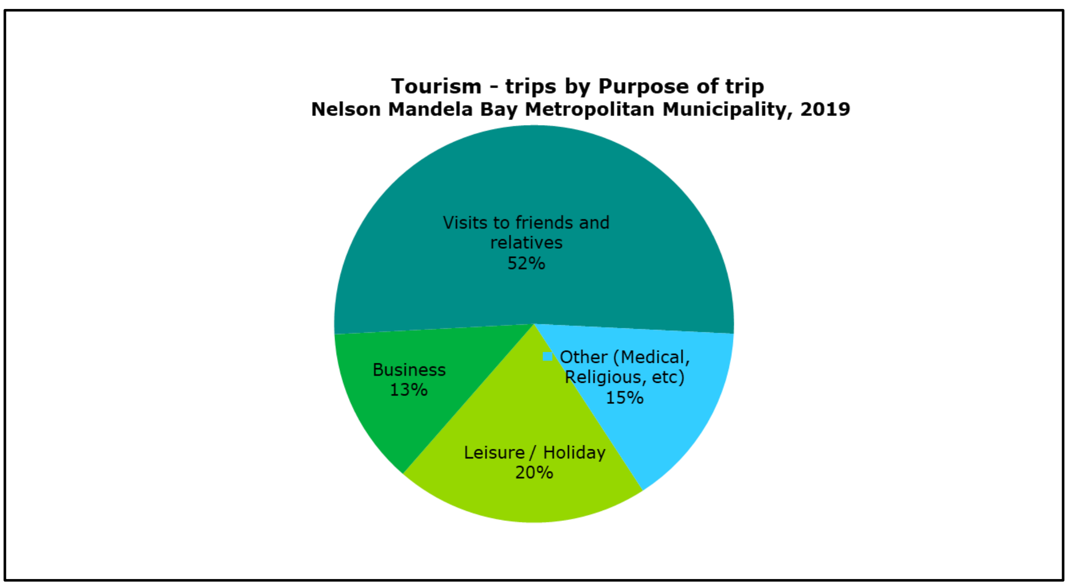


Figure 6-26: NMBM Tourism Trips by Purpose of trip

<u>Tourism spending as a share of GDP</u>

The data and information provided in this section was obtained from the IHS Market Statistical Overview of Nelson Mandela Bay Metro Municipality where the Ngqura port is located.

- According to the report, tourism spending as a percentage of GDP in 2019 was 4.7% in Nelson Mandela Bay Metro.
- Meanwhile, tourism spending as a percentage of GDP for 2019 was 5.1% in Eastern Cape Province and 5.6% in South Africa.

Table 6-18: Tourism contribution to GDP for Nelson Mandela Bay Metro

Year	Nelson Mandela Bay	Eastern Cape	National Total
2009	5.4%	6.0%	6.1%
2010	5.3%	6.0%	6.1%
2011	5.1%	5.6%	5.8%
2012	5.5%	6.0%	6.1%
2013	5.5%	5.9%	6.2%
2014	5.6%	6.1%	6.3%
2015	4.9%	5.4%	5.7%
2016	5.4%	6.0%	6.1%
2017	5.2%	5.7%	6.0%
2018	4.8%	5.2%	5.6%
2019	4.7%	5.1%	5.6%

Source: IHS Statistical Overview “Nelson Mandela Bay” 2020

6.5 TRAFFIC

6.5.1 Traffic

During the construction stage of the project, the typical type of traffic that is generated is staff traffic and construction vehicle traffic.

During the overall construction stage of the project, 171 people will be employed. Due to the nature of the activity, it is estimated that 70% of staff would arrive using public transport. It is further estimated that the vehicle occupancy for car would be 1,1 persons per vehicle and for public transport 14 persons per vehicle. Therefore, 54 peak hour trips would be generated during the construction stage. These trips would not be concentrated in one area, rather they would be assigned to the different construction sites and therefore the impact is diluted.

If general public transport is being used, then the designated Transnet public transport pick up and drop off area should be utilised. Alternatively, if there is a dedicated Transnet shuttle available for staff working at the port, then permission may be sought to utilise such services. For staff arriving by private vehicles, space should be allocated for off-street parking.

According to COTO TMH 16 South African Traffic Impact and Site Traffic Assessment Manual V1.0 August 2012, development that generate less than 50 trips in the peak hour do not require a TIA. In this regard, if general public transport is being used then the designated Transnet public transport pick up and drop off area should be utilised. Alternatively, if there is a dedicated Transnet shuttle available for staff working at the port, then permission may be sought to utilise such a service. For staff arriving by private vehicles, space should be allocated for off-street parking.

The operation of the site is not expected to generate any significant amount of truck and service vehicle trips on a typical day. There may be a need for ad-hoc trips for maintenance and replenishment of supplies. Any trips made by trucks and service vehicles are likely to occur outside the commuter peak hours.

From time to time there will be a need for trucks to travel from the site to regional road network which in this case is the N2. This would occur during both the construction stage and operational stage of the project. The Port of Nqgura has direct access to the N2 via Neptune Road. The route does not pass any sensitive land uses, hence there is no traffic or social impacts.

6.5.2 Marine Traffic

The site for the FSRU is located at the base of the eastern breakwater and is seaward of the admin craft basin. There is where the STS operation of the LNGC to the FSRU will take place. In the identification of the preferred site in the Port of Ngqura, the sites of existing cargo facilities and the future short term developments were avoided. There is a consideration of a liquid bulk berth (A100) in the site selected for the Powership mooring. As the nature of the Karpowership Powership project is considered a short to medium-term emergency power solution and the development of Berth A100 is based on commodity demand, the conflict with TNPA’s LTPF (2015) or NPP (TNPA, 2019) plans may not be significant. The existing and anticipated vessel traffic in the Port of Ngqura in 2020 is 712 vessels with approximately 93% of these vessels being container vessels. The current demand for container handling is 980 000 TEUs and is expected to grow to approximately 2 million TEUs by 2051. The liquid bulk terminal in Port Elizabeth is scheduled to move to the Port of Ngqura and is forecast to increase handling of total liquid bulk products from approximately 1 Mtpa in 2021 to approximately 2 Mtpa in 2051. The manganese ore terminal is set to be operational by 2021 and is forecasted to increase to approximately 22 Mtpa by 2051.

CMR data was used to analyse the historic trends of vessel activity at the Port of Ngqura (LTPF, 2015). The annual percentage growth in demand was used to estimate the future vessel traffic for the various cargo handled within the port for the years 2021 to 2051. Container vessel calls are forecasted to increase from 687 in 2021 to 1 497 in 2051. The number of additional vessels contributable to the Powership operations is 7 vessels per annum, increasing to 8 vessels in 2028 and 14 vessels per annum in 2051. This only considers the relatively more frequent LNGC refuelling of the FSRU and excludes the once-off arrival of the Powership and FSRU upon commissioning within the Port of Ngqura.

All vessel slots, including the LNGC vessels arriving for refueling, were calculated assuming an appropriate slot duration where the navigation channels, pilotage and tug resources of the port are utilised. The assumed slot durations considered a 2.5 hour duration for both berthing and sailing operations of the existing vessel types in the port (i.e. cargo vessels), while LNGCs will consider a duration of approximately 4 hours to moor and unmoor at the FSRU.

The results of the marine vessel traffic assessment, which considers vessel traffic forecasts up to 2051 and an upper limit of LNGC vessel calls, indicate that the LNG vessels, only representing 1% of the 2051 vessel traffic slot durations, are not expected to significantly add to congestion within the port. The Port of Ngqura is forecasted to have approximately 76% and 47% spare slot capacity in 2021 and 2051 respectively.

7 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

7.1 OVERVIEW OF EIA PROCESS

The EIA process, including public participation, is prescribed by the EIA Regulations, 2014 as a requirement for the application for an EA and an atmospheric emission licence. Thus, the EIA process for the proposed Gas to Power via Powership project must comply with these Regulations in order for the application to be valid. The process applicable to Karpowership's application is Scoping & Environmental Impact Reporting (S&EIR).

Subsequent to the application form for environmental authorisation having been submitted to the competent authority, DFFE at the beginning of October 2020, Triplo4, the EAP, commenced with the first phase of the EIA process, the Scoping Phase. In order to meet the prescribed 44-day timeframe, Triplo4 had already started identifying, notifying and engaging with Interested and Affected Parties (I&APs) in September 2020.

The EAP, with guidance from DFFE and input from specialists and I&APs, including relevant organs of state, identified issues, impacts and risks associated with the proposed activities and their alternatives in context of the receiving environment and regulatory framework. The Draft Scoping Report was made available for a 30-day comment prior to it being submitted for consideration to DFFE from 17 November 2020 – 06 November 2020.The Final Scoping Report, including the Plan of Study for the EIA contained therein, was accepted by DFFE on 06 January 2021.

The approval of the Scoping Report automatically triggered the commencement of the current phase, the EIA (also referred to as the Environmental Impact Report (EIR)) for which the applicant and EAP have 106 days to complete. The Final EIAr and EMPr were submitted to the DFFE on the 26 April 2021. The DFFE refused the EA application and provided KSA with the Record of Refusal (RoR) on 23 June 2021. KSA appealed the DFFE refusal on 13 July 2021. On 1 August 2022, the Appeal Authority (the Minister of the DFFE), dismissed the grounds of appeal but in doing so exercised her powers in terms of Section 43(6) of NEMA to:

"*remit the matter to the CA […] so that the various gaps in information and procedural defects in relation to the PPP that led to the rejection of the EA application may be addressed during the reconsideration and re-adjudication of the EA application, provided that the timeframes prescribed by the 2014 EIA Regulations in respect of the EIA process are adhered to by the appellant and the CA".*

As a result of the Minister's decision, the previous EIA from 2020 has been archived, updated and additional specialist studies have been undertaken and an enhanced PPP is underway to address the gaps raised by the Minister.

In preparing this Draft EIA Report for I&AP comments, Triplo4 engaged with numerous specialists and detailed studies were conducted and considered. Refer to Table 1-4 for the details of the Specialist and Technical Team, as well as Appendix 9 for the full list of specialists and technical studies. Section 6 of this DEIR contains the baseline descriptions of the environment, based on research conducted by the specialists in the various fields of expertise.

The site layout alternatives assessed during the Scoping Phase and considered feasible were brought forward to the EIA phase for further assessment (including the 'No-Go Option' as an alternative), and are discussed in Section

3 of this DEIR. All site layout alternatives fall within the site approved by DFFE at the end of the Scoping Phase, which is the Port of Nqgura.

The methodology used to assess the potential impacts is described in Section 7.2.1. Deviations from approved Scoping Report (including Plan of Study) and the assumptions, uncertainties and gaps in knowledge relating to the assessment and mitigation measures proposed are also presented and highlighted in Sections 7.3 and 7.4 respectively.

The findings of the assessment of the potential impacts and risks associated with the proposed project and alternatives, as well as identification of mitigation measures, are reported in detail in Section 7. The mitigation measures are also collated into the draft Environmental Management Programme (EMPr). Both the draft EIA Report and EMPr are made available for an extended 33-day period for I&APs to comment. Comments received will be incorporated into the final EIA Report for submission to DFFE in order for it to make a decision. DFFE will either grant or refuse environmental authorisation, and if granted, a number of conditions of approval will be imposed, including compliance with the approved EMPr.

7.2 IMPACT ASSESSMENT METHODOLOGY

2014 NEMA EIA Regulations (as amended), Appendix 3 (3)(1)(h)(v) the impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts can be reversed; may cause irreplaceable loss of resources; and can be avoided, managed or mitigated; (vi) the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks; viii) the possible mitigation measures that could be applied and level of residual risk.

7.2.1 Impact Assessment Methodology

This section describes the processes undertaken to identify impacts, to assess and rank the impacts and risks, to describe environmental impacts and risks identified during the EIA process, to assessment of the significance of each impact, risk and an indication of the extent to which the issue and risk can be avoided or addressed by the management actions, and any deviations from approved Scoping Report (including Plan of Study). Assumptions, uncertainties and gaps in knowledge relating to the assessment and mitigation proposed are also discussed. In the EIAR, the significance of the potential impacts are considered before and after identified mitigation is implemented, for direct, indirect, and cumulative impacts, in the short and long term, for all phases of the proposed project. The specialist studies are synthesised and integrated into the overall impact assessment and recommendations for mitigation are included in the EMPr.

The following criteria were considered for the assessment of each impact.

The **nature** of an impact is the type of effect that the activity will have on the environment. It includes what is being affected and how.

The **duration** of the impact is the period during which the impact is occurring. Inherent in this is the **reversibility** of the impact, meaning that if the duration of the impact is not permanent, then it can be reversed, i.e. the impact is reversible. Should an impact not be reversible, then this is explicitly stated.

The **irreplaceable loss of resources** has been assessed, but not explicitly stated as such. For example, a less severe impact will be insignificant or non-harmful and the resultant loss of resources can be replaced. In contrast, the loss of resources from disastrous or extremely harmful impacts cannot be satisfactorily replaced.

The **significance** of an impact is determined by a combination of its consequence and likelihood.

The table below describes the scoring of the impacts and how they determine the overall significance.

Table 7-1: Impact Scoring.

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	1 – Insignificant / Non-harmful 2 – Small / Potentially harmful 3 – Significant / Slightly harmful 4 – Great / Harmful 5 – Disastrous / Extremely harmful
Duration a measure of the lifetime that the impact will be present	1 – Up to 1 month 2 – 1 month to 3 months 3 – 3 months to 1 year 4 – 1 to 10 years 5 – Beyond 10 years / Permanent
Spatial Scale the extent / size of the area that may be affected	1 – Immediate, fully contained area / within the site 2 – Surrounding area (< 2km) 3 – Within farm / town / city 4 – Within municipal area 5 – Regional, National, International
Overall Consequence = (Severity + Duration + Extent) / 3	
Likelihood	
Frequency how often the impact will occur	1 – Once a year or once / more during operation 2 – Once or more in 6 months 3 – Once or more a month 4 – Once or more a week 5 – Daily or hourly
Probability the likelihood or the chances that the impact will occur	1 – Almost never / almost impossible 2 – Very seldom / highly unlikely 3 – Infrequent / unlikely / seldom 4 – Often / regularly / likely / possible 5 – Daily / highly likely / definitely
Overall Likelihood = (Frequency + Probability) / 2	

Overall Environmental Significance = Overall Consequence X Overall Likelihood	
Overall Environmental Significance:	
0 - 2.9	Very Low
3 - 4.9	Low
5 - 6.9	Medium - Low
7 - 8.9	Medium
9 - 10.9	Medium - High
11 and above	High

7.2.2 Cumulative Impact Assessment

Table 7-2 below lists other similar potential projects in the area, which were considered for the cumulative impacts assessments.

Table 7-2: Other Similar Potential Projects in Port of Ngqura Area

Project Name and Description	Applicant	Status in Oct 2022 (to Triplo4 knowledge)
3 000 MW Coega Gas-to-Power Project (Number of projects within CDC) The proposed project will ultimately include a land-based LNG terminal and three 1 000 MW Gas to Power plants, two in Zone 10 and one in Zone 13 of the SEZ. Power generation will be by means of a hybrid of Combined Cycle Gas Turbines (CCGT), Open Cycle Gas Turbines (OCGT), and Reciprocating Engines (RE). Each power plant will use LNG as the primary source of fuel, with diesel and fuel oil as back up fuels.	Coega Development Corporation	The EIAs have recommenced for the Zone 10 North & South power stations and the Gas Infrastructure. The Zone 13 power station, Phase 1 (200MW power station) was authorised. The remainder (800MW of the 1000MW – Phase 2) will be re-applied for.
200 MW Engie CB Hybrid Power Project The proposed 200 MW Engie CB Hybrid Power Project will be adjacent to the Dedisa Substation in Zone 13 of the Coega SEZ. It will used LNG. A FSU will located be in Port of Ngqura and will be resupplied by an LNG carrier. LNG will be transported daily from the port to the plant utilising gas tanker trucks.	Engie South	Application was refused, No re-application

7.3 ASSUMPTIONS, UNCERTAINTIES OR GAPS IN KNOWLEDGE RELATING TO THE ASSESSMENT AND MITIGATION PROPOSED

Certain assumptions, limitations, and uncertainties are associated with the EIA Phase and this chapter, in accordance with Item 3(1)(p) and Item 3(1)(u) in Appendix 3 of GN 326, describes the assumptions, limitations, uncertainties and gaps in knowledge which relate to the assessment, mitigation measures proposed and opinions expressed by Triplo4 and Specialists.

This EIR from Triplo4, is based on the following:

- The EIA process and report is based on the technical information and process description provided by the client, the technical team and available technical reports, methodologies and procedures and is aimed to close out the gaps raised by the Honorable Minister in the Appeal decision;
- Opinions presented considered the site conditions and aspects as they existed at the time of the assessments. These opinions were also informed by the extensive Specialists investigations and enhanced public participation process with consideration of reasonably foreseeable circumstances and situations. These opinions specifically exclude conditions, comments and aspects that may have arisen after the date of the Report.
- The description of the baseline environment, the significance of impacts with mitigations and contributions to the Need & Desirability were obtained or augmented from specialist studies, desktop research and analysis and public participation contributions. It is assumed that the information provided in the specialist studies and research papers are accurate.
- The report is technology specific as per the Applicant's RMI4P submission and different energy sources and technologies as part of the energy mix is excluded from the assessment of alternatives. It is assumed that the requirement for gas generated power was, as per inter alia the IRP 2019, NDP 2030 and RMIPPP programme, developed with regulated public participation was approved for RSA at political and strategic level within all relevant spheres of Government.
- As typical with EIA processes, the EIA generally assessed concept designs. However, in some instances due to the existing technology having been proven in various countries and extensive engagements between the technical team, TNPA and ESKOM technical input was provided on more detailed design information and it is thus assumed that the project is viable from an engineering perspective.

Notwithstanding these assumptions, Triplo4 is of the opinion that the potential aspects and impacts associated with the proposed project could be adequately interpreted and assessed and informed opinions and conclusions could therefore be reached.

Please refer to the Specialist studies for specialist study specific limitations. The summary table below provides a quick reference to the assumptions and limitations presented in specialist studies:

Table 7-3: Specialist Studies Assumptions and Limitations

Specialist Report	Page No.	Section	Specialist Report	Page No.	Section
Appendix A1 – Hydrology Assessment	28	5.4	Appendix A2 - Aquatic Assessment	6	2.1
Appendix A3 - Hydropedology Assessment	12	1.4	Appendix A4 - Geohydrology Assessment	32	5.8.2
Appendix A5 - Water Balance Assessment	4 & 7	1.5 & 2.3	Appendix A6 - Wetland Delineation and Functional Assessment	18	6
Appendix A7 - Heritage Assessment	18	6.3	Appendix A8 - Terrestrial Biodiversity Assessment	2	1.4

Specialist Report	Page No.	Section	Specialist Report	Page No.	Section
Appendix A9 - Avifauna Assessment	2	-	Appendix B1 - Baseline Underwater Noise Assessment	-	-
Appendix B2 - Underwater Noise Assessment	18	6.1	Appendix B3 - Underwater Heritage Compliance Letter	-	-
Appendix B4 - Marine Ecology, Avifauna and Fishers Assessment	64	4.1	Appendix B5 - Coastal and Estuary Assessment	vii & 55	8.1
Appendix C1 - Atmospheric Impact Report	9 & 10	2.9	Appendix C2.1 - Terrestrial Noise Assessment	12	1.5
Appendix C2.1 - Ghana Ambient	-	-	Appendix C3 - Climate Change Impact Assessment	10 & 14	3.1.6 & 3.2.5
Appendix D1 - Socio-economic Impact Assessment	-	-	Appendix D1.1 - Small Scale Fishers Engagement	-	-
Appendix D1.2 - Tourism Assessment	17	5,1,2	Appendix D1.3 - Traffic Evaluation	7	2.2
Appendix D2 - Visual Impact Assessment	8	1.6	Appendix D3 - MHI Assessment	19	2.4.5

7.4 SCOPING REPORT AND PLAN OF STUDY DEVIATIONS

All deviations from the Scoping Phase have been identified and included in this EIA Report. The list of deviations include:

- The Alternative 1 Transmission Line is the preferred alternative based within the services servitude of the CDC and the CDC's preferred position. The services servitude within the industrial zoned area, as per environmental authorisation, provides for the establishing of inter alia a 132kV powerline. The Alternative 2 Transmission Line is based within the services servitude of the CDC and not supported by the landowner and no longer the preferred alternative.
- The transmission component of the project includes detailed description on the associated infrastructure such as switching station, various other transmission components.
- Detailed descriptions and locations on contractor facilities were included for the stringing yard, back of quay loading area and site office complex.
- A corridor servitude were determined for both the gas pipeline and transmission line installation. The transmission corridor will allow for technical construction requirements to be maintained on site, with a 50 metre corridor which includes the 31m working servitude. The gas line was determined in consideration with sensitivities on site. The subsea section of the pipeline will have a servitude of approximately 50m each side. The onshore buried section will require an anticipated servitude of 0.5 m each side.
- Polygon for Vessels (Powerships and FSRU & LNGC): Polygons were included to allow for optimal positioning of the vessels post Environmental Authorization (if issued) within the polygon as part of detail designs. Marine traffic studies and full mission bridge simulations (with TNPA harbour masters) have been completed and the Karpowership team are confident that final locations of the vessels, within the polygons provided, would be supported and approved by TNPA.
- The recommended impact assessment methodology was provided to all Specialists for the EIA. Some Specialists deviated from the recommended impact assessment methodology provided by Triplo4 as they

were of the opinion that a different impact assessment methodology was more appropriate to their specific discipline / area of specialization in order to ensure a scientifically aligned conclusion after proposed mitigation measures are implemented.

7.5 SPECIALIST FINDINGS, IMPACT ASSESSMENT AND RECOMMENDATIONS

A description of the environmental impacts and risks identified during the EIA and looked at by the specialists is contained in this section together with their recommendations.

The specialists' assessments inform the impact assessment findings presented in Section 7.5 and the specialists recommendations for the mitigation of potential impacts have been incorporated into the EMPr, attached as Appendix 6.

The assessment of the significance of potential impacts, including the extent to which impacts can be avoided or mitigated, is included in this section, the latter containing the detailed workings (severity, duration, extent, frequency, probability and significance ratings) used to determine the overall significance presented in the tables below.

The reversibility of impacts and irreplaceable loss of resources, although not explicitly rated as such in some specialist studies, are inherent in the duration and severity on each impact respectively as informed by the specialist studies, the findings of which are presented in Section 7.5.

The following potential impacts were considered in the EIA Phase for the proposed project:

7.5.1 Hydrological Impacts

The delineated flood lines for the 1:10, 1:20, 1:50 and 1:100-year return periods for the Coega River that runs adjacent to the Coega Bay Port proposed development – refer Figure 7-1. The aerial extent of the flood line reveals that there will not be any impact on the proposed "permanent" structures along the river course for the preferred and alternative 1 options.

The 1:100-year flood line area can be considered an exclusion area. With regards to downstream impacts (i.e. for the development portion outside the footprint of the flood line but directly downstream of the flood line), marginal impacts in terms of flood bank erosion or damage to infrastructure are expected. This is based on the flatter topography near the coastline, consideration of tide effects in inflowing surface water and calculated peak flows.

The overall hydrological risk associated with the proposed development is considered low to neutral, with reversible impacts. The impact of the proposed activity on the hydrological sub-catchments conceptual hydrological cycle is zero.

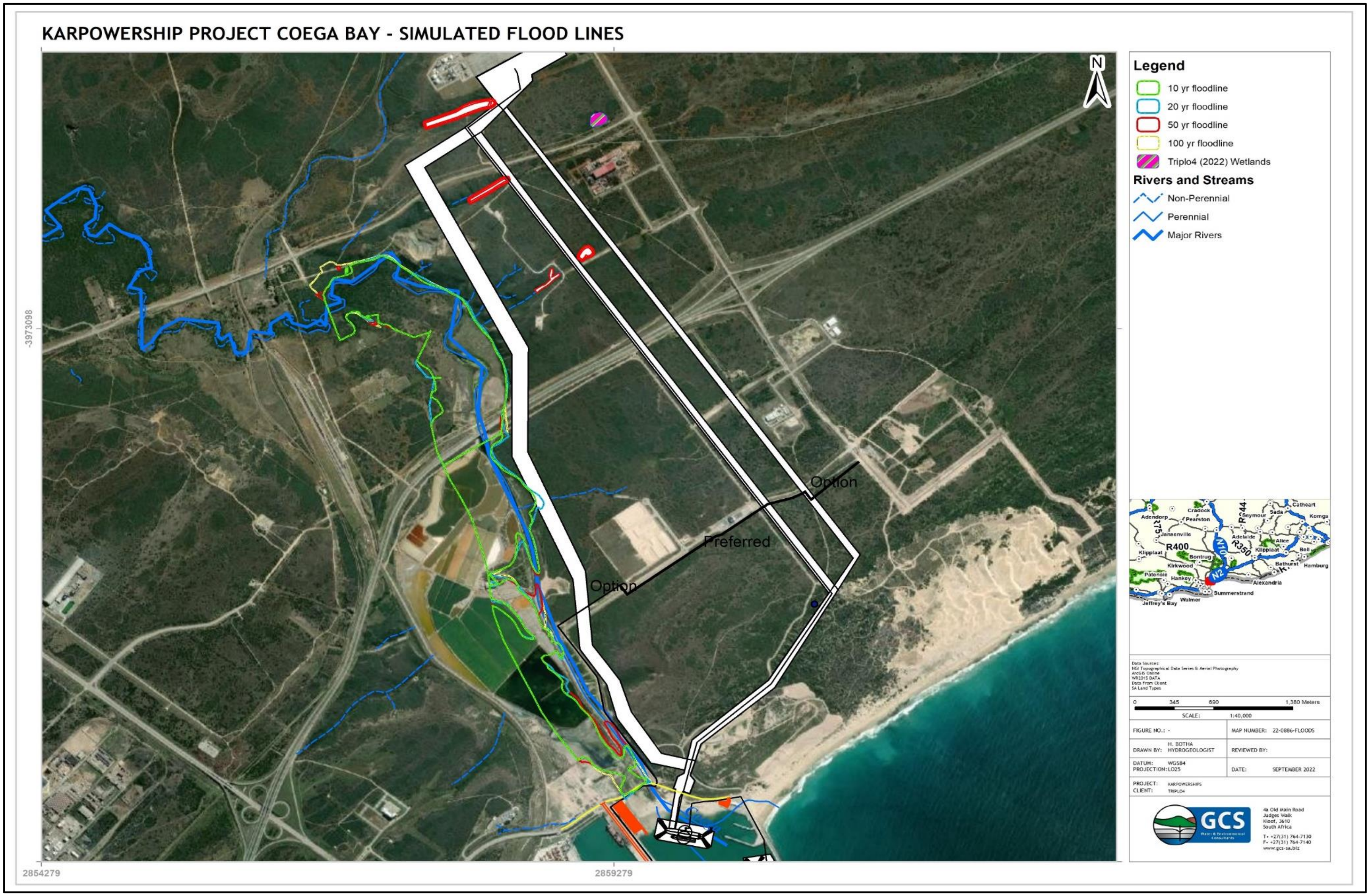


Figure 7-1: Delineated Flood Lines at the Coega Bay Port

7.5.1.1 *Impact assessment findings (with and without mitigation): **<u>Transmission Line Alternatives 1, 2 and Laydown Area: Construction Phase</u>***

Based on the available development layout plans the following will likely have an impact on the surface water bodies surrounding the site during the construction and preparation:

- The building of relevant surface infrastructure.
- Areas will have to be cleared for construction lay down and to provide storage, ablution, and office space. This would expose bare soil and the soil will be “stockpiled” to be used to backfill the trench.
- Construction vehicles will be constantly manoeuvring through the area, compacting the soil, and any mishaps or damages could cause leakages of fuel and oil from the vehicles.
- Water from surface water bodies may be used for the washing of vehicles and other equipment, as well as for ablution purposes.
- Altering natural drainage lines may cause ponding or increased runoff patterns.
- Any flooding that occurs during this phase is likely to cause surface water contamination as soil and other debris are washed away into watercourses.

Table 7-4: **Estimated hydrological risks (construction/preparation phase)**

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation: Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	Recommended Mitigation Measures	Post Mitigation: Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	Confidence
Vadose zone soils.	Disturbing vadose zone during soil excavations/construction activities.	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6) (-5)	Probable (1)	Neutral/ Negligible (0 to -12) (-5)	Only excavate areas applicable to the project area. Cover excavated soils with a temporary liner to prevent contamination. Retain as much indigenous vegetation as possible. Exposed soils are to be protected using a suitable covering or revegetating.	Short-term (2)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-4)	Probable (1)	Neutral/ Negligible (0 to -12) (-4)	Medium
	• Exposure of soils, leading to increased runoff from cleared areas and erosion of the watercourses, and thus increased the potential for sedimentation of the watercourses. • Soil compaction; and • Soil erosion.	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10)	Definite (2)	Low – negative (-13 to -24) (-20)	Place drip trays under vehicles at the site. Visual soil assessments for signs of contamination (monthly)	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-5)	Definite (2)	Neutral/ Negligible (0 to -12) (-10)	Medium
Primary Surface Water Receivers > Non-perennial streams > Coega River > Wetland system (Watercourses)	Surface water contamination and sedimentation from the following activities: o Equipment and vehicles are washed in the water bodies (when there is water); o Erosion and sedimentation of watercourses due to unforeseen circumstances (i.e. bad weather); and o Alteration of natural drainage lines which may lead to ponding or increased runoff patterns (i.e. may cause stagnant water levels or increase erosion).	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10)	Definite (2)	Low – negative (-13 to -24) (-20)	install a temporary cut-off trench to contain poor-quality runoff (if required) Routine inspections of all infrastructure (monthly)	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-5)	Definite (2)	Neutral/ Negligible (0 to -12) (-10)	Medium

*7.5.1.2 Impact assessment findings (with and without mitigation): **Transmission Line Alternatives 1, 2 and Laydown Area: Operational Phase***

Table 7-5: Estimated hydrological risks (operational phase)

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation: Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	Recommended Mitigation Measures	Post Mitigation: Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	Confidence
Soil disturbance & erosion and sedimentation of nearby watercourses.	Transmission line installation areas that were backfilled with collapsible soils may cause soil subsidence.	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6) (-5)	Probable (1)	Neutral/ Negligible (0 to -12) (-5)	• Only excavate areas applicable to the project area. • Retain as much indigenous vegetation as possible.	Short-term (2)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-4)	Probable (1)	Neutral/ Negligible (0 to -12) (-4)	Medium

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance		Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	
Water quality degradation of nearby watercourses	Switching station spillages (incidents only)	Spillages from switching station may run off into watercourses or leach through the soil. (incidents only)	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6) (-5)	Probable (1)	Neutral/ Negligible (0 to -12) (-5)	• Ensure maintenance of switching station to prevent incidents	Short-term (2)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-4)	Probable (1)	Neutral/ Negligible (0 to -12) (-4)	Medium
	Leakages from vehicles occurring during transmission line maintenance	Poor quality overland runoff or seepage from hydrocarbon spills from vehicles parked at the site.	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6) (-5)	Probable (1)	Neutral/ Negligible (0 to -12) (-5)	• Water quality monitoring of the nearby river if there are visual signs of any sedimentation or surface pollution.	Short-term (2)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-4)	Probable (1)	Neutral/ Negligible (0 to -12) (-4)	Medium

7.5.1.3 Cumulative Impacts

As the proposed activities will stretch over several sub-catchments and take place close to other proposed power development there will be cumulative impacts (however limited due to the project type.

Other proposed energy developments are situated in different drainage areas, rendering the likely impact associated with this project, zero. Any hydrological risk for this project will be confined to the delineated sub-catchments (worst case). Considering the sub-catchment conceptual hydrological cycle and the activities associated with the site and surroundings, no impacts are expected in terms of the hydrological cycle. This is due to the proposed site activities not significantly altering the hydrological functions of the given environment.

7.5.1.4 Mitigation Measures and Recommendations

The following mitigation measures were proposed for inclusion into the EIA and EMPr:

- During the construction phase, it is recommended that sandbags and temporary berms be used, to manage stormwater runoff (if storms do occur). Temporary stormwater systems should be sufficient to manage the stormwater at the site during the construction phase.
- Ensure that eroded areas are re-vegetated, to ensure reduced sedimentation risk and reduced runoff volumes to the streams.
- The Department of Environmental Affairs (DEA) published a generic Environmental Management Plan (EMPr) for substations and powerlines (22 March 2019). It is proposed that the mitigation and monitoring plan presented in this report be further supplemented by the generic EMP document.
- It is proposed that water monitoring be implemented as discussed in Section **Error! Reference source not ound.**, and as required.
- To prevent erosion and deposition during construction use:
  - Minimise vegetation disturbance during construction.
  - Re-vegetate as soon as possible to establish and maintain good ground cover across the site.
  - Conduct regular inspections and maintenance of the site to ensure that vegetation cover is adequate, and no rivulets are generated.
- Stormwater management should focus on the following, for each site, before the work takes place:
  - **Assess the site constraints and any site-specific concerns, including:**
    - Specific vegetation that may need to be identified and/or isolated from the site disturbance.
    - Highly erodible soils may require additional erosion control measures.
    - The type of construction should consider landform. Avoid slab-on-ground construction on steep sites.
    - Up-slope drainage catchments that may need to be diverted around the work site.
    - Workspace limitations may require site-specific sediment control measures and/or the extensive use of skips or bins for material storage and waste management.
    - Expected rainfall intensity during the period of disturbance (wet season vs dry season).
  - **Stabilise the site entry/exiting points:**
    - A stabilised site access must be established and if possible, limited to one point only. The access allows for the construction vehicles to enter the work area of goods while preventing the unnecessary tracking of sediment onto the nearby environment from multiple locations. A stabilised entry/exit point normally consists of a stabilised rock pad.

- **Prevent erosion & manage stockpiles:**
  - Suitable material storage areas must be located up-slope of the main sediment barrier (e.g. sediment fence).
  - Stockpiles kept on site for more than two weeks will require an impervious cover (e.g. builder's plastic or geofabric) to protect against raindrop impact. Stockpiles of sandy material located behind a sediment fence will only need a protective cover if the stockpiles are likely to be exposed to strong winds.
  - On steep sites and sites with limited available space, erodible materials may need to be stored in commercial-sized bins or mini-skips before use.
- **Manage Site Waste:**
  - Adequate waste receptacles must be provided on-site and maintained in a way that potential and actual environmental harm resulting from such material waste is minimised.
  - Building activities must be carried out on a pervious surface, such as grass or open soil, or in such a manner that all sediment-laden runoff is prevented from discharging into a water body.

7.5.1.5 Specialist Conclusion

The Hydrological Report could not find any grounds or identify high hydrological risks to not proceed with the development of the proposed transmission lines. This is grounded on the assumption that the proposed mitigation measures, EMPr and EIA recommendations are implemented during the construction and operational phase of the transmission lines.

7.5.2 Aquatic Impacts

Coega Port is situated within a low rainfall region. The Mean Annual Precipitation (MAP) is in the order of 434 mm/annum and the Mean Annual Evapotranspiration (MAE) in the order of 1 550 mm/a (S-Pan) (WRC, 2015).

Four assessment sites were investigated, to assess the possible impacts associated with the proposed project. Due to the absence of water flow at the site as well as the rest of the study area, the in situ Water Quality, Integrated Habitat Assessment Index, and SASS5 results could not be obtained. However only one assessment site was observed to have a true channel PE1, although the reach does not display a true riparian and is likely only a natural depression. Impacts to these depressions/ drainage lines are of low concern, the implementation of good practice construction activities will limit potential impacts to aquatic resources downstream.

Even though the assessment event was undertaken in spring, directly after the winter rainfall season, no water flow was present within the study site. Therefore, no aquatic assessment could be conducted, in accordance with the SASS5 protocol.

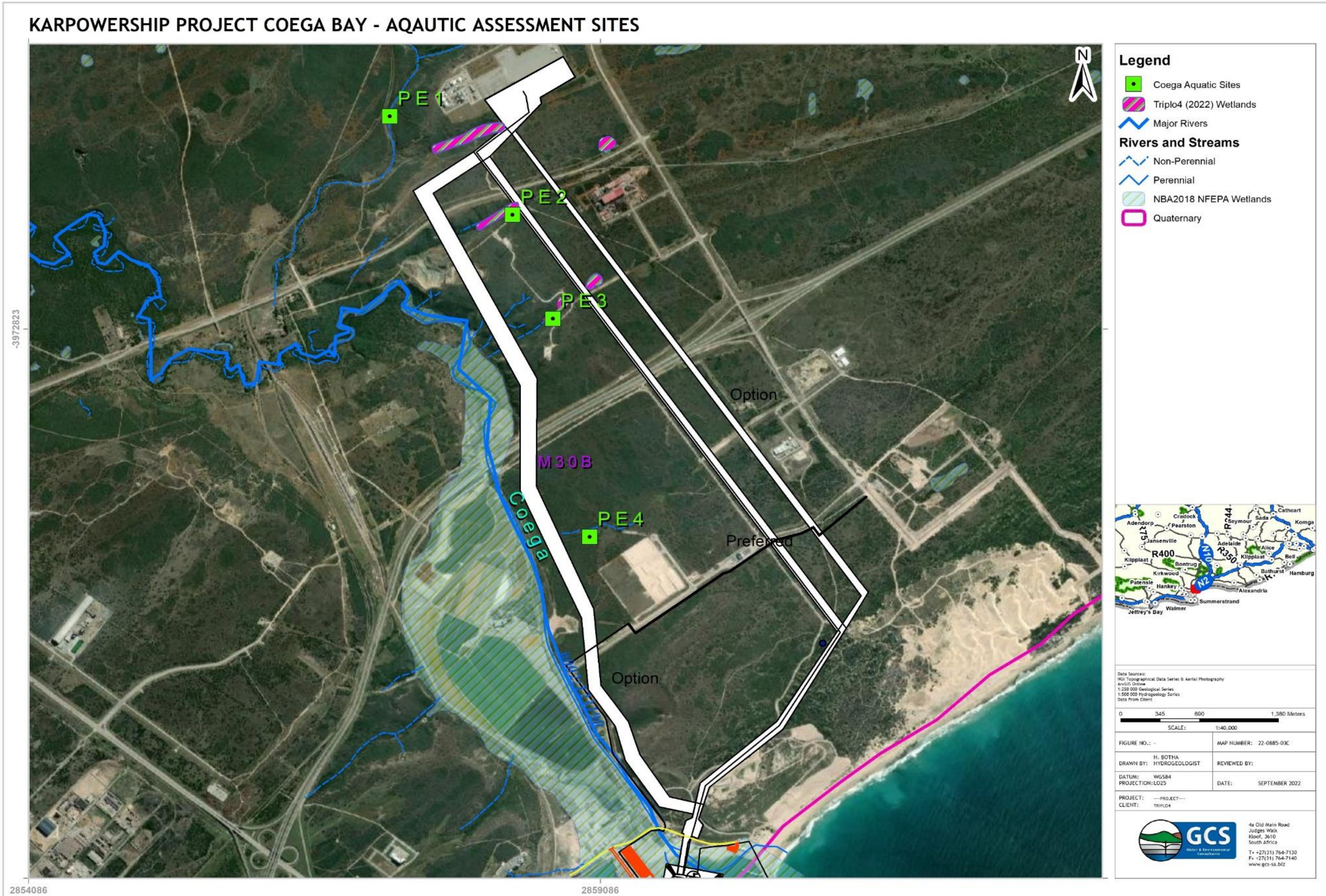


Figure 7-2: Aquatic Sites in relation to the Proposed Transmission Lines

7.5.2.1 Specialist Conclusion

The quality of the instream and riparian habitat has a direct influence on the aquatic community. Evaluating the structure and functioning of an aquatic ecosystem must therefore take into account the physical habitat to assess the ecological integrity. Keeping this in mind and the linear nature of the project it was established that there will not be any impacts on the aquatic environment, and this project can be considered for approval. Further based on available information for the above-mentioned projects, and in terms of the potential contributing impact on the aquatic environment after consideration of this project, it is concluded that there will be no contributing impacts to other similar projects in the area.

7.5.3 Hydropedology Impacts

In the determination of Hydrological Soil Types (HST), soils were divided into classes based on their expected hydrological responses. Hydrological processes were perceived from traceable signatures in the soil matrix resulting from the soil's ability to transmit, store and react with water. Hillslopes and preferential soil flow paths were evaluated based on a 30 m ALOS digital terrain model (DTM). The hillslopes generally feed into responsive soil types or streams/rivers. Two (2) hillslopes are associated with the project area (i.e. associated with the proposed development site).

Several hydropedological risks were identified for the construction and operational phase of the transmission line. The risk associated with the construction and operational phase is estimated to be low and decrease to neutral after consideration of proposed mitigation measures.

Due to the project type (i.e. linear development over a large area, where only a small soil area will be disturbed), no impacts on hydropedological flow drivers are anticipated. In context, this would mean that a 'no change in the hydropedological processes is predicted to occur for the proposed activities relating to no likely change in PES or EIS.

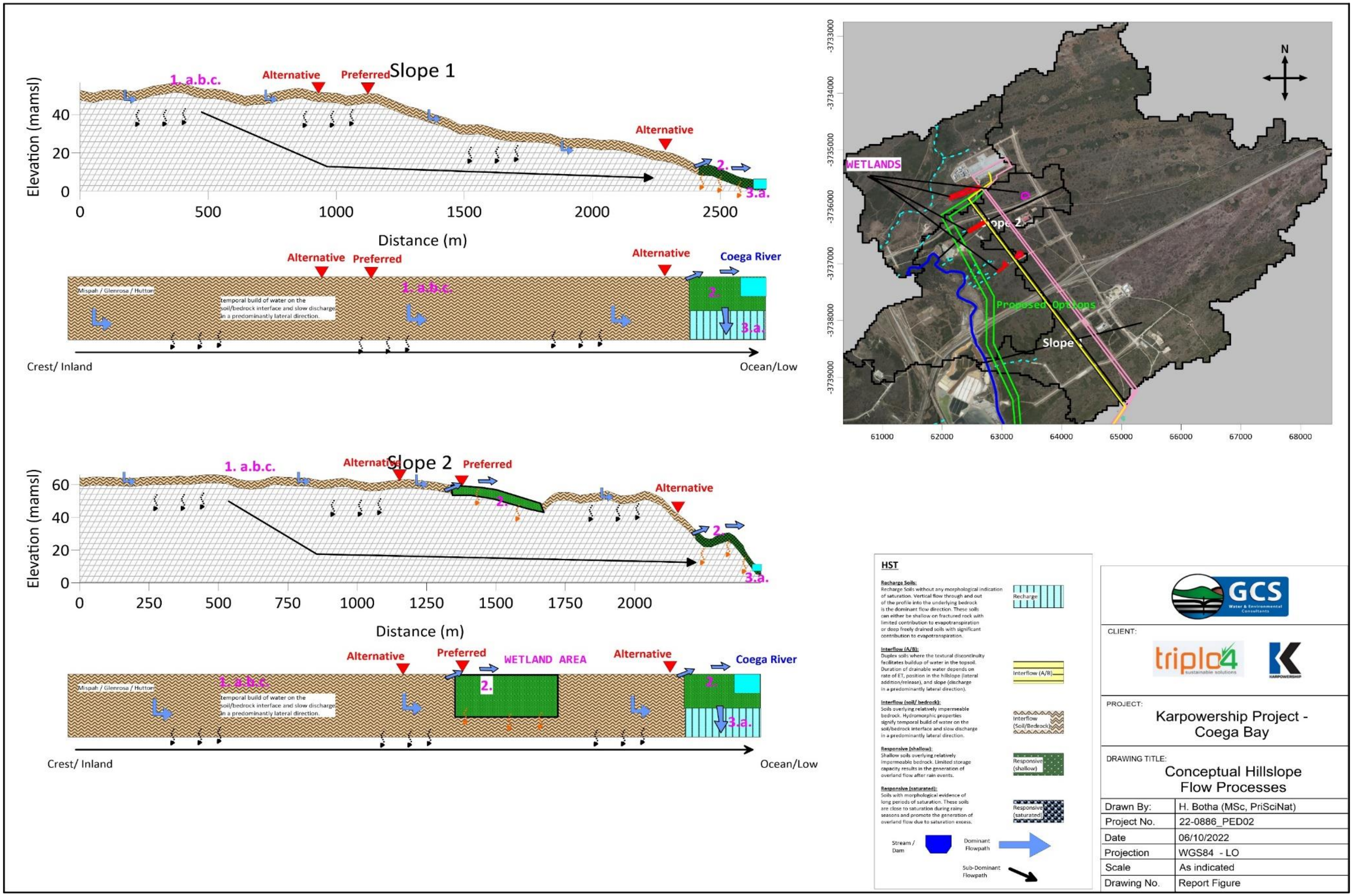


Figure 7-3: Hillslope hydropedological behaviours and flow zones

7.5.3.1 *Impact assessment findings (with and without mitigation):* ***<u>Transmission Line Alternatives 1, 2 and Laydown Area: Construction Phase</u>***

Table 7-6: Estimated hydropedological risks (Preparation & Construction Phase)

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance		Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	
Soil interflow processes: • Infilling of wetlands and watercourses inducing alternative flow paths. • Alteration to natural hydropedological flow paths. • Impacts on the macro-soil structure. • Impacts on the hydropedological processes supporting the watercourses. Soil structure & land capability: • Exposure of soils, leading to increased runoff from cleared areas and erosion of the watercourses, thus increasing the potential for sedimentation of the watercourses. • Vegetation loss. • Soil compaction; and Soil erosion. Soil quality: • Natural nutrient content decreases due to soil exposure. • Loss of natural bio-organisms essential to soil processes.	Site preparation, including placement of contractor laydown areas and storage (i.e. temporary stockpiles, bunded areas etc.) facilities.	Earthworks	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6) (-5)	Probable (1)	Neutral/ Negligible (0 to -12) (-5)	Only excavate areas applicable to the project area. Cover excavated soils with a temporary liner to prevent contamination. Keep the site clean of all general and domestic wastes. All development footprint areas remain as small as possible and vegetation clearing is limited to what is essential. Retain as much indigenous vegetation as possible. Exposed soils are to be protected using a suitable covering or revegetating. Existing roads should be used as far as practical to gain access to the site, and crossing watercourses in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles. Have emergency fuel & oil spill kits on site.	Short-term (2)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-4)	Probable (1)	Neutral/ Negligible (0 to -12) (-4)	Medium
	Disturbing vadose zone during soil excavations / infilling activities.	Earthworks	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10)	Definite (2)	Low – negative (-13 to -24) (-20)		Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-5)	Definite (2)	Neutral/ Negligible (0 to -12) (-10)	Medium
	In-situ placement of new soils, altering existing soil-flow processes (i.e. infilling of wetlands or excavations).	Earthworks	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10)	Definite (2)	Low – negative (-13 to -24) (-20)		Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-5)	Definite (2)	Neutral/ Negligible (0 to -12) (-10)	Medium
	Vegetation clearing & soil stockpiling.	Earthworks	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10)	Definite (2)	Low – negative (-13 to -24) (-20)		Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-5)	Definite (2)	Neutral/ Negligible (0 to -12) (-10)	Medium

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance		Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	
Surface water (wetland) quality	Leakages from vehicles and machines. Surface water contamination and sedimentation from the following activities: • Equipment and vehicles are washed in the water bodies (when there is water); • Erosion and sedimentation of watercourses due to unforeseen circumstances (i.e. bad weather); and • Alteration of natural drainage lines which may lead to ponding or increased runoff patterns (i.e. may cause stagnant water levels or increase erosion).	Mechanised machinery & seepage/runoff from building materials.	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10)	Definite (2)	Low – negative (-13 to -24) (-20)	Visual soil assessment for signs of contamination at vehicle holding, parking and activity areas. Place oil drip trays under parked construction vehicles and hydraulic equipment at the site. Surface water monitoring if visual signs of pollution are noted.	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-5)	Definite (2)	Neutral/ Negligible (0 to -12) (-10)	Medium
Soil quality	Oil & fuel spills from vehicles installing the transmission line	Mechanised machinery & seepage/runoff from building materials.	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10)	Definite (2)	Low – negative (-13 to -24) (-20)	Have emergency fuel & oil spill kits on site.	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-5)	Definite (2)	Neutral/ Negligible (0 to -12) (-10)	Medium

7.5.3.2 Impact assessment findings (with and without mitigation): ***<u>Transmission Line Alternatives 1, 2 and Laydown Area: Operational Phase</u>***

Table 7-7: Estimated hydropedological risks (Operational Phase)

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance		Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	
Soil interflow processes: • Infilling of wetlands and watercourses inducing alternative flow paths. • Alteration to natural hydropedological flow paths. • Impacts on the macro-soil structure. • Impacts on the hydropedological processes supporting the watercourses.	Disturbing the inner-soil architecture of the original soil profile will disturb natural flow processes – during the construction phase. Excavated soil will be placed in other areas (i.e. on top of other soils) and will have an impact on the flow dynamics of the soil it is dumped on top of. This may reduce rainfall infiltration and induce runoff.	The net result of earthworks & development activities.	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10)	Definite (2)	Low – negative (-13 to -24) (-20)	Revegetate areas (with vegetation growing at the site) where heavy machinery was used to excavate the soils to prevent erosion.	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-5)	Definite (2)	Neutral/ Negligible (0 to -12) (-10)	Medium
Soil quality	Oil & fuel spills from vehicles installing the transmission line	Mechanised machinery & seepage/runoff from building materials.	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10)	Definite (2)	Low – negative (-13 to -24) (-20)	Have emergency fuel & oil spill kits on site during maintenance runs.	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-5)	Definite (2)	Neutral/ Negligible (0 to -12) (-10)	Medium

7.5.3.3 *Cumulative Impacts*

From review of similar energy developments EIA Reports for the projects, the impacts in terms of wetlands which are predominantly sustained by hydropedological attributes are described as being insignificant.

Based on available information for the study area, and in terms of the potential contributing impact on the hydropedological system after consideration of this project, it is concluded that the contributing impact to other similar projects in the area will be low to neutral. The cumulative impact in terms of construction and operation phases associated with this project is anticipated to be low to neutral.

7.5.3.4 *Mitigation Measures and Recommendations*

The following mitigation measures were proposed for inclusion into the EIA and EMPr:

- Maintain the construction buffer around wetlands identified by Triplo4 (2022) in the project area (as specified by the wetland report); and
- Maintain the operational phase buffer (working servitude) for any vehicles servicing the transmission line.
- Appropriate erosion and protection barriers/structures should be considered for areas where land will be cleared. There is some potential for erosion. Measures should be taken to ensure that this is minimized where possible.
- The Department of Environmental Affairs (DEA) published a generic Environmental Management Plan (EMPr) for substations and powerlines (22 March 2019). It is proposed that the mitigation and monitoring plan presented in this report be further supplemented by the generic EMP document.
- It is recommended that mitigation measures, be implemented during the construction and operational phase of this project.

7.5.3.5 *Specialist Conclusion*

The Hydropedology Report could not find any grounds or identify high hydropedological risks to not authorising the proposed transmission lines. The risks are considered low to neutral, and only small areas where pylons are erected will be disturbed. This is further grounded on the assumption that the proposed mitigation measures and recommendations are implemented during the construction and operational phase of the transmission lines.

7.5.4 Geohydrology Impacts

The site conceptual geohydrological model (SCM) for the site – Figure 7-4. The SCM shows that two (2) aquifers exist in the area:

- An unconfined aquifer associated with the unconsolidated sands; and
- A confined and fractured aquifer network associated with deeper and older Uitenhage Series.

The aquifer underlying the site can be regarded as a low to moderate-yielding aquifer, with reported yields ranging from 0.1 to 0.5 l/sec - Class B2 aquifer. Based on extrapolated groundwater level data, it is estimated that the groundwater level for the site is in the order of 20 mbgl. Available data suggest that the groundwater table mimics the topography and groundwater flows from high-lying areas (water divides) to low-lying areas.

In the SCM, the main source of groundwater recharge is rainfall. The rainfall infiltrates into the ground to become groundwater through the Vadose Zone. The water then moves both vertically and horizontally in the weathered zone. Water flowing horizontally towards the south-west is likely to discharge into the perennial streams/river as base flow whereas water flowing vertically is likely to recharge the fractured aquifer (i.e. partially due to vertical percolation through the vadose zone and weathered aquifer zones).

Any poor-quality seepage from the activities associated with the development of the transmission lines (worst case and only if these activities take place i.e. crossing of waterbodies with vehicles, seepage and runoff from oil spillages and building material dumping along the watercourse) could potentially lead to contamination of the vadose zone which could percolate to the shallow aquifer. This risk is more likely to occur during the construction phase and not the operational phase of the project.

The Darcy seepage velocity suggests very slow-moving groundwater through the study area. The scale of abstraction and aquifer stress for the combined groundwater sub-catchment it was determined that the current scale of abstraction for the sub-catchment associated with the project is predicted at “Small Scale”, and aquifer stress is “Class A - Unstressed or low level of stress”. The stress-induced is maintained under the climate change scenario (Projected reduction in MAP for 2021 - 2050 under the RCP 8.5 = 43.73 mm/yr). The proposed development involves several transmission lines (i.e. limited impermeable surface generation), and no groundwater abstraction activities are proposed. Hence, the impact of the proposed development on the groundwater reserve is considered zero.

The site conceptual geohydrological model for the site is shown in Figure 7-4 below.

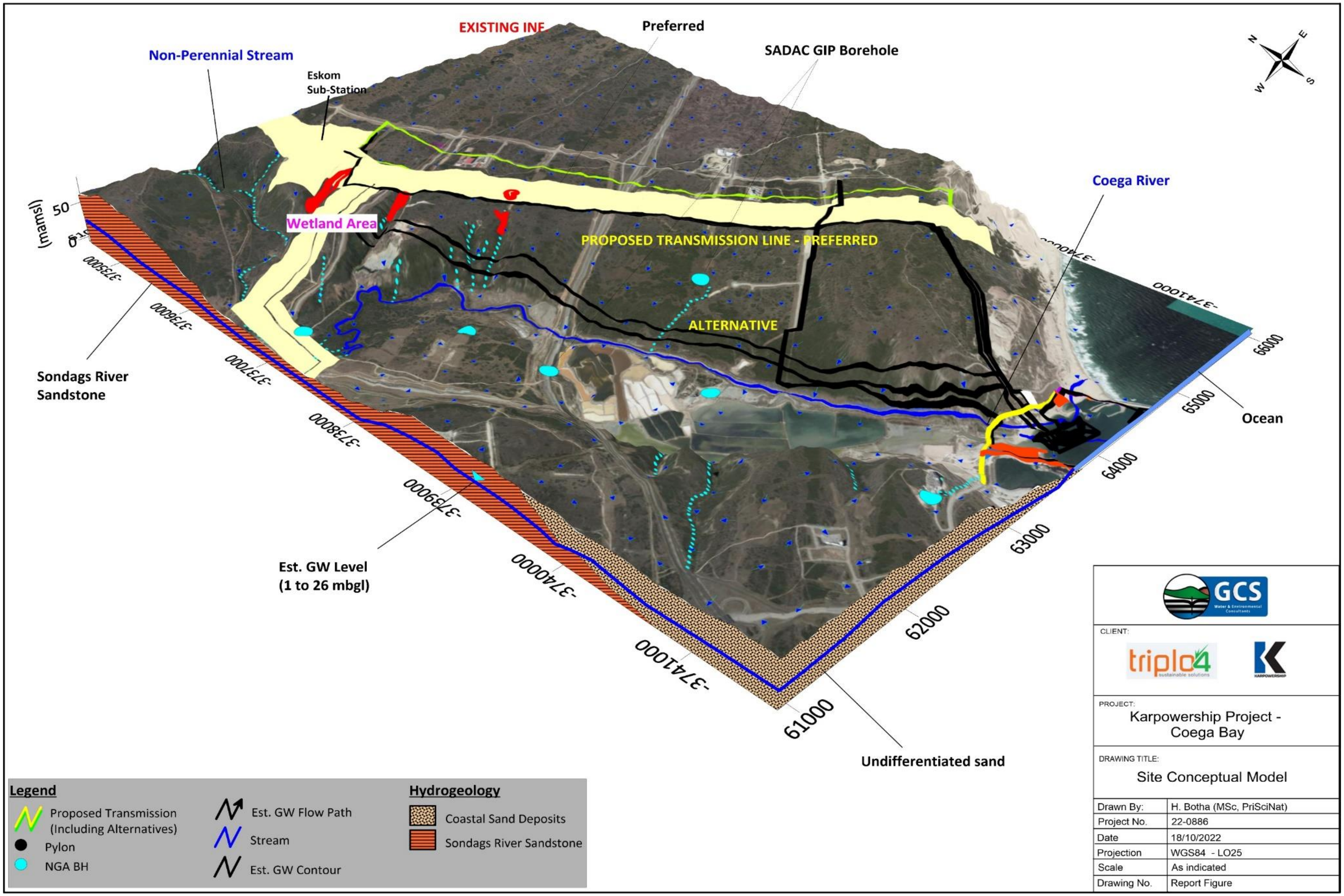


Figure 7-4: Site conceptual geohydrological model for the proposed transmission lines.

7.5.4.1 *Impact assessment findings (with and without mitigation):* ***Transmission Line Alternatives 1, 2 and Laydown Area: Construction Phase***

Based on the risk assessment and project type, the impacts on the groundwater environment are low to neutral. Moreover, it is anticipated that the impact on groundwater is going to be uniform for all of the tower/pylon sites (i.e. there is no need for tower-specific mitigation). No decommissioning phase is anticipated for this project. However, similar risks as for the construction phase are anticipated if the facilities at the site are ever decommissioned; or if additional facilities are constructed.

7.5.4.2 *Impact assessment findings (with and without mitigation): **Transmission Line Alternatives 1, 2 and Laydown Area: Construction Phase***

Table 7-8: Potential geohydrological risks and mitigation measures (construction phase)

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance		Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	
Vadose zone soils and subsequent aquifer (groundwater table)	Disturbing vadose zone during soil excavations/construction activities.	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6) (-5)	Probable (1)	Neutral/ Negligible (0 to -12) (-5)	Only excavate areas applicable to the project area. Cover excavated soils with a temporary liner to prevent contamination. Retain as much indigenous vegetation as possible. Exposed soils are to be protected using a suitable covering or revegetating.	Short-term (2)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-4)	Probable (1)	Neutral/ Negligible (0 to -12) (-4)	Medium
	Poor quality seepage from machinery used to excavate soils. Oil, grease and fuel leaks could lead to hydrocarbon contamination of the vadose zone which could percolate to the shallow aquifer.	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10)	Definite (2)	Low – negative (-13 to -24) (-20)	Place drip trays under vehicles at the site. Visual soil assessments for signs of contamination (monthly)	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-5)	Definite (2)	Neutral/ Negligible (0 to -12) (-10)	Medium
Primary Surface Water Receivers > Non-perennial streams > Coega River > Wetland system (Watercourses)	Surface water contamination and sedimentation from the following activities: o Equipment and vehicles are washed in the water bodies (when there is water); o Erosion and sedimentation of watercourses due to unforeseen circumstances (i.e. bad weather); and o Alteration of natural drainage lines which may lead to ponding or increased runoff patterns (i.e. may cause stagnant water levels or increase erosion).	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10)	Definite (2)	Low – negative (-13 to -24) (-20)	Install a temporary cut-off trench to contain poor-quality runoff (if required) Routine inspections of all infrastructure (monthly)	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-5)	Definite (2)	Neutral/ Negligible (0 to -12) (-10)	Medium
Groundwater Users in the Area (Groundwater table and users of groundwater)	Two (2) groundwater user/register borehole falls downstream of the proposed development. Limited impacts are anticipated due to the project type.	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6) (-5)	Probable (1)	Neutral/ Negligible (0 to -12) (-5)	Neutral impact. No mitigation required.								
Perched Water Table Dewatering	Temporary dewatering of perched groundwater (if it occurs)	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6) (-5)	Probable (1)	Neutral/ Negligible (0 to -12) (-5)	Have appropriate dewatering systems in place.	Short-term (2)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-4)	Probable (1)	Neutral/ Negligible (0 to -12) (-4)	Medium

7.5.4.3 *Impact assessment findings (with and without mitigation):* ***Transmission Line Alternatives 1, 2 and Construction Facilities: Operational Phase***

Table 7-9: Potential geohydrological risks and mitigation measures (operational phase)

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance		Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	
Vadose zone soils and subsequent aquifer (groundwater table)	Poor quality seepage from machinery used to excavate soils. Oil, grease and fuel leaks could lead to hydrocarbon contamination of the vadose zone which could percolate to the shallow aquifer.	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6) (-5)	Probable (1)	Neutral/ Negligible (0 to -12) (-5)	Place drip trays under vehicles at the site. Visual soil assessments for signs of contamination (when servicing of transmission lines takes place)	Short-term (2)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-4)	Probable (1)	Neutral/ Negligible (0 to -12) (-4)	Medium
Groundwater Users in the Area (Groundwater table and users of groundwater)	Two (2) groundwater user/register borehole falls downstream of the proposed development. Limited impacts are anticipated due to the project type.	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6) (-5)	Probable (1)	Neutral/ Negligible (0 to -12) (-5)	No monitoring is proposed. Impact probability is neutral.								

7.5.4.4 Cumulative Impacts

As the proposed activities will stretch over several sub-catchments and take place close to other proposed power development there will be cumulative impacts (however limited due to the project type).

From review of similar energy developments EIA Reports, the impacts in terms of groundwater are described as being low to neutral (regarding the impacts on the Groot-Winterhoek TMG aquifer and shallow Alexandria formation aquifer).

Other proposed energy developments are situated in different drainage areas, rendering the likely impact associated with this project zero. Any geohydrological risk for this project is minor and will be confined to the delineated sub-catchments (worst case). The construction and operational phase risk tables consider cumulative risks.

Based on available information for the study area, and in terms of the potential contributing impact on the groundwater system after consideration of this project, it is concluded that the contributing groundwater impact to other similar projects in the area will be zero. The cumulative impact in terms of construction and operation phases associated with this project is anticipated to be low to neutral.

7.5.4.5 Mitigation Measures and Recommendations

The following mitigation measures were proposed for inclusion into the EIA and EMPr:

- All waste generated during construction on-site (i.e. building rubble, used oil and paint containers etc.) must be stored in designated areas which are isolated from surface drains. Waste storage facilities should be covered to prevent dust and litter from leaving the containment area, and to prevent rainwater ingress.
- Minimise the amount of exposed ground and stockpiles of building material (i.e. sand, cement, wood, metal, paint, solvents etc.) to prevent suspended solid transport loads and leaching of rocks/materials. Stockpiles can be covered, and sediment fences constructed from a suitable geotextile.
- The Department of Environmental Affairs (DEA) published a generic Environmental Management Plan (EMPr) for substations and powerlines (22 March 2019). It is proposed that the mitigation and monitoring plan presented in this report be further supplemented by the generic EMP document.
- It is proposed that water monitoring be implemented as discussed in Section 7 in Geohydrological Report – Appendix 9.A4 and as required.

7.5.4.6 Specialist Conclusion

The Geohydrological Assessment could not find any grounds or identify high geo-hydrological risks to not proceed with the development of the proposed transmission lines. This is grounded on the assumption that the proposed mitigation measures, EMPr and EIA recommendations are implemented during the construction and operational phase of the transmission lines.

7.5.5 Wetland Impacts

A total of five (5) watercourses were delineated in which one (1) was classified as degraded Port Waters, one (1) depression wetland and three (3) as A channelled streams. During the initial risk assessment screening, it was determined that Rip01, Rip02 and Dep01 was a **moderate risk** as a result of potential indirect impact from the proposed development – Refer to Figure 7-5. Features which calculated a risk in the initial risk assessment were assessed further using the appropriate assessment tools/methods. The following Tables 7-10 and 7-11 present the at-risk watercourses and the Present Ecological State (PES) score that was calculated for it along the Preferred and Alternative 1 Transmission Line Route and associated infrastructure (e.g: switching station and temporary laydown areas). The PES of all the at-risk watercourses was calculated utilising the IHI tool (Kleynhans, 2012) and WET-Health Tool (Macfarlane *et al.,* 2009). It must be noted that due to Rip01 and Rip02 being classified as A channel streams, these systems were considered to not have a riparian zone.

Table 7-10: **Assessed at-risk watercourse associated with the preferred alternative route, switching station and temporary laydown areas**

IHI SCORES				
Watercourse	Instream	Riparian	Overall	
Rip01	82 (B)	N/A	82 (B)	
Rip02	61 (C)	N/A	61 (C)	
Wet-Health Scores				
Watercourse	Hydrology	Geomorphology	Vegetation	**Overall Score**
Dep01	1.0 (B) →	0.4 (A) →	1.7 (B) →	**1.0 (B) →**

Table 7-11: **Assessed at-risk watercourses associated with the alternative route 1, switching station and temporary laydown areas**

IHI SCORES			
Watercourse	Instream	Riparian	Overall
Rip01	82 (B)	N/A	82 (B)

Riverine Systems Functional Importance

The Ecosystem Services (ESS) supplied by the riverine system includes the binding action of riverine plant roots on the soil which reduces erosion of the stream bed and banks during flooding (Naiman and Decamps, 1997). Furthermore, the riverine system contributes to the aesthetic quality of the overall landscape of the area, certain fauna may utilise the riverine zone during parts of their life cycles, allowing an important corridor for the movement of animals and for the dispersal of plants (Naiman and Decamps, 1997).

Wetland Systems Functional Importance

Dep01 provided ESS at a moderate level for the following services: nitrate and toxicant removal, sediment and phosphate trapping, erosion control and carbon storage; whereas flood attenuation was provided at a moderately low level. Furthermore, most socio-cultural ESS were calculated to be supplied at a moderately low to low level as these wetlands were predominantly not utilised by the surrounding community. Maintenance of biodiversity provided a moderate scoring, due to the unique formation of these wetlands that should be conserved within the area.

Ecological Importance and Sensitivity (EIS)

The EIS of the assessed watercourses were calculated utilising the EIS Tools developed by Rountree *et. al.* (2013) and Kleynhans (1999), respectively. The overall EIS scores calculated for Rip01, Rip02 and Dep01 were Low EIS.

Buffer Determination

It is recommended that the buffer zone, which was calculated for the at-risk watercourses which may potentially be impacted on by the proposed development utilising the best practice buffer zone tool (Bredin and Macfarlane, 2016) be applied. The following activities and the proposed development footprint should not be conducted within the calculated buffer zones: no ablution facilities, washing of vehicles, stockpiling, waste dumping (organic or artificial), access roads, haulage roads, site camps and any other activities which may be detrimental to the health and functionality of the watercourses.

Table 7-12 Recommended buffer zones for the wetlands that will be potentially impacted on by the proposed development (Macfarlane & Bredin, 2016).

WATERCOURSE	CONSTRUCTION PHASE (M)	OPERATIONAL PHASE (M)
Rip01 and Rip02	15	10
Dep01	15	10
Watercourses not at risk	10	10

Impact Statement

As per the request from the Department of Forestry, Fisheries and the Environment (DFFE), a quantitative impact assessment was conducted for the proposed development which provides an overall significance of impact pre-mitigation and post mitigation; and determines the reversibility, irreplaceable features and fatal flaw of the project as per each aspect. Table 7-13 is a summary of the pre-mitigation and post-mitigation overall significance scores to understand the potential impacts on the receiving environment.

It must be noted that it is the opinion of the specialists of this report that the scoring methodology provided is not a true reflection of the project situation and the findings of this assessment (*e.g.* impact duration). The overall specialist recommendation scoring has thus been added to provide the best assessment possible as indicated in the table below.

From the quantitative impact assessment conducted in Table7-13, it can be seen that the overall impact significant scores can be mitigated to very low impact rating as per DFFE preferred scoring method. All impacts are regarded as reversible, and no features are regarded as irreplaceable loss. However, it must be noted that in order to achieve reversibility of impacts and no loss of irreplaceable features, the mitigation measures outlined in this report must be implemented. Lastly, in terms of all aspects, the project is not regarded as a fatal flaw.

Table 7-13: **Impact overall significance pre-and-post mitigation, reversibility, irreplaceable features and fatal flaw for each aspect of the proposed development.**

Aspect:	Overall Significance - Pre as per DFFE	Overall Significance-Pre as per Specialist Recommendation	Overall Significance - Post as per DFFE	Overall Significance-Post as per Specialist Recommendation
Catchment modifications (land cover and surface runoff)	Low (Negative)	Low (Negative)	Very Low (Negative)	Very Low (Negative)
Water Quality (Pollution)	Low (Negative)	Low (Negative)	Very Low (Negative)	Very Low (Negative)

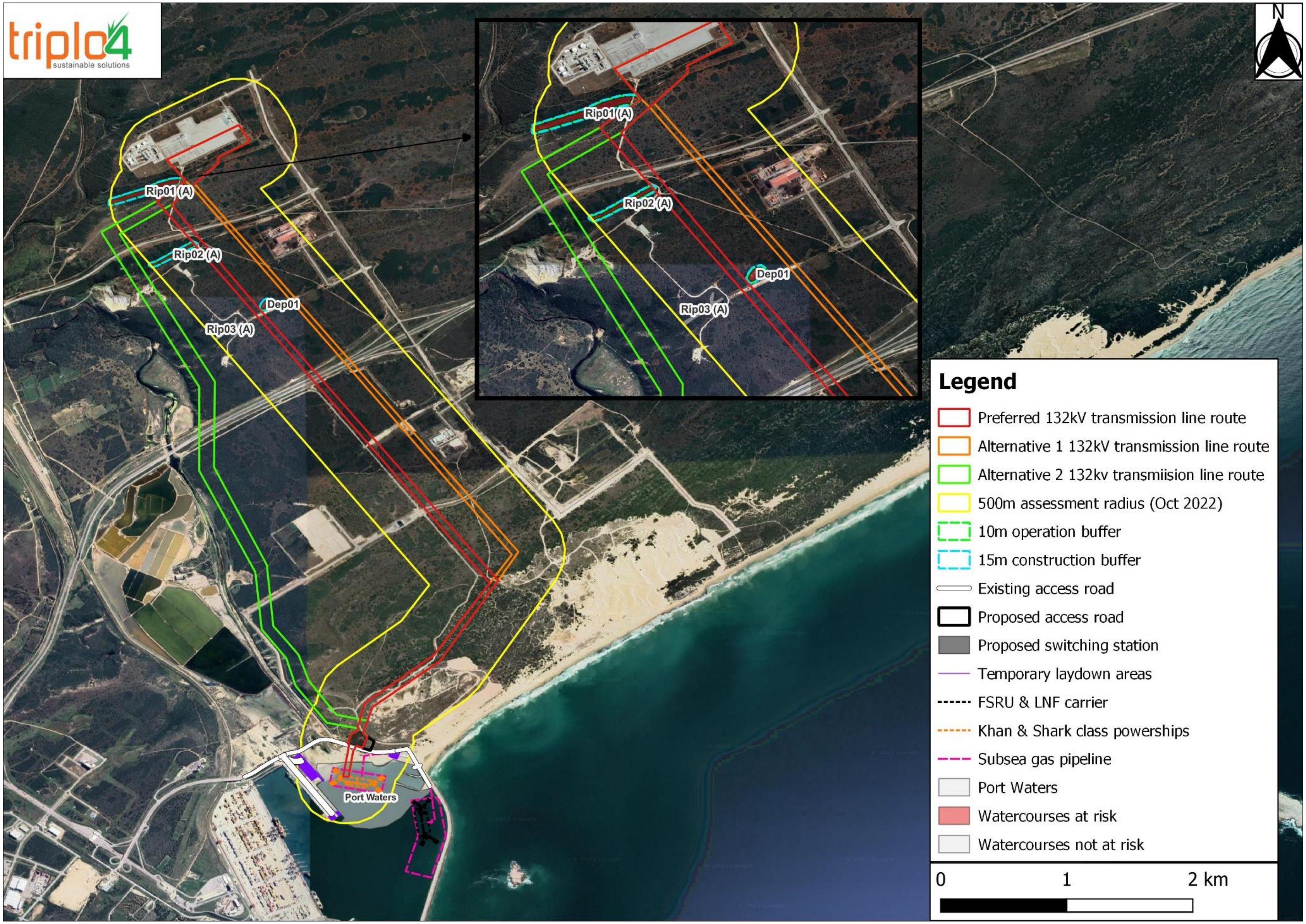


Figure 7-5: Map illustrating the calculated buffer segments for the watercourses delineated within the 500m assessment radius

The following is a representation of the quantitative impact assessment for the proposed development, as well as the mitigation measures that must be implemented to realise the post-mitigation significance scores. This quantitative impact assessment was conducted in line with the request from the Minister of Environmental Affairs. It must be noted that it is the opinion of the wetland specialists that the scoring methodology provided is not a true reflection of the project situation and the findings of this assessment (e.g. impact duration). The overall specialist recommendation scoring has thus been added to provide the best assessment possible as indicated in the table below.

7.5.5.1 *Impact assessment findings (with and without mitigation):* ***Transmission Line Alternatives 1, 2 and Laydown Area: Construction Phase***

Table 7-14 - Impact categories and significance rating relating to the proposed development.

Aspect:	Risk/ Aspect Description	Overall Significance - Pre as per DFFE	Overall Significance-Pre as per Specialist Recommendation	Mitigation Of Impacts	Overall Significance - Post as per DFFE	Overall Significance-Post as per Specialist Recommendation	Reversibility	Irreplaceable Loss of Resources	Fatal Flaw
INDIRECT IMPACTS									
Catchment modifications (land cover and surface runoff)	- *Vegetation removal* - *Erosion* - *Sedimentation* - *Increased surface runoff volume and velocity* - *Reduced infiltration* - *Alteration in habitat types* - *Reduction in soil permeability*	Low (Negative)	Low (Negative)	• Existing access roads and areas where existing overhead powerlines have been built must be utilised, only those areas that do not have existing linear infrastructure and which are in line with the construction site plan can be disturbed for the newly introduced overhead powerlines. The disturbance should not deviate unnecessarily from the construction site plan. Any disturbance outside of the construction site plan is prohibited. • All excavated topsoil and subsoil from the terrestrial areas must be stockpiled separately and reinstated in the order of subsoil and topsoil once construction activities are completed. • Stockpiled terrestrial subsoil and topsoil must not contain any AIPs when being reinstated. • All areas in which erosional and depositional features have formed	Very Low (Negative)	Very Low (Negative)	Reversible	No	No

				must be reinstated to its natural condition. • Temporary access roads must be reinstated to the natural environmental condition. • AIP encroachment must be controlled as per the monitoring requirements in the Wetland Report.						
Water Quality (Pollution)	- *Hydrocarbon input from construction vehicles* - *The incorrect positioning and maintenance of the portable chemical toilets and use of the surrounding environment as ablution facilities may result in sewage and chemicals entering the watercourse.* - *General waste being deposited into the watercourse by construction personnel* - *Excess sediment input as a result of the construction activities and associated soil displacement.* - *Raw cement entering the watercourse through incorrect batching procedure and/or direct disposal.*	Low (Negative)	Low (Negative)	• Inspect all storage facilities and vehicles daily for the early detection of mechanical deterioration or leaks. • The placement of drip trays must be conducted under vehicles that are stationary on site. • Mixing and transferring of chemicals or hazardous substances must take place on drip trays, shutter boards or other impermeable surfaces within bunded areas and should only be mixed or transferred by suitably trained personnel. • Drip trays must be utilised at all fuel dispensing areas. • Vehicles and machinery should preferably be cleaned off site. Should cleaning be required on site it must only take place within designated areas and should only occur in areas that have been previously disturbed and bunded areas. • Dispose of used oils, wash water from cement and other pollutants at an appropriate licensed waste facility. • Clean up any spillages immediately with the use of a chemical spill kit and dispose of contaminated material at an appropriately registered facility. • The digging of pit latrines is not allowed under any circumstances. • None of the open areas or the surrounding environment may be used as ablution facilities.	Very Low (Negative)	Very Low (Negative)	Reversible	No		No

From the quantitative impact assessment conducted above, it can be seen that the overall impact significant scores can be mitigated to very low impact rating. All impacts are regarded as reversible, and there no features that are regarded as irreplaceable loss. However, it must be noted that in order to achieve reversibility of impacts and no loss of irreplaceable features, the mitigation measures outlined in this report must be implemented. Lastly, in terms of all aspects, the project is not regarded as a fatal flaw.

7.5.5.2 Cumulative Impacts

The following represents the cumulative impacts which takes into consideration proposed similar projects within the Port of Ngqura and the SEZ.

Table 7-15 - Impact categories and associated impacts (without mitigation) relating to the proposed development.

Broad Impact Category		Assumed Impacts	
		Construction Phase	Operational Phase
1	Proposed Coega Gas-to-Power Plant - Gas Infrastructure	- Potential increase of hardened surfaces in the catchment, thus reducing area for infiltration of water which will flow either at the subsurface or surface to wetlands. - Potential decrease in opportunity of groundwater recharge during rainfall events due to increased hardened surfaces. - Potential increase in dust pollution. - Potential increase in sedimentation of downstream watercourses.	- Potential increase of hardened surfaces in the catchment, thus reducing area for infiltration of water which will flow either at the subsurface or surface to wetlands. - Potential decrease in opportunity of groundwater recharge during rainfall events due to increased hardened surfaces. - Potential toxic spills into terrestrial environments which can be transported into watercourses if no effective clean-up is conducted. - Possibility of continued proliferation of AIPs, opportunist weeds and pioneer species due to ineffective rehabilitation which can be transported to watercourses by faunal species that go in and out of watercourses.
2	Proposed "Risk Mitigation Power Project" in the Coega SEZ	- Potential increase of hardened surfaces in the catchment, thus reducing area for infiltration of water which will flow either at the subsurface or surface to wetlands. - Potential decrease in opportunity of groundwater recharge during rainfall events due to increased hardened surfaces. - Potential increase in dust pollution. - Potential increase in sedimentation of downstream watercourses.	- Potential increase of hardened surfaces in the catchment, thus reducing area for infiltration of water which will flow either at the subsurface or surface to wetlands. - Potential decrease in opportunity of groundwater recharge during rainfall events due to increased hardened surfaces. - Potential toxic spills into terrestrial environments which can be transported into watercourses if no effective clean-up is conducted. - Possibility of continued proliferation of AIPs, opportunist weeds and pioneer species due to ineffective rehabilitation which can be transported to watercourses by faunal species that go in and out of watercourses.
3	Proposed Coega 1000 MW Gas to Power Plant – Zone 10 (North)	- Potential increase of hardened surfaces in the catchment. - Potential decrease in opportunity of groundwater recharge during rainfall events due to increased hardened surfaces. - Potential increase in dust pollution.	- Potential increase of hardened surfaces in the catchment, thus reducing area for infiltration of water which will flow either at the subsurface or surface to wetlands.

		- Potential increase in sedimentation of downstream watercourses.	- Potential decrease in opportunity of groundwater recharge during rainfall events due to increased hardened surfaces. - Potential toxic spills into terrestrial environments which can be transported into watercourses if no effective clean-up is conducted. - Possibility of continued proliferation of AIPs, opportunist weeds and pioneer species due to ineffective rehabilitation which can be transported to watercourses by faunal species that go in and out of watercourses.
4	Proposed Coega 1000 MW Gas to Power Plant – Zone 10 (South)	- Potential increase of hardened surfaces in the catchment. - Potential decrease in opportunity of groundwater recharge during rainfall events due to increased hardened surfaces. - Potential increase in dust pollution. - Potential increase in sedimentation of downstream watercourses.	- Potential increase of hardened surfaces in the catchment, thus reducing area for infiltration of water which will flow either at the subsurface or surface to wetlands. - Potential decrease in opportunity of groundwater recharge during rainfall events due to increased hardened surfaces. - Potential toxic spills into terrestrial environments which can be transported into watercourses if no effective clean-up is conducted. - Possibility of continued proliferation of AIPs, opportunist weeds and pioneer species due to ineffective rehabilitation which can be transported to watercourses by faunal species that go in and out of watercourses.
5	Proposed Coega 1000 MW Gas to Power Plant – Zone 13	- Potential increase of hardened surfaces in the catchment, thus reducing area for infiltration of water which will flow either at the subsurface or surface to wetlands. - Potential decrease in opportunity of groundwater recharge during rainfall events due to increased hardened surfaces. - Potential increase in dust pollution. - Potential increase in sedimentation of downstream watercourses.	- Potential increase of hardened surfaces in the catchment, thus reducing area for infiltration of water which will flow either at the subsurface or surface to wetlands. - Potential decrease in opportunity of groundwater recharge during rainfall events due to increased hardened surfaces. - Potential toxic spills into terrestrial environments which can be transported into watercourses if no effective clean-up is conducted. - Possibility of continued proliferation of AIPs, opportunist weeds and pioneer species due to ineffective rehabilitation which can be transported to watercourses by faunal species that go in and out of watercourses.

In taking into consideration the five (5) projects, the potential cumulative loss of watercourses (riverine and wetland) could be considered. Overall, watercourses within the Port of Ngqura and SEZ have been moderately disturbed due to current land use practices such as industrial and port activities.

The Proposed Coega Gas-to-Power Plant - Gas Infrastructure project consisted of no watercourses on site. However, the route of the gas pipeline was identified to be in a similar position of the Preferred Alternative Transmission Line in which the Wetland Ecologist identified wetland and riverine systems. Thus, the cumulative impact will be a (Low Negative) loss due to a few projects in the area affecting watercourses indirectly.

The Proposed "Risk Mitigation Power Project" in the Coega SEZ project consisted of no watercourses on site. Thus, due to the size of the project and the location in the landscape, no impacts will occur to watercourses.

The Proposed "Coega 1000MW Gas to Power Plant - Zone 10 - North" in the Coega SEZ project consisted of no watercourses on site. Thus, due to the size of the project and the location in the landscape, no impacts will occur to watercourses.

The Proposed "Coega 1000MW Gas to Power Plant - Zone 10 - South" in the Coega SEZ project consisted of no watercourses on site. Thus, due to the size of the project and the location in the landscape, no impacts will occur to watercourses.

The Proposed "Coega 100MW Gas to Power Plant – Zone 13" project consisted of two (2) depression/pan wetlands near the proposed developable extent. It was determined in the assessment that these wetlands will be indirectly impacted and any moderate risk can be reduced to a low risk after mitigation. Thus, the cumulative impact will be a (Low Negative) loss due to a few projects in the area affecting watercourses indirectly.

The overall cumulative impacts and with the KSA Gas to Power project can be measured as a (Low Negative) loss of watercourses, and thus the proposed development in terms of the preferred alternative that was assessed in this report can proceed.

The potential residual impact assessment with the proposed development were considered to be Very Low, should the mitigation measures in this report be strictly implemented.

7.5.5.3 *Mitigation Measures and Recommendations*

Table 7-16 – Mitigation Measures for Pre-construction, Construction, Post-Construction, Rehabilitation, Operational

MITIGATIVE MEASURES	PHASE OF PROPOSED DEVELOPMENT - PRE-CONSTRUCTION
Generic/Broad	- The footprint of the temporary laydown area and the construction footprint must be kept to a minimum, to ensure there is no unnecessary intrusion into any watercourses and associated buffer zones. - All access points, roads and turning areas must be agreed by the engineer and Environmental Control Officer (ECO) prior to commencement of construction. No ad hoc haulage roads or turning areas may be created. - Stockpile areas of raw materials and other construction material must be clearly identified and demarcated prior to materials being brought onto site. None of these areas must be on or near slopes or water resources. All stockpiling areas must be approved by the ECO before stockpiling occurs.

	- Detailed planning, positioning and demarcation of onsite waste dump sites must be completed prior to any waste handling occurring (this includes rubbish) and the waste areas must not occur in the demarcated water resources and associated buffer zones. All onsite personal must also be trained in proper waste management techniques and shown the appropriate waste dumps for specific materials prior to any construction activities occurring (including site establishment). - The contractor must utilize a Stormwater Management Plan (which may form part of the construction method statement) to ensure that all construction activities do not cause, or precipitate, soil erosion which may result in sediment input into the surrounding environment. The designated responsible person on site, as indicated in the stormwater control plan (usually the contractor/ECO) must ensure that no construction work takes place before the stormwater control measures are in place and must include post-construction/operational phase stormwater requirements. - Soft engineering (grassed swales (Teff Grass or Red Grass ideal for this climate)) instead of hard gutters should be used where possible. - All staff are to be trained on their environmental responsibilities before commencing work. All new staff are to be trained before they start work on site. - No-go areas must be determined and demarcated and agreed upon by contractors, engineers and ECO before any construction activities occur onsite. Special attention must be given to the identified at risk watercourses (and their associated buffers) in the vicinity of the development activities. Unnecessary intrusion into these systems is prohibited. These areas must be clearly demarcated onsite and indicated to all construction workers onsite before any construction activities (including site establishment) takes place. Where intrusion is required, the working corridor must be kept to a minimum and identified and demarcated clearly before any construction commences to minimize the impact.
Site/Project Specific	- Existing access/haulage routes must be utilised during construction as far as possible. - All watercourses delineated within this report and their associated buffers must be demarcated and considered as no-go areas. All demarcated areas must be considered no-go areas for the duration of the construction phase. Any construction personnel found working inside the no-go areas should be fined as per fining schedule/system setup for the project.
MITIGATIVE MEASURES	**PHASE OF PROPOSED DEVELOPMENT - CONSTRUCTION**
Generic/Broad	- A construction method statement is required to be compiled by the applicant/contractor for all activities associated with the proposed development. This method statement must include the phases of the project, activities associated with the construction and all mitigation measures stipulated within this report and the site-specific EMPr. The applicant, engineer, contractor and ECO must agree and approve the statement as this will become a binding document which must be implemented onsite. The independent ECO must ensure this document is continuously implemented onsite to ensure no unnecessary disturbance. - A serial plan of construction must be developed: • Construction must be immediately followed by rehabilitation; • Soil replacement must be conducted in same sequence as excavated; • Soil surfaces must not be left open for lengthy periods to prevent erosion. • Affected surface vegetation must be removed, appropriately stored then reinstated, immediately post-construction, as close to their original position as possible, to reduce the possibility of longer-term change to the vegetation community. The vegetation must be removed keeping the root systems intact as far as possible. • If required vegetation plugs can be sorted from areas adjacent to the construction site, under the supervision of the Environmental Control Officer.

	- Environmental inductions and training must include the contents of the above method statement. - During the necessary removal of the natural vegetation for the development of the associated infrastructure (e.g. site camp, access roads) any protected species which are recorded must be safely relocated to an adequate habitat within the same catchment area. An independent botanist must be consulted during this process. - Excess dust observed in the vicinity of the proposed development must be noted and the appropriate dust suppression techniques implemented to ensure no excess sediment input into the surrounding freshwater resources. - Cut and fill must be avoided where possible during the set-up of the construction camp. The utilisation of the already heavily disturbed areas should be encouraged. - The relocation of services, i.e. water, stormwater and especially sewerage infrastructure, must not result in the contamination of the surrounding environment. - Removal of vegetation must only be done when essential for the proposed development. Do not allow any disturbance to the adjoining natural vegetation cover or soils. All disturbed areas must be prepared and then re-vegetated to the satisfaction of the ECO. - Where feasible, construction activities should be conducted during the drier months of the year (April – August) to minimize the possibility of erosion, sedimentation and transport of suspended solids associated with disturbed areas and rainfall events. No construction activities must be conducted during storm events. - All potential stormwater contaminants must be bunded in the site camp to prevent run-off into the surrounding environment. A drainage system must be established for the construction camp. The drainage system must be regularly checked to ensure an unobstructed water flow. Establish cut off drains and berms to reduce stormwater flow through the construction site. The contractor must prepare a Stormwater Control Plan (which may form part of the construction method statement) to ensure that all construction activities do not cause, or precipitate, soil erosion sediment which may result in sediment input into the surrounding environment. The designated responsible person on site, as indicated in the stormwater control plan (usually the contractor/ECO) must ensure that no construction work takes place before the stormwater control measures are in place and must include post-construction/operational phase stormwater requirements. - No contaminated runoff or grey water is allowed to be discharged from the construction camp. - The demarcated riverine systems must be protected from erosion and direct or indirect spills of pollutants, e.g. sediment, refuse, sewage, cement, oils, fuels, chemicals, wastewater. - All exposed surfaces within the construction site must be checked for AIPs monthly and any identified AIPs must be removed by hand pulling/uprooting and appropriately disposed of. Herbicides should **only** be utilised where manually removing is not possible. Herbicides utilised are restricted to products which have been certified safe for by an independent testing authority. The ECO must be consulted before the purchase of any herbicide. - Stockpiles and topsoil storage areas must not be located within 50 metres of any rivers or riverine channels or within the 1:100-year flood lines. The furthest threshold must be adhered to. They should not be placed in vegetated areas that will not be cleared. Erosion control measures including silt fences, low soil berms and/or shutter boards must be put in place around the stockpiles to limit sediment runoff from stockpiles. - Water used on site must be from an approved source. - The digging of pit latrines is not allowed under any circumstances. - None of the open areas or the surrounding environment may be used as ablution facilities.

	- Material Safety Data Sheets (MSDSs) must be readily available on site for all chemicals and hazardous substances to be used on site. Where possible and available, MSDSs should additionally include information on ecological impacts and measures to minimize negative environmental impacts during accidental releases or escapes.
	- Hazardous material storage areas must not be within 50 m of any watercourse or within the 1:100-year flood line. The furthest threshold must be adhered to. Hazardous storage areas to be hard surfaced and bunded with an impermeable liner to protect groundwater quality and undercover. The bunded a catch pit must have at least 110% the storage capacity of the total stored quantity.
	- Should any spills of hazardous materials occur on the site or in the storage area, the relevant clean-up specialists must be contacted immediately. Materials that absorb fuel & oil, such as spill kits or earth should be placed over the spill. This contaminated material must be uplifted, placed within impermeable container and disposed of at a recognized disposal site.
	- In the event of a spillage that cannot be contained and which poses a serious threat to the local environment, the following Departments must be informed of the incident in accordance with Section 30 of the National Environmental Management Act, Act 107 of 1998, within forty-eight (48) hours:
	  • The Local Authority;
	  • DWS;
	  • The Department of Economic Development, Tourism and Environmental Affairs
	  • The Local Fire Department when relevant; and
	  • Any other affected departments.
	- An incident record must be completed for all spills that do occur onsite. Minor incidents will include small spills of less than 5 litres that do not enter a watercourse, stormwater drains, housekeeping issues and general small non-compliances with the requirements of this report, method statements, EA and/or EMPr. The record of incidents is to be included in the reporting to the authorities. Major incidents must be reported to the authorities, which include spills larger than 5L and all incidents involving contamination of water resources, stormwater or other reportable incidents. **Minor incidents**: small spills less than 5l that do not enter stormwater, minor non-compliance with EMPr that does not cause major environmental impact i.e. Housekeeping issues. **Action**: Supervisor and staff on site to record and address and notify ECO. ECO to advise on remediation measures and to follow up on actions taken to address incident. **Records**: On site incident register. **Major incidents**: Large spills or any spills that enter watercourses, stormwater, contamination of soil, fires, explosions. **Action**: Report immediately to ECO, action to be taken to prevent further damage and incident to be reported to authorities. ECO to advise on remediation measures and to follow up on actions taken to address incident. **Records**: On site incident register and report to authorities as listed above.
	- The harvesting of firewood, medicinal plants, tree bark, flowers or other natural materials is forbidden on the site and surrounding environment.
	- The Contractor must, as an initial and on-going exercise, implement erosion and sedimentation control measures (e.g. gabion structures, geotextiles) to the satisfaction of the ECO. Stabilisation of cleared areas to prevent and control erosion and/or sedimentation must be actively managed.
	- Sediment control: construct silt fences/traps in areas prone to erosion, to retain sediment-laden runoff. (i.e. place silt traps strategically on the periphery of watercourses, remove sediment on a regular basis and transport to designated dumping site, ensure silt fences/traps are adequately maintained).

	- A designated waste area, which must be located outside of the 50 m buffer and the 1:100 year flood line, must be utilised at all times. Bins must be provided and emptied at no less than monthly intervals. - All solid waste generated during the construction process (including packets, plastic, rubble, cut plant material, waste metals) must be placed in the waste collection area in the construction camp and must not be allowed to blow around the site, be accessible by animals, or be placed in piles adjacent the skips / bins. - Burying of waste, rubble on site, or dumping in drainage lines/rivers is strictly prohibited. - The recommended buffer zones (Section 8 of this report) are implemented to maintain basic aquatic processes, services and values, reduce impacts from upstream activities and adjacent land-use practices, meeting life-need requirements for aquatic and semi-aquatic species, providing habitat for terrestrial species and providing ancillary societal benefits.
Site/Project Specific	- Erosion and sedimentation must be monitored closely. After every heavy rainfall event, the contractor must check the site for erosional damage and rehabilitation must occur immediately if damage is found. - Topsoil and subsoil which is excavated from the study area must be stockpiled with the topsoil separate from the subsoil and preserved for future rehabilitation. Cleared vegetation and soils which will not be utilised for rehabilitation purposes must be disposed of at a registered waste disposal facility. Stockpiles must be seeded with indigenous grasses or stabilised with geotextiles to reduce erosion potential. - All areas of loose sand, which are prone to wind erosion must be sprayed with water or other dust suppression techniques.
Mitigative Measures	**Phase of Proposed Development - Post-Construction/Rehabilitation**
Generic/Broad	- Rehabilitation is not the static endpoint of a recipe-like process (Kusler & Kentula, 1990). Rather, it is a process in its own right, whereby the wetland/riverine system is given an opportunity for a new beginning (Grenfell, *et. al*., 2007). - Rehabilitation requires that there is an attempt to imitate natural processes and reinstate natural ecological driving forces in such a way that it aids the recovery (or maintenance) of dynamic systems so that, although they are unlikely to be identical to their natural counterparts, they will be comparable in critical ways so as to function similarly (Jordan, et. al., 1987). - It must be recognised that rehabilitation interventions may have different ecological starting points (ranging from totally degraded to slightly degraded) and different goal endpoints (ranging from a state that is close to the pristine to one which is still far from pristine, but nonetheless an improvement on the state of the system without any rehabilitation intervention). The chosen goal endpoint depends on what is achievable, given the site conditions, and those ecosystem attributes and services that are considered most important. Any rehabilitation project should therefore be based on an understanding of both the ecological starting point and on a defined goal endpoint, and should accept that it is not possible to predict exactly how the wetland/riparian system is likely to respond to the rehabilitation interventions. - The most typical rehabilitation interventions designed to assist in the recovery of degraded wetland ecosystems are ‘plugs’. The ‘plugs’ are placed with the intention of reinstating a more natural hydrology. Typical interventions for maintaining the health wetland ecosystems that are in the process of degrading are the placement of erosion control structures which assist in halting the advance through a wetland of an erosion headcut. However, rehabilitation is not confined to physical structures, and rehabilitation may include

	interventions such as reducing livestock grazing-pressure or reducing the frequency of burning. - All post-construction building material and waste must be cleared in accordance with the EMPr, before any re-vegetation may take place. - Erosion features that have developed as a result of construction related disturbance are required to be stabilised. This may also include the need to deactivate any erosion head cuts/rills/gullies that may have developed by either compacted soil infill, rock plugs, gabions or any other suitable measures. - If the gradient of the banks is greater than 1:1.75, the banks must be stabilised with a biodegradable cover such as Geojute which must be secured to the steep slope with wooden (biodegradable) pegs. This will reduce soil erosion potential. - Any areas, which fall outside the direct construction footprint, that have been compacted are required to be ripped to allow for the establishment of vegetation. This ripping must not result in the mixing of sub - and topsoil. - No imported soil material may be utilised for rehabilitation, unless it can be ensured that it is free of any AIPs seeds. - Before adding the topsoil weeds and AIPs must be removed. - Additional stabilisation of cleared areas to prevent and control erosion must be actively managed. The method of stabilisation should be determined in consultation with the ECO and engineer. The following methods (or a combination) may be considered, depending on the specific conditions of the site: • Brush packing • Mulch or chip cover • Terracing • Straw stabilising (at the rate of one bale/m² and rotated into the top 100mm of the completed earthworks) • Watering • Planting / sodding • Hand-seeding / Hydro-seeding • Mechanical cover or packing structures (Geofabric, Hessian cover, Armourflex, Log / pole fencing) - The landscape architect/horticulturist must supervise the handling, maintenance and planting of the plant/trees. No trees must be planted within the authorised/agreed transmission servitudes. - No AIPs may be utilised during the rehabilitation process. - Rapidly germinating indigenous species (e.g. fast growing, deep rooting, rhizomatous, stoloniferous) known to bind soils in terrestrial, riparian and/or wetland areas must be utilised where there is a strong motivation for stabilisation over reinstating similar plant communities to that being disturbed. This should be informed by a qualified specialist. - Exposure of plant root systems to drying winds, high temperatures or water logging must be avoided. - Where possible, revegetation must take place at the start of the spring rains to maximise water availability and minimise the need for irrigation. This will ensure optimal conditions for germination and rapid vegetation establishment. If not possible during the correct season, revegetation can start immediately with regular irrigation to assist with revegetation growth, under the guidance of a horticulturist. - If this is not possible, irrigation of planted areas may be necessary during dry periods (external sources of water must be utilised e.g. Joe-Joe tanks). - Water utilised for irrigation must be free of any chlorine or contaminants that may negatively affect the plant species.

	- The use of irrigation may be halted where hydro-seeding shall be utilised, until seeds have germinated and growth has commenced. - It is the contractor's responsibility to continuously monitor the area for AIPs during the contract and establishment period, and any AIPs encountered must be removed. - Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas. - AIPs shall not be stockpiled, they should be removed from site and dumped at an approved site. - Any use of herbicides in removing alien plant species is required to be investigated by the ECO before use, for the necessity, type proposed to be used, effectiveness and impacts of the product on aquatic biota.
Site/Project Specific	- Rehabilitation must commence within 30 days from the period when the construction phase has ended. - All alternative tracks and footpaths created during the construction phase should be appropriately rehabilitated (e.g. tillage and re-vegetation of the affected areas). This rehabilitation should result in improved surface roughness and increased infiltration along with reduced stormwater flow and consequently reduced rill erosion. - Any haulage or access roads (legal or illegal) which were created must be decommissioned and rehabilitation to reinstate the natural vegetation, increase the surface roughness and resultantly increase infiltration (e.g. tillage and revegetation). - All construction waste materials must be removed, and temporary structures (e.g. offices, workshops, storage containers, ablution facilities) dismantled, from site and the surrounding environment, this will need to be checked by the ECO and the various contractors. - All banks where there is exposed soil, with the potential for rill/gully erosion to take place, must be stabilised. - AIPs must be removed manually without further disturbance to the surrounding ecosystems. If manual removal is not possible, seek guidance from a local cooperative extension service or Working for Water. - Rehabilitation of the sections where AIPs are removed must take place. The appropriate indigenous grass and woody vegetation species seeds must be attained from a registered nursery with the guidance of a botanist who is familiar to the region (Plant list can be sourced from Ecological Impact Assessment).
MITIGATIVE MEASURES	**PHASE OF PROPOSED DEVELOPMENT - OPERATIONAL**
Generic (Broad)	- The establishment and infestation of AIPs must be prevented, managed and eradicated in the areas impacted upon by the proposed construction activities. The type of species and location of that species will determine the type of methodology required for its management and eradication. This methodology should target all lifecycle phases and propagules of the specific species, e.g. seedlings/saplings, seeds, roots. - Indigenous vegetation within the site must not be removed or damaged, where possible, during the AIPs control, increasing the probability of indigenous species propagating and preventing the re-establishment of AIPs. - As stated above, any use of herbicides in removing AIPs is required to be investigated by the ECO before use, for the necessity, type proposed to be used, effectiveness and impacts of the product on aquatic biota.
Site/Project Specific	- Additional monitoring is required as per the monitoring requirements. - A monitoring programme must be in place not only to ensure compliance with the EMPr throughout the construction phase, but also to monitor any post-construction environmental issues and impacts during the vegetation establishment phase. Compliance against the EMPr must be monitored during the construction phase monthly by an independent ECO. The period

	and frequency of monitoring required post-construction must be determined by the competent authorities and implemented by the ECO. Once the initial transplants / plugs are planted, the landscaper must conduct weekly site visits to remove AIPs (in accordance with the latest revised NEM:BA requirements) and address any re-vegetation concerns until re-vegetation is considered successful (i.e. >80% indigenous cover). An accepted monitoring period of re-vegetated areas after this initial period is monitoring every 3 months for the first 12 months and every 6 months thereafter until the vegetation has successfully been established. If the re-vegetated areas have inadequate surface coverage (less than 30% within 9 months after re-vegetation) the area should be prepared and re-vegetated again. - The cost-effective qualitative monitoring of the rehabilitation area may be time based through the use of periodic photographs taken from permanent photo points. These points are required to be established during site inception. The timeline created between the pre- and post-rehabilitation photos will provide an invaluable visual representation of the progress that is conveyed in a straightforward manner. The photographer should be an environmental scientist therefore allowing an expert assessment of the site adding to the qualitative information gathered from the photographs. - The below mentioned criteria must be adhered to, ensuring the quality of the information collected: • Establishment of the photo points must be completed during site inception/establishment. This will allow for pre-rehabilitation imagery spanning more than a once off photograph. • These points should be permanently marked and assigned a unique identify number to ensure continual relocation and accuracy of the photographs. GPS co-ordinates should be recorded of each site. This is to ensure if any markers are removed or vandalised then they can be replaced. • Photo point locations should be easily relocated and accessible and must not be obscured by future vegetation growth. • The level of detail captured must be appropriate to the area that has undergone rehabilitation. • Photo record forms must be development and utilised for every photo taken. The information required will be project name, location, unique identity number, directional point (e.g. North, South), date, time, photographers name and additional comments. • Qualitative ecological information that must be visually interpreted and recorded at the same time as taking the photograph include: o Evidence of any channelling. o Extent of the site vegetation ground cover. o General level of plant growth, substrate levels, and water levels. o General observations of water quality such as clarity and presence of litter. o Evidence of anthropogenic presence and bird species. o Vegetation condition, extent of AIPs; and o Evidence of erosion and close monitoring of the post-construction erosion-control measures which must be implemented.

7.5.5.4 Specialist Conclusion

From a freshwater perspective associated with the proposed development in Port of Ngqura, Karpowership will have a minimal impact on freshwater resources, seeing that it will occur in an operational port and will only require monopole transmission lines on land, some of which will be placed in an already existing transmission line servitude and degraded areas. Therefore, the need from an energy, social and economic perspective will be positive for South Africa, whilst environmental impacts will need to be mitigated and monitored as outlined in this report.

The specialist further recommends that all construction activities of the proposed development (Preferred Alternative) switching station and temporary laydown areas) can occur but must take into cognizance the surrounding watercourses and their associated buffers in which no construction activities should occur.

7.5.6 Heritage and Palaeontology Impacts

Archaeological Impacts

The archaeological landscape is dominated by tools assigned to the Middle Stone Age (MSA). These included small numbers of isolated weathered, quartzite flakes, broken flakes, and chunks. All the tools are in locally available quartzite, recorded either on gravels and compact grey soils below the coversands (Zone 7), on fine red sands (Zone 6), or on exposed rounded colluvial cobbles and gravels (Zone 11 & Zone 14). No formal tools such as points, backed pieces or scrapers were found.

Low-density scatters of tools (GPS Points 158, 208, 217 & 527), including chunky and triangular shaped flakes, chunks, flaked chunks/minimal cores, round cores, and a few heavily weathered, miscellaneous retouched and modified pieces were recorded on an elevated ridge, covered in limestone pebbles and surface bedrock south of the N2, in Zone 7.

No evidence of any human settlement or occupation was recorded during the field study, and indications are that most of the tools comprise discarded flakes and flake debris.

No archaeological resources were recorded on the high back dunes aligned alongside the sandy shoreline in Zone 10 and Zone 8, where dunes are covered in extremely dense Acacia thicket vegetation.

No Early Stone (ESA) tools, or Later Stone Age (LSA) resources including ostrich eggshell or pottery were recorded in the proposed powerline servitude.

The small numbers, and isolated context in which they were found means that the archaeological remains have been graded as having Low (Grade IVC) local significance

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Fragmented and weathered marine fossil shell was also noted in previously disturbed land, and on the large berm alongside the National Port Authority Road, near the Port of Ngqura (GPS Point 411).

Palaeontological Impacts

A palaeosensitive area has been recognized but it is relatively small (Figure 7.6). This area comprises the Alexandria Formation. It is covered by aeolian sand which is itself disturbed and not exposed. These lithologies have already been disturbed and palaeontlogical material destroyed by the Port of Ngqura construction. Due to this area already being disturbed and consequently any fossils will also be disturbed. Further there is little to no rock exposure.

Figure 7-6: Area which has been red flagged in the SAHRIS Palaeosensitivity Map.

Marine shell debris, due to contemporaneous wave-action, are likely to be encountered on this site, but these are unlikely to be significant. Significant palaeontological material could be found within the highlighted area (Figure 7-6) but this is likely to be broken and highly fragmented due to the Port of Ngqura construction. Should intact shells of other fossils be found these should be archived and a competent Palaeontologist consulted.

Due to the Ngqura Port construction and the disturbance that this has caused no purpose can be served by a pre-construction visit. Should the “Chance Find Protocol” be triggered, the need for a Palaeontology Field Visit may have to be re-evaluated.

*7.5.6.1 Impact assessment findings (with and without mitigation): **Transmission Line Alternatives 1, 2 and Construction Facilities: Construction Phase***

Archaeological Impacts

The proposed 7.4km long, 132kV overhead powerline for the proposed Gas to Power Powership Project crosses multiple zones with the Coega SEZ, including Zones 8, 10, 7, 6, 11, and 14.

According to Binneman (2010a:40) Zone 6 and Zone 11 are the considered the `least archaeologically sensitive’, where dispersed scatters of MSA tools of low archaeological significance are likely to be encountered, while Zone 7 and Zone 10 are regarded `as the most sensitive’.

Construction of a proposed Site Office Complex (3000m²) and Stringing Yard (19950m²) - used to assemble the gas pipeline, is situated on reclaimed and previously disturbed land within the port area, is unlikely to impact on archaeological heritage resources.

The small numbers, and isolated context in which they were found means that the archaeological remains have been graded as having Low (Grade IVC) local significance.

It is important to note that without mitigation and rescue of exposed archaeological deposits there will be a complete loss of resources within the development footprint area. Archaeological resources are unique, and their loss is irreversible.

The study has identified no significant impacts to pre-colonial archaeological remains that will need to be mitigated prior to construction activities commencing.

7.5.6.2 Cumulative Impacts

Regarding Cumulative Impacts associated with the Karpower Gas to Power Powership Project, the following comparable projects have been assessed:

The Proposed Coega 1000MW Gas-to-Power Plant – Zone 10 (South). Draft EIA report prepared for the Coega Development Corporation (SRK 2021a)
The Cumulative Impact is rated as being potentially High.

The Proposed Coega 1000MW Gas-to-Power Plant – Zone 10 (North), Draft EIA report prepared for the Coega Development Corporation (SRK 2021b)
The Cumulative Impact is rated as being as being potentially High.

The Proposed Coega 1000MW Gas-to-Power Plan – Zone 13. Draft EIA report prepared for the Coega Development Corporation (SRK 2021c):
The Cumulative Impact is rated as being Low

Draft Environmental Impact Report, Proposed 200MW "Risk Mitigation Power Project" in the Coega SEZ. Report prepared for Engie Southern Africa (SRK 2021d):
The Cumulative Impact is rated as being Low.

7.5.6.3 Mitigation Measures and Recommendations

Archaeological Impacts
No mitigation is required prior to proposed construction activities commencing. The following mitigation measures were proposed for inclusion into the EIA and EMPr:

- Vegetation clearing in the powerline servitude must be monitored by a professional archaeologist.
- Excavations for powerline footings must be monitored by a professional archaeologist.
- The Radar Station (Technical hut), and possibly the Sonop building, need to be saved as they form part of a series of related lookouts dating from World War II.
- If any unmarked human remains are exposed during excavations, work must immediately stop, and an archaeologist appointed to inspect the remains. Human remains must not be disturbed until inspected by the archaeologist. Human remains will have to be removed under a permit issued by the South African Heritage Resources Agency, or the Eastern Cape Provincial Heritage Authority (ECPHRA).

Palaeontological Impacts
As this site includes areas flagged red on the SAHRIS Palaeosensitivity Map (Figure 7-6), a *"Chance Find Protocol"* is recommended.

In the case of any unusual finds, a Palaeontologist must be notified immediately by the ECO and/or EAP and a site visit must be arranged at the earliest possible time with the Palaeontologist.

In the case of the ECO or the Site Manager becoming aware of suspicious looking palaeo-material:

- The construction must be halted in that specific area and the Palaeontologist must be given enough time to reach the site and remove the material before excavation continues.
- Mitigation will involve the attempt to capture all rare fossils and systematic collection of all fossils discovered. This will take place in conjunction with descriptive, diagrammatic and photographic recording of exposures, also involving sediment samples and samples of both representative and unusual sedimentary or biogenic features. The fossils and contextual samples will be processed (sorted, sub-sampled, labelled, and boxed) and documentation consolidated, to create an archive collection from the excavated sites for future researchers.

Functional responsibilities of the Developer include:

- At full cost to the project, and guided by the appointed Palaeontological Specialist, ensure that a representative archive of palaeontological samples and other records is assembled to characterize the palaeontological occurrences affected by the excavation operation.
- Provide field aid, if necessary, in the supply of materials, labour and machinery to excavate, load and transport sampled material from the excavation areas to the sorting areas, removal of overburden if necessary, and the return of discarded material to the disposal areas.
- Facilitate systematic recording of the stratigraphic and palaeo-environmental features in exposures in the fossil-bearing excavations, by described and measured geological sections, and by providing aid in the surveying of positions where significant fossils are found.
- Provide safe storage for fossil material found routinely during excavation operations by construction personnel. In this context, isolated fossil finds in disturbed material qualify as “normal” fossil finds.
- Provide covered, dry storage for samples and facilities for a work area for sorting, labelling and boxing/bagging samples.
- Costs of basic curation and storage until collected. Documentary record of palaeontological occurrences must be done.
- The contractor will, in collaboration with the Palaeontologist, make the excavation plan available to the appointed specialist, in which appropriate information regarding plans for excavations and work schedules must be indicated on the plan of the excavation sites. This must be done in conjunction with the appointed specialist.
- Initially, all known specific palaeontological information will be indicated on the plan. This will be updated throughout the excavation period.
- Locations of samples and measured sections are to be pegged, and routinely and accurately surveyed. Sample locations, measured sections, etc., must be recorded three-dimensionally if any “significant fossils” are recorded during the time of excavation.

7.5.6.4 *Specialist Conclusion*

Archaeologist

Overall, the results of the study indicate that the proposed Gas to Power Powership Project at the Port of Ngqura does not pose a significant threat to local archaeological heritage resources.

From an archaeological perspective there are no fatal flaws and provided that the recommendations made by the archaeologist are implemented, there are no objections to the authorisation of the proposed activities.

Palaeontologist

A small potentially palaeosensitive area is identified. This is covered by alluvial sand and consequently a pre-construction palaeontological visit will serve no purpose. Further this area is heavily disturbed due to the Port of Ngqura construction. It is recommended that a paleontological visit should only take place if the “Chance Find Protocol” is triggered.

The Stringing Area is to be developed on reclaimed land and land disturbed due to Ngqura Port construction and is not palaeontologically significant.

7.5.7 Terrestrial Biodiversity Impacts

Flora:

Overall, the expected (POSA and Mucina and Rutherford) and recorded species list includes 505 species. Species recorded from the site include a variety of trees, shrubs and succulents typical of the region, with the sedge Ficinia truncata an indicator of Bontveld. Several of the succulent and geophytic species found on site are of conservation importance including listed on the provincial Conservation Ordinance as well as some on the national Red List.

Overall, 32 SCC have been previously or currently recorded from the site. Some SCC recorded from the site include several species of succulent, many of which are protected. Of note is the presence of a large (over 20 individuals) population of *Euphorbia meloformis* as well as a population of *Euphorbia globosa.*

One protected tree was found on site: Sideroxylon inerme, which occurs in almost every thicket clump. Permits have been obtained by the CDC for the transmission line corridor for the destruction or transplantation of any protected species. Further a search and rescue in conjunction with the Standard Operating Procedures of the CDC will be necessary for either route option.

Fauna.

The study area is known to house various faunal species, some of which are of conservation importance. It is important that as much natural space is conserved as possible. The taxa listed include mammals and herpetofauna (reptiles and amphibians).

- Forty-eight (48) mammal species have been recorded from the QDS;
- Fifteen (15) species of frogs; and
- Fifty-eight (58) reptile species.

Of the mammal species recorded from the area, fifteen (15) are rodent species from the family Muridae, and buck recorded from the area include four (4) species of the Bovidae family. Amphibian species are represented by five (5) families primarily from Pyxicephalidae (7 species) and Hyperoliidae (4 species). Reptiles include eighteen (18) families the most common of which are the Lamprophiidae (13 species), the Scincidae (7 species) and the Colubridae (6 species).

Species expected include those that are likely to make use of the habitats present on site including thicket, mesic thicket and bontveld. Although fragmented due to the nature of an IDZ and associated continual disturbance, the Coega IDZ does hold suitable habitat for numerous faunal species. There are highly likely to be several of these species on site (especially mammals and reptiles) due to the large areas of intact vegetation on site. However, most of these faunal species are mobile and will be able to move out of the way of the construction process. Fauna that burrows (including moles, lizards, and snakes) will have to be relocated according to the CDC recommendations and permit restrictions if and when encountered during any earth moving operations in the construction phase.

Some faunal species recorded from the site through tracks, spoor or field observation include porcupine (*Hysterix africaeaustralis*), Vervet monkey (*Cercopithecus pygerythrus*), Yellow mongoose (*Cynictis penicillata*), Duiker species, and the reptiles red-sided skink (*Trachlepis homalocephala*) and angulate tortoise (*Chersina angulata*), among others.

There are several Species of Special Concern (SCC) that are expected for the site. That is, they have been recorded from the same QDS into which the site falls. This does not necessarily mean that these species will occur on site, however, some may occur. The likelihood of occurrence is assessed for each of the conservation important (Red Listed Critically Endangered and Endangered species) species.

Mammal SCC include eight (8) species as per the ADU lists including four (4) Bovidae species. Although each of the species listed may possibly occur on site, none are listed as Critically Endangered or Endangered on the South African Red List. However, note must be made of Duthie's Golden Mole (Chlorotalpa duthieae), which, as a burrowing animal listed as Vulnerable, may be encountered during earth moving activities of the proposed transmission line construction.

Reptile SCC include sixteen (16) species as per the ADU lists. Several other marine species including turtles are included on this list but have been removed as this report deals exclusively with terrestrial aspects, and not marine aspects of the project. Although each of the species listed may possibly occur on site, only one is listed as Endangered on the South African Red List: the Elandsberg Dwarf Chameleon (*Brachypodian taeniabronchum*). The Elandsberg Dwarf Chameleon is a small, endemic species that lives in protea bushes, and feeding on insects that visit the protea flowers (Branch 1998).

All amphibian species are listed on the Provincial Conservation Ordinance as protected however, there are no wetlands within the footprint of the proposed transmission line route and associated infrastructure, so it is considered unlikely that amphibian species of concern (none are listed as Critically Endangered or Endangered on the South African Red List).

The site is sensitive overall as it has high number of Species of Conservation Concern, primarily succulents. The vegetation ranges from the somewhat degraded Cape Seashore Vegetation to relatively pristine impenetrable thicket and mesic thicket. The bontveld on site is, in places, also largely intact. It is important to note that despite the presence of intact indigenous habitats, the area is located within an Industrial Development Zone, and is thus earmarked for development with the resultant loss of vegetation, flora, and fauna habitat.

An area of bontveld has been set aside by the Coega Development Corporation for conservation and as a No-Go zone. As this protects some of this highly sensitive range-restricted vegetation type a trade-off has been reached for allowing development within the bontveld elsewhere in the IDZ. Mesic thicket and thicket on the slopes adjacent to the estuary and river are also of high sensitivity and should be avoided where possible. The importance of high numbers of SCC, faunal movement corridors and faunal habitat in addition to ecosystem services provided by the vegetation on these slopes must not be overlooked.

There are some areas that have been previously degraded or transformed, most of which is present adjacent to, beneath or surrounding existing infrastructure. In these areas, sensitivity is low as the sites have little to no natural vegetation structure though they may contain indicator and indigenous species. These areas have also been disturbed and are thus prone to invasion by indigenous ruderal species as well as alien invasive species.

Preferred Alternative 1: The majority of the preferred route is located in areas of high SEI within the bontveld of the area. Some sections are located within disturbed vegetation, and these areas are of medium to very low SEI. However, it should be noted that the preferred route is located to 300m to the west of the east alternative within the same designated transmission line corridor, for which environmental authorisation has been granted. This route is thus considered an option with the east alternative as an acceptable alternative route.

Alternative 2: The east alternative is located in or adjacent to areas that have been previously disturbed as well as within some Areas of high SEI bontveld. It has been placed within an existing services corridor that has already been partially cleared for existing infrastructure. This corridor does already have environmental authorisation. As such, these areas of low sensitivity due to the loss of indigenous vegetation, increased erosion risk and high levels of invasive of alien plant species, primarily *Acacia longifolia* but also including some common weeds. This route is recommended over the preferred route and west alternative.

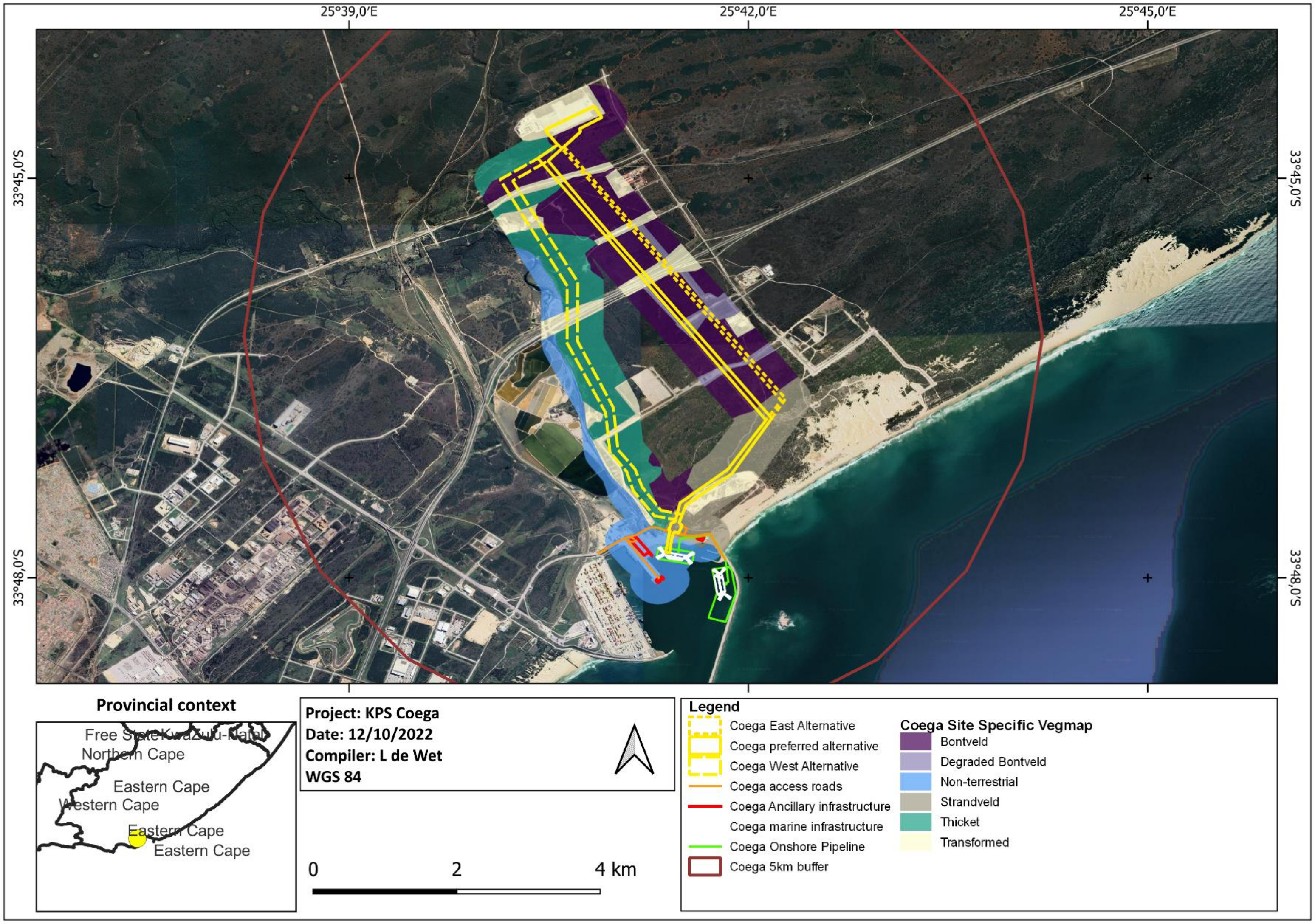

Figure 7-7: Site specific vegetation map for the Karpowership site and surrounds.

7.5.7.1 *Impact assessment findings (with and without mitigation): **<u>Transmission Line Alternatives 1, 2 and Construction Facilities: Construction Phase</u>***

Table 7-17: Terrestrial Impact Assessment – Construction Phase

	Consequence							**Likelihood**					**Total Score**	**Significance**
	Severity		Duration		Spatial scale		TOTAL	Frequency		Probability		TOTAL		
Impact 1: Loss of Strandveld														
Alternative 2														
Construction Phase														
Without mitigation	Significant	3	Short term	2	Surrounding area	2	2.3	Once a year	1	Definitely	5	3	6.9	Medium-Low
With mitigation	Small	2	Brief	1	Immediate	1	1.3	Once a year	1	Definitely	5	3	3.9	Low
Preferred Alternative 1														
Construction Phase														
Without mitigation	Significant	3	Short term	2	Surrounding area	2	2.3	Once a year	1	Definitely	5	3	6.9	Medium-Low
With mitigation	Small	2	Brief	1	Immediate	1	1.3	Once a year	1	Definitely	5	3	3.9	Low
Impact 2: Loss of intact bontveld														
Alternative 2														
Construction Phase														
Without mitigation	Great	4	Long term	4	Surrounding area	2	3.3	Once a year	1	Definitely	5	3	9.9	Medium-High
With mitigation	Small	2	Long term	4	Immediate	1	2.3	Once a year	1	Possible	4	2.5	5.75	Medium-Low
Preferred Alternative 1														

	Consequence							Likelihood					Total Score	Significance
	Severity		Duration		Spatial scale		TOTAL	Frequency		Probability		TOTAL		
Construction Phase														
Without mitigation	Great	4	Long term	4	Surrounding area	2	3.3	Once a year	1	Definitely	5	3	9.9	Medium-High
With mitigation	Significant	3	Long term	4	Surrounding area	2	3	Once a year	1	Possible	4	2.5	7.5	Medium
Impact 3: Loss of Degraded Bontveld														
Alternative 2														
Construction Phase														
Without mitigation	Small	2	Long term	4	Surrounding area	2	2.6	Once a year	1	Possible	4	2.5	6.5	Medium-Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Possible	4	2.5	5	Low
Preferred Alternative 1														
Construction Phase														
Without mitigation	Small	2	Long term	4	Surrounding area	2	2.6	Once a year	1	Possible	4	2.5	6.5	Medium-Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Possible	4	2.5	5	Low
Impact 4: Loss of Flora SCC														
Alternative 2														
Construction Phase														
Without mitigation	Significant	3	Long term	4	Surrounding area	2	3	Once a year	1	Definitely	5	3	9	Medium-High
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Highly unlikely	2	1.5	3	Low

	Consequence							Likelihood					Total Score	Significance
	Severity		Duration		Spatial scale		TOTAL	Frequency		Probability		TOTAL		
Preferred Alternative 1														
Construction Phase														
Without mitigation	Significant	3	Long term	4	Surrounding area	2	3	Once a year	1	Definitely	5	3	9	Medium-High
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Highly unlikely	2	1.5	3	Low
Impact 5: Loss of Fauna SCC														
Alternative 2														
Construction Phase														
Without mitigation	Significant	3	Long term	4	Surrounding area	2	3	Once a year	1	Seldom	3	2	6	Medium-Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Highly unlikely	2	1.5	3	Low
Preferred Alternative 1														
Construction Phase														
Without mitigation	Significant	3	Long term	4	Surrounding area	2	3	Once a year	1	Seldom	3	2	6	Medium-Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Highly unlikely	2	1.5	3	Low
Impact 6: Loss of biodiversity in general														
Alternative 2														
Construction Phase														
Without mitigation	Great	4	Long term	4	Surrounding area	2	3.3	Once a year	1	Definite	5	3	9.9	Medium-High

	Consequence							**Likelihood**					**Total Score**	**Significance**
	Severity		Duration		Spatial scale		TOTAL	Frequency		Probability		TOTAL		
With mitigation	Significant	3	Long term	4	Immediate	1	2.6	Once a year	1	Possible	4	2.5	6.5	Medium-Low
Preferred Alternative 1														
Construction Phase														
Without mitigation	Great	4	Long term	4	Surrounding area	2	3.3	Once a year	1	Definite	5	3	9.9	Medium-High
With mitigation	Significant	3	Long term	4	Immediate	1	2.6	Once a year	1	Possible	4	2.5	6.5	Medium-Low
Impact 7: Fragmentation														
Alternative 2														
Construction Phase														
Without mitigation	Significant	3	Long term	4	Surrounding area	2	3	Once a year	1	Definite	5	3	9	Medium-High
With mitigation	Small	2	Long term	4	Immediate	1	2.3	Once a year	1	Definite	5	3	6.9	Medium-Low
Preferred Alternative 1														
Construction Phase														
Without mitigation	Significant	3	Long term	4	Surrounding area	2	3	Once a year	1	Definite	5	3	9	Medium-High
With mitigation	Small	2	Long term	4	Immediate	1	2.3	Once a year	1	Definite	5	3	6.9	Medium-Low
Impact 8: Invasion of alien species														
Alternative 2														
Construction Phase														

	Consequence							Likelihood					Total Score	Significance
	Severity		Duration		Spatial scale		TOTAL	Frequency		Probability		TOTAL		
Without mitigation	Significant	3	Long term	4	Surrounding area	2	3	Once a year	1	Definite	5	3	9	Medium-High
With mitigation	Small	2	Long term	4	Immediate	1	2.3	Once a year	1	Definite	5	3	6.9	Medium-Low
Preferred Alternative2														
Construction Phase														
Without mitigation	Significant	3	Long term	4	Surrounding area	2	3	Once a year	1	Definite	5	3	9	Medium-High
With mitigation	Small	2	Long term	4	Immediate	1	2.3	Once a year	1	Definite	5	3	6.9	Medium-Low

7.5.7.2 *Impact assessment findings (with and without mitigation): **<u>Transmission Line Alternatives 1, 2 and Construction Facilities: Operational Phase</u>***

Table 7-18: Terrestrial Impact Assessment – Operational Phase

	Consequence							Likelihood					Total Score	Significance
	Severity		Duration		Spatial scale		TOTAL	Frequency		Probability		TOTAL		
Impact 1: Loss of Strandveld														
Alternative 2														
Operational Phase														
Without mitigation	Small	2	Long term	4	Surrounding area	3	3	Once a year	1	Possible	4	2.5	7.5	Medium
With mitigation	Small	2	Long term	4	Immediate	1	2.3	Once a year	1	Unlikely	3	2	4.6	Low
Preferred Alternative 1														
Operational Phase														

	Consequence							Likelihood					Total Score	Significance
	Severity		Duration		Spatial scale		TOTAL	Frequency		Probability		TOTAL		
Without mitigation	Small	2	Long term	4	Surrounding area	3	3	Once a year	1	Possible	4	2.5	7.5	Medium
With mitigation	Small	2	Long term	4	Immediate	1	2.3	Once a year	1	Unlikely	3	2	4.6	Low
Impact 2: Loss of intact bontveld														
Alternative 2														
Operational Phase														
Without mitigation	Significant	3	Long term	4	Surrounding area	2	3	Once a year	1	Possible	4	2.5	7.5	Medium
With mitigation	Small	2	Long term	4	Immediate	1	2.3	Once a year	1	Seldom	3	2	4.6	Low
Preferred Alternative 1														
Operational Phase														
Without mitigation	Significant	3	Long term	4	Surrounding area	2	3	Once a year	1	Possible	4	2.5	7.5	Medium
With mitigation	Small	2	Long term	4	Immediate	1	2.3	Once a year	1	Seldom	3	2	4.6	Low
Impact 3: Loss of Degraded Bontveld														
Alternative 2														
Construction Phase														
Operational Phase														
Without mitigation	Small	2	Long term	4	Surrounding area	2	2.6	Once a year	1	Possible	4	2.5	6.5	Medium-Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Seldom	3	2	4	Low

	Consequence							Likelihood					Total Score	Significance
	Severity		Duration		Spatial scale		TOTAL	Frequency		Probability		TOTAL		
Preferred Alternative 1														
Construction Phase														
Operational Phase														
Without mitigation	Small	2	Long term	4	Surrounding area	2	2.6	Once a year	1	Possible	4	2.5	6.5	Medium-Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Seldom	3	2	4	Low
Impact 4: Loss of Flora SCC														
Alternative 2														
Operational Phase														
Without mitigation	Insignificant	1	Long term	4	Surrounding area	2	2.3	Once a year	1	Highly unlikely	2	1.5	3.45	Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Almost impossible	1	1	2	Very Low
Preferred Alternative 1														
Operational Phase														
Without mitigation	Insignificant	1	Long term	4	Surrounding area	2	2.3	Once a year	1	Highly unlikely	2	1.5	3.45	Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Almost impossible	1	1	2	Very Low
Impact 5: Loss of Fauna SCC														
Alternative 2														
Operational Phase														
Without mitigation	Insignificant	1	Long term	4	Surrounding area	2	2.3	Once a year	1	Highly unlikely	2	1.5	3.45	Low

	Consequence							Likelihood					Total Score	Significance
	Severity		Duration		Spatial scale		TOTAL	Frequency		Probability		TOTAL		
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Almost impossible	1	1	2	Very Low
Preferred Alternative 1														
Operational Phase														
Without mitigation	Insignificant	1	Long term	4	Surrounding area	2	2.3	Once a year	1	Highly unlikely	2	1.5	3.45	Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Almost impossible	1	1	2	Very Low
Impact 6: Loss of biodiversity in general														
Alternative 2														
Without mitigation	Great	4	Long term	4	Surrounding area	2	3.3	Once a year	1	Definite	5	3	9.9	Medium-High
With mitigation	Significant	3	Long term	4	Immediate	1	2.6	Once a year	1	Possible	4	2.5	6.5	Medium-Low
Operational Phase														
Without mitigation	Small	2	Long term	4	Surrounding area	2	2.6	Once a year	1	Highly unlikely	2	1.5	3.9	Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Almost impossible	1	1	2	Very Low
Preferred Alternative 1														
Without mitigation	Great	4	Long term	4	Surrounding area	2	3.3	Once a year	1	Definite	5	3	9.9	Medium-High
With mitigation	Significant	3	Long term	4	Immediate	1	2.6	Once a year	1	Possible	4	2.5	6.5	Medium-Low
Operational Phase														

	Consequence							Likelihood					Total Score	Significance
	Severity		Duration		Spatial scale		TOTAL	Frequency		Probability		TOTAL		
Without mitigation	Small	2	Long term	4	Surrounding area	2	2.6	Once a year	1	Highly unlikely	2	1.5	3.9	Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Almost impossible	1	1	2	Very Low
Impact 7: Fragmentation														
Alternative 2														
Without mitigation	Significant	3	Long term	4	Surrounding area	2	3	Once a year	1	Definite	5	3	9	Medium-High
With mitigation	Small	2	Long term	4	Immediate	1	2.3	Once a year	1	Definite	5	3	6.9	Medium-Low
Operational Phase														
Without mitigation	Insignificant	1	Long term	4	Surrounding area	2	2.3	Once a year	1	Highly unlikely	2	1.5	3.45	Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Almost impossible	1	1	2	Very Low
Preferred Alternative 1														
Without mitigation	Significant	3	Long term	4	Surrounding area	2	3	Once a year	1	Definite	5	3	9	Medium-High
With mitigation	Small	2	Long term	4	Immediate	1	2.3	Once a year	1	Definite	5	3	6.9	Medium-Low
Operational Phase														
Without mitigation	Insignificant	1	Long term	4	Surrounding area	2	2.3	Once a year	1	Highly unlikely	2	1.5	3.45	Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Almost impossible	1	1	2	Very Low
Impact 8: Invasion of alien species														

	Consequence							Likelihood					Total Score	Significance
	Severity		Duration		Spatial scale		TOTAL	Frequency		Probability		TOTAL		
Alternative 2														
Operational Phase														
Without mitigation	Insignificant	1	Long term	4	Surrounding area	2	2.3	Once a year	1	Highly unlikely	2	1.5	3.45	Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Almost impossible	1	1	2	Very Low
Preferred Alternative 1														
Operational Phase														
Without mitigation	Insignificant	1	Long term	4	Surrounding area	2	2.3	Once a year	1	Highly unlikely	2	1.5	3.45	Low
With mitigation	Insignificant	1	Long term	4	Immediate	1	2	Once a year	1	Almost impossible	1	1	2	Very Low

7.5.7.3 Cumulative Impacts

Cumulative impacts are assessed in context of the extent of the proposed project area; other developments in the area; and general habitat loss and transformation resulting from other activities in the area.

The impacts of projects are often assessed by comparing the post-project situation to a pre-existing baseline. Where projects can be considered in isolation this provides a good method of assessing a project's impact. However, in areas where baselines have already been affected, or where future development will continue to add to the impacts in an area or region, it is appropriate to consider the cumulative effects of development. This is similar to the concept of shifting baselines, which describes how the environmental baseline at a point in time may represent a significant change from the original state of the system. This section describes the potential impacts of the project that are cumulative for fauna and flora. Localised cumulative impacts include the cumulative effects from operations that are close enough to potentially cause additive effects on the environment or sensitive receivers, dust deposition, noise and vibration, disruption of corridors or habitat, groundwater drawdown, groundwater and surface water quality, and transport.

There are two other similar projects proposed for the Port of Ngqura. The cumulative impacts are expected to be high.

Cumulative impacts of these projects on the site include increased fragmentation risks due to transmission line construction as well loss of SCC and conservation important vegetation. Existing servitudes should be used whenever possible.

It is essential that these port users work with the CDC and Karpowership to ensure that terrestrial ecological impacts are reduced as far as possible. This includes management of alien invasive species, rehabilitation (both of which cannot occur in isolation) and protection of populations of important plant species.

7.5.7.4 Mitigation Measures and Recommendations

- A full site walk-through must be conducted in the summer prior to any construction activities to list all SSC and ensure existing permits held by the CDC include those plants that will need to be rescued.
- A qualified specialist must be on site during construction to safely remove all slow-moving (chameleons and tortoises) and burrowing (moles, lizards and snakes) species from the path of the excavator and relocated to a conservation area.
- A rehabilitation plan must be developed and implemented for areas that will be used during construction but not operation, especially within services corridors to reduce the numbers of alien invasive plants and allow recovery of some indigenous vegetation within these areas. This must be done in conjunction with the CDC rehabilitation plans in place.
- A search and rescue of protected plants must be done prior to construction taking place.
- Areas of indigenous vegetation should be incorporated into the open space management plan of the IDZ in conjunction with the CDC where practicable.
- Boundaries of the site must be adhered to, and no additional loss of vegetation should occur.
- Construction measures must consist of the least impactful individual erection of monopole structures in areas of intact indigenous vegetation and all protected species avoided where possible.

- Development and implementation of an alien invasive plant species management plan, which would remove and control the alien vegetation within and bordering the site. This must be done in conjunction with the existing CDC plans for alien invasive plant control.
- In areas of modified habitat, construction using excavation and backfilling is acceptable however, this method of construction cannot be used in any other areas.
- Keep the construction footprint as small as possible.
- No construction or storing of materials will be located outside of the defined layout area. These areas must be demarcated prior to any activities commencing and personnel instructed of the rules to stay out of these areas (unless clearing alien invasive plants).
- No use of the surrounding vegetation will be allowed. This includes use as a toilet facility, for hunting, harvesting of indigenous plants, making fires etc.
- Post-construction clearing of vegetation beneath the transmission line must be restricted to the minimum possible.
- The area of construction and operation must be demarcated, and personnel not allowed to use the surrounding natural vegetation.
- Wherever possible, and in conjunction with the Coega CDC, area that will be used for construction but not for operation should be rehabilitated as soon as possible.

7.5.7.5 Specialist Conclusion

It is the opinion of the specialist that the proposed development go ahead, provided the mitigation measures are put into place.

7.5.8 Avifauna Impacts

Impacts that could potentially affect avifauna beyond the physical footprints of the transmission lines and moored powerships and FSRU include:

- Atmospheric emissions from the powerships
- Changes in water temperatures during operations of the powerships and FSRU
- Noise (atmospheric and underwater) during powership operations
- Major hazard risks (e.g. gas vapour explosion)
- Obstructions to flight paths to and from important bird feeding, breeding and roosting areas

The Project Area of Influence (PAOI) (SANBI 2020) for avifauna was determined taking the above potential impacts into consideration together with areas of Environmental Sensitivity, the author’s knowledge of the areas of importance to birds in the vicinity of the Port of Ngqura and the proposed transmission line routes to the Dedisa Sub-station and comments from Interested and Affected Parties (I&APs) in response to the 2020/21 EIA process.

The following features of importance to avifauna are included in the PAOI:

- St Croix, Brenton and Jahleel Islands: Important breeding colonies of African Penguins and other species. An AENP Protected Area within a Marine Protected Area
- Damara Tern breeding colony north-east of the Port of Ngqura
- Attenuation pond south of the N2 near the Hougham Park / N2 interchange
- Coega River immediately upstream of the N2
- Coega Saltpans and mouth of the Coega River
- Kelp Gull colony at the west side of the entrance to the Port of Ngqura

- Undisturbed Bontveld in good condition north of the Port of Ngqura

The resulting PAOI is approximately 12.5 km long by 4 km wide.

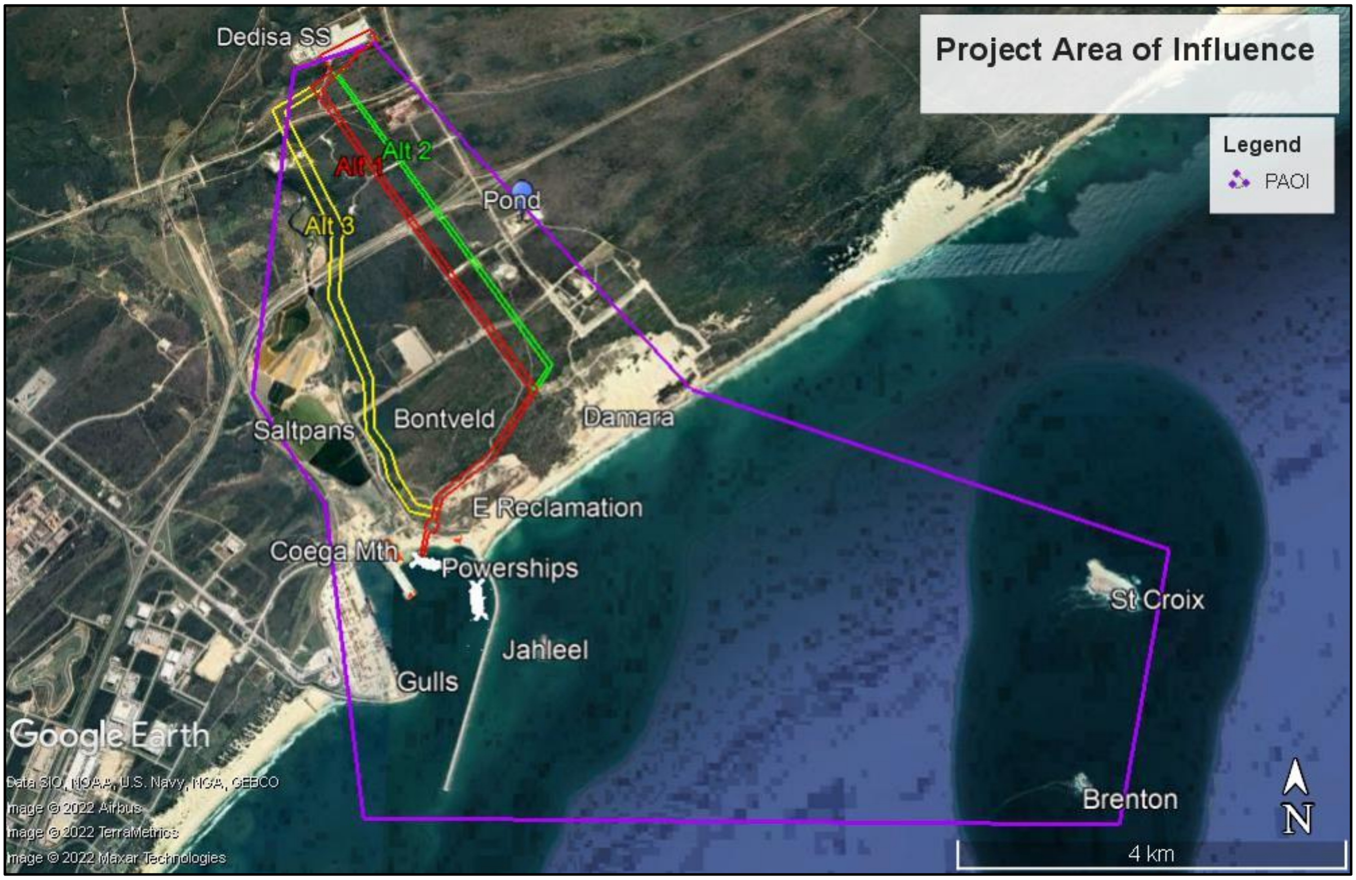

Figure 7-8: Powerships Gas to Power Project Area of Influence (PAOI)

Protected Areas and Important Bird and Biodiversity Areas

Three Global Important Bird and Biodiversity Areas (IBAs) close to the Coega SEZ (Marnewick *et al*. 2015) include:

a) *Woody Cape Section: Addo Elephant National Park.* This IBA starts at the Sundays River 17 km E of the Port of Ngqura and stretches 60 km E to Cannon Rocks. It includes the Alexandria Coastal Dunefield and grassland inland of the dunefield and Alexandria Forest. Of consequence to this project is that the dune system between the Port of Ngqura and Sundays River is an extension of the Alexandria dunefield. Trigger species for the IBA that are also found in the gas to power project area include Damara Terns and African Black Oystercatchers in the mobile dune areas, Denham's Bustard and Secretarybird in the grassland whilst the dune thicket supports a variety of Southern African endemic species including Knysna Woodpecker, Cape Bulbul, Olive Bush-Shrike.

b) *Algoa Bay Islands: Addo Elephant National Park.* This IBA includes Jahleel, Brenton and St Croix Islands located 750m SE, 6.6km SE and 6.5km E respectively of the proposed positions of the FSRU in the Port of Ngqura and the Bird Island complex located at the eastern end of Algoa Bay offshore of Woody Cape. St Croix Island has an important breeding colony of African Penguins *Spheniscus demersus.* Other endangered species that breed on the Algoa Bay Islands include Cape Gannet (Bird Isalnd), Cape Cormorant and Roseate Tern. Of consequence to the gas to power project is that impacts that extend beyond the Port of Ngqura into the marine environment may impact on the IBA.

c) *Swartkops Estuary, Redhouse and Chatty Saltpans.* This IBA is 10km SW of the Port of Ngqura. Important for its coastal wetlands, this IBA has many species that also occur on the Coega Saltpans and estuary and there is some movement of birds between these localities.

The closest terrestrial Protected Areas of consequence to the gas to power project are the portions of AENP that form part of the Woody Cape Section. The Algoa Bay Islands are part of the AENP and Jahleel Island is located 530m from the Eastern Breakwater of the Port of Ngqura. The AENP Marine Protected Area (MPA) gazetted on 23 May 2019 covers much of Algoa Bay east of the Port of Ngqura below the high water mark. At its closest point the MPA is 166m from the Ngqura breakwater.

Biodiversity Plans and Bird Habitats

The Coega OSMP is the primary environmental planning tool to guide development proposals within the Coega SEZ (CDC 2014). The OSMP showing the Critical Biodiversity Areas (CBA) within the Project Area of Influence (PAOI) is shown in **Figure 8**. Important bird habitats and bird flyways are also shown in **Figure 7**. The vegetation types in this account follow the classification in Mucina & Rutherford (2006).

The Port of Ngqura provides a sheltered coastal environment with artificial reefs (the breakwaters and concrete dolos) along an otherwise high energy sandy coastline and it is an important habitat for both juvenile and adult fish (Dicken 2010). While the marine waters of the Port are utilized as a feeding area by coastal bird species such as cormorants (Phalacrocoracidae), including the Endangered Cape Cormorant, gulls and terns (Laridae), including the Critically Endangered Damara Tern (mostly during January/February), the density of feeding birds is generally similar or only marginally greater than in the adjacent coastal areas.

A Kelp Gull colony (424 pairs in 2021) breeds between September and January next to the Western Breakwater near the Port entrance.This colony has relocated from their former nesting area on the Coega Saltpans Within the Port of Ngqura, all that remains of the original coastal habitat is a 500m stretch of Sandy Beach and hummock dunes between the Coega River mouth and the Admin Craft Basin. The preferred location for the Powerships (Alternative 1) is adjacent to this area. Approximately 11 pairs of Kelp Gulls (2021) and 1-2 pairs of African Oystercatchers breed in this area. The mouth of the Coega Estuary provides a sheltered roosting area for several bird species, including Damara Terns (especially during January / February) and upto 36 African Oystercatchers. A few estuarine species (waders - Charadrii, gulls and terns - Laridae and herons - Ardeidae) feed here. Future authorized developments are planned that will transform all of the existing estuary mouth and adjacent sandy beach habitat.

Upstream of the mouth, the Coega River has been canalized with earth berms along the eastern edge of its floodplain to separate it from the adjacent Coega Saltpans. There is usually little water flow in the estuary and it is very saline due to the adjacent saltpans. It supports <10% of the bird numbers using the Coega Floodplain while the adjacent artificial saltpans support >90% of the bird population on the floodplain (Morant 2013). The Coega Saltpans are very important for waterbirds with median counts of 1244 birds of 41 species (Morant 2013) and a maximum count of 5485 birds (Pers.Obs. CWAC).

The Port of Ngqura and the Coega Estuary and Saltpans are not classified as a CBA in the NMB Bioregional Plan or Coega OSMP as they are earmarked for future Port developments. There is a busy bird flyway along the coast and up the Coega Valley.

Terrestrial Areas

North of the Admin Craft Basin and proposed mooring sites for the Powerships is a large disturbed area called the Eastern Reclamation – an area used to stockpile cut and fill material during Port construction projects (**Figure 5**). The vegetation between the Eastern Reclamation and the Dedisa Sub-station is predominantly Coega Bontveld. It occurs on shallow soils overlying limestone and consists of scattered clumps of thicket in a matrix of grassland and shrubs characteristic of fynbos, succulent karoo and grassland vegetation types (Mucina & Rutherford 2006). In disturbed areas it is easily invaded by alien Rooikrans *Acacia cyclops*.

Sundays Valley Thicket occurs on clay soils on the steep sides of the Coega Valley and along drainage lines. It forms a dense thicket of often spiny shrubs, trees and succulents including Aloes (Mucina & Rutherford, Stewart *et.al* 2004; SRK 2010).

An area of Coega Bontveld in good condition north of the Eastern Reclamation and the Sundays Valley Thicket on the eastern side of the Coega Valley are demarcated as CBAs in the Coega OSMP. Another small (10ha) CBA protecting a small colony of Damara Terns is located in a mobile dunefield 2.2km north east of the Port of Ngqura.

The Management Guidelines for CBAs require them to be protected from development. Linear services (e.g. power lines) must follow identified Service Corridors and if this is not possible special mitigation and rehabilitation will be required (CDC 2014).

Coega Bontveld is important habitat for several large Species of Conservation Concern, especially Secretarybird, Blue Crane and Denham's Bustard within the PAOI, all of which are known to use the Bontveld CBA. The Blue Cranes frequently roost at a stormwater attenuation pond near the N2.

North-east of the Eastern Reclamation is the inland edge of the vegetated dune system where the vegetation is classified as Algoa Dune Strandveld with small trees such as Dune Crow-berry *Searsia crenata*, Candlewood *Pterocelastrus tricuspidatus* and White Milkwood *Sideroxylon inerme* (Mucina & Rutherford 2006, Stewart *et.al* 2004; SRK 2010). Alternatives 1 and 2 of the overhead transmission line pass through a short section of this vegetation type that is in good condition. Several endemic bird species are found in the vegetated dunes and in the Thicket vegetation, with Knysna Woodpecker being the only Species of Conservation Concern.

7.5.8.1 *Impact assessment findings (with and without mitigation):* ***<u>Powerships & FSRU, Gas Pipeline & Construction Facilities: Construction Phase</u>***

In preferred Alternative 1, the powerships will be moored close to a medium sensitive receptor, being the mouth of the Coega River (used as a feeding and roosting area and where a small colony of Kelp Gulls breed) and the gas pipeline will traverse the dune area. These areas will be modified during planned future developments of the Port of Ngqura that have already been authorised (marine infrastructure Environmental Authorisation dated 24 November 2014).

In Alternative 2, the powerships will be moored at the Admin Craft Basin breakwater, away from the Coega River and the FSRU will be moored further down the Eastern Breakwater.

7.5.8.1.1 *Impact on Physcial Disturbance of Terrestrial Avifauna Habitat*

Impacts on avifauna habitat will generally be largely reversible upon rehabilitation following site establishment and fully reversible when the powerships depart at the end of the project.There is good connectivity with coastal habitat adjacent to the Port of Ngqura and with the Coega estuary and saltpans that will continue to provide coastal and terrestrial avifauna habitat that is not impacted by the powership project. There is a very high probability that avifauna displaced due to physical disturbance from the project will relocate to less disturbed areas nearby

Table 7-19: Physical Disturbance of terrestrial avifauna habitat by project infrastructure

Nature of Impact: Physical Disturbance of terrestrial avifauna habitat by project infrastructure (Site establishment, Powerships, FSRU, LNG Carrier and gas pipelines).
Phases: Site establishment and construction, operations and closure

		Alternative 1		Alternative 2	
		No Mitigation	With Mitigation	No Mitigation	With Mitigation
A	Severity	1 Insignificant	1 Insignificant	1 Insignificant	1 Insignificant
B	Duration	5 >10 yrs	5 >10 yrs	5 >10 yrs	5 >10 yrs
C	Spatial	1 Immediate	1 Immediate	1 Immediate	1 Immediate
D	**Consequence =(A+B+C)/3**	**2.3**	**2.3**	**2.3**	**2.3**
E	Frequency	1 Once	1 Once	1 Once	1 Once
F	Probability	3 Infrequent	2 V. Unlikely	2 V. Unlikely	1 Almost never
G	**Likelihood= (E+F)/2**	**2.0**	**1.5**	**1.5**	**1.0**
H	**Significance=DxG**	**4.6 Low**	**3.5 Low**	**3.5 Low**	**2.3 V Low**
	Reversibility	**Fully**	**Fully**	**Fully**	**Fully**
	Irreplaceable Loss of Resources	**No**	**No**	**No**	**No**
	Fatal Flaw	**No**	**No**	**No**	**No**
	Mitigation:	▪ Alternative 1: Once in position off of the Coega River mouth, to reduce impacts due to re-positioning anchors and moorings, the powerships should not be moved unless in an emergency. ▪ To avoid disturbance to breeding Kelp Gulls and African Oystercatchers, the gas pipeline should not be constructed over the dune area during the period 1 October to 31 January. Areas must be surveyed prior to construction/camp establishment to determine the presence of nesting birds and these areas must be cordoned off until nesting has ceased. ▪ Comply with TNPA's Construction Environmental Management Programme for the Port of Ngqura and relevant sections of the Environmental Management Programme for the Operation of the Port of Ngqura. This includes minimizing disturbance footprints and rehabilitation of disturbed areas, ▪ Continue annual monitoring of the Kelp Gull breeding colonies in the Port.			

7.5.8.2 Impact assessment findings (with and without mitigation): ***Powerships & FSRU, Gas Pipeline & Construction Facilities: Operational Phase***

7.5.8.2.1 Impact on Disturbance to Terrestrial Avifaunal by Atmospheric Noise and Light

Predicted terrestrial noise from the powership is 40-50dBA (equivalent to a suburban area) at the mouth of the Coega River and adjacent shoreline and 30-40dBA (equivalent to a rural area) for approximately 630m upstream (i.e. from the causeway to the first evaporation saltpan) (Figure 8). There will be no residual noise due to the project at the sensitive Damara Tern colony approximately 2.8km to the north-east (Wiliams 2022).

Note 6 of SANS 10103:2008, the Measurement and Rating of Environmental Noise with Respect to Annoyance, and to Speech Communication states that noise produced by humans in natural quiet spaces such as national parks, wilderness areas and bird sanctuaries, should not exceed a maximum A-weighted sound pressure level of 50dBA at 15m from each individual source.

Anthropogenic noise and light produce physiological and behavioural responses in a wide variety of bird species and can affect breeding and overall fitness. Species living in closed environments (e.g. forests) are generally more affected than those in open environments (Senzaki et al. 2020). In a review of the effects of noise on wildlife, responses of terrestrial species started at 40dB and 20% of studies reported a response at 50dB (Shannon et al. 2015).

From the above, given that the area is naturally a dynamic and noisy coastal environment and terrestrial noise due to the project is not expected to exceed 50dBA at terrestrial avifauna receptors, noise impacts due to the project on terrestrial avifauna are expected to be limited but as the noise is continuous during operations the significance remains Medium even after mitigation. Habitat connectivity allows the birds to relocate if the noise is too disturbing and the impacts are reversible.

Table 7-20: Disturbance to terrestrial avifauna by atmospheric noise and light

Nature of Impact: Disturbance to terrestrial avifauna by atmospheric noise and light (Powerships, FSRU). **Phase**: Operations					
		Alternative 1		Alternative 2	
		No Mitigation	With Mitigation	No Mitigation	With Mitigation
A	Severity	2 Small	1 Insignificant	2 Small	1 Insignificant
B	Duration	5 >10 yrs	5 >10 yrs	5 >10 yrs	5 >10 yrs
C	Spatial	1 Nearby	1 Immediate	2 Nearby	1 Immediate
D	**Consequence =(A+B+C)/3**	**3.0**	**2.3**	**3.0**	**2.3**
E	Frequency	5 Hourly	5 Hourly	5 Hourly	5 Hourly
F	Probability	2 V Unlikely	2 V Unlikely	2 V Unlikely	2 V Unlikely
G	**Likelihood= (E+F)/2**	**3.5**	**3.5**	**3.5**	**3.5**
H	**Significance=DxG**	**10.5 Med-High**	**8.0 Medium**	**10.5 Med-High**	**8.0 Medium**
	Reversibility	**Fully**	**Fully**	**Fully**	**Fully**
	Irreplaceable Loss of Resources	**No**	**No**	**No**	**No**
	Fatal Flaw	**No**	**No**	**No**	**No**
	Mitigation:	▪ All lighting to be down / shielded lighting. Lighting to be limited to that required for safe operations. ▪ No lights to illuminate or be directed towards the Coega estuary and shoreline. ▪ Undertake a night light audit on a moonless night and 24 hour noise audits in accordance with SANS 10103:2008 at the Klub Road causeway crossing the Coega Estuary before operations start to determine the baseline, once operations start and annually thereafter.			

		▪ To track any changes on sensitive avifauna receptors, ensure that monitoring of the nearby Damara Tern colony continues. Continue annual monitoring of the Kelp Gull breeding colonies in the Port and bi-annual Co-ordinated Waterbird Counts on the saltpans. ▪ Noise can be reduced by reducing the number of reciprocating engines / steam turbines in operation and by implementing recommendations in the Terrestrial Noise Impact Assessment.

7.5.8.2.2 Impact on Terrestrial Avifauna due to Emergency Events

MHR (2022) advise that their Risk Assessment is not an Environmental Risk Assessment. Nevertheless the Risk Assessment does provide a good indication of environmental risk due to explosions. No terrestrial avifauna habitat will be directly impacted by an explosion although the resulting vessel damage is likely to result in a pollution event. Other possible major environmental risks during operations include:

- Gale force winds and high swells. These have previously caused problems with ship moorings in the Port of Ngqura. The FSRU and powerships will be moored permanently and will not be able to quickly exit the harbour ahead of extreme weather events.
- Flooding of the Coega River. This will be mostly applicable to the powerships moored at Alternative 1 and mitigation will be similar to that required for extreme weather events.
- Marine Traffic accidents. Almost all potential impacts can be confined within the Port with adequate planning and mitigation

Table 7-21: mpact on avifauna due to emergency events

Nature of Impact: Impact on avifauna due to emergency events (Powerships, FSRU, LNG Carrier, gas pipelines, gales, swells, flooding and marine traffic accidents).
Phases: Operation

		Alternative 1		Alternative 2	
		Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
A	Severity	4 Harmful	2 Small	4 Harmful	2 Small
B	Duration	2 <3 mths	1 <1 mth	2 <3 mths	1 <1 mth
C	Spatial	3 Several kms	2 Nearby	3 Several kms	2 Nearby
D	**Consequence =(A+B+C)/3**	**3.0**	**1.7**	**3.0**	**1.7**
E	Frequency	1 < yearly	1 < yearly	1 < yearly	1 < yearly
F	Probability	2 V Unlikely	1 Almost never	2 V Unlikely	1 Almost never
G	**Likelihood= (E+F)/2**	**1.5**	**1.0**	**1.5**	**1.0**
H	**Significance=DxG**	**4.5 Low**	**1.7 Very Low**	**4.5 Low**	**1.7 Very Low**
	Reversibility	**Likely**	**V Likely**	**Likely**	**V Likely**
	Irreplaceable Loss of Resources	**Unlikely**	**V. Unlikely**	**Unlikely**	**V. Unlikely**
	Fatal Flaw	**No**	**No**	**No**	**No**
	Mitigation:	▪ Have emergency plans in place, to include operational risks (gas explosions, etc), extreme weather events, marine traffic accidents)			

		▪ Ensure Standard Operating Procedures for all operations and extra checks for hazardous processes (e.g. hose connections) ▪ Use suitably qualified and trained people for all operations ▪ Ensure adequate emergency equipment is available and maintained and hold regular audits and emergency drills ▪ Emergency plans / equipment are to include plans to minimize and address environmental pollution and to capture and rehabilitate injured or at risk birds.

*7.5.8.3 Impact assessment findings (with and without mitigation): **<u>Transmission Line Alternatives 1, 2 and Construction Facilities: Construction and Operational Phase</u>***

7.5.8.3.1 Impact on Avifauna due to Habitat Distrubance and Fragmentation

Along Alternatives 1 and 2 the area behind the Eastern Reclamation is already extensively impacted, with a fence and road (under construction in February 2021) and a high density of alien rooikrans bushes. Thereafter there is approximately 750m of intact Algoa Dune Thicket that is habitat for the Near-Threatened Knysna Woodpecker. North of this section of the proposed route is Bontveld CBA, part of the Coega OSMP that is sometimes used by Species of Conservation Concern such as Blue Cranes, Secretarybirds and Denham's Bustards.

South-east of the N2 Alternatives 1 and 2 cross Bontveld that has been moderately invaded by alien rooikrans, especially in the existing electrical services corridor where this fire prone vegetation has not been controlled. North-west of the N2 the servitude crosses indigenous Bontveld and Sundays Valley Thicket vegetation with relatively few alien rooikrans bushes. The western boundary of the electrical services corridor taken by the preferred Alternative 1 has a more pristine bontveld / thicket mosaic than for Alternative 2 and will require more judicious access route selection as there is not a dedicated access track for this alignment. With suitable rehabilitation and maintenance the impact of habitat disturbance and fragmentation on avifauna is generally reversible if large areas are not cleared.

Table 7-22: Impact on avifauna due to habitat disturbance and fragmentation

Nature of Impact: Transmission lines: Impact on avifauna due to habitat disturbance and fragmentation **Phases**: Construction and Operations					
		Alternative 1: Central Route (preferred)		Alternative 2: Eastern Route	
		Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
A	Severity	2 Small	1 Insignificant	2 Small	1 Insignificant
B	Duration	4 <10 years	3 <1 year	4 <10 years	3 <1 year
C	Spatial	2 Nearby	1 Immediate	2 Nearby	1 Immediate
D	**Consequence =(A+B+C)/3**	**2.7**	**1.7**	**2.7**	**1.7**
E	Frequency	2 >6 mths	1 < yearly	2 >6 mths	1 < yearly
F	Probability	2 V Unlikely	1 Almost never	2 V Unlikely	1 Almost never
G	**Likelihood= (E+F)/2**	**2.0**	**1.0**	**2.0**	**1.0**
H	**Significance=DxG**	**5.4 Med-Low**	**1.7 Very Low**	**5.4 Med-Low**	**1.7 Very Low**
	Reversibility	**Fully**	**Fully** **Fully**	**Fully**	

	Irreplaceable Loss of Resources	**No**	**No**	**No**	**No**
	Fatal Flaw	**No**	**No**	**No**	**No**
	Mitigation:	▪ Comply with the RoD dated 7 Nov 2006 for the transmission line corridor between the coastal area and Dedisa Sub-Station. ▪ Comply with the Generic EMPr for Substation and Overhead Electricity Transmission and Distribution Infrastructure (GN 435 dated 22 March 2019) ▪ Comply with Coega OSMP Management Guidelines for Service Corridors ▪ Use monopoles in preference to lattice towers to minimize tower footprints and to match the monopoles along the existing transmission lines in the services corridor. ▪ Use existing access tracks and access tower positions from existing tracks by the shortest / least impact route. ▪ As per RoD / Generic EMPr / Coega OSMP requirements: No clear-felling of indigenous vegetation. Only clear the minimum vegetation required for access for construction of towers and stringing of cables (1m wide path). Trim high bushes under the transmission lines to the Minimum Vegetation Clearing Distance. ▪ Clear all alien vegetation, especially rooikrans bushes within at least a 30m wide servitude under the transmission lines. This will reduce fire risk. ▪ Annually inspect and maintain the transmission line servitude free of alien vegetation and maintain the Minimum Vegetation Clearing Distance for indigenous bushes under the transmission lines. ▪ Within TNPA areas: Comply with TNPA's Construction Environmental Management Programme for the Port of Ngqura and relevant sections of the Environmental Management Programme for the Operation of the Port of Ngqura. ▪ Within CDC areas: Comply with CDC's Standard Environmental Specification for Construction and Standard Vegetation Specification for Construction.			

*7.5.8.4 Impact assessment findings (with and without mitigation): **Transmission Line Alternatives 1, 2 and Construction Facilities: Operational Phase***

7.5.8.4.1 Impact on Avifauna due to Collisions and Electrocution

The power line spans between the Powerships and the coastal area (to the proposed Saltpan Switching Station and thence to the top of the Eastern Reclamation) are the greatest threat for bird collisions and the impact ratings are based on this risk. This portion of the power line is at right angles to a busy bird flyway along the coast to and from the Coega River Mouth and saltpans. Species of Conservation Concern using this flyway include Damara and Caspian Terns and night flying flamingos. A small colony of Kelp Gulls breeds in this area. Dynamic bird flappers that emit flashing lights at night or are highly reflective should be installed on the earth wire in this area.

Other vulnerable portions of the transmission line routes include where the power lines cross the N2 and R102 (Martin 2012; Morant 2013). Alternatives 1 and 2 are stand-alone prior to the electrical services corridor. Alternative 1 will be the first transmission line along the western boundary of the services corridor and closer to the top of the ridge above the Coega valley, making it slightly more vulnerable to collisions than Alternative 2 that is located adjacent to existing 132kV monopole lines in the electrical services corridor. It is recommended that for Alternatives

1 and 2 from the top of the Eastern Reclamation to Dedisa Sub-station, alternating black and white Spiral "pigtail" Bird Flight Diverters be installed on the earth wires in accordance with "Specifications for Bird Flight Diverters Installation on a Transmission Line" and the ESKOM Collision Guidelines.

Table 7-23: Impact on avifauna due to collisions and electrocution

	Nature of Impact: Transmission lines: Impact on avifauna due to collisions and electrocution **Phase**: Operations				
		Alternative 1: Central Route (preferred)		Alternative 2: Eastern Route	
		Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
A	Severity	3 Significant	2 Small	3 Significant	2 Small
B	Duration	5 >10 years	5 >10 years	5 >10 years	5 >10 years
C	Spatial	3 Several Kms	2 Nearby	3 Several Kms	2 Nearby
D	**Consequence =(A+B+C)/3**	**3.7**	**3.0**	**3.7**	**3.0**
E	Frequency	2 >6 mths	1 <Yearly	2 >6 mths	1 <Yearly
F	Probability	3 Unlikely	2 V. Unlikely	3 Unlikely	2 V Unlikely
G	**Likelihood= (E+F)/2**	**2.5**	**1.5**	**2.5**	**1.5**
H	**Significance=DxG**	**9.1 Med-High**	**4.5 Low**	**9.1 Med-High**	**4.5 Low**
	Reversibility	**Fully**	**Fully**	**Fully**	**Fully**
	Irreplaceable Loss of Resources	**V Unlikely**	**No**	**V Unlikely**	**No**
	Fatal Flaw	**No**	**No**	**No**	**No**
	Mitigation:	▪ Comply with the Generic EMPr for Substation and Overhead Electricity Transmission and Distribution Infrastructure (GN 435 dated 22 March 2019). ▪ At the switching station use appropriate engineering designs to protect / insulate live components that may pose a risk to perching birds. ▪ Use monopoles in preference to lattice towers to match the conductor heights of the existing power lines thereby reducing the vertical risk area to flying birds. ▪ Provide bird perches on top of the monopoles to encourage them away from perching on the conductors. ▪ Use dynamic reflective bird flappers, preferably with lights that flash at night, on the most sensitive spans of the transmission line between the Powerships and the top of the Eastern Reclamation (Alternatives 1 & 2). ▪ Use alternating black and white static pigtail flight diverters on the remaining spans of the power line as per Eskom Guidelines ▪ Every three months survey the transmission line routes for avian casualties and check and if necessary replace / maintain bird flight diverters ▪ Report any bird casualties additional to those found during the surveys to the CDC or TNPA Environmental Officer and the Coega / Ngqura Environmental Control Officer.			

7.5.8.5 Cumulative Impacts

There have already been impacts on terrestrial avifauna and their habitats due to the development of the Port of Ngqura and developments within the Coega SEZ. In addition to the Karpowership project 3000MW of gas to power projects in Zones 10 and 13 (CDC application) are at the Draft EIR stage. If these projects go ahead there will be two FSRU vessels moored against the Eastern Breakwater (if space allows), in addition to the powerships in the port.

Eight other relevant projects are at the EIA stage or have Environmental Authorisations and operations have not yet started: Additional marine infrastructure in the Port of Ngqura; Transnet and Newlyn manganese projects; Marine intake and outfall servitude; Two aquaculture development zones (sea-based and in Zone 10); Bulk liquid tank facilities; Coega sand mining right.

Disturbance to Terrestrial Avifauna

Cumulative terrestrial noise contours if all of the proposed Gas to Power projects are operational in the Coega SEZ are shown in **Figure 7-9** (Williams 2022).

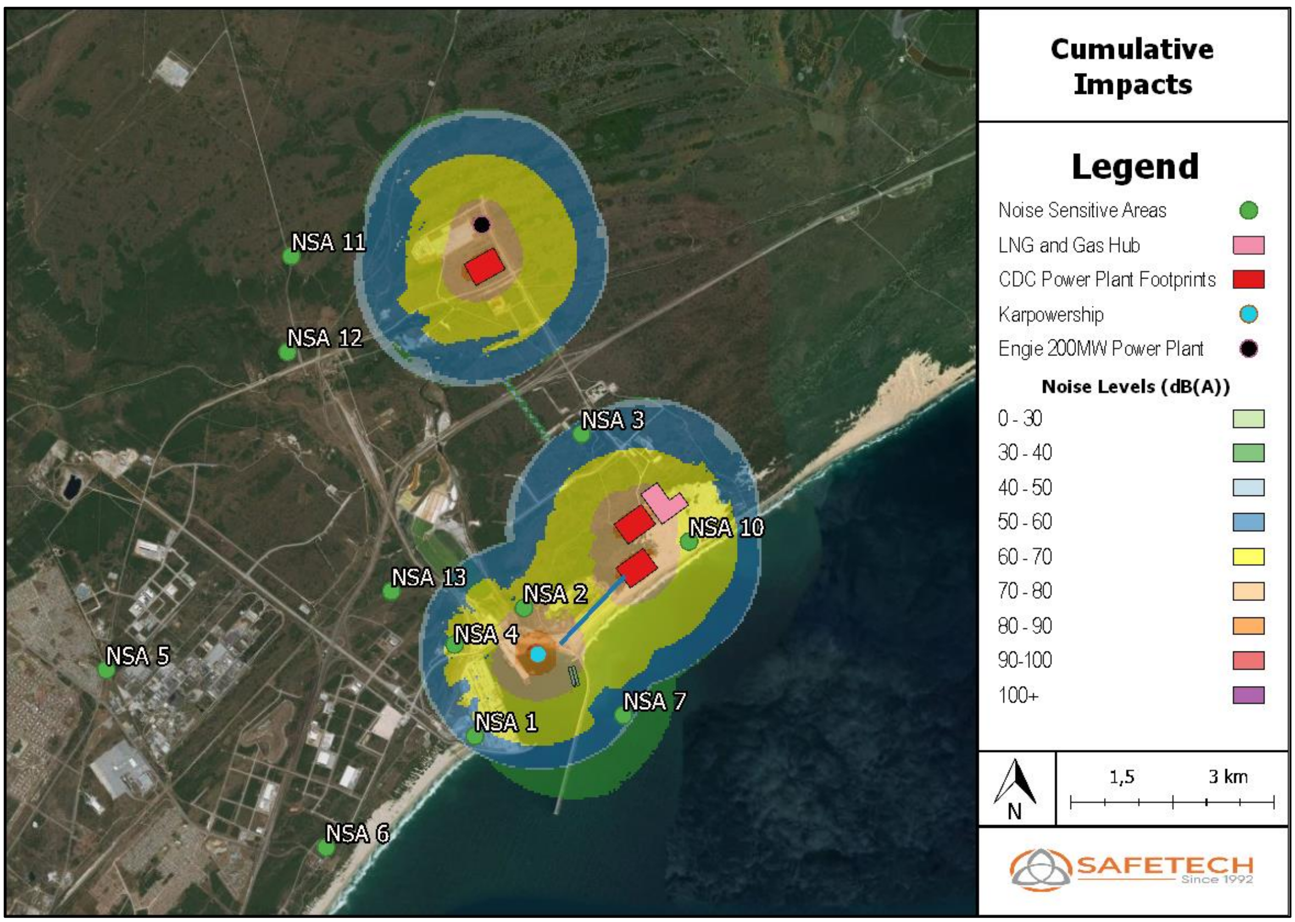

Figure 7-9: Cumulative noise impacts within the Coega SEZ (Williams 2022)

The small Damara Tern colony (NSA10 in Figure 7-9) supports 5-8% of the South African population (Knoppersen & Martin 2021) and is among the most sensitive terrestrial avifauna receptors within the Coega SEZ. The two 1000MW Gas to Power projects proposed in Zone 10 of the Coega SEZ are located approximately 350m from the colony. The cumulative noise model indicates 60-70dBA (equivalent to an industrial area) at the colony, a finding supported by Knoppersen & Martin 2021 who determined that the cumulative impacts on the colony were Very High, even though the Karpowership project's influence is Very Low.

Cumulative disturbance on birds at the Coega River Mouth and the portion of the saltpans closest to the Port are expected to be Medium-High due to noise (60-70dBA, Figure 7-9) and light disturbance from the nearby Karpowerships and the TNPA marine infrastructure planned for this area. Affected birds will be able to move away from the disturbance and no Species of Conservation Concern breed in this area.

Other Cumulative Impacts on Terrestrial Avifauna

Avifauna is mobile and able to avoid adverse impacts when not breeding. Consequently, with the exception of the Damara Tern colony (see above), Cumulative Impacts such as Physical Disturbance of Important Avifauna Habitat, Atmospheric Emissions and Emergency Events are unlikely to exceed a Medium-Low impact for terrestrial avifauna. Cumulative impacts of overhead transmission lines on avifauna can be reduced if the mitigation recommended in this assessment and the Generic EMPr for Substation and Overhead Electricity Transmission and Distribution Infrastructure (GN 435 dated 22 March 2019) is implemented.

7.5.8.6 Specialist Conclusion

None of the potential impacts to terrestrial avifauna were assessed to be greater than Medium after mitigation and the Author is of the opinion that the proposed Powerships Gas to Power Project at the Port of Ngqura / Coega SEZ may proceed with acceptable levels of environmental risk to terrestrial avifauna subject to implementation of the preferred alternatives and recommended mitigation measures.

7.5.9 Underwater Noise Impacts

In order to identify any significant risks from underwater noise that could arise due to this proposed project and to determine the noise impacts, a baseline noise survey was carried out in the Port of Ngqura. Noise levels at a fixed location monitor located near to the position of a proposed Powership were subject to significant variation due to vessels associated with port operation that passed frequently. In other locations, especially in the vicinity of the Finger Jetty where cargo vessels were berthed, or the Container Terminal, noise levels were directly influenced by these cargo vessels, whether moving or stationary. Away from berthed vessels, the source of noise controlling the ambient conditions was biological snapping sound, thought to be caused by fish or crustaceans.

A survey was also carried out at the location of a large Khan class Powership in Ghana, of a similar class specification (sister ship) to that of the Powership planned at the Port of Ngqura to sample the noise levels that such a vessel produces at various distances and power outputs. In addition, an FSRU with a single engine running was assessed. This data was applied to the baseline data using standard methodology to calculate the noise levels that would be present if all proposed ships were installed and operated at a maximum capacity.

The various noise producing sources expected to be present during the construction of the infrastructure required for the Powerships and supporting vessels which include vibropiling and drilling for Powership mooring piles, and breaking rock on the pipeline route. As per the guidelines in Southall et al. (2019) and Popper et al. (2014), any impacts would require an individual marine mammal to remain within 520 m of vibropiling for its entire duration of 2 hours in a day, or within 950 m from rock breaking for 6 hours. This range is for the VHF cetacean marine mammal category, which are not present in this location. Other marine mammal groups are less sensitive, and would need to be less than 400 m for a significant period. Fish would need to remain within 50 m of the activity. Impacts from any other noise source are significantly lower.

The results of the assessment showed that after installing two Powerships and an FSRU, with both operating at maximum output, the background noise could increase by approximately 3 dB in the middle of the harbour. This is equivalent to a noise level of 130.4 dB SPLRMS re 1 µPa. This is a worst-case scenario, with the Powerships maximum permitted output (450 MW) significantly lower than the maximum capacity (total ~541 MW) on which this has assessment has been conducted. For context, large cargo vessels passed frequently in the Port of Ngqura during the baseline survey and, for example, a bulk carrier typical of the type frequently accessing the harbour produced noise levels of 146.2 dB SPLRMS re 1 µPa at 75 m from its side as it passed, being significantly higher than that which will be produced by Powership operations.

The effect on baseline noise will be negligible where the Powership is operating at a low power, which was found to be typical during the survey of the operational Powership in Ghana.

Predictions of the noise at the entrance of the harbour will be less than 2 dB above baseline with the Powerships operating at maximum power. Outside, no significant noise is expected to escape based on the findings of the survey at the operational Powership and that no ship noise was audible on the far side of the breakwater at the Port of Ngqura. No significant noise is expected to pass through the breakwater, and the waters around Jahleel Island are also approximately 1km from the Powerships, before which point the noise from the Powership in Ghana was only slightly above background at full power.

7.5.9.1 Impact assessment findings (with and without mitigation): __Preferred Powership and FSRU: Construction Phase__

7.5.9.1.1 Impact of vibropiling and drilling on marine mammals or fish

Vibropiling noise is generated in the piles through the coupling to the piling hammer.
Source levels used for drilling are based on 1/3rd octave band measurements undertaken by Subacoustech of underwater drilling. The project was drilling anchor sockets in rock for a tidal turbine, similar to the requirement for the anchor piles in the Port of Ngqura, although the bedrock here is deeper than the surface rock for the tidal turbine. The source level was calculated to be 168.8 dB SPLRMS and will represent a precautionary prediction as it is based on shallower bedrock.

The ranges for vibropiling have been calculated for both a stationary and moving animal and are based on 2 hours of operation in any 24 hour period. For drilling, the calculations have assumed a stationary animal and drilling being undertaken for up to 12 hours in a given 24-hour period.

Table 7-24: TTS ranges to Southall et al. (2019) SELcum criteria for vibropiling and drilling operations

Threshold	Criteria SELcum (weighted)	Vibropiling (2 hours)		Drilling, stationary (12 hours)
		Stationary animal	Moving animal (1.5 m/s)	
LF Cetaceans TTS	179 dB re 1 µPa²s	200 m	<50 m	110 m
HF Cetaceans TTS	178 dB re 1 µPa²s	<50 m	<50 m	<50 m

VHF Cetaceans TTS	153 dB re 1 µPa²s	520 m	<50 m	130 m
PCW Pinnipeds TTS	181 dB re 1 µPa²s	120 m	<50 m	<50 m
OCW Mammals TTS	199 dB re 1 µPa²s	<50 m	<50 m	<50 m

The pipeline is laid onto the seabed and, whilst no dredging is required, an option is available for the requirement to clear some of the hard rock substrate that may protrude above the level seabed under the route of the pipeline at the Powerships, to avoid the risk of the pipeline 'riding' on a rock outcrop which would create portions of pipeline that are unsupported by the seabed. The equipment required will depend on the portion of rock (if any) that requires flattening out, but a mechanical breaker is expected. The potential rock to be levelled is in shallow water north of the Powerships and north of the location of the FSRU.

The duration in a day that this hammer may be used for is expected to be less than 6 hours, and will not be prolonged due to the relatively small area of rock that would need to be levelled, and the intermittent nature of this equipment. However, a precautionary 6 hours a day has been applied to the noise predictions.

Table 7-25: TTS ranges to *Southall et al. (2019) SEL$_{cum}$* criteria for rock breaking operations

Threshold	**Criteria SELcum (weighted)**	**Rock breaking (6 hours)**	
		Stationary animal	**Moving animal (1.5 m/s)**
LF Cetaceans TTS	179 dB re 1 µPa²s	360 m	<50 m
HF Cetaceans TTS	178 dB re 1 µPa²s	80 m	<50 m
VHF Cetaceans TTS	153 dB re 1 µPa²s	950 m	<50 m
PCW Pinnipeds TTS	181 dB re 1 µPa²s	220 m	<50 m
OCW Mammals TTS	199 dB re 1 µPa²s	<50 m	<50 m

The maximum distance for potential TTS onset for VHF cetaceans is 950 m, which would include the majority of the harbour where there is line of site. As previously, this would still require a marine mammal to remain present for the entire duration, presuming six hours of rock breaking. This species is not expected in this location. Any other species group would need to be considerably closer. A fish would also need to remain in the near vicinity (<50 m) of the breaking for an extended period to reach the requirements for TTS exposure.

7.5.9.2 Impact assessment findings (with and without mitigation): ***Preferred Powership and FSRU: Operational Phase***

7.5.9.2.1 Impact of underwater noise on marine mammals

The impact assessment of underwater noise on marine mammals will be undertaken using the criteria presented in the Southall *et al.* (2019) guidelines. In order to correctly assess the impact on various species, the underwater noise must be appropriately weighted to account for the differing hearing sensitivities of each species.

To present a worst-case scenario, it has been assumed that the Powership will operate at maximum capacity for 24 hours a day; it is understood however that Powership operation in Port of Ngqura is limited to 16.5 hours a day and will not be operating at maximum installed capacity.

Table 7-26:TTS thresholds for marine mammals exposed to the Powership continuously for 24 hr/day, based on TTS thresholds defined in Southall et al. (2019)

	TTS threshold	**Range to meet TTS onset**
Low-frequency cetaceans (LF)	179 dB SEL_{cum}	350 m
High-frequency cetaceans (HF)	178 dB SEL_{cum}	<50 m
Very high-frequency cetaceans (VHF)	153 dB SEL_{cum}	850 m
Phocid carnivores in water (PCW)	181 dB SEL_{cum}	70 m
Other carnivores in water (OCW)	199 dB SEL_{cum}	<50 m

Only LF cetaceans (baleen whales) and VHF cetaceans (porpoises) have calculated impact ranges in excess of 200 m. The largest range, for VHF cetaceans, would require an individual to remain in 'line of sight' of the Powership within the above range for a full 24-hour period to be exposed to noise sufficient to produce the onset of TTS symptoms, even under the worst-case scenario conditions described above. To produce PTS onset, the most sensitive species (VHF cetaceans) would need to remain within approximately 50 m of the Powership for an entire day under maximum load (much closer for the other species categories), and as such there is no reasonable expectation of this. This species group is not expected to be present at the Port of Ngqura.

Based on the above, particularly the high durations of exposure required and full power operation in excess of expected maximum load for the entire duration, no impact is expected on any marine mammal species from the installation of the Powership in Port of Ngqura.

As the noise levels produced by the ships associated with this project are also not substantially different to the noise levels produced by ships typically using the harbour, no significant disturbance effect outside of the normal operational port is anticipated, except if potentially directly adjacent to the ships.

7.5.9.2.2 Impact of underwater noise on fish

The assessment of underwater noise on fish is simpler than for marine mammals; based on the Guidelines in Popper *et al.* (2014) no weighting is applied or required to calculate the impact thresholds. The exposure criterion for TTS to the most sensitive species of fish is 158 dB SPLRMS, to which a fish must be exposed for 12 hours.

The calculated noise levels in the Port of Ngqura do not reach this threshold in any position. All noise measurements at any range from the Ghanian Powership were at least 10 dB below this value. No risk to fish in the Port of Ngqura is expected as a result of the Powership installation.Please refer to Appendix 9 - B4 - Marine Ecology Assessment.

7.5.9.2.3 Cumulative Impacts

Predictions of the noise at the entrance of the harbour will be less than 2 dB above baseline with the Powerships operating at maximum power. Outside the harbour entrance, or where shielded by the breakwater, no significant noise is expected to escape based on the findings of the survey at the operational Powership and that no ship noise was audible on the far side of the breakwater at the Port of Ngqura, despite a busy harbour. No significant noise is expected to pass through the breakwater, and the waters around Jahleel Island are also approximately 1km from the Powerships, before which point the noise from the Powership in Ghana was only slightly above background at full power.

Any risk to marine mammals or fish will be negligible. The lower order of effect defined in the guidelines, temporary threshold shift (TTS), would only occur when marine mammals of the most sensitive species (VHF cetaceans, i.e. porpoises) remained within 700 m of the Powership operating at maximum capacity for a full 24 hours. This condition of extended presence of marine mammals close to the ships in the port and maximum output is highly unlikely to occur in practice, especially considering that the Powership operations are only permitted for 16.5 hours per day. The most sensitive species of fish would need to remain directly adjacent to the Powership for the same full 24 hour period.

7.5.9.2.4 Specialist Conclusion

Based on this assessment, no significant impacts on fish or marine mammals are predicted as a result of the operation of the Powership in Port of Ngqura as it will not materially change existing underwater noise associated with the Port. **No additional noise mitigation is deemed necessary, and this project is thus supported from an underwater noise assessment perspective.**

7.5.10 Underwater Heritage Impacts

The area for the pipelines is near to where the County of Pembroke was found. The MUCH specialist indicated that:

- These areas for the laying of the pipeline had already been extensively dredged far below the historic ground level and concluded that it is extremely unlikely that any heritage resources remain.
- The presence of unknown wooden wreckage lying in the inshore area of the proposed pipeline must be monitored by an archaeologist during excavations for the pipeline.

7.5.11 Marine Ecology Impacts

*7.5.11.1 Impact assessment findings (with and without mitigation): **Construction Phase***

7.5.11.1.1 Impact 1: The effects of gas pipeline construction and installation and vessel mooring on the littoral and benthic community

The seabed installations will result in the disturbance of approximately 5 (approx. 500 m pipeline in total on seabed multiplied by approx. 10 m servitude + the mooring blocks) of benthic habitat within the site-specific area of about 78.5 ha. This will result in the modification of approximately 0.6% of the benthic and intertidal community structure on site. Following installation, sessile organisms should colonise hard surfaces causing a minor increase in benthos biodiversity in the project area and resulting in restored ecological function.

Furthermore, the development will occur within an already compromised port area due to the admin craft basin's construction. CSIR (2018) reported macrofaunal abundance near the admin craft basin and the proposed FSRU location. The macrofauna at these sites mainly comprised small deposit-feeding polychaetes that are generally more opportunistic in nature and can proliferate in disturbed environments. Thus, following disturbance, recolonisation should be rapid, on the scale of months.

The sandy beaches where the pipeline will cross into the sea offer a soft sediment habitat. These areas support benthic macrofauna typical of sandy beaches in the region i.e., suspension feeders such as molluscs and mysid shrimps (CSIR 2013). Low biomass levels along sandy beaches and in the nearshore compared to deeper areas have been reported (CSIR 2013). Given the low biomass of marine fauna in the littoral zone and the evidence that the area in the vicinity of the proposed FPP facilities is disturbed, ecological damage is predicted to be negligible.

Table 7-27: Impact 1 scoring table (without mitigation): Pipeline construction and installation, and vessel mooring.

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	2 - Site-specific and wider natural processes and functions are slightly altered
Duration a measure of the lifetime that the impact will be present	1 – up to 1 year
Spatial Scale the extent / size of the area that may be affected	1 – Project footprint
Overall Consequence = 4 / 3 = 1.33	
Likelihood	
Frequency how often the impact will occur	4 – Once or more a week
Probability the likelihood or the chances that the impact will occur	4 – 50% - 75% (highly probable)
Overall Likelihood = 8 / 2 = 4	
Overall Environmental Significance = 1.33 x 4 = 5.32	
Overall Environmental Significance:	
5 - 6.9Medium - Low	
Reversibility	
Reversibility degree to which the impact can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	
Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw	No – the impact does not result in a fatal flaw

degree to which the impact is a fatal flaw	
Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	High

Mitigation measures

Disturbance to benthic and littoral habitats and fauna is an unavoidable consequence of the proposed development. However, disturbance to potentially sensitive habitats should be minimised. If minimised, the probability of marine biota being impacted is reduced. This reduces the Overall Environmental Significance to “Low

Table 7-28: Impact 1 scoring table (with mitigation): Pipeline construction and installation, and vessel mooring

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	2 - Site-specific and wider natural processes and functions are slightly altered
Duration a measure of the lifetime that the impact will be present	1 – up to 1 year
Spatial Scale the extent / size of the area that may be affected	1 – Project footprint
Overall Consequence = 4 / 3 = 1.33	
Likelihood	
Frequency how often the impact will occur	4 – Once or more a week
Probability the likelihood or the chances that the impact will occur	3 – >25% - 50% chance of occurring (probable)
Overall Likelihood = 7 / 2 = 3.5	
Overall Environmental Significance = 1.33 x 3.5 = 4.67	
Overall Environmental Significance:	
3 - 4.9	Low
Reversibility	
Reversibility degree to which the impact can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	

Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw degree to which the impact is a fatal flaw	No – the impact does not result in a fatal flaw
Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	High

7.5.11.1.2 Impact 2: The effects of increased noise and vibration levels from construction on the marine ecology

Anthropogenic noise in and around underwater habitats can impact the marine species inhabiting them. The extent and likelihood of underwater noise causing adverse impacts on marine life is dependent on the qualities of the sound such as the sound level, source frequency, duration of exposure, and/or repetition rate of an impulsive sound (Hastings and Popper 2005, in Subacoustech Environmental 2022).

Depending on their distance from the proposed FPP location, the biota in the Port of Ngqura could be impacted by underwater noise from the construction activities. Exposure to noise for a long period of time, such as is expected of the construction, can cause chronic effects, including developmental deficiencies and physiological stress (Popper and Hawkins 2016). These may affect life functions, including individual health and fitness, foraging efficiency, avoidance of predation, swimming energetics and reproductive behaviour (Popper and Hawkins 2016). However, as stated above, these responses to sound are dependent on the sound qualities and the sensitivity of different organisms to sound.

The most noise-sensitive groups in the Port of Ngqura are expected to be mammals and fish. The Port of Ngqura functions as an essential nursery area for many fish species and is an important habitat and activity zone for juvenile and neonate dusky shark (Dicken 2011). Juveniles are considered more susceptible to noise disturbances as they are less mobile, while adult fish (and marine mammals) can move out of affected areas. It is often assumed that animals will avoid disturbing noise. However, territoriality or a response of immobility may mean that the animal does not move away from the noise source (de Soto 2016). Other important marine receptors in the area are the various seabird species. Marine invertebrates may also be impacted by underwater noise; however, evidence is limited (de Soto 2016).

Southall *et al*. (2019) provides groupings of marine mammals of similar species by their hearing range and approximates the hearing sensitivities of each group by applying filters to unweighted noise.

Southall *et al*. (2019) also provides individual criteria based on whether the noise source is considered impulsive or non-impulsive. Examples of non-impulsive noise include sonar, vibropiling, drilling, shipping, and other relatively low-level continuous noise. The noise produced by the construction activities is considered non-impulsive.

The most sensitive species of fish (those with a swim bladder involved in hearing) must be exposed to 158 dB SPLRMS from continuous noise sources, such as shipping, for 12 hours to experience the onset of TTS. Sciaenidae are examples of such fish, of which dusky kob Argyrosomus japonicus and silver kob *A. inodorus* are present in The Port of Ngqura.

As defined in Popper *et al*. (2014), masking is the "impairment of hearing sensitivity by greater than 6 dB, including all components of the auditory scene, in the presence of noise." This is not a direct physiological effect on hearing but describes the effect of making a sound harder to hear due to the increase background noise. Behavioural effects are defined as "substantial change in behaviour for the animals exposed to a sound. This may include long-term changes in behaviour and distribution, such as moving from preferred sites for feeding and reproduction, or alteration of migration patterns. This behavioural criterion does not include effects on single animals, or where animals become habituated to the stimulus, or small changes in behaviour such as a startle response or small movements" (Popper *et al*. 2014).

Construction noise sources

The noise producing activities expected to be present during the construction of the infrastructure required for the Powerships and supporting vessels includes vibropiling, drilling, and rock clearance. Vibropiling will be required to install the first stage of the piled anchors for the Powerships and FSRU. Drilling will be needed to install the piles for the remained of the required depth into bedrock, and rock clearance is potentially required for the installation of the pipelines. High intensity impulsive piling will not be used.

Subacoustech Environmental (2022) predicted the subsea noise levels produced by construction activities based on data from measurements of similar equipment, scaled to relevant parameters for the site and to the specific noise sources used. Underwater noise transmission loss for non-impulsive sources was calculated based on an empirical analysis of the noise measurements taken along transects around these noise sources (Subacoustech Environmental 2022).

Drilling and vibro-piling

The coupling of the piles to the piling hammer generates vibropiling noise in the piles. Subacoustech Environmental (2022) based their noise calculations on measurements from a similar, but slightly more powerful vibro hammer to the one to be used in the Port of Ngqura. Therefore, the noise levels predicted are potentially slightly worse than will actually be produced. The source level for vibropiling (i.e., theoretical noise level at 1 m from the noise source, used for calculations) was calculated to be 184.0 dB SPLRMS.

The source levels for drilling were based on measurements from underwater drilling on shallower rock than the bedrock in the Port of Ngqura and as a result, represent a precautionary prediction. The source levels for drilling were calculated to be 168.8 dB SPLRMS (Subacoustech Environmental 2022).

The impact ranges for vibropiling show that an individual of the most sensitive group of marine mammals, VHF cetaceans, would need to remain stationary at 520 m from the noise source for 2 hours in order to experience the onset of TTS. VHF cetaceans are not expected to be found in the Port of Ngqura and all other groups of marine mammal would need to be 200 m or nearer to meet the TTS threshold. The Indo-Pacific humpback dolphins that occur in the Port are HF cetaceans and would therefore need to be within 50 m of the vibropiling or drilling for the duration of the activity to experience the onset of TTS. The likelihood of this occurring is considered to be low.

The PTS impact ranges for all marine mammal species and noise types was calculated to be less than 50 m.

For fish, all impact ranges will be less than 50 m, based on the 158 dB SPLRMS threshold for TTS in fish from continuous noise sources. This also requires 12 hours of continuous exposure for an individual.

Based on the qualitative criteria provided by Popper et al. (2014), fish and fish larvae and eggs will experience moderate to high levels of masking and behavioural impacts within hundreds of metres of the construction noise source. The extent to which this will impact their ecological functioning is uncertain.

TTS and PTS thresholds are not available for invertebrates or diving seabirds. However, threshold levels for marine mammals are generally considered appropriate for seabirds as well.

There is limited information on the effects of anthropogenic underwater noise on invertebrates such as crustaceans (de Soto 2016). However, there is evidence that anthropogenic noise can cause marine invertebrates to experience masking of important biological sound cues, as well as sub-lethal physiological stress in response to high levels of sound such as that from vessel traffic or construction noise (Hudson et al. 2022, Jézéquel et al. 2021, Solan et al. 2016). Exposure to underwater broadband sound fields at 135–140 dB re 1 μPa can reduce sediment-dwelling invertebrates' (in this case, the decapod *Nephrops norvegicus*, and clam *Ruditapes philippinarum*) ability to undertake ecologically-important benthic nutrient cycling processes (Solan et al. 2016). These sound levels will be experienced by invertebrates within hundreds of metres of the construction activities. Crustaceans have been shown to experience short- to medium-term stress or tissue repair effects in response to exposure to ship noise but may become adapted to such noise (Hudson et al. 2022, Wale, Simpson & Radford 2013). European lobsters (Homarus gammarus) were found to significantly increase their call rates in the presence of shipping noise of around 118.4 ± 7.7 SPLRMS dB re 1 μPa, suggesting the need to vocally compensate for the reduction in intraspecific communication ability due to noise (Jézéquel et al. 2021). This is within the range of noise already experienced in the Port of Ngqura but suggests that crustaceans near to the construction activities may experience noise interference with ecologically important sounds.

Rock breaking

It is possible that some of the hard rock substrate under the route of the pipeline at the Powerships will be cleared, to avoid the risk associated with the pipeline "riding" on a rock outcrop. There have been no specifications of equipment that will be used for clearing rock, but a mechanical breaker would be expected. The site where rock may be broken is in shallow water north of the Powerships and north of the FSRU.

The shallowness of the water in which the rock breaking will occur is beneficial in reducing underwater noise levels, as noise attenuates more readily in shallow water. The predictions of noise produced by rock breaking were based on noise measured from rock breaking using 4.2 tonne, 10.4 kJ hydraulic hammer, which had a calculated source noise level of 175.1 dB SPLRMS at 1 m.

The duration for which a rock breaking hammer will be used in a day is unknown but is not anticipated to be prolonged as there is a relatively small area of rock to be cleared, and the equipment is intermittent by nature. However, 6 hours a day was applied to the noise predictions as a precaution.

The ranges at which marine mammals would experience the onset of TTS due to continuous exposure of 6 hours to rock breaking noise were determined. The most sensitive group of marine mammals, VHF cetaceans, would need to be stationary within 950 m of the noise source for the entire 6 hours in order to experience the onset of TTS. This group of species is not found in South Africa, and all other species would need to be much closer in order to experience the onset of TTS.

Fish would need to remain within less than 50 m of rock breaking for an extended period in order to experience the onset of TTS.

Based on the qualitative criteria provided by Popper et al. (2014), fish and fish larvae and eggs will experience moderate to high levels of masking and behavioural impacts within hundreds of metres of the rock breaking. The extent to which this will impact their ecological functioning is uncertain.

TTS thresholds are not available for marine invertebrates or diving seabirds. However, as discussed above, invertebrates such as crustaceans within hundreds of metres of the construction may have reactions to the noise that include changes in their ecological functioning, increased stress levels and the need to acoustically compensate for the masking of intraspecific communication. Impacts on diving seabirds are likely to be similar as for marine mammals.

The noise produced by the FPP construction is not anticipated to contribute meaningfully to the existing noise levels in the Port of Ngqura. Furthermore, the construction noise is not anticipated to produce noise to the extent that it will cause direct harm to marine organisms, based on current understanding and available research. Marine mammals and fish would need to be very close, in the order of tens of metres, for the duration of the construction activities within a day, in order to experience the onset of a temporary reduction in hearing ability (TTS), and this is considered to be unlikely to occur. However, it is possible that marine organisms within hundreds of metres of the construction will experience noise levels that interfere with ecologically relevant sounds, or which cause behavioural changes, which could have negative impacts over time. There is limited research available on the sensitivity of invertebrates to construction noise. Considering these factors, the severity of the noise produced by the construction activities is considered to be "Site-specific and wider natural processes and functions are slightly altered". Noise produced by the construction will increase the ambient underwater noise levels within hundreds of metres of the source, so it will impact a greater area than the immediate site. It is unclear as to how frequently the noise-producing construction activities will take place, but over the course of the duration it is assumed that they will occur once or more in a week. The likelihood of the marine ecology experiencing an impact from the construction noise is considered as being possible. Accordingly, the assigned overall environmental significance rating is "Medium-Low" without mitigation and with mitigation remains at "Medium-Low". As there is limited research into the impacts of continuous low-level noise on marine organisms, the confidence of this assessment is Medium.

Table 7-29: Impact 2 scoring table: Impacts of increased noise from construction on the marine ecology

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	2 - Site-specific and wider natural processes and functions are slightly altered
Duration a measure of the lifetime that the impact will be present	1 – up to 1 year
Spatial Scale the extent / size of the area that may be affected	2 – Within the broader Port

Overall Consequence = 5 / 3 = 1.66	
Likelihood	
Frequency how often the impact will occur	4 – Once or more a week
Probability the likelihood or the chances that the impact will occur	2 – >5 - 25% chance of occurring (possible)
Overall Likelihood = 6 / 2 = 3	
Overall Environmental Significance = 1.66 x 3 = 4.98	
Overall Environmental Significance:	
5 - 6.9	Medium - Low
Reversibility	
Reversibility degree to which the impact t can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	
Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw degree to which the impact is a fatal flaw	No – the impact does not result in a fatal flaw
Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	Medium

Mitigation measures

In order to ensure that the noise levels produced by construction are not higher than predicted in this report, the equipment used should be similar or less powerful than the equipment used as a model by Subacoustech Environmental (2022). No unnecessary production of noise should take place, to minimise the exposure of the marine biota to noise and help to avoid disturbances and potential harm to marine organisms. If a marine mammal is observed in the near vicinity of the construction activity, construction should be halted until the marine mammal is outside the range of hundreds of metres from the noise source, as a precaution. These measures will reduce the probability of the marine biota being impacted by construction noise but does not reduce it enough to change the score.

A noise impacts monitoring programme should be implemented to validate the predictions made of the impacts of the noise produced by the construction operations on the marine ecology. A baseline study of the ecology in the immediate vicinity of the FPP should be undertaken following a before-after-control-impact (BACI) approach. This should include an assessment of the local macrofauna and video surveys and fish sampling to understand the fish community in the area of the port where the Powerships will be moored. An assessment of the distribution and behaviour of diving seabirds in the context of the Powerships should also be undertaken. These surveys should be ongoing and following a sampling methodology that is robust when assessing the impacts of the noise produced by construction on the distributions of benthic macrofauna, fish, seabirds, and marine mammals. If an effect if observed, adaptive management informed by monitoring results must be implemented. The results of such monitoring will be valuable in informing other developments and contributing to the international understanding of the effects of noise from construction activities on marine biota.

Table 7-30: Impact 2 scoring table (with mitigation): Impacts of increased noise from construction on the marine ecology

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	2 - Site-specific and wider natural processes and functions are slightly altered
Duration a measure of the lifetime that the impact will be present	1 – up to 1 year
Spatial Scale the extent / size of the area that may be affected	2 – Within the broader Port
Overall Consequence = 5 / 3 = 1.66	
Likelihood	
Frequency how often the impact will occur	4 – Once or more a week
Probability the likelihood or the chances that the impact will occur	2 – >5 - 25% chance of occurring (possible)
Overall Likelihood = 6 / 2 = 3	
Overall Environmental Significance = 1.66 x 3 = 4.98	
Overall Environmental Significance:	
5 - 6.9	Medium - Low
Reversibility	
Reversibility degree to which the impact t can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	
Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw degree to which the impact is a fatal flaw	No – the impact does not result in a fatal flaw
Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	Medium

7.5.11.1.3 *Impact 3: The effects of impacts from construction on ecosystem services*

The impacts of the FPP construction on the ecosystem services are mainly dealt with in other reports. This report covers the impacts of the FPP construction on the marine provisioning services provided by Algoa Bay and the Port of Ngqura, i.e., fisheries and mariculture.

The construction phase of the proposed FPP project includes the construction and installation of a gas pipeline and the mooring of a Powership and an FSRU. A gas pipeline to supply fuel to the Powership from the FSRU will be installed between the vessels and will also run to the shore. No dredging will be required for the construction of the pipeline, but seabed levelling of high spots and placing of crushed stone in low spots may be required.

The mooring of the Powerships and FSIU will involve the construction of infrastructure and will include noise-producing activities such as vibropiling, drilling, and rock clearance. The noise levels produced by these activities are outlined in the previous section. Fish would need to stay within 50 m of these noise sources for 12 hours, continuously, to experience the onset of TTS, in which a temporary reduction in hearing sensitivity can be expected. Therefore, it is unlikely that any fish will experience harm from the noise from the construction activities, so impacts on fisheries from this source are considered to be unlikely.

However, fish and fish eggs and larvae will experience moderate to high levels of masking and behavioural effects within hundreds of metres of the construction noise sources, which could have negative consequences. Within the context of the Port of Ngqura and especially the pre-existing noise levels, these impacts will be relatively localised and are considered unlikely to have fisheries-level effects.

Although there are no TTS thresholds for invertebrates such as crustaceans, there is evidence that they are also sensitive to noise (Hudson et al. 2022, Jézéquel et al. 2021, Solan et al. 2016). However, they are considered to have a higher threshold than the one held for fish with a swim bladder involved in hearing, referred to above, and so are considered unlikely to experience direct harm from the noise from the construction activities. There is relatively low abundance of crustaceans at the project site, as the benthos is dominated by polychaetes. Thus, impacts of noise on invertebrates is expected to be relatively minor.

The pipeline will have a servitude of approximately 10 m, which will run along a 500 m length of pipeline on the seabed, resulting in a benthic habitat disturbance of approximately 5 200 m^2 (considering the preferred design option). The benthic habitat of the port area seabed covers about 78.5 ha, so this will result in the modification of approximately 0.6% of the benthic and intertidal community structure on site. This area of the port is already compromised due to the admin craft basin’s construction. The macrofauna reported at the project site is mainly comprised of small deposit-feeding polychaetes that tend to be opportunistic in nature and proliferate in disturbed environments, meaning that their post-disturbance recolonisation should be rapid. It is expected that the hard surfaces added by the pipeline will be colonised by sessile organisms, which will cause a minor increase in the benthic biodiversity in the project area, unless the hard surfaces are inundated by sediment. As such, the impact from the construction of the pipeline is considered to be minor.

Construction activities will temporarily disturb the sediment and increase the turbidity. However, this effect will be very localised and is expected to be within the normal level of turbidity experienced within the Port due to dredging and natural episodic high turbidity events, so should not have much effect on the biological communities.

There is no aquaculture active or planned for the Port of Ngqura, but an Aquaculture Development Zone in Algoa Bay is in the process of establishment. The nearest ADZ precinct, Algoa 7, is located approximately 2.5 km from the entrance to the Port of Ngqura and is approved for finfish farming. Considering the spatial extent of the construction impacts, which is in the order of hundreds of metres at a maximum, there will be no impacts from the construction of the FPP on the local aquaculture.

Due to the lack of research into the effects of construction noise on fish, and the uncertainty around the extent to which fisheries will be affected by the construction of the FPP, the severity of the impacts is considered as “Site-specific and wider natural processes and functions are slightly altered". The duration of these impacts will be as long as the planned construction of the project, which is 3 to 12 months. The noise produced by construction will raise the ambient underwater noise levels within hundreds of metres of the vessel. It is unclear as to how frequently the noise-producing construction activities will take place, but over the course of the duration it is assumed that they will occur once or more in a week. The probability of the impacts is considered to be possible. The scoring results in a "Medium - Low" Overall Environmental Significance, which will remain Medium-Low even with mitigation. The research gaps in the understanding of the effects of noise on the local fisheries means that the assessment is given a medium confidence.

Table 7-31: Impact 3 scoring table (pre-mitigation): Impacts of the construction phase on ecosystem services

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	2 - Site-specific and wider natural processes and functions are slightly altered
Duration a measure of the lifetime that the impact will be present	1 – up to 1 year
Spatial Scale the extent / size of the area that may be affected	2 – Within the broader Port
Overall Consequence = 5 / 3 = 1.66	
Likelihood	
Frequency how often the impact will occur	4 – Once or more a week
Probability the likelihood or the chances that the impact will occur	2 – >5 - 25% chance of occurring (possible)
Overall Likelihood = 6 / 2 = 3	
Overall Environmental Significance = 1.66 x 3 = 4.98	
Overall Environmental Significance:	
5 - 6.9	Medium - Low
Reversibility	
Reversibility degree to which the impact t can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	
Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw degree to which the impact is a fatal flaw	No – the impact does not result in a fatal flaw
Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	Medium

Mitigation measures

The mitigation measures for the effects of construction are provided in in the previous sections discussing the impacts of noise. These are mitigation measures for the marine ecology that underpin the ecosystem services. The mitigation measures reduce the likelihood of impacts occurring, but not sufficiently to change the score.

Table 7-32: Impact 3 scoring table (with mitigation): Impacts of the construction phase on ecosystem services

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	2 - Site-specific and wider natural processes and functions are slightly altered
Duration a measure of the lifetime that the impact will be present	1 – up to 1 year
Spatial Scale the extent / size of the area that may be affected	2 – Within the broader Port
Overall Consequence = 5 / 3 = 1.66	
Likelihood	
Frequency how often the impact will occur	4 – Once or more a week
Probability the likelihood or the chances that the impact will occur	2 – >5 - 25% chance of occurring (possible)
Overall Likelihood = 6 / 2 = 3	
Overall Environmental Significance = 1.66 x 3 = 4.98	
Overall Environmental Significance:	
5 - 6.9	Medium - Low
Reversibility	
Reversibility degree to which the impact t can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	
Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw degree to which the impact is a fatal flaw	No – the impact does not result in a fatal flaw
Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	Medium

*7.5.11.2 Impact assessment findings (with and without mitigation): **Operational Phase***

7.5.11.2.1 Impact 4: The effects of the intake of cooling water on marine organisms in the surrounding water body

The operation of the Powerships involves the continuous abstraction of seawater for cooling of the reciprocating engines, condensers and other auxiliaries. The cooling water would be discharged into the sea at a depth of 8 m, as recommended in the modelling report (PRDW 2022). The estimated total intake/outlet flow rate for both vessels (all generators combined) is 8.49 m^3/s. The temperature of the discharged seawater ranges from 10.0 to 15.0°C. No biocides or other additives will be used to control biofouling in seawater pumping and temperature exchange systems.

Seawater abstracted by the Powerships will entrain small marine organisms such as holoplankton, meroplankton and ichthyoplankton from the surrounding water body into the condenser cooling systems. This will be coupled with the impingement or trapping of larger organisms against the screens used to prevent debris from being drawn into the cooling water intake. As entrained organisms pass through the pumps, they are exposed to collective hydrostatic pressure, shear forces, accelerative forces from changes in velocity and direction, and mechanical buffeting and collision against the pump mechanisms' hard surfaces. These can cause physical damage to marine organisms, especially larger and more fragile species, resulting in death or incapacitation, the latter reducing their ability to escape predators post-discharge. Furthermore, the abstracted seawater receives excess heat and increases in temperature through the cooling process, inducing thermal stress on entrained organisms. Temperatures of the cooling water can be expected to increase by a maximum of 15°C (ΔT) whilst in the system. Rapid temperature increases above ambient conditions can affect marine organisms' survival, growth, metabolism, morphology, reproduction, and behaviour. No chemical stress on organisms is predicted as no biocides, chemicals, or brine will be discharged.

Algoa Bay is nutrient-limited, and thus phytoplankton biomass and production are generally low, with high variability driven by upwelling events. Chlorophyll-a concentrations (indicative of phytoplankton biomass) in the vicinity of the Port of Ngqura were low. However, the Coega River is considered an essential contributor of nutrients to the shallow subtidal zone. Elevated phytoplankton biomasses have been recorded adjacent to the river mouth (CSIR 2012), where the Powerships will be located for the proposed first alternative. There is a high spatial and temporal variability in zooplankton abundance and biomass in Algoa Bay and the Port of Ngqura. Previous studies have also indicated a high density of fish eggs within and surrounding the Port, although the numbers of fish larvae were low.

While the significance of both impingement and entrainment is related to the location of an intake, impingement is primarily a function of intake velocity, and entrainment depends largely on the overall volume of water drawn into plant. Impingement and entrainment can be mitigated through optimal designs to open water intakes. The horizontal extraction of water should aid in reducing fish entrainment as fish have been shown to avoid rapid changes in horizontal flow (Pankratz 2004).

The number of mobile organisms becoming entrained in the intake structure and the ability of larger organisms to escape impingement is dependent on the intake velocity. There is a broadly accepted rule that water extraction velocities should not exceed 0.15 m/s to minimize debris and marine life impingement (Fedorenko 1991). However, this mitigation measure is only effective for mobile organisms which can swim away and not planktonic organisms, which have little or no mobility and drift passively with currents, or organisms that are incapable of sustained mobility against water flow. However, phytoplankton biomass recovers quickly due to short generation times (~0.3/day), and populations are quickly replenished via tidal mixing processes from the wider port water body and the adjacent continental shelf. Additionally, it is reported by Poornima *et al*. 2005, amongst others, that the mortality rate from thermal and mechanical stress of plankton entrained is not 100%. Thus, survivors are returned to the host environment. Zooplankton carcasses are also returned where they may be consumed or decomposed so the biological material is not lost to the system. Accordingly, it is anticipated that the volumes of plankton entrained will not affect broader ecosystem functioning.

The seawater abstraction process also affects other, generally larger, marine organisms such as juvenile fish through impingement on the intake pipes' screens. Dicken (2011) demonstrated that the Port functions as an important nursery area for many fish species and is an important habitat and activity zone for juvenile and neonate dusky shark. Therefore, notable organisms that may be impinged in the Port of Ngqura include juvenile fish and shark species.

The impact's spatial scale will be site-specific with minor intensity as natural functions are hardly altered. The duration of the effect will be up to 20 years as the intake of cooling water and the consequent entrainment and impingement of organisms will last for the project's duration. The ecological effect, however, will be temporary as plankton biomass recovers quickly due to short generation times. However, the likelihood of impact occurring is probable, and this will be taking place on an hourly basis. Accordingly, the assigned overall environmental significance rating is Medium.

Table 7-33: Impact 4 scoring table (without mitigation): Cooling water intake

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	2 - Site-specific and wider natural processes and functions are slightly altered
Duration a measure of the lifetime that the impact will be present	3 – 2 to 20 years
Spatial Scale the extent / size of the area that may be affected	1 – Project footprint
Overall Consequence = 6 / 3 = 2	
Likelihood	
Frequency how often the impact will occur	5 – Daily or hourly
Probability the likelihood or the chances that the impact will occur	3 – >25% - 50% chance of occurring (probable)
Overall Likelihood = 8 / 2 = 4	
Overall Environmental Significance = 2 x 4 = 8	
Overall Environmental Significance:	
7 - 8.9	Medium
Reversibility	
Reversibility degree to which the impact can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	
Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw degree to which the impact is a fatal flaw	No – the impact does not result in a fatal flaw
Confidence (from Anchor methodology)	

Status of impact	– ve (cost)
Confidence of assessment	High

Mitigation measures

The intake of cooling water is an unavoidable impact of the operation of Powerships. However, intake velocities can be reduced through the use of footer values — these increase the area of intake, resulting in a decrease in intake velocity to safe levels. The following mitigation measures are proposed:

- Intake velocities should be kept as close to 0.15 m/s as possible to ensure that fish and other mobile organisms can escape the intake current. Intake velocities can be reduced through the use of footer values.
- Intake structures should not draw in water from the upper meter of the water column.
- Intake structures should ensure the horizontal intake of water.

Mitigation measures will reduce the severity of the impact, which changes the Overall Environmental Significance to "Medium-Low".

Table 7-34: Impact 4 scoring table (with mitigation): Cooling water intake

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	1 - Site-specific and wider natural functions and processes are not altered
Duration a measure of the lifetime that the impact will be present	3 – 2 to 20 years
Spatial Scale the extent / size of the area that may be affected	1 – Project footprint
Overall Consequence = 5 / 3 = 1.67	
Likelihood	
Frequency how often the impact will occur	5 – Daily or hourly
Probability the likelihood or the chances that the impact will occur	2 – >5 - 25% chance of occurring (possible)
Overall Likelihood = 7 / 2 = 3.5	
Overall Environmental Significance = 1.67 x 3.5 = 5.85	
Overall Environmental Significance:	
5 - 6–9	Medium - Low
Reversibility	
Reversibility degree to which the impact can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	
Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw degree to which the impact is a fatal flaw	No – the impact does not result in a fatal flaw

Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	High

7.5.11.2.2 Impact 5: The effects of the discharge of cooling water on the marine ecology in the receiving water body

The operation of the Powerships will involve the continuous discharge of cooling water into the sea at a depth of 8 m, as recommended in the modelling report (PRDW 2022). The seawater is discharged through multiple outlets on the vessel hull. The outlets have diverting elbows and pipes running down the vessel hull to discharge below the water surface. Total intake/outlet flow rates can range from 2.4 to 11.4 m^3/s (PRDW 2020a). Based on the modelled scenario detailed in PRDW (2022), in which the reciprocating engines, steam turbine generators and freshwater generators are in use with 100% loads (i.e., the worst-case scenario), the estimated total intake/outlet flow rate for both vessels (all generators combined) is 8.49 m3/s. The temperature of the discharged seawater ranges from 10.0 to 15.0°C. No biocides, brine or chemicals such as chlorine will be discharged with the cooling water

The discharge of warmed cooling water to the surrounding water body causes temperature changes, generating chronic level effects on biota. These include alterations in growth, metabolism, respiration patterns and reproduction, and/or influence ecosystem-level processes such as alterations of the amount of oxygen dissolved in seawater, which can be detrimental to marine life (Robinson 2013, Anchor 2015).

The sensitive receptors comprise the 'resident biota' including plankton communities, sandy shore communities, the invertebrate species on the port structures, benthic crustaceans, fish larvae, and juvenile fish and sharks in the water column (that are less able to move away from the discharged water). Bird species which feed on fish in the Port are also considered. The Port functions as an important nursery area for many fish species and is a critical habitat and activity zone for juvenile and neonate dusky shark (Dicken 2011). Larger animals that are more mobile are considered less sensitive to these water temperature changes, as they can move away from the thermal plume if they feel discomfort. However, they may still be affected by increased temperatures in the Port.

The biota in the Port of Ngqura experience water temperatures that are generally warm, ranging between 15.4 and 16.4°C in winter and 20.3 and 22.6°C in summer (CSIR 2018).

Allowed dimensions of initial mixing zones vary across jurisdictions and by sensitivity classification of the receiving water body. For example, the World Bank (1998) indicates 100 m in all directions from the discharge point (with $\Delta T = 3°C$). Local (Anchor 2015) advice is 100 m radius for enclosed water bodies and those classed as sensitive environments and 300 m radius in open coast settings where water depths exceed 10 m and the distance offshore is >500 m. Sheltered, nearshore and shallow water environments such as estuaries are considered to have a smaller capacity to assimilate effluent than offshore, deep water, and well-flushed environments (Anchor 2015). The Port of Ngqura is classified as an open coastal and deeper water regime in this assessment, and therefore a 300 m mixing zone is applicable (Anchor 2015).

A three-dimensional (3D) hydrodynamic modelling study was undertaken by PRDW (2022) to predict the extent of the thermal plume generated by the Powerships at the Port of Ngqura. This included environmental conditions such as currents and ambient water temperature for winter and summer. The 95th percentile ΔT over winter and summer combined, near the surface at the 'worst' (most affected) location along the 100 m and 300 m mixing zone boundaries was determined, with comparison to the ecological thresholds. The recommended site-specific threshold for the Powerships in Ngqura is ΔT = 1°C at 300 m from the discharge (Anchor 2015).

The 95th percentile ΔT exceeds the 1°C threshold on the 300 m mixing zone boundary by 0.2°C inside the admin craft basin in the north-east of the Port, shown as the red dotted line in Figure 4.3 (PRDW 2022). However, the guidelines were met outside the admin craft basin. The basin is a small, sheltered, and artificial environment separated from the main port, and this type of environment is not as well flushed as the main Port body.

Although the guideline is exceeded by 0.2°C, the absolute temperature of the plume did not exceed any of the biological thresholds and, where exceedance of the guideline was observed (within 300 m, at the admin craft basin), the area is a highly modified habitat. Since the admin craft basin is a small, artificial environment separated from the main port and the port entrance leading to Algoa Bay, PRDW (2022) suggested that a less stringent guideline may be applicable here.

As the largest temperature increases occur near the surface, benthic organisms are unlikely to be affected by the thermal plume. Furthermore, the macrofaunal density in the region of the proposed location of the Powerships is relatively low and has species reflecting its status as a disturbed habitat that is not particularly sensitive. Thus, any potential impacts to the marine biota in the immediate vicinity of the discharge are of relatively low concern.

Deleterious effects within the Zone of Initial Dilution (ZID) are expected, but these should be limited to non-acute levels. Therefore, the probability of damage to marine ecology if guidelines are met is extremely low outside of the ZID; but could be low within the ZID. Community structure may be changed, but ecological function should continue.

The bird species which feed in the Port are not dependent on the Port as a food supply, meaning that any impact of the discharge water on their prey is unlikely to impact them (Martin 2021). Furthermore, an example of a worst-case scenario occurred in 2014, when warm waters in Algoa Bay resulted in a 2-month long harmful algal bloom, which led to two large fish die-offs in the Port of Ngqura. The dead and dying fish were fed on by birds, resulting in the densest concentration of birds ever recorded in the Port. Afterwards, bird use of the port returned to normal levels, indicating the reversibility of warm water effects on avifauna (Martin 2021).

The impact's spatial scale will be within the broader Port and the severity will be “Site-specific and wider natural processes and functions are slightly altered”. The duration of the effect will be up to 20 years as the discharge of heated cooling water and the consequent effect on organisms in the receiving water body will last for the project’s duration. The ecological effect, however, will be more temporary. This is due to rapid rates of plankton regeneration (Sommer 2009), large sessile organisms, including mussels, being replaced over >6 months and large macrobenthos taking about 1 year to re-establish. Furthermore, the impact will be reversed once the project infrastructure is removed. The frequency of the impact is hourly, and the likelihood of impact is probable. Accordingly, the assigned overall environmental significance rating is Medium-High. No irreplaceable loss of marine fauna or flora is expected.

Table 7-35: Impact 5 scoring table (without mitigation): Cooling water discharge

Scoring of Impacts	
Consequence	
Severity	2 - Site-specific and wider natural processes and functions are slightly altered

the degree to which the project affects or changes the environment	
Duration a measure of the lifetime that the impact will be present	3 – 2 to 20 years
Spatial Scale the extent / size of the area that may be affected	2 – Within the broader Port
Overall Consequence = 7 / 3 = 2.33	
Likelihood	
Frequency how often the impact will occur	5 – Daily or hourly
Probability the likelihood or the chances that the impact will occur	3 – >25% - 50% chance of occurring (probable)
Overall Likelihood = 8 / 2 = 4	
Overall Environmental Significance = 2.33 x 4 = 9.32	
Overall Environmental Significance:	
9 - 1–.9	Medium - High
Reversibility	
Reversibility degree to which the impact can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	
Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw degree to which the impact is a fatal flaw	No – the impact does not result in a fatal flaw
Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	High

The results show that a smaller footprint of temperature increase (ΔT) is achieved when discharging at a deeper depth below the water surface. Discharging at a deeper depth allows the thermal plume to entrain colder sub-surface ambient water as it rises to the surface, reducing the temperature of the plume. The following mitigation measured are suggested:

- cooling water is discharged into the sea at a depth of 8 m, as recommended in the modelling report (PRDW 2022).
- To reduce the risk of recirculation of the discharge back to the intakes, it is recommended that the discharge pipeline running down the vessel hull has a second elbow to discharge horizontally away from the vessel, and that the discharge pipes be positioned as far from the intakes as possible

A water quality monitoring programme should be implemented to validate the predictions of the hydrodynamic modelling study and monitor constituents of the effluent. Adaptive management, informed by monitoring results must be implemented to ensure compliance with water quality guidelines. The mitigation measures reduce the probability of impacts occurring and therefore reduce the Overall Environmental Significance to “Medium”.

Table 7-36: Impact 5 scoring table (with mitigation): Cooling water discharge

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	2 - Site-specific and wider natural processes and functions are slightly altered
Duration a measure of the lifetime that the impact will be present	3 – 2 to 20 years
Spatial Scale the extent / size of the area that may be affected	2 – Within the broader Port
Overall Consequence = 7 / 3 = 2.33	
Likelihood	
Frequency how often the impact will occur	5 – Daily or hourly
Probability the likelihood or the chances that the impact will occur	2 – >5 - 25% chance of occurring (possible)
Overall Likelihood = 7 / 2 = 3.5	
Overall Environmental Significance = 2.33 x 3.5 = 8.16	
Overall Environmental Significance:	
7 - 8.9	Medium
Reversibility	
Reversibility degree to which the impact can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	
Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw degree to which the impact is a fatal flaw	No – the impact does not result in a fatal flaw
Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	High

7.5.11.2.3 *Impact 6: The effects of increased noise and vibration levels on the marine ecology*

The noise generated by the FPP operations is expected to be semi-continuous, up to 16.5 hours a day. In order to identify any significant risks from underwater noise that could arise due to this project, a study was undertaken to model the underwater noise from the proposed FPP operations in Ngqura. A baseline noise survey was conducted in the Port of Ngqura, identifying the noise levels to which the receiving environment is already exposed (Subacoustech Environmental Report No. P292R0901, 2022). Additionally, a survey was carried out in Ghana at the location of a large Khan class Powership that has similar specifications (a sister ship) to that of the Khan class Powership planned for the Port of Ngqura, in order to sample the noise levels produced by such a ship at various power outputs and distances. The data from the Ghanaian survey was applied to the baseline data via standard methodology to predictively model the noise levels that would be present in Ngqura if all the proposed ships were installed and operating at maximum capacity.

Three vessels are proposed for installation in Ngqura Port, on the east side of the harbour, with another vessel intermittently visiting. The vessels are as follows:
Two Powerships,

- one 21 engine Khan class Powership (installed capacity 415.6 MW)
- one 6 engine Shark class Powership (installed capacity 125.4 MW)

Two auxiliary vessels:

- One floating storage regasification unit (FSRU) and
- one Liquefied Natural Gas Carrier (LNGC) ship that will dock next to the FSRU and will be present intermittently.

The Powerships are predicted to have an average load of 327 MW, which cannot exceed 450 MW at any point. The two auxiliary vessels are mainly storage vessels and have very little machinery active when they are in port, especially in comparison to a Powership. When the FSRU is engaged in the periodic regasification operations, its total load will be lower than 4 MW.

For the purposes of predicting the impact of the proposed Powerships in Ngqura on underwater noise, the noise levels measured in Ghana were combined with the noise levels from the smaller Shark class Powership and then overlaid with the baseline noise measured in Ngqura.

The results of the underwater noise assessment of the Ngqura Port show that after the installation of two Powerships and an FSRU, with the Powerships operating at a maximum output in excess of that proposed for the port, an increase in background noise of approximately 8.5 dB in close proximity to the Powerships would be observed. This is equivalent to a noise level of 134.5 dB SPLRMS re 1. In the middle of the harbour, the background noise could increase by approximately 3 dB, equivalent to a noise level of 130.4 dB SPLRMS re 1 µPa. With the Powerships operating at full power, the noise at the entrance of the harbour is predicted to be 2 dB above the baseline.

Outside the harbour, on the shielded side of the breakwater, the noise effect from the FPP will be negligible. This is based on measurements taken in Ghana, in which the sound from the Powerships was inaudible directly adjacent to the other side of the jetty. In Ghana the measured position was 100 m to 200 m from the Powership, while in Coega there is the additional benefit that the point outside the harbour adjacent to Jahleel Island is 1km from the Powerships and 600 m from the FSRU. As a result, there is no impact predicted on the marine life associated with Jahleel Island, including the penguins.

The baseline noise survey of Ngqura also measured the noise produced by other ships in the vicinity. Large cargo vessels were transiting Port at the time and the noise produced by them can provide context for the noise levels produced by the Powerships. For example, a bulk carrier typical of the type accessed in the harbour produced noise levels of 146.2 dB SPLRMS re 1 µPa at 75 m from its side as it passed. Based on the measurements of the noise produced by other large vessels in Ngqura, it is evident that the noise levels resulting from the introduction of the Powerships will be exceeded by a transiting container or bulk carrier vessel moving into or out of the port, since noise levels from those existing operations were measured to be higher at equivalent distances. In cases where the Powership is operating at a low power, which was found to be typical during the survey of the operational Powership in Ghana, the effect on baseline noise levels will be negligible.

Depending on their distance from the Powerships, the biota in the Port of Ngqura could be impacted the underwater noise from the vessel operations. Exposure to noise for a long period of time, such as is expected of the Powership operations, may cause chronic effects, including developmental deficiencies and physiological stress (Popper and Hawkins 2016). These may affect life functions, including individual health and fitness, foraging efficiency, avoidance of predation, swimming energetics and reproductive behaviour (Popper and Hawkins 2016). However, as stated above, these responses to sound are dependent on the sound qualities.

The most noise-sensitive groups in Ngqura are expected to be mammals and fish. The Port of Ngqura functions as an essential nursery area for many fish species and is an important habitat and activity zone for juvenile and neonate dusky shark (Dicken 2011). Juveniles are considered more susceptible to noise disturbances as they are less mobile, while adult fish (and marine mammals) can move out of affected areas. It is often assumed that animals will avoid disturbing noise. However, territoriality or a response of immobility may mean that the animal does not move away from the noise source (de Soto 2016). Other important marine receptors in the area are the various seabird species, including penguins, gannets and cormorants. Marine invertebrates may also be impacted by underwater noise; however, evidence is limited (de Soto 2016).

As the density of fish within the intermediate field of the proposed Powership location is unknown, the extent to which fish will be affected in this vicinity is unclear. If the location of the Powerships and FSRU is regularly inhabited by sound-sensitive species such as dusky kob and silver kob, and the noise level interferes with their communication such that they avoid utilising the Port, it is possible that the fisheries may experience shifts in the physical distribution of populations of their target species. However, overall catches will not necessarily be affected. It should be noted that the noise from the Powerships is of a similar level to that of existing ships using the port, and the FSRU much lower, so will not change the existing soundscape of the bay to any meaningful extent. Therefore, it is unlikely that the distribution of fish will be affected.

This assessment has focused on noise in the water, although seabed vibration can have an impact on benthic species. The ship's hull will vibrate, which transmits noise into the surrounding water. This noise will reach the seabed, affecting species here. Benthic (non-marine mammal) species have a relatively low sensitivity to noise as they do not have a swim bladder, the presence of which leads to a higher sensitivity, as stated by Popper et al. 2014. However, there is very little research available on the effects of vibration on benthic species (Roberts & Howard 2022). There is a Moderate risk of TTS close to the ship, and a Low risk of any greater impacts. The evidence of measurements from the operational Powership shows that the noise emitted from the Powerships, and therefore by extension the vibration in surrounding surfaces, will be of the same order of magnitude as other vessels characteristic of those already accessing and mooring at the port.

There is limited information on the effects of anthropogenic underwater noise on invertebrates such as crustaceans (de Soto 2016). However, there is evidence that anthropogenic noise can cause marine invertebrates to experience masking of important biological sound cues, as well as sub-lethal physiological stress in response to high levels of sound such as that from vessel traffic or construction noise (Hudson et al. 2022, Jézéquel et al. 2021, Solan et al. 2016). Exposure to underwater broadband sound fields at 135–140 dB re 1 μPa can reduce sediment-dwelling invertebrates' (in this case, the decapod *Nephrops norvegicus*, and clam *Ruditapes philippinarum*) ability to undertake ecologically-important benthic nutrient cycling processes (Solan et al. 2016). These sound levels are produced within 100 m of the Powerships when operating at full power. Crustaceans have been shown to experience short- to medium-term stress or tissue repair effects in response to exposure to ship noise but may become adapted to such noise (Hudson et al. 2022, Wale, Simpson & Radford 2013). European lobster (*Homarus gammarus*) were found to significantly increase their call rates in the presence of shipping noise of around 118.4 ± 7.7 SPLRMS dB re 1 μPa, suggesting the need to vocally compensate for the reduction in intraspecific communication ability due to noise (Jézéquel et al. 2021). This is within the range of noise already experienced in Ngqura but suggests that crustaceans near to the Powerships may experience noise interference with ecologically important sounds.

As African penguins *Spheniscus demersus* are flightless, they are less able to quickly escape underwater noise and pollution (Martin 2021). This species is listed as Endangered both globally and regionally (IUCN 2022). Globally, the African penguin population has declined more than 65% since 1989 to 17 700 breeding pairs counted in 2019. The breeding population on St Croix Island has collapsed from hosting the largest breeding population of African penguins in the world, at 5 663 pairs in 2018, to just 560 pairs in 2021. At 530 m from the Eastern Breakwater, Jahleel Island has the closest breeding population of African penguins to the FPP operations, with 232 breeding pairs (Martin 2021). Considering their greatly reduced population status, any impact on the local populations should be avoided.

The noise from the Powership operations is not anticipated to leave the Port, and penguins are not seen foraging in the Port (Martin 2021). Therefore, underwater noise produced by the Powership operations is unlikely to impact African penguins.

The Port of Ngqura is anticipated to receive 901 vessel visits in 2022 (PRDW 2020b, in Martin 2021). A Liquefied Natural Gas Carrier (LNGC) will supply the Liquefied Natural Gas (LNG) to the FSRU over a one-to-two-day period, approximately every 20 to 30 days, or potentially less frequently. This resupply will increase vessel traffic. Assuming vessels resupply every 25 days this will increase the number of ships entering the port by approximately 15 per annum, 1.67% of current vessel traffic (not considering continued presence of the Powership and FSRU). In the context of all the traffic in Algoa Bay, which includes vessel traffic to the Port of Gqeberha, the additional traffic of the LNGC is relatively small. As such, the contribution of the LNGC traffic to the cumulative vessel noise in Algoa Bay and potential associated effect on the African penguins is considered to be negligible.

The noise produced by the FPP operations is not anticipated to contribute meaningfully to the existing noise levels in the Port of Ngqura. Furthermore, when considering an "above worst-case" scenario, the Powerships do not produce noise to the extent that will cause direct harm to marine organisms, based on current understanding and available research. Marine organisms within hundreds of metres of the ship will experience noise levels higher than the general background noise of the Port, and these will be similar to those noise levels experienced within similar distances to the typical large vessels that transit the Port, however, noise associated with the Powerships will be continuous (16.5 hours a day). It is possible that marine organisms within hundreds of metres of the Powerships will experience noise levels that interfere with ecologically relevant sounds, which could have negative impacts over time. Sound-sensitive marine organisms would need to stay within a few hundred metres of the Powerships for 24 hours in order to experience the onset of TTS (where a temporary reduction in hearing sensitivity may occur). Considering these factors, the severity of the noise produced by the FPP is considered to be "Site-specific and wider natural processes and/or functions continue albeit in a modified way (general integrity maintained)". The duration of the effect will be beyond from 2 to 20 years as noise will be produced by the vessel for the duration of its operation. Noise produced by the FPP will increase the ambient underwater noise levels within hundreds of metres of the source, so it will impact a greater area than the immediate site. The Powerships are expected to run hourly, for up to 16.5 hours a day, making the frequency of the impact hourly. The likelihood of there being an impact of FPP-induced noise on the marine ecology is considered "Possible". No irreplaceable loss of marine fauna or flora is expected. The impact of noise will stop when the project is finished. Accordingly, the assigned overall environmental significance rating is "Medium-High" without mitigation and with mitigation is reduced to "Medium". As there is limited research into the impacts of continuous low-level noise on marine organisms, the confidence of this assessment is "medium".

Table 7-37: Impact 6 scoring table: Impacts of increased noise on the marine ecology

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	3 - Site-specific and wider natural processes and/or functions continue albeit in a modified way (general integrity maintained)
Duration a measure of the lifetime that the impact will be present	3 – 2 to 20 years
Spatial Scale the extent / size of the area that may be affected	2 – Within the broader Port
Overall Consequence = 8 / 3 = 2.66	
Likelihood	
Frequency how often the impact will occur	5 – Daily or hourly
Probability the likelihood or the chances that the impact will occur	2 – >5 - 25% chance of occurring (possible)
Overall Likelihood = 7 / 2 = 3.5	
Overall Environmental Significance = 2.66 x 3.5 = 9.31	
Overall Environmental Significance:	
9 - 1–.9	Medium - High
Reversibility	
Reversibility degree to which the impact t can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	
Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw degree to which the impact is a fatal flaw	No – the impact does not result in a fatal flaw
Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	Medium

Mitigation measures

Mitigation measures should ensure that the worst-case scenario assumptions made in this assessment are not met, so that noise levels created by the FPP are lower than what is predicted. This will help to avoid disturbances and potential harm to marine organisms. For example:

- The Powerships should not be operational for 24 hours a day, to reduce chronic exposure of noise to marine organisms. It is expected that the Powerships will operate for 16.5 hours a day.
- Maximum power output from the Powerships should be avoided. Noise levels produced by the Powerships are proportional to the amount of power output, so lower noise levels will be achieved with lower power capacity.
- In the case that a marine mammal, especially a baleen whale, is in the near vicinity i.e., within hundreds of metres of the FPP, the Powerships should not operate at maximum power output, to reduce the noise level produced and thus the chances of disturbing the animal.
- When moving in and out of the port, the LNGC should not move at maximum speed, so as to reduce the amount of noise produced by its engines.

A baseline study of the ecology in the immediate vicinity of the FPP should be undertaken following a before-after-control-impact (BACI) approach. This should include an assessment of the local macrofauna and video surveys and fish sampling to understand the fish community in the region associated with the Powerships. An assessment of the distribution and behaviour of diving seabirds in the context of the Powerships should also be undertaken. These surveys should be ongoing and following a sampling methodology that is robust when assessing the impacts of the noise produced by the Powerships on the distributions of benthic macrofauna, fish, seabirds, and marine mammals. If an effect if observed, adaptive management informed by monitoring results must be implemented. The results of such monitoring will be valuable in informing other developments and contributing to the international understanding of the effects of noise from large vessels on marine biota.

The implementation of the mitigation methods should reduce the severity of the impact, such that the Overall Environmental Significance is reduced to a "Medium".

Table 7-38: Impact 6 scoring table (with mitigation): Impacts of increased noise on the marine ecology

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	2 - Site-specific and wider natural processes and functions are slightly altered
Duration a measure of the lifetime that the impact will be present	3 – 2 to 20 years
Spatial Scale the extent / size of the area that may be affected	2 – Within the broader Port
Overall Consequence = 7 / 3 = 2.33	
Likelihood	
Frequency how often the impact will occur	5 – Daily or hourly
Probability the likelihood or the chances that the impact will occur	2 – >5 - 25% chance of occurring (possible)
Overall Likelihood = 7 / 2 = 3.5	
Overall Environmental Significance = 2.33 x 3.5 = 8.16	
Overall Environmental Significance:	
7 - 8.9	Medium

Reversibility	
Reversibility degree to which the impact t can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	
Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw degree to which the impact is a fatal flaw	No – the impact does not result in a fatal flaw
Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	Medium

7.5.11.2.4 *Impact 7: The effects of impacts on ecosystem services*

The range of ecosystem services that Algoa Bay provides are listed in Section 2.1. The effects of the impacts of the FPP on these ecosystem services are mainly dealt with in other reports. This report covers the impacts of the FPP on the marine provisioning services provided by Algoa Bay and the Port of Ngqura, i.e., fisheries and mariculture. The operational-phase impacts assessed here are the effects of the intake of cooling water, the discharge of cooling water, and increased noise produced as a result of the FPP, on fisheries and mariculture.

As the Port of Ngqura Port already has relatively high levels of background noise due to the operation of the Port and the transit of large vessels, the contribution of the FPP to the noise levels is predicted to be minor and only of any potential consequence in within hundreds of metres of the Powerships. No fisheries take place directly in the Port of Ngqura. As the noise produced by the FPP will have attenuated to levels undetectable above background noise, fisheries outside of the Port will not be directly affected by the noise produced by the FPP.

As there is little to no overlap between the recreational and commercial fisheries with the areas impacted by the production of noise and intake and discharge of cooling water, no direct impacts from the FPP on fisheries are anticipated.

Any reduction of the nursery function of the Port of Ngqura may cause fisheries of species which use the Port as a nursery to be impacted. Previously, the Coega Estuary served as essential nursery habitat for fish. However, the function of Coega Estuary has collapsed, and the Estuary is listed as critically modified i.e., it has been modified completely with an almost complete loss of natural habitat and biota.

Given the critically modified state of the Coega Estuary, it is likely that the populations of local estuarine-dependent species have already been affected by the loss of estuary function. However, maintaining the biological potential of the Port as a nursery habitat could be important for fisheries species such as the dusky kob. Dusky kob are also an example of the most noise-sensitive group of fish (those with a swim bladder involved in hearing) according to Popper et al. (2014). This group of fish must be exposed to 158 dB SPLRMS from a continuous noise source, such as shipping, for 12 hours to experience the onset of a temporary threshold shift (TTS) in which an individual experiences a temporary reduction in hearing sensitivity (Southall et al. 2019). The noise measured at any distance from the Ghanaian Powership was consistently 10 dB below this value, or greater (Figure 4.5), and the calculated noise levels in the Port of Ngqura did not meet this threshold. Therefore, no TTS risk to fish is anticipated as the result of the proposed Powerships in the Port of Ngqura. The grunters Pomadasys commersonnii small-spotted grunter and P. olivaceus olive grunter are also fish to which acoustics are important. These species may have similar responses to noise as the dusky kob. Small-spotted grunter is commonly targeted by anglers (Beckley et al. 2008).

Marine invertebrates may also be impacted by underwater noise (de Soto 2016, Hudson et al. 2022, Jézéquel et al. 2021, Solan et al. 2016), or the intake and/or discharge of cooling water. If the invertebrate prey of fish are impacted, this could have knock-on effects to the fisheries. However, as the impacts of noise and the cooling water system are expected to be relatively localised, and there is relatively low abundance and diversity of benthic macrofauna in the vicinity of the Powerships, it is unlikely that any impacts on invertebrates will have consequences felt at the fisheries-level.

Due to the lack of research into the effects of the type of noise produced by the FPP on fish, and the uncertainty around the extent to which fisheries will be affected by the operation of the FPP, the probability of the impacts is considered possible. The severity is considered as "Site-specific and wider natural processes and functions are slightly altered". The duration of these impacts will be as long as the planned operation of the project, which is 20 years. The noise produced by the FPP will raise the ambient underwater noise levels outside of the immediate footprint of the FPP, within hundreds of metres. The frequency of the impacts will be hourly. The scoring results in a "Medium" Overall Environmental Significance. The research gaps in the understanding of the effects of noise on the local fisheries means that the assessment is given a medium confidence.

Table 7-39: Impact 7 scoring table (pre-mitigation): Impacts of the operational phase on ecosystem services

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	2 - Site-specific and wider natural processes and functions are slightly altered
Duration a measure of the lifetime that the impact will be present	3 – 2 to 20 years
Spatial Scale the extent / size of the area that may be affected	2 – Within the broader Port
Overall Consequence = 7 / 3 = 2.66	
Likelihood	
Frequency how often the impact will occur	5 – Daily or hourly
Probability the likelihood or the chances that the impact will occur	2 – >5 - 25% chance of occurring (possible)
Overall Likelihood = 7 / 3 = 3.5	
Overall Environmental Significance = 2.66 x 3.5 = 8.15	
Overall Environmental Significance:	
7 - 8.9	Medium
Reversibility	
Reversibility degree to which the impact can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	

Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw degree to which the impact is a fatal flaw	No – the impact does not result in a fatal flaw
Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	Medium

Mitigation measures

The mitigation measures for the intake and discharge of cooling water and for the additional noise produced by the FPP are provided in previous sections. These are mitigation measures for the marine ecology that underpin the ecosystem services. The mitigation measures reduce the probability of an impact occurring, but not enough to affect the score.

Table 7-40: Impact 7 scoring table (with mitigation): Impacts of the operational phase on ecosystem services

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	2 - Site-specific and wider natural processes and functions are slightly altered
Duration a measure of the lifetime that the impact will be present	3 – 2 to 20 years
Spatial Scale the extent / size of the area that may be affected	2 – Within the broader Port
Overall Consequence = 7 / 3 = 2.66	
Likelihood	
Frequency how often the impact will occur	5 – Daily or hourly
Probability the likelihood or the chances that the impact will occur	2 – >5 - 25% chance of occurring (possible)
Overall Likelihood = 7 / 3 = 3.5	
Overall Environmental Significance = 2.66 x 3.5 = 8.15	
Overall Environmental Significance:	
7 - 8.9	Medium
Reversibility	
Reversibility degree to which the impact can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	
Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw	No – the impact does not result in a fatal flaw

degree to which the impact is a fatal flaw	
Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	Medium

7.5.11.2.5 Impacts of catastrophic accidents on marine ecology and ecosystem services

The introduction of the Powership and FSRU vessels increase the risk of the likelihood of catastrophic accidents occurring. Here, we considering the following to be a catastrophic accident:

- Large hydrocarbon spills
- Explosion/flash fires.
- Major vessel collision/sinking.
- Unintentional removal of vessel from moorings.
- Introduction of toxins, biocides or alien species considered extremely harmful to marine ecology.

All these catastrophic events have protocols in place to avoid incidents, therefore the probability and overall significance score for catastrophic accidents in Low. These catastrophic accidents have been assessed together with the consideration of impacts on marine ecology and the provision of ecosystem services.

Table 7-41: Catastrophic accident impact scoring table

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	5 - Site-specific and wider natural functions and/or processes are completely altered/cease
Duration a measure of the lifetime that the impact will be present	4 – Beyond 20 years
Spatial Scale the extent / size of the area that may be affected	3 – Beyond the Port
Overall Consequence = 12 / 3 = 4	
Likelihood	
Frequency how often the impact will occur	1 – Once a year or once or more during operation or once off
Probability the likelihood or the chances that the impact will occur	1 – < 5% chance of occurring (improbable)
Overall Likelihood = 2 / 2 = 1	
Overall Environmental Significance = 4 x 1 = 4	
Overall Environmental Significance:	
3 - 4.9	Low
Reversibility	
Reversibility degree to which the impact t can be reversed	Irreversible – the impact is not reversible

Irreplaceable Loss of Resources	
Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	Yes – the impact causes a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw degree to which the impact is a fatal flaw	No – the impact does not result in a fatal flaw
Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	High

7.5.11.3 Cumulative Impacts

Anthropogenic activities can result in numerous and complex effects on the natural environment. While many of these are direct and immediate, the environmental effects of individual activities or projects can interact with each other in time and space to cause incremental or aggregate effects. Impacts from unrelated activities may accumulate or interact to cause additional effects that may not be apparent when assessing the activities individually. Cumulative effects are defined as the total impact that a series of developments, either present, past, or future, will have on the environment within a specific region over a particular period of time (DEAT IEM Guideline 7, Cumulative effects assessment 2004).

By definition, cumulative marine environmental impacts emanating from the proposed FPP are related to the overlap with various other sources of anthropogenic disturbance in the vicinity of the Powership sand FRSU. This "zone of impact" where cumulative impacts may be of concern has been defined by the FPP operational thermal and noise modelling results. Under the worst-case scenario, the thermal zone of impact extends 100 m from the Powerships location, and the underwater noise zone of impact extends further into the Port. Cumulative thermal and underwater noise impacts are only of concern within this area, however, additional cumulative impacts that could occur outside of this area are detailed below. The high impact areas for both thermal and underwater noise operational impacts do not currently overlap with other developments with expected similar impacts (i.e., discharge of cooling water, underwater noise generation (not including other vessels in the Port)). A detailed assessment of the cumulative impacts is provided in the table below.

Table 7-42: Cumulative impact scoring table.

Scoring of Impacts	
Consequence	
Severity the degree to which the project affects or changes the environment	3 - Site-specific and wider natural processes and/or functions continue albeit in a modified way (general integrity maintained)
Duration a measure of the lifetime that the impact will be present	3 – 2 to 20 years
Spatial Scale the extent / size of the area that may be affected	2 – Within the broader Port
Overall Consequence = 8 / 3 = 2.66	
Likelihood	
Frequency	5 – Daily or hourly

how often the impact will occur	
Probability the likelihood or the chances that the impact will occur	3 – >25% - 50% chance of occurring (probable)
Overall Likelihood = 8 / 2 = 4	
Overall Environmental Significance = 2.66 x 4 = 10.64	
Overall Environmental Significance:	
9 - 10.9	Medium–- High
Reversibility	
Reversibility degree to which the impact can be reversed	Reversible – the impact is reversible
Irreplaceable Loss of Resources	
Irreplaceable Loss of Resources degree to which the loss of resources can be replaced	No – the impact does not cause a loss of resources that cannot be replaced
Fatal Flaw	
Fatal Flaw degree to which the impact is a fatal flaw	No – the impact does not result in a fatal flaw
Confidence (from Anchor methodology)	
Status of impact	– ve (cost)
Confidence of assessment	High

There are several gas to power projects proposed within the Port of Ngqura and in the Coega Special Economic Zone. This includes the development of three onshore gas to power plants each with up to 1 000 MW generation capacity (Zone 10 (north), Zone 10 (south) and Zone 13) and associated gas infrastructure proposed by the Coega Development Corporation (CDC) (SRK 2021a). An application for the development of an onshore gas to power plant and associated infrastructure proposed by Engie Southern Africa (Pty) Ltd (SRK 2021b) was refused and has not been reapplied for. Furthermore, the CDC has proposed the construction of an integrated common user marine pipeline servitude project at the Port of Ngqura (Wright *et al* 2021). This project is designed to allow current and future investors to establish infrastructure for the abstraction of seawater and the discharge of effluent as required by industrial or factory processes. These projects, in combination with the proposed Karpowership floating power generating facility, may result in cumulative impacts on the surrounding marine ecology which need to be considered. These projects are, however, all in the initial planning and assessment phase. The comprehensive, quantitative assessment of cumulative impacts requires extensive input from government departments, regulating authorities and other stakeholders.

Any disturbance of sediments in the Port of Ngqura as a result of development or maintenance activities will have cumulative impacts on the benthic communities associated with those sediments. Furthermore, any developments that require the installation of hard structures will have a cumulative impact on the availability of hard substrata for colonisation by marine organisms. These impacts will occur at a local scale and are unlikely to affect benthic community functioning outside of this. Over the lifetime of the Port, cumulative disturbance of benthic communities would result in an impact of increased significance at the local scale.

With the development of multiple gas to power projects within and near the Port, large volumes of seawater will be required for cooling. Any impingement and entrainment effects will therefore be cumulative and may extend over the long-term or be permanent, depending on the project lifespans. These cumulative effects of impingement and entrainment would increase the significance of the impact on marine organisms in the receiving port water body.

The cumulative impact of the thermal effluents from the proposed Karpowership Powerships, the proposed CDC FSRUs and onshore facilities need to be considered. It is understood that the proposed CDC outfall occurs to the east of the breakwater, outside of the Port and that water quality guideline targets with respect to temperature will be met within 300 m of the discharge. There will therefore be no overlap of the thermal discharges from the Powerships with the thermal discharges from the CDC outfall.

The marine space in the Port of Ngqura is already limited in terms of space. Although the Port of Ngqura is an artificial environment, it offers a variety of habitats to marine organisms and its biological potential as a nursery habitat is worth consideration (Dicken 2010). The addition to the proposed Powerships, development further reduces the space available to marine organisms that use the environment of the Port of Ngqura. Considering this it is reasonable to assume that a threshold will exist where an exceedance of which (in terms of disturbance space) will have substantial negative effects on the marine environment as a whole. Marine organisms will be displaced to elsewhere in the Port until a lack of available habitat causes significant spatial changes to their distribution i.e., vacation of the Port entirely.

The cumulative impact of increased anthropogenic noise levels in oceans has been recognised as an ongoing and widespread issue of concern (Koper and Plon 2012). The operation of the Powerships will contribute to the cumulative noise within the Port of Ngqura, but as the Port already experiences similar levels of noise from other Port activities and the transit of large vessels, the overall soundscape is not significantly affected.

The Port of Ngqura is anticipated to receive 901 vessel visits in 2022 (PRDW 2020b, in Martin 2021). A Liquefied Natural Gas Carrier will supply the Liquefied Natural Gas (LNG) to the FSRU over a one-to-two-day period, approximately every 20-30 days or potentially less frequently. This resupply will increase vessel traffic. Assuming the FPP vessels resupply every 25 days this will increase the number of ships entering the port by approximately 15 per annum, 1.67% of current vessel traffic (not considering continued presence of the Powership and FSRU). In the context of all the traffic in Algoa Bay, which includes vessel traffic to the Port of Gqeberha, the additional traffic of the LNGC is relatively small.

7.5.11.4 Specialist Conclusion

Overall, given that impacts on marine biodiversity and associated ecosystem services are mostly very localised and are all reversible, we are of the opinion that the project can proceed from a marine ecology perspective.

7.5.12 Coastal and Estuary Impacts

In general, the level of ecosystem services provided by the Coega Estuary is low (Table 7-43) on a scale of high, medium or low. This is directly related to the history of human modifications of estuarine and coastal habitats, and the concomitant loss of ecological infrastructure. However, despite extreme modification, the system provides an important supporting service as a regionally important breeding and feeding habitat for a number of specialised and threatened bird species by virtue of the salt pans, as well as numerous other waterbird species (CES, 2001; CSIR, 2015a). From an economic perspective, the production of salt was once a key activity within the Coega Estuary. This service has since dwindled, with the relocation of the operator. The beach environment is reportedly used to a limited extent for recreational angling. This activity may be restricted in future due to port development and operations.

Table 7-43. Ecosystem goods and services provided by the Coega Estuary

ECOSYSTEM SERVICES		DESCRIPTION	RATING
Provisioning services (goods)	Water	Provision of water for subsistence and agricultural use (only applicable in fresher upper reaches)	Low
	Food, medicines	Production of fish and food plants; medicinal plants	Low
	Raw materials	Production of craftwork materials, construction materials, fodder and biofuel (especially important in rural and arid areas)	Medium
Regulating services	Climate regulation	Carbon sequestration, oxygen and ozone production, urban heat amelioration	Low
	Disturbance regulation	Flood control, drought recovery, refuges from pollution events	Low
	Water regulation	Provision of dry season flows for agricultural, industrial and household use (only applicable in fresher upper reaches)	Low
	Erosion control and sediment retention	Prevention of soil loss by vegetation cover and capture of soil, *e.g.* reeds and sedges preventing bank erosion	Low
	Ecological regulation	Regulation of malaria, bilharzia, liver fluke, black fly, invasive plants as salinity assist with pest control.	Low

The current pressures on the Coega Estuary are a product of the long history of human interference, modification and destruction, resource exploitation, and port development coupled with ongoing modern-day impacts associated with activities at the port and the IDZ. The overall cumulative pressure on the system is considered to be Very High (van Niekerk et al., 2019a). Table 7-44 provides a list of current pressures on the estuary and the level of intensity rated from very high to low (van Niekerk et al., 2019a). Collectively, these pressures have resulted in:

- Severe modification of important estuarine processes;
- Reduction of biomass, loss of species or changes in community composition;
- Reduction/loss of nursery function;
- Loss/modification of habitat; and
- Modification of aesthetic values.

Table 7-44. Pressures and level of intensity on the Coega Estuary (Van Niekerk *et al*., 2019)

PRESSURE	COMMENTS	2018 NBA Rating
1. Flow modification *(freshwater additions and diversions)*	• Canalisation of parts of the river channel • Creation of saltpans and diversion of the river channel resulting in significant changes in the hydrodynamics and functioning of the estuary	HIGH
2. Pollution	• The system likely receives limited contaminated stormwater run-off	LOW

PRESSURE	COMMENTS	2018 NBA Rating
	containing urban contaminants (heavy metals, fuels, oils and greases) as well as plastic pollution	
3. Habitat loss	• The majority of the habitat within the EFZ has been lost due to the development of the commercial saltworks • Roads traverse both the upper and lower reaches • Canalisation of parts of the river channel • Diversion of the river channel resulting in significant changes in the hydrodynamics of the estuary • The mouth of the estuary has been critically modified by the construction of the port	VERY HIGH
4. Overexploitation	• Fishing effort in the system is regarded as low. Bait collection has been recorded.	LOW
5. Invasive alien species	• The threat from invasive alien fish species is considered high, with three extralimital fish species recorded in the system.	HIGH
6. Sea-level rise (SLR)	• With a built-up port environment occupying the mouth of the estuary, the system is less vulnerable to SLR. The estuary is also protected from storm/tidal surges by the harbour breakwater	LOW

Although estuarine ecosystems are considered key environmental assets, they are one of the most threatened ecosystems in the country and often heavily impacted by often unsuitable activities. Within the Port of Ngqura, the proposed Gas to Power project will be located predominantly within the deeper waters of the port, but in close proximity to the mouth of the estuary. While the estuary, and the saltworks therein, are earmarked for future port expansion, with major earthworks currently taking place near to the estuary, it is important that potential environmental impacts be assessed in order to minimise further environmental degradation and to formulate and implement appropriate mitigation measures, as part of environmental best practice until the long-term plans are realised. With proactive management, the impacts can be greatly reduced in terms of the extent, duration and overall significance. In following sub-section, the potential impacts of the proposed project on the estuary are assessed and mitigation measures to minimise the potential negative impacts are provided. The duration of construction/assembly of the respective infrastructure components is estimated at more than one year (<5 years) for the pylons and less than one year for the pipeline, whilst the life span of the project is expected to be 20 years (or less should the need no longer exist).

The potential impacts of the proposed project on the larger coastal zone are also assessed and mitigation measures to minimise potential negative impacts are proposed. It is reiterated that integrated coastal and estuarine management is a cross-cutting speciality and many of the key issues and their potential impacts have been collectively identified and addressed in the other specialist assessments. For example, matters relating to 'sense of place' and potential obstruction of views are considered in the landscape and visual impact assessment report (Environmental Planning & Design, 2022).

A comment noted during the initial assessment process was the lack of socio-economic impacts related to many aspects. Taking cognisance of the ICM Act requirements, socio-economic aspects are an important part of any coastal specific assessment, however, these aspects were best considered in the socio-economic assessment. Holistic issues included (Environmental Planning & Design, 2022):

- The cost of continued loss of biodiversity versus the benefit of job creation in the Coega IDZ;
- The implications of the proposed activities on tourism value, related jobs and sense of place;
- The socio-economic impact on livelihoods should this activity not be authorised; and
- The loss of opportunities for local fisher folk as well as future mariculture prospects.

An additional priority in and requirement of the ICM Act is the provision of equitable (and safe) public access to the coastal zone and its resources. Such coastal access must, however, not conflict with protected areas, protection of the environment or the interests of the community or be located within a harbour, defence or other strategic area without permission of relevant Minister (DEA, 2014b). The NMBM also requires that any development should allow for safe access and enjoyment of the coastal zone by people. This includes allowing the sustainable utilisation of natural coastal resources by all members of the community, in order to enhance their quality of life (CEN, 2015). However, as the majority of the infrastructure is proposed to be installed within the already access-controlled Coega IDZ and Port of Ngqura, no further change in coastal access is expected, as access is <u>already restricted</u>. Neither proposed locations of the transmission lines restrict access to the coast nor access routes to the coastline. Coastal access is therefore not highlighted as or rated as an impact.

The construction or assembly of the respective infrastructure components is estimated to last more than one year (but less than five years), whilst contractual period of operation is 20 years (*i.e.* more than 10 years), During operation, the duration of the impact is thus life span of the project (*i.e.,* more than 10 years), but may not necessarily be permanent, and therefore be reversible. Should an impact not be reversible, then this is explicitly stated.

The irreplaceable loss of resources has been assessed, but not explicitly stated as such. For example, a less severe impact will be insignificant or non-harmful and the resultant loss of resources can be replaced. In contrast, the loss of resources from disastrous or extremely harmful impacts cannot be satisfactorily replaced.

It is the opinion of the specialists that the scoring methodology provided is not a true reflection of the project situation and the findings of this assessment (*e.g.* impact duration). The scoring has thus been adapted and/or added to, to provide the best assessment possible.

7.5.12.1 *Impact assessment findings (with mitigation):* ***<u>Construction Phase</u>***

Impact 1: Effect on estuarine habitat as a result of construction within the estuarine functional zone

The area has undergone drastic modifications including infilling, canalisation of the Coega Estuary, quay wall construction, dredging, and industrial infrastructure development. The position and natural dynamics of the estuary mouth have been significantly altered and what natural habitat remains in the vicinity of the port is highly disturbed.

A portion of the gas pipeline transferring gas from the FSRU to the powership will be above ground in the vicinity of the Admin Craft Basin building (~ 100m). The remaining ~320m will be trenched in the modified sandy beach environment alongside the existing access road and then buried through the shoreline crossing and placed on the seabed to connect to the powership. The site office complex will be located in a transformed area immediately adjacent to the Admin Craft Basin building. In addition, the first land-based connection of the transmission line, that is the terminal tower (monopole design), will be located, some 250-300 m east of the estuary mouth and in proximity to existing port infrastructure and buildings. Access will be via the existing road that provides access to the eastern breakwater.

Despite the modified state, the beach provides valuable roosting habitat to threatened coastal bird species, although there is a vast amount of beach habitat available on either side of the port (Martin, 2022). This area will be disturbed during the laying of the pipeline and construction of the site office complex and terminal tower. The footprint of monopole terminal tower will be permanently lost however the area is minimal, whilst the surface footprint of the buried pipeline will be temporary, and the beach environment and vegetation can be rehabilitated. The site office will be partially located on a stabilised/hardened surface. Marginal disturbed areas can be rehabilitated.

Table 7-45: Impact 1 ratings for effect on habitat as a result of construction within the estuarine functional zone

	Duration	Extent	Severity	Consequence	Probability	Frequency	Likelihood	Significance
Site office	1	2	1	**1.3**	5	5	**5**	**6.7**
Gas pipeline Alternative 1	1	2	2	**1.7**	5	5	**5**	**8.5 Medium**
Gas pipeline Alternative 2	**No impact on the beach environment**							**N/A**
Terminal tower	1	2	2	**1.7**	5	5	**5**	**8.5 Medium**
Mitigation measures: • Work areas on the beach and transmission line corridor must be demarcated, and all construction activities including vehicle movement must be restricted to these areas only. No work or vehicle movement westward of the old estuary channel. • The removal/damage to endemic vegetation must be limited to the construction footprint only. • Beach environment to be rehabilitated to pre-establishment conditions as part of decommissioning, including beach profiling, and revegetation. Invasive alien vegetation invasion in respect of disturbed areas must be removed and controlled. • The beach environment must not be used for anything other purpose (*e.g.* assistance with vessel mooring, or storing of materials) • Construction must be undertaken according to a site-specific approved Environmental Management Programme (EMPr) and must be monitored by an on-site environmental officer. • All solid waste must be removed to an appropriate disposal facility. • Dust or sand suppression should be undertaken by watering down and limiting activity in windy conditions. • The Karpowership must be aware of TNPA Environmental Management Systems as well as emergency preparedness and response procedures and apply such on an ongoing basis and in the event of emergencies, for example, tidal surge, dust storms and other extreme events. • In the event of a large-scale marine pollution event, pollution controls response measures must be initiated to prevent pollution of the beach environment and Coega Estuary.								
Site office	1	1	1	**1.0**	5	5	**5**	**5.0 Medium-low**
Gas pipeline Alternative 1	1	1	2	**1.3**	5	5	**5**	**6.7 Medium-low**
Gas pipeline	**No impact on the beach environment**							**N/A**

Alternative 2								
Terminal tower	1	1	1	**1.3**	5	5	**5**	**6.5 Medium-low**
Reversibility	The impact is reversible with moderate mitigation measures, such as beach profiling and revegetation with indigenous plant cover.							
Irreplaceability of Resources	The impact causes a loss of resources that can be replaced.							
Fatal flaw	This impact does not result in a fatal flaw.							

Impact 2: Effect on estuarine/beach fauna and avifauna as a result of construction activities and noise

Physical disturbance of the intertidal and supratidal beach zone is expected during the laying/burial of the gas pipeline within the beach / dune environment and undertaking of other construction related activities for the Gas to Power project. This may involve heavy machinery accessing and moving along the beach in the vicinity of the pipeline route. The intertidal zone is inherently highly dynamic, being exposed to constant daily changes and disturbance by wind and wave action. Therefore, recovery of the intertidal beach infauna due to the disturbance by construction activities will be fairly rapid. Similarly, the upper beach or primary dune environment is a highly dynamic and stressful environment, and likely to support limited terrestrial coastal fauna species (*e.g.* reptiles, such as snakes and lizards, and possibly small mammals, such as rodents). These fauna are generally highly mobile, accustomed to the disturbed environment of the port, and able to quickly evade the area of disturbance.

While the proposed project is located within an industrial and commercial port where noise pollution is already prevalent, additional noise will be generated through the presence of heavy machinery, vehicles and other plant on the beach. However, this is not anticipated to be beyond the current ambient noise levels (61.5 dB) measured at the landward point of the Eastern Breakwater attributed to strong winds and wave activity (Safetech, 2022). Furthermore, the port environment is already experiencing a significant amount of noise (natural and anthropogenic), and this may be slightly higher for the Coega Estuary as a result of the topography, and current construction activities for the IDZ taking place along the margins, and slightly set-back from the estuary.

The beach environment continues to provide important roosting and nesting habitat to threatened coastal bird species despite its modified state (Martin, 2022). Kelp gulls and Black Oystercatchers have been recorded breeding in the dunes of the port environment along the gas pipeline route and below the transmission lines (Martin, 2022). Furthermore, during open mouth conditions following good seasonal rainfall, increased numbers of palearctic bird species, *e.g.* threatened Damara Tern (especially during January / February), and other bird species (*e.g.* waders, gulls, terns, herons) utilise the estuary mouth and the beach environment (Martin, 2022). The physical disturbance and temporary increase in local noise levels will disturb and potentially displace roosting or nesting birds utilising the beach/mouth environment over the construction period. However, there is good connectivity with coastal habitat adjacent to the Port of Ngqura and with the Coega Estuary and saltpans and construction noise is unlikely to reach the saltpans or be of greater disturbance than current activities in and around the port, and therefore continue to provide suitable habitat (Martin, 2022). There is a very high probability that avifauna displaced due to physical disturbance from the project will relocate to less disturbed areas nearby (Martin, 2022). General disturbance to the beach environment could be reduced by assembling and launching the pipeline from the breakwater, however this would incur greater impacts to the sensitive breeding penguin colonies on Jahleel Island, which is of greater significance, and therefore not supported (Martin, 2022).

With regards to the transmission lines, the Alternative route 3 corridor (western corridor) lies within 50m of the EFZ above the N2 road bridge comprising degraded wetland habitat (and traverses as prominent drainage lines entering the upper estuary as well as Thicket CBA outside of the EFZ). By virtue of the ephemeral nature of the Coega River entering the estuary, the invertebrate fauna occurring this area are likely to be extremely limited, and/or transient, with a strong response to flood/high flow conditions. Despite the degraded state of this wetland area, this area remains an important area for coastal birds (Martin, 2022). Moreover, the drainage lines and Thicket CBA are classified as CBA 1 areas and should be avoided. No construction related impacts on the estuary are anticipated for the Alternative route 1 (preferred) or Alternative route 2 (eastern corridor) (apart from the terminal tower) and are therefore not assessed.

Table 7-46: Impact 2a ratings for effect on estuarine/beach fauna as a result of construction activities and noise

	Duration	Extent	Severity	Consequence	Probability	Frequency	Likelihood	Significance
Site office complex	1	2	1	**1.3**	2	5	**3.5**	**4.6 Low**
Gas pipeline Alternative 1	2	2	3	**2.3**	3	5	**4.0**	**9.3 Medium-high**
Gas pipeline Alternative 2	1	2	1	**1.3**	1	5	**3.0**	**3.9 Low**
Transmission route Alternative 3 & terminal tower	2	2	3	**2.3**	3	5	**4.0**	**9.2 Medium-high**
Mitigation measures: • The gas pipeline must not be constructed/buried over the dune/beach environment during 1 October to 31st January, to prevent disturbance to breeding pairs of Kelp Guls and African Black Oystercatchers • The surrounding area must be surveyed prior to construction/camp establishment to determine the presence of wildlife utilising the beach (*e.g.* snakes, rodents) and these must be cordoned off for safe relocation. • The conservation authority must be contacted for the relocation of wildlife. • No animals (birds, reptiles, mammals) are to be disturbed unnecessarily and no animals are allowed to be shot, trapped or caught for any reason. • Conduct a comprehensive environmental awareness programme amongst contracted construction personnel about sensitive estuarine and coastal habitats and fauna. • Construction areas on the beach and adjacent the estuary must enclosed/shielded with appropriate materials to reduce sound emissions (*e.g.* corrugated sheeting, wooden fencing) • Restrict access to work areas only, *i.e.* vehicle access to other beach areas is not permissible. • Restrict vehicles to clearly demarcated access routes only. • Only allocated access points to the beach be used. • Construction vehicles, plant and machinery must be well maintained and fitted with silencers. • Regular maintenance on vehicle and equipment undertaken.								
Site office complex	1	1	1	**1.0**	2	5	**3.5**	**3.5 Low**
Gas pipeline Alternative 1	2	1	2	**1.7**	2	5	**3.5**	**6.0 Medium-low**
Gas pipeline Alternative 2	1	1	1	**1.0**	1	5	**3.0**	**3.0 Low**

Transmission route Alternative 3 & terminal tower	2	2	2	**2.0**	2	5	**3.5**	**7.0 Medium**
Reversibility	This impact is reversible.							
Irreplaceability of Resources	The impact causes a loss of resources that can be replaced.							
Fatal flaw	This impact is not a fatal flaw.							

Table 7-47: Impact 2b ratings for effect on terrestrial and estuarine avifauna as a result of construction activities and noise (adapted from Martin, 2022)

	Duration	Extent	Severity	Consequence	Probability	Frequency	Likelihood	Significance
Alternative layout 1	2	1	1	**1.3**	3	1	**2.0**	**2.6 Very-low**
Alternative layout 2	2	1	1	**1.3**	2	1	**1.5**	**2.0 Very-low**
Mitigation measures: • Alternative 1: Once in position off of the Coega River mouth, to reduce impacts due to re-positioning anchors and moorings, the powerships should not be moved unless in an emergency. • To avoid disturbance to breeding Kelp Gulls and African Oystercatchers, the gas pipeline should not be constructed over the dune area during the period 1 October to 31 January. • Areas must be surveyed prior to construction/camp establishment to determine the presence of nesting birds and these areas must be cordoned off until nesting has ceased. • Construction activities, specifically excavation and moving/transporting of large components, to be restricted to daylight hours to prevent potential disturbance to roosting bird populations, and the core estuarine area. • Comply with TNPA's Construction Environmental Management Programme for the Port of Ngqura and relevant sections of the Environmental Management Programme for the Operation of the Port of Ngqura. This includes minimizing disturbance footprints and rehabilitation of disturbed areas, • Continue annual monitoring of the Kelp Gull breeding colonies in the Port.								
Alternative layout 1	2	1	1	**1.3**	2	1	**1.5**	**2.0 Very-low**
Alternative layout 2	2	1	1	**1.3**	1	1	**1.0**	**1.3 Very-low**
Reversibility	This impact is reversible.							
Irreplaceability of Resources	No, the impact does not result a loss of irreplaceable resources.							
Fatal flaw	This impact is not a fatal flaw.							

Impact 3: Effect of solid waste pollution

Solid waste will be generated by construction activities and may include concrete rubble and bricks, metal materials, material off-cuts and surplus, plastic waste and general litter. If not properly managed and contained, these materials may find their way into the marine and coastal environment and/or the Coega Estuary through wind transport or direct discarding of waste, where it will lead to contamination, habitat degradation and potential harm to fauna (e.g. entrapment or entanglement). Poor management of the site office construction, the stringing yard and its operations (e.g. waste management facilities), and construction areas (e.g. pylons) may also lead to contamination of the surrounding environment.

Waste management during the construction phase, in terms of the handling, storage and disposal of general, construction and hazardous waste, must continue for the duration of the construction phase. There is a definite possibility that the impacts will occur if waste is not properly managed, and the intensity of these impacts may be severe and expensive or time-consuming to mitigate.

Floating or submerged solid waste (especially plastics) in the marine environment can be transported over vast distances through the ocean currents and therefore the area of impact could potentially be extensive. Debris in the oceans may have a lethal impact on marine fauna, with potentially severe consequences for rare and endangered species. It is recommended that intensive awareness training should be done with all staff regarding the impacts of construction waste and litter on the marine, coastal and estuarine environments, especially taking consideration of Gqeberha's status as South Africa's windy city.

Any waste materials must be collected, appropriately stored and then transported to appropriate disposal facilities.

Table 7-48: Impact 3 ratings for effect of solid waste pollution

	Duration	Extent	Severity	Consequence	Probability	Frequency	Likelihood	Significance
General construction	2	5	4	**3.7**	4	3	**3.5**	**12.8 High**
Mitigation measures: • Construction must be undertaken according to a site-specific approved Environmental Management Programme (EMPr) and must be monitored by an on-site environmental officer. • Construction workers and operational staff to adopt best practice waste minimisation procedures. • Implement the correct handling and disposal procedures for general and hazardous waste. • Reduce the amount of waste generated from the construction phase by means of efficient operations and recycling of general waste. • Good housekeeping to be done daily. • No mixing of concrete in the intertidal zone. • No dumping of construction materials or excess concrete in the intertidal and subtidal zones. • Wind screening (*e.g.* fine mesh shade cloth fencing, or solid fencing) must be installed to prevent excessive wind-blown sand and light-weight solid waste (*e.g.* litter) entering the Coega Estuary. • Dust or sand suppression should be undertaken by watering down and limiting activity in windy conditions. • Conduct a comprehensive environmental awareness programme amongst contracted construction personnel about sensitive estuarine/marine habitats and good house-keeping.								
General construction	2	5	2	**3.0**	2	2	**2**	**6.0 Medium-low**
Reversibility	This impact is reversible, with ongoing management and timeous mitigation.							
Irreplaceability of Resources	The impact may result in irreplaceable loss of resources (*e.g.* disturbance /harm/ displacement to threatened/migratory bird species), however mitigation measure may prevent complete loss or provide a suitable substitute.							
Fatal flaw	This impact is not a fatal flaw.							

Impact 4: Effect of chemical pollution arising from construction related spills of hazardous substances

During the construction period, there is the potential for accidental spills of hydrocarbons, oils from construction vehicles and equipment, and other harmful substances and chemicals used (*e.g.* concrete). Incorrect handling and improper spill management, will result negative impacts on marine and estuarine sediment and water quality, as well as toxic health effects in marine and/or estuarine fauna, especially avifauna species of conservation concern that utilise the beach, the estuary mouth and port waters. Considering the sensitive nature of these environments and species, accidental spills, regardless of volume or concentration, could lead to significant environmental damage.

Table 7-49: Impact 4 ratings for effect of chemical pollution arising from construction related spills of hazardous substances

	Duration	Extent	Severity	Consequence	Probability	Frequency	Likelihood	Significance
General construction	2	5	4	**3.7**	3	3	**3.0**	**11.0 High**
Mitigation measures: • Construction must be undertaken according to a site-specific approved Environmental Management Programme (EMPr) and must be monitored by an on-site environmental officer. • The laydown area must not be established within a high-risk area (*i.e.* the Coega Estuary or below the high water mark). • The establishment and operation of the laydown area/site camp must follow a stringent Environmental Management Programme. • Sufficient ablution facilities must be provided for construction personnel and sited away from high-risk areas. These must be frequently cleared (preferably every two weeks depending on the number of staff). • The laydown area must be adequately protected against adverse weather conditions, particularly the chemical storage areas, to prevent erosion and run-off of contaminants into the port. • A Spill Prevention and Management Plan must be compiled and implemented. In the event of any significant spill the TNPA must be notified. • A method statement in respect to the use, handling, storage and disposal of all chemicals as well as anticipated generated waste, must be compiled and submitted as part of any Environmental Management Programme. • Ensure correct handling, storage and disposal procedures followed (*e.g.* bunded storage areas to contain 110% of volume). • Maintain vehicles and equipment - no leaking vehicles or equipment to be permitted on site. All vehicles and machinery must be parked or stored on an impervious surface. • Conduct a comprehensive environmental awareness programme amongst contracted construction personnel about sensitive estuarine and marine habitats and the need for careful handling and management of chemical substances. • In the event of a spill, a penalty should be issued and the 'polluter pays' principle should be applied for clean-up operations and rehabilitation, if necessary.								
General construction	2	5	1	**2.7**	2	2	**2.0**	**5.4 Medium-low**
Reversibility	This impact is reversible, with ongoing management and timeous mitigation.							
Irreplaceability of Resources	The impact may result in irreplaceable loss of resources (*e.g.* disturbance/ harm/ displacement to threatened/migratory bird species), however mitigation measure may prevent complete loss.							
Fatal flaw	This impact is not considered a fatal flaw.							

7.5.12.2 Impact assessment findings (with mitigation): ***Operational Phase***

Impact 5: Effect on estuarine and terrestrial avifauna due to collisions and electrocutions at the powerlines

Power generated by the powerships will be transmitted to the national power grid by means of overhead lines (or potentially underground cables). Three routes are proposed. The alternative route 1 corridor (preferred) is located approximately 1.5 km east of the Coega saltpans, circumventing the Bontveld, and alternative route 2 (eastern corridor) is located 1.7 km further east. Alternative route 3 (western corridor) runs adjacent to degraded wetland habitat in the upper reaches of the Coega Estuary upstream the N2 road bridge, Thicket CBA as well as prominent drainage lines entering the upper estuary.

In general, powerlines pose a significant threat to large-bodied bird species, which utilise the saltpans, as well as other large species that may fly over the system. Of the seven species of conservation concern which utilise estuary and the river, flamingos (*Phoenicopterus* sp., Near-Threatened) are most at risk. The risk of bird collisions is likely to be greater at night (*e.g.* for flamingos, which typically move during the night), or in poor weather conditions, when visibility is poor. Collisions would be greater for alternative route 3, located in closer proximity to the primary bird habitat of the Coega Estuary in comparison to the preferred route further afield, especially as it will be a single stand-alone line and not located within an electrical services corridor (Martin, 2022). This can be mitigated for the most part by ensuring that the overhead lines are located as far from the estuary as possible (*i.e.* selection of the preferred route, or alternative 2), and/or following existing transmission line routes.

The power line span between the powerships and the Saltpan Switching Station on the dune ridge constitutes the greatest risk area for bird collisions because it spans a busy fly way along the coast to and from the Coega mouth and saltpans (used by Species of Conservation Concern, such as Damara and Caspian Terns), and because there is a small colony of Kelp Gulls (*Larus dominicanus*) breeding beneath the proposed span (Martin, 2022). It is important to note that the Jahleel is the most sensitive avifauna receptor with respect to potential impacts from the powerships (Lwandle and Anchor Environmental, 2022).

Impacts on terrestrial (including estuarine) bird species and marine bird species, are assessed in greater detail in the Avifaunal Specialist Report (Martin, 2022) and Marine Ecology Specialist Report (Lwandle and Anchor Environmental, 2022), respectively.

Table 7-50: Impact 5 ratings for effect on estuarine and terrestrial avifauna due to collisions and electrocutions at the powerlines (adapted from Martin, 2022)

	Duration	Extent	Severity	Consequence	Probability	Frequency	Likelihood	Significance
Transmission route Alternative 1	3	3	3	**3.0**	3	2	**2.5**	**7.5 Medium**
Transmission route Alternative 2	3	3	3	**3.0**	3	2	**2.5**	**7.5 Medium**
Transmission route Alternative 3	3	3	3	**3.0**	3	3	**3.0**	**9.0 Medium-high**

Mitigation measures:

- Comply with the Generic EMPr for Substation and Overhead Electricity Transmission and Distribution Infrastructure (GN 435 dated 22 March 2019).
- Use monopoles in preference to lattice towers to match the conductor heights of the existing power lines thereby reducing the vertical risk area to flying birds.
- Provide bird perches on top of the monopoles to encourage them away from perching on the conductors.
- Use dynamic reflective bird flappers, preferably with lights that flash at night, on the most sensitive spans of the transmission line between the Powerships and the top of the Eastern Reclamation (Alternatives 1 & 2) and next to the Coega River (Alternative 3).
- Use alternating black and white static pigtail flight diverters on the remaining spans of the power line as per Eskom Guidelines
- Every three months survey the transmission line routes for avian casualties and check and if necessary, replace / maintain bird flight diverters

• Report any bird casualties additional to those found during the surveys to the CDC or TNPA Environmental Officer and the Coega / Ngqura Environmental Control Officer								
Transmission route Alternative 1	3	2	2	**2.3**	2	1	**1.5**	**3.5 Low**
Transmission route Alternative 2	3	2	2	**2.3**	2	1	**1.5**	**3.5 Low**
Transmission route Alternative 3	3	2	2	**2.3**	2	2	**2.0**	**4.6 Low**
Reversibility	This impact is reversible, provided mitigation measures are implemented.							
Irreplaceability of Resources	It is very unlikely that the impact will result in irreplaceable loss of resources (*e.g.* disturbance/ harm/ displacement to threatened/migratory bird species), provided that mitigation measures implemented, *e.g.* preferred route and with bird diverters/deterrents.							
Fatal flaw	This impact is not considered a fatal flaw							

Impact 6: Effect on coastal/estuarine avifauna due to atmospheric noise and light

The proposed Gas to Power project will be located within the industrial and commercial Port of Ngqura where noise and light pollution is already prevalent. Once in operation, the powerships will operate throughout the day and night, or part thereof, with noise emanating from power generation, supportive activities and other potential sounds (e.g. alarms sirens/bells etc.). There will be lighting on the vessels, adding to the already substantial ambient light associated with the Port of Ngqura and can be partially mitigated to limit disturbance to avifauna. There is high ambient light during full moon conditions.

The noise generation study (Safetech, 2022) indicates that the ambient noise levels at the landward point of the breakwater was 61.5 dBA, i.e. the area is already subject to a noteworthy level of noise close to industrial levels. There is no indication of the ambient noise levels currently experienced within the Coega saltpans. This would provide an indication of the current level of noise that the residing bird populations are exposed to, and whether the proposed project will exceed this level thresholds of acceptable change, and therefore create additional disturbance. It must be stated however, that port environment is already experiencing a significant amount of noise pollution (measured at the breakwater), and this is may be similar for the Coega Estuary as a result of the topography, and current construction activities taking place along the margins and slightly set-back from the estuary.

Noise impacts due to the project would be greatest during calm weather conditions when the ambient noise (from wind and waves) is low. The greatest sources of noise during operation of the powerships are from the engine air inlets and engine heat outlets that are located on the port side of the vessel (Martin, 2022; Safetech, 2022). There are no legislated noise limits for environmentally sensitive areas or protected areas (Martin, 2022; Safetech, 2022).

Assuming that the port side of the powerships face away from the shore, the predicted terrestrial noise levels for Alternative layout 1, Safetech (2022), show that the area immediately surrounding the powerships facing the inner port will experience 60 – 70 dBA (industrial noise levels) during operation. The inner portion of the port from the distal half of the finger jetty, across the port to the mooring position of the FSRU and LNGC, and slightly over the Eastern breakwater, and small section adjacent to the port beach, will be subject to 50-60 dBA (urban noise levels). The estuary mouth up to the arterial road, the beach environment to the base of the breakwater and moving upslope of the beach toward the crest of dune will experience 40-50 dbA (rural to low urban area noise levels). The lower estuary (namely Pan 9) will experience 30-40 dBA (rural noise levels) (however the saltpans are possibly already experiencing slightly higher noise levels), whilst no measurable noise impacts due to operation of the powerships are predicted for the remaining middle- to upper reaches of the estuary.

Any sensitive bird species utilising the estuary mouth and beach environment for feeding, roosting or nesting may be disturbed by the additional noise and artificial light (Martin, 2022), especially during the night (Adams et al., 2019) due the close proximity of the powership (Alternative layout 1). Studies have also shown that artificial lighting can disorientate and thus pose a threat to migrating species (Adams et al., 2019). The populations of near threatened/threatened species are of most concern. Lighting impacts can be mitigated.

In terms of noise, it is possible that the estuary mouth and beach areas become unfavourable, however good habitat connectivity allows the birds to relocate if the noise is too disturbing (Martin, 2022). Martin (2022) reports that responses of terrestrial wildlife to noise have been recorded at 50 db. However, given that the area is naturally a dynamic and noisy coastal environment and terrestrial noise, due to the project, is not expected to exceed 50dB at terrestrial avifauna receptors, noise impacts due to the project on terrestrial avifauna are expected to be limited. However, as the noise is continuous during operations, the significance remains Medium even after mitigation.

The impacts of noise and light pollution on the estuary and associated beach area can be further mitigated by ensuring low light emission from the powership and relocation of the powership component to a less sensitive location within the port, i.e. away from the shoreline (i.e. the Alternative layout 2 option). However, the impact on the endangered African penguin (Spheniscus demersus) breeding colonies at Jahleel Island would be more severe under the Alternate layout 2 option, and this option is therefore not supported.

An additional mitigation measure/recommendation is the off-site protection of alternate, more viable bird habitat as per the recommendations of the port EIA (CES, 2001).

The evaluation of noise and light disturbance to marine birds, especially species occupying Jahleel Island, is addressed in the Marine Ecology and Fisheries Specialist Assessment (Lwandle and Anchor Environmental, 2022).

Table 7-51: Impact 6 ratings for effect on terrestrial and estuarine avifauna due to atmospheric noise and light (adapted from Martin, 2022)

	Duration	Extent	Severity	Consequence	Probability	Frequency	Likelihood	Significance
Alternative layout 1	3	2	2	**2.3**	2	5	**3.5**	**8.1 Medium**
Alternative layout 2	3	2	2	**2.3**	2	5	**3.5**	**8.1 Medium**

Mitigation measures:

- All lighting to be down / shielded lighting. Lighting to be limited to that required for safe operations.
- No lights to illuminate or be directed towards the Coega Estuary and shoreline.
- Undertake a night light audit on a moonless night and 24-hour noise audits in accordance with SANS 10103:2008 at the Klub Road causeway crossing the Coega Estuary before operations start to determine the baseline, once operations start and annually thereafter.
- To track any changes on sensitive avifauna receptors, ensure that monitoring of the nearby Damara Tern colony continues.
- Continue annual monitoring of the Kelp Gull breeding colonies in the Port and bi-annual Co-ordinated Waterbird Counts on the saltpans.

• Noise can be reduced by reducing the number of reciprocating engines / steam turbines in operation and by implementing recommendations in the Terrestrial Noise Impact Assessment.								
Alternative layout 1	3	1	1	**1.7**	2	5	**3.5**	**6.0 Medium-low**
Alternative layout 2	3	1	1	**1.7**	2	5	**3.5**	**6.0 Medium-low**
Reversibility	This impact is reversible.							
Irreplaceability of Resources	No, the impact does not result a loss of irreplaceable resources.							
Fatal flaw	This impact is not a fatal flaw.							

Impact 7: Effect on estuarine/marine ecology at the Coega Estuary mouth

Natural and artificial sheltered coastal environments, such as estuaries and ports provide important nursery habitat for coastal fishes, which is particularly important for commercially exploited species. Some marine species are dependent on estuaries for various parts of their lifecycle and recruitment into estuaries typically occurs during high flow periods or seasonal breaching of estuary mouths in response to environmental cues. Estuarine-associated marine fish species have been recorded both in the estuary (prior to port development) (James and Harrison, 2010) and within the port (pre-operational) (Dicken, 2010), however, the overall functioning of the Coega Estuary is severely modified, with limited marine connectivity and negligible favourable habitat for such species to persist, and as such, the fish (and invertebrate) communities are reportedly depauperate and severely modified (CSIR, 2013; van Niekerk et al., 2019c). This illustrates that the system all natural processes and functions that support various fish and invertebrate populations have been lost, and considered as irreversible. Lwandle and Anchor Environmental (2022) allude to the Port of Ngqura now fulfilling this critical estuarine nursery function. However, coastal bird species still utilise the estuary mouth as a feeding area.

Temperature sensitive marine fauna (mainly fish and invertebrate species and their larvae) utilising in the intertidal and shallow subtidal areas at the mouth within the port, or possibly attempting to enter the estuary, may be vulnerable to disturbance/mortality as result of the discharge of heated cooling water and resultant change in water quality conditions. Thermal plume modelling under the worst-case scenario indicates that surface water temperatures within the vicinity of the estuary mouth will increase by 1.00°C and 0.75 °C during winter and summer, respectively, as a result of the discharge (8 m depth) relative to the current conditions under the preferred layout option (PRDW, 2022). The dispersion of the thermal plume in proximity to the mouth meets the limits of the South Africa Water Quality Guidelines for Coastal Waters (i.e. ±1°C) (DWAF, 1995; PRDW, 2022), and the thresholds set by the marine ecology specialist (Lwandle and Anchor Environmental, 2022). Consequently is thus not expected to adversely impact on marine and/or estuarine biota in the region of the Coega Estuary mouth (in the water column or in the sediment of the shallow channel), the worst impacts would be felt in the zone of immediate dilution immediately adjacent the powerships (Lwandle and Anchor Environmental, 2022). In addition, temperature changes of the water column are not expected to impact on the biota within Coega Estuary beyond this point, because of the beach profile and outflows through the constricted mouth during open conditions, or lack of marine connectivity during closed mouth conditions. The rating for the impacts of cooling water discharge is provided below.

Table 7-52: Impact 7a ratings for effect of cooling water discharge on estuarine/marine ecology (adapted from Lwandle & Anchor Environmental, 2022)

	Duration	Extent	Severity	Consequence	Probability	Frequency	Likelihood	Significance

Layout Alternate 1 &2	3	2	2	**2.3**	3	5	**4.0**	**9.2 Medium-high**
Mitigation Measures:								
• Discharge of heated cooling water must be maintained at 8m depth to reduce adverse thermal effects on marine/estuarine biota in the mouth region during open mouth conditions. • To reduce the risk of recirculation of the discharge back to the intakes, it is recommended that the discharge pipeline running down the vessel hull has a second elbow to discharge horizontally away from the vessel, and that the discharge pipes be positioned as far from the intakes as possible. • Discharges must be compliant with the South African Water Quality Guidelines for Coastal and Marine Waters (DWAF, 1995; DEA, 2018b), thresholds set for the project. • Powerships must maintain a minimum 200 m offset distance from the estuary mouth to reduce adverse thermal effects on marine/estuarine biota that may occur in the mouth region during open mouth conditions. • A water quality monitoring programme should be implemented to validate the predictions of the hydrodynamic modelling study and monitor constituents of the effluent. Adaptive management, informed by monitoring results must be implemented to ensure compliance with water quality guidelines.								
Layout Alternate 1 &2	3	2	2	**2.3**	2	5	**3.5**	**8.1 Medium**
Reversibility	This impact is reversible							
Irreplaceability of Resources	The impact causes a loss of resources that can be replaced.							
Fatal flaw	This impact is not considered a fatal flaw.							

Lwandle & Anchor Environmental (2022) indicated that marine biota residing and/or entering the Port of Ngqura will be affected by the underwater noise generated by operation of the Gas to Power project dependent on the distance from the ships. This would include organisms at the Coega Estuary mouth. Chronic effects from long term exposure to noise include development deficiencies, and physiological stress. These may affect life functions, including individual health and fitness, foraging efficiency, avoidance of predation, swimming energetics and reproductive behaviour (Lwandle & Anchor Environmental 2022). Fish and mammals are considered the most noise-sensitive groups in the Port of Ngqura. Noise is therefore a critical issue given that the Port of Ngqura functions as an essential nursery area for many fish species and is an important habitat and activity zone for certain shark species. While adult fish and marine mammals can evade noisy areas, juveniles, as well as territorial species are more susceptible to noise disturbances because they are less mobile (Lwandle and Anchor Environmental, 2022).

Lwandle & Anchor Environmental (2022) maintain that no fish will experience reduced reduction in hearing sensitivity however most species will experience a high effect of masking (impairment of hearing a due to the increase background noise) and at least moderate levels of behavioural change within hundreds of metres of the powership. Based on the criteria used in the noise impact assessment, the authors indicate that this is likely an overestimate. Similarly, marine invertebrates (e.g. crustaceans) in close proximity to the ships would also experience masking effects (Lwandle and Anchor Environmental, 2022).

Overall, the noise produced by operation of the Gas to Power project is not anticipated to contribute meaningfully to the existing noise levels in the Port of Ngqura (Lwandle and Anchor Environmental, 2022). The Powerships do not produce noise to the extent that will cause direct harm to marine organisms. Organism would need to remain in close proximity (within a few hundred metres) for extended periods (24 hours) to experience detrimental effects. Noise produced by the project will increase the ambient underwater noise levels within hundreds of metres of the source, so it will impact a greater area than the immediate site (Lwandle and Anchor Environmental, 2022). The rating for the impacts of underwater noise is provided below.

Table 7-53: Impact 7b ratings for effect of underwater noise on marine ecology (adapted Lwandle & Anchor Environmental, 2022)

	Duration	Extent	Severity	Consequence	Probability	Frequency	Likelihood	Significance
Layout Alternate 1 &2	3	2	3	**2.7**	2	5	**3.5**	**9.5 Medium high**
Mitigation Measures: • **See below.**								
Layout Alternate 1 &2	3	2	2	**2.3**	2	5	**3.5**	**8.1 Medium**
Reversibility	This impact is reversible							
Irreplaceability of Resources	The impact causes a loss of resources that can be replaced.							
Fatal flaw	This impact is not considered a fatal flaw.							

Mitigation measures (taken from Lwandle & Anchor Environmental, 2022):

Mitigation measures should ensure that the worst-case scenario assumptions made in this assessment are not met, so that noise levels created by the Gas to Power project are lower than what is predicted. This will help to avoid disturbances and potential harm to marine organisms. For example:

- The Powerships should not be operational for 24 hours a day, to reduce chronic exposure of noise to marine organisms. It is expected that the Powerships will operate for 16.5 hours a day.
- Maximum power output from the Powerships should be avoided. Noise levels produced by the Powerships are proportional to the amount of power output, so lower noise levels will be achieved with lower power capacity.
- In the case that a marine mammal, especially a baleen whale, is in the near vicinity *i.e.*, within hundreds of metres of the Gas to Power project, the Powerships should not operate at maximum power output, to reduce the noise level produced and thus the chances of disturbing the animal.
- When moving in and out of the port, the LNGC should not move at maximum speed, so as to reduce the amount of noise produced by its engines.

A noise impacts monitoring programme should be implemented to validate the predictions made of the impacts of the noise produced by the Gas to Power project on the marine ecology. A baseline study of the ecology in the immediate vicinity of the Gas to Power project should be undertaken following a before-after-control-impact (BACI) approach. This should include an assessment of the local macrofauna and video surveys and fish sampling to understand the fish community in the region associated with the Powerships. An assessment of the distribution and behaviour of diving seabirds in the context of the Powerships should also be undertaken. These surveys should be ongoing and following a sampling methodology that is robust when assessing the impacts of the noise produced by the Powerships on the distributions of benthic macrofauna, fish, seabirds, and marine mammals. If an effect if observed, adaptive management informed by monitoring results must be implemented. The results of such monitoring will be valuable in informing other developments and contributing to the international understanding of the effects of noise from large vessels on marine biota.

Impact 8: Effect on coastal estuarine associated fauna and habitat destruction due to fires and explosion

According to the MHR (2022), the greatest risk during the operation of the powerships is the possible rupture or shear of one of the transfer hoses between the LNGC and FSRU, which are located approximately 1 km from the estuary mouth.

In terms of the types of risks, a flash fire and vapour cloud explosion caused by transfer hose shear have the greatest predicated area of impact (Figure 10) (MHR, 2022). All major risks are associated with the extent in a north-easterly direction toward the shoreline beyond and east of the breakwater. The potential risk closest to the shoreline and estuary is that of a jet fire cause by hose shear at the powership manifold connection. However, the greatest extent of predicted thermal radiation (147m) will not reach the adjacent shoreline or the estuary mouth (MHR, 2022). No mortalities of fauna utilising the estuary or beach are anticipated, unless flying directly over or within the impact area when the incident occurs, which is highly unlikely but not impossible.

Overall, the level of risk on sensitive areas including the Coega Estuary and coastline within the port is low, with 1: 10 000 risk area confined to the two ships around the hose connections, the 1: 1 million risk area stretching for a maximum distance of 300 m from the FSRU/LNGC ships and approximately 25 m around the powership hose connection, 1: 30 million risk area stretching for a maximum distance of 320 m from the FSRU/LNGC ships and approximately 40 m around the powership hose connection (MHR, 2022).

While such incidents are infrequent and largely unpredictable, the probability of occurrence of any fire or explosion can be mitigated by ongoing strict adherence to the Major Hazardous Installation regulations, TNPA's pollution, emergency, and health and safety protocols, MARPOL and other applicable maritime legislation and policies. However, the possibility of such an incident cannot be ruled out completely. The significance of any potential impact is slightly lower for the alternate layout as it is further from the beach and estuary mouth region.

Table 7-54: Impact 8 ratings for effect on coastal/estuarine associated fauna and habitat destruction due to fires and explosion

	Duration	Extent	Severity	Consequence	Probability	Frequency	Likelihood	Significance
Layout Alternate 1	3	2	2	**2.3**	2	1	**1**	**2.3 Very Low**
Layout Alternative 2	3	2	1	**2.0**	2	1	**1**	**2.0 Very Low**
Mitigation measures: • Strict adherence to TNPA pollution, emergency, and health and safety protocols, MARPOL and other applicable maritime legislation and policies for the storage and handling of LNG, and power generation processes. • An emergency plan that is compliant with the Major Hazardous Installation Regulations must be compiled and implemented. • Comprehensive safety checks frequently undertaken of all project components and processes. • Only suitably qualified people must be used for all installation work. All applicable certificates of conformance must be on site. • Good housekeeping to be done daily. • Frequent risk assessments and adaptive management where required.								
Layout Alternate 1	3	2	2	**2.3**	0.5	1	**0.5**	**1.2 Very Low**

Layout Alternative 2	3	2	1	**2.0**	0.5	1	**0.5**	**1.0 Very Low**
Reversibility	This impact is reversible.							
Irreplaceability of Resources	It highly unlikely that irreplaceable resources will be lost, unless estuarine/coastal birds are flying directly over to within the impact area when the incident occurs.							
Fatal flaw	This impact is not a fatal flaw.							

Impact 9: Effect of the generation of coastal pollution

The potential for pollution from shipping (including spent oil and lubricants, paint, solvents and waste detergents, waste from ship maintenance activities, sewage, galley waste, sweepings from hatches and engine rooms, lops from holds and tanks, ballast water, general domestic waste, medicinal/medical waste, spent batteries, discharge of heated water, etc.) as a result of the proposed gas to power project is considered to be high and specific controls will need to be incorporated into the environmental authorisation, if approved.

It should be noted that since such pollution is deemed to not be land-based, it will not be controlled by the ICM Act, but rather in terms of International Convention for Prevention of Pollution from Ships Act (Act No. 2 of 1986) (MARPOL Act), the South Africa Maritime Safety Authority Act (Act No. 5 of 1998) (SAMSA Act), the Marine Pollution Act (Act No. 6 of 1981) (Control and Liability Act) as well as the Merchant Shipping Act (Act No. 57 of 1951). It is also primarily the responsibility of the National Department of Transport and the South African Maritime Safety Authority (SAMSA) to manage. Discharges must also be compliant with the South African Water Quality Guidelines for Coastal and Marine Waters (DEA, 2018; DWAF, 1995). As such it has been reported that SAMSA is undertaking a risk assessment for the purposes of oversight. Residual risks are also being addressed through the legal requirements for major hazard installations and are considered in the major hazard installations impact report (MHR Consultants, 2022). The responsibility, in the case of oil pollution from ships and oil released to sea, lies with the DFFE, specifically through their Kuswag Programme, which undertakes regular oil spill surveillance and monitors for potential illegal oil discharges. This includes shoreline protection and clean-up, and at-sea response using dedicated oil response vessels and aircraft and dispersant spraying operations (DEA and RHDHV, 2017).

As the proposed operation of the gas to power process takes place within a port environment, the necessary TNPA environmental management programme and systems, specifically policies and processes relating to waste, dockside maintenance and repairs and comprehensive emergency response plans dealing with all foreseeable environmental emergencies, must be applied. It should be noted that the "Polluter Pays" principle whereby those responsible for the spill are held liable for the clean-up costs, will apply in any pollution incident.

Table 7-55: Impact 9 ratings for the effect of coastal pollution

	Duration	Extent	Severity	Consequence	Probability	Frequency	Likelihood	Significance
Alternate layout 1	3	5	4	**4.0**	3	3	**3.0**	**12.0 Medium**
Alternate layout 2	3	5	4	**4.0**	3	3	**3.0**	**12.0 Medium**

Mitigation measures:

- Shipping:
  - Mitigation measures proposed relate to normal shipping and should fall in line with the necessary TNPA programmes and systems. The necessary formal agreements will need to be entered into;
  - An inventory of waste produced and the nature of waste being produced to be provided;

   - Compliance with the Transnet National Ports Authority and SAMSA legislation, regulations and instruction;
   - Environmental accidents and emergencies to be reported immediately to the Port Captain;
   - A Formal Failure Analysis (FFA) must be conducted to conclude each incident investigation in order to inform future preventative measures;
   - Training of emergency response teams to deal with environmental and safety implications of an emergency;
   - In the event of a large-scale pollution event, DFFE and SAMSA requirements must be followed and every effort must be made to prevent it reaching and negatively impacting the Addo Elephant MPA, its islands as well as mariculture operations; and
   - The polluter pay principle where Karpowership will be held liable for any clean-up costs associated with an incident.
- Operation must be undertaken according to a site-specific approved Environmental Management Programme (EMPr) and must be monitored by an on-site environmental officer.
- All solid waste must be removed to an appropriate disposal facility.

Alternate layout 1	3	2	4	**3.0**	1	2	**1.5**	**5.0 Low**
Alternate layout 2	3	2	4	**3.0**	1	2	**1.5**	**5.0 Low**
Reversibility	The impact is reversible.							
Irreplaceability of Resources	No, the impact causes a loss of resources that can be replaced.							
Fatal flaw	This not a fatal flaw.							

Impact 10: The effect of/on dynamic coastal processes

The coastal location of the proposed activity within a port, and the link into the existing Dedisa Substation located approximately 6 km inland from the port, means that these activities will be inherently exposed to risks associated with natural and dynamic coastal processes that continually reshape the coastal zone, such as wind, waves and sediment movement. As such, the anticipated key issues identified in the scoping report (Moore and Breetzke, 2020) related to the movement of sediment and wind erosion are collectively included within this assessment of impact and detailed collectively as Dynamic Coastal Processes. This includes climate change vulnerability, which is addressed fully in a separate specialist report (Promethium Carbon, 2022; Themis Environmental, 2021)

Movement of sediment/ Wind-blown sand

The Port of Ngqura effectively blocks the natural eastward littoral drift of sand causing severe sediment accretion to the west of the port and beach erosion to the east. Beyond the beach impact, dune fields fed by windblown sand from the beaches also exhibit sedimentary changes. Maintenance of this port therefore requires constant removal of dune sands and constant dredging of the harbour mouth. This impact has been remedied with the construction of a by-pass system that is required to move a minimum of 240 000 t of sediment per annum via the pump system form the western side of the port to the eastern side thereby mimicking littoral drift (Petterson, 2019).

It is noted that, and as detailed in CEN (2015), and most likely in other specialist reports, the terrestrial habitat surrounding the estuary and the coastal dune field are classified as critical biodiversity areas with the latter being part of a greater sand process corridor stretching from the Sundays River in Algoa Bay east of Gqeberha and Coega to the Swartkops River west of Gqeberha. This area forms part of one of the largest active dune fields in the world, the greater Alexandria dune field. Any development or hard structures proposed need to take cognisance of this and the potential impacts it may have especially on sediment transport (CEN, 2015). Rehabilitation of currently spoilt and degraded systems is encouraged as is responding to dynamic processes through increasing the resilience of natural and social systems.

Potential impact on these dune systems during the transmission line installation is deemed to be negligible with impacts limited to the construction area. Any increase in wind-blown sand, as a result of construction, can be mitigated through best practice methods.

As detailed in the original Climate Change specialist report (Themis Environmental, 2021) and subsequent updated report, a trend of increasing aridity (arid, steppe, hot climate category) is likely to alter sediment dynamics and transport regimes as more arid conditions allow for the liberation of dune sediments, increasing the likelihood of aeolian sediment transport as well as increases in the conditions favourable for the development and spread of wildfires. This is of particular relevance to the sand corridor and neighbouring greater Alexandria dune field.

The City of Port Elizabeth (now Gqeberha) /Nelson Mandela Bay Metropole, proposes that a holistic assessment be undertaken, in conjunction with TNPA, which considers the dune/sand system (erosion, deposition) and includes the determination of a 'sand budget' for the coastal zone. As detailed in CEN (2015), "*the study should inform best practice methods to protect landward structures and infrastructure from coastal erosion and/or sand inundation, and measures to encourage beach nourishment and dune stabilisation*".

Climate change vulnerability

The proposed operation could be susceptible to impacts relating to sea level rise (SLR), which is projected globally to be between 60 and 90 cm by 2100 according to the Intergovernmental Panel on Climate Change (IPCC). While possibly not relevant considering the intended lifespan of the project, locating the proposed activity within the port (safe harbour) and the inland orientation of the transmission line greatly reduces the potential of these impacts. It should be noted that the activity, as a result of its location within a port, will not be regulated by the Coastal Management Line proposed to be determined by the Eastern Cape Government. This specific impact is rated in the Climate Change specialist report (Promethium Carbon, 2022).

Table 7-56: Impact 10 Ratings for the effect on/of dynamic coastal processes

	Duration	Extent	Severity	Consequence	Probability	Frequency	Likelihood	Significance
Transmission Route Alternative 1 (preferred)	**3**	**2**	**3**	**2.3**	**2**	**1**	**1.5**	**3.5 Low**
Transmission route Alternative 2	**3**	**2**	**3**	**2.7**	**2**	**1**	**1.5**	4.0 **low**
Transmission route Alternative 3	**3**	**2**	**3**	**2.7**	**3**	**1**	**2.0**	**5.3 Medium - low**
Site office complex	**1**	**1**	**2**	**1.3**	**4**	**3**	**2.5**	**3.3**
Stringing yard	**1**	**1**	**2**	**1.3**	**4**	**3**	**2.5**	**3.3**
Gas pipeline Alternative 1 Preferred	**3**	**2**	**3**	**2.7**	**3**	**1**	**1.5**	**4 Medium-low**

Gas pipeline Alternative 2	**3**	**2**	**2**	**2.3**	**2**	**1**	**1.5**	**3.5 Low**
Mitigation measures: • Locate transmission lines along the preferred route – *i.e.* along existing roads/routes • During the construction of the transmission lines, limit the removal of endemic vegetation, however, invasive alien vegetation infestation in respect of disturbed areas must be removed, controlled and the area rehabilitated. • Dust or sand suppression should be undertaken by watering down and limiting activity in windy conditions. • The Karpowership must be aware of TNPA Environmental Management Systems as well as emergency preparedness and response procedures and apply such on an ongoing basis and in the event of emergencies, for example, tidal surge, dust storms and other extreme events. • Consideration must be taken of sediment transport routes and the impact the construction of the transmission lines will have on this as well as the impact the liberated sand will have on it – innovative design solutions which will avoid the build-up of sand and possible damage to transmission infrastructure should be considered. Any areas disturbed should be rehabilitated. • Coastal development must be designed to build resilience to the impacts of climate change, sea-level rise and increased storminess. • Environmental quality control and monitoring of construction and operational activities is required.								
Transmission Route Alternative 1 (preferred)	**3**	2	2	**2.3**	**2**	**1**	1.5	**3.5 Low**
Transmission route Alternative 2	**Not applicable**							
Transmission route Alternative 3	**Not applicable**							
Site office complex	**1**	**1**	**1**	**1.0**	**2**	**3**	2.5	**2.5 Very Low**
Stringing yard	**1**	**1**	**1**	**1.0**	**2**	**3**	2.5	**2.5 Very Low**
Gas pipeline Alternative 1	**3**	**2**	**2**	**2.3**	**2**	**1**	1.5	**3.5 Low**
Gas pipeline Alternative 2	**3**	**2**	**2**	**2.3**	**2**	**1**	1.5	**3.5 Low**
Reversibility	The impact is reversible.							
Irreplaceability of Resources	The impact causes a loss of resources that can be replaced.							
Fatal flaw	This impact is not considered a fatal flaw.							

7.5.12.3 Cumulative Impacts

The ICM Act is clear in its directive not to view development activities in isolation from their local and regional contexts, but rather to consider direct and indirect impacts as well as potential cumulative and synergistic impacts of proposed activities in the coastal zone. Assessing cumulative impacts involves examining the impacts of a proposed activity at a coarser scale, and in relation to adjacent and regional activities. Need and desirability, and potential oversupply of power, of the various options should be considered in the overarching environmental impact assessment.

As the project site is located within the existing and operational Port of Ngqura, existing and operational facilities in proximity include: various powerlines, a sub-station, a Health Care Risk Waste (HCRW) incinerator, a smelter, marine intake and outfall infrastructure, solid and liquid bulk storage facilities, an automotive manufacturing plant and the Coega Power Peaking Plant on Zone 13. Other proposed alternate power projects identified within the area include:

- 3 000 MW Coega Gas-to-Power Project (Number of projects within CDC)
- 200 MW Engie CB Hybrid Power Project (Application was refused, No re-application)

It should be noted that not all these identified projects may be implemented making the collective assessment of potential cumulative impacts a hypothetical exercise. Should the proposed Gas to Power project be approved and go ahead, cumulative impacts that may arise and are anticipated to be discussed in more detail in the collective environmental impact report (EIR) will include, but not be limited to, the following considerations:

- The project will positively impact on the port function and the economic activities related thereto by providing for short term provision of power to the SEZ when the country is experiencing power shortages. The increased electricity generation capacity, when considered as part of the national Integrated Resources Plan (IRP), from the project will contribute to an enabling environment for economic growth even at times of power shortfalls and during load shedding;
- The Project compliments the other technologies (wind, solar and battery storage) involved in RMI4P. Other technologies also have significant GHG emissions, lack more local content, and harm the fragile marine environment. All technologies have some environmental impact; Importantly, energy procurement considerations (RMIPPP, IRP, SIP) do not override environmental considerations;
- The project might add to the potential polluting activities in Algoa Bay and the port, especially when combined with other shipping, LNG deliveries and port and SEZ heavy industrial activities, with resultant negative impacts on the Marine Protected Area, marine mammals and birds. There is also the potential for the introduction of pathogens which could affect mariculture facilities and operations (CEN, 2015). Such events must be controlled collectively by the TNPA and SAMSA. While issues relating to pollution are not considered to be of greater threat or significance than current port activities, the risk of cumulative impacts to the sensitive marine and estuarine environments increases as activities within the port increases;
- The cumulative impact of the project in relation to dynamic coastal processes (increased storminess, tidal surge etc.), should the proposed additional LNG projects be successful, could increase the risk to all vessels (possible collision etc.) and port operations. Again, this would be part of normal shipping practices controlled by the TNPA;
- The project will contribute to further disturbance to coastal/estuarine bird populations utilising the estuary, the beach within the port and surrounding dune environments with significant development projects underway around the estuary, the birds will gradually be displaced, especially under the long-term plans to excavate the estuary to increase the size of the port. Ultimately, all remaining estuary functioning (*i.e.* habitat provision) will be entirely lost with the ongoing development and expansion of the port; and
- A final issue to be considered when assessing the potential cumulative impacts of these various options is the transient nature of the Power Ship gas to power proposal, this activity, in comparison to the infrastructural development, landscape transformation of longer-term environmental impacts of the proposed land-based operations.

All efforts should be made to mitigate potential negative cumulative impacts identified by considering the proposed development in both a local and regional context in terms of other current and proposed coastal activities.

7.5.12.4 Specialist Conclusion

Taking into account the applicable specialist assessments the overall impact of the Gas to Project on the Coega Estuary and coastal environment will be medium-low to low. The proposed project is considered acceptable from a coastal and estuarine perspective and, should it be authorised, the preferred alternative is recommended taking due consideration of the suggested mitigation measures in this, and all other, specialist reports.

7.5.13 Atmospheric Impacts

The combustion of LNG results in gaseous emissions of sulphur dioxide (SO_2), oxides of nitrogen (NO + NO_2 = NO_X), carbon monoxide (CO), and some particulate matter (PM). Carbon dioxide (CO2) is the main Greenhouse Gas resulting from LNG combustion. SO_2 is produced from the combustion of sulphur in the LNG. NO_X is produced from thermal fixation of atmospheric nitrogen in the combustion flame and from oxidation of nitrogen bound in the LNG. The quantity of NOx produced is directly proportional to the temperature of the flame. The non-combustible portion of the fuel remains as solid waste and emitted as particulates.

The original Karpowership configuration presents a worst case emission scenario for the Karpowership Project with 6 more engines than the current case. The original configuration of a Khan Class Powership and an Orca Class Powerbarge is therefore retained in this assessment. For the original assessment it is also assumed that operations are continuous, i.e. 24 hours per day for 365 days. For the current proposed configuration, operations are likely to be limited to 16.5 hours per day. The estimated emissions are for the worst case emission scenario (original Karpowership configuration). The total emission rates from the point sources on the Powership and Powerbarge, and the FSRU are presented in Table 7-57.

Table 7-57: Annual emissions from the Karpowership project (t/a) – 39 Engines

Source	SO_2	NO_X	PM_{10}
Powership	36.7	917.1	183.4
Powerbarge	21.0	524.1	104.8
FSRU	7.0	174.7	34.9

LNG supply vessels will restock the FSRU approximately once every 20 to 30 days. The supply vessel will dock alongside the FSRU during the transfer which will take approximately 24 hours. For the purposes of this assessment the emissions from the LNG resupply are regarded as fugitive emissions. Emissions from the ship manoeuvring from the port entrance to the berth, and during the LNG transfer are presented in Table 7-55. Ship manoeuvring assumes main engines while auxiliary engines are assumed during LNG transfer.

Table 7-58: LNG supply ship emissions (tonnes/annum)

Source number	SO_2	NO_X	PM_{10}
Ship manoeuvring	0.66	5.91	0.13
At berth	0.55	3.50	0.10
Total	1.12	9.41	0.23

The air quality impacts associated with the proposed Karpowership Project is assessed based on the predicted ambient SO2, NO2 and PM10 concentrations.

7.5.13.1 *Impact assessment findings (with and without mitigation):* ***Powership and FSRU: Operational Phase***

The air quality impacts associated with the proposed Karpowership Project is assessed based on the predicted ambient SO2, NO2 and PM10 concentrations and the methodology described above. The Karpowership Project is assessed alone, and the cumulative effect of the project to ambient air quality in Coega SEZ is assessed. Impact scores are presented in the tables below.

Impact Status

Emissions of SO_2, NO_X and particulates form the sources associated with the Karpowership Project result in an increase in ambient concentration of SO_2, NO_2 and PM_{10}. Exposure to air pollutants through inhalation poses a health risk, regardless of the concentration. The status of the impact is therefore negative for Karpowership alone and cumulatively with other sources.

Impact confidence

The assessment is based on reliable emissions data, reliable meteorological data and applies the DEA recommended dispersion modelling principles (DEA, 2014b). The assessment team has significant experience and is familiar with the project site and the powership concept. The confidence in the impact assessment is therefore high for the Karpowership alone and cumulatively with other sources.

Severity

The severity of the impact of the Karpowership Project emissions on ambient air quality isassessed by comparison of the predicted SO_2, NO_2 and PM_{10} concentrations with the health-based NAAQS.The predicted ambient SO_2 concentrations are very low relative to the NAAQS. The maximum predicted concentrations are less than 1% of the limit value of the NAAQS. The severity of the impact associated with SO_2 for the Karpowership Project is therefore predicted to be insignificant. The predicted ambient NO2 concentrations are low relative to the NAAQS. The maximum predicted annual concentrations are less than 5% of the NAAQS limit value while the maximum predicted 24-hour concentrations are 16% of the NAAQS. There are no predicted exceedances of the NAAQS. The severity of the impact associated with NO_2 for the Karpowership Project is therefore predicted to be low.

The predicted PM_{10} concentrations are very low, with the maximum concentrations less than 1% of the limit value of the NAAQS. The severity of the impact associated with PM_{10} is therefore predicted to be insignificant. Monitoring has shown ambient SO_2, NO_2 and PM_{10} concentrations as relatively low in the Coega SEZ and below the NAAQS. The cumulative effect of the contribution from the Karpowership Project is predicted to be very small and the potential increase in ambient concentrations is highly unlikely to result in exceedances of the NAAQS. The severity of the cumulative impact associated with SO_2 and PM_{10} is therefore predicted to be insignificant, and small for NO_2.

Duration

The duration of the impact of the Karpowership Project emissions on ambient air quality depends on the life of the project. The impacts will exist while the project is operational. It is assumed that this will be more than 10 years. The duration will be long-term for the cumulative impact, i.e. while the Karpowership Project and other sources are in operation.

Spatial scale

The spatial scale of the impact of the Karpowership Project emissions on ambient air quality is assessed by evaluation the spatial extent of predicted SO2, NO2 and PM10 concentrations. In all cases the predicted ambient concentrations are low relative to the NAAQS and the highest predicted concentrations occur over the Coega SEZ. The spatial scale of the impact is limited to the Coega IDZ and the immediate surrounding areas for the Karpowership project alone, as well as the cumulative impact with other sources.

Consequence

Consequence is a function of the severity, duration, and spatial scale. The severity is very low for SO_2 and PM_{10}, and low for NO_2. The duration will be for life of the project, and the spatial scale is limited to the Coega SEZ. The consequence of increased ambient concentrations of SO_2, NO2 and PM_{10} from emissions from the Karpowership Project is therefore predicted to be low. The consequence of the addition to existing ambient concentrations, i.e. the cumulative effect, is also low.

Frequency

The predicted ambient concentrations of SO_2, NO_2 and PM_{10} are very low. The highest predicted concentrations are well below the respective NAAQS and occur over the Coega SEZ. Impacts are unlikely to occur and the frequency is therefore predicted to be very low. The frequency rating is also low for the cumulative effects.

Probability

The predicted ambient concentrations of SO_2, NO_2 and PM_{10} are very low. The highest predicted concentrations are well below the respective NAAQS and occur over the Coega SEZ. The probability of impacts occurring is unlikely and is therefore predicted to be almost never alone and cumulative with existing sources.

Likelihood

Likelihood is a function of frequency and probability. These are both low for SO_2, NO_2 and PM_{10} so the likelihood of air quality impacts occurring is also low for Karpowership alone and cumulatively with existing sources.

Reversibility

The predicted ambient concentrations of SO_2, NO_2 and PM_{10} are very low and well below the respective NAAQS. Air quality impacts occurring in the ambient environment are therefore expected to reverse with minimal rehabilitation and negligible residual effects, and is therefore considered to be completely reversible for Karpowership alone and cumulatively with existing sources.

Irreplaceability

The predicted ambient concentrations of SO_2, NO_2 and PM_{10} are very low and well below the respective NAAQS. Air quality impacts occurring in the ambient environment are therefore not expected to incur a loss of any resources for Karpowership alone and cumulatively with existing sources.

Significance

Significance is a function of consequence and likelihood. For SO_2 and PM_{10} the consequence of impacts is very low, and for NO_2 is low. With a low likelihood of occurrence of impacts associated with SO_2, NO_2 and PM_{10}, the significance of any impacts is predicted to be very low for Karpowership alone and cumulatively with other sources.

Table 7-59: Air Quality Impact Scores

Description	Pollutants	Severity	Duration	Spatial scale	Consequence	Frequency	Probability	Likelihood	Significance	Status	Confidence	Reversibility	Irreplaceability
Karpowership Project	SO_2	1	4	1	2	1	1	1	2 – Very low	-ve	High	Completely reversible	No loss
	NO_2	2	4	2	2.7	1	1	1	2.7 - Very low	-ve	High	Completely reversible	No loss
	PM_{10}	1	4	1	2	1	1	1	2 – Very low	-ve	High	Completely reversible	No loss
Cumulative assessment	SO_2	1	4	1	2	1	1	1	2 – Very low	-ve	High	Completely reversible	No loss
	NO_2	2	4	2	2.7	1	1	1	2.7 – Very low	-ve	High	Completely reversible	No loss
	PM_{10}	1	4	1	2	1	1	1	2 – Very low	-ve	High	Completely reversible	No loss
Cumulative assessment of other gas-to-power projects	SO_2	1	4	1	2	1	1	1	2 – Very low	-ve	High	Completely reversible	No loss
	NO_2	2	4	2	2.7	1	1* 2**	1* 2**	2.7 – Very low* 4.7 – Low**	-ve	High	Completely reversible	No loss
	PM_{10}	1	4	1	2	1	1	1	2 – Very low	-ve	High	Completely reversible	No loss
* : Engie using LNG **: Engie using diesel													

***7.5.13.2** Cumulative Impacts*

The Department of Mineral Resources and Energy launched the Risk Mitigation Independent Power producers Programme (RMI4P) in August 2020 to procure 2 000 MW of new generation from a range of energy technologies. The objective being to fill the short-term supply gap, alleviate the current electricity supply constraints and reduce the extensive use of diesel-based peaking generators.

Besides the Karpowership Project, it is reasonable to expect that other electricity generation project may be procured in the Coega SEZ as part of the RMI4P. It is therefore relevant to assess the potential cumulative effects of these project on ambient air quality in the Coega SEZ. Two potential gas-to-power projects are reviewed to assess the potential cumulative impacts of the suite of gas-to-power project.

3 000 MW Coega Gas-to-Power Project

The proposed Coega 3000 MW Integrated Gas-to-Power Project will ultimately include a land-based LNG terminal and three 1 000 MW Gas to Power plants, two in Zone 10 and one in Zone 13 of the SEZ. Power generation will be by means of a hybrid of Combined Cycle Gas Turbines (CCGT), Open Cycle Gas Turbines (OCGT), and Reciprocating Engines (RE). Each power plant will use LNG as the primary source of fuel, with diesel and fuel oil as back up fuels. On-site storage of back up fuels will include two 4 000 m³ tanks for diesel and two 4 000 m³ tanks for fuel oil, or 8 000 m³ in total. AIRs were done for the four projects individually (uMoya-NILU, 2020a ,b, c, d). Each

AIR also considered cumulative effects of the respective individual projects with other sources in the Coega SEZ, with the other three project comprising the 3 000 MW Integrated Gas-to-Power Project, and the 3 000 MW project with other sources in the Coega SEZ. The cumulative effects of the 3 000 MW Integrated Gas-to-Power Project was also assessed with two other gas-to-power projects, namely Karpowership and the Engie CB Hybrid project. The findings of the AIR's are summarised here:

The 3 000 MW Coega Gas-to-Power Project:

- For SO_2, NO_2 and PM_{10} the extent of the potential impact limited to the Coega SEZ.
- The predicted ambient concentrations resulting from the power plant emissions are very low and the intensity is rated as very low, but will endure for the life of the power project.
- As the intensity of impacts is very low and the probability of air quality impacts from the power stations are improbable for all pollutants.
- The significance of the impacts on ambient air quality was rated as insignificant for all pollutants.

Cumulative effect of the 3 000 MW Coega Gas-2-Power Project with existing sources:

- For SO_2, NO_2 and PM_{10}, the extent of the potential impact is small and limited to the SEZ. The cumulative effect in the SEZ will therefore be very small or negligible.
- The predicted ambient concentrations resulting from emissions from four project components are very low and the intensity is rated as low for NO_2 and irrelevant for SO_2 and PM_{10}. It is highly unlikely that they will contribute to exceedances of the ambient standards.
- The significance of the cumulative effect of the project in the SEZ was rated as very small or negligible.

Cumulative effect of the other proposed gas-to-power project in the Coega SEZ

- The proposed Karpowership project in the port of Ngqura is predicted maximum concentrations of SO_2, NO_2 and PM are very low relative to the NAAQS.
- The proposed Engie fired power plant will result in very low ambient concentrations of SO_2, NO_2 and PM relative to the NAAQS. In all cases the predicted maximum concentrations will occur over the Coega SEZ.
- For SO_2, NO_2 and PM_{10} the extent of the potential impact of the other gas-to-power projects is small and limited to the SEZ. The contribution will not significantly increase the ambient concentrations and will not result in exceedances of the NAAQS. The cumulative effect in the SEZ will therefore be very small or negligible.
- The intensity of the cumulative is rated as low for NO_2 and irrelevant for the other pollutants. The cumulative effect of the gas-to-power projects will be very small or negligible.

200 MW Engie CB Hybrid Power Project

The proposed 200 MW Engie CB Hybrid Power Project will be adjacent to the Dedisa Substation in Zone 13 of the Coega SEZ. The power plant will use LNG as the primary source of fuel in Reciprocating Engines, with diesel as back up fuel. Both fuel options were assessed in the AIR (uMoya-NILU, 2021).

The predicted ambient SO_2, NO_2 and PM_{10} concentrations are very low for the LNG fuel option. The significance of the air quality impacts for the LNG option were rated as insignificant for SO_2 and PM_{10} and low for NO_2. The significance of the air quality impacts for the LNG option are therefore insignificant for SO_2 and PM_{10} and low for NO_2.

The predicted ambient SO_2 and PM_{10} are low for the diesel fuel option. The significance of the air quality impacts for the diesel option are very low to insignificant for SO_2 and PM_{10} and medium for NO_2. The significance of the air quality impacts for the diesel option are therefore rated very low to insignificant for SO_2 and PM_{10} and medium for NO_2.

Summary

The cumulative impacts on air quality of the possible gas-to-power projects with the Karpowership Project may be assessed if it is assumed that the project operate together. The significance of the impacts resulting from operations of the individual projects are presented in Table 7-60. The highest rating for an individual project is used to assess the potential cumulative impact of the four gas-to-power projects Table 7-60.

For SO_2 and PM_{10} the significance of the cumulative impact of Karpowership with other gas-to-power projects are rated as very low, and medium for NO_2. The same conclusion was drawn regarding the cumulative impacts of the gas-to-power projects in the AIRs for the Coega 3 000 MW Integrated Gas-to-Power project (uMoya-NILU 2000a, b, c, d)

Table 7-60: Significance of Project and Cumulative Impacts

Project	SO_2	NO_2	PM_{10}	Reference
Karpowership	Very low	Very low	Very low	This report
Coega 3 000 MW gas-to-power	Very small to negligible	Very small to negligible	Very small to negligible	uMoya-NILU (2020a, b, c, d)
200 MW Engie CB Hybrid Power Project	Insignificant[1]	Low[1]	Insignificant[1]	uMoya-NILU (2021)
	Very low to insignificant[2]	Medium[2]	Very low to insignificant[2]	1: LNG 2: Diesel
Cumulative impact	Very low[1,2]	Low[1] Medium[2]	Very low[1,2]	1: Engie using LNG 2: Engie using diesel

7.5.13.3 Mitigation Measures and Recommendations

- LNG is a clean fuel with very low SO2 and particulate emissions. No emission abatement will be installed for the control of these emissions.
- NOX emissions are controlled to the required concentration at source using selective catalytic reduction (SCR).

7.5.13.4 Specialist Conclusion

From an air quality perspective, it is the reasonable opinion of the authors that the Karpowership Project should be authorised considering the findings of this AIR.

7.5.14 Terrestrial Noise Impacts

In order to determine the noise impacts of a powership at the Port of Ngqura, a study on the noise levels of a similar vessel had to be determined. Airborne noise levels were sampled during the operation of the Osman Khan Powership at Sekondi-Takoradi, Ghana, in September 2022. The noise from the powership came from two clear source types. On the water in the harbour, low elevation air intakes produced noise from the ducts linked to operating engines. At high level, heat exhaust outlets behind a louvre are a significant source of noise. A sample noise measurement was taken on the ship at 3 m from this position (1 engine operating). There was no obvious noise audible from the chimney stacks, suggesting that the primary noise sources were the air intake and exhaust duct openings, although the hull itself is likely to radiate to some extent. Built-in noise attenuation such as silencers in the stacks and machinery vibration isolation will help to reduce the escape of noise.

Measurements were taken on a mobile survey vessel that transited on transects around the ship. A total of eight datasets were sampled, at three power outputs, i.e. at low output with 1 engine running at approximately 16 MW, at medium output with 14 engines at approximately 250 MW, and at maximum available power with 23 engines at approximately 420 MW (1 engine was offline for maintenance), each under downwind and upwind conditions. Conditions during the surveys were ideal for environmental noise measurement, clear and dry, with temperatures around 24-27°C and relative humidity above 80% remaining fairly consistent day to day. Wind direction was south westerly and typically remained between 1 and 3 m/s. The wave height was less than 0.5 m at all times.

Noise levels were sampled on the survey vessel at various distances from the ship, between 50 m at the closest point and 800 m at the furthest. Noise from the Powership was audible at all distances. The noise level was 70.0 dB LAeq at the closest measured position on the water, 50 m, at 420 MW. On the adjacent quayside, 35 m away from the hull, a higher noise level was recorded at 71.3 dB LAeq (and 74.3 dB under significant venting from the ship a condition which was not noted at any other time).

At the furthest location, 800 m downwind from the ship and at full power, the measured noise was 55.0 dB LAeq. Due to the lack of other noise sources in the vicinity, no noise other than the Powership contributed significantly to the survey environment.

The effect on the noise at lower electrical power outputs was as would be expected, where a reduction in power output led to a commensurately lower noise level, and noise attenuated more quickly with distance upwind, compared to downwind.

The impact of the noise pollution that can be expected from the site during the construction and operational phase will largely depend on the climatic conditions at the site. The noise impact however will be the most significant during calm meteorological conditions when little wind noise masking will occur, therefore this worst-case was considered and wind speed and direction was not considered during the impact assessment process.

7.5.14.1 *Impact assessment findings (with and without mitigation):* ***Transmission Line Alternatives 1, 2 and Construction Faciliities: Construction Phase***

The field study results showed that the ambient noise levels in the area of the proposed development was 61.5 dB(A). NSA 2 is approximately 620m away from the nearest major noise source (the Powership). Taking this distance and Table 61 into consideration, it can be inferred that NSA 2 will experience noise levels of 55.0 dB(A), which is lower than the ambient noise levels. The receptor at NSA 2 will therefore experience no noise impact as the noise from construction will be masked by the ambient noise from the wind, sea, and other port operations.

Mitigation actions for the Construction phase:

As a precautionary measure vibro-piling (if required) should not occur at night. Secondly, all staff on the construction project should receive training to mitigate the noise impacts. In summary, for the construction phase it is unlikely that the construction noise will impact on the noise sensitive areas over the short term.

With the effective implementation of the above recommended mitigation measures, the residual noise impact associated with construction activities are predicted to be of **low** significance. It is recommended that the ambient noise around the project and at the closest receptors be monitored during the construction phase.

Table 7-61: Noise Impact for the Construction Phase

	Severity	Duration	Spatial Scale	Consequence	Frequency	Probability	Likelihood	Significance	Status	Confidence	Reversibility	Irreplaceability	Fatal Flaw
Before Management	2	4	2	2.6	2	2	2	5.2	Medium-Low	High	Yes	No	No
Management Measures													
Measures related to the construction phase: • All construction operations should only occur during daylight hours if possible. • No construction piling should occur at night where possible. Piling should only occur during the day to take advantage of unstable atmospheric conditions that aids noise attenuation. A noise survey should be conducted at the noise sensitive receptors during the construction phase.													
After Management	2	4	2	2.6	2	1	1.5	3.9	Low	High	Yes	No	No
No-go Option	-	-	-	-	-	-	-	-	-	High	-	-	-

7.5.14.2 *Impact assessment findings (with and without mitigation):* ***<u>Powership and FSRU: Operational Phase</u>***

The operational noise levels of the proposed project are below the SANS 10103:2008 recommended levels for a majority of the human receptors within the Coega SEZ and at the SEZ boundary.

The noise impact associated with the operational activities of the proposed project is predicted to be of Low significance after mitigation on the employees of the Port of Ngqura and CDC tenants. The terrestrial environmental noise impact statement for the operational phase rating is presented in Table 7-62 below.

Table 7-62: **Noise Impact for the Operational Phase**

	Severity	Duration	Spatial Scale	Consequence	Frequency	Probability	Likelihood	Significance	Status	Confidence	Reversibility	Irreplaceability	Fatal Flaw
Before Management	2	5	2	3	1	3	2	6	Medium Low	High	Yes	No	No
Management Measures													
Measures related to the construction phase: • The noise impact from the proposed project should be measured during the operational phase, to ensure that the impact is within the required legal limits.													

	Severity	Duration	Spatial Scale	Consequence	Frequency	Probability	Likelihood	Significance	Status	Confidence	Reversibility	Irreplaceability	Fatal Flaw
• Ensure that any acoustic enclosures or attenuators that are installed on the vessel are permanently in place during operations. • If possible, position the ship so that the port side that contains the air inlets is positioned away from the very sensitive receptors such as residential communities.													
After Management	1	4	2	2.3	1	2	1.5	3.45	Low	High	Yes	No	No
No-go Option	-	-	-	-	-	-	-	-	-	High	-	-	-

7.5.14.3 *Impact assessment findings (with and without mitigation):* ***Powership and FSRU: Operational Phase***

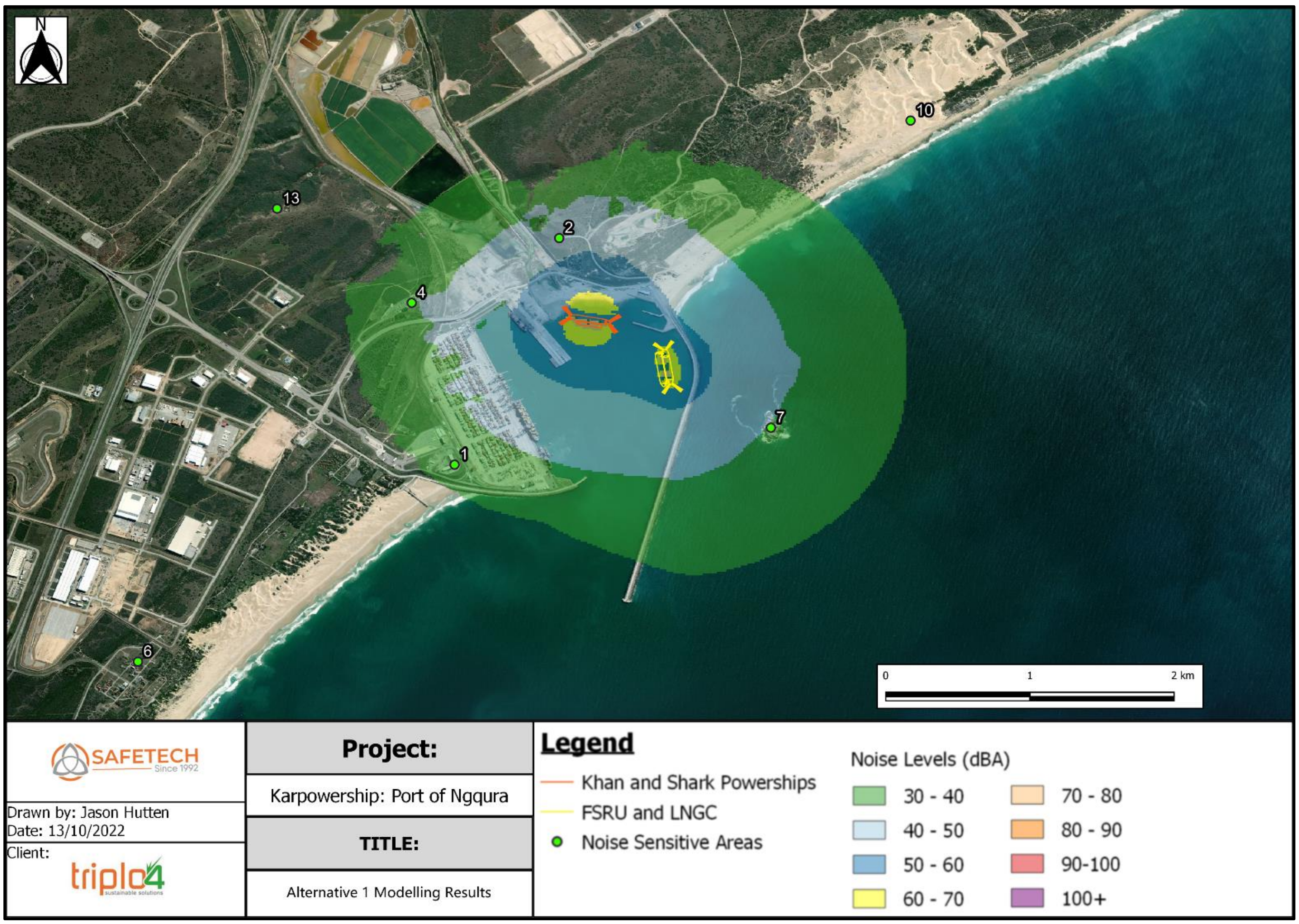

Figure 7-10: Predicted noise levels during the operational phase

7.5.14.4 *Cumulative Impact*

The cumulative impact from the other noise sources in the Port of Ngqura is extremely difficult to predict. As the noise level at a receptor increases, the "loudest noise" will generally be heard. Therefore, if in future another noise source e.g. a power plant, is located closer to the receptor and it is generating more noise energy, the new noise source will be prevail above the other noise sources.

Currently, several projects pertaining to power generation are being considered within the Coega SEZ and Port of Ngqura. These proposed developments include the CDC Gas to Power Projects (comprised of 3 power plants and auxiliary gas infrastructure) and the Engie Gas to Power Project.

Due to the lower Sound Power Levels expected based on the updated information supplied by the Osman Khan Ghana Study, the major contributor of noise impacts on the NSAs will be the proposed power plants in Zone 10 of IDZ. The noise impact was thus not remodelled as the noise produced by the Powerships, FSRU and LNGC will be masked by the Zone 10 Power Plants.

7.5.14.5 Specialist Conclusion

The results of the noise impact assessment of the proposed Gas to Power - Powership Project within the Port of Ngqura in the Coega SEZ shows that at none of the terrestrial receptors the SANS 10103:2008 rating limits will be exceeded. The noise impact associated with the operational activities of the proposed project is predicted to be of Low significance after mitigation measures are implemented. The construction related noise impacts will be of Low significance after mitigation measures are implemented.

7.5.15 Climate Change Impacts

Several scenarios are assessed in terms of the generation and resulting emissions from the Project. The emissions are calculated for three scenarios where the Project is run at 100%, 50% and 25% of the full 16.5hrs/day at the contract capacity. The results are shown in Table 7-63 below. The scenarios indicate that the impact intensity of the project falls into the medium threshold when the Project is not operated at 100% of the contracted capacity.

Table 7-63: **Emissions by generation scenario**

Scenario	Operating hours/day	Annual emissions	Lifetime emissions	Impact Intensity
100%	16.5 hrs/day	1 536 078 tCO_2e	30 721 561 tCO_2e	High
50%	8.25 hrs/day	768 039 tCO_2e	15 360 781 tCO_2e	Medium
25%	4.125 hrs/day	384 020 tCO_2e	7 680 390 tCO_2e	Medium

Table 7-64: Operation emissions (100% scenario)

Emission category	Emission source	Operation phase	Total over life of project (20 years)
Category 1: Direct GHG emissions and removals	Natural gas combustion	1 388 200 tCO_2e	27 763 994 tCO_2e
Total Direct emissions		**1.4 million tCO_2e**	**27.8 million tCO_2e**
Category 3: Indirect GHG emissions from transportation	Natural gas transport	49 082 tCO_2e	981 642 tCO_2e
Category 4: Indirect GHG emissions from products used by organization	Purchased steel	Not significant	Not significant
	Purchased cement	Not significant	Not significant
	Natural gas production	99 174 tCO_2e	1 983 480 tCO_2e
	Total Category 4 emissions	**99 174 tCO_2e**	**1 983 480 tCO_2e**
Total indirect emissions		**148 $ktCO_2e$**	**3.0 million tCO_2e**
Total emissions		**1.5 million tCO_2e**	**30.7 million tCO_2e**

The lifetime emissions in this report assume that the project operates for a full 16.5 hours a day for the full lifetime duration. This represents a worst-case scenario for the lifetime emissions. However, the actual emissions are directly proportional to the dispatch instructions received from the System Operator. The RFP for the RMIPPP states "*dispatchable and flexible generation"* as a performance requirement. This means that the project will only export electricity, thus combusting natural gas for its generation, upon receipt of a dispatch instruction. As a result, the actual emissions from the project may be much lower depending on these instructions.

The use of natural gas as an energy source in electricity generation is less emissions intensive than coal-based power. Natural gas combustion releases approximately half the emission of that of coal (if coal is not used as a feed product in the production of the natural gas and that the fugitive emissions during extraction are well managed). Thus, the use of natural gas for electricity generation could reduce the amount of GHG emissions and pollutants produced in the generation of electricity in South Africa.

The combustion of natural gas also results in lower emissions than the combustion of diesel. This is a relevant comparison as Eskom operates its peaking plants on diesel. The combustion of diesel results in approximately 74.1 tCO_2e/TJ in comparison to natural gas which emits approximately 56.1 tCO_2e/TJ.

The combustion of natural gas is also cleaner than that of diesel and coal in terms of air quality and pollution prevention. Natural gas combustion does not release particulate matter, nor does it emit as many harmful nitrates (NO_X) and sulphates (SO_X) as are emitted during the combustion of coal.

A comparison of the emissions per unit of energy from alternative power sources is provided in Table 7-65 below. Using coal as a feedstock will result in the largest emissions while renewables have minimal operational emissions. Natural gas has an emission factor that is much lower than coal and diesel resulting in less emissions during operation.

Table 7-65: **Alternative generation sources**

Power source	Emission Factor
Coal	96.1 tCO_2/TJ
Diesel	74.1 tCO_2/TJ
Natural Gas	56.1 tCO_2/TJ
Renewables	0 tCO_2/TJ

Avoided emissions

The implementation of the Project may result in avoided emissions. These are emissions that may be emitted if the project is not implemented. These emissions are calculated in accordance with the GHG Protocol's guidance document for comparing products. In accordance with this guidance, the baseline technology for calculating the avoided emissions is Eskom's coal fleet.

The avoided emissions are only calculated as the emissions avoided from the switch to gas from coal. The grid emission factor from the IRP has been used to calculate the avoided emissions to reflect the anticipated change in the energy mix as set out by national policy. The emissions are only calculated for the period up to 2030, thereafter it is assumed that the majority of the energy mix will be renewables and there will be no avoided emissions from a coal fleet.

The avoided emissions from the Karpowership Project at Ngqura are shown in Table 7-66 below. The total avoided emissions between 2023 and 2030 is approximately 17 million tCO_2e.

Table 7-66: **Avoided emissions**

	2023	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
IRP Grid EF (tCO$_2$e/MWh)	0.85	0.86	0.85	0.83	0.81	0.77	0.73	0.67
Avoided emissions (m**illion tCO$_2$e**)	2.27	2.3	2.27	2.2	2.2	2.1	2.0	1.8

7.5.15.1 *Impact assessment findings (with and without mitigation):* ***Powership and FSRU: Operational Phase***

The proposed Karpowership Project would result in approximately 1.5 million tCO_2e/annum and 31 million tCO_2e over the PPA duration assuming that the project operates 16.5hours per day per year. This falls within the high intensity as assessed against the thresholds. The emissions from the Project would have a negative climate change impact.

The Project can offer load following capability required to stabilise additional renewable energy capacity until sufficient battery storage is added to the grid. The additional renewable energy that this enables would result in avoided emissions that exceed the operational emissions of the project. These avoided emissions are in addition to the avoided emissions from switching from the coal fleet in the national grid. This would be a positive impact from the Project on climate change.

Natural gas power plants offer a transitional option to switch from a predominantly coal based grid system to a lower emission option. This enables electricity generation to allow economic growth while sufficient renewable generation with battery storage is brought online. Operating the natural gas power plant would allow for less emissions than generating the same electricity from a coal fired power station. The natural gas power plant further offers dispatchable power as required unlike renewables without battery storage.

The lifetime operational emissions of the Project, 31 million tCO_2e, can be compared to the impact category thresholds as well for a cumulative impact analysis. The emissions over the 20-year lifetime of the project are comparable to 2 years of running a new coal fired power station which the upper threshold is based on. This supports the paragraph above that natural gas can be used as a transitional technology to move away from reliance on coal. If the operational emissions of the Project are analysed for just a 5-year period, the emissions total 8 million tCO_2e which remains in the high category but below the emissions from operating a coal fired power station for a year. This can be considered a positive impact allowing for economic growth while reducing the reliance on coal fired power stations.

When considering all impacts related to the project, it can be considered to have a low positive impact. Despite having a high intensity impact from operational emissions, the project enables significant reductions through avoided emissions and enabled renewables. Furthermore, it allows for economic development to occur by providing dispatchable power onto the grid which is critical for the economy.

7.5.15.2 *Mitigation Measures and Recommendations*

There are a few measures that could reduce the impact of the Project on climate change through mitigation. These measures result in lower GHG emissions and therefore reducing its impact.

- The first measure is shortening the duration of the PPA. This would result in fewer lifetime emissions from the project as the powerplant would be run for a shorter duration. However, this measure may affect the financial viability for the project.
- It is noted that the nature of the RfP for the RMIPPP is for power to be dispatched at the request of Eskom. In the case that Eskom does not require the dispatch of power, no greenhouse will be emitted from the project. It is assumed that Eskom will have increasing access to renewable energy over the duration of the project, and that more renewable energy plus battery storage projects will come on line. This may result in the project emitting significantly less emissions than what has been estimated above.
- The other measure is switching the feedstock of the Powership to a renewable energy source such as green hydrogen. This would eliminate the GHG emissions associated with the production, transport and combustion of natural gas. Within the current economic circumstances in South Africa, the use of green hydrogen is not considered a viable option for mitigation.

7.5.15.3 *Specialist Conclusion*

The project will emit 31 million tons of CO2e over its lifetime, assuming that it runs at 100% of the contracted capacity. We note that the RMIPPP RfP states that the power from the plant must be dispatchable at required of the grid operator and requires that the plant bid into this program must be capable of stable operation at 25% of the contacted capacity. Should the plant run at this level, the total emissions of the plant over its lifetime will be 7.7 million tons CO2e.

In accordance with the findings of this CCIA, the proposed Karpowership Project at Ngqura should not be refused environmental authorisation based on climate change related issues.

7.5.16 Socio-Economic Impacts

Table 7-67 provides an overview of the key socio-economic impacts which the Port of Ngqura Powerships and associated land-based infrastructure will have on the impact areas.

Table 7-67: *Economic Development Information for Port of Ngqura Powerships*

Indicator	Value	Page number
Total investment value	R277.95 million	36
Local content spend during construction measurement period (12 months)	R176.56 million	4
Local content spend during operating measurement period (20 years)	R6619.14 million	4
Value of total revenues received during the operating measurement period	R86.76 billion	4
Socio-Economic Development Contributions Spend during the Operating Measurement Period in Local Communities	R694.08 million	4
Enterprise Development Contributions Spend during the Operating Measurement Period in Local Communities	R277.63 million	4

Source: (Urban-Econ, 2021).

*7.5.16.1 Impact assessment findings (with and without mitigation): **Construction Phase***

7.5.16.1.1 Temporary Stimulation of the national and local economy

It was estimated by (Urban-Econ, 2021) that the national and local economies would be positively impacted in the following ways during the construction period:

Table 7-68: *Estimated impact on the nation and local economies – CAPEX*

Indicator	**Production**	**GDP**	**Page number**
Direct	R176.54 million	R50.49 million	38
Indirect	R308.31 million	R88.1 million	38
Induced	R233.96 million	R66.88 million	38
Total	R718.81 million	R205.47 million	38

Source: (Urban-Econ, 2021).

It was estimated that the largest stimulation effects to production and GDP will be through the multiplier effect, with the majority of direct spending spent within local economies. Consumption effects are the result of construction workings spending on local goods and services. (Urban-Econ, 2021) noted that mitigation/enhancement would be to encourage the engineering, construction, and procurement contractor to increase local procurement and employment as far as possible. Cumulative impacts are noted, with regards to a number of similar proposed developments in the area would drive demand for goods and services for construction of similar facilities, which could provide sufficient economies of scale for new industries.

Table 7-69: *Nature: Temporary increase in the GDP and production of the national and local economies during construction*

	Without mitigation	**With mitigation**

Spatial Scale	Regional, National, International (5)	Regional, National, International (5)
Duration	3 months to 1 year (3)	3 months to 1 year (3)
Severity	Significant (3)	Significant (3)
Frequency	Once a year (1)	Once a year (1)
Probability	Highly likely (5)	Highly likely (5)
Significance	**11 (High)**	**11 (High)**
Reversibility	Benefit is terminated with the end of construction	
Status (positive or negative)	Positive	Positive
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	

Mitigation/Enhancement:

- The developer should encourage the EPC contractor to increase the local procurement practices and promote the employment of people from local communities, as far as feasible, to maximise the benefits to the local economies.
- The developer should engage with local authorities and business organisations to investigate the possibility of procuring construction materials, goods and products from local suppliers where feasible.

Cumulative impacts:

- Currently there are no major gas developments proposed for the Eastern Cape, however, should any arise, the demand for goods and services required for the construction of similar facilities would grow. This could provide sufficient economies of scale and thus open up opportunities for the establishment of new industries in the country and new businesses in the local area, specifically in the sectors that are not well represented in the economy.

Residual Impacts:

- None foreseen at this stage

Source: (Urban-Econ, 2021).

7.5.16.1.2 *Temporary increases in employment in the national and local economies*

Urban-Econ (2021) estimated that the Powerships would create a total of 776 Full Time Equivalent (FTE[2]) employment positions during the construction phase, with the breakdown between direct, indirect, and induced employment listed below:

Table 7-70: *Breakdown of estimated Full Time Equivalent employment positions during the construction phase*

Indicator	Value	Page number
Direct	90	40
Indirect	390	40
Induced	296	40
Total	776	40

Source: (Urban-Econ, 2021).

[2] FTE refers to the total number of hours worked by one employee on a full-time basis.

It was estimated that the construction industry in the NMBMM is large enough to provide the 90 construction workers required, and it is recommended that the contractor employ as many individuals as possible from the NMBMM. Urban-Econ's (2021) review of the NMBM education and skill levels indicate that while levels are higher than other areas of the Eastern Cape, levels are still low and as such most un- and semi-skilled required during the project will be sourced from NMBM, skilled personal from outside the area would initially need to be brought in.

The direct employment opportunities are expected to have a positive spin-off effect on employment in other sectors through the procurement of goods and services, which will indirectly support an additional 390 FTE employment positions. The investment and infrastructure development by Karpowership is expected to induce a further 296 FTE employment positions.

Table 7-71: *Nature: Temporary increase in employment in local and national economies*

	Without mitigation	**With mitigation**
Spatial Scale	Regional, National, International (5)	Regional, National, International (5)
Duration	3 months to 1 year (3)	3 months to 1 year (3)
Severity	Significant (3)	Significant (3)
Frequency	Once a year (1)	Once a year (1)
Probability	Highly likely (5)	Highly likely (5)
Significance	**11 (High)**	**11 (High)**
Reversibility	Benefit is terminated with the end of construction	
Status (positive or negative)	Positive	Positive
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation/Enhancement: ▪ Organise local community meetings to advise the local labour force about the project that is planned to be established and the jobs that can potentially be applied for. ▪ Establish a local skills desk (in NMBM) to determine the potential skills that could be sourced in the area. ▪ Recruit local labour as far as feasible. ▪ Employment of labour-intensive methods in construction where feasible. ▪ Sub-contract to local construction companies particularly SMME's and BBBEE compliant and women-owned enterprises where possible. ▪ Use local suppliers where feasible and arrange with the local SMME's to provide transport, catering and other services to the construction crews.		
Cumulative impacts: ▪ None foreseen given the nature of employment.		
Residual Impacts: ▪ None foreseen at this stage		

Source: (Urban-Econ, 2021).

7.5.16.1.3 Contributions to skills development in the national and local economy

There will likely be a positive impact on skills development in both the national and local economies from construction phase and associated infrastructure development. This is partly because foreign technical experts will work with local labour during the establishment phase, which will lead to skills and knowledge transfer. Construction crews are likely to gain knowledge of development of gas industry electrical infrastructure, which is likely to have long term benefits for the industry considering the IRP 2019 targets illustrating generating capacity of 2000-3000 MW of electricity from gas by 2030 (DMRE, 2019). These skills will likely reduce the cost of future gas-related developments in the municipality and could contribute to the development of local gas industry R&D and manufacturing.

Table 7-72: *Nature: Contribution to skills development in the country and in the local economy*

	Without mitigation	**With mitigation**
Spatial Scale	Regional, National, International (5)	Regional, National, International (5)
Duration	3 months to 1 year (3)	3 months to 1 year (3)
Severity	Small (2)	Small (2)
Frequency	Once a year (1)	Once a year (1)
Probability	Unlikely (3)	Likely (4)
Significance	**6.7 (Medium-Low)**	**8.3 (Medium)**
Reversibility	Yes, skills can be lost if not practiced	
Status (positive or negative)	Positive	Positive
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	
Mitigation/Enhancement: ▪ Facilitate knowledge and skills transfer between foreign technical experts and South African professionals during the pre-establishment and construction phases. ▪ Set up apprenticeship programmes to build onto existing skill levels or develop new skills amongst construction workers especially those from local communities.		
Cumulative impacts: ▪ Improved labour productivity and employability of construction workers for similar projects. ▪ Possible development of local skills and expertise in R&D and manufacturing industries related to the gas industry through partnerships with NMU.		
Residual Impacts: ▪ South Africa's human capital development		

Source: (Urban-Econ, 2021).

7.5.16.1.4 Temporary increase in household and government earnings

The FTE employment listed in the table below are estimated to result in the following increases in household incomes:

Table 7-73: *Estimated household revenue created during construction*

Indicator	**Value**	**Page number**
Direct	R23.04 million	42
Indirect	R40.19 million	42
Induced	R30.51 million	42
Total	R93.74 million	42

Source: (Urban-Econ, 2021).

It is recommended that where feasible local labour is recruited to benefit local households not just in the short term but in the long term too (through the mechanisms mentioned in the previous section). Further it is recommended that labour intensive methods during construction are used where feasible, and that services such as transport, catering, and other services are provided to construction crews by small, medium, and medium enterprises (SMMEs) and BBBEE enterprises. The increases in household earnings, while temporary, will improve the standard of living of benefitting households.

Table 7-74: *Nature: Temporary improvement of the standard of living of the positively affected households*

	Without mitigation	**With mitigation**
Spatial Scale	Regional, National, International (5)	Regional, National, International (5)
Duration	3 months to 1 year (3)	3 months to 1 year (3)
Severity	Small (2)	Small (2)
Frequency	Once a year (1)	Once a year (1)
Probability	Likely (4)	Likely (4)
Significance	**8.3 (Medium)**	**8.3 (Medium)**
Reversibility	Benefit is terminated with the end of construction	
Status (positive or negative)	Positive	Positive
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation/Enhancement: ▪ Recruit local labour as far as feasible to increase the benefits to the local households. ▪ Employ labour intensive methods in construction where feasible. ▪ Sub-contract to local construction companies where possible. ▪ Use local suppliers where feasible and arrange with local SMME's and BBBEE compliant enterprises to provide transport, catering and other services to the construction crews.		
Cumulative impacts: ▪ Improved standard of living of the affected households		
Residual Impacts: ▪ Possible increase of households' saving accounts		

Source: (Urban-Econ, 2021).

The construction phase is expected to further generate revenue for government through companies' taxes, corporate income tax, personal income tax, and value add tax (VAT). These earnings will contribute both to local government earnings through municipal taxes – improving surrounding communities – and contribute to the national fiscus through national government levied taxes.

Table 7-75: *Nature: Temporary increase in government revenue*

	Without mitigation	**With mitigation**
Spatial Scale	Regional, National, International (5)	Regional, National, International (5)
Duration	3 months to 1 year (3)	3 months to 1 year (3)
Severity	Small (2)	Small (2)

Frequency	Once a year (1)	Once a year (1)
Probability	Likely (4)	Likely (4)
Significance	**8.3 (Medium)**	**8.3 (Medium)**
Reversibility	Benefit is terminated with the end of construction	
Status (positive or negative)	Positive	Positive
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation/Enhancement: ▪ None suggested		
Cumulative impacts: ▪ Lower government debt and servicing costs		
Residual Impacts: ▪ None envisioned		

Source: (Urban-Econ, 2021).

7.5.16.1.5 Temporary increase in social disruptions associated with the influx of people

It is likely that some of the construction workers will be drawn from areas outside of the local community, which could cause social disruptions between the local population and existing construction workers in the area with the new workers due to the local population view the migrant workers as 'stealing' their jobs. The influx of people may lead to a temporary increase in petty crime, illicit activity, litter, and the spread of communicable diseases. Semi- and unskilled construction workers may choose to remain in the area after construction is complete, and if they have no alternative sources of income these individuals are at risk of increasing local poverty levels. It should be noted that the 61% of local jobs are for skilled workers, which would increase the skills base in the area. To mitigate these negative impacts, it is recommended that potential social impacts are discussed with and addressed with local stakeholders.

Table 7-76: *Nature: Temporary increase in social conflicts associated with the influx of construction workers and job seekers to the area*

	Without mitigation	**With mitigation**
Spatial Scale	Surrounding area (2)	Surrounding area (2)
Duration	3 months to 1 year (3)	3 months to 1 year (3)
Severity	Insignificant (1)	Insignificant (1)
Frequency	Once a year (1)	Once a year (1)
Probability	Highly likely (5)	Highly unlikely (2)
Significance	**6 (Medium-Low)**	**3 (Low)**
Reversibility	Reversibility within a short period	
Status (positive or negative)	Negative	Negative
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation/Enhancement:		

▪ Set up a recruitment office in the nearby towns (i.e. Port Elizabeth, Uitenhage, Despatch) and adhere to strict labour recruitment practices that would reduce the desire of potential job seekers to loiter around the properties in the hope of finding temporary employment. ▪ Control the movement of workers between the site and areas of residence to minimise loitering around the site. This should be achieved through the provision of scheduled transportation services between the construction site and area of residence. ▪ Employ locals as far as feasible through the creation of a local skills database. ▪ Establish a management forum comprising key stakeholders to monitor and identify potential problems that may arise due to the influx of job seekers to the area. ▪ Ensure that any damages or losses to nearby buildings that can be linked to the conduct of construction workers are adequately reimbursed. ▪ Assign a dedicated person to deal with complaints and concerns of affected parties
Cumulative impacts: ▪ None foreseen
Residual Impacts: ▪ Contribution towards social conflicts in the area by construction workers and job seekers who decide to stay in the area after construction is complete and who are unable to find a sustainable income

Source: (Urban-Econ, 2021).

7.5.16.1.6 Negative impacts on economic and social infrastructure

The construction phase of the project will directly create 90 FTE employment opportunities, which will result in many people on the construction site – a notable portion of which will come from outside of the NMBMM, and other parts of Eastern Cape. This will result in an increase in demand for rental accommodation, social services, and access to water and electricity. More specifically:

- Healthcare facilities are likely to see an increase in demand from the influx in workers and job seekers. The NMBMM's IDP (2020) notes a number of healthcare facilities situated in Gqeberha, Uitenhage, and Despatch which will likely be under increased demand given their proximity to the construction site, and due to the influx of workers and job seekers. An increase demand in health care is an opportunity for procuring on-site medical testing for labourers at regular intervals to ensure a healthy workforce. On-site medical testing can mitigate increased demand on health facilities in the primary area.
- Construction workers and other professionals from outside the area are expected to have little difficulty in securing accommodation through B&Bs, hotels, or self-catering accommodation.
- Water will be utilised from local access points, and thus will not adversely affect existing municipal infrastructure. Electricity will be accessed through the closest Eskom take-off point with a back-up generator (if and when required), and a generator only where no take-off points are close at hand.
- There are expected to be increases in usage of local road infrastructure due to an increase in traffic during the construction phase which could lead to deterioration of local road conditions where roads are already in a poor state, although this is unlikely. This impact however is expected to be minimal as a traffic management plan has been developed that demonstrates a minimal increase in traffic, with vehicles mainly operational on the construction site, and thus will not have a material impact on local road infrastructure (Fulcrum Development Consultants, 2022).

Table 7-77: *Nature: Added pressure on economic and social infrastructure during construction as a result of increase in local traffic and in migration of construction workers*

	Without mitigation	**With mitigation**
Spatial Scale	Surrounding area (2)	Surrounding area (2)
Duration	3 months to 1 year (3)	3 months to 1 year (3)
Severity	Small (2)	Insignificant (1)
Frequency	Once a year (1)	Once a year (1)
Probability	Likely (4)	Unlikely (3)
Significance	**5.8 (Medium-Low)**	**4 (Low)**
Reversibility	Reversible within a short period	
Status (positive or negative)	Negative	Negative
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation/Enhancement: ▪ Provide adequate signage along relevant road networks to warn the motorists of the construction activities taking place on the site. ▪ Engage with local authorities and inform them of the development as well as discuss with them their ability to meet the additional demands on social and basic services created by the in migration of workers. ▪ Where feasible, assist the municipality in ensuring that the quality of the local social and economic infrastructure does not deteriorate through the use of social responsibility allocations.		
Cumulative impacts: ▪ None foreseen due to the temporal nature of the construction phase		
Residual Impacts: ▪ None foreseen at this stage		

Source: (Urban-Econ, 2021).

7.5.16.1.7 *Changes to the sense of place*

Changes to surrounding communities' sense of place are expected, given that there will be a change to the visual landscape of the Port, and increased noise during construction, albeit limited given that the Powerships and FSRU are being moored in an already active Port, which is situated within a larger industrial zone. The Powerships and FSRU will also be largely visually screened by the infrastructure of the Port, and the surrounding dunes and coastal vegetation which look at the specific impacts on tourism and housing respectively. From a noise perspective there is expected to be some minor temporary noise due to the temporary increase in construction vehicle traffic and will occur primarily during the day. While the visual impacts are expected to be of a low significance, they will remain for the duration of the 20-year project and as such the duration increases the impact significance.

Table 7-78: *Nature: Impact on the sense of place experienced by the local community as a result of visual and noise effects that appear during the construction phase*

	Without mitigation	**With mitigation**
Spatial Scale	Immediate (1)	Immediate (1)
Duration	Beyond 10 years (5)	Beyond 10 years (5)
Severity	Once a year (1)	Once a year (1)
Frequency	Small (2)	Insignificant (1)

Probability	Highly unlikely (2)	Highly unlikely (2)
Significance	**4.7 (Low)**	**3.5 (Low)**
Reversibility	Possible to reverse but only with decommissioning	
Status (positive or negative)	Negative	Negative
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation/Enhancement: ▪ The mitigation measures proposed by the visual and noise specialists should be adhered to ▪ Efforts should also be made to avoid disturbing such sites during construction.		
Cumulative impacts: ▪ Change in perception of the area due to the construction of the infrastructure linked to similar developments albeit temporarily		
Residual Impacts: ▪ Altered characteristics of the environment		

Source: (Urban-Econ, 2021).

7.5.16.2 Impact assessment findings (with and without mitigation): ***Operational Phase***

7.5.16.2.1 Sustainable increase in production and GDP nationally and locally

The annual impact on total production is expected to be R581.32 million an annum, and will primarily be generated within the NMBMM through the multiplier effect as a result of the high annual spending on labour and procurement of local goods and services needed to operate the Powerships and related infrastructure. Most of the spending will be on utilities, however the electrical machinery and apparatus, insurance, and transport service will also experience a significant portion of the stimulus.

A smaller portion will be accounted for in the rest of the Eastern Cape and country because of this, and under the assumption that revenue generated is accounted for in the NMBMM rather than in the province where the developers' headquarters are located. A lower, but still significant impact will be experienced through value added to GDP, which will equate to R353.07 million per annum in the national economy. The full break down of Production and GDP impacts in 2022 Rand terms are listed in Table 7-79, and the related impact assessment in Source: (Urban-Econ, 2021).

Table 7-79: *Estimated annual impact on the national and local economies – OPEX*

Indicator	Direct	Indirect	Induced	Total
Production	R215.26 million	R173.46 million	R192.6 million	R581.32 million
GDP	R130.67 million	R105.37 million	R117.03 million	R353.07 million

Source: (Urban-Econ, 2021).

Table 7-80: *Nature: Temporary increase in the GDP and production of the national and local economies during construction*

	Without mitigation	**With mitigation**
Spatial Scale	Regional, National, International (5)	Regional, National, International (5)

Duration	Beyond 10 years (5)	Beyond 10 years (5)
Severity	Great (4)	Great (4)
Frequency	Once a year (1)	Once a year (1)
Probability	Highly likely (5)	Highly likely (5)
Significance	**14 (High)**	**14 (High)**
Reversibility	Benefits are sustained only over project's lifespan	
Status (positive or negative)	Positive	Positive
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	
Mitigation/Enhancement: ▪ The operator of the Powerships and related infrastructure should be encouraged to, as far as possible, procure materials, goods and products required for the operation of the facility from local suppliers to increase the positive impact in the local economy.		
Cumulative impacts: ▪ Improved energy supply in the country ▪ Reduced carbon emissions in generation of electricity ▪ Sufficient economies of scale could be created to establish new businesses in the local economies. These businesses could then supply the goods and services required for the operation and maintenance of the facility than cannot currently be procured in the area. This would contribute to the local economies' growth and development.		
Residual Impacts: ▪ None foreseen at this stage.		

Source: (Urban-Econ, 2021).

7.5.16.2.2 Creation of sustainable employment positions nationally and locally

The operations phase is expected to generate 166 FTE positions which will be retained for the lifespan of the development, and will be related to the operation, maintenance, and monitoring of the Powerships and their related infrastructure. The annual spending outlined in Table 7-81 will result in 58 indirect jobs, and 64 induced jobs through production and consumption induced effects. These jobs will also mostly be created in the primary area due to the nature of the spending, with the trade, utilities, and community and personal services sectors benefiting the most from these new employment positions.

Table 7-81: *Estimated Full Time Equivalent positions to be created during operations*

Indicator	**Employment (FTE)**
Direct	166
Indirect	58
Induced	64
Total	**288**

Source: (Urban-Econ, 2021).

Table 7-82: *Nature: Creation of sustainable employment positions nationally and locally*

	Without mitigation	**With mitigation**
Spatial Scale	Regional, National, International (5)	Regional, National, International (5)
Duration	Beyond 10 years (5)	Beyond 10 years (5)
Severity	Great (4)	Great (4)
Spatial Scale	Once a year (1)	Once a year (1)
Probability	Highly likely (5)	Highly likely (5)
Significance	**14 (High)**	**14 (High)**
Reversibility	Benefits are sustained only over project's lifespan	
Status (positive or negative)	Positive	Positive
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	
Mitigation/Enhancement: ▪ Where possible, local labour should be considered for employment to increase the positive impact on the local economy. ▪ As far as possible, local small and medium enterprises should be approached to investigate the opportunities for supply inputs required for the maintenance and operation of the Powerships and related infrastructure.		
Cumulative impacts: • Improved living standards of the directly and indirectly affected households		
Residual Impacts: • Experience in operating and maintaining Powerships and their related infrastructure		

Source: (Urban-Econ, 2021).

7.5.16.2.3 Skills development of permanently employed workers

The gas industry in South Africa is currently in its infancy and there are currently no FSRU facilities present in the country, consequently there is a lack of skills required to operate and maintain future facilities. Thus, it is likely that skilled personal – such as mechatronics engineers (dual specialised electrical and mechanical engineers) – will need to be recruited from outside of the NMBMM and trained by Karpowership, as will less skilled workers doing safety, security, and mechatronic assistance work.

Table 7-83: *Nature: Skills development of permanently employed workers during operations phase*

	Without mitigation	**With mitigation**
Spatial Scale	Surrounding area (2)	Surrounding area (2)
Duration	Beyond 10 years (5)	Beyond 10 years (5)
Severity	Insignificant (1)	Insignificant (1)
Frequency	Once a year (1)	Once a year (1)
Probability	Likely (4)	Highly likely (5)
Significance	**6.7 (Medium-Low)**	**8 (Medium)**
Reversibility	Yes, skills can be lost in not practiced	
Status (positive or negative)	Positive	Positive

Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	
Mitigation/Enhancement:		
▪ The developer should consider establishing vocational training programmes for the local labour force to promote the development of skills required by the Powerships and their related infrastructure and thus provide for the opportunities for these people to be employed in other similar facilities elsewhere.		
Cumulative impacts:		
▪ Development of new skills and expertise in the country to support the development of the gas industry		
Residual Impacts:		
▪ Human capital development of the affected workers		

Source: (Urban-Econ, 2021).

7.5.16.2.4 *Improved standards of living for benefiting households*

The increases in FTE detailed in **Error! Reference source not found.** will have a positive impact on household evenues during the operations phase, and are estimated to result in a total of R97.46 million in household revenue, and based on average household size will support an additional 1 037 people across the country. These incomes will be sustained for the duration of the project, and will contribute positively to the standard of living of benefitting households.

Table 7-84: *Estimated household revenue created during operations*

Indicator	Value	Page number
Direct	R36.08 million	52-53
Indirect	R29.04 million	52-53
Induced	R32.34 million	52-53
Total	R97.46 million	52-53

Source: (Urban-Econ, 2021).

Table 7-85: *Nature: Improved standard of living for benefitting households*

	Without mitigation	**With mitigation**
Spatial Scale	Regional, National, International (5)	Regional, National, International (5)
Duration	Beyond 10 years (5)	Beyond 10 years (5)
Severity	Small (2)	Small (2)
Frequency	Once a year (1)	Once a year (1)
Probability	Likely (4)	Likely (4)
Significance	**10 (Medium-High)**	**10 (Medium-High)**
Reversibility	Benefits are sustainable only over project's lifespan	
Status (positive or negative)	Positive	Positive
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	

Mitigation/Enhancement:
▪ Where possible, the local labour supply should be considered for employment opportunities to increase the positive impact on the area's economy. ▪ As far as feasible, local small and medium enterprises should be approached to investigate the opportunities for supply inputs required for the maintenance and operation of the Powerships and their related infrastructure.
Cumulative impacts:
▪ Improved productivity of workers ▪ Improved health and living conditions of the affected households
Residual Impacts:
▪ None foreseen at this stage

Source: (Urban-Econ, 2021).

7.5.16.2.5 *Sustainable increase in national and local government revenue*

The project will contribute to both national and local revenues during its operations. At a local level utilities payments to operate the Powerships and associated infrastructure will be earned by local government. National government will benefit from tax revenues collected from the payment of salaries and wages, as well as corporate income taxes. It is impossible to know how exactly these revenues will be allocated, but any increase to national and local revenue will result in an increase in development spending

Table 7-86: *Nature: Sustainable increase in national and local government revenue*

	Without mitigation	**With mitigation**
Spatial Scale	Regional, National, International (5)	Regional, National, International (5)
Duration	Beyond 10 years (5)	Beyond 10 years (5)
Severity	Small (2)	Small (2)
Frequency	Once a year (1)	Once a year (1)
Probability	Likely (4)	Likely (4)
Significance	**10 (Medium-High)**	**10 (Medium-High)**
Reversibility	Benefits are sustained only over project's lifespan	
Status (positive or negative)	Positive	Positive
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	
Mitigation/Enhancement:		
• None suggested.		
Cumulative impacts:		
• Possible improvement in service delivery		
Residual Impacts:		
• None foreseen at this stage		

Source: (Urban-Econ, 2021).

7.5.16.2.6 Provision of electricity for future development

South Africa is currently in the grips of an energy crisis which is likely to last for several years, and requires immediate and substantial action to address it (M. Steenkamp & Weaver, 2022). The RMI4P plays a critical role in this, as it is the nearest term procurement programme to provide short-term energy relief which is critical for reducing the risk to the energy supply and resulting loadshedding when demand outstrips supply. The Powerships will allow Eskom to reduce their use of diesel-fired open cycle gas turbine (OCGT), which will both reduce the cost of electricity, and the climate change impacts given that natural gas-fired power plants produce less emission than diesel-fired plants and is around half the price which Eskom pays per kWh to run diesel-fired OCGT (M. Steenkamp & Weaver, 2022). Thus, the project will allow for cost savings and improved environmental outcomes in the short-term, support business development, and improve households' standards of living by providing a reliable source of electricity.

Table 7-87: *Nature: Provision of electricity for future development*

	Without mitigation	**With mitigation**
Spatial Scale	Regional, National, International (5)	Regional, National, International (5)
Duration	Beyond 10 years (5)	Beyond 10 years (5)
Severity	Small (2)	Small (2)
Frequency	Once a year (1)	Once a year (1)
Probability	Highly likely (5)	Highly likely (5)
Significance	**12 (High)**	**12 (High)**
Reversibility	Benefits are sustained only over project's lifespan	
Status (positive or negative)	Positive	Positive
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	No	
Mitigation/Enhancement: ▪ None suggested.		
Cumulative impacts: ▪ Increase volume and certainty of the energy supply.		
Residual Impacts: ▪ None foreseen at this stage		

Source: (Urban-Econ, 2021).

7.5.16.2.7 Local economic and social development derived from the project's operations

Karpowership has committed to a corporate social responsibility plan which includes both social and enterprise development, a full list of which is detailed under Annexure B. Current regulations require that a minimum of 1% of project revenue (R567.92 million) is allocated towards socio-economic development, with a further 0.4% allocated to enterprise development (R227.169 million) (Karpowership SA, 2022). The DMRE will verify these contributions through quarterly audits. Approximately 80% of these two contributions will accrue directly to the local community, with communities living in close proximity to the development benefiting the most (typically 50km radius). Government requirements mean that these funds will be directed towards addressing the local communities' social and economic needs.

7.5.16.2.8 Local community and social development benefits derived from the project's operations

Table 7-88: Local community and social development benefits derived from the project's operations

	Without mitigation	**With mitigation**
Spatial Scale	Surrounding area (2)	Surrounding area (2)
Duration	Beyond 10 years (5)	Beyond 10 years (5)
Severity	Small (2)	Small (2)
Frequency	Once a year (1)	Once a year (1)
Probability	Likely (4)	Highly likely (5)
Significance	**7.5 (Medium)**	**9 (Medium-High)**
Reversibility	Benefits could stretch beyond project's lifespan	
Status (positive or negative)	Positive	Positive
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes (enhanced)	

Mitigation/Enhancement:

- A three-year social development and economic development programmes should be devised by the developer throughout the project's lifespan.
- The plan should be developed in consultation with local authorities and local communities to identify community projects that would result in the greatest social benefits.
- These plans should be reviewed on an annual basis and, where necessary, updated.
- When identifying enterprise development initiatives, the focus should be on creating sustainable and self-sufficient enterprises.
- In devising the programmes to be implemented, the developer should take into account the priorities set out in the local IDP.

Cumulative impacts:

- Declining levels of poverty in NMBM, and Eastern Cape.
- Improved standards of living of the members of the community and households that benefit from the various programmes.
- Possible improvements in access to services and status of local infrastructure

Residual Impacts:

- None foreseen at this stage

Source: (Urban-Econ, 2021).

7.5.16.2.9 Negative changes to sense of place

The negative impact to the community's sense of place will be similar to that during the construction phase, although somewhat less significant as there will not be the increase in traffic due to construction vehicles. The Powerships and FSRU will be largely visually screened by the infrastructure of the Port, and the surrounding dunes and coastal vegetation. This factor coupled with the fact that the Powerships and FSRU will be situated in an industrial area, in an already operational port, means that there will not be a significant change to the sense of place as the Powerships and FSRU will not increase the level of industrialisation from a visual standpoint.

Table 7-89: *Nature: Impact on the sense of place experienced by the local community as a result of visual and noise effects that appear during the construction phase*

	Without mitigation	**With mitigation**

Spatial Scale	Immediate (1)	Immediate (1)
Duration	Beyond 10 years (5)	Beyond 10 years (5)
Severity	Small (2)	Insignificant (1)
Probability	Highly unlikely (2)	Highly unlikely (2)
Significance	**4.7 (Low)**	**3.5 (Low)**
Reversibility	Possible to reverse but only with decommissioning	
Status (positive or negative)	Negative	Negative
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation/Enhancement: ▪ The mitigation measures proposed by the visual and noise specialists should be adhered to ▪ Efforts should also be made to avoid disturbing such sites during construction.		
Cumulative impacts: ▪ Change in perception of the area due to the construction of the infrastructure linked to similar developments albeit temporarily.		
Residual Impacts: ▪ Altered characteristics of the environment		

Source: (Urban-Econ, 2021)

7.5.16.3 *Polycentric Impacts*

7.5.16.3.1 *Fisheries and Mariculture*

Impact 1: The effects of gas pipeline construction and installation and vessel mooring on the littoral and benthic community

The gas pipeline will be laid along the sea floor from the FSRU, coming onshore, before being routed back on to the sea floor to the Powerships (Lwandle & Anchor Environmental Consultants, 2022). The three ships will be secured using 16 anchor legs running to embedment anchors or gravity-based mass concrete anchors (Lwandle & Anchor Environmental Consultants, 2022). The construction is expected to disturb benthic species within the project site, however there is not expected to be a irreplaceable loss of resources, as benthic species are expected to recolonise both the pipeline and anchors in time (Lwandle & Anchor Environmental Consultants, 2022). As such the impact has a medium-low significance without mitigation, and a low significance with mitigation measures to avoid sensitive habitats (Lwandle & Anchor Environmental Consultants, 2022). Due to the site-specific nature of the impacts, which are recoverable from, and the low significance with mitigation, it is expected that no negative socio-economic impacts will arise from Impact 1.

Impact 2: The effects of increased noise and vibration levels from construction on the marine ecology

Underwater habitats can be impacted by anthropic noise, resulting in the disturbance of natural processes, and in severe cases resulting in temporary or permanent hearing loss (Lwandle & Anchor Environmental Consultants, 2022). The construction period will produce underwater noise from vibropilling, drilling, and rock clearance (Lwandle & Anchor Environmental Consultants, 2022). The noise produced during the construction period is not expected to contribute meaningfully to the existing noise levels in the Port, and will not produce underwater noise to the extent that marine species will be harmed (Lwandle & Anchor Environmental Consultants, 2022). Marine species within hundreds of meters of the construction site, however, may experience interference with ecologically relevant sounds (Lwandle & Anchor Environmental Consultants, 2022). As such, with and without mitigation the impact will have a medium-low significance, however the impact will be site specific, and remain within the Port (Lwandle & Anchor

Environmental Consultants, 2022). The lack of wider impacts on surrounding marine environments, and the fact that the impact is reversible indicates that there will not be negative socio-economic impacts arising from this impact. A more in depth overview of the impact of underwater noise on the marine environment can be found in 3.4.1 Underwater Noise.

Impact 3: The effects of impacts from construction on ecosystem services.
This impact considers the cumulative impacts of Impact 1 and 2, and comes to the same conclusion that there is no direct harm expected for marine mammals, fish, or benthic species, however the underwater noise may lead to increased masking which could interrupt ecological processes (Lwandle & Anchor Environmental Consultants, 2022). There is a lack of research of the effects of construction noise on fish, however it is still anticipated that the impacts will be localised to within the Port, and as such will not have a wider impact on the fisheries industry outside of the Port (Lwandle & Anchor Environmental Consultants, 2022). Lwandle and Anchor Environmental Consultants (2022) accordingly assigned the impact a medium-low significance with, and without, mitigation, and due to the site-specific nature of the impact we do not anticipate any wider negative socio-economic impacts.

Impact 4: The effects of the intake of cooling water on marine organisms in the surrounding water body.
The Powerships will be berthed in Port for 20 years, during which continuous abstraction of sea water for the cooling of the reciprocating engines, condensers, and other auxiliaries will occur, and will discharge cooling waters into the sea at a depth of 8m. The abstracted seawater will entrain small marine organisms (mainly plankton), while larger organisms will be impinged or trapped against the water intake screens (Lwandle & Anchor Environmental Consultants, 2022). The volume of entrained plankton will not have an effect on the broader functioning of the ecosystem due to its site-specific impacts, and the fast recovery times of phytoplankton biomass (Lwandle & Anchor Environmental Consultants, 2022). Smaller mobile organisms may become entrained in the intake structure, and large mobile species may be impinged, however this will be dependent on the intake velocity which at a rate of 0.15 m/s will minimise impingement, however significantly higher intake velocities are expected (Lwandle & Anchor Environmental Consultants, 2022). The overall impact is rated as medium without mitigation, and medium-low with mitigation, however natural functions are not expected to be altered, and impacts will be reversed at the end of the project lifetime, and will be localised to the project site (Lwandle & Anchor Environmental Consultants, 2022).
Based on these findings, and the site-specific nature of the impact which is not expected to result in an irreplaceable loss of resources, and which is reversible, there are not expected to be negative socio-economic impacts.

Impact 5: The effects of the discharge of cooling water on the marine ecology in the receiving water body.
Multiple outlets along the vessels hull will be used for discharging cooling water, and the discharged water will contain no additives, including biocides, brine, or chemicals such as chlorine (Lwandle & Anchor Environmental Consultants, 2022). The outflow was modelled at a worst-case scenario of the Powerships running at 100% capacity for 24 hours a day, although the contracted running times will not exceed 16.5 hours (Lwandle & Anchor Environmental Consultants, 2022).

It was found that within 100m of the Powerships temperatures will increase by 1.3°C, by 1.2°C within 300m (within the admin craft basin), and by 1°C beyond 300m (outside admin craft basin) (Lwandle & Anchor Environmental Consultants, 2022). The first two zones of dilution’s (ZID’s) temperature increases are marginally above the 1°C guideline thresholds, but does not exceed any biological thresholds (Lwandle & Anchor Environmental Consultants, 2022). It has been suggested by PRDW (2022) that because the admin craft basin is a small, artificial environment which is separate from the main Port and Algoa Bay entrance, that less stringent guidelines may be applicable (Lwandle & Anchor Environmental Consultants, 2022). Lwandle and Anchor Environmental Consultants (2022) find that because these temperature increases within the ZID are expected to result in deleterious effects, but that the probability of damage to marine ecology is low, and extremely low outside of the ZID, the harmful effects are likely to be limited to non-acute levels (Lwandle & Anchor Environmental Consultants, 2022). The harmful effects are expected to be fairly temporary due to the rapid rates of recovery for plankton, large sessile organisms, and large macrobenthos, as such the impact shall be reversed once the project infrastructure has been removed (Lwandle & Anchor Environmental Consultants, 2022). As such the impact is given a significance of medium-high without mitigation, and medium with mitigation (Lwandle & Anchor Environmental Consultants, 2022). Due to the site-specific nature of the impact which is not expected to affect the wider fisheries or mariculture industries, there are no negative socio-economic impacts expected from Impact 5.

Impact 6: The effects of increased noise and vibration levels on the marine ecology.
Increasingly there is scientific evidence that underwater noise levels from human activity impacts marine species, the extent of these impacts is dependent on the duration of exposure, sound level, source frequency, and/or repetition rate of an impulsive sound (Lwandle & Anchor Environmental Consultants, 2022). These impacts can result in auditory injury (permanent or temporary) and disturbance of normal activities. Sound sources are either classified as impulsive or non-impulsive (Southall et al., 2019), of which the Powerships are non-impulsive sound sources, defined as a continuous sound (Mason & Midforth, 2022).

As no Powerships were present in the Port of Ngqura for noise level testing, an equivalent ship for comparison was used. The Mason and Midforth (2022) visited Sekondi in Ghana where a similar port has a Osman Khan Powership, and tested the noise levels as a representative case. Noise levels were calculated based of the findings from the Sekondi Powership with estimates of the Powerships and auxiliary ships running at full power, in conjunction with the existing noise levels measured in the Port.

It was found that the noise levels of the large cargo vessels which frequently utilise the Port exceeded the underwater noise levels resulting from the Powerships (Lwandle & Anchor Environmental Consultants, 2022). Baseline noise within the Port was dominated by machines operating on vessels in the Port, while outside the Port background noise was dominated by sounds generated by marine life (Mason & Midforth, 2022). Thus, noise from the Port was not detected beyond the Port limits, and based on the findings of the modelling no underwater noise from the Powerships or FSRU is expected to impact baseline noise levels outside of the Port (Mason & Midforth, 2022).

Based on these findings Lwandle and Anchor Environmental Consultants (2022) find that there may be negative impacts on marine species within the Port, however the results and severity will depend on the distance of these organisms from the vessels. It is important to note that juvenile fish utilise the Port as a nursery, and are less mobile, and as such could be more impacted than adult fish, however more research is required to understand the impact which low continues noise could have (Lwandle & Anchor Environmental Consultants, 2022). Adult fish in the area are likely to experience increased masking, but are highly unlikely to experience temporary or permanent hearing loss (Lwandle & Anchor Environmental Consultants, 2022). The masking effects, and other impacts on biological functions could cause fish to move out of the area of noise, which could impact fishers by shifting the distribution of fish stocks, but would not reduce the fish stocks available, and thus the catch amounts (Lwandle & Anchor Environmental Consultants, 2022). However, this impact is uncertain given that the density of fish within the Port is unknown (Lwandle & Anchor Environmental Consultants, 2022).

It is anticipated that there will be no expected impact from the underwater noise produced by the Powerships on marine mammals (Lwandle & Anchor Environmental Consultants, 2022). This is due to the duration of operation, existing baseline Port noise, and the distribution of marine mammal species in the area (Lwandle & Anchor Environmental Consultants, 2022). Penguins are not anticipated to be impacted by underwater noise which could impact their ability to catch fish, as penguins do not fish in the Port, and underwater noise from the Powerships will not reach the areas which they do fish in (Lwandle & Anchor Environmental Consultants, 2022).
Considering these factors Lwandle and Anchor Environmental Consultants (2022) finds that the impact severity will be site-specific, and wider natural processes and/or functions continue albeit in a modified way, and that the spatial scale will be constrained to within the Port. Thus, a medium-high significance is expected without mitigation measures, and medium with mitigation (Lwandle & Anchor Environmental Consultants, 2022). Based on these findings, and the site-specific impacts, it is expected that there will not be negative socio-economic impacts associated with Impact 6. However, if it is found that juvenile fish species which are important to the local fisheries industry are significantly disturbed to the point where fish stocks decrease, then negative socio-economic impacts are likely to arise.

Impact 7: The effects of impacts on ecosystem services.
Impact 7 considers the previous operational impacts in terms of their cumulative impact on ecosystem services within Algoa Bay. The impact of low-level, continuous underwater noise on marine organisms is uncertain due to a lack of research, however there is evidence that this type of noise can potentially be harmful or interfere with marine species ecological functioning (Lwandle & Anchor Environmental Consultants, 2022). The Powerships are situated within an already busy Port, which has relatively high levels of background noise, and as such will only contribute minorly to background noise (Lwandle & Anchor Environmental Consultants, 2022). As a result, the potential to cause harm will only be within hundreds of meters of the Powerships, and thus fisheries outside of the Port will not be directly affected by the underwater noise produced by the Powerships (Lwandle & Anchor Environmental Consultants, 2022).

There is the potential for a wider impact on the local fisheries industry through the possible changes to the Port due to increased underwater noise, or cooling water intake or discharge (Lwandle & Anchor Environmental Consultants, 2022). The Coega Estuary was previously an important nursery ground for juvenile fish, however due to its significant modification, its functions as an estuary have collapsed (Lwandle & Anchor Environmental Consultants, 2022). Thus, this suggests the Port serves as a nursery in lieu of the estuary (Lwandle & Anchor Environmental Consultants, 2022). This means that it could be important to maintain the biological potential of the Port as a nursery for estuarine-dependent species, such as dusky kob, which is in a critical state and is important to the commercial line fishing industry (Lwandle & Anchor Environmental Consultants, 2022). As such, if juvenile fish are disturbed from the Port and move out of the Port to more heavily fished areas, then this could result in more pressure on fish stocks, and reduced fish stock in the future (Lwandle & Anchor Environmental Consultants, 2022). The degree or presence of this impact is however uncertain, as it is unknown to what degree the Port is used by juvenile fish, and to what degree they could be disturbed (Lwandle & Anchor Environmental Consultants, 2022).

There are no impacts on mariculture expected, as there is no mariculture present or planned for within the Port (Lwandle & Anchor Environmental Consultants, 2022). The closest Aquaculture Development Zone (ADZ) is in Algoa Bay, and located 2.5km from the entrance of the Port (Lwandle & Anchor Environmental Consultants, 2022). Thus, as the impact area is confined to hundreds of meters from the Powerships at a maximum, there is no impact anticipated for the ADZ (Lwandle & Anchor Environmental Consultants, 2022).

Overall, Lwandle and Anchor Environmental Consultants (2022) assigns this impact a medium significance with and without mitigation, stating that the impact will be within the broader Port, site-specific and wider natural processes and functions are slightly altered, however the impact is reversible, and is not considered a fatal flaw. Based of these findings it anticipated that the site-specific nature of the impact that does not affect the wider fisheries industry or the ADZ, suggests that there will not be any negative socio-economic impacts due to Impact 7. This assessment would change if it were found that the project site is an important nursery ground for juvenile fish species which are important to the commercial fishing industry and will result in juveniles moving to more heavily fished areas, placing further pressure on already low stocks. If this is the case then Impact 7 will result in a negative socio-economic impact on the commercial fishing industry, both for large companies, and small-scale fishers.

7.5.16.3.2 *Small-scale Fishers*

Small-scale fishing communities were identified as operating in close proximity to the Port, however no cooperatives are registered to use the site, although two Gqeberha based cooperatives utilise the old Port Elizabeth harbour (T. Steenkamp & Rezaei, 2022). Thus, considerations for the impact of the project on small-scale fishers pertains to how the project could impact marine ecology, and fish stocks outside of the Port. This area of focus was confirmed by the stakeholder engagement where during the community mapping exercise, stakeholders did not note any fishing activities within the Port or on the project site itself, and only indicated fishing activities outside of the Port (T. Steenkamp & Rezaei, 2022).

It is crucial to understand that no fishing is permitted within the Port area. As an active Port and industrial zone, Transnet National Port Authority (TNPA) does not grant access for fishing. DFFE have also confirmed that there are no registered small scale fishing cooperative associated with the Port.

During the stakeholder engagement conducted Steenkamp and Rezae (2022), community members acknowledged the benefits of the Karpowership project to their communities, and South Africa as a whole, but outlined the following concerns:

- Noise pollution and water temperature fluctuations negative impact on fish populations in the area.
- The impact which the Powerships could have resulting in a loss of sustainable livelihoods, and subsistence associated with the ocean economy.

7.5.16.3.3 *Environmental*

Underwater Noise

Based on the findings of the underwater noise assessment, the Powerships and FSRU will have negligible impact on underwater noise levels, and therefore no significant impact on marine species (Mason & Midforth, 2022). Considering these findings the socio-economic impact will be negligible too. This, primarily informed by the fact that no finishing is permitted within the port, and therefore the fishers livelihood unlikely to be negatively impacted as a result of the underwater noise. Furthermore, tourism borne as a function of the biodiversity associated with marine species will also remain unimpacted.

Coastal and Estuarine

Impact 1: Disturbance/loss of estuarine habitat as a result of construction within the estuarine functional zone

The proposed project site is located within the existing Port of Ngqura, which has already undergone drastic modifications, and has significant development planned and approved for the future (Coastwise Consulting &

GroundTruth, 2022). The laying of the approximately 320m of underground gas pipeline on a portion of the already modified beach, which will result in a temporary disturbance of the beach which can be rehabilitated and will have a medium-low impact (Coastwise Consulting & GroundTruth, 2022). The siting of the first terminal tower which carries the overhead transmission lines will be located 250-300m east of the estuary and in close proximity to the Port, while a site office complex will be situated in a transformed area adjacent to the Admin Craft Basin building (Coastwise Consulting & GroundTruth, 2022). The footprint of the terminal tower will be lost permanently and have a medium impact with mitigation, while the site office is located on a stabilised/hardened surface and will have a medium-low impact (Coastwise Consulting & GroundTruth, 2022). Given the limited impact of these infrastructure developments on the estuarine functional zone, and is limited to the project site, it is not anticipated to have any negative socio-economic impacts due to the loss of biodiversity in the area, and will be offset through the employment opportunities created during the construction and operations phase.

Impact 2: Disturbance/mortality of estuarine/beach fauna as a result of construction activities and noise
The intertidal and supratidal beach zone is expected to experience physical disturbances due to the laying/burial of the gas pipeline in the beach and dune environment (Coastwise Consulting & GroundTruth, 2022). The fauna and flora in the intertidal zone however already exist in a highly dynamic area and as such are expected to recover rapidly from the construction activities (Coastwise Consulting & GroundTruth, 2022). The upper beach and dune environment supports highly mobile fauna, which are accustomed to the disturbed Port environment, and are able to quickly evade the area, limiting the impact (Coastwise Consulting & GroundTruth, 2022).

The increase in noise due to construction activities is unlikely to exceed that of ambient port noise, and unlikely to reach the saltpans, causing increased disturbance to bird life (Coastwise Consulting & GroundTruth, 2022). Heavy machinery on the beach may disturb threatened coastal bird species which roost along the pipelines proposed path, and in the case of good seasonal rainfall, increased numbers of palearctic bird species are known utilise the estuary mouth and beach environment (Coastwise Consulting & GroundTruth, 2022). These species may be disturbed by the increased noise in the immediate area, and due to the physical presence of machinery (Coastwise Consulting & GroundTruth, 2022). These impacts can, to some extent, be mitigated through the mitigation measures suggested in their report, and overall due to the limited nature of the impacts in an already disturbed environment, there are not expected to be direct negative socio-economic impacts, and will be offset through the positive socio-economic impacts accrued through the employment opportunities created during the construction period.

Impact 3: Generation of solid waste pollution
The construction period will generate solid waste such as concrete, rubble, metal, plastic waste, and general litter, which if allowed to enter into the surrounding environment through improper handling and storage could cause irreversible harm, which would be time-consuming and expensive to mitigate. Therefore, without mitigation measures this impact is scored high, and medium-low with mitigation measures which make the potential impact reversible (Coastwise Consulting & GroundTruth, 2022). If adequate mitigation measures are undertaken then the negative socio-economic impacts due to environmental degradation are not expected, given the existing transformed nature of the area. Positive socio-economic impacts are expected from the increased labour and expertise required to implement the mitigation measures, which includes training construction workers on proper environmental controls.

Impact 4: Chemical pollution arising from construction related spills of hazardous substances
The potential spilling of hydrocarbons and other harmful substances could have significantly negative impacts on the surrounding environment, particularly if hydrocarbons enter the water which could be lethal to marine species

and coastal bird life (Coastwise Consulting & GroundTruth, 2022). Without mitigation the impact will be high, resulting in negative socio-economic impacts due to biodiversity loss, however through mitigation measures the impact will be medium-low (Coastwise Consulting & GroundTruth, 2022). Proper training and education for construction workers as a component of the mitigation measures will have positive socio-economic impacts, as it will lead to knowledge transfer of construction workers, increasing their future employability, and decreasing the likelihood of environmental degradation on future job sites.

Considering these four impacts and the limited negative socio-economic impacts which may arise, and the fact that these will be offset by positive socio-economic impacts due to increased employment and increased skills development when mitigation measures are employed, a positive socio-economic impact is expected. As such, based on the socio-economic impacts during the construction phase, the project is deemed to be desirable, but should be considered in conjunction with the operational phase impacts which are listed below.

Impact 5: Injury / mortality of coastal/estuarine associated birds related to powerlines

The powerlines pose the greatest threat to birds out of all the elements of the project due to the potential for fatalities from collisions with the powerlines (Coastwise Consulting & GroundTruth, 2022). Of the three alternative routes suggested for the powerlines, Alternative 3 is likely to have the greatest impact due to its proximity to the Coega Estuary which is a prominent habitat for bird life (Coastwise Consulting & GroundTruth, 2022). The Alternate Route 1 (the preferred route) and Alternate Route 2 have the least impact. The risk of collision is increased at night and during poor weather conditions, with large-bodied bird species at greatest risk, particularly flamingos who utilise the estuary and river, and which typically move during the night (Coastwise Consulting & GroundTruth, 2022). These impacts are considered to be of regional to national importance given that migratory species may be impacted. Several mitigation measures are suggested, including installing high visibility bird diverters, and perch deterrents, and as such with mitigation Alternate Route 1 and 2 have a medium-low significance (Coastwise Consulting & GroundTruth, 2022). The socio-economic impacts related to the locality of the transmission lines are expected to be low-negative given that there are likely to be an increase in bird fatalities, which could disturb both local and migratory bird populations, reducing environmental tourism to the area by birdwatchers. However, these impacts are not expected to be significant enough to be seen as a fatal flaw, and can be minimised through the mitigation measures proposed by the specialists.

Impact 6: Disturbance to coastal/estuarine associated birds due to noise and light pollution

The ambient noise and light produced by the Powerships may cause disturbances to the birds in the estuary mouth, beach environment (at the base of the breakwater and upslope of the beach), and on Jahleel Island, but are not expected to impact the saltpans (Coastwise Consulting & GroundTruth, 2022). The area of the estuary mouth and beach environment may to become unfavourable for sensitive birds for feeding, roosting or nesting (specifically during the night due to light emissions) (Coastwise Consulting & GroundTruth, 2022). These impacts are expected to be high for both Layout Alternate 1 and 2 without mitigation, and with mitigation Layout Alternate 1 is expected to be high (due to its closer proximity to Jahleel island) and Layout Alternative 2 is expected to be medium-high (Coastwise Consulting & GroundTruth, 2022). The disturbance of threatened and migratory birds from the area is expected to have a negative socio-economic impact if it reduces the amount of bird life in the wider area, and thus possibly reducing the amount of eco-tourism. However, given the impact is limited to the proximity of the Port, it is likely that the wider negative socio-economic impacts may not occur.

I

mpact 7: Change in water quality in nearshore marine environment

The estuary and river mouth have been severely modified by the development of the Port of Ngqura, which has resulted in limited marine connectivity and limited favourable habitats for species to live in, and as a result, invertebrate communities have been severely modified (Coastwise Consulting & GroundTruth, 2022). The system has lost almost all natural processes and functions to support fish and invertebrate populations, however, coastal bird species do still utilise the estuary mouth for feeding (Coastwise Consulting & GroundTruth, 2022). There has been concern lodged over the potential impact from the thermal plume from the discharge of cooling water, which could impact marine fauna entering the estuary (Coastwise Consulting & GroundTruth, 2022). Modelling of the thermal plume by PRDW (2022) found that if the thermal plume is dispersed at a discharge depth of 8m, which increases the water temperature at the estuary mouth will increase by 1°C in winter, and 0.75°C in summer. These temperature increases are within in the limits set by the South African Water Quality Guidelines for Coastal Waters (PRDW, 2022), and thus if the 8m discharge depth is maintained, no adverse impacts on marine and/or estuarine biota in the Coega Estuary mouth is expected (Coastwise Consulting & GroundTruth, 2022). No further mitigation measures are suggested, and the impact is expected to be reversible, and any loss of resources can be lost, resulting in a low significance for Alternate 1 as it is further from the estuary mouth, and medium-low for Alternate 2 given that it is relatively close to the estuary mouth (Coastwise Consulting & GroundTruth, 2022).

Given that there are limited negative environmental impacts contingent on which alternative is pursued, and that negative impacts are isolated to the estuary mouth within the existing port. Therefore, no negative socio-economic impacts anticipated given Impact 7.

Impact 8: Disturbance / injury of coastal estuarine associated fauna and habitat destruction due to fires and explosion

There is a very small chance of a rupture or shearing of the transfer hoses between the LNGC and FSRU, which are located approximately 1km from the estuary mouth (Coastwise Consulting & GroundTruth, 2022). For any environmental impact to occur, a flock of birds would need to be flying directly in the vapour cloud explosion radius, making the likelihood of a negative impact even lower (Coastwise Consulting & GroundTruth, 2022). As such the significance of the impact with mitigation is very low and is not expected to have any negative socio-economic impacts given the low probability of occurrence and resultant environmental damage. It is important to note that no Powerships or FSRU have ever experienced a gas fuelled explosion, although a failure of an over pressurised seem did result in an explosive venting of steam in 2018 resulting in no fatalities. Subsequently the faulty component has been replaced on all Powerships and steam operating pressures have been reduced on all Powerships as a further safety measure. No socio-economic impacts are anticipated given the unlikely nature of an event occurring.

Impact 9: Generation of coastal pollution

There is significant potential harm from potential spillage of ship pollutants into the Port, resulting in negative environmental impacts (Coastwise Consulting & GroundTruth, 2022). These impacts could originate with the Powerships, FSRU, or LNGC and expected to be medium-high significance without any mitigation measures (Coastwise Consulting & GroundTruth, 2022). However, given that all four vessels will be within the Port of Ngqura, and thus are subject to both domestic and international legislation on preventing marine pollution and thus are subject to the “Polluter Pays” principle (Coastwise Consulting & GroundTruth, 2022). With these considerations, and the mitigation measures which are listed by Coastwise Consulting and GroundTruth (2022) mean that the significance of impacts is low.

Given the extensive legislation, established marine pollution control measures in place, and the mitigation measures listed by the specialists, it is unlikely that there will be any significant negative environmental impacts from marine pollution. As such there are no negative socio-economic impacts anticipated from potential marine pollution spillages, although in the case of a significant spill which is not mitigated for, there could be negative socio-economic impacts due to the loss of flora and fauna in the affected area.

In summary, the operational phase socio-economic impacts are not expected to have a significant negative impact. Due to the limited negative impact on the local environment there is not expected to be a significant impact on eco-tourism in the area, nor a catastrophic die-off of marine or terrestrial organisms, resulting in a detrimental health impact, or decline in income potential for surrounding communities.

Wetlands and watercourse impacts

The Wetland Delineation and Functional Assessment was undertaken by Triplo4 Sustainable Solutions and involved a desktop analysis of the project area utilising GIS data to identify wetlands, rivers, and other water courses, and infield verification and data collection to confirm the results of the desktop analysis (Hoosen, 2022). Through this process a total of five watercourses were identified as lying within the construction area, one of which was determined to be the transformed estuarine environment/Port waters, two were determined to be wetlands, and two were determined to be rivers (Hoosen, 2022). It was established that only through impacts from the construction and operation of the overhead powerlines will have any impact on watercourses, given that there are no other watercourses present on the rest of the project site (Hoosen, 2022). It was established that the impacts posed by powerlines to the river during the construction phase have a low significance, however a medium significance is attributed to the operations phase for the Preferred Alternative for the following factors:

- Potential for groundwater and watercourse contamination from oil spills from vehicles during the maintenance of the powerlines.

Extensive mitigation measures have been suggested which involve proper environmental training of workers, and labour intensive practices such a revegetation of cleared areas, reinstating of topsoil where erosional features have formed, removal of alien and invasive plants, and the monitoring and removal of sediment build up to stop alteration of the watercourse (Hoosen, 2022). As such the negative impacts are of a low significance on average, and comprehensive mitigation measures have been suggested which will increase the employment potential of the project and upskill construction and maintenance workers on environmental management measures. As such, on balance the socio-economic impacts are likely to be positive given the increased employment opportunities and skills development required by the mitigation measures, and the limited and on average low significance of negative environmental impacts.

7.5.16.3.4 *Climate Change*

The climate change impact through the emission of greenhouse gases (GHG) was calculated by Promethium Carbon (2022), with a full analysis, and explanation of the method followed found in their report. Project emissions were based on the construction, and operations phase of the project, however, the direct emissions from the decommissioning phase will be insignificant in comparison to the emissions of the construction and operations phases. The GHG emissions from this project contribute to the global stock of GHG emissions. While it is important for each project to mitigate as far as possible the contribution of this project to global GHG emissions is very low. This project will assist in alleviating the socio-economic pressures caused by South Africa's electricity supply crisis, and the benefit associated with this outweighs the contribution of the project to global GHG emissions.

Total GHG emissions were calculated as a combination of the direct emissions caused by the production of electricity through the burning of LNG, while indirect emissions were calculated as the emissions from the upstream production of materials used during the construction and operations phase, and the downstream emissions of the end-of-life materials and the use of sold products, such as waste management activities, or steel manufacture, and the transport of LNG to the project site (Promethium Carbon, 2022). The emissions by the project were calculated assuming that a worst-case scenario whereby the project will run at 100% capacity for 16.5 hours a day, for the duration of the project (Promethium Carbon, 2022). It is important to note that this may not be the case for the lifetime of the project, as while the current energy crisis will result in high demand for electricity from the project, the RMI4P stipulates that electricity is sold based on the demand of the purchaser (Promethium Carbon, 2022). Therefore, if other sources of electricity generation reach commercial operation the amount of electricity purchased will vary and possibly reduce the generation requirement of Karpowership. Considering these factors, and that the Powership is able to run at varying generation capacities, the project is expected to have a high significance of impact at 100% capacity, and medium at 50% and 25% capacity (Promethium Carbon, 2022).

South African electricity generation is dominated by coal, accounting for 83% of electricity generation in 2020 (Calitz & Wright, 2020), and as coal is the predominant source of baseload electricity in South Africa, and is planned to be until 2030, it is the best source of comparison out of the generation sources (Promethium Carbon, 2022). LNG produces around half the GHG emissions than that of coal, and does not produce any particulate, or nitrates (NOx) and sulphates (SOx) which coal produces significant amounts of, and as such is significantly better for human health (Promethium Carbon, 2022). A comparison of GHG emissions between Eskom's main fuel sources, including diesel given the current heavy reliance on diesel generation (Pram et al., 2022). South African electricity generation is dominated by coal, accounting for 83% of electricity generation in 2020 (Calitz & Wright, 2020), and as coal is the predominant source of baseload electricity in South Africa, and is planned to be until 2030, it is the best source of comparison out of the generation sources (Promethium Carbon, 2022). LNGC produces around half the GHG emissions than that of coal, and does not produce any particulate, or nitrates (NOx) and sulphates (SOx) which coal produces significant amounts of, and as such is significantly better for human health (Promethium Carbon, 2022). This stark difference in emissions is highlighted by the fact operational emissions of the Powerships for 5 years will result in less emissions than running a coal fired plant for a year (Promethium Carbon, 2022). This highlights the role of LNG as a transition fuel, which will enable the move from heavily polluting coal plants to a full renewable future.

The project's role in assisting the transition to a low carbon future is not limited to the reduction of GHG and particular emissions when compared to coal, but also its ability to support renewable energy plants coming online by making up for their intermittent energy generation (Promethium Carbon, 2022). In the future renewable energy plants paired with battery storage will preclude the need for fossil fuel based generation, however this will only become a reality in the future when battery storage technology and manufacturing capacity has improved (Promethium Carbon, 2022). By providing load following and dispatchable electricity, which renewable energy cannot provide, the project will enable more renewable energy projects to come online than would have been otherwise be possible, providing the energy stabilisation needed until sufficient battery technology can be deployed (Promethium Carbon, 2022).
This will result in additional emissions saving, as it will allow a further reduction in demand for coal fired electricity as more renewable energy comes online (Promethium Carbon, 2022). It is important to note that coal-fired power cannot fill the same role as LNG in supporting renewable energy because coal fired plants do not provide dispatchable energy. Coal-fired plants have to run for extend periods of time with limited shutdown periods to remain efficient and operational, and have long start up times (Ramirez-Meyers et al., 2021). Gas-to-power plants by

comparison can turn on and off when required with much faster start up times and ramp up rates, providing electricity as dispatch demands fluctuate, and only experiencing efficiency losses between cold and hot starts (Ramirez-Meyers et al., 2021).

These avoidances in GHG emissions enabled by the project due to a direct avoidance of coal emissions, and an indirect avoidance through the support of renewable energy means that the project will ultimately provide more GHG emissions avoidance than the total amount of GHG emissions it will produce over its lifetime, even when accounting for the worst case scenario (Promethium Carbon, 2022). Coupled with the positive economic impacts at a national level from providing dispatchable electricity which is critical for economic development, and reducing the negative impacts of loadshedding on the economy, means that Promethium Carbon (2022) estimates that the project will have a low positive impact. Thus, on a climate change basis, Promethium Carbon (2022) finds that the project is desirable.

When considering the project’s impact on climate change in conjunction with the climate change impacts of surrounding gas-to-power plants planned for the area, a similar conclusion is drawn. Increased intensification of gas-to-power projects in the area will increase the expertise and infrastructure available, improving the efficiency of construction which will reduce construction emissions. Secondly, other plants utilising LNG are expected to result in similar avoidance of emissions from coal and enabling greater renewable energy deployment. Thus, while an increase in gas-to-power plants will increase the amount of emissions being produced in NMBMM, it will reduce the amount of emissions being produced nationally if it leads to reduced use of coal, and greater renewable energy development. Climate change impacts are not driven by local contributions to emissions, due to the distributed nature of GHG, but rather than the global level of GHG, and as such the local emissions cannot be directly tied to the climate change impacts which will be felt in the NMBMM (Promethium Carbon, 2022).

It is important to note that there are two main mitigation measures which are suggested by Promethium Carbon, which can reduce the lifetime emissions of the project. Firstly, the contract period of the power purchasing agreement, and operating intensity can be reduced to reduce the total number of GHG emissions, however the former suggestion is unlikely given that the RMI4P is set for 20 years (Promethium Carbon, 2022). Secondly, in the future LNG could be supplemented, or replaced by, green hydrogen (Promethium Carbon, 2022). Green hydrogen is hydrogen gas which is produced using renewable energy and is likely to be the fuel of the future as it can be used in hydroelectric fuel cells, or burned in gas turbines. Hydrogen supplemented fuels produce significantly less carbon, while replacing LNG with hydrogen will result in a 99% reduction in CO2 produced, although the latter will only be a possibility in the future (Goldmeer, 2019), significantly reducing the carbon emissions in both cases (Promethium Carbon, 2022).

The final mitigation measure is of particular importance from an economic perspective, given that South Africa has significant potential for producing green hydrogen. South Africa has 94% of the worlds platinum group metals (PGM) (Minerals Council South Africa, 2019) which is used in catalytic converters to produce hydrogen (Metcalfe et al., 2020). Coupled with the fact that South Africa is the third highest wind and solar energy density in the world, allowing for the large scale and cost effective production of green hydrogen for both domestic and international consumption (Jain & Jain, 2017). Thus, hydrogen provides economic growth potential from a mining, manufacturing, and fuel perspective, enabling carbon neutral energy production and storage domestically, and a significant source of export income if a surplus of green hydrogen can be produced for the international market. As such integration of existing gas-fired-plants such as the Powership into a domestic hydrogen industry could result in cost savings on electricity production, and reduced GHG emissions.

Considering the assessment by Promethium Carbon (2022), which contextualises the project's GHG emissions in comparison to the direct avoidance of GHG and particulate emissions from coal and diesel fired plants, and the indirect avoidance of GHG emissions by enabling a greater development of renewable energy sources, the long term socio-economic impacts are expected to be positive

Impact of climate change on climate sensitive industries

Climate change is the largest challenge which humanity has to face, and will result in increased temperatures, increased water stress, displacement of communities, and rising sea levels. These impacts are expected to be experienced in South Africa, and lead to more difficult working conditions in all aspects of the economy, but particularly for agricultural workers. These impacts however will be the result of global impacts on climate change due to the distributed nature of GHG emissions, and while the Project will increase GHG emissions, it is expected to result in more avoided emissions. As such, it is not possible to draw a direct connection between the Project and the climate change impacts which the South Africa will experience.

7.5.16.3.5 *Tourism*

Overview of the local tourism industry

Tourism is an important, yet small, contributor to the economy of NMBMM, contributing 4.7% of municipal GDP, which is lower than the rest of the Eastern Cape where the tourism contributes 5.1% to provincial GDP (3T Business Fusion, 2022). Local travel to NMBMM has declined over the 2009 to 2019 period, with an average annual decrease of 5.97%. International visitors to NMBMM have declined by an average of 2.7% per annum (3T Business Fusion, 2022).

The COVID-19 pandemic, to a large extent, prevented the movement of individuals locally, and internationally. As a result, international tourism saw a significant decline due to the pandemic, resulting in border restrictions and increased financial pressure. Furthermore, the financial pressure on individuals as a result of the pandemic further resulted in less international and local travel (3T Business Fusion, 2022). Travel to the Eastern Cape is mainly dominated by visiting relatives and friends category (VRF) – which declined over 2019 and 2020, but recovered to above 2019 levels in 2021 resulting in a 71.5% increase from 2020 to 2021 (3T Business Fusion, 2022). The visitors on holiday (VH) segment has seen consistent growth, even during the hard lockdown periods in 2020, and 2021, with levels higher in 2021 than in 2019 (3T Business Fusion, 2022).

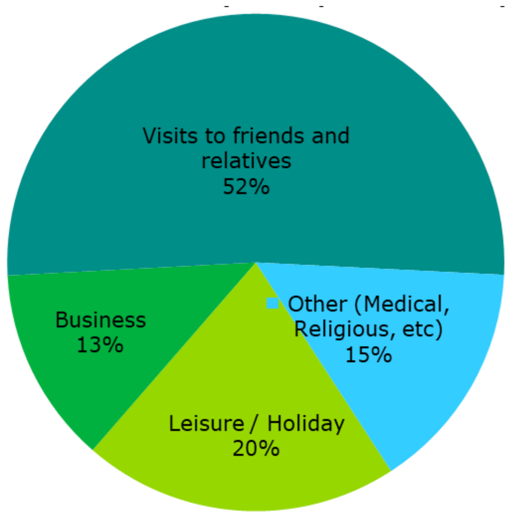

Figure 7-11: Tourism trips by purpose of trip to Nelson Mandela Bay Metropolitan Municipality (2019)

Source: (3T Business Fusion, 2022).

Impact of loadshedding on the tourism industry

Loadshedding has had a significant negative impact on industries across South Africa, including tourism. This has been further compounded by the COVID-19 pandemic. The impacts of loadshedding are experienced most acutely by SMMEs which incur a higher cost for adapting to loadshedding, and are more likely to go out of business compared to larger businesses due to comping costs and the impacts to revenue generation (Mbomvu et al., 2021). This creates significant issues for economic recovery, as SMMEs are drivers of economic growth in South Africa (Bruwer et al., 2018), employing 64% of the labour forces in 2021 (SEDA, 2021), and which already operate in a harsh economic environment with 75% of SMMEs failing within in their first three years(Bruwer & Coetzee, 2016). This experience is mirrored in the tourism industry, where SMMEs are impacted heavily by loadshedding (3T Business Fusion, 2022). The tourism industry in South Africa has experienced consistent growth, even as the national economy has seen slow growth, however this is being significantly threatened by loadshedding (3T Business Fusion, 2022).

Impact of the Powerships and FSRU on the local tourism industry

Beginning with the visual impact of the project on the local tourism industry, the Port of Ngqura is visible from the south-western (beach) section of Addo Elephant Park, which is 18 km away from the Port (Marshall, 2022). Views of the ships are intermittent in this area as it is partly screened by the dune slope ridges and dune vegetation in the area (Marshall, 2022). The ships would be seen within the context of the Port infrastructure, including cranes, container stacks, and ships at anchor and moving through the Port (Marshall, 2022). Within the context of the Port infrastructure, and the significant distances involved, the ships are likely to be seen as part of the existing Port operations, and thus not adding negatively to the existing views. As such it is expected that the Powerships and FSRU within the Port of Ngqura are unlikely to have a negative impact on tourism from a visual perspective (3T Business Fusion, 2022). This impact is expected to be small, however it will have a long duration (20 years) and as such the duration of the impact is expected to be significant (3T Business Fusion, 2022).

Secondly, the proposed power line alternatives intermittently obscured from this viewing angle, and due to their building materials and colour are highly unlikely to be visually obvious (Marshall, 2022). As such the proposed ships and related infrastructure were assessed as having a low visual significance. No impact is expected on Swartkops Valley Local Nature Reserve as neither the Powership, FSRU, nor powerlines will be visible from the area.

Considering the visual impact on beaches closer to the Port, the Powership will be partially screened by Port buildings and tall cranes (Marshall, 2022). The FSRU is closer to the Port entrance, and further away from the screening of the buildings and cranes, however there will be a degree of screening provided by the southern breakwater, particularly from closer viewpoints (Marshall, 2022). Both ships will be seen within the context of Port operations, and its existing visual impact, and as such are unlikely to be seen as separate industrial operations. Finally, considering the view of powerlines from beaches, alternatives 1 and 2 will have the smallest visual impact (Marshall, 2022). Alternative 1 will be visible from the top of the dune slope, but will cross the due in close proximity to the Port, and as such be seen within the context of Port operations and infrastructure (Marshall, 2022). Alternative 2 is unlikely to be seen from the beaches. Considering these conditions, the Powership, FSRU, and powerlines are assessed as likely to have a low significance in terms of visual impact on the beaches close to the Port, and thus a limited negative impact on a tourism activities which may be conducted on them (3T Business Fusion, 2022).

There is anticipated to be a negative impact on the tourism industry during the construction phase, mainly from increased vehicle traffic and the noise impact of the construction of related infrastructure (3T Business Fusion, 2022), however these impacts will be temporary in nature and will take place within proximity to the existing industrial area. There are however anticipated to be positive impacts on the tourism industry during the construction period, given that there will be an influx of workers who will be requiring temporary accommodation, and thus are likely to utilise B&Bs, hotels, and self-catering accommodation (3T Business Fusion, 2022).

A further impact which the Powerships could have on the tourism industry is through terrestrial noise disturbing tourists staying in accommodation, visiting restaurants, or tourist attractions such as nature reserves in the vicinity of the Powerships (3T Business Fusion, 2022). Acoustic modelling was undertaken by Safetech (2022), which involved testing the sound levels of the Sekondi Powership in Ghana, and modelling the resulting data for the Port of Ngqura case. It was found that the operations phase of the project will have a low sound impact with mitigation measures, and will not exceed the noise limits for any residential or conservation areas within the zone of noise (Safetech, 2022). Noise above 40 decibels will only be experienced within the Port itself, which are still within industrial noise levels (Safetech, 2022). Thus, there are not expected to be any negative socio-economic impacts on the tourism industry due to reduced tourist revenues for tourists reducing the length of their stay or activities due to noise levels (3T Business Fusion, 2022).

It is further anticipated that there could be a positive impact on tourism from the increase in special interest tourism, particularly energy or industrial tourism, whereby tourists visit an area specifically visit its industrial infrastructure (3T Business Fusion, 2022). This type of tourism is expected to increase as development of global energy increases, and as such could be a source of tourism for NMBMM if it is correctly marketed and advertised (3T Business Fusion, 2022).

As such, on balance there is not anticipated to be any negative socio-economic impacts on the tourism industry due to the project, given the limited visual impacts and lack of noise impacts. There are however positive impacts expected from the possibility of energy or industrial tourism, and from the definite benefits arising from the Tourism and Hospitality Economic Development project. This project will train under and unemployed people (with preference for the youth) to be tour guides, and support black owned guesthouses to attain a minimum of a three-star rating from the Tourism Grading Council of South Africa (Karpowership SA, 2022). This is expected to have a strongly positive socio-economic impact on the tourism industry, and increase benefits through the multiplier effect by increasing local consumption and production spending.

7.5.16.3.6 Health

The severity is very low for SO2 and PM10, and low for NO2. The duration will be for life of the project, and the spatial scale is limited to the Coega SEZ. The consequence of increased ambient concentrations of SO2, NO2 and PM10 from emissions from the Karpowership Project is therefore predicted to be low. The consequence of the addition to existing ambient concentrations, i.e. the cumulative effect, is also low. It is evident from the specialise report that from an air quality perspective, the Karpowership Project should be authorised considering the findings of this air quality impact assessment (Zunckel et al., 2022).

7.5.16.3.7 Housing

Visual Impact

Visual impact can have an influence on both a sense of place, and property values associated with scenic views, and as such the Landscape and Visual Impact Report by Marshall (2022) is considered with context to surrounding communities which are within sight of the Port of Ngqura. As noted under the Tourism section, the Powership, FSRU, and powerlines are situated within an operational Port and as such have an industrial area as their backdrop. Thus, the Powership will be partially screened by existing Port infrastructure such as superstructures (gantries and cranes), Port buildings, and other ships, although the FSRU will be more visible given that it is closer to the mouth of the Port (Marshall, 2022). The resulting impact will be that the ships and additional infrastructure will not extend the industrial area. The Powership, and FSRU will also be partially screened by the coastal dunes near the Port (Marshall, 2022). The powerline placements are also in close proximity to the Port and as such are likely to be viewed as part of the Port. In summary, the proposed project is expected to have a low significance on visual impact. The Landscape and Visual Impact assessment (Marshall, 2022) clearly illustrates that both the change in view from urban areas due to the location of the proposed ships and the alternative power line alignments were assessed as likely to have low significance. This is primarily because the Powerships will be seen as part of normal Port operations. In terms of the powerlines, again, these will be partly screened by the Port infrastructure as none of the proposed powerline alignments are likely to be visually obvious, and are less likely to be visually obvious given the distance from the powerlines and the structure from surrounding residential areas, and colour of building materials used (Marshall, 2022). This remains true, even from the beach side as the Powerships will be screened by Port infrastructure and will be seen against the tall coastal dune. Furthermore, because all works will be located within a busy commercial and the surrounding IDZ industrial area, landscape character change due to the proposed ships and the power line alternatives were assessed as likely to have landscape impacts of low significance (Marshall, 2022).

The visual impact of the Powerships may have an impact on residential property values, although the likelihood of this is negligible, as the presence of a ship is not an unfamiliar sight. Similarly, the transmissions lines will follow existing infrastructure with the visual change being minimal. (Marshall, 2022) notes that the Powerships, FSRU, and powerlines are unlikely to be visible from lower floors of buildings in urban areas – particularly St George's Strand and Bluewater Bay – but possibly visible from upper floors of houses. However, as noted above the view of the proposed project infrastructure and ships is obscured by existing Port infrastructure, obscured by coastal dunes and vegetation, will be viewed from a large distance, and part of an existing port and thus not extending the industrial zone.

Impact of terrestrial noise on the housing market

The noise levels produced by the Powerships and FSRU do not extend to any residential areas within the vicinity of the Port (Safetech, 2022). Saint Georges Strand is the closest residential area to the Port, and is out of the lowest zone of noise by more than 2km (Safetech, 2022). Thus, given that none of the residential areas fall within the zone of noise of the vessels, there are no negative impacts anticipated to the price of housing in the area as a result of Powerships and FSRU's noise generation, the noise levels produced by the Powerships and FSRU do not extend to any residential areas within the vicinity of the Port (Safetech, 2022). Saint Georges Strand is the closest residential area to the Port, and is out of the lowest zone of noise by more than 2km (Safetech, 2022). Thus, given that none of the residential areas fall within the zone of noise of the vessels, there are no negative impacts to the price of housing in the area as a result of Powerships and FSRU's noise generation.

Increased demand for housing during construction period

As indicated in the socio-economic impact assessment, the demand of housing, among others, will understandably be under additional pressure during the construction period, given the increased labourers working on-site. The report further indicates that these potential impacts can easily be mitigated through timeous engagement between the municipal authorities and Karpowership, where a clear action plan is put in place (Urban-Econ, 2021). The accompanying summary of impact related to the economic and social infrastructure during the construction period as a result of the increase in local traffic and migration of workers, highlights the significance thereof to be medium without mitigation and low with mitigation measures (Urban-Econ, 2021). In the short term, the area may be less desirable, as a place of residence, given the impacts during construction period however, this does not have a material impact on the assessment made in the specialist report, and therefore remains unchanged. Moreover, and as indicated above, once construction is complete the demand for housing as a result of personnel required during the construction phase will decline.

Summary of impacts on housing market around the Port of Ngqura

The Powerships, FSRU, and associated infrastructure will have a limited visual impact (as described in previous chapters) on any surrounding residential areas, as no residential areas have a clear line of sight to the project area. What may be visible will be an already operational Port. Therefore, no negative impact on housing prices are anticipated as a result of the visual impact. Similarly, the area which will experience noise from the Powerships and FSRU's operations will not extend to any residential areas, and therefore have no negative impact on housing prices. Thus, it is reasonable to concluded that there are no negative socio-economic impacts from the project during operations phase on the housing market of residential areas surrounding the project.

7.5.16.4 *Cumulative Impacts*

The Karpowership project is one of many projects planned for the Port of Ngqura and the Coega SEZ. Including one of a number of gas-to-power projects. Karpowership is well poised to contribute to- and help build the gas industry locally. Moreover, Karpowership will invest in the local community and industry through the implementation of a social and economic development plan. The cumulative socio-economic impacts through this mechanism, along with the multiplier effects further creates positive impact on the local economy.

The cumulative impacts of the Karpowership project on the biophysical environment and climate change have been presented above (with more detail available in each specialist impact report). Mitigation measures should be implemented to reduce the (low) negative impact on the small-scale fishers and tourism where necessary. Longer term positive impacts continuing beyond the 20-year life-time of the project, particularly in relation to the gas industry, should be implemented together with the local municipality and other key stakeholders.

7.5.16.5 Specialist Conclusion

No fatal flaws have been identified as part of the supplementary socio-economic impact assessment. Based on the findings of the socio-economic impact assessment done by Urban-econ (2021) and supplemented by this assessment the Karpowership project should be implemented.

7.5.17 Tourism Impacts

Over the last 20 years, it has become increasingly evident from focused research that noise from human activities in and around underwater environments can have an impact on the marine species in the area. The extent to which intense underwater sound might cause adverse impacts in species is dependent upon the incident sound level, source frequency, duration of exposure, and/or repetition rate of an impulsive sound (see, for example, Hastings and Popper, 2005). Marine mammals use sound as a primary means of underwater communication and sensing. They emit a sound to communicate regarding the presence of danger, food or other animals, and also about their position, identity, and reproductive or territorial status. Whales communicate using low-frequency acoustic signals which allow interaction over large distances. Noise in the ocean including from large ships or offshore mining activities can overlap with these acoustic signals used by humpback whales has been reported to induce habitat displacement, behavioural changes and alterations in their acoustic signals.

*7.5.17.1 Impact assessment findings (with and without mitigation): **Powership and FSRU: Operational Phase***

7.5.17.1.1 Impact of Noise on Marine Wildlife & Tourism Activities

There are no tourism activities of note inside the port itself by virtue of strict access control within the national key point area. However, the Port of Ngqura, the third largest port in South Africa, shares more than 40 km of coastline in the beautiful clear waters of Algoa Bay. Several charters are on offer in Algoa Bay which generally runs from June until December and enables one to see Cape Fur Seals, numerous sea birds, numerous shipwrecks, whales and Humpbacks, Southern Right Whales, Bryde's whales, depending on the season. Other charters specialise in scuba diving, deep-sea fishing, ocean safaris, and Island cruises. Out of the whale watching season, they specialise in Penguin Island Cruises, which takes guests out to St Croix Island. Raggy Charters also offer a Dolphin Watching Cruise all year round which often goes to St Croix Island as well, as there are often encounters with dolphins in this area.

The Marine Protected Area (MPA) increases the Big Five - found within the Addo Elephant National Park - to the Big Seven through the protection of Great White Sharks and whales (Brydes, Minke, Southern Right Whale, Humpback and Right). The MPA protects important feeding areas for the 9,000 pairs of endangered African penguins breeding at St Croix Island and the 60,000 pairs of endangered Cape gannets breeding at Bird Island.However, there is a significant and dramatic decline by 85% in penguin numbers from St Croix Island since 2016. As of 2022, this population has now decreased by 85 % (Pichegru *et. al*, 2022).

Considering all the existing charters on offer and active cruises to the bird islands, watching whales, dolphins, and all other marine tourism activities, the current ship traffic has not impacted negatively on the plethora of tourism activities in Algoa Bay or the Greater Addo Elephant Park, including the Marine Protected Area.

As described in the underwater noise assessment by Manson & Midforth (2022), the proposed Karpowership has noise mitigation built into the design of the ship, reducing any potential noise emission from the machinery on board. The High-frequency (HF) cetaceans (dolphins) are most likely to be present in the Port of Ngqura, which are considerably less sensitive to the adverse effects of noise. However, for the noise to have a significant impact, the dolphins would need to remain extremely close to any of the sources to obtain a noise exposure sufficient to lead to Temporary Threshold Shift (TTS). Therefore, the application of any noise mitigation is not deemed to be appropriate according to the underwater noise assessment (Manson & Midforth, 2022).

Table 7-90: Potential noise impacts in the Port of Ngqura on marine tourism activities

Ranking	**Without Mitigation**	**No Mitigation Required**
Magnitude	Minor (1)	
Reversibility	Completely reversible (1)	
Extent	Site bound (1)	
Duration	Immediate (1)	
Probability	Extremely remote (1)	
Consequence = Magnitude + Reversibility + Extent Duration	**= 1+1+1+1** **= 4**	
Significance = Consequence (Magnitude + Reversibility + Extent Duration) x Probability	**= (1+1+1+1) x 1** **= 4**	
Can impacts be mitigated	No	

The significance impact on marine tourism is low to significant. The noise levels produced by the ships associated with this Karpowership project are not substantially different to the noise levels produced by ships typically using the harbour and will not affect the wider bay or the species of marine mammals and fish in it (Manson & Midforth, 2022). No mitigation measure will be required.

7.5.17.1.2 *Impact of Visual and Noise on Hospitality and Tourism Industry*

The Karpowership project will be located at the Port of Ngqura which is classified as a national key point. The main Addo Elephant National Park lies 72 kilometres north of Gqebera and offers nature lovers the taste of a true African safari. The park covers more than 444 000 acres, extending from the Karoo in the north over the Zuurberg Mountains. It also includes offshore islands which shelter important breeding populations of Cape gannets and African penguins. Addo Elephant National Marine Protected Area (MPA), including St Croix Island, is located within 5km from the port, and Jaheel Island is located within 530m from the port. The Addo Elephant Important Bird Area (IBA) is within 5km of the port.

The 1200 km^2 Marine Protected Area (MPA) protects a wide range of ecosystems, including sandy beaches, rocky shores, reefs, an estuary and islands. Protection of the estuary and reefs are important for the recovery of valuable fisheries resources such as abalone and kob. Being close to the city, the MPA facilitates nature-based tourism, maintains attraction for marine ecotourism, and serves as an outdoor classroom for educational activities.

In general, the visual impact will be insignificant as the Powerships are placed in an existing operational port and views of the harbour and ships are part of the port landscape. For example, tourists still visit the cities of Durban and Cape Town, despite the visibility of heavy ship traffic destined for the harbours. Table 7-91 below summarises the significance and consequence impacts.

Table 7-91: Potential negative visual and noise impacts on tourism at Port of Ngqura

Ranking	Without Mitigation	No mitigation Required
Magnitude	None (0)	
Reversibility	Completely reversible (1)	
Extent	Site bound (1)	
Duration	Immediate (1)	
Probability	Extremely remote (1)	
Consequence = = Magnitude + Reversibility + Extent Duration	**= 0+1+1+1** **= 3**	
Significance = Consequence (Magnitude + Duration +Extent +Reversibility) x Probability	**= (0+1+1+1) x 1** **= 3**	
Can impacts be mitigated	No	

The visual and noise significance impact is low to insignificant. According to the findings by Manson & Midforth (2022), no ship noise was audible on the far side of the breakwater at the Port of Ngqura, despite it being a busy harbour. Therefore, no significant noise is expected to pass through the breakwater including the surrounding islands such as the Jahleel Island in proximity to the Powerships, Other hospitality and tourism establishments such as national parks (i.e. Addo Elephant NP) and hotels are located far from the port and there will be no visual and noise impacts. The consequence and significance of the visual impacts are therefore too small to have adverse impacts on tourism and hospitality industries.

7.5.17.1.3 Impact of Electricity Provision on Hospitality & Restaurant Establishment

Several studies on the impact of load shedding on the tourism sector suggest that the health and viability of the tourism and hospitality industry is key for the stimulation of national economic growth (Steenkamp *et al*. 2016). Small businesses such as Bed and Breakfasts (B&B's) and Guesthouses are therefore most likely to be negatively affected by load shedding as their survival was regarded as hanging in the balance (Mokwena, 2021, Banda *et al*., 2020 and van Niekerk, 2020).

The continuous power outages may also have a negative impact on the tourism and hospitality industry, resulting in a decline in both local and international visitors (Sefako-Musi 2019). The continuous power outages brought about by Eskom in the country are having adverse impacts on Small to Medium Enterprises (SMMEs), especially in the accommodation and restaurant sectors. The majority of these businesses do not have sufficient financial reserves to absorb the losses incurred through load shedding and more often have had to resort to extreme measures to remain viable and competitive (i.e., job cuts and business closure). The usage of alternative power supplies such as generators and solar power are options for few businesses but in general, the cost implication for these businesses is unsustainable over the long term

The biggest concerns from the Small to Micro Medium Enterprises (SMMEs) are that small businesses in the hospitality sector already face the uncertainty of seasonal revenue fluctuations and the power outages are worsening the situation as they now need to contend with the added insecurity of load shedding. These factors paint an accurate picture of the stresses faced by the larger SMME community in South Africa.

This assessment focuses mainly on the impact of the Karpowership development of gas-to-power Powerships at the Port of Ngqura on the hospitality and tourism sectors. However, impact assessments such as the socio-economic, noise on fauna, and underwater noise, are interlinked, and the cross-linkages will be highlighted where applicable. The table below summarises the consequence and significant impacts.

Table 7-92: Potential positive impacts of Karpowerships electricity provision on the hospitality and tourism industry Nelson Mandela Bay

Ranking	Without Mitigation	With Mitigation
Magnitude	Low (2)	Moderate (3)
Reversibility	Completely reversible (1)	Moderate (3) – Reversible with human intervention
Extent	Local (2)	Moderate (3)
Duration	Immediate (1)	High (4) – 15 years and more
Probability	Can occur (3)	Can occur (3)
Consequence = Magnitude + Duration +Extent +Reversibility	**2+1+2+1** **= 6**	**= 3+3+3+4** **= 13**
Significance = Consequence (Magnitude + Duration +Extent +Reversibility) x Probability	**= (2+1+2+1) x 3** **= 18**	**= (3+3+3+4) x 3** **=39**
Can impacts be mitigated	Yes	

The provision of energy will have a very high positive impact in the hospitality and tourism industry (i.e. savings on fuel for generators) and a general increase in GDP in the province as tourists will stay longer in the establishments and dine for longer periods as there will be no power cuts. During the construction phase, it is likely that construction workers coming from outside of the area may wish to be accommodated in the B&B's, hotels, or self-catering accommodation, resulting in a positive impact on tourism.

7.5.17.1.4 Impact on Energy and Industrial Tourism

In addition to marine tourism activities such as charters and conservation tourism products, the demand for tourism with special interest (such as energy tourism) is likely to increase across the globe (Alekseeva & Katarína Hercegová 2021). Energy tourism for example is one of the less-researched fields of tourism. The area proposed for the development as well as its surrounds is currently an industrial area with several, large buildings and surrounding powerlines. These structures have a similar visual footprint to the proposed Powerships and their related infrastructure. With the remarkable increase in tourism development products, the demand for tourism with special interest (such as energy tourism) is likely to increase across the globe (Alekseeva & Katarína Hercegová 2021). Energy tourism for example is one of the less-researched fields of tourism. This type of tourism includes visits to the energy facilities and locations such as factories, mines, renewable energy sites and power stations such as in the Nqgura port.

The majority of South Africans across the cultural divide have never seen a Powership and do not know what it looks like. There is a strong possibility that some segments of tourists would want to view a Powership and its associated FSRU when they are in the harbour. This might be a promising and emerging type of tourism that will likely grow due to the ongoing industrialization and expenditure of energy-generating facilities envisaged for meeting the growing demand for energy all around the world (Alekseeva & Katarína Hercegová 2021).

The table below reflects the positive effects that can be brought about by marketing the highly developed industrial (i.e., Port of Ngqura) as part of the marine tourism sites. For example, Volga River in Russia is the only hydropower station in the world that has a highway built over its roof and is one of the local tourist attractions visited by thousands of people every year in Russia.

Table 7-93: Potential Positive Impacts on Energy and Industrial Tourism at Port of Nqgura

Ranking	Without Mitigation	With Mitigation
Magnitude	Minor (1)	Minor (1)
Reversibility	Completely reversible (1)	Completely reversible (1)
Extent	Site bound (1)	Local (2)
Duration	Immediate (1)	Medium term (3)
Probability	Extremely remote (1)	Extremely remote (1)
Consequence = Magnitude + Reversibility + Extent Duration	**= 1+1+1+1** **= 4**	**= 1+1+2+3** **= 7**
Significance = Consequence (Magnitude + Reversibility + Extent Duration) x Probability	**= (1+1+1+1) x 1** **= 4**	**= (1+1+2+3) x 1** **= 7**

The significant impact of Karpowerships on energy and industrial tourism is low to insignificant as visitors are not allowed into the port to view the Powerships because of the breakwater and vessel traffic entering and leaving the port. However, the limited view from the ocean side may still have positive spinoffs.

7.5.17.2 *Mitigation Measures and Recommendations*

Electricity Provision on Hospitality & Restaurant Establishment

- The provision of power supply from the Karpowership will positively benefit the hospitality and restaurant establishments in the area (i.e. savings on fuel for generators) and a general increase in GDP in the province as tourists will stay longer in the establishments and dine for longer periods as there will be no power cuts. During the construction phase, it is likely that construction workers coming from outside of the area may wish to be accommodated in the B&B's, hotels, or self-catering accommodation, resulting in a positive impact on tourism

Energy and Industrial Tourism

- Mitigation measures include changing people's perception of traditional tourism (visiting national parks, reserves, and beaches) to embracing new tourism products such as energy tourism. Energy tourism can have a remarkable positive impact on the economy of the Eastern Cape Province.
- Different charters providing marine activities mostly from Algoa Bay will most probably include the Powerships as part of their discovery and exploratory sites. However, it is acknowledged that Transnet National Ports Authority (TNPA) will not change its existing policy of strict access into the port by allowing visitors to view the Powerships because of the breakwater and vessel traffic entering and leaving the port, although the limited view from the ocean side may still have positive spinoffs.

7.5.17.3 Specialist Conclusion

It can be concluded that there are no negative impacts on the tourism industry should the Karpowership SA initiative be implemented. Instead, it can be assumed that the generation of an alternative power supply will be an added advantage to the product owners as the majority are dependent on Eskom for power provision.

7.5.18 Marine Traffic Impacts

The construction stage of the project is expected to generate 54 peak hour trips. These trips would not be concentrated in one area, rather they would be assigned to the different construction sites and therefore the impact is diluted. The development is not expected to generate a high amount of truck trips during the construction stage of the project. The trucks trips will largely remain within the footprint of the construction area.

During the operational stage, the gas to power project is expected to generate some 34 trips onto the broader road network during the commuter peak hour. During the operational stage, the gas to power project will only generate ad-hoc truck and service vehicle trips for maintenance and replenishment of supplies. These trips will occur primarily outside the normal commuter peak hours. Vehicular movement routes within the port were established through engagement with Transnet.

7.5.18.1 Recommendations

The following are the recommendations of the Traffic and Transportation Evaluation:

- During the construction stage and operational stage of the project dedicated off-street parking should be provided as per Transnet's requirements.
- During the construction and operational stage of the project, if general public transport is being used, then the designated Transnet public transport pick up and drop off area should be utilised. Alternatively, if there is a dedicated Transnet shuttle available for staff working at the port, then permission may be sought to utilise such as service.

7.5.19 Visual Impacts

The assessment defined four discrete landscape areas including;

- Settlement areas. These include the coastal settlement areas of St George's Strand and Bluewater Bay. They are generally inward looking drawing little character influence from external areas. External views along the coast are also generally blocked by the coastal dune. These areas could be sensitive to change in view due largely to their use.
- Undeveloped sections of the Coastal Plain. This area is relatively flat with generally low vegetation. This LCA is therefore currently unlikely to provide significant visual absorption capacity. Within the vicinity of the proposed project this LCA largely includes undeveloped sections of the Coega SEZ. Whist these areas are currently undeveloped, it is planned that industrial development will extend over much of this area. This situation is therefore likely to change. Because this change in use is planned and is ongoing this area is unlikely to be sensitive to a change in view associated with the proposed project.
- Industrial sections of the Coastal Plain. This is comprised of the SEZ area immediately to the south west of the Port. Buildings and infrastructure will provide a degree of screening in this area. This area will not be sensitive to a change in view associated with the proposed project.

- The Port and coastal strip. The coastal strip can be differentiated from the rest of the coastal plain due to its proximity to the sea. It is obviously different from adjacent industrial areas due to the scale of equipment and structures. Cranes and gantries are highly obvious from a distance. The beach runs north and south of the Port mouth abutting directly onto container storage on the southern side and ship mooring berths on the northern side. Because these structures are existing and currently impact on beach areas, it is unlikely that adjacent areas of beach will be highly sensitive to a change in view associated with the proposed project. It should be noted that the beach to the north of the existing Port entrance falls within the SEZ.

The following possible sensitive receptors were identified:

- Area Receptors including;
  - Urban areas and particularly the coastal settlements of St George's Strand and Bluewater Bay.
  - Conservation areas including the Addo Elephant Park and the Swartkops Valley Local Nature Reserve.
- Linear Receptors including;
  - Routes through the area particularly the N2.
  - Beaches particularly to the south east on the seaward side of the coastal dune close to of St George's Strand and Bluewater Bay.

The significance of a change in a view for a visual receptor is likely to relate to use. Uses that relate to recreation and tourism are likely to be the most sensitive to change. These include local beaches, the coastal settlement areas of St George's Strand and Bluewater Bay as well as the Addo Elephant Park and Swartkops Valley Local Nature Reserve.

7.5.19.1 Impact assessment findings mitigation: ***<u>Constuction and Operational Phase</u>***

7.5.19.1.1 The proposed development could change the character and sense of place of the landscape setting (Landscape Change)

Nature of impact:

The proposed Powership and FSRU are large industrial ships that will be located within the port. Whilst they will include industrial superstructure that is not typical of most shipping that visits the port, they are essentially ships within a busy port. It was also noted that Port infrastructure includes large cranes and gantries that are taller than the stacks on the Powership.

Immediately inland and to the north and south of the Port is the Coega SEZ. The visual influence of the proposed project will be largely limited to the tall coastal dunes which largely screen views of the Port from areas inland.

This natural character of the immediately affected area therefore has an industrial port feel which is likely to intensify as the SEZ is developed. The proposed project is very much in keeping with this character.

	Without mitigation	With mitigation
Extent	**Power Ship & FSRU** Site and immediate surroundings, **(2)** **Power lines 1, 2, 3** Site and immediate surroundings, **(2)**	**Power Ship & FSRU** N/A **Power lines 1, 2, 3** Site and immediate surroundings, **(2)**
Duration	Long term, **(4)**	Medium term, **(3)**

Magnitude	**Power Ship & FSRU** Small, **(0)** **Power lines 1, 2** Minor, **(2)** **Power line 3** Small, **(0**	**Power Ship & FSRU** N/A **Power lines 1, 2** Minor, **(2)** **Power line 3** Small, **(0)**
Probability	**Power Ship & FSRU** Probable, **(3)** **Power lines 1, 2** Probable, **(3)** **Power line 3** Improbable, **(2)**	**Power Ship & FSRU** N/A **Power lines 1, 2** Probable, **(3)** **Power line 3** Improbable, **(2)**
Significance	**Power Ship & FSRU** Low, **(18)** **Power lines 1, 2** Low, **(24)** **Power line 2** Low, **(12)**	**Power Ship & FSRU** N/A **Power lines 1, 2** Low, **(21)** **Power line 2** Low, **(10)**
Status	Probably the majority of people would expect to see ships in the Port and wouldn't necessarily differentiate between types of ship. However some are likely to see the Powership in a negative light. Proposed power lines will be also be viewed in the context of other industry. **Neutral - Negative**	**Power lines 1, 2 & 3** **Neutral - Negative**
Reversibility	High	**Power lines 1, 2 & 3** High
Irreplaceable loss	The proposed project will be removed from site on completion of contract period There will therefore be **no irreplaceable loss**.	**Power lines 1, 2 & 3 no irreplaceable loss.**
Can impacts be mitigated?	**Yes (only powerlines**	**N/A**
Mitigation / Management: POWER LINE ALTERNATIVES ONLY		

Planning: ▪ Plan to undertake rehabilitation and erosion control. Operations: ▪ Minimise disturbance. ▪ Undertake rehabilitation and erosion control. Decommissioning: ▪ Remove infrastructure not required for the post-decommissioning use of the site; ▪ Rehabilitate and monitor areas for vegetation cover post-decommissioning and implement remedial actions.
Cumulative Impacts: The proposed project will be located within a Port that is surrounded by industry. Therefore the proposed project will not extend the industrialisation of the area. The cumulative contribution to the overall impact of industry within the area is therefore anticipated to be low.
Residual Impacts: No residual risks identified.

7.5.19.1.2 *The proposed development could change the character of the landscape as seen from urban areas and particularly the coastal settlements of St George's Strand and Bluewater Bay.*

Nature of impact: The proposed ships are unlikely to be visible from lower floors of buildings and roads running through these settlements. They may however be visible from upper floors of houses. If the ships are visible, the FSRU is likely to be the most obvious as it will be seen closer to the harbour entrance and away from Port cranes and buildings. The Powership will be seen closer to the coastal dune and will be partially screened by Port buildings and cranes. It is therefore likely to be less obvious than the FSRU. Due to distance and screening infrastructure, none of the overhead 132kV powerline alternatives will be visually obvious. The proposed ships will be seen as part of normal Port operations. The likely visual impact experienced from coastal settlements is therefore expected to have a negligible significance with no irreplaceable loss. Powership alternative 2 may be slightly more obvious but this is not likely to be sufficient to change the significance. The impact will be reversible on removal of the ships.		
	Without mitigation	**With mitigation**
Extent	**Power Ship & FSRU** Site and immediate surroundings, **(2)** **Power lines 1, 2, 3** Site and immediate surroundings, **(2)**	**Power Ship & FSRU** N/A **Power lines 1, 2, 3** Site and immediate surroundings, **(2)**
Duration	Long term, **(4)**	Medium term, **(3)**

Magnitude	**Power Ship & FSRU** Small to Minor, **(1)** **Power lines 1, 2, 3** Small, **(0)**	**Power Ship & FSRU** N/A **Power lines 1, 2, 3** Small, **(0)**
Probability	**Power Ship & FSRU** Probable, **(3)** **Power lines 1, 2, 3** Very improbable, **(1)**	**Power Ship & FSRU** N/A **Power lines 1, 2, 3** Very improbable, **(1)**
Significance	**Power Ship & FSRU** Low, **(21)** **Power lines 1, 2, 3** Low, **(6)**	**Power Ship & FSRU** N/A **Power lines 1, 3** Low, **(5)**
Status	Probably the majority of people would expect to see ships in the Port and wouldn't necessarily differentiate between types of ship. However some are likely to see the Powership in a negative light. Proposed power lines will be also be viewed in the context of other industry. **Neutral - Negative**	**Power lines 1, 2 & 3** **Neutral - Negative**
Reversibility	High	**Power lines 1, 2 & 3** High
Irreplaceable loss	The proposed project will be removed from site on completion of contract period There will therefore be **no irreplaceable loss**.	**Power lines 1, 2 & 3** **no irreplaceable loss**.
Can impacts be mitigated?	**Yes (powerlines only)**	**N/A**
Mitigation / Management: POWER LINE ALTERNATIVES ONLY Planning: ▪ Plan to undertake rehabilitation and erosion control. Operations: ▪ Minimise disturbance. ▪ Undertake rehabilitation and erosion control. Decommissioning:		

▪ Remove infrastructure not required for the post-decommissioning use of the site; ▪ Rehabilitate and monitor areas for vegetation cover post-decommissioning and implement remedial actions.
Cumulative Impacts: The proposed project will be located within a Port that is surrounded by industry. Therefore the proposed project will not extend the industrialisation of the area. The cumulative contribution to the overall impact of industry within the area is therefore anticipated to be low.
Residual Impacts: No residual risks identified.

7.5.19.1.3 *The proposed development could change the character of the landscape as seen from roads particularly the N2.*

Nature of impact: The analysis indicates that the proposed ships and overhead 132kV power line will be visible from a short section of the N2. In the case of the overhead 132kV powerline, which ever alternative is selected, this element will be seen in the future in the context of industrial development associated with the Coega SEZ. Should powerline alternative 2 be selected, the crossing of the N2 will be seen in the context of a similar powerline crossing. Should alternative powerline alignments 1 or 3 be selected this will impact a new section of the road. For this reason power line alternative 1 and 3 are not favoured. Both proposed ship alternatives will be seen at a distance of approximately 3.3km and in the context of Port operations and infrastructure. The FSRU is likely to be visible to a greater extent than the Powership which will be located closer to and will be partially screened by the coastal dune. The likely visual impact of both ship alternatives experienced from the N2 is therefore expected to have a negligible / low significance with no irreplaceable loss. The impact will be reversible on removal of the ships.		
	Without mitigation	**With mitigation**
Extent	Site and immediate surroundings, **(2)**	Power lines 1, 2 and 3 Site and immediate surroundings, (2)
Duration	Long term, **(4)**	Power lines 1, 2 and 3 Medium term, (3)
Magnitude	**Power Ship & FSRU** Small to Minor, **(1)** **Power line 2** Small, **(0)** **Power lines 1 and 3** Minor, **(2)**	**Power Ship & FSRU** Small to Minor, **(1)** **Power line 2** Small, **(0)** **Power lines 1 and 3** Minor, **(2)**
Probability	**Power Ship & FSRU** **Probable, (3)** **Power line 2** Improbable**, (2)**	**Power Ship & FSRU** **N/A** **Power lines 2** Improbable, **(2)**

	Power lines 1 and 3 Probable, **(3)**	**Power lines 1 and 3** Probable, **(3)**
Significance	**Power Ship & FSRU** **Low, (21)** **Power lines 2** Low, **(12)** **Power lines 1 and 3** **Low, (24)**	**Power Ship & FSRU** **N/A** **Power lines 2** Low, **(10)** **Power lines 1 and 3** **Low, (21)**
Status	Probably the majority of people would expect to see ships in the Port and wouldn't necessarily differentiate between types of ship. However some are likely to see the Powership in a negative light. Proposed power lines will be also be viewed in the context of other industry. **Neutral - Negative**	**Power lines 1, 2 and 3** **Neutral - Negative**
Reversibility	High	Power lines 1, 2 and 3 High
Irreplaceable loss	The proposed project will be removed from site on completion of contract period There will therefore be **no irreplaceable loss**.	**Power lines 1, 2 and 3** **no irreplaceable loss.**
Can impacts be mitigated?	**Yes (power lines only)**	**N/A**
Mitigation / Management: POWER LINE ALTERNATIVES ONLY Planning: ▪ Plan to undertake rehabilitation and erosion control. Operations: ▪ Minimise disturbance. ▪ Undertake rehabilitation and erosion control. Decommissioning: ▪ Remove infrastructure not required for the post-decommissioning use of the site; Rehabilitate and monitor areas for vegetation cover post-decommissioning and implement remedial actions.		
Cumulative Impacts: The proposed project will be located within a Port that is surrounded by industry. Therefore the proposed project will not extend the industrialisation of the area. The cumulative contribution to the overall impact of industry within the area is therefore anticipated to be low.		
Residual Impacts:		

No residual risks identified.

7.5.19.1.4 *The proposed development could change the character of the landscape as seen from the south east on the seaward side of the coastal dune close to of St George's Strand and Bluewater Bay.*

Nature of impact: Views of the proposed project from beaches are likely to be similar in character as those from coastal residential areas. The closest section of public beach is approximately 1.9km from the proposed FSRU. The closer the viewer is to this point, the greater screening effect that the southern breakwater is likely to have. From beaches close to the Port, powerline alternative 3 could be highly obvious on the dune slope adjacent to the Port. For this reason these alternatives are not favoured. None of the Powerline alternatives are likely to be visually obvious. The proposed Powership will be partially screened by port buildings and tall cranes. The proposed FSRU will be located closer to the Port entrance and away from buildings and cranes. It is therefore likely to be more obvious than the Powership. There will however be a degree of screening provided by the southern breakwater particularly for closer viewpoints. Both ships will be seen in the context of Port operations and are unlikely to be seen as unusual industrial operations in their own right. The likely visual impact experienced by beach goers is therefore expected to have a negligible significance with no irreplaceable loss. The impact will be reversible on removal of the ships.		
	Without mitigation	**With mitigation**
Extent	Site and immediate surroundings, **(2)**	Power lines 1, 2 & 3 Site and immediate surroundings, (2)
Duration	Long term, **(4)**	Power lines 1, 2 & 3 Medium term, **(3)**
Magnitude	**Power Ship & FSRU** Small to Minor, **(1)** **Power lines 3** Small, **(0)** **Power lines 1 & 3** Minor, **(2)**	**Power Ship & FSRU** **N/A** **Power line 3** Small, **(0)** **Power lines 1 & 3** Minor, **(2)**
Probability	**Power Ship & FSRU** **Probable, (3)** **Power lines 1, 2 & 3** Very improbable, **(1)**	**Power Ship & FSRU** **N/A** **Power lines 1,2 & 3** Very improbable, **(1)**
Significance	**Power Ship & FSRU** Low, **(21)** **Power lines 1,2 & 3** Low, **(6)**	**Power Ship & FSRU** **N/A** **Power lines 1,2 & 3** Low, **(5)**

Status	Probably the majority of people would expect to see ships in the Port and wouldn't necessarily differentiate between types of ship. However some are likely to see the Powership in a negative light. Proposed power lines will be also be viewed in the context of other industry. Neutral - Negative	**Power lines 1,2 & 3** **Neutral - Negative**
Reversibility	High	Power lines 1, 2 and 3 High
Irreplaceable loss	The proposed project will be removed from site on completion of contract period There will therefore be **no irreplaceable loss**.	**Power lines 1, 2 & 3** **no irreplaceable loss.**
Can impacts be mitigated?	**Yes (power lines only)**	**N/A**
Mitigation / Management: POWER LINE ALTERNATIVES ONLY Planning: ▪ Plan to undertake rehabilitation and erosion control. Operations: ▪ Minimise disturbance. ▪ Undertake rehabilitation and erosion control. Decommissioning: ▪ Remove infrastructure not required for the post-decommissioning use of the site; ▪ Rehabilitate and monitor areas for vegetation cover post-decommissioning and implement remedial actions.		
Cumulative Impacts: The proposed project will be located within a Port that is surrounded by industry. Therefore the proposed project will not extend the industrialisation of the area. The cumulative contribution to the overall impact of industry within the area is therefore anticipated to be low.		
Residual Impacts: No residual risks identified.		

7.5.19.1.5 *The proposed development could change the character of the landscape as seen from Conservation areas including the Addo Elephant Park and the Swartkops Valley Local Nature Reserve.*

Nature of impact: The proposed alternative 132kV overhead power line will not be visible from the Swartkops Valley. Both the Power Ship and the FSRU may be visible from the south-western section (beach) of the Addo Elephant Park. If visible they will be seen from a distance of approximately 18km. At this distance they are unlikely to be highly obvious. They will also be viewed in the context of Port infrastructure including cranes and container

storage as well as other vessels both at anchor in the bat as well entering and leading Port. There will therefore be very limited visual impact. Views will be intermittent because the main views will be from elevated positions on the dune and vegetation / dune topography will screen views from areas. Proposed power line alternatives will not be visible from this distance.		
	Without mitigation	**With mitigation**
Extent	Region, **(3)**	N/A
Duration	Long term, **(4)**	N/A
Magnitude	Small, **(0)**	N/A
Probability	Improbable, **(2)**	N/A
Significance	Low, **(14)**	N/A
Status	Probably the majority of people would expect to see ships in the port and wouldn't necessarily differentiate between types of ship. However some are likely to see the powership in a negative light. Neutral - Negative	N/A
Reversibility	High	N/A
Irreplaceable loss	The proposed project will be removed from site on completion of contract period There will therefore be no irreplaceable loss.	N/A
Can impacts be mitigated?	**Yes**	N/A
Mitigation / Management: N/A		
Cumulative Impacts: The proposed project will be located within a Port that is surrounded by industry. Therefore the proposed project will not extend the industrialisation of the area. The cumulative contribution to the overall impact of industry within the area is therefore anticipated to be low. **See appendix IV.**		
Residual Impacts: No residual risks identified.		

7.5.19.1.6 *The potential visual impact of operational, safety and security lighting of the facility at night on observers.*

Nature of impact:

<table>
<tr><td colspan="3">The ships will be operational at night and so will be lit at deck level to enable this.
The lighting of shipping at deck level is normal practice while in Port.

The Port area is also brightly lit at night to enable on going operations and Port security.

There will be no lighting associated with the alternative power lines.</td></tr>
<tr><td></td><td>Without mitigation</td><td>With mitigation</td></tr>
<tr><td>Extent</td><td>Region (3)</td><td>N/A</td></tr>
<tr><td>Duration</td><td>Long term, (4)</td><td>N/A</td></tr>
<tr><td>Magnitude</td><td>Minor (2)</td><td>N/A</td></tr>
<tr><td>Probability</td><td>Probable (3)</td><td>N/A</td></tr>
<tr><td>Significance</td><td>Low (27)</td><td>N/A</td></tr>
<tr><td>Status</td><td>Probably the majority of people would expect to see ships in the Port and wouldn’t necessarily differentiate between types of ship. However some are likely to see the Powership in a negative light.
Proposed power lines will be also be viewed in the context of other industry.
Neutral - Negative</td><td>N/A</td></tr>
<tr><td>Irreplaceable loss</td><td>The proposed project will be removed from site on completion of contract period
There will therefore be no irreplaceable loss.</td><td>N/A</td></tr>
<tr><td>Reversibility</td><td>High</td><td>N/A</td></tr>
<tr><td>Can impacts be mitigated?</td><td>No</td><td>N/A</td></tr>
<tr><td colspan="3">Mitigation / Management:
N/A</td></tr>
<tr><td colspan="3">Cumulative Impacts:
The proposed project will be located within a Port that is surrounded by industry. Therefore the proposed project will not extend the industrialisation of the area.
The cumulative contribution to the overall impact of industry within the area is therefore anticipated to be low.</td></tr>
<tr><td colspan="3">Residual Impacts:
No residual risk has been identified.</td></tr>
</table>

All works will be located within a busy commercial Port and the surrounding SEZ industrial area, landscape character change due to the proposed ships and the power line alternatives were assessed as likely to have landscape impacts of low significance.

The impact of both the change in view from urban areas due to the location of the proposed ships and the alternative power line alignments were assessed as likely to have low significance.

All visual impacts on the N2 were assessed as likely to have a low significance.

All visual impacts on beaches were assessed as likely to have a low significance.

In relation to the visual impact on Protected Areas (Swartkops Valley and Addo Elephant Park), the proposed overhead power line alternatives are highly unlikely to be visually obvious. The impact was assessed as having a low significance. The analysis also indicates that the project will not be visible from the Swartkops Valley.

For lighting Impacts, potential security and operational lighting was assessed as likely to have an impact of low significance.

7.5.19.2 *Cumulative Impacts*

The proposed Project will be located within a commercial Port that is surrounded by industry. Therefore the proposed Project will not extend the industrialisation of the area. The cumulative contribution to the overall impact of industry within the area is therefore anticipated to be low.

7.5.19.3 *Mitigation Measures and Recommendations*

No mitigation measures are deemed required for the Powerships as the low impact is congruent with the proposed and anticipated character of the area.

It is possible to mitigate potential impacts associated with the power line alternatives. However, such mitigation is limited to ensuring that good working practices are employed and that appropriate measures are taken to minimise disturbance and rehabilitate disturbed areas during construction. Such measures, particularly on the dune face, will prevent possible erosion and visibility thereof.

7.5.19.4 *Specialist Conclusion*

The proposed project will be located within a busy commercial Port that is surrounded by industry.Due to the location of the Port in a relatively narrow opening in the high coastal dune, the proposed ships will be largely screened from inland viewpoints. Wherever the proposed ships may be visible from they will be seen in the context of other shipping, Port operations and industrial development.

Whilst power line alternatives 1 and 3 have not been ruled out, alternative 2 is the favoured power line alignment due to its reduced impact on the coastal dune and the N2. Therefore from a landscape and visual impact perspective the proposed project should be authorised.

7.5.20 Major Hazard Installation Impacts

Specific Individual Risk Levels

The likelihood that a person in some fixed relation to a hazard (e.g. at a location, level of vulnerability, protection and escape) might sustain a specific level of harm. The frequency at which an individual may be expected to sustain a given level of harm from the realisation of specified hazards. For example, there may be an individual risk of one-in-a million that a person would be killed by an explosion at a major hazard near their home for every year that a person lives at that address. [HSE Societal Risk: Initial briefing to Societal Risk Technical Advisory Group: p60].

Employee Risk

Scenarios considered regarding risk to employees are toxic vapour clouds from Ammonia and chlorine plant failures, vapour cloud explosions and BLEVEs from gas vessel failures, and pool fires from fuel installations. Employees and the public are indoors and outdoors during the day and major events associated with these installations would occur outside of the building near the installation areas. When exposed to hazards such as toxic clouds, people who are indoors (sheltered) will generally be less vulnerable than those outdoors (unsheltered). The risks should not be more than one-in-a-thousand (1.0e-3 per year).

Individual Risk

The proposed LNG operations were modelled for this Risk Assessment. The results were as follows:

- The 1.0e-4 (one in a ten thousand) red contour, is confined to the two ships and
- 170m around the hose connections;
- The 1.0e-5 (one in a hundred thousand) orange contour, is confined to the two ships and 235m around the hose connections;
- The 1.0e-6 (one-in-a-million) yellow contour, stretches for a maximum distance of 300m from the generator barge hose;
- The 3.0e-7 (one-in-thirty million) green contour, does not reach any sensitive populations. The contour stretches for a maximum distance of 320m from the generator barge hose connection.

Figure 7-12: Individual Risk

Risk Levels and Ranking

Individual risk levels at several important points around the operations at the Port:

Table 7-94: Risks at the Breakwater

No	Scenario	Contribution %	Risk Value
1	Pipe Rupture (STS1)	71.8	2.73e-06
2	Pipe Leak (STS1)	20.8	7.91e-07
3	Pipe Rupture (STS3)	3.86	1.47e-07
4	Pipe Rupture (STS2)	3	1.14e-07
5	Leak (Venting)	0.536	2.04e-08

Table 7-95: Risks at Breakwater Jetty

No	Scenario	Contribution %	Risk Value
1	Pipe Rupture (STS1)	99	8.81e-07
2	Leak (Venting)	1.03	9.14e-09

Table 7-96: Risk to Population

Population	Risk Level

Risks at Bulk Terminal	No risks
Risks at Container Terminal	No risks
Risks at Jaheel Island	No risks

No one within the port area is exposed to a risk greater than 1.0e-06 (one-in-a million) and ship staff is exposed to a risk of no more than 1.0e-05 (one-in-ten thousand). These risks are acceptable for persons operating in a national port.

Societal risk is defined as the relationship between frequency and the number of people suffering from a specified level of harm in each population from the realisation of specified hazards. Societal risk evaluation is concerned with estimation of the chances of more than one individual being harmed simultaneously by an incident. The societal risks were determined to be less than 1.0e-6 of one fatality and are therefore acceptable.

The specialist determined that the individual risks at the Gas to Power facility are 'Tolerable' as they fall within the ALARP range. The risks off site are 'Broadly Acceptable'. As can be seen on the graph above, the societal risks are less than 1.0e-6 of one fatality and are therefore acceptable.

7.5.20.1 *Mitigation Measures and Recommendations*

The following is recommended to reduce the risks associated with the installations at the site:

- Good housekeeping must always be observed on site;
- Only suitably qualified people must be used for all installation work;
- An accredited installer must conduct a pressure test and provide the relevant compliance certificates;
- There must be an Operations Manual for each operation.

7.5.20.2 *Specialist Conclusion*

This Assessment established that an incident involving the Gas to Power Project at the Port of Ngqura could impact on the neighbouring berths. The risks associated with this MHI were found to be acceptable.

A site is deemed to be an MHI if more than the prescribed quantity is stored as per the General Machinery Act or if a product is stored, handled or produced which has the potential to cause a major incident as per the Major Hazard Installation Regulations.

7.5.21 Marine Traffic Impacts

The marine vessel traffic assessment assessed the potential risks posed by the additional marine vessel traffic associated to the proposed Powership project and the anticipated vessel traffic in the short term (i.e. 7-year horizon) and medium term development (i.e. 7-year to 30-year horizon) of the Port of Coega. The infrastructure developments include the relocation of the existing fuel berth in Port Elizabeth to the Port of Ngqura. Within the next year, Berth B100 will be converted from an MPT berth to a liquid bulk facility able to accommodate Handymax tankers (TNPA, 2019).

In 2021, Berth C100 is being equipped and operationalised to handle bulk export manganese considering both Panamax and Mini-Capesize bulk carriers (TNPA, 2019). By 2023, Berth C101 will be converted to a bulk export manganese berth to further increase the manganese export capacity (TNPA, 2019).

In 2027, depending on the demand for liquid bulk cargo, Berth B100 may be reverted back to MPT and the liquid bulk facilities will be relocated to a new berth at Berth A100 (TNPA, 2019).

The existing and anticipated vessel traffic in the Port of Ngqura in 2020 is 712 vessels with approximately 93% of these vessels being container vessels. The current demand for container handling is 980 000 TEUs and is expected to grow to approximately 2 million TEUs by 2051. The liquid bulk terminal in Port Elizabeth is scheduled to move to the Port of Ngqura and is forecast to increase handling of total liquid bulk products from approximately 1 Mtpa in 2021 to approximately 2 Mtpa in 2051. The manganese ore terminal is set to be operational by 2021 and is forecasted to increase to approximately 22 Mtpa by 2051.

CMR data was used to analyse the historic trends of vessel activity at the Port of Ngqura (LTPF, 2015). The annual percentage growth in demand was used to estimate the future vessel traffic for the various cargo handled within the port for the years 2021 to 2051. Container vessel calls are forecasted to increase from 687 in 2021 to 1 497 in 2051. The number of additional vessels contributable to the Powership operations is 7 vessels per annum, increasing to 8 vessels in 2028 and 14 vessels per annum in 2051. This only considers the relatively more frequent LNGC refuelling of the FSRU and excludes the once-off arrival of the Powership and FSRU upon commissioning within the Port of Ngqura.

All vessel slots, including the LNGC vessels arriving for refueling, were calculated assuming an appropriate slot duration where the navigation channels, pilotage and tug resources of the port are utilised. The assumed slot durations considered a 2.5 hour duration for both berthing and sailing operations of the existing vessel types in the port (i.e. cargo vessels), while LNGCs will consider a duration of approximately 4 hours to moor and unmoor at the FSRU.

The results of the marine vessel traffic assessment, which considers vessel traffic forecasts up to 2051 and an upper limit of LNGC vessel calls, indicate that the LNG vessels, only representing 1% of the 2051 vessel traffic slot durations, are not expected to significantly add to congestion within the port. The Port of Ngqura is forecasted to have approximately 76% and 47% spare slot capacity in 2021 and 2051 respectively.

7.6 DECOMMISSIONING PHASE

Karpowership has prepared this decommissioning report to outline the methods and means to decommission the Port of Nqgura Project at the end of the Power Purchase Agreement (PPA). The project has a potential life time of approximately 20 years. At the end of the PPA, the ship will depart the harbour and all pipelines and grid connections which are classified as own built will be decommissioned and the infrastructure subsequently removed. The decommissioning process will begin at the end of the PPA. Prior to commencing decommissioning the Project will be shut down, de-energised and disconnected from the national grid. The Project Company will give landowners sufficient notice prior to the commencement of the decommissioned activities.

Legal Context

The RMI4P requires the decommissioning of all assets which are owned and operated by the Project Company to be safely decommissioned and the land reinstated after the PPA has ended. The decommissioning process needs to comply with all relevant environmental legislation inclusive of any conditions contained within the lease agreements entered into.

GENERAL DEMOLITION APPROACH:

Switching station

Disassembly of the switching station, should future use by Eskom not be viable, would include the removal of the steel, transformers, circuit breakers, conductors, and other materials that could be reconditioned and reused or sold as scrap.

In addition to steel structures, the control building will be disassembled and removed from the site. Fencing around the substation will be broken down and removed. The gravel or aggregate surface at the substation will loaded onto trucks and removed for sale and reuse

Transmission lines

Transmission lines are often reconditioned and used to facilitate the reliable delivery of energy, however, if the transmission line need to be removed, above-ground elements of the transmission line, such as the overhead monopoles, conductor and fibre would be removed and the materials would be disposed, recycled, or sold. Underground equipment such as stay wires buried less than 1 m below ground would be removed.

Foundations

Foundations would be exposed using backhoes, bulldozers, and other heavy earth moving equipment. Monopole foundations would be excavated to a depth sufficient to remove anchor bolts, rebar, conduits, cable, and concrete to a depth of at least 1m below ground. After removal of noted foundation materials, the areas would be filled with clean compatible subgrade material compacted to a density similar to the surrounding sub- grade material. All disturbed areas will be restored to pre-existing conditions and contours

Gas pipeline

Once the Project vessels have been demobilised the decommissioning and removal of the gas pipeline can commence. The pipeline will be pigged clean then divers will disconnect the pipeline end manifold (PLEM) flanges and insert blank flanges. Once disconnected the PLEMs can be lifted off the seabed using marine equipment. The offshore pipeline will then be cut into sections using subsea tools and either floated and pulled to shore using lift bags or lifted onto a material barge for transport to shore for disposal. The seabed disturbance during removal will be minimal as the pipeline is sitting on the seabed and not buried. The onshore portion of the pipeline the will be dug up in sections and all crossings removed. The existing hard stand, road siding or revetment rock will be replaced and the affected areas returned to their initial condition. The beach at the shore crossing will be instated to its natural condition.

Reseeding, revegetation, backfilling and grading

After the powerlines, ancillary structures and associated substation equipment have been removed, site rehabilitation will commence. This includes reseeding and revegetation, including the use of plants endemic to the site. To the extent necessary, topsoil would be removed prior to removal of structures from all work areas and stockpiled and separated from other excavated material. The topsoil would be de-compacted to match the density and consistency of the immediate surrounding area. The topsoil would be replaced to original depth, and original surface contours re-established where possible. If the disturbed areas will not be used for agricultural purposes, then the areas will be reseeded with native grasses. All disturbed areas will be restored to pre-construction conditions including topography, native grasses and/ or land use. Stabilization measures will be implemented in disturbed areas to control erosion and sedimentation during reclamation of the site. To prevent the introduction of undesirable plant species into reclaimed areas and ensure slope stability, seeding and site reclamation efforts will utilize seed for grasses native to the area and free of noxious weeds. If mulch is used, the mulch will be certified weed-free prior to use in reclamation efforts. Agricultural seed will be secured from a local source.

All disturbed soil surfaces within agricultural fields would be seeded with a seed mix agreed upon with the landowner to maintain consistency with the surrounding agricultural uses. All other disturbed areas would be restored to a condition and forage density reasonably like original conditions. In all area’s restoration shall include levelling, terracing, mulching, and other necessary steps to prevent soil erosion, to ensure establishment of suitable grasses and to control noxious weeds and pest. Reseeding will occur on all disturbed surfaces.

Restoration methods and Best Management Practices to minimize wind and water erosion will be implemented where practical to maximize revegetation success. The topsoil will be placed in a roughened condition to prevent erosion and additional erosion control and soil stabilization measures may be required on steeper slopes, areas of erodible soils or areas adjacent to streams and creeks. Topsoil will be scarified, tilled, or harrowed to a depth of approximately 10cm below ground surface to create a suitable seedbed for germination and establishment of seed. In areas not conducive to this method (e.g., steep slopes, rocky areas, etc.), the soil will be dozer- tracked perpendicular to the slope or left with sufficient roughness following topsoil placement to provide microsites for seed germination, capture and retention of available precipitation and reduce soil movement or erosion. Grading activities will be limited to the minimal area required to complete site restoration of disturbed areas using a bulldozer, grader or similar earth moving equipment. Disturbed areas will be graded and contoured to restore the natural topography and drainage of the site prior to construction of the grid connection equipment.

Debris, waste management and clean-up

Following clean-up and seeding, vegetative debris (woody and non- woody) will be reused as mulch over reclaimed areas. Trees and other shrubs will not be permanently windrowed along the edge of disturbed areas. Solid waste management will include the provision of trash containers and regular site clean-up for proper disposal of solid waste (scrap metal, food, containers, etc.) during decommissioning and site reclamation. Trash and bulk waste collection areas with containers (dumpsters, roll off containers or similar waste receptacles) will be designated at the site and materials will be recycled when possible (paper, wood, concrete, etc.). Litter, bottles, and assorted trash will be removed daily from decommissioning areas and placed in designated trash containers for disposal. Trash, debris, and any other solid waste generated during decommissioning will be minimized and managed in accordance with applicable regulations and routinely removed from the site, as needed.

7.7 NO-GO ALTERNATIVE

Should the Karpowership gas-to-energy project not be implemented, the benefits of the proposed activity will not be realised and neither will the associated negative impacts/risks i.e. the status quo will remain. This means that the supply of additional electricity to the national grid will not be supplemented by Karpowership as a preferred RMI4P bidder.

The status quo with regard to the national supplier will remain, i.e. the national grid will continue to be strained as a result of aging and failing systems within the fleet until additional supplies can be secured. The potential negative impacts as a result of the project on the physical and social environmental will also not occur. In contrast, any positive impacts or opportunities that will be created by the proposed development, such as job creation or social upliftment, will not be realised.

The No-go alternative entails that the proposed gas-to-power facility would not become part of the RMI4P to provide dispatchable power to the national grid in order curtail the disastrous effects of loadshedding, resulting in the down-wind spiralling effect on the economy and general decline of individual well-being. Continuous power outages may have a negative impact on the tourism and hospitality industry, resulting in a decline in both local and international visitors, which impact on Small to Medium Enterprises (SMMEs), especially in the accommodation and restaurant sectors. The majority of these businesses do not have sufficient financial reserves to absorb the losses incurred through load shedding and more often have had to resort to extreme measures to remain viable and competitive (i.e., job cuts and business closure).

In terms of GHG emissions, the implementation of the Project may result in avoided emissions. These are emissions that may be emitted if the project is not implemented. These emissions are calculated in accordance with the GHG Protocol's guidance document for comparing products. In accordance with this guidance, the baseline technology for calculating the avoided emissions is Eskom's coal fleet. The avoided emissions are only calculated as the emissions avoided from the switch to gas from coal. There may be further avoided emissions from the enabling of additional renewables due to gas power plants load following capabilities. However, these emissions have not been estimated in the Climate Change specialist's report, as there is insufficient evidence to support this increased renewable capacity.

The grid emission factor from the IRP has been used to calculate the avoided emissions to reflect the anticipated change in the energy mix as set out by national policy. The emissions are only calculated for the period up to 2030, thereafter it is assumed that the majority of the energy mix will be renewables and there will be no avoided emissions from a coal fleet.
The avoided emissions from the Karpowership Project at Ngqura are shown in Table 7-96 below. The total avoided emissions between 2023 and 2030 is approximately 17 million tCO_2e.

Table 7-97: **Avoided emissions**

	2023	2024	2025	2026	2027	2028	2029	2030
IRP Grid EF (**tCO_2e/MWh**)	0.85	0.86	0.85	0.83	0.81	0.77	0.73	0.67
Avoided emissions (m**illion tCO_2e**)	2.27	2.3	2.27	2.2	2.2	2.1	2.0	1.8

Further ecological research (arising from long-term monitoring of the Project) is desperately needed to understand the reasons for the decline of the local penguin population, as well as to improve the management of marine protected areas. In addition, the Project will contribute to the prevention of environmental degradation in rural and poor / disadvantaged communities which would, in the absence of a reliable electricity supply, have to revert to the destruction of flora for cooking and heating purposes. This would impact negatively on air quality. Prolonged loadshedding will further exacerbate these impacts. Adequate electricity provision also reduces potential environmental pollution associated with, for instance, raw sewage pumpstation overflows, the inadequate treatment of sewage, and the generation of poor quality final effluent from sewage treatment works, which is discharged into freshwater systems and ultimately discharged into the ocean. Such discharges destroy both freshwater and marine ecosystems not only due their toxicity levels, but also due to high oxygen demand. Within the commercial and more affluent residential communities a more common method of dealing with loadshedding is by the operation of diesel generators. This too results in negative air quality impacts with accompanying increased sulphur dioxide, oxides of nitrogen and particulate matter levels as well as noise pollution. In contrast, the Project will result in insignificant sulphur dioxide and particulate matter levels which can be properly monitored and managed. It is only the very affluent households and businesses which can presently invest in solar power alternatives and therefore natural gas generated energy as a transitional and alternative fuel to coal and diesel, is preferred from an environmental perspective.

While the no-go alternative will not result in any direct negative environmental impacts from the gas-to power project, it will also not result in any positive indirect environmental benefits or direct and indirect socio-economic benefits. The status quo cannot be assumed to be environmental and socio-economically neutral as the micro and macro environmental and economic conditions will continue to result in both positive and negative impacts to the environment, economy and society regardless of whether the proposed project is developed or not.

When the minimal potential environmental and socio-economic risk with mitigation is measured against the potential environmental and socio-economic benefits, there is simply no contest. The environmental benefits are significant and the social and economic benefits vastly outweigh the mitigated environmental and socio-economic impacts.

The no-go option will also not assist government in addressing its set target for a sustainable energy supply mix, nor will it assist in supplying the increasing electricity demand within the country. It will also not contribute further to the local economy by provide employment opportunities. Hence the “no-go” alternative is not recommended.

7.8 POLYCENTRIC APPROACH

7.8.1 Overview

The intention of this Sustainability Report is to support the findings of the EIA with a focus on facilitating transdisciplinarity in a manner that assists with understanding holistically the dynamics of the Karpowership Projects and the associated impacts. Furthermore, this approach enables the development of appropriate mitigation and management recommendations.

A polycentric approach to the proposed project requires the holistic consideration of all relevant factors, inclusive of potential impacts that the proposed project could have on the local as well as the broader community. Section 2(4)(b) of NEMA states that Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated, and it must take into account the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option. Sustainable development as per NEMA requires the integration of social, economic, and environmental factors in the planning, implementation, and evaluation of proposed projects, to ensure that development serves the needs of present and future generations.

This specialist assessment therefore considers both the positive and negative impacts of actual and potential impacts on the geographical, physical, biological, social, economic, and cultural aspects of the environment in a polycentric and holistic approach that:

- Acknowledges that this environment is a complex and dynamic system
- Acknowledges the interrelated socio-ecological and socio-economic relationships
- Identifies the risks and consequences of alternatives and options for mitigation of activities, to minimise negative impacts, maximise benefits, and promote compliance with the principles of environmental management as set out in section 2 of NEMA.

7.8.2 Transdisciplinary Specialist Integration

To facilitate co-learning and co-creation of knowledge amongst the specialist team, towards the development of holistic specialist assessments the following approaches were employed:

- ***Specialist integrative workshop*** and weekly meetings were held during the EIA process where specialists raised matters to be considered by the team and verified technical information to prevent any discrepancies and where relevant, to co-ordinate approaches. This approach assisted with addressing gaps in specialist reports and the development of a holistic assessment of the project – thus allowing for a polycentric assessment of environmental and socio-economic impacts. Critically, this enabled the identification of appropriate mitigations and recommendations for potential negative impacts, the maximisation of positive impacts and the value of the project to society.

- ***Thematic specialist engagements*** were encouraged amongst the specialist team to share information (co-learning) and debate various applicable topics, potential connections and cross-sectional issues, and the related impacts and potential mitigation and management recommendations. Specialist contact details were shared openly amongst the team, and specialists were encouraged to set-up their own meetings, preferably including the Environmental Assessment Practitioner. Meetings which the author for the Sustainability Report attended of this nature included thematic discussions regarding:
    - Corporate social investments, job creation and capacity development, enterprise development and supplier development.
    - Vulnerable communities, including small scale fishers, and the potential impacts (positive and negative) associated with the powerships.
    - Links between the visual assessment and socio-economic impacts, including tourism
    - Links between the impacts on marine ecology and local mariculture and fisheries.

- ***Integration of specialist findings*** where overlaps and connections were identified, and/or considered applicable, specialists reviewed each other's reports and integrated findings into their own work.

Critically, for this report, the findings of the specialist assessments were used to inform three methods that assist with synthesizing and conceptualizing technical information for decision making purposes, namely: 1. Matrix of strategic issues and thresholds, 2. Systems maps, and 3. 1^{st} to 4^{th} Order Framework. These methods are described in the sub-chapters that follow, and the findings are discussed thereafter. The specialists assisted in some instances with providing input directly to each tool, review and comment, and engagement at team strategic integration workshops. The outcomes of these methods have assisted with strengthening of impact mitigation / management recommendations, and the inclusion of adaptive management principles from a transdisciplinary perspective.

7.8.3 Matrix of Strategic Issues & Thresholds

Two matrices were developed to assist with summarising the key findings of the specialist assessments, and highlighting critical variables, mitigation and management recommendations, and interconnections and overlaps in the specialist areas. This is a valuable tool for any project, and especially so for this EIA because of the numerous specialist studies that were undertaken.

The integration matrix presents the list of specialist studies across both axes. This matrix is facilitated transdisciplinarity of specialist study understanding across all specialist studies, and identification of cascading impacts Appendix 9 – 8.4, Appendix A of the Sustainability Report).

The strategic issues matrix provides a synthesis of the key findings from each specialist assessment undertaken for the relevant site, into one comprehensive table. This includes, where relevant, limits of acceptable change or ecological thresholds, mitigation or management recommendations and a final risk rating in line with that provided under the NEMA Overall Environmental Significance Impact Rating (refer to Section 7.2). These issues have been arranged into overarching themes for ease of reference, namely: physical, ecological, socio-economic and heritage (natural, cultural, tangible, intangible).

7.8.4 Mapping System Dynamics

Drawing from the findings of the specialist studies a systems map of the operational phase of the proposed project was developed drawing on knowledge from literature associated with social-ecological systems and complex adaptive systems (CAS). The systems map attempts to illustrate the complex human-environment dynamic at the site scale, with potential causal links or cause-and-effect relationships illustrating potential shift arising because of the Karpowership SA operating in the Port. This 'map' is intended to provide a simplified conceptual understanding of the site as a dynamic and complex system.

In applying this framework, the general organising principles of CAS as described in **Error! Reference source not ound.** is relevant to understanding the site.

Table 7-98: A summary of the general organising principles of complex adaptive systems, and implications for research and planning (adapted from Preiser et al 2022, pg. 35-38)

Organising principles of Complex Adaptive Systems (CAS)		Conceptual implications for social-ecological systems (SES)
Constituted relationally	• Complex adaptive systems are constituted relationally - complex behaviour and structures emerge because of the recursive and aggregate patterns of relations that exist between the component parts of systems. • These relations usually give rise to rich interactions within the system, meaning that any element in the system influences and is influenced by many other ones either directly, or indirectly via positive (reinforcing) or negative (balancing) feedbacks.	• The nature and structure of relationships in a SES have to be considered explicitly. • Diversity and redundancy is key and allows for different kinds of SES interactions to take place.
Adaptive	• CAS have adaptive capacities - they self-organise and co-evolve in relation to contextual changes. • Self-organisation happens when a system develops complex structures from unstructured beginnings without the intervention of an external designer or the presence of some centralised form of internal control. • Coevolution describes the recursive patterns or relations of influence that result from ongoing exchanges between components of evolving systems, practices, knowledge, beliefs and values, and the biophysical environment that mutually influence one another.	• The function and structure of SES changes with temporal and spatial changes. • Multiple modes of reorganisation are possible when systems undergo change. • Adaptive capacity results from a system's ability to learn and have memory. • Change happens through adaptation, evolution and transformation. • Control is not located in one isolated element of the system but is spread throughout the nodes and relations of the system.
Dynamic	• CAS are characterised by dynamic relations - the relationships in a system are constantly changing in rich and unexpected ways. • These relations are mostly non-linear. • Non-linearity can be the result of feedbacks, path dependencies, time lags or multiple time scales, which suppress or magnify processes and interactions, both internally and between the system and its environment. • Non-linear dynamics also arise because the relations between variables constantly change, which renders them uncertain and unpredictable and makes these systems difficult to predict. • Change and not stability is the norm in CAS, shifting the focus from analysing stable states to analysing transient	• System behaviour is amplified or dampened by feedback loops and can lead to tipping points and regime shifts. • Feedback structures are responsible for the changes we experience over time. • Structures are responsible for the changes we experience over time. • SES are characterised by inherent unpredictability and uncertainty.

Organising principles of Complex Adaptive Systems (CAS)		Conceptual implications for social-ecological systems (SES)
	processes (the behaviour of the system in between equilibria), and from analysing outcomes to focusing on the trajectories or processes of the system.	
Radically open	• Complex adaptive systems are radically open – the activity of the system in relation to the environment that constitutes the system itself. • We cannot clearly discern the boundary between the system and its environment because the environment co-constitutes the identity of the system. • Our definitions of systemic boundaries are the product of physical properties (e.g. a watershed boundary that signals a system boundary), mental constructions (i.e. where we choose to draw the line between the system and the environment or the problem or research question we want to address (including the temporal and spatial scales of interest).	• Delimiting SES problems and systems is challenging as real-world problems have no natural boundaries. • External variables could have important influences on system behaviour but cannot be included in the models of the system. • Any modelled system is embedded in a larger system.
Contextual	• CAS are context dependent - the function(s) of CAS are contingent on context. • Changing the context will have an impact on the function of the system, i.e., the environment suppresses or enhances possible systemic functions and are contingent on the level of analysis that we employ to understand a system.	• SES are context sensitive. • SES components have multiple functions that change when the context changes. • Context is not passive backdrop to a system, but an active agent in itself, which enables or inhibits systemic agency. • Many contested problem definitions exist simultaneously and the various stakeholders involved in a SES will have different mental models or beliefs that inform values and understandings of both the causes and the possible actions that could be taken to find possible pathways for action.
Complex causality and emergency	• CAS are characterised by complex causality and emergence. • Cause-and-effect interactions in CAS are not unidirectional or linear but marked by complex recursive causal pathways that are non-linear and dynamic. • Emergence occurs when entities are observed to have systemic properties that are different and non-reducible to the properties of the constituent elements. It is not that the sum is greater than the parts, but rather that the system's effects are different from those of its parts.	• Cause-and-effect cannot be traced in linear causal trajectories • Emergent phenomena arise from multiple recursive patterns and unintended outcomes.

Organising principles of Complex Adaptive Systems (CAS)		Conceptual implications for social-ecological systems (SES)
	• Emergent phenomena have causal agency and are real, i.e. they have ontological status.	

Given the CAS organising principles as described in Table 9-98, it is important to highlight the following associated with the application of this method to the proposed project:

- As an active port there is a strong and complex relationship between the community for livelihoods in a variety of ways, e.g. subsistence and commercial fishing, jobs associated with the industrial zone and the nearby tourism industry.
- The Port is zoned as industrial, and therefore includes associated infrastructure and activities on the landside and associated maritime activities in the Port.
- This is a complex ecological transition zone considering the Port is an interface of the terrestrial habitat, the riparian, estuarine and lagoon environments, and the ocean.
- For the systems maps generated for the Karpowership projects it is important to acknowledge that the boundary of the map will be set at the site scale.
- The maps were developed to consider the operational phase of the proposed project, and the likely consequences in system shifts related thereto.
- Each map is developed considering an imposed change to the environment. In this instance the change to the environment will be the addition of the powership, and its operations associated with the provision of peaking power in line with the 20 year contract.
- These maps synthesis and illustrate the socio-ecological and socio-economic shifts (positive and negative) that the Karpowership SA projects will likely bring about at each site. But will also anecdotally acknowledge wider system impacts, e.g. to nearby protected and/or sensitive natural environments, local communities, and tourism activities.
- The operation of the Powerships is in response to the country’s energy crisis, and therefore the provision of electricity generated by the Powership(s) influences a greater system associated with the country’s energy stability and the consequences for the economy – although this important trend is acknowledged, this will, however, not be mapped here.
- The operation of the Powership(s) will result in greenhouse gas emissions, which will contribute to global stock of emissions — although this important trend is acknowledged, this will, however, not be mapped here.

Overall, the map presents an understanding of the site as a CAS, as a holistic transdisciplinary perspective of shifts to the system that may be realised because of the Powership. The systems map represents both positive and negative shifts. In addition, it attempts to highlight the significance of these anticipated shifts with alignment of the impact ratings provided by the specialist team (Sectiojn 7.2). This impact and risk rating further informed the development of the systems map, providing perspective on the likelihood and significance of the impacts and/or system shifts.

7.8.5 Cascading Impacts of Climate Change

The 1st to 4th Order Framework assists with organising our experiences of the cascading impacts of climate change into a logical framework of cause-and-effect related impacts, based on work done by the World Bank. It is a conceptual framework based on the findings in the Climate Impact Assessment Report and influenced by other specialist findings and specialist team discussions.

It is critical to note that this tool is presenting the modelled projections of potential climatic changes to a particular region and attempts to understand how the cascading direct and indirect impacts of climate change may impact on the site. These projections do not make causal links to the presence of the Powership influencing climate change, in a positive manner through any rehabilitation of natural habitats of social investments, or negatively through emissions, etc. It is therefore based on climate change projections, as well as the anecdotal inputs of specialists, and is anticipated to be associated with global climatic shifts.

The framework presents four 'orders' or categories of interrelated direct and indirect impacts of climate change (see Figure 7-13 for the framework and Figure 7-14 for an example). The first order summarises the anticipated or modelled direct impacts that are anticipated for the general area. For example, increase in average temperatures and number of hot days. The second order explains the cascading physical impacts that may arise because of the first order basic climatic changes, e.g. water scarcity. Third order impacts are experienced as impacts to ecosystem health and functioning, including the consequences for human activities that rely on these ecosystem goods and services. Examples may include decreased agricultural yield. Lastly, the fourth order impacts relate to social and economic systems, e.g. local community decline in health because of reduced access to adequate nutrition and clean drinking water sources; this may further have an impact on productivity. Each of these orders are interrelated, and therefore are likely to have numerous interconnections and cascading systems impacts between the orders. This may also include consideration of adaptive practices or what may be described as 'positive' such as advances in technology, pharmaceuticals, farming practices, etc.

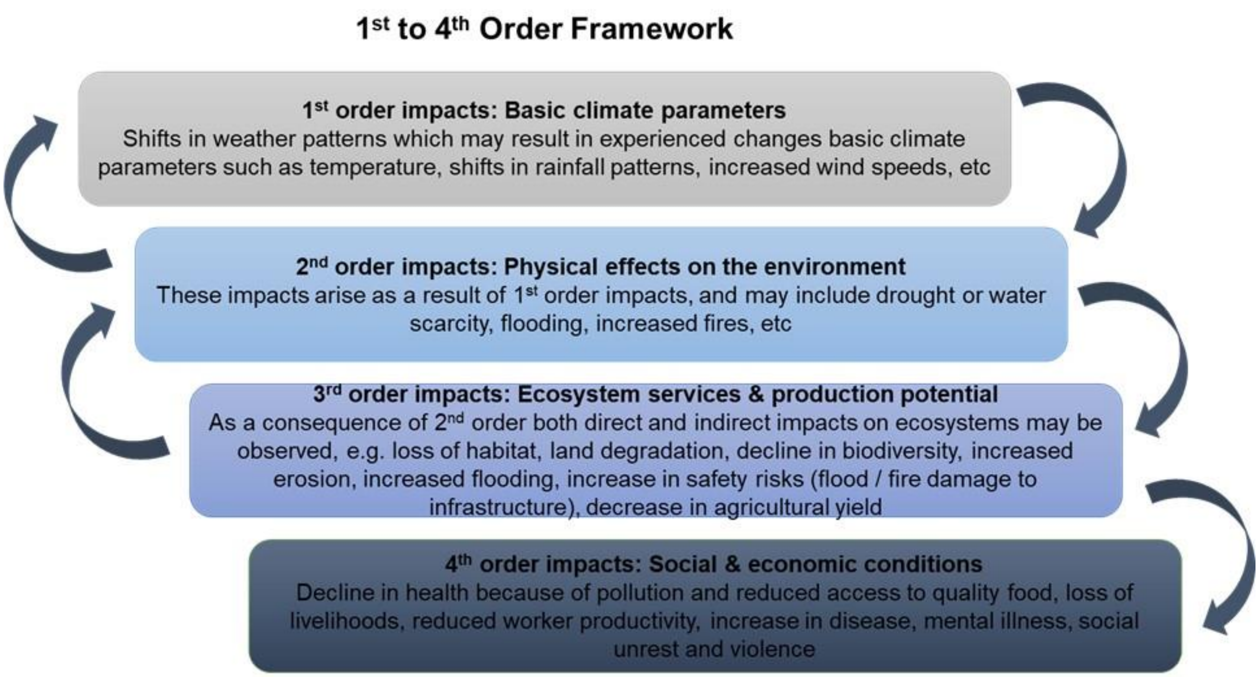

Figure 7-13: Description of the 1st to 4th order framework

As a conceptual framework, this tool provides a valuable means to deepen the understanding of climate change, vulnerability, risk and impacts to communities by making the connections between potential direct and indirect environmental pressures and the link to societal impacts. Some less obvious drivers include socio-economic and community-based factors, such as education, literacy, gender, poverty and access to public health care (amongst others). A key component of this framework is that communities and socio-economic systems are viewed as central to broader ecological, geographical and biophysical systems. This framework is therefore useful for translating technical information in a means that informs our understanding of how impacts may be experienced on the ground. It therefore enables decision makers and stakeholders and raises awareness and understanding of particularly of the less tangible drivers of climate vulnerability. The foresight provided by identifying how we may indirectly and directly experience climate change influences how we prepare, thus enabling more appropriate decision making for infrastructure, adaptive management, disaster risk response and preparedness.

These insights are useful for the Karpowership SA projects because it provides an understand of the site and potential changes because of climate, for which Karpowership SA can ensure that it considers in design and disaster risk management – this may be for the Karpowership SA related infrastructure and operations, as well as the investments that are made in local communities.

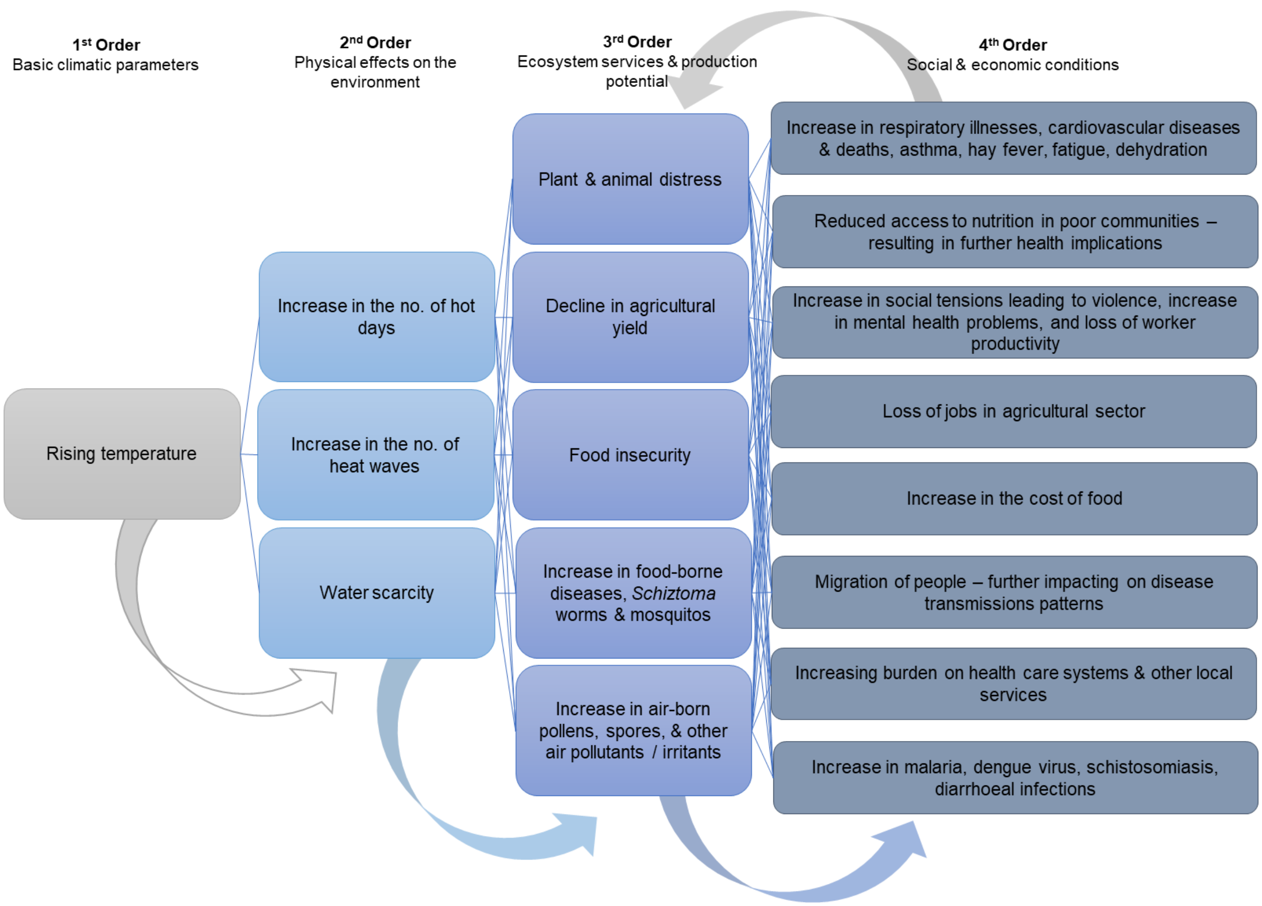

Figure 7-14: Example of cascading impacts of climate change on a region experiencing an increase in average temperature and an increase in the number of hot days

The Climate Impact Assessment report prepared by Promethium Carbon (2022) illustrate how the project will emit 1.5 million tCO2e/year during the operational phase and 31 million tCO2e over its lifetime. This will contribute to the global stock of greenhouse gas emissions, although the contribution is understood to be low. It is, however, worth noting that operational emissions of the Powership for 5 years will result in less emissions than running a coal fired plant for a year. This highlights the role of LNG as a transition fuel that will enable the move from heavily polluting coal plants to a full renewable future (Promethium Carbon, 2022; Steenkamp & Weaver, 2022).

The Promethium Carbon report (2022) concludes that this project will assist in alleviating the socio-economic pressures caused by South Africa's electricity supply crisis, and the benefit associated with this outweighs the contribution of the project to global GHG emissions. The assessment of the climate change impact of this project has been done on the impact of the project on climate change, the resilience of the project to climate change, as well as the options for mitigation of the impacts. The Climate Impact Assessment should be referred to for further detail. However, this chapter provides a supplementary discussion to this assessment, providing a lens through which direct and indirect cascading impacts of climate change can be understood at the project site.

A direct causal relationship between the proposed project and climate change impacts that will be experienced in Ngqura cannot be established. This is because of the transboundary nature of greenhouse gases, and the fact that climatic systems are global systems. Therefore, it is the global stock driving the climatic changes that are being experienced in a range of ways across the world. However, this chapter illustrates how we may understand these cascading impacts at the site scale to further interrogate the climate readiness of the proposed project, and better inform management and mitigation recommendations.

Key aspects that the Climate Change Impact Assessment report highlights for this chapter include anticipated climate shifts that are expected to be experienced in Ngqura over the next 30 years, based on climate change modelling (Promethium Carbon, 2022):

- Mean annual temperature is expected to increase between 0.1°C and over 1.0°C over the next 30 years whilst very hot days is likely to increase by up to 7 days per year.
- Mean annual precipitation has been particularly low in recent years. Future rainfall is likely to increase from this level to levels similar as in the late 20th century, with substantial variability. The expected change in extreme rainfall days is negligible to small.
- By 2050, drought and coastal flooding risks are classified as extreme relative to the current/near-historic baseline, whilst the fire risk are classified as medium.
- With regards to storm surges and wave height, Algoa Bay is vulnerable to increasing intensity of cut-off lows and frontal systems that are responsible for most storm activity. Detailed information is however, lacking. Given the low-lying topography of the bay surrounds (particularly around the estuary mouth and riparian environment), there is a high risk of coastal flooding if storm activities increase in combination with higher sea level (see Figure 5). Again, this has been considered in the project design and impacts are anticipated to be low and will not affect core operations. However, this may still affect the surrounding environment and local communities
- Ocean pH levels have consistently declined since at least the middle of the 20th century and will continue to do so. This will not have a material impact on the project but could impact marine biota. The impacts thereof should be informed by the relevant specialist(s).
- There is little information on changes in wind in under future climate scenarios. Research suggests generally stronger winds by small percentages over current speeds. Any increases in wind speeds will, however, amplify the impacts during storm events due to the interaction with waves and ocean currents.
- Sea level has increased by ±7.6 cm since the late 1970s and is likely to rise by 11-39 cm by the middle of the 21st century. This is not likely to have a material impact on the project but could act to amplify storm surges during storm events (see Figure 5).

- Mean sea surface temperature has increased by ±01.05˚C since 1900 and is currently around 20.3˚C. This could increase to up to 21.3˚C by 2030 and 22˚C by 2050. This should not impact the project materially but could have impacts on marine biota which should be assessed by the relevant specialist/s. The further warming of temperatures in the Bay may pose a risk to important sectors in the region such as aquaculture and fisheries.

Based on the above-mentioned points, a 1st to 4th Order Framework was prepared for the Port of Ngqura. As described in the methodology chapter this approach is based on work done by the World Bank and tries to categorise impacts in 4 groups: 1. Basic climatic parameters; 2. Physical effects on the environment; 3. Ecosystem services and production potential; 4. Social and economic conditions. Increase in mean annual precipitation and mean annual temperature were taken as the two most prominent changes that will be experienced as basic climatic parameters over the next 30 years. This influenced the understanding of the remaining orders.

Water scarcity and drought are anticipated to be an extreme risk as a consequence of reduced rainfall, and the increased number of very hot days by as much as 7 days. This is in a region which already receives low rainfall. This is a risk to the municipality, local industry and local residents that will need to be managed with foresight and careful planning. Given that the Nelson Mandela Bay Municipality has already experienced challenges with drought over the past few years, this is a concern that will need to be strategically planned for.

The Promethium Carbon (2022) report further found that there is potential for increased exposure to tropical storms and cyclones, with a high impact and low probability of occurrence. This risk may be further exacerbated if coupled with the increased risk of storm surges and intense wave action. This will also increase the likelihood of localised flooding events – again, this is anticipated to be marginal in the port because it is a relatively sheltered environment. While the proposed project has considered this in the design and operations, and therefore the impact is considered to be low and will not affect core operations, it is not clear to what extent the surrounding environment and community may be affected. This should be carefully considered in terms of disaster risk management and emergency responses. This may include early warning systems, and community preparedness programmes, which could be aligned with corporate social investment of the Karpowership project.

There is also an anticipated medium risk for fires in the region over the next 30 years. This risk has likely been compounded by the drought conditions and increased number of very hot days. Similar to the flooding response, this should be carefully considered in terms of disaster risk management and emergency responses. This may include early warning systems, and community preparedness programmes.

Cascading effects on ecosystem services and production potential will likely be experienced as heat and water security related stresses; enhanced evaporation rates, furthering the water security challenges; infrastructure and ecosystem damage, declining agricultural yield and consequently food insecurity; increase in food-borne diseases, worms and mosquitoes; increased air-born pollens, spores and other irritants; and increased reliance on cooling systems, furthering greenhouse gas emissions. This in turn could yield an increase in respiratory illnesses, cardiovascular diseases and deaths, increased malaria, dengue virus, schistosomiasis, and diarrhoeal infections; rising cost of food, water shortages and potentially a ‘day-zero’ scenario; reduced productive work days and job losses; reduced access to nutrition, particularly in the lower income households, resulting in further health implications; Overall, there is likely to be an increased burden on the various healthcare services, basic services and infrastructure; with increased social tensions leading to increased violence, mental health problems, and further loss of worker productivity. Through foresight in planning and service delivery this could be well managed. There is also potential for Karpowership SA to identify related specific community needs which they can invest in through its CSI projects

7.9 PROPOSED IMPACT MANAGEMENT OUTCOMES

EIA Regulations, Appendix 3 3(1) (m) based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation;

The following outcomes must be considered for this project:

- Impacts relating to site establishment are managed and minimised;
- Impacts on flora and fauna are managed and minimised;
- Impacts on heritage resources are managed and minimised;
- Construction vehicle movement are restricted to approved footprint;
- Construction of fencing and gate of the construction camp / laydown area are managed within sensitive environments;
- Reduce or eliminate collisions of avifauna with the transmission lines
- Water use during construction is compliant with the requirements of the National Water Act (Act No. 36 of 1998);
- Impacts related to storm and waste water are avoided, prevented and managed;
- Impact to watercourses and estuaries are managed in adherence to legislation and specialist recommendations;
- Impacts to marine environment are managed in adherence to legislation and specialist recommendations;
- Reduce catchment modifications;
- Prevent deterioration of water quality;
- Vegetation clearance and associated impacts are minimised and managed;
- All precautions are taken to minimise the risk of injury, harm or complaints;
- No pollution or disease arises in terms of poorly maintained ablution / sanitation facilities or lack thereof;
- Emergency procedures are in place to enable a rapid and effective response to all types of environmental emergencies;
- Safe storage, handling, use and disposal of hazardous substances;
- Spillages and contamination of soil, surface water and groundwater are avoided, minimised and managed;
- Dust prevention measures are applied to minimise the generation of dust;
- Noise management is undertaken in accordance with SANS 10103 and the Occupational Health and Safety Act (Act No. 85 of 1993).
- Noise abatement measures to minimise noise disturbance;
- Fire prevention measures are carried out in accordance with the relevant legislation.
- Erosion and sedimentation as a result of stockpiling are reduced.
- Minimise the risk of environmental impact during periods of site closure;
- Post-construction and rehabilitation activities are undertaken in accordance with EMPR requirements as well as Rehabilitation Plans;
- Socio-economic development is enhanced and job creation and economics in the area are improved;

- Effective awareness and training for all construction staff to minimise environmental impacts;
- Ensuring social and ecological well-being of the site and community;
- Impact on No-Go areas are avoided through effective demarcation and management of these areas;
- Impacts resulting from earthworks are managed and guided by specifications;
- Construction materials are sourced from authorised sites;
- Potential impacts to the environment caused by waste (general and hazardous) are avoided or managed;
- All onsite staff are aware and understands the individual responsibilities in terms of this EMPr.
- Stormwater related impacts are avoided, minimised and managed;
- Dust, emissions and odour impacts are minimised and managed;
- Impact to heritage and palaeontological resources are managed in terms of the National Heritage Act.
- Compliance with all environmental legislative requirements during the operational phase of the project is implemented and managed; and
- Environmental impacts during the Operation and Maintenance Phase are managed in terms of Operational Maintenance Management Plan requirements.

8 MOTIVATION, NEED AND DESIRABILITY

EIA Regulations, Appendix 3 -3(1) (f) a motivation for the need and desirability for the proposed development, including the need and desirability of the activity in the context of the preferred development footprint within the approved site as contemplated in the accepted scoping report; (g) a motivation for the preferred development footprint within the approved site as contemplated in the accepted scoping report;

8.1 STATUTORY REQUIREMENTS

Guidance on how to assess "Need and Desirability" (N&D) is set out in Integrated Environmental Management Guideline "Guideline on Need and Desirability", Department of Environmental Affairs, 2017. Section 24O of NEMA requires that the CA must have regard for any Guidelines published in terms of section 24J of NEMA and the Guideline on Need and Desirability is such a guideline.

At its core, addressing N&D is a way of ensuring that a development is sustainable and that a development is ecologically sustainable and socially and economically justifiable, ensuring the simultaneous achievement of the triple bottom-line N&D and thus also necessitates the assessment of the "broader community's needs and interests" within the context of the proposed project, its location and alternatives.

One of the ways that this is done is by considering applicable national strategy as developed from the broader global agreements and collaborations as well as locally adopted policies, programmes and plans:

- National Development Plan 2030 (NDP) (2012);
- The Integrated Resource Plan (IRP) 2019;
- The Framework for a Just Energy Transition (JET) in South Africa (2022);
- SADC Regional Gas Master Plan (2022).
- Regional and Municipal and Sectoral Planning e.g. SEA, IDP, SDF and TNPA Port Planning.

Assessment of N&D in the EIA context involves the consideration and application of the principles set out in section 2 of NEMA. (Guideline on Need and Desirability; Sections 1 - 4). The guideline on Need and Desirability sums up the above conveniently as follows: "The consideration of "need and desirability" in EIA decision-making therefore requires the consideration of the strategic context of the development proposal along with the broader societal needs and the public interest. The government decision-makers, together with the environmental assessment practitioners and planners, are therefore accountable to the public and must serve their social, economic and ecological needs equitably. Ultimately development must not exceed ecological limits in order to secure ecological integrity, while the proposed actions of individuals must be measured against the short-term and long-term public interest in order to promote justifiable social and economic development – i.e. ensuring the simultaneous achievement of the triple bottom-line. Considering the merits of a specific application in terms of the need and desirability considerations, it must be decided which alternatives represent the "most practicable environmental option", which in terms of the definition in NEMA and the purpose of the EIA Regulations are that option that provides the most benefit and causes the least damage to the environment as a whole, at a cost acceptable to society, in the long-term as well as in the short-term".

The Guideline accordingly identifies two fundamental questions, broken down into numerous sub-questions, to be investigated and assessed in considering the N&D of a proposed project. These are:

- How will it secure the ecological sustainable development and use of natural resources?" and

- How will it promote justifiable economic and social development?

For the purposes of this report, the authors have made every effort to comply as fully as possible with the Guideline on Need and Desirability, as modified by the context of the application, by considering the above questions (and sub-questions) posed in the Guideline on Need and Desirability.

The authors provided detailed discussions on the macro and micro related aspects of the project as well as a summary of those aspects of the project which demonstrate that the proposed project is both necessary and desirable (Section 8.2.7 – 8.29). Many may constitute a repeat of material in other sections of the report but have been replicated in order to ensure the fullest compliance with NEMA and its regulations.

Considering the NGOs and green lobbyist groups that fundamentally oppose gas as a transition fuel or a desirable option within the current energy crisis, information regarding the geopolitical context, gas-to-power projects and the Just Energy Transition in the South African political economy as well as loadshedding was provided, based on independent contributions as per below (refer to Appendix 9 for CV and Independence Declarations and for the full reports):

- Gas-to-Power Projects and the Just Energy Transition from Fossil Fuels in the South African Political Economy by the team of experts from Political Economy Southern Africa (PESA),
- South Africa Country Specific Energy Security Assessment by Noqazo Group;
- The economic impacts of rolling blackouts in South Africa by Afro Development Planning;
- Sustainability Report – a synthesis of the impacts of the proposed Powership at the Port of Ngqura, South Africa. By Afro Development Planning.

These contributions contextualised the need as well as desirability from which it is concluded that the project is both needed for South Africa as well as being a desirable technology to alleviate loadshedding and climate change impacts associated with avoidance of impacts due to the replacement of coal or diesel with gas.

The latter part of this chapter addressed the need and desirability from a local perspective in terms of the alternatives as well as ecological perspective. Chapter 7 further showed that the project is environmentally acceptable (desirable) from a polycentric perspective having given due consideration to the local as well as broader social-ecological factors. The summary and conclusion is repeated for completeness purposes.

8.2 PROPOSED DEVELOPMENT WITHIN THE GLOBAL, SOUTH AFRICAN LOCAL SETTING

This section contextualises the macro (global, national and strategic) as well as micro (local) political, socio-economic, environmental and planning setting within which the Project is being proposed.

8.2.1 United Nations Sustainable Goals

The United Nations Sustainable Development Goals (SDGs) or Global Goals were adopted by all member states of the United Nations in 2015 in the commitment to end poverty, protect the planet and ensure peace and prosperity for all people by 2030. South Africa was one of these nations.

The provision of electricity falls under the SDG 7: Affordable and Clean Energy (DBSA, 2022). Notably, the goals are integrated and an improvement in one area affects the outcome of the other SDG areas. For example, an improvement in SDG 7: Affordable and Clean Energy is likely to lead to an improvement in the other SDGs such as:

1: No Poverty – The economy is sustained or growing with job security or creation ensuring social upliftment;

3: Good Health and Well-Being – Waste water treatment systems are working and raw sewage is not polluting watercourses causing cholera and diarrhoea to those without waterborne sewage. Rural communities, healthcare services and poor households without alternative energy back-up systems may sustain lives and air quality improvements from cleaner burning fuel or renewable alternatives may ensure improved health;

4: Quality Education – Energy for modern training (internet, computers) and studying with adequate light is available;

5: Gender Equality – Women is not required to collect wood and to "cook down" over open fires;

8: Decent Work and Economic Growth – Work and economic development opportunities (direct and indirect);

9: Industry, Innovation and Infrastructure – New technology; and

13: Climate Action – Improved technologies, transition and mitigations ensuring progress to meeting targets.

Figure 8-1: United Nations Sustainable Development Goals (Source: UN General Assembly, 21 October 2015).

South African legislation, including the Constitution and NEMA, entrenches the principle of sustainable development as do the various National strategies, policies, programmes and plans, including the National Development Plan 2030 (NDP).

8.2.2 Paris Agreement, National Development Plan (NDP) (2030) and IRP 2019

South Africa is a signatory to the Paris Agreement on Climate Change and has ratified the agreement. In line with Intended Nationally Determined Contributions (INDCs) (submitted to the UNFCCC in November 2016), South Africa's emissions are expected to peak, plateau and from year 2025 decline. The energy sector contributes close to 80% towards the country's total greenhouse gas emissions of which 50% are from electricity generation and liquid fuel production alone. There is action to reduce emissions with investment already in renewable energy and energy efficiency (IRP, 2019).

The NDP envisages that, by 2030, South Africa will have an energy sector that provides reliable and efficient energy service at competitive rates; that is socially equitable through expanded access to energy at affordable tariffs; and that is environmentally sustainable through reduced emissions and pollution. In formulating its vision for the energy sector, the NDP took as a point of departure the Integrated Resource Plan (IRP) 2010–2030 promulgated in March 2011.The IRP is an electricity infrastructure development plan based on least-cost electricity supply and demand balance, taking into account security of supply and the environment minimize negative emissions and water usage (IRP, 2019).

The promulgated IRP 2010–2030 identified the preferred generation technology required to meet expected demand growth up to 2030. It incorporated government objectives such as affordable electricity, reduced greenhouse gas (GHG) emissions, reduced water consumption, diversified electricity generation sources, localisation and regional development (IRP, 2019).

Natural gas is an efficient and relatively widely available alternative to other fossil fuels and produces roughly half of the amount of CO2 per unit energy as coal. This scenario makes natural gas attractive as a potential 'bridge' or transitional fuel in the global shift toward renewable energy. South Africa's Integrated Resource Plan (IRP) lists gas-to-power technology as having the ability to provide flexible baseload capacity to complement the inherently intermittent sources of renewable energy.

The importance of energy for socio-economic benefit is well documented as early as 2012. The Draft 2012 Integrated Energy Planning Report: Executive Summary (IEPR) stated that "energy access is now widely recognised as a prerequisite for human development". The Draft 2012 IEPR states that "energy access is now widely recognised as a prerequisite for human development". The access to electricity is outlined within the Municipal Services Act 32 of 2000, giving priority to the provision of basic needs to the local community that is "conducive to the prudent, economic, efficient and effective use of available resources". NEMA supports this through the principle of "equitable access to environmental resources, benefits and services to meet basic human needs and ensure human well-being must be pursued and special measures may be taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination", as would be the case for facilities and citizens unable to afford the more expensive countermeasures to stable electricity supply throughout load shedding.

According to the National Development Plan (NDP) (2030), Government is committed to ensure economic growth and development through adequate provision of sustained energy services that are competitively priced, reliable and efficient. This must be ensured to promote sustainable development and to ensure that the living standard of South African citizens is maintained and improved.

South Africa has experienced a progressively worsening energy crisis from 2007 that has resulted in numerous load shedding events including Level 6 load shedding. Eskom, which provides over 90% of power generating capacity in South Africa (Donnelly, 2018; Mthethwa, 2019; Gosling, 2019; Cohen & Vecchiatto, 2019), has been unable to meet the demands of both the private and public sector. The load shedding measures which were implemented to prevent a total blackout has had dire effects on the South African Economy according to Goldberg,

2015. Load shedding reduced the South African GDP by roughly 0.30% in 2019, which translates to 8.5 billion of real, inflation-adjusted Rand (Writer, 2019).

As stated by DMR, *"Emissions will peak as South Africa completed Medupi and Kusile, plateau for a while and then decline from about 2025 as South Africa decommissions some of the old coal fire power plants and replaces them with cleaner energy forms. There will, of course, still be some emissions, but South Africa is going to curb them, and cannot necessarily eliminate them. Even as we include gas to power going forward, as well as the much criticised 1,500 MW of new coal fired power in terms of the IRP, South Africa's projections show that emissions will remain well below peak plateau decline commitments South Africa has made in terms of the Paris agreement.* ***The gas to power we (South Africa) are now procuring in terms of the RMIPPP program will actually displace coal fired power that is not necessarily being decommissioned right now. So, emissions will reduce as less coal is burned, because the burning of gas is cleaner and has lower emissions than that of coal (DMR, www.esi-africa.com).***

8.2.3 Integrated Resource Plan (IRP) 2019

Government interventions of introducing additional power stations, generators and even tariff increases have proved to be inefficient in terms of addressing the country's electricity shortages. The Integrated Resource Plan (IRP) 2019 stressed a short-term gap in supply to be anticipated between 2019 and 2022 due to the time expected for the new power stations (Medupi and Kusile) and the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) to come online. This may further be delayed by the poor design and planning of the Medupi and Kusile plants and the delayed correction thereof (Hosken, 2020). The IRP specified the need for new energy efficient technology and the diversification of both the supply and nature of energy production to reduce pollution and minimise impacts related to climate change.

The objective of the policy which is as follows: *"**The energy mix. South Africa continues to pursue a diversified energy mix that reduces reliance on a single or few primary energy sources.** The extent of decommissioning of the existing coal fleet due to the end of design life, could provide space for a completely different energy mix relative to the current mix. In the period prior to 2030, the system requirements are largely for incremental capacity addition (modular) **and flexible technology**, to complement the existing installed inflexible capacity.*

In the policy document, **natural gas** is specifically referred to as follows: *"**Gas to power technologies in the form of CCGT, CCGE or ICE provide the flexibility required to complement renewable energy.** While in the short term the opportunity is to pursue gas import options, local and regional gas resources will allow for scaling up within manageable risk levels. Exploration to assess the magnitude of local recoverable shale and coastal gas are being pursued and must be accelerated."*

Gas to power is furthermore part of the Integrated Resource Plan 2019 at clause 5.3.5 which states: *"Whilst the plan indicates a requirement for 1000 MW in 2023 and 2000 MW in 2027, at a 12% average load factor, this is premised on certain constraints that we have imposed on gas, taking into account the locational issues like ports, environment, transmission, etc. This represents lower gas utilisation, which will not likely justify the development of new gas infrastructure and power plants predicated on such sub-optimal volumes of gas.*

Consideration must therefore be given to the conversion of the diesel powered peakers on the east coast of South Africa, as this is taken to be the first location for gas importation infrastructure and the associated gas to power plants.

It must be noted that the unconstrained gas is a "no regret option" because the power system calls for increased gas volumes when there are no constraints imposed." The risk assessment associated with the policy should also be incorporated in the environmental impact assessment and is identified as follows: *"The availability of gas in the short to medium term is a risk as South Africa does not currently have gas resources. There is also a supply and foreign exchange risk associated with likely increase in gas volumes depending on the energy mix adopted post-2030 when a large number of coal fired power stations are decommissioned."*

In terms of the mitigation measures adopted in the policy pursuant to gas, it is stated: *"For the period up to 2030 gas to power capacity in the IRP has realistically taken into account the infrastructure and logistics required around ports/pipelines, electricity transmission infrastructure. The IRP has therefore adjusted the lead times. As proposed in the draft IRP update, work to firm up on the gas supply options post 2030 is ongoing. This work will inform in detail the next iteration of the IRP."*

The CSIR (*Setting up for the 2020s: Addressing South Africa's electricity crisis and getting ready for the next decade, 2020*) further predicts that load shedding can be expected for the next 2 – 3 years and that an urgent response is required to ensure reliable short-term energy supply.

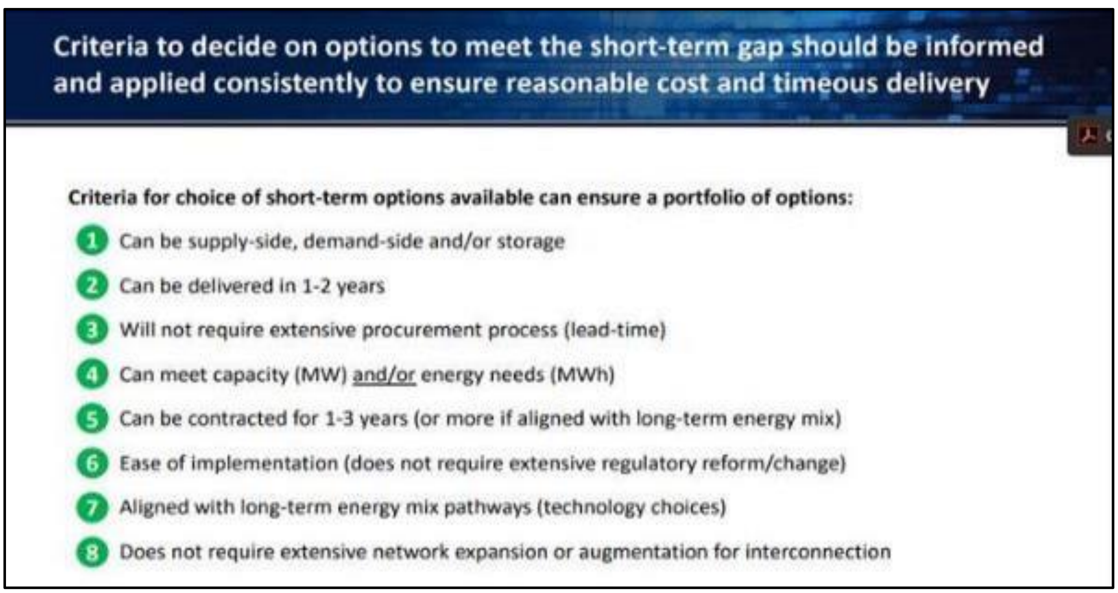

Figure 8-2: Extract from the CSIR Report (Setting up for the 2020s: Addressing South Africa's electricity crisis and getting ready for the next decade, 2020).

The Minister of Mineral Resources and Energy published regulations to help address South Africa's ongoing power issues (Staff Writer, 2020 (b)). In addition, the National Development Plan (2030) outlined the need to move the electricity system from Eskom to an independent system and for accelerated procurement of independent power producers on a wide range of alternatives, moving away from the unsustainable use of coal as fuel resource.

The Integrated Resource Plan (IRP) 2019 identifies the necessary generation mix of technologies to respond to the demand for electricity. Inherent in the planning process is the commitment to energy security, cost efficiency and effectiveness, and environmental sustainability. The Risk Mitigation IPP Procurement Programme succeeded in attracting project proposals featuring a variety of technology combinations. These determinations facilitate the process of procuring the required electricity capacity. The preferred bidders in the (RMI4P) were awarded to ACWA Power Projects DAO, Oya Energy, Umoyilanga, with two projects for Mulilo Total and three for Karpowership SA and three for Scatec. The Gas to Power Karpowership forms part of the solutions provided by the RMI4P preferred bidders that provides for a combination of a range of technologies that include, solar PV, wind, liquefied natural gas and battery storage.

Gas, as per the DMRE, has been identified as one of the most affordable forms of power. From the preferred bidders, only 1 bidder provided a lower cost, confirming the affordability of the gas to power project. Karpowership, projects will meet and exceed Economic Development qualification criteria stipulated within the RMI4P. Reference is made to Appendix 9 – D1 SEIA, Nov 20220 detailing the Economic Development Plan. Karpowership is committed to supporting Local Economic Transformation processes and as such, once the project has achieved Financial Close (FC), it will finalise local jobs and local procurement procedures. A comprehensive and transparent Community and Stakeholder Engagement process will be implemented once the project is confirmed. This will include engagements via local media such as the local newspaper, local radio stations and through whatever local communication channels exist. All businesses will have the opportunity to apply for tenders, provided that they meet the necessary criteria and all persons will have the opportunity to apply for jobs provided they have the necessary skill.

Karpowership projects create significant direct and indirect employment, driving knowledge and skills transfer across a broad spectrum of disciplines including some that are unique to floating power plants. Karpowership also emphasizes youth development as the future of our business, industry, and the local economy. As a globally recognized leader with 260 000+ direct employees , 100 00 + indirect employees they provide an opportunity for South Africans, which will make up the majority of their personnel, to develop specific skills and knowhow which will ultimately benefit the South African economy. They will also be provided with the opportunity to become part of an internationally diverse team, gaining and sharing experience and knowledge either locally or worldwide alongside industry leading colleagues. There will be a significant number of local employees for both the construction (excluding vessels) operation period which will exceed the Economic Development criteria that must be met in terms of the RMI4P.

Considering all the above, Karpowership SA has committed to invest at least R18 billion directly into local economies. This R18 billion investment includes contributions to skills transfer and socio economic, local supplier, SME and women empowered enterprise development. Aside from the above positive effects, the project will contribute to skills development in the country, increase government revenue, as well as raising household earnings by R115.9 million. The increase in household earnings is also likely to improve the standards of living of the affected households albeit temporarily. In addition, government revenue will rise, electricity supply will be increased, and various socio-economic and enterprise development initiatives will be undertaken from the revenue generated by the development. These funds will be allocated towards socio-economic development in the area and are expected to bring a significant benefit to local communities.

The assessment of the Powerships and their associated infrastructure, or its net effect from a socio-economic perspective, indicates that the development would generate greater socio-economic benefits during both the construction and operational phases than the potential losses that could occur as a result of their establishment.

8.2.4 New Generation Capacity and Risk Mitigation IPP Procurement Programme

The Department of Mineral Resources and Energy (DMRE) issued the Request for Proposals (RFP) to procure new energy generation capacity as per Government Notice 753 (7 July 2020): Determination Under Section 34(1) of the Electricity Regulation Act, 2006 (Act No. 4 of 2006) wherein the Minister, in consultation with the National Energy Regulator of South Africa (NERSA) has determined “that new generation capacity is needed to be procured to contribute towards energy security” and “the electricity must be purchased from independent power producers”.

The RMI4P has been identified by the DMRE as the appropriate programme to procure the new generation capacity designated in the above Determination. As such, a call for proposals to IPPs was published by DMRE “to ensure the establishment of this new generation capacity:

- The RMI4P has been designed to procure the target of 2000 MWs of new generation capacity to be derived from different types of dispatchable power generation projects that will enter into public-private agreements with Eskom to provide new generation capacity in compliance with the Performance Requirements, among other things.
- The dispatchable power generation projects may utilise fuel to produce the energy output and may be comprised of more than one facility and project Site.
- Furthermore, the selected projects will contribute towards socio-economic development and sustainable economic growth, while enabling and stimulating the participation of independent power producers in the electricity supply industry in South Africa.”

The decommissioning of the existing coal fleet (due to end of design life) will provide space for a relatively different energy mix. It must be noted that, in the period preceding 2030, the system requirements are largely for incremental capacity addition (modular) and flexible technology, to complement the existing installed inflexible capacity (IRP, 2019). This is essentially what a system like the Karpowership fleet can provide, ship-based power generating and transmission of energy to land-based transmission connection points. This capacity can be modularly up-scaled on site with a very short lead time to meet additional requirements, should these be required at a later stage.

Also of particular importance is acquiring energy security by developing adequate electricity generation capacity to meet our demand under both the low-growth economic environment as well once the economy improves to the level of 4% growth per annum. Electricity generation capacity must therefore be paced to restore the necessary reserve margin and to be ahead of the economic growth curve at least possible cost (IRP, 2019).

8.2.5 Eskom Power Reliability and Government’s Response to the Energy Demand

Eskom’s existing generation plant Energy Availability Factor (EAF) was assumed to be averaging 86% in the promulgated IRP 2010–2030. The actual EAF at the time (2010) was averaging 85%. Since then, Eskom’s EAF declined steadily to a low average of 71% in the 2015/16 financial year before recovering to average around 77% in the 2016/17 financial year. Information as at January 2018 indicated that EAF had regressed further to levels below 70%. This low EAF was the reason for constrained capacity early in December 2018 and January 2019 that resulted in load shedding (IRP, 2019).

Additionally, the IRP (2019) states that there are a number of Eskom coal plants that will reach end of design life from year 2019 and that most of the Eskom plants were designed and constructed for operation for 50 years. Eskom had also submitted a revised plant end of design life (decommissioning) plan. This submission brings forward the shutdown of some units at Grootvlei, Komati and Hendrina. The IRP (2019) showed that approximately 5 400 MW of electricity from coal generation by Eskom will be decommissioned by year 2022, increasing to 10 500 MW by 2030 and 35 000 MW by 2050. The socio-economic impact of the decommissioning of these Eskom plants were not quantified or included in the IRP.

A number of Eskom power plants (Majuba, Tutuka, Duvha, Matla, Kriel and Grootvlei) have been retrofitted with emission abatement technology to ensure compliance with the law (IRP, 2019). In 2014 Eskom applied for postponement of the date for compliance and permission in this regard was granted for a period not exceeding 5 years. According to the IRP (2019), Grootvlei was the only station that has been brought to compliance and failure to undertake abatement retrofits is likely to result in non-compliant plants. It is understood that Eskom has applied to postpone compliance with the minimum emissions standards for air pollution with multiple additional postponement applications for the majority of its powerstations during 2020. Eskom has stated that it will apply for rolling postponement rather than trying to meet the sulphur dioxide standards. Should these not be issued, Eskom maybe required to expedite plans to decommission old polluting stations that cannot meet the MES with potential dire consequences for secured energy supply.

Industrialisation of South Africa has led to increased demand for electricity by an ever-growing population from a strained power service operated by, Eskom. This has led to a number of power shortfalls throughout the country, as supply cannot meet demand. The power shortfalls and the unreliable electricity generation has had major impact on the South African economy (Goldberg, 2015). Furthermore, certain temporary and permanent shut downs of power plants across the country have come with serious impacts to energy supply. These shutdowns directly impact the energy supply to the host community thus directly impact the local economy. This has generated the need for a diversified/ innovative power supply. This is based on national policy and informed by ongoing planning undertaken by the Department of Energy (DoE) and the National Energy Regulator of South Africa.

The National Development Plan 2030 has outlined access to electricity as one of the “Elements of a Decent Standard of Living”. South Africa has faced significant electricity shortages over a number of years and the escalating electricity crises experienced since 2007 has significantly impacted the standard of living of its citizens and resulted in ruinous economic losses.

The vision of the NDP includes the promotion of economic growth and development though adequate provision of quality energy services that are competitively priced, reliable and efficient. Addressing access to energy will promote sustainable development, encourage economic competition and ensure that living standards are maintained and improved. According to the Integrated Resource Plan 2019, the Minister of Energy determined that 39,730 MW of new generation capacity must be developed.

A key component of the 20-year master-plan is the requirement for new energy generating capacity from a range of technologies like renewables and natural gas. **Alternative sources of power generation allow countries to move away from open cycle gas turbines (OCGTs) (South Africa’s- Eskom situation), and use of expensive diesel to generate electricity during peak demand** (Siyobi, 2015).

The use of natural gas from LNG in power generation provides a cleaner alternative to coal and other fossil fuels, reducing carbon and other emissions such as SO_2 and PM_{10}, resulting in both immediate and long-term benefits for public health and the environment. Models developed by the CSIR indicate how an increase in flexibility of the grid would occur with increased gas technology uptake. In their modelling on least-cost renewable energy uptake scenarios, more than 70% of the energy mix should be renewable energy by 2050 to be cost-optimal. The

International Renewable Energy Agency (IRENA) was specific in their modelling, proposing that is it possible to have 85% renewable by 2050, to reach the 2°C scenario. Gas-to-power technologies hold a key role in the abovementioned models regarding the uptake of renewable energy onto the South African grid. The CSIR model proposes that gas-powered electricity should have an installed capacity of approximately 6GW by 2030 and 14GW by 2050. The proposed project could contribute to maximising the renewable energy uptake of the national grid, as well as decrease the emissions from electricity generation for South Africa.

As part of his 2020 State of the Nation Address on 13 February 2020, the President announced that government would implement measures to "rapidly and significantly increase generation capacity outside of Eskom". Established measures include the Section 34 Ministerial Determination that supports the Integrated Resource Plan 2019, which facilitates additional energy generation to the national grid through renewable energy, natural gas, hydro power, battery storage and coal. As per the President's speech at the 2021 State of the Nation Address on 11 February 2021, in December 2020, government and its social partners signed the historic Eskom Social Compact, which outlines the necessary actions to be taken collectively and as individual constituencies, to meet the country's energy needs now and into the future. Government have taken action to urgently and substantially increase generation capacity in addition to what Eskom generates. The following actions were highlighted as per the President's address:

"The Department of Mineral Resources and Energy will soon be announcing the successful bids for 2,000 megawatts of emergency power. Government will soon be initiating the procurement of an additional 11,800 megawatts of power from renewable energy, natural gas, battery storage and coal in line with the Integrated Resource Plan 2019. Despite this work, Eskom estimates that, without additional capacity, there will be an electricity supply shortfall of between 4,000 and 6,000 megawatts over the next 5 years, as old coal-fired power stations reach their end of life."

The RMI4P has been declared a Strategic Integrated Project (SIP) under the Infrastructure Development Act, 2014 under SIP 20. One of the objects of this Act is "the identification and implementation of strategic integrated projects which are of significant economic or social importance to the Republic or a region in the Republic or which facilitate regional economic integration on the African continent, thereby giving effect to the national infrastructure plan".

South Africa's electricity generation capacity shortfall can only be solved by additional generating capacity. Although additional power stations are under construction, there is a lengthy gap of time between the present shortage and the commissioning of all units of these new power stations. In the meantime, the economy suffers from the reduction of productivity and increased costs resulting from power interruptions caused by equipment failure (so-called unplanned maintenance) and load shedding.

Access to cost-effective temporary base-load generation of a significant magnitude will help to solve the problem by supplying the power to meet the load which is often being shed or reduced at present. Reliable power generation facilities are required to address both the immediate power shortfalls, as well as the longer term increasing demand for electricity. Powerships can deliver electricity in a very short timeframes as the normal delays associated with land-based power plants construction are negated as these Powerships have been purpose built prior to deployment.

8.2.6 Economic Recovery and Energy Requirements

Sustainable energy provision is a key to ensuring economic recovery. The CSIR reported that in 2019 load shedding reduced the South African economy by between R 60 billion to R 120 billion (Wright and Callitz, 2020). There are estimations that the overall economic loss to the South African economy over the last 10 years is as high as R 338 billion. Energy analysts have determined that every hour of every stage of load shedding costs the economy R 50 million to R 100 million (Hosken, 2020). Energy analysts predict that load-shedding will have a greater detrimental impact to South Africa's failing economy and may drive many businesses into bankruptcy and reduce investment into the country (Hosken, 2020).

8.2.7 South Africa Country Specific Energy Security Assessment by Noqazo Group

8.2.7.1 Loadshedding in South Africa

This section provides an overview of the geopolitical environment regarding renewables, decarbonation and the current energy crises, as well as the context thereof for South Africa in view of the loadshedding being experienced in South Africa and the intended purpose of the RMI4P to reduce the energy defecit.

As stated in the Noqazo Group Report, (referenced from the CSIR, 2022) South Africa has been plagued by energy insecurity, manifesting itself particularly in electricity shortages, for well over a decade. This has led to loadshedding that is estimated to cost the economy approximately R87.5/kWh of unserved energy (CSIR, 2022), with losses to the economy of between 1 and 4 Billion Rand per day.

During 2022 the shortages reached the highest level ever, with the highest level of loadshedding being introduced over the longest period and for the most days per year so far. When considering that 84.4% of the South African population have access to electricity, it means that loadshedding directly and negatively impacts the lives and wellbeing of the 84.4% of the population. The economic cost of loadshedding is however experienced by everyone, although it is not felt equally due to the greater financial resilience of the affluent and their ability to invest in alternatives such as solar power and gas-powered appliances.

The impacts of loadshedding can be categorised as follows:

- Direct impacts are those which are most visible, for example a firm relying on electricity to power the machines required for operating;
- Indirect impacts are those related to the cost of coping with unreliable power supply;
  (Coping costs are those costs incurred to mitigate the impact of loadshedding on operations).

The extent of the impact of loadshedding on businesses depends on a number of factors including, the sector in which business operates, the geographic location of the business, its operations and the ownership structure (i.e., state owned, domestic owned or foreign owned), etc (Rentschler et al., 2019).

At national level the impact of loadshedding would, for instance, be a function of electrification, population density and urbanisation. These factors, amongst other contextual variables, have a bearing on the extent of adverse effects of loadshedding on the South African economy.

Loadshedding has had a significant impact on the entire South African economy, from the largest energy consumers such as mines and manufacturers to SMMEs, increasing the risk for both international and local investors and impacting consumer sentiments. It is estimated that every day of Level 6 loadshedding in 2022 costs the South

African economy R4bn (BusinessTech, 2022), while loadshedding in 2021 is estimated to have resulted in up to a 3.1% decrease in GDP growth, eliminating the opportunity for up to 400 000 potential jobs to be created (BusinessTech, 2022).
Studies conducted across 23 African countries found that a 1% increase in the frequency of power outages results in up to a 3.3% decrease in business output (Rentschler et al., 2019). These impacts are felt more significantly by small firms (Alby et al., 2013), as large firms tend to be better equipped to withstand electricity disruptions due to their ability to invest in back-up generation and due to their improved ability to cope with reduced sales and revenue attributed to interrupted production or service provision (Rentschler et al., 2019).

In addition to the direct impact on businesses, loadshedding has a tangible impact on investor confidence, reducing investment from both international and local sources.

Loadshedding has placed additional strain on economic growth, further hindering the economic recovery after significant economic contractions experienced during the COVID-19 pandemic (Statistics South Africa, 2022a). This impact on economic recovery is set to continue, given that as of the 14th of September 2022, 38% of 2022 experienced loadshedding (Whitfield, 2022), and Eskom expects at least level 2 loadshedding to continue intermittently for the remainder of 2022 (BusinessTech, 2022d). Furthermore, access to sufficient reliable energy is a fundamental driver of any country's economy – South Africa has a 35% overall unemployment rate, an unemployment rate of 63,9% for those aged 15-24 and 42,1% for those aged 25-34 years (StatsSA, 2022). Besides providing much needed electricity, the Karpowership projects are estimated to create 2287 job years per project (Other RMIPPP projects average 1341).

Considering that the energy demand gap is likely to widen over the next five to eight years as old coal-fired plants are decommissioned, the operational challenges associated with the older coal-fired power stations are likely to increase, and there is a delay in new energy provision relative to the timing presented in the IRP 2019 outlook, it is likely that loadshedding will continue until 2025 and possibly until 2030, with at least stages two to seven and possibly higher (Cruise, 2022; Davis, 2021).

The lack of electricity furthermore impedes the quality of service delivery such as health care, education, and other public services (Blimpo & Cosgrove-Davies, 2019). When considering the risk associated with intermittent power supply to medical facilities, the potential for loss of human life cannot be understated or quantified.

While most medical equipment can manage the switch between grid fed power and back-up generators some crucial equipment such as those required for ventilation is not able to do so (Mkize, 2019). Furthermore, the cost of utilising back-up generators for medical facilities can be costly, with Netcare reporting spending an average of R800 000 over a 6-month period on the diesel required to power their generators (de Wet, 2019). With approximately, 80% of South African citizens reliant on public health facilities, medical facilities will continue to be under significant stain during periods of loadshedding (Laher et al., 2019). Liberty Energy (2022) states that there is a clear correlation between energy access and the state of public health care.

8.2.7.2 Global Trends and Decarbonisation

As of 2021, primary energy consumption by source comprised coal which accounted for 25%, oil which accounted for 29% and gas which accounted for 23% of electricity generation globally.

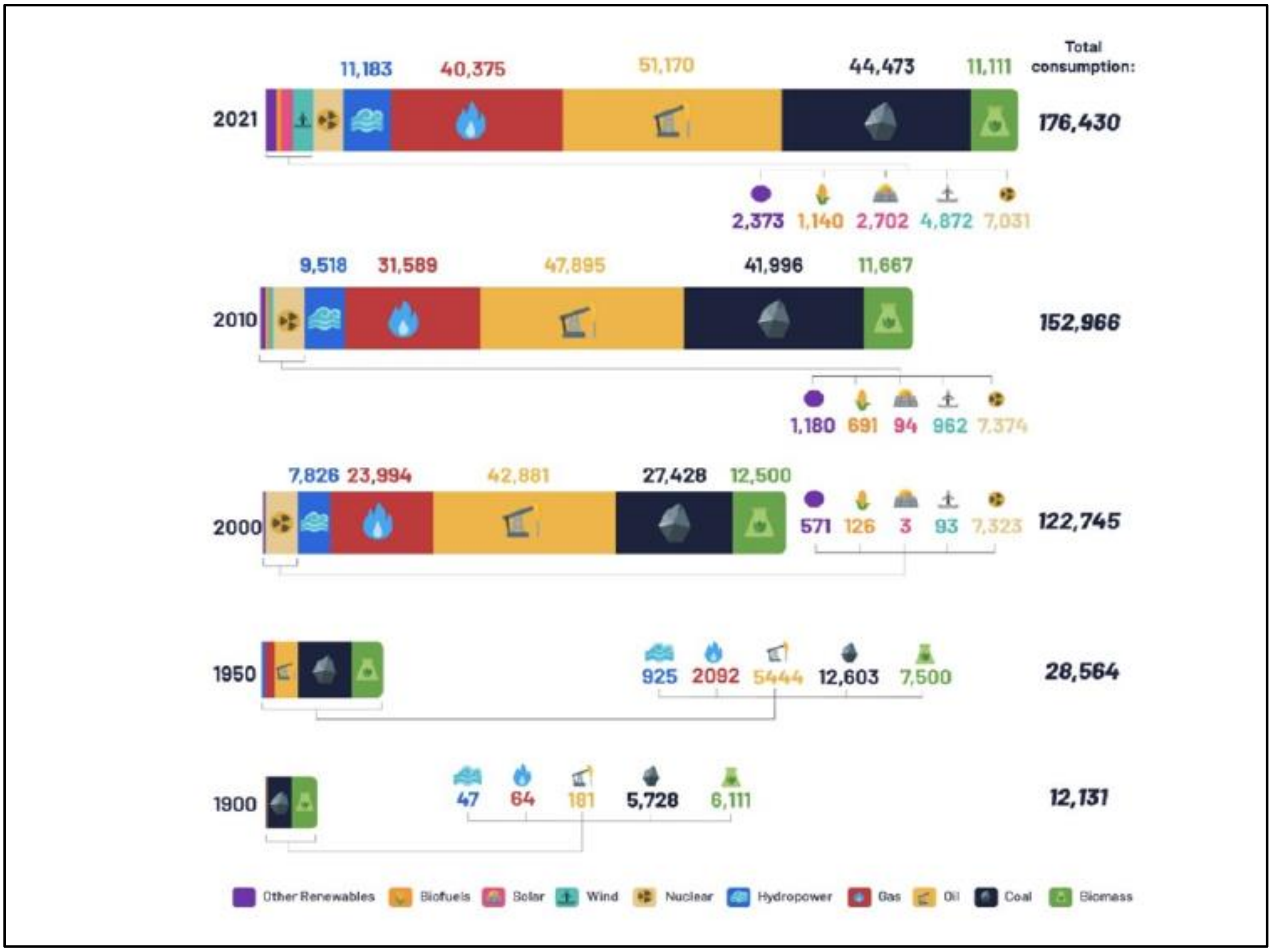

Figure 8-3: Global primary energy consumption by source (OurWorldInData, 2022a) (Noqazo, 2022)

Since 2005 the use of oil and gas has increased in the US. This was driven particularly by the increased use of and investment in shale gas, which was a clear and deliberate U.S. policy to delink their economy from Middle East oil and gas. Since the increase in domestic gas production, the U.S. has moved from being a net energy importer to a net producer of gas. Coal-burning in the U.S. is in the midst of its biggest revival in a decade, while China is reopening shuttered mines and planning new ones (Bloomberg, 2022).

The increase in production and consumption of oil and gas is not isolated as North America as a region also shows an increase. The picture in Europe is no different, as it has made energy security a priority ahead of its climate commitments. Europe continues to use more and more oil and gas and has now also increased its use of coal, energy security being the key driver.

Although Europe has significantly reduced its hydrocarbon production and has invested massively in wind, solar, and biofuel based energy, it has become more dependent on imported energy, primarily from Russia. As a result Europe is in the unenviable position of heavy reliance on Russia for natural gas, oil, and coal.

Although Africa is being encouraged into decarbonisation by those who have benefited and continue to benefit from fossil fuels, the developed world has failed to set the example. The EU is buying up African gas from countries like Algeria, Nigeria, Senegal, Mauritania, and Mozambique (ABC News, 2022, FurtherAfrica, 2022) and is also buying up coal in large quantities (coal exports from South Africa are currently at very high levels) to secure their own energy needs. Several European countries have very recently stated that they are seeking Powerships from Karadeniz Holdings or other floating gas to power solutions to meet their energy needs this winter and beyond.

The UK government has placed the importance of energy security above environmental considerations stating: “the consequences of the Ukraine crisis have made the task of achieving net zero, while ensuring energy security and affordability, more complex. To help avoid a disorderly transition and to provide clarity to investors, the Government should publish a net zero delivery plan which takes account of energy security, making clear what decisions and operational actions are needed, and by when. Any such plan will need to incorporate the flexibility required by a three-decade, economy-wide transition” (House of Lords Economic Affairs Commitee, 2022). The report continued: “In the short term, Europe needs alternative sources of oil and gas to replace supply from Russia; and the UK will continue to require gas during the transition.”

In Germany and Italy, coal-fired power plants that were once decommissioned are now being considered for a second life and the amount of coal exported from SA to Europe has increased. In the US coal-burning is in the midst of its biggest revival in a decade, while China is reopening shuttered mines and planning new ones (Bloomberg, 2022).

Global geopolitics and global geopolitical risks need to be considered in energy making security decisions making. During times of conflict, global energy prices has been shown to rise due to global energy interdependencies and nations looking to safeguard their own energy security. History has also shown that the access to energy is a weapon of war and “disruptions in energy supply chains has the potential to adversely affect the economies of nations that have not developed their own indigenous sources” (Noqazo Group, 2022).

The data presented as per Figure 8.3 shows that despite industrialised nations paying lip service to regarding their commitment to the decarbonisation of their energy systems, the demand for coal, oil and gas has continued to grow globally. Furthermore the EU has declared nuclear and gas to be green (Deutsche Welle, 2022).

8.2.7.3 The Renewable Energy Myth

One of the most common myths in renewable energy circles entails the assumption that all necessary materials, global manufacturing capacity and supply chains are available. The IEA however estimates that supply of lithium, graphite, nickel and rare earths will have to increase by 4 200%, 2 500%, 1 900% and 700% respectively by 2040 to cope with the increased demand. The table below shows the most important materials required for the energy transition.

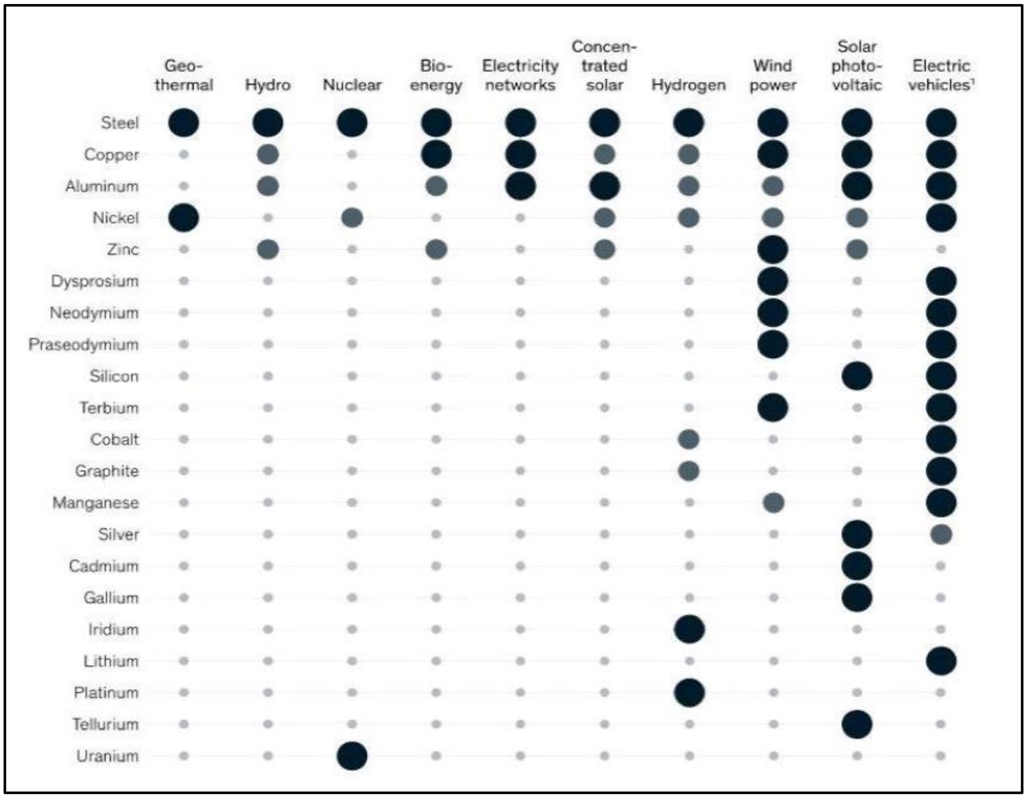

Figure 8-4: Materials critical for transition to a low carbon economy (Bobba et al., 2020)

Should South Africa continue a shift to reliance on renewables, instead of a wider mix exposure to global geopolitics and supply chain limitations may impact the economy, should geopolitics shift.

Renewable energy is often lobbied for being cheaper, however, Germany and Britain who have progressed much further in the transition have experienced electricity rate increases of 60% - 110% over the last two decades.

From an environmental perspective, the environmental and socio-economic impacts of obtaining the required materials via mining activities should be considered together with climate change impacts (inclusive of those generated through mining). In many countries therefore, gas has been accepted as a transitional fuel to provide dispatchable, reliable grid connected generation capacity as it has a lower greenhouse gas impacts than coal, diesel and other similar alternatives.

8.2.7.4 South Africa

The issues of energy access, sustainable development goals (SGDs) and justice cannot be separated, especially in light of the tremendous pressure put on Africa by the developed world to decarbonise and not make use of indigenous fossil fuels which ironically is in direct contrast to their own decisions to focus on their energy security. Significant discrepancies exist between electricity consumption in Africa that in the EU, confirming the developed world's hypocrisy, since per capita, the average EU citizen uses as much as 10 times more electricity than the average African user.

The United Nations' Human Development Index (HDI) is used as an indicator for human condition, combining life expectancy at birth, years of education received, and per capita gross national product. Globally it has significantly increased from 62% of the global population scoring low in 1990 to currently only 12% scoring low – many of these people are however from Africa.

As with child mortality, there seems to be a clear correlation between energy consumption and an improved HDI. South Africa and the African continent need to improve access to affordable energy, to be able to improve the HDI. The impact and consequences of loadshedding on health has already been referred to earlier.

Another important measure of SDG 7.1 is access to clean cooking, which can be facilitated by both gas and electricity. Approximately 13% of the population is without access to clean cooking. As a percentage of the population, this number may seem relatively small, but this equates to a staggering 7.8 million people in South Africa without access to clean cooking. During loadshedding, this percentage increases dramatically as most of the lower income and disadvantaged population of South Africa does not have alternative means and revert primarily to wood fed open fires and paraffin use.

Although South Africa has done very well to improve electricity access (SDG 7.1) to about 95% of the population, this however is insufficient since access alone without the security of supply and accompanying affordability does not guarantee energy equity.

South Africa's energy mix (Total Energy Supply) is currently dominated by coal at about 75%, followed by oil at around 15%, with gas currently playing a minor role in the region of 5%. The renewable energy sector currently plays a very limited role in South Africa's energy mix, with only about 6GW installed to date.

Natural Gas (which can be imported in LNG form), is preferred over LPG for industrial and electrification applications due to higher available efficiency and lower environmental impact.

The South African situation can be summarised as follow:

- The country depends heavily on fossil fuels, primarily coal, and this cannot be abandoned overnight.
- Decarbonising the economy rapidly will undoubtedly lead to increased loadshedding and even lower energy security, stifling the economy and causing major job losses in the country, potentially leading to increased crime, political and social upheaval.
- Dependence on Mozambiquan gas exposes South Africa to single source political risk in Mozambique.

8.2.7.5 South Africa's Just Transition

According to the Presidential Climate Commission, 2022 South Africa's "just transition" framework is based on 3 principles of justice: distributive justice (e.g. equipping South Africans with skills, assets and opportunities for the future), restorative justice (e.g. acknowledging the health and environmental impacts to communities in coal and other fossil fuel impacted areas and supporting all South Africans' constitutional rights to a healthy environment, shifting away from resource intensive sectors and fossil fuels, creating a more decentralised(net-zero-emissions) economy, and procedural justice (e.g. empowering and facilitating transition with all stakeholders).

It is important to note the above core principles of the Just Transition framework because in reality the implication is that for South Africa's transition to be "just" it needs to:

- Be centred on Energy security, which is embodied in the principles of Distributive and Restorative Justice. This includes Ownership of:
    - Energy Resources
    - South Africa driving its own energy agenda, making own decisions on the energy mix;

  - South African energy Policy needs to be owned and driven by and in South Africa's national interests
- Energy security also must include the principle of Energy Equity, which speaks to:
  - Availability which includes all energy sources available to the country
  - Accessibility and
  - Affordability

The critical role of energy has also been highlighted by the former United Nations Secretary-General Ban Ki-moon: "energy is the golden thread that connects economic growth, social equity, and environmental sustainability".

8.2.7.6 The Karpowership SA Projects

Insofar as the Karpowership SA projects are concerned, the average bid cost was R1,55/kWh for the 3 winning projects while the other winning bidders, offering primarily renewable energy technologies backed up with battery and fossil fuel technology to provide the required benefit of dispatchability, averaged about R1,63/kWh per project (DMRE, 2020a).

This clearly shows that renewable energy is not consistently cheaper and cannot presently provide dispatchable power at scale, which Gas to Power is able to do.

Spatially, a typical Karpowership will utilise 15 000m^2 to generate 470MW and that in the sea with minimum use of land for connection infrastructure whilst the footprint for a similar gas to power plant on land would be approximately four time as much.

8.2.7.7 Conclusion

South Africa, like most of the rest of the world, is experiencing an energy security crisis and the SA government has acknowledged the need to create additional energy sources and has amended some legislation accordingly.

It is necessary that the solutions be sought and implemented:

- in a holistic manner,
- taking into consideration global trends and experience and lessons learnt from other countries,
- taking cognisance of all related aspects and their various inter-relationships
- considering various options open-mindedly without being brainwashed or coerced by other countries & organisations.

It is evident that gas is a necessary transitional energy source (and has been declared as 'green' by the EU) and that not all arguments against gas such as cost and environmental impact are founded within the context of the project within South Africa's energy crisis and policy frameworks for climate change and renewable energy.

8.2.7.8 Salient Points

- SA is in an energy crisis like many other countries
- Other countries have progressed further in energy transition and have experience and expertise
- It is not for other countries, organisations or individuals to be prescriptive to SA while not following the same agenda in practise, or acting with ulterior motives
- A number of myths exist regarding decarbonisation

- A number of myths exist regarding gas as a source of energy
- These myths should be dispelled and true facts disseminated and considered
- It is not a matter of “the one or the other”, rather obtaining the ideal energy mix
- The UN has declared gas to be “green”
- LNG is a cleaner gas than LPG and is cleaner than coal and oil
- The Karpowership projects:
    - meet the criteria of affordability
    - provide positive solutions to the energy crisis
    - reduce the negative impact of loadshedding on the citizens of SA
    - reduce the negative impacts of loadshedding on the economy
    - improve the wellbeing of the country and its people.

8.2.8 Gas-to-Power Projects and the Just Energy Transition from Fossil Fuels in the South African Political Economy by the team of experts from Political Economy Southern Africa (PESA)

There are many areas of debate regarding the global transition away from fossil fuels, including the potential impact of the transition on existing livelihoods that are dependent on fossil fuels and related value-chains, the correct pathways towards achieving net zero, or even the feasibility and reliability complete dependence on renewable energy. The many competing arguments also struggle with balancing between the need to resolve energy shortages versus minimising the adverse impacts on the environment. This is certainly the case in South Africa due to the necessary interventions needed to deal with the severe energy shortages, transform the economy away from long-term dependence on raw mineral commodities, and reducing environmental degradation impacts.

South Africa takes an integrated approach to economic planning, environmental management and sustainable development. This approach requires the integration of social, economic and environmental factors into planning, implementation and decision making so as to ensure that development serves present and future generations. The approach takes a polycentric view to sustainable development and emphasises social, economic, environmental and political economy factors that are crucial for sustainable development. A polycentric view allows for more than one centre of development or control, which allows various stakeholders to play their part or cooperate towards the central objective of sustainable development. Hence, the integrated approach to environmental management and economic planning has led to the development of the just transition approach to the global transition from fossil fuels as a way to ensure that the many diverse developmental needs can be consolidated around a common objective of sustainable development.

8.2.8.1 The Political Economy of the Just Energy Transition in South Africa

In South Africa, the energy sector contributes close to 80% towards the country’s total greenhouse gas emissions of which 50% are from electricity generation and liquid fuel production. More than 90% of South Africa’s electricity is generated from coal and it is anticipated to remain the main fuel source for power generation for the foreseeable future. South Africa’s National Development Plan (NDP) prioritised the need for energy infrastructure to be robust, extensive, and affordable to the meet the needs of industry, the commercial sector as well as households. As part of addressing the goals of the NDP and simultaneously addressing the need for South Africa to lower its GHG emissions, the Integrated Resource Plan (IRP) 2019 was developed, and numerous independent power producer (IPP) procurement programmes launched to procure additional generation capacity through renewable energy, coal fired power, and more recently, generation capacity from a range of dispatchable energy technologies, through the RMI4P.

The RMI4P was designed to procure new generation capacity from a range of source technologies to address the electricity capacity supply gap as identified in the IRP2019; and to reduce the extensive utilisation of expensive diesel-based peaking open cycle gas turbine (OCGT) generators in the medium-to-long-term.

The DMRE envisaged the RMI4P being based on the following qualifying criteria:

- Job creation, Local content, Preferential Procurement, Enterprise Development, Socio-economic development requirements being met
- The minimum dispatch commitment under the RMIPPPP is for a 50% load factor in a year
- Provide different charge rates for a load factor of 100% and at 75%
- Provision of ancillary services
- There is no take or pay, buyer will issue a dispatch notice

The key benefits of this programme are not having to sign take or pay PPAs however one should be cognisant that without the certainty of take or pay contracts and without a 20-year PPA, the tariff could have easily increased threefold.

The balance was designed to transition South Africa's energy mix while recognising the limitations of the coal fleet and balancing that with renewables, gas and lesser extent batteries. World over, transitions are taking place with the increased use of gas for balancing the electricity generation system, as is seen below from the sample countries:

Figure 8-5 depicts the use of gas by Germany, Great Britain and Ireland in June 2020. Gas is preferred for nations undergoing an energy transition and who also have a growing variable renewable energy penetration. Figure 8-6 shows how 2 years later there is an ever-growing need for gas and it makes up a significant part of the energy mix.

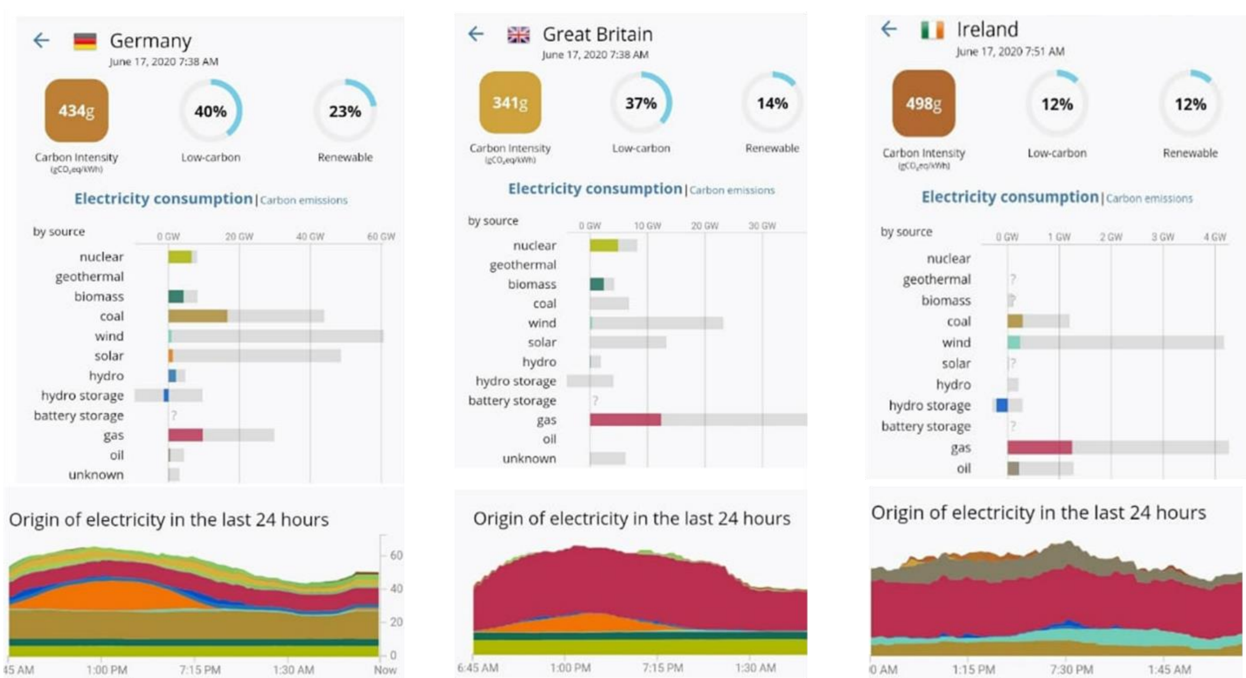

Figure 8-5: Electricity Map June 17 2020

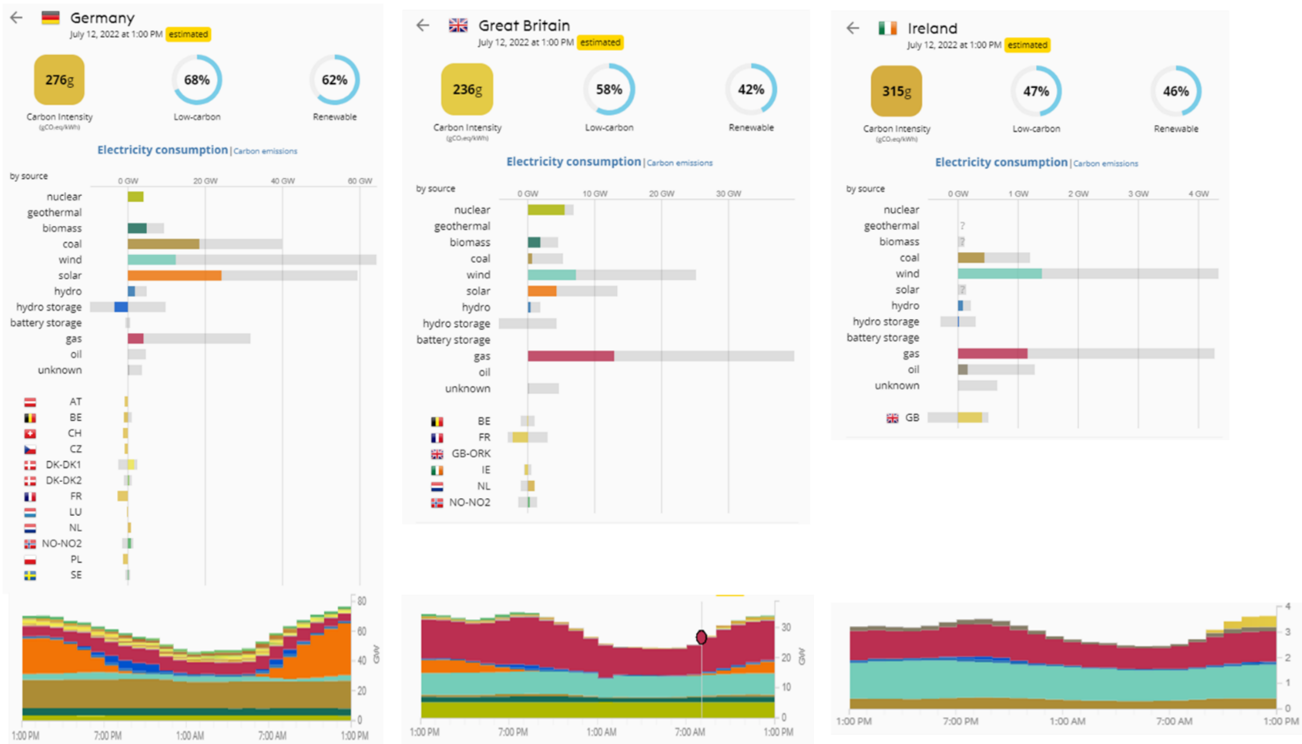

Figure 8-6: Electricity Map July 12 2022

The greyed-out bars on both figures 8-5 and 8-6 indicate the installed capacity of the technology and the colour indicates what was dispatched. In both instances we see the low dispatch of renewables necessitating the need for the dispatching of nuclear (Germany and Britain), coal and gas. The need for dispatchable technologies is an immutable fact given the variance of renewable energy that could threaten energy security. Governments worldwide are considering various technologies to ensure energy security however in gas constrained Europe, Germany has decided to keep their nuclear plants opened and are considering Powerships.

8.2.8.2 Role of Gas-to-Power in the South African Energy Mix

As South Africa increases its renewable energy penetration through further renewable bid windows, it is evident that dispatchable and flexible generation is required – which is found in gas and to a much lesser extent, battery technology. The role of gas is indisputable in the just energy transition as it provides additional dispatchable capacity at scale that enables the large exploitation of renewable resources.

The oft mentioned costs of gas and lack of infrastructure are the two main inhibitors to the mass adoption of gas infrastructure. It has become acceptable to quote the declining costs of renewables and their offering as the least cost of energy however this basis of comparison with dispatchable technology is factually incorrect. As what is found in the Meridian Economics Report titled “Resolving the Power Crisis Part A: Insights from 2021 - SA’s Worst Load Shedding Year So Far. The Meridian report states that had South Africa installed 5GW of renewable capacity, it would have reduced loadshedding significantly in 2021.

However, least-cost as a measure of comparison leaves out the cost of service from the tariff, thus inappropriate comparisons lead to inappropriate expectations. The cost of service includes frequency and voltage control, transmission, synchronous power, dispatched ramping, system balancing and last mile connections. In developing and maintaining energy systems, optimisation outcomes of energy modelling must not be confused with the technical requirements of operating an energy system.

In South Africa, continuous renewable bid windows have resulted in decreased tariffs over the last decade. The REIPPPP bidders bid on a per unit energy costs and not the cost of the actual service. The service costs are borne by Eskom with no compensation from the renewable IPPs. The closest the system costs have been reflected was with the RMIPPPP tariffs, which included energy, dispatchability, voltage stability and storage costs.

It is for this reason that when technologies are modelled for the IRP2019, they include a multitude of parameters such as system and transmission constraints, load following, dispatch costs and energy costs amongst others.

8.2.8.3 South Africa's Energy Demands

With the likely demand profile for electricity in South Africa being uncertain, the amount of generation required will remain unknown. However, for portions of generation that will be provided by variable sources, provision must be made for supplying all the generation from dispatchable resources in the times where the variable sources do not provide the required energy. Energy technologies are classified as dispatchable or non-dispatchable. Both these technology groupings play an important role in meeting baseload and peaking demand and thereby ensuring security of supply. Non dispatchable technologies provide capacity and intermittent energy.

Dispatchable technologies such as gas, coal, nuclear, oil and even hydro play a pivotal role in ensuring security of supply globally. Dispatchable technologies provide the following benefits.

- Peak Capacity
- Dispatched Ramping
- Energy
- Synchronous Power
- System Strength
- Frequency moderation
- Voltage stability

When considering energy supply options, the continuous delivery of customer requirements needs to be achieved. Typically, the morning and evening peak as well as daytime load needs to be catered for with a sufficient reserve margin and peaking capacity. A typical daily load profile graph is given below, the lines indicate the continuous delivery of the customers' requirements. The orange line, residual demand, is the hourly average demand that needs to be supplied by all resources that can be dispatched by Eskom National Control. It includes Eskom generation, international imports, dispatchable IPPs and Interruption of Supply. The grey line indicates South Africa's contracted daily demand which includes residual demand as well as supply from all sources such as IPPs.

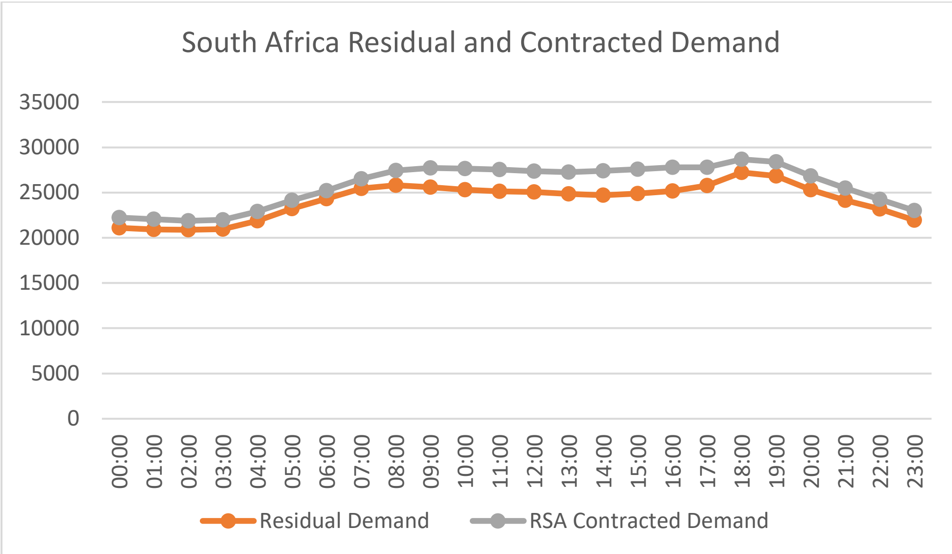

Figure 8-7: Typical Daily Load Profile (01/04/2022)

When comparing energy supply options, the 6 Cs need to be considered (LCOE cake):

- Cost;
- Convenience;
- Continuity;
- Consistency;
- Choice; and
- Consciousness.

Dispatchable technologies typically meet these requirements and thus meet the needs of the customer. Generators must meet two criteria to ensure security of supply – dispatch and energy. The question then arises of what the optimal energy mix is to ensure security of supply. The illustration below points to a diversified grouping of technologies that will ensure an optimal mix, however people only want to focus on the levelised cost of energy (LCOE) element as the only determinant of technology selection. LCOE includes the initial capital, discount rate, as well as the costs of continuous operation, fuel, and maintenance over the life of the project. However, it does not address energy security. An optimal energy mix considers the needs of the system throughout the day, it is technology agnostic and considers grid limitations.

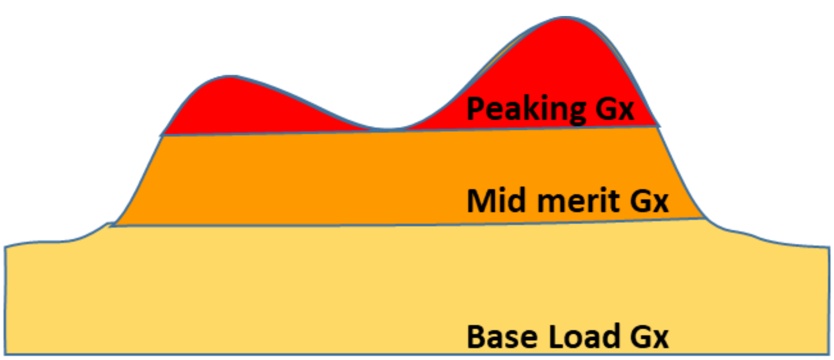

Figure 8-8: Optimal Energy Mix

Figure 8-8 illustrates how wind and solar provide energy during their typical hours, albeit intermittently however they are not able to provide all the other requirements for a functional energy system. Figure 8 however looks at the benefits of a stacked product offering which considers both dispatchable and non-dispatchable technologies. In that instance, all the elements to ensure energy security are met.

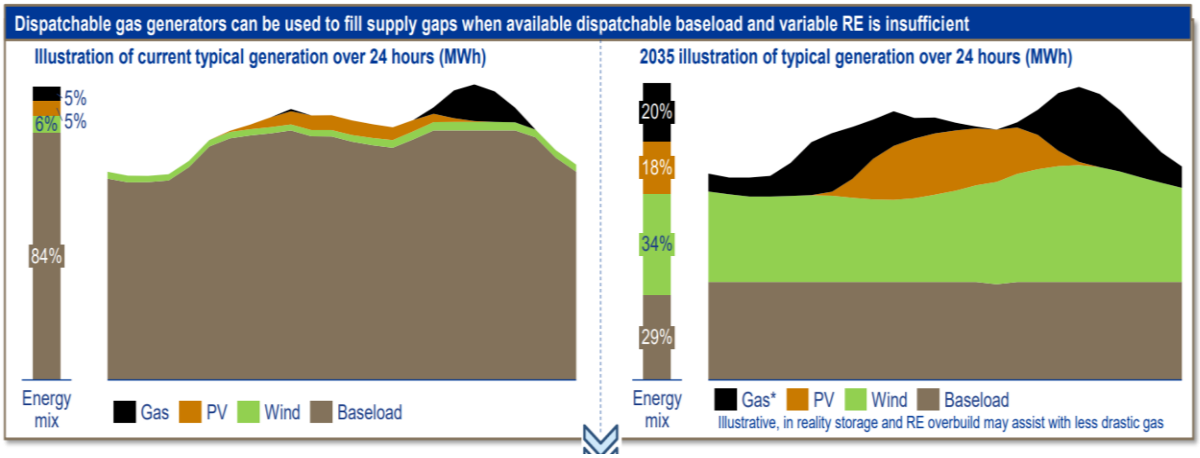

Figure 8-9: Stacked Product Offering (Eskom)

This stacked product offering is premised on the following insights:

- Increasing levels of variable renewable energy (RE) in an energy system will result in the increased need for balancing resources to supply energy when non-dispatchable renewable energy is not available
- Montecarlo simulations run by Eskom system modelling indicate a need for dispatchable power to achieve an operable system
- Based on available technology, gas plants are viable solutions for grid balancing because of their relatively low capital costs and fast ramp rates
- Commodity pricing, political risk and forex exposure present significant risks to gas investment - price and exchange rate volatility associated with gas (EU gas up >400% y-o-y)
- While the technology developments and decreasing costs of alternative or supplementary resources (BESS) is promising - indigenous and regional gas development will mitigate the risks related to commodity pricing and forex

Techno-economic and social considerations, as well as long term sustainability should guide technology selection decisions. The following considerations should be made when assessing technologies:

- Short Term: Lowest cost option with viable technology delivery mechanisms that enable energy security, accessibility, affordability, and sustainability, and
- Long Term: Mitigate risks associated with stranded assets.

8.2.8.4 Risk and Opportunities for Gas-to-Power in the Just Transition

While most of the gas is currently supplied and distributed by Sasol, further development of a gas economy and infrastructure in South Africa will require significant planning and investment in the context of South Africa's NDC commitments. The required infrastructure includes LNG import terminals, storage and regasification facilities, primary high-pressure gas transmission pipelines and secondary distribution pipeline networks. As to ensure stronger regional integration and sustainable development the planning and implementation of gas-to-power infrastructure in the SADC region should follow a carefully considered collaborative and partnership approach. This has already been evidenced by the partnership between South Africa and Mozambique on the ROMPCO pipeline. A similar approach will also serve to advance a just transition by supporting the creation of new economic activity around the gas-to-power value chain. The table below summarises a cost-benefit analysis of developing a sustainable gas-to-power industry in SADC:

Table 8-1: Cost-Benefit Analysis of Gas-to-Power in SADC

Approach/Cost-Benefits	Gas-to-Power	JET	Renewables Reliant
Costs	Environmental – While gas is a cleaner energy source that oil and coal, it remains a source of GHG emission especially when the entire value chain is considered.	Extensive socio-economic impact that requires meaningful consultation of all key stakeholders.	Flexibility component in the form of new dispatchable power or storage required to ensure continue stability of the grid.
	High cost of developing and upgrading gas infrastructure.	Investment in reskilling and upskilling of staff employed in existing coal fired stations.	Investment required to resuscitate local manufacturing capacity for components and research and development in enhancing technologies.
	Gas price indexed to global oil prices, and as such exposed commodity price shocks.	Gradual and phased process that may require detailed industrialisation and beneficiation components to be built.	Constrained transmission capacity, particularly in the Northern Cape will require investment in capacity expansion an identification of new sites.
Benefits	Supports transition towards lower carbon future.	Existing connection and transmission infrastructure which reduces deployment cost construction time relative to new renewable plants.	Short time frame of 18 to 24 months in getting renewable power onstream.
	Strong demand for gas in South Africa and the SADC region.	Potential for creation of new local industries in the repurposing of old power stations. Allows for shift to	Established technologies with well mapped resources.

Approach/Cost-Benefits	Gas-to-Power	JET	Renewables Reliant
		community ownership models	
	Collaboration supports regional integration, diversification of gas sources and ultimately regional energy security by developing already discovered resources.	Unlocks access to Just Energy Transition Partnership (JETP) funding and other financing opportunities.	Cost of technologies have declined over time with established financing framework.
	Established regulatory framework requiring minor amendments.	Preserves energy security but may be limited in term of scale and speed of implementation.	Can incorporate battery storage technologies to enhance security of supply.
	Gas as an alternative to diesel fuel with the conversion of existing/decommissioned plants.	Maintains livelihoods of affected individuals.	Established framework in the form of the REIPPPP.

The key economic consideration for gas-to-power is to ensure the sustainability of gas as an energy source given the requirements of the South African economy. South Africa's IRP2019 provides details in terms of the sources of gas supply and required supporting infrastructure. Government has however identified the development of Coega LNG Hub and/ or Richards Bay LNG Hub in partnership with Transnet, which will facilitate the importation of LNG to South Africa. To increase the access to gas and support the gas-to-power industry, the government of South Africa through the Central Energy Fund and its subsidiaries looks to strengthen the downstream gas market increase the utilisation of some of its underutilised assets including:

- Repurposing of aging coal fired power plants with 5,000MW planned for decommissioning by 2024 (and another 5,000MW by 2030);
- Planned 3,000MW Gas Power Plant which will require connection loop to the pipeline network;
- Current OCGTs which can be switched from diesel to Gas;
- Develop industrial/commercial markets with limited access supply from Sasol;
- Collaboration with Transnet, which operates the Lilly Gas Pipeline which connects Secunda and Durban and presents opportunity to connect the pipeline to Coega LNG terminal;
- Development of a Gas Trading capability, focusing in the Short-Medium Term on Mozambican gas supply and in the Long Term on Southern African gas supply.

The national power utility Eskom remains under significant financial pressures and operational challenges. This has resulted in the delay of major projects while the breakdowns within its aging coal fleet have resulted in long running rolling blackouts. The economic impact caused by the impact of loadshedding, and a lack of clear policy co-ordination will further slow the achievement of a just energy transition. More especially as Eskom battles to implement the repurposing of its old power stations such as the Komati Power Station.

8.2.8.5 Why Gas-to-Power Supports Sustainable Development

Despite underinvestment in oil exploration activities, gas discoveries on the African continent have increased with proven natural gas reserves seeing a significant increase of 37% to 625.6 trillion cubic feet (tcf) in 2022. An estimated 175 tcf of proven gas reserves across Africa have not been able to proceed to production. Gas consumption and gas pipeline exports have increased by 7.1% and 45% respectively which demonstrates to potential for gas to sustain economic developments on the journey towards decarbonisation. In the South African context these discoveries including its own Luiperd-Brulpadda gas condensate discovery, expected to produce its first gas by 2027 present further opportunities for regional integration as well as diversification benefits in terms of the energy mix. The key positive for gas to power remains in its ability to provide flexibility to the power system and complement renewable energy sources as the JET is implemented, Gas to power also presents significant job creation opportunities both upstream and downstream. Gas to power is an important cog that addresses the economic social and environmental considerations within the South African and region context wherein the impending decommissioning of aging coal plants needs to be balanced with the need to solve South Africa's energy crisis with the least possible disruption the livelihoods of the otherwise affected parties.

8.2.9 The Economic Impacts of Loadshedding by Afro Development Planning

8.2.9.1 Context

This report presents the global energy landscape and current trends, the local energy context in which the Karpowership project has significant relevance, the economic challenges and impacts of loadshedding on the South African economy, and the various responses to loadshedding.

This includes perspective on the Karpowership proposed project by setting the context for this proposed project and providing an explanation of the contribution that the Karpowership Project makes towards the Risk Mitigation Independent Power Producer Procurement Programme (RMI4P).

To address loadshedding within the next few years the current baseload capacity challenges needs to be addressed through, among others, replacing this with similar generation technologies, or dispatchable power plants which have the flexibility to address both baseload and load following needs.

Few generation technologies are able to provide both consistent and stable baseload power, as well as load following capabilities. Karpowership's floating power fleet is able to provide both, effectively.

Understandably, one company being awarded the majority of generation capacity of the RMI4P highlights the potential risk that the country faces should Karpowership be unable to deliver the required energy - especially given the urgent need to remedy the energy crisis in South Africa which has been precipitated by an ailing national utility, namely Eskom. While Karpowership is confident that it is extremely unlikely that it will fail to deliver on its contractual obligations, there are other externalities that may result in Karpowership being unable to deliver, e.g., legal processes, permitting and licensing requirements, sabotage, etc.

Gas-to-power plants play a critical role in providing dispatchable electricity, which neither coal nor renewable energy can provide. This is important to understand as gas-to-power can provide stabilisation to the energy mix, and Karpowership more specifically, can provide baseload, mid-merit and peaking power. Furthermore, and given the role of gas-to-power in the energy mix it serves to enable and support the deployment of large-scale renewable energy, while still significantly reducing emissions by reducing the reliance on electricity produced by coal-fired plants.

In the South African context, the IRP 2019 provision has been made for gas in the energy mix. Coupled with the urgent need to respond to the energy crisis makes it clear that due consideration is to be made for the Karpowership Project. The Karpowership Project has significant relevance given the following:

- The Karpowership fleet can be deployed immediately, and the Karpowership Project can reach commercial operation in 12 months, given the infrastructural requirements on the landside. This allows for additional generation capacity coming online timeously, given the urgency to resolve loadshedding.
- Karpowership can provide dispatchable baseload, mid-merit and peaking power, it can respond in minutes when the energy supply is under strain.
- Given the nature of the RMI4P, and the associated purchase agreements, Karpowership will only generate electricity after being issued a dispatch instruction by the system operator.
- Because Karpowership is a floating powerplant, there is little risk of stranded assets or lengthy decommissioning timeframes.
- The Karpowership Project will create thousands of new jobs over the construction and operational phases of the Project. During the operational phase Karpowership will also contribute to skills and capacity development which will benefit locals and that contribute to South Africa’s just transition.
- The Karpowership Project will produce less than half the GHG emissions, and a fraction of the particulate emissions to that of coal. It is therefore expected to directly result in more emissions avoided (from coal-fired plants) than it will contribute to the global stock of greenhouse gas emission and will have a positive climate change impact by supporting the deployment of renewable energy in the country (Promethium Carbon, 2022).
- Powerships should not be considered a replacement of renewable energy, but rather a complementary technology to renewable energy, which supports the transition away from coal. A full transition to renewable energy will require a significant increase in battery manufacturing and deployment – a 44 times increase internationally by 2030 (IEA, 2022) is required to achieve renewable energy providing baseload. This significant increase in demand is highly likely to see developed, richer countries, out bidding and securing battery capacity ahead of developing countries. The Powerships provide a highly feasible alternative through its ability to provide rapidly dispatchable electricity which can make up any shortfalls in renewable energy’s intermittent electricity production which might arise.
- Development of a gas industry in South Africa is already underway, and will continue, and thus the skills, supply, and enterprise development undertaken by Karpowership will further contribute to establishing a more efficient and viable domestic industry. This will ultimately lead to increased job creation activities.
- While coal-based electricity generation has decreased relative to other technologies, 2021 saw the highest amount of power generation from coal as economies began to recover from the strict lockdowns implemented to deal with the height of the COVID-19 pandemic (IEA, 2021).

Beyond the COVID-19 pandemic and the Russian invasion of Ukraine, the global transition from coal has seen increases in gas-based generation (IEA, 2019). Gas based electricity generation results, on average, in 50% less

CO_2 emissions than coal fired plants (Shuai et al., 2018). It is therefore an attractive alternative to coal during the transition to renewable energy - although this is context specific (Roff et al., 2022).

When simply comparing the cost of fossil fuels to renewable energy, fossil fuels are significantly higher, but when accounting for the impact on human health (Vohra et al., 2021), the cost of coping with the impacts of the climate crisis, and the potential economic growth and job creation from switching to renewable energy (Wood, 2021), the gap between renewable energy and fossil fuels continues to grow. However, the impact of intermittent supply, especially in the South African context cannot be ignored, as the economic impact of loadshedding has been significant. In other words, it's not a question of cost alone, but the generation technology's dispatchability in conjunction with the cost as energy security (among others) is crucial for economic activity to take place.

Reliable infrastructure - water, sanitation, energy and transport - are universally accepted to be crucial for facilitating progress toward raising the quality of life of people (Rentschler et al., 2019). Access to clean, reliable, and affordable energy is widely acknowledged as the foundation to addressing developmental needs especially in the developing world context and is fundamental to economic - growth and development. Understanding the challenges and impact of rolling blackouts in South Africa is fundamental to contextualising the appropriateness of generating electricity through various energy generation technologies. This is of relevance in a country where the national power utility, namely Eskom, has failed to deliver stable electricity for more than a decade.

For the financial year end March 2021, Eskom, heavy dominated by coal-fired power, with the average age of those power stations (excluding Medupi and Kusile) being approximately 40 years, generated 191,852 GWh from their 30 power stations with a capacity of 46,466 MW (Eskom, 2021d). Despite this, Eskom also implemented 47 days of loadshedding over the same period, at an estimated cost of R942 million per day to the South African economy (Eskom, 2021d) with loadshedding in 2022 already exceeding this (Bloomberg, 2022b).

PWC estimates that loadshedding in 2021 resulted in up to a 3.1 percentage point decrease in Gross Domestic Product (GDP) growth, costing the economy up to 400,000 potential jobs (BusinessTech, 2022a). In an article by BusinessTech (2022b), chief economist at Alexforbes estimates that the stage 6 loadshedding in mid-2022, cost South Africa approximately R4 billion in GDP per day. The Council for Scientific and Industrial Research (CSIR), found that 2021 was the worst year of loadshedding at the time with a 37% increase in electricity unserved relative to 2020, with a total of 2,455 GWh of generation lost, and an estimated cost of unserved energy amounting to R215 billion (CSIR, 2021).

In the South African context, the failure to deliver stable electricity is a function of numerous factors including corruption, non-payment by citizens, public entities and private sector firms, demand inelasticity, misallocation of resources, lack of infrastructure maintenance, a stagnation in the demand for electrical energy in South Africa since 2007, and the inflexible construction programme marred with delays and cost over-runs (i.e., Medupi and Kusile) (Department of Public Enterprises, 2019).

The reduction in Eskom's electricity supply has been driven by an aging coal-fired fleet, and decommissioning of old coal-fired plants, that will account for a 33,364 MW reduction in capacity by 2030 (DMRE, 2019b). This aging coal fleet has put significant pressure on Eskom's ability to provide consistent electricity, and in late September 2022 roughly 21,878 MW (BusinessTech, 2022d) of Eskom's total 46,466 MW (Eskom, 2021a) was offline due to maintenance issues, meaning that only 53% of Eskom's generation capacity was available. This has forced Eskom to increasingly rely on <diesel fired> OCGT, which is significantly more costly than coal for instance, and as of the

18th of September 2022 already cost Eskom R7.7bn for its financial year-to-date (Fin24, 2022), while costing Eskom approximately R54bn since 2012 (Msomi, 2022).

Over the last decade the price of electricity generated by Eskom increased by more than 350% (Moolman, 2017). The increase in electricity tariff is a direct result of Eskom's capital expansion programme, driven almost exclusively by the construction of Kusile and Medupi and to a lesser extent, the Ingula pump storage scheme. These significant price increases have been higher than annual inflation since 2005 (excluding 2007), and have been, in part, used to meet the increasing costs of Eskom maintaining their aging coal fleet (NERSA, 2021).

Coupled with steadily increasing electricity tariffs which have significantly outpaced inflation (Labuschagne, 2020; Moolman, 2017), Eskom's inflexible construction programme marred with delays and cost over-runs (partly driven by design flaws see: Labuschange (2022b)), and previous delays in Eskom signing power purchase agreements with new independent power producers (IPPs)(Moyo, 2016) and more recently the delays in achieving financial close (Mavuso, 2022), South Africa's electricity crisis is set to continue. Beyond the issues listed above, there have been two additional drivers of the South African energy crisis, namely the delay of new IPP deals, i.e., the Renewable Energy Independent Power Producer Programme (REI4P) and the RMI4P – and Eskom's continued monopoly in the electricity market leading to inadequate and mismanaged supply.

Dispatchable power is critical for stabilising the supply of electricity, as Eskom's current generation capacity is unable to service the demand. This necessitates an expansion and continuation of the IPP programmes, which beyond increasing the energy supply will likely result in significant cost savings to the consumer, and public purse. This as electricity generation costs in South Africa have followed global trends with decreasing cost of renewable energy, which has already demonstrated renewable energy plants producing electricity at a lower cost than coal-fired and gas plants in South Africa (Eberhard & Naude, 2016). What is important to understand however is that the c/kWh cost of the REI4P BWs is not the cost of the service itself, as it does not account for the transmission and distribution costs (for instance, phase shifting, system balancing, voltage control, capacitive and inductive effects, dispatched ramping etc.). However, the RMI4P tariffs do reflect dispatchability, voltage stability and storage cost.
Finally, to appreciate the South African energy context, it is critical to examine the issues pertaining to Eskom's monopoly on electricity-generation, transmission, and distribution. While Eskom's monopoly predates a democratic South Africa, the 1998 White Paper on the Energy Policy of the Republic of South Africa, outlined the need to unbundle Eskom and transform it into a modern electricity utility and create opportunities for IPPs and alternate sources of energy. This in an effort to reduce fossil fuel pollution, and to address the shortfall in electricity supply which was anticipated to commence in 2007 (PARI, 2013).

8.2.9.2 Economic Impacts

What are the economic impacts of rolling blackouts (or loadshedding) in South Africa? Or put differently, loadshedding is bad, but how bad is it really? This question is tackled by presenting the economic impact of loadshedding to the individual, big business (incl. energy intensive users), small, micro and medium enterprises (SMMEs), and investors relative to the direct, indirect, and macro-economic impacts to these groups. Similarly, the coping cost will briefly be discussed. Thereafter, the response to the energy crisis, by Eskom, government, and the customer, is discussed.

The impact of loadshedding is not felt equally by all firms and individuals, but it is felt by all to some extent. The extent of the impact of loadshedding on firms is a function of a number of factors including the sector within which said firm operates, the geographic location of the firm itself and its operations, and the ownership structure (i.e., state owned, domestic owned or foreign owned), etc. (Rentschler et al., 2019). Moreover, a lack of electricity impedes and lowers the quality of service delivery such as health care, education, and other public services (Blimpo & Cosgrove-Davies, 2019). More importantly, if one considers the risk associated with intermittent power supply to medical facilities, the potential for loss of human life cannot be understated or quantified.

South Africa is considered an upper-middle income country (World Bank, 2020), has both very high inequality, but also high human development (2018; UNDP, 2020; World Bank, 2020). South Africa, until 2012, was also considered the largest economy in Sub-Saharan Africa in terms of GDP (World Bank, 2021). However, the country is riddled with economic challenges, including growing unemployment, stagnant economic growth (macrotrends, 2022a), ballooning public debt (Statista, 2022b) and fiscal constraints, and corruption (Foley & Swilling, 2018). South Africa has been struggling to achieve, at the very least, economic growth experienced in the mid-2000s (macrotrends, 2022a). One of the culprits to stifling economic growth is loadshedding.

Loadshedding has added additional strain on economic growth, and further hindering the economic recovery after significant economic contractions experienced during the height of the COVID-19 pandemic (Statistics South Africa, 2022a). This impact on economic recovery is set to continue, given that as of the 14th of September 2022, 38% of 2022 had loadshedding (Whitfield, 2022), and Eskom expects at least level 2 of loadshedding to continue intermittently for the remainder of 2022 (BusinessTech, 2022d). Furthermore, and considering that: 1) the energy demand gap is likely to widen over the next five to eight years, as old coal-fired plants are decommissioned, coupled with the 2) likely increased operational challenges with the older coal-fired power stations, and 3) due to the delay in new builds relative to the timing presented in the IRP 2019 outlook, it is likely that loadshedding will continue until 2025 and possibly until 2030, with at least stages two to seven and possibly higher (Cruise, 2022; Davis, 2021).
This needs to be viewed in the context of Eskom's current decommissioning schedule, where a total of 8,087MW of generation capacity will be decommissioned by 2030 (DMRE, 2019b). This will be offset by commissioning of energy from IPPs (REI4P BW5 - 2,600 MW (DMRE, 2021b), BW6 – 4,200 MW (IPP Office, 2022), and RMI4P – 2,000 MW (IPP Office, 2021b)) totalling 8,800 MW. While in terms of capacity there is a marginal difference between what is decommissioned and what is commissioned, it is important to understand that baseload is being replaced by intermittent capacity through the REI4P BWs, which is likely to only partly supply the required energy, and therefore not resolve the generation constraint which requires dispatchable power.

Studies conducted across 23 African countries found that a 1% increase in the frequency of power outages results in up to a 3.3% decrease in firms output (Rentschler et al., 2019).

8.2.9.3 Impact on Business

These impacts are felt more significantly by small firms (Alby et al., 2013), as large firms tend to be better equipped to withstand electricity disruptions due to their ability to invest in back-up generation and due to their improved ability to cope with reduced sales and revenue attributed to interrupted production or service provision (Rentschler et al., 2019). This results in reduced competition in the market, and therefore an increase in prices, and reduction in demand; a reduction in sales places pressure on businesses to manage their cost, with labour often being reduced as a cost cutting measure, thus reduced employment (Mensah, 2018).

Mining, manufacturing-including the concrete and steel industry which are critical for infrastructure development - and large-scale commercial agriculture, as represented by the Energy Intensive Users Group (EIUG) make up a significant portion of the South African economy, contributing over 22% to GDP and accounting for 40% of the electricity bought from Eskom (EIUG, 2020). By firm type, firms in the manufacturing – particularly those fabricating metal products or refining minerals – and mining tend to be more vulnerable to electricity disruptions (Rentschler et al., 2019). Loadshedding significantly impacts this group of businesses, which has resulted in a reduction of operations and significant retrenchments, with some big businesses closing down South African operations (EIUG, 2020).

Firms are less likely to upgrade machinery to more productive technologies under the threat of blackouts, which over time can reduce the economy's ability to remain internationally competitive, and generate wealth (Rentschler et al., 2019). Loadshedding causes significant disruptions to mining operations, forcing several hour delays as miners exit mines, while smelters and refineries are unable to run given that they need a constant supply of electricity to operate (Van der Nest, 2015). The significance of exporting precious metals and other mining products to the South African economy means that power disruptions can result in a depreciation of the local currency (i.e., the ZAR), increasing the cost of imports and the cost of doing business internationally (Van der Nest, 2015).

SMMEs are regarded as key drivers of economic growth in South Africa, accounting for the majority of businesses in South Africa, and employing 64% of the South African labour force as of Q1 of 2021 (SEDA, 2021). SMMEs are therefore key drivers of economic growth, job creation, and innovation in the economy (Bruwer et al., 2018). Infrastructure disruptions, such as loadshedding, reduces competitiveness of small business to a greater extent (than comparatively larger businesses) given their lower coping cost capacities (Mensah, 2018). In other words, SMMEs are particularly vulnerable to loadshedding, given that many cannot afford alternate sources of electricity or backup generators, and are forced to either limit or stop operations during loadshedding periods (Mbomvu et al., 2021). Given that South Africa already has a harsh economic environment for SMMEs, with 75% of SMMEs failing after operating for less than three years (Bruwer & Coetzee, 2016), persistent loadshedding further compounds the existing operations - and business environment challenges placed on these businesses, reducing their viability and decreasing their chances of long-term success and survival (Mbomvu et al., 2021).

Beyond the direct impact on businesses, loadshedding continues to have a tangible impact on investor confidence, reducing investment from both international and local sources. International credit ratings agencies have indicated that while current levels of loadshedding are unlikely to lead to a credit downgrading, if there is persistent and more severe loadshedding then this could contribute to a downgrading of South Africa's investment grade by credit rating agencies (Fin24, 2019a; Investec, 2022; Smit, 2021). South Africa had its credit rating downgraded in 2020 by both Fitch and Moody's, which while not triggered by loadshedding, have placed South Africa in an already difficult position (Cronje, 2020). The downgrading of a country's credit rating increases the cost of borrowing money on the international debt market – both for firms and the state – and reduces the amount of foreign direct investment flowing into a country (Elkhoury, 2008).

8.2.9.4 Gas to Power Vs OCGT

Eskom has made use of OCGT to generate electricity during peak periods for a number of years now, and given the cost associated thereto the utilisation is tracked very closely (Eskom, 2020). It is evident that Eskom has utilised OCGT to a greater extent for the financial year to date, than the previous period, with September 2022 illustrating a stark contrast and demonstrating a reliance on OCGT that is financially unsustainable. This cost is then passed on to the customer, and Eskom in its most recent updated assumptions for its tariff application, for 2023, indicated that it intends to use R16.8bn of diesel in the next financial year – up from the R5bn initially applied for, which has, in part, driven the potential electricity increase to 38% (Businesstech, 2022; Moneyweb, 2022). This amounts to approximately five percent of the allowable revenue applied for in the financial year 2023/24 (Businesstech, 2022), but contributed to less than one percent of electricity supplied the previous financial year (Eskom, 2021d).

As expected, an over-reliance on OCGT poses an economic - and energy security risk to the South African economy. This is because of two factors, firstly, the cost, and secondly because of the divergence from its intended application as a peaker. OCGT is comparatively more expensive than the alternatives, including Karpowership, coal-fired power, onshore wind, utility scale PV, nuclear and CCGT, but more importantly its evidently more than the South African consumer can afford. Considering the LCOE, Karpowership is situated between solar PV and OCGT, making it an ideal candidate as a cost-effective consideration for South Africa's energy mix. OCGT is also vulnerable to volatility associated with the supply and demand of the primary energy source (in this case diesel), and the volatility of the local currency (ZAR) relative to the USD – which has been depreciating over the same period. Perhaps more concerning, is the application of the OCGT peaker being utilised to supplement baseload electricity supply constraints far above the 1% (load factor) emergency reserve requirement. This is evident from both the (over) utilisation of the OCGT and the load factor for the financial year to date hovering around 16%. What is further evident is the speed of response of Karpowership with power being dispatchable within minutes of receiving the dispatch instruction.

Apart from this, OCGT is more harmful in terms of emissions and human toxicity, than onshore wind, solar PV, and gas power (whether terrestrial or Powership). Natural gas provides a reduced emissions factor when compared to diesel, however it is still far higher solar PV and onshore wind. In terms of human toxicity, coal continues to have the highest impact due to higher levels of arsenic This is followed by natural gas (mostly to the materials used in gas-to-power plants), and then by solar PV, the latter of which is higher than other renewables due to its high use of copper as an input material, where arsenic is released during copper mining (United Nations Economic Commission for Europe, 2021).

Regarding land use and the associated impact on urban or agricultural land as well as the overall land quality considering aspects of erosion resistance, mechanical filtration, physicochemical filtration, groundwater regeneration, and biotic production. Coal mining will have a higher score with high land occupation during the extraction phase (open pit or underground), and the use of timber braces in mines which impacts forestry. In perspective, natural gas plants generally having a lower land-use impact than other fossil fuels, which is due to the nature in which natural gas is extracted from underground. Solar PV on the other hand has a significantly high score (6 times that of gas peaking for instance) for two reasons, firstly there are large amounts of copper utilised in solar PV panels, which leads to a high mining impact during material sourcing. Secondly, solar PV plants are typically built over a larger geographic area than most power plants as multiple panels are required. Given the nature of the Powership, the land-based impact is minimal as the land utilised is mostly land that is already transformed (like a port, including its bulk infrastructure), with a small footprint required for the transmission lines, and to store replacement parts for instance.

The largest number of jobs are created in solar PV and is a key argument behind the growth creating potential of a transition to renewable energy. Onshore wind, and utility scale solar PV technologies create the largest portion of jobs during the construction and instillation period, with the next largest amount concentrated in maintenance and operation (although maintenance and operations employment is expected to exceed construction past 2030), with a lower amount in manufacturing (Ram et al., 2020).

Solar PV and wind resources fall under baseload, but are intermittent energy sources due to their dependence on weather conditions at any given time. Secondly, load-following plants are ones which provide varying electricity output dependent on fluctuating electricity demand, these generation technologies include: OCGT, floating Powerships that utilise combined cycle reciprocating gas engines, and CCGT.

Solar PV, onshore wind and OCGT have similar lead times to commercial operation, which are longer than that of Powerships, and once operational OCGT is far more responsive to demand than onshore wind and solar PV, although it is only marginally more rapid than Powerships with a few minutes' discrepancy. Considering the comparison presented above, a balanced energy mix is required to ensure that energy security is maintained, economic productivity is facilitated, and environmental impacts are minimised. An imbalance in the energy mix will inevitably compromise one or more of these three factors. At the moment, an over reliance on OCGT is a symptom of an imbalance in the energy mix and a deficit of baseload, coming at a significant cost to the consumer. Within this context the Powerships provide a strong alternative to OCGT.

Table 8-2: Conventional generation vs alternative energy generation technologies

Parameters	New build coal-fired	Existing coal-fired	Nuclear	Onshore Wind	Solar PV (Utility scale)	Gas peaking	Karpowership[3]	Gas - Combined cycle gas turbine (CCGT)	Hydro
LCOE (c/kWh)	96 – 225* (Lazard, 2021a)	55 – 70* (Lazard, 2021a)	194 – 302* (Lazard, 2021a)	68 – 105** (Lazard, 2021a)	65 – 203** (Lazard, 2021a)	296 – 355** (Lazard, 2021a)	More than Solar PV, but less than low-end gas peaking	105 – 149** (Lazard, 2021a)	78* (International Renewable Energy Agency, 2019)
Capex (ZAR/kW)	43 634 – 92 075* (Lazard, 2021a)	N/A	115 371 – 189 327* (Lazard, 2021a)	15 160 – 19 968* (Lazard, 2021a)	11 832 – 14 051* (Lazard, 2021a)	10 353 – 13 681* (Lazard, 2021a)	Lower than Gas peaking and CCGT	10 353 - 19 228 (Lazard, 2021a)	Significant variability (Context specific)
Decommissioning cost (c/kWh)	212.99 **** (Raimi, 2017)	212.99 **** (Raimi, 2017)	R42bn ***** (Kings, 2016; Winkler, 2018)	92.84 **** (Raimi, 2017)	103.76 **** (Raimi, 2017)	27.31 **** (Raimi, 2017)	0.5% - 1.3% of Capex	27.31 **** (Raimi, 2017)	
Commercial operational lead time (Financial Close to operation)	96 -120 months (Eskom, 2022a)	N/A	96 -120 months (Eskom, 2022a) 84 months (Statista, 2022a)	12 – 18 months (Heneghan, 2019) 15 – 28 months*** (IPP Office, 2021a)	12 – 18 months (IFC, 2022) 15 – 28 months*** (IPP Office, 2021a)	12 – 36 months (Eskom, 2022a)	12 months	36 Months (Gross & Lyons, 2015)	
Typical Design life or Useful life	50 years (Kusile and Medupi) (Blignaut, 2012)	N/A	40 years (Koeberg - without refurbishment) (Fin24, 2019b)	20 – 25 years (Kis et al., 2018; NREL, 2016)	25 – 40 years (NREL, 2016)	30 years (Fathi et al., 2016)	20 years (contract period in South Africa) Similar to onshore wind	34 years (Kis et al., 2018)	60 years (Kis et al., 2018)
Capacity Factor (% of available power)	85% (Medupi) (SA Government	76.8% (Kriel) – 93.8% (Matla)	85-92% (Yellend, 2016)	39% (IPP Office, 2021a)	24% (IPP Office, 2021a)	6-12% (Eskom's OCGT usage)	96.4%	Significant variability (Context specific)	69% (IPP Office, 2021a)

[3] Due to the proprietary nature of the Karpowership technology, only some information was made available for the purposes of the report. This information was sourced directly from Karpowership and is based on the generation technology that will be deployed for the South African projects.

Parameters	New build coal-fired	Existing coal-fired	Nuclear	Onshore Wind	Solar PV (Utility scale)	Gas peaking	Karpowership[3]	Gas - Combined cycle gas turbine (CCGT)	Hydro
	News Agency, 2022)	(Eskom, 2021b)				(Creamer, 2022e)			
Speed of response to load changes (% capacity/minute)	4-6 **** (Ramirez-Meyers et al., 2021)	4-6 **** (Ramirez-Meyers et al., 2021)	0.26-2 **** (Ramirez-Meyers et al., 2021)	Weather dependent (Ramirez-Meyers et al., 2021)	Weather dependent (Ramirez-Meyers et al., 2021)	NGCC: 0.66-8 **** NG Boiler: 7 **** NGCT: 25 **** (Ramirez-Meyers et al., 2021)	12-20	0.66-8 **** (Ramirez-Meyers et al., 2021)	15-25 **** (Ramirez-Meyers et al., 2021)
Application	Baseload (Lazard, 2021a)	Baseload (Lazard, 2021a)	Baseload (Lazard, 2021a)	Intermittent (Lazard, 2021a)	Intermittent; Peaking (Lazard, 2021a)	Peaking; Load-following (Lazard, 2021a)	Baseload; Peaking; Load-following	Load-following; Baseload (Lazard, 2021a)	Baseload, Peaking (Clarke, 2012; Eskom, 2021c)
Employment (job-years/ GWh)	0.11**** (NICE, 2021)	N/A	0.14**** (NICE, 2021)	0.16**** (NICE, 2021)	0.87**** (NICE, 2021)	Significant variability (Context specific)	0.02	Significant variability (Context specific)	0.27 – 0.9 (Wei et al., 2010)
Emissions (gCO2/kWh)[4]	341*[5] (United Nations Economic Commission for Europe, 2021)	1003.5* (United Nations Economic Commission for Europe, 2021)	5.5* (United Nations Economic Commission for Europe, 2021)	11.9* (United Nations Economic Commission for Europe, 2021)	52.5* (United Nations Economic Commission for Europe, 2021)	458* (United Nations Economic Commission for Europe, 2021)	508.5	458* (United Nations Economic Commission for Europe, 2021)	8.55* (United Nations Economic Commission for Europe, 2021)
Land use	3.1* (United Nations	2.15* (United Nations	0.06* (United Nations Economic	0.105* (United Nations	2.85* (United Nations	0.45* (United Nations	Not available	0.45* (United Nations Economic	0.165* (United Nations

[4] Emissions are considered over the lifetime of the project, and as such also considers emissions from production, and transport of construction materials, and emissions from the decommissioning process.
[5] Assuming carbon capture systems are installed.

Parameters	New build coal-fired	Existing coal-fired	Nuclear	Onshore Wind	Solar PV (Utility scale)	Gas peaking	Karpowership[3]	Gas - Combined cycle gas turbine (CCGT)	Hydro
(Points/kWh)[6]	Economic Commission for Europe, 2021)	Economic Commission for Europe, 2021)	Commission for Europe, 2021)	Economic Commission for Europe, 2021)	Economic Commission for Europe, 2021)	Economic Commission for Europe, 2021)		Commission for Europe, 2021)	Economic Commission for Europe, 2021)
Human Toxicity (non-carcinogenic) (CTUh/TWh)[7]	123,5* (United Nations Economic Commission for Europe, 2021)	82,5* (United Nations Economic Commission for Europe, 2021)	5,3* (United Nations Economic Commission for Europe, 2021)	2,9* (United Nations Economic Commission for Europe, 2021)	11,45* (United Nations Economic Commission for Europe, 2021)	12,35* (United Nations Economic Commission for Europe, 2021)	Assumed to be similar to other gas-based generation technologies	12,35* (United Nations Economic Commission for Europe, 2021)	1,1* (United Nations Economic Commission for Europe, 2021)

[6] United Nations Economic Commission for Europe (UNECE) scores power plants based on its direct and indirect impact on land use, considering both the area occupied by the plant, and materials and fuel needed to supply the plant and assigning points accordingly. Thus, this considers not only the area of land used, but what type of land is being impacted (urban or agricultural), and as such reflects the overall land quality considering aspects of erosion resistance, mechanical filtration, physicochemical filtration, groundwater regeneration, and biotic production e.g., coal mining will have a higher score with high land occupation during the extraction phase (open pit or underground), and the use of timber braces in mines which impacts forestry.

[7] The UNECE considers the impact on human toxicity from power generation projects ranging from emissions during the extraction of construction materials to the emissions of waste after construction.

8.2.9.5 RMI4P Project Duration

Dispatchers have a minimum commitment of a 50% load factor in a year, with 95% of the price comprising of the electricity cost calculated at 100% load factor and at 75% load factor, the cost of grid connections, carbon taxes if applicable, operation and maintenance costs, variable costs, and fuel charge rates, with the remaining 5% accounting for the ancillary services (DMRE, 2021a). These two sets of requirements also provide the reasoning for the 20-year RMI4P contract; because dispatchers provide electricity at the request of Eskom and are not providing constant electricity, they have a higher risk in operating as they are remunerated based on their provision of electricity (DMRE, 2021a). Hence, the DMRE has stated that the 20-year contract will allow for dispatchers to service the costs of operating and establishing, as well as debt, equity, and other obligations, and without which the price would have been triple its current amounts (DMRE, 2021a). Thus, the RMI4P successful bidders operate in a fundamentally different paradigm to those of the REI4P, and are more comparable to battery storage, hydroelectric pump storage, renewable plants paired with battery storage, or the diesel-fired generators currently being used to address peaking demand in South Africa.

8.2.9.6 Key Findings

It has been acknowledged in the IRP2019 that gas to power technologies provide the flexibility required to complement renewable energy (National Department of Energy, 2019), when designed to operate flexibility contribute to optimising energy systems in response to demand patterns given the variable supply of renewable energy. In other words, gas power does not serve to replace renewable energy in the energy mix, but rather supports the further penetration of renewable energy.

While coal has been the main source of electricity generation both globally and in South Africa, there is an active and steady transition to alternative energy, including gas and renewables. This transition has been driven by the need to reduce greenhouse gas emissions to mitigate the climate crisis, and the improvement in cost efficiency of renewable energy relative to fossil fuel-based electricity generation. This transition has further been emphasised in the South African context, given the necessity of addressing the energy crisis and the persistent loadshedding. Loadshedding has had a significant impact on the South African economy, reducing economic growth and recovery post Covid-19 restriction, and limiting firms' ability to operate and forcing businesses to bear the burden of coping costs, increasing the cost of living to individuals, and negatively impacting on investor sentiment. The impacts of loadshedding are either direct or indirect and have a long-term implication. For instance, loadshedding affects business directly through increasing production costs and reducing their ability operate optimally. Indirectly these businesses competitiveness is negatively impacted due to lower sales and increased operational cost, or the need to incur coping cost. In the long term, the cumulative impact of loadshedding results in decreased international competitiveness, reduced demand for labour, and stifling of expansion of key industrial sectors. The impact of loadshedding has resulted in a reduction in economic growth (estimated at 3.1% in 2021) and decrease in employment (estimated at 400,000 jobs lost in 2021 alone) with the impact being more significant for SMMEs relative to larger firms, although mining and manufacturing companies have been hard hit too. For South African consumers loadshedding has resulted in interruptions to the service of medical support, interruptions to both private and working lives, including interrupted work, increased time spent planning for and finding alternate solutions during loadshedding.

Loadshedding has had a significantly negative impact on the South African economy which has resulted in the loss of jobs and a loss of potential jobs, and reduction in economic growth which has reduced the economy's ability to recover from the Covid-19 pandemic.

Finally, investor confidence in South Africa has been reduced, which has reduced the amount of both international and local investment into the South African economy, while loadshedding has had a negative impact on credit rating agencies outlook for South Africa. Given this significant impact of loadshedding on the South African economy, Eskom and the government has embarked on several measures in an attempt to remedy the energy crisis. Eskom has attempted to meet the shortfall in electricity supply with diesel-fired open cycle gas turbines which has proven to be an expensive solution, costing Eskom approximately R54bn since 2021. These measures, however, have failed to mitigate loadshedding as there have already been 100 days of loadshedding in 2022 by September 2022 (Bloomberg, 2022b). The government has attempted to address the shortfall in electricity supply by procuring power from IPPs under the REI4P, CI4P and RMI4P, the former of which has concluded four successful BWs and has seen significant cost declines for renewable generation technologies. BW-5 and 6, and the RMI4P will continue to add to balancing South Africa's energy mix, if these reach financial close. However, if Eskom's current maintenance issues persist, and the coal-fired plant decommissioning schedule is followed, it seems likely that loadshedding will continue until 2030.

Gas-based electricity production has an important role to play in the energy transition, as it provides a near term replacement for coal, with reduced GHG and particulate emissions, and able to provide similar baseload energy production, with the advantage of being highly effective in providing load following and peaking power output. This provides an important synergy with renewable energy, reducing the fluctuations in electricity availability, as energy storage technologies advance to the point where they can smooth out the variability in energy provision which wind and solar experience. In the interim however, Karpowership is able to provide dispatchable power within minutes of receiving a dispatch instruction and can do so at a cost less than Eskom's diesel-fired OCGT. Moreover, and should the need arise, Karpowership can provide stable baseload power while emitting almost half the GHG emissions of coal-fired power.

More importantly, the Karpowership fleet can be deployed immediately with the 12-month timeframe to commercial operation being contingent on the construction of the infrastructure required (i.e., transmission lines, gas pipes, mooring etc.). It is within this context that the RMI4P bids by Karpowership should be considered, along with the other interventions already discussed. The economic impacts of loadshedding are significant and need to be addressed urgently to minimise its impact on the economy and mitigate the risk to energy security in South Africa. It is therefore reasonable to conclude that an expansion in electricity generation through IPP purchase agreements, for both baseload and intermittent supply, is necessary in the short-term to address the energy crisis, which will facilitate improved economic growth and development in South Africa.

8.2.10 Importance of National & Provincial Collaboration and Private Partnerships

The planned economic recovery for the Country will be impossible in the absence of a reliable and adequate power supply to the economic sectors. Therefore, the success of one province impacts on the success of other provinces. The establishment of reliable power in one province has a domino effect on other provinces.

8.2.10.1 Provincial Development

Goal 4 of the 2030 Provincial Development Plan envisions vibrant, equitably enabled communities. In particular the universal access to social infrastructure. Within the PDP it is outlined that a potential constraint on economic potential within the Eastern Cape is the high municipal charges (electricity, water, rates) and deteriorating delivery quality.

Strategic action 1.1.6: Position the province as a key investment hub in the energy sector and ensure reliable energy supply to high-potential sectors

The Eastern Cape Province aims to draw in investment for the energy sector (wind farms, imported liquefied natural gas, shale-gas and nuclear energy). The proposed establishment of the Powerships and transmission lines directly supports this strategic action. It is hoped that the attraction of investment could be a great facilitator for economic development.

Strategic action 1.5.8: Grow and develop the ocean economy

The province envisions there to be growth within the port, maximising the Port's potential. The Powerships project will greatly support this initiative.

<u>Eastern Cape Strategic Plan 2020 – 2025</u>

The vision for the Eastern Cape Province is that "By 2030, the Eastern Cape will be an enterprising and connected province where all people reach their potential". The main focus is aligned to the 2030 Provincial Development Plan (PDP). Outcome 2 of the Strategic Plan 2020 - 2025 "An inclusive economy that grows sustainably, created decent jobs and is innovative." From the preceding sections that a sustained energy supply is a foundation for economic growth. The proposed Powership project supports this vision in enabling economic growth and job creation. Outcome 2 ties in with the United Nation's Sustainable Development Goals, South Africa's National Development Plan and the Eastern Cape's Provincial Development Plan all aim to halve poverty, end hunger and reduce inequality by 2030. Energy dependent

Karpowership SA (Pty) Ltd proposes to establish Powerships within the port of Ngqura, feeding energy into the South African national electricity grid. This is in line with the following plans developed for future planning of the area. As per the Eastern Cape Vision 2030 Provincial Development Plan, the 2030 Provincial Development Plan (PDP) outlines the vision for the Eastern Cape Province. The main focus is economic transformation and job creation, education, skills and health, reliable and quality basic services, spatial integration, human settlements and local government, safe communities, a capable as well as an ethical and developmental state. These priorities form the framework for Eastern Cape Socio Economic Consultative Council's (ECSECC) 5-year strategy. The Applicant will prioritise employment of local people wherever possible, as well as develop local skills to make it possible in cases where those skills do not exist in the local workforce

8.2.10.2 Port Planning

The future planning of the port is steering towards a multi-purpose port. The Port is also making provision for Liquid Natural Gas (LNG), which further establishes the Port as an energy hub (National Port Plan, 2019). Leading technological innovation is evident in the implementation of an Integrated Port Monitoring System (IMPS) and Automated Mooring System (AMS) that aim to enhance productivity, safety, and efficiency within the port (National Port Plan, 2019).

As per the National Port Plan (2019), the Port of Ngqura has been earmarked for further development, and the proposed development site is situated within the planned expansion area.

The project proposal has been assessed by PRDW in relation to the proposed Port Plans, and together with Karpowership is in ongoing engagement with TNPA to ensure that its project is aligned with Port planning and operational requirements. The position of the Powerships, FSRU and gas pipeline has approved by TNPA having jurisdiction of all Port activities and infrastructure being established.

8.2.10.3 Coega SEZ

The Coega Industrial Development Zone which was established in 1999 at the Nelson Mandela Bay Metropolitan Municipality (NMBM) in the Eastern Cape Province. It was designated as a Special Economic Zone (Coega SEZ) in terms of the Special Economic Zones Act 16 of 2014. The Coega IDZ, managed by the Coega Development Corporation (CDC) is adjacent to the deep water Port of Ngqura SEZ which was developed and is managed by the Transnet National Ports Authority (TNPA)

The Coega SEZ created opportunities through clusters that facilitate synergy and supply chain integration. Zone 8 Port Area and Zone 13 – Energy Cluster enable the location of the proposed project as per the lay-out and provisions of the Energy Cluster. It is anticipated that the proposed project can be accommodated within the Coega IDZ, Energy Cluster layout below.

There are several conservation planning tools that help with guiding proposed developments within the area as well as assessing their ecological sensitivity, each of these was considered and assessed. For example the Coega Open Space Management Plan provides guidelines for development within the Port of Ngqura as well as within the Coega Industrial Development Zone. The OSMP identifies sensitive ecological areas and areas of high biodiversity, ensuring that planning considers the ecological sensitivities. The proposed transmission alignment was re-aligned to ensure adherence to the Coega Open Space Management Plan.

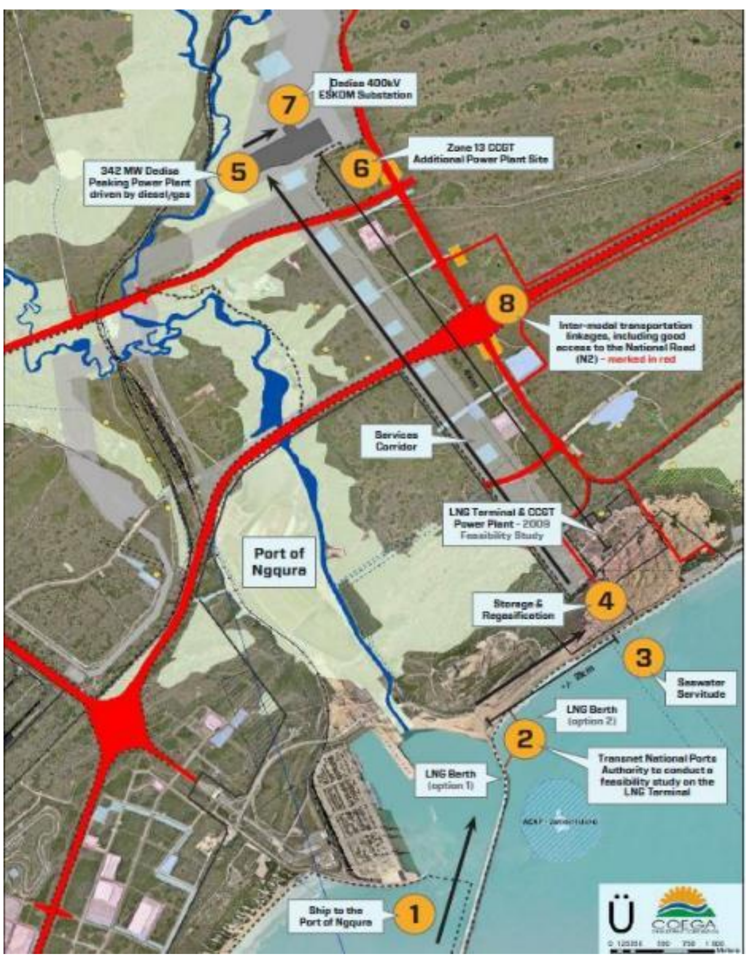

Figure 8-10: Port of Ngqura long-term layout (incl. the new SPM).

8.2.11 Municipal Planning

8.2.11.1 Nelson Mandela Bay Integrated Development Plan (IDP) – 2017/18 – 2021/22

As per the IDP, in possesses two ports, namely Port Elizabeth Harbour and Ngqura, the city has the advantage of creating a number of opportunities linked to the diversification of port activities, the maritime sector and the separation of 'dirty' and 'clean' port uses. The Ports are the Port of Port Elizabeth near the City Centre and the deep water Port of Ngqura in the Coega Special Economic Zone (SEZ) located 30 km north of the City Centre.

The Port of Ngqura, conceptualised in 1990, envisaged the Port to be a heavy industrial port which would allow the transformation of the Port of Port Elizabeth into a "clean" Port. The Coega Strategic Economic Zone, covering 110 km² of land situated adjacent to the Port of Ngqura, was purposed for heavy, medium and light industries presents opportunities for the growth of the City and the region. The Port of Ngqura is South Africa's newest port and the deepest container port in the country with various Transnet Business activities in Nelson Mandela Bay.

The IDP provided insights into the Ocean Economy and National Government's Operation Phakisa within the context of NMB. The potential priority growth areas identified included

- marine transport and manufacturing;
- offshore oil and gas exploration;
- aquaculture;
- marine protection services and ocean governance;
- small harbours work stream;
- coastal and marine tourism.

The IDP also included the proposed new 1,000MW liquefied natural gas (LNG) plant Gas-to-Power Programme, at the Coega Special Economic Zone.

Based on the afore-mentioned, the Karpowership project is proposed within the Port of Ngqura and the adjacent Coega SEZ and fit within the strategic planning as a similar activity.

8.2.11.2 Nelsion Mandela Bay Metropolitan Spatial Development Framework (MSDF), 2015

The NMBM MSDF notes that the Coega SEZ is a critical vehicle for the economic development of the NMBM. It notes that investment in the energy sector, with the purpose of feeding into the electrical grid is an important priority for the SEZ, and that these investments should focus on renewable energy, peaking power generation capacity, base load, and associated beneficiation opportunities. The MSDF also notes, that the Coega SEZ is well positioned to establish a Liquefied Natural Gas handling facility and associated power generation facilities.

8.3 NEED AND DESIRABILITY AS PER GUIDELINE

The principles outlined in the National Environmental Management Act 107 of 1998 (NEMA) must be applied to all decision-making that may affect the environment and its biodiversity. The first two principles in Section 2 of NEMA are that, "environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably" and "development must be socially, environmentally and economically sustainable".

8.3.1 Cumulative Impacts

This assessment of cumulative impacts has assessed the 200 MW Risk Mitigation Power Project in the Coega IDZ and the Proposed Coega 1000 MW Gas-to-Power Plant in terms of avifauna, wetlands, hydropedology, hydrology, geohydrology, climate change, estuaries, marine ecology, air quality, heritage, archaeology and palaeontology, major hazard risks, socio-economy, noise and marine traffic.

Many of the environmental specialist assessments considered these cumulative impacts when undertaking the impact assessments, and therefore they have already been accounted for. However, it is also worth noting that given that the project site is the active port of Ngqura which is also an industrial zone, in line with land use planning and zoning the project will be located in an appropriate site for the proposed activities. This is not to overlook the ecological importance of the site, and the impacts of the proposed project thereon. However, it must be noted that this is not a greenfields project, and that many of the impacts that will be associated with the project, such as light pollution, air pollution, underwater and terrestrial noise, and visual impacts should be carefully considered, as these will provide little cumulative impact to the existing industrial activities and port infrastructure.

The operation of the Powerships will result in cumulative GHG emissions from the LNG Carrier component and the addition to the potential polluting activities in the Algoa bay and Port will have High negative impacts on climate change and marine resources respectively. The cumulative impact of underwater noise and atmospheric emissions will have a Medium-High negative impact on avifauna. The cumulative loss of wetlands and the potential for fugitive emissions during the transfer of LNG will have Medium negative impacts on the wetlands and on climate change respectively. In contrast, the increase in economic activities as well as the increase in the GDP and production will have High positive impacts on the estuary and the socio-economy.

All negative cumulative impacts can be adequately managed, mitigated and reduced to lower significance ratings. This must also be consistently enforced on the 200 MW Risk Mitigation Power Project and the Coega 1000 MW Gas-to-Power Plant project. The cumulative positive impacts of these projects will have multi-fold social and economic benefits on both a local and national scale. The proposed development can proceed.

Given the integrative nature of sustainability, the requirement for and provision of reliable energy will cross cut various environmental, social and economic goals. Various specialist environmental studies were conducted to identify the potential environmental impacts of the proposed project on life below water, life on land and climate change in order to establish required mitigation in terms of alternatives and other mitigation measures. These studies were done integratively and assessed independently by the Sustainability Consultant. The findings were discussed in detail in Section 7. For completeness the following is repeated:

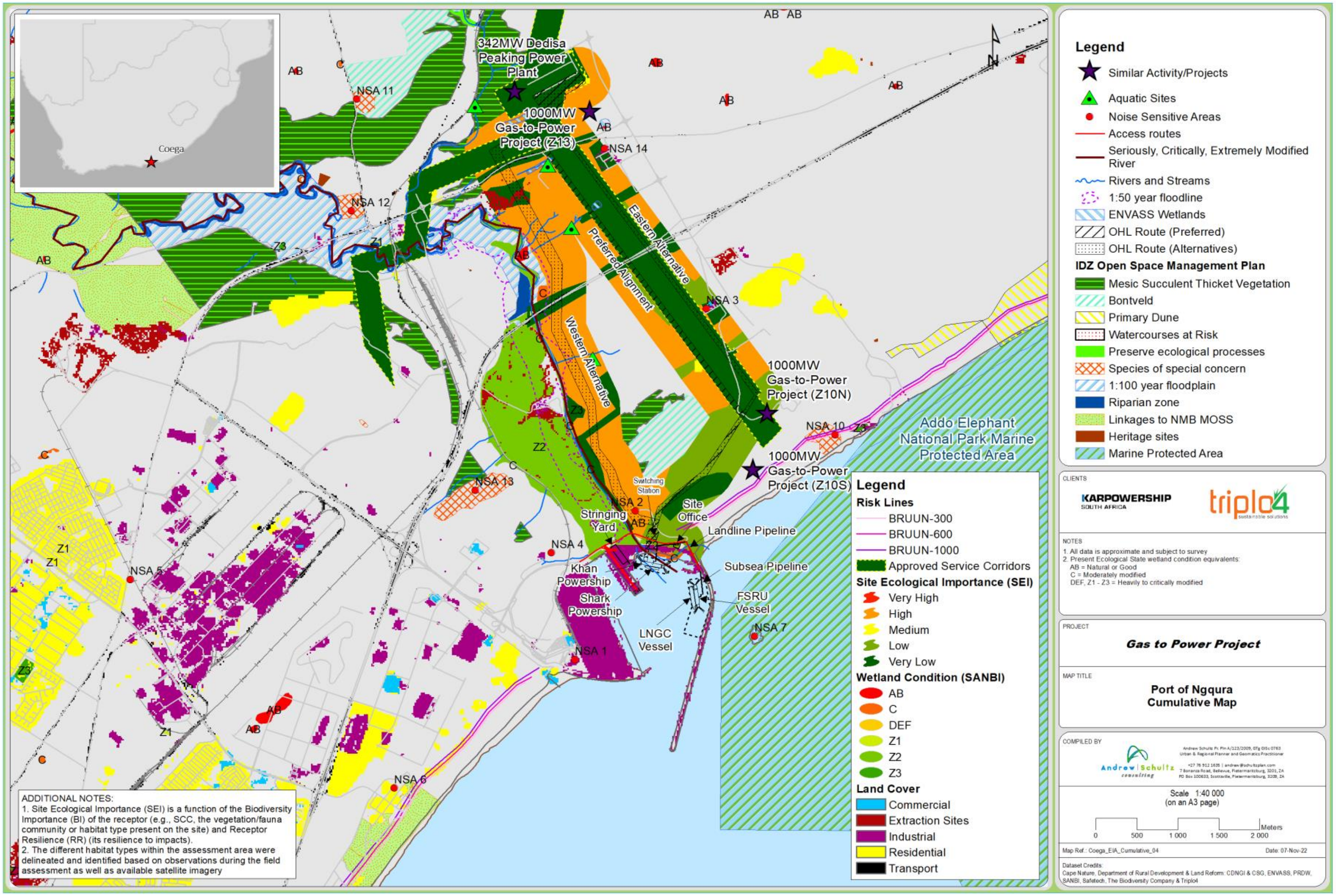

Figure 8-11: Port of Ngqura – Cumulative Map

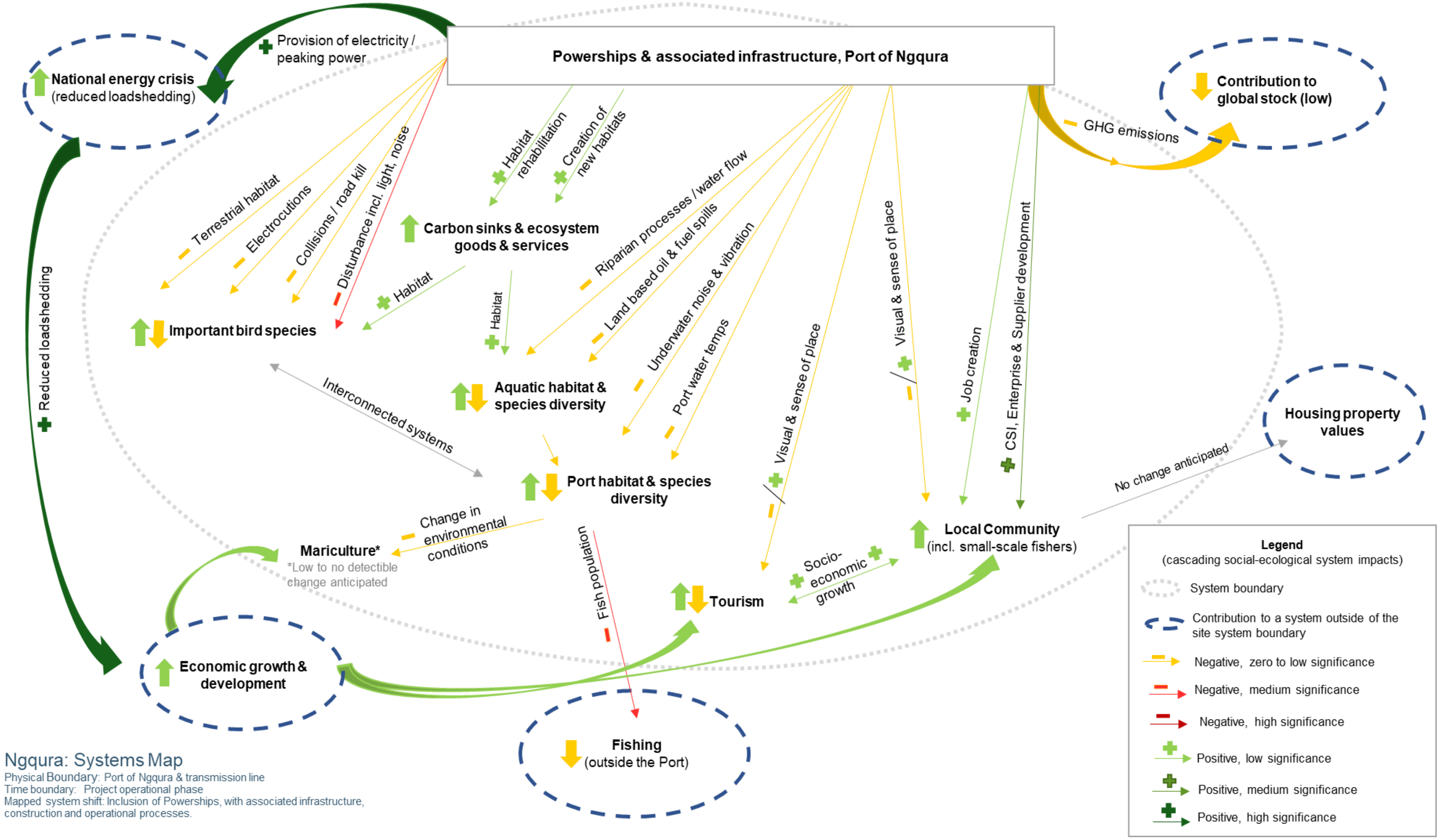

Figure 8-12: System map illustrating the anticipated shifts to the socio-ecology system following the inclusion of the powership and associated infrastructure in Port Nqgura

From the integrative, polycentric perspective adopted in conducting the EIA, the following key findings gathered from the matrices regarding identified impacts, and the systems map regarding anticipated system shifts, include:

- The key contribution that the proposed project will provide, is to reduce the burden of loadshedding on the country. There are several consequences of this, including opportunities for economic recovery and transition to the energy mix as proposed in the IRP 2019. Please see the Economic Impacts of Loadshedding discussion paper and the Socio-Economic Impact Assessment Supplementary report for further details.
- There is opportunity for the small-scale fishers and the rest of the community to benefit from corporate social investments, skills development, and supplier and enterprise development because of Karpowership SA's local content commitments (medium-low impact). In addition, there will be jobs created associated with the construction and operational phases of the project (low impact). Please see the Socio-Economic Impact Assessment Supplementary report and the Enterprise and Supplier Development report for further details.
- There is industrial and value chain development potential for the gas industry through increased economies of agglomeration. Please see the Economic Impacts of Loadshedding discussion paper and the Socio-Economic Impact Assessment Supplementary report for further details.
- Underwater noise and the thermal plume associated with the operations of the Powership, will affect marine life in the port. While low impacts are anticipated associated with the mariculture, it is anticipated that marine mammals may be negatively impacted as a consequence of the long duration of the project (anticipated high overall environmental significance impact rating). A key concern is the impact on juvenile fish who make use of the port as a nursery (medium impact). Consequently, this may negatively affect fish populations, which are already under strain because of overfishing.
- The terrestrial noise caused by the Powership during electricity generation, should not extend into residential areas and therefore is not anticipated to affect local communities.
- In the 12,5km x 4km project area of influence 200 bird species have been recorded, including 21 species of conservation concern, this includes a small colony (usually 4 pairs) of critically endangered Damara Tern (not expected to be impact). The Coega Saltpans can hold >5000 waterbirds of more than 40 species, including >2000 flamingos who are at risk of collisions with overhead transmission lines. Light and noise pollution are anticipated to have medium impacts, while physical disturbances are anticipated to have very low impact at construction and operational phase.
- Construction and maintenance of the gas pipeline, transmission line and switching stations is anticipated to result in a loss of important fauna and flora. Both mitigation recommendations and rehabilitation have been proposed to limit the impacts to very low overall environmental significance, with mitigation.
- Tourism is not anticipated to be negatively affected by the presence of the Powership, and associated infrastructure. This is largely because the Powership will be located in the port and will blend in with other ships and port infrastructure. The tourism sector may further benefit from peaked interest in the Powerships, yielding 'energy tourism'. This may further stimulate maritime recreational themed economic opportunities.
- Tropical cyclones are typically high impact low probability hazards and are generally quite difficult to manage due to their unpredictable nature. This has been considered in the design of the project and impacts are anticipated to be low and not to affect core operations. However, these storms can have detrimental impacts as an environmental disaster that will impact surrounding communities and ecosystems.
- Operation of the Powerships will contribute only marginally to the global GHG stock. Operation of the Powership cannot directly be tied to the experience of climate change impacts at this site, as this is a dynamic function of the global climate system and GHG stock.

- Major hazards were identified around fire risks associated with gas leaks - which was also found to be normal, and operation can continue with appropriate mitigation and emergency responses. This could also provide opportunity for skills development in the area relating to monitoring and evaluation as well as emergency risk response.
- It is not anticipated that ambient SO_2 and NO_2 particulate concentrations will exceed NAAQS, and therefore is not anticipated to impact on the local community.
- Underwater archaeology will not be affected if underwater archaeology mitigation measures are followed in the case of an archaeological find. It is however, not anticipated that there will be a find. However, an archaeologist should be on site during the construction phase.
- Riparian zones provide a range of ecological goods and services to communities, fortunately no impact is anticipated on any watercourse because of the Powership.
- No heritage and palaeontology impacts are anticipated.
- No significant findings were noted regarding impacts to geohydrology and hydropedology.
- There is potential for the Karpowership SA project to contribute positively to natural habitats through creation of habitats and rehabilitation, although marginal. This could include removal and management of alien invasive plant species; and mooring structures may provide hard structures for benthic communities to colonise. There is also further potential that may be identified through corporate social investment programmes.

The Sustainability Specialist, based on Specaialists' inputs, independently assessed the project's geographical, physical, biological, social, economic and cultural aspect of the environment through the application of three methods that assisted with synthesizing and conceptualizing technical information for decision making purposes. The following conclusion was reached: *"Given that the professionals who undertook the specialist studies have supported the granting of the environmental authorisation, with various requirements for mitigation and management, I support this project be granted the environmental authorisation, provided the necessary mitigation and management recommendations are upheld. The recommendations provided in this report offer further opportunity to reduce the negative impacts of this project on the environment and enhance the positive contributions and legacy that Karpowership SA can contribute to this community."*

8.3.2 Summarised Table for the Need and Desirability

Table 8-3: Summarised Table for Need and Desirability

Ref No:	Question	Response
1.	Securing ecological sustainable development and use of natural resource	
1.1.)	How were the ecological integrity considerations taken into account in terms of: Threatened Ecosystems,	Numerous independent specialists studies were commissioned in terms of terrestrial and marine environments: ▪ Wetland Delineation and Functionality ▪ Terrestrial Ecology ▪ Avifauna ▪ Heritage & Palaeontology ▪ Underwater Heritage ▪ Estuarine and Coastal ▪ Marine Ecology & Fisheries

Ref No:	Question	Response
	Sensitive and vulnerable ecosystems, Critical Biodiversity Areas, Ecological Support Systems, Conservation Targets, Ecological drivers of the ecosystem,	▪ Climate Change ▪ Project Sustainability ▪ Geohydrology ▪ Hydropedology ▪ Hydrology (incl. 1:100 Year Floodline) ▪ Aquatic ▪ Major Hazard Installation Risk ▪ Air Quality ▪ Socio-Economic, Tourism, Small-Scale Fishers & Energy ▪ Underwater & Terrestrial Noise ▪ Visual Impact ▪ Thermal Plume No fatal flaws were identified from the specialists and provided supportive conclusions. The specialists considered the status (sensitivity, vulnerability and threatened) of the ecosystems. The study area is located outside of any Threatened Ecosystems. Terrestrial: The transmission route was aligned to be outside of the Bontveld CBA area within the CDC property. The majority of the alignment is within an existing services servitude with existing environmental authorisation. Marine: The project site is situated outside Greater Addo Elephant National Park and the Bird Island Marine Protected Area (MPA) which includes Saint Croix and Jahleel Islands that are approximately 5km and 1km away respectively. The project is confined to the west of the breakwater and form part of the activities of the Port under TNPA jurisdiction. An independent project sustainability assessment was conducted that considered the individual ecological as well as integrated ecological, socio-economic aspects and impacts (positive and

Ref No:	Question	Response
	Environmental Management, Framework, Spatial Development Framework (SDF) and Global and international responsibilities	negative) to ensure the project was sustainable from an ecological perspective. Both the Port and CDC forms part of the Strategic Economic Zones as per the Environmental Management, Framework (EMF) Spatial Development Framework (SDF). The proposed development will reduce the pressure on other alternative to other fossil fuels and produces roughly half of the amount of CO2 per unit energy as coal. This scenario makes natural gas attractive as a potential 'bridge' or transitional fuel in the global shift toward renewable energy. South Africa is a signatory to various international treaties and each specialist considered the project and its potential impacts in terms of the international commitments, national and local requirements. Mitigations were provided to ensure negative impacts can be managed to acceptable levels and positive impacts can be optimised.
1.2.	How will this development disturb or enhance ecosystems and/or result in the loss or protection of biological diversity? What measures were explored to firstly avoid these negative impacts, and where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	The project avoided the CBA as well as marine protected areas and confined its activities to existing authorised services servitude and to the west of the breakwater and form part of the activities of the Port under TNPA jurisdiction. Modelling confirmed that the impacts to air emissions, ambient noise and underwater noise were low as were the overall potential impacts to hydrology, geohydrology, hydropedology. Mitigations were provided to reduce negative impacts as specified by the specialists incorporated into the EMPr (refer to Appendix 7). These included for e.g. the use of dynamic reflective bird flappers, preferably with lights that flash at night, on the most sensitive spans of the

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		transmission line significantly reduce the risk of collisions. The Applicant committed to formal agreements and collaboration with SANCCOB and SANPARK and EWT to not only assist with monitoring but also contribute to research and funding to conserve and promote biodiversity.
1.3.	How will this development pollute and/or degrade the biophysical environment? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	The use of natural gas avoid the SO2 and PM10 pollution associated with the generation of power utilsing coal or LPG. Discharge of biocides and chlorine will be avoided into the marine environment through the use of appropriate technology and closed-loop FSRU.
1.4.	What waste will be generated by this development? What measures were explored to firstly avoid waste, and where waste could not be avoided altogether, what measures were explored to minimise, reuse and/or recycle the waste? What measures have been explored to safely treat and/or dispose of unavoidable waste?	Being operational within the Port, all TNPA and MARPOL requirements will be relevant and complied with to prevent marine pollution. Hull cleaning will also be conducted in accordance with the Port's authorisations and requirements. All effluent and solid waste will be removed from the ships and treated and disposed of in terms of the applicable legislation by authorised service providers. In terms of energy waste, Powerships operate with a lean waste philosophy. Every type of energy generated from the fuel is used in a specific way to reduce waste energy. While engines burn fuel, heat is ejected from the engines via exhaust gasses. In order to utilise this waste heat, Powerships use Exhaust Gas Boiler Equipment to convert waste heat to superheated steam which is redirected to the Steam Turbine Generators to generate electricity.
1.5.	How will this development disturb or enhance landscapes and/or sites that constitute the nation's cultural heritage? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts?	All activities will be located within a busy commercial Port and the surrounding SEZ industrial area. The proposed ships and the power line alternatives were assessed to have landscape

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	What measures were explored to enhance positive impact?	impacts commensurate with existing land uses and landscape character. The transmission alternatives have the low visual impact as per the Visual Impact Assessment Specialist conclusion.
1.6.	How will this development use and/or impact on non-renewable natural resources? What measures were explored to ensure responsible and equitable use of the resources? How have the consequences of the depletion of the non-renewable natural resources been considered? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	The Powerships are located within the Port (marine environment). Therefore, the use of freshwater resources that is generally constrained in a water scarce country with frequent water restrictions, will unlike land-based Power Plants, be avoided. The natural gas will be sourced from Shell SA with relevant licenses and permissions for the supplier's full supply/value chain. The Applicant has also indicated that they have received assurances from the LNG supplier that the natural gas will not be sourced from fracking. Natural gas usage is optimised through the use of steam turbine generators. The control room of the Powership monitors an extensive range of parameters to ensure the efficient generation of power from natural gas.
1.7.	How will this development use and/or impact on renewable natural resources and the ecosystem of which they are part? Will the use of the resources and/or impact on the ecosystem jeopardise the integrity of the resource and/or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds? What measures were explored to firstly avoid the use of resources, or if avoidance is not possible, to minimise the use of resources? What measures were taken to ensure responsible and equitable use of the resources? What measures were explored to enhance positive impact?	Karpowership SA through its Economic Development contributions and Economic Development Plan (EDP) will support the development of renewable energy projects and Blue Oceans Economy.
1.7.1.	Does the proposed project exacerbate the increased dependency on increased use of resources to maintain economic growth or does	The Department of Mineral Resources and Energy launched the Risk Mitigation Independent Power producers Programme (RMIPPPP) in August 2020 to procure 2 000 MW of new

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	it reduce resource dependency (i.e. de-materialised growth)?	generation from a range of energy technologies. The objective being to fill the short-term supply gap, alleviate the current electricity supply constraints and reduce the extensive use of diesel-based peaking generators.
1.7.2.	Does the proposed use of natural resources constitute the best use thereof? Is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used (i.e. what are the opportunity costs of using these resources this the proposed development alternative?	The Poweships will provide dispatchable power to the national grid in response to the ESKOM's requirements to reduce load shedding and the significant economic impacts to country.
1.7.3.	Do the proposed location, type and scale of development promote a reduced dependency on resources?	The concept of generating power on the sea has several benefits over land-based power plants, including small footprint (e.g. the same amount of output can be achieved in a much smaller area compared to land based power plants), significantly shorter timeframes for project delivery / adding capacity, as the Powerships arrive already assembled and ready-to-operate, and land-based impacts are limited and of short term, associated with the establishment of the transmission line and the temporary assembly area for the gas pipeline.
1.8.	How were a risk-averse and cautious approach applied in terms of ecological impacts?	
1.8.1.	What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	Numerous independent specialists' studies were commissioned in terms of terrestrial and marine environments comprising of consultation of databases (e.g. SANBI), conducting of site visits and modelling of data. South African as well international standards, specialist experience and site-specific knowledge contributed to informed decisions.
1.8.2.	What is the level of risk associated with the limits of current knowledge?	The level of risk is considered low.
1.8.3.	Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	
1.9.	How will the ecological impacts resulting from this development impact on people's environmental right in terms following?	

Ref No:	Question	Response
1.9.1.	Negative impacts: e.g. access to resources, opportunity costs, loss of amenity (e.g. open space), air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts	As per the independent specialist studies and sustainability report, the negative impacts on environmental rights from an ecological perspective is by large low. This is as a result of the type of technology and location of the project as well as the avoidance measures implemented in terms of this Project. Climate change will have a low positive impact on the Project. The CCIA (Climate Change Impact Assessment) considered the impact of the project on the environment and reduced use of diesel generators, paraffin and natural wood combined with plastic which is burned due to load shedding. Natural gas has an emission factor that is much lower than coal and diesel resulting in less emissions during operation.
1.9.2.	Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts	As a result of the type of technology and location of the project as well as the avoidance measures implemented in terms of this Project, the following positive impacts: ▪ Improved air quality as coal, LPG, diesel generators, paraffin and natural wood will not be burned to generate energy; ▪ No discharge of biocides and chlorine into the marine environment and water temperature will be within acceptable limits; ▪ No freshwater will be extracted and therefore no competing use in terms of the ecological reserve and no impact will occur during times of drought. ▪ Limited impacts to terrestrial ecology due to sea-based Powership concept.
1.10.	Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socio- economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	The linkages and dependencies were accessed in an integrated manner by all specialists. As per the Project Sustainability Report, Under the Constitution, the right to access to electricity flows from the constitutional and statutory obligations of Eskom, South Africa's power utility, to provide reliable electricity supply and to ensure just administrative action when taking actions that result in the deprivation of electricity. From a Bill of Rights perspective, the cases show that the

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		right to electricity, albeit not expressed in the text of the Constitution, is a condition for the exercise of other rights, including the rights to human dignity and access to adequate housing, water, and health care. The positioning of the Powership in the Port and the associated transmission route via the CDC services servitude will ensure the availability of dispatchable power via the ESKOM substation in an equitable manner.
1.11.	Based on all of the above, how will this development positively or negatively impact on ecological integrity objectives/ targets/ considerations of the area?	It is the Specialist's opinions that the Project will not impact negatively on ecological integrity objectives of the area. This Project will positively impact through collaborative partnerships to further conservation and research related to improved ecosytems.
1.12.	Considering the need to secure ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the "best practicable environmental option" in terms of ecological considerations?	The preferred alternative considers adequate navigational routes, sufficient water depth making, available grid capacity to accommodate the project and utilsing existing infrastructure where possible and uses the least ecologically sensitive transmission route from the Powership to the Dedisa substation. Please refer Section 3 – Alternatives and 8.3 Need and Desirability of the Activity in the Context of the Preferred Development Footprint.
1.13.	Describe the positive and negative cumulative ecological/biophysical impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and existing and other planned developments in the area?	Negative cumulative impacts of the development are largely Low/Moderate and the same as the direct impacts due to the locality of the project and the impacts being confined to the area. This Project has been located in the Port and SEZ which has been earmarked for energy and gas development.
2.	Promoting justifiable economic and social development	
2.1.	What is the socio-economic context of the area, based on, amongst other considerations, the following considerations	
2.1.1.	The IDP (and its sector plans' vision, objectives, strategies, indicators and targets) and any other	Nelson Mandela Bay Integrated Development Plan (IDP), 2020

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	strategic plans, frameworks of policies applicable to the area	The NMBM IDP sets out a range of sectoral priorities linked to the municipality's respective directorates, one of which is electricity and energy. In terms of its mandate as articulated in the IDP, the NMBM seeks to provide a safe, reliable, environmentally friendly, sustainable, and cost-effective electricity supply to electricity users in the municipality. Pursuant to this, the NMBM is classified as an energy distribution utility and holds a NERSA licence to distribute and trade in energy to end consumers within the defined licenced area. According to the NMBM IDP, the amendments to the Electricity Regulations Act (No. 4 of 2006) make it possible for the municipality to procure electricity directly for Independent Power Producers (IPP's). The IDP, however acknowledges that this needs to be carefully considered and possible utilised to develop the renewable energy economy in the city. The IDP also proposes the development of an Energy Mix Master Plan that will enable to the NMBM to curb its use of fossil fuels as well as reduce its reliance on the Eskom grid. This plan should consider alternative energy sources and the spin-offs will result in decreased cost of energy to consumers. The propose Powerships and its related infrastructure would thus closely align to these objectives, particularly were the managing entity sell directly to the NMBM. Nelson Mandela Bay Municipality Integrated Development Plan (IDP) (1st Edition Draft), 2022/23 to 2026/27. The Nelson Mandela Bay Municipality Integrated Development Plan (IDP) cites one of the economic challenges as an unstable electricity grid dominated by coal powered energy. The proposed Powership project aligns to the Nelson Mandela Bay Municipality's Electricity and Energy Directorate mandate of environmentally friendly, sustainable and cost effective electricity supply to the national grid.

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		The proposed project is proposed within the Strategic Environmental Zone of the Port and immediately adjacent Special Economic Zone at Coega. Furthermore, in line with the planned expansions on the Port (as per the National Ports Plan, 2019), the port expansion is also captured in the Nelson Mandela Bay Metro Municipality: IDP (2017/18-2021/22) and the Metropolitan Spatial Development Framework (dated 2009).
2.1.2.	Spatial priorities and desired spatial patterns (e.g. need for integrated of segregated communities, need to upgrade informal settlements, need for densification, etc.)	Land is an asset, often with multiple environmental considerations and possible beneficial uses, from agriculture to industry, tourism to nature reserve and so on. There is also the added dimension of history and sensitivity around land use, ownership, and land claims/reparations in South Africa. One Khan Class Powership, capable of delivering up to 450MW of dispatchable power reliably and consistently, has a footprint of circa 15,000m2. It is important to keep in mind however that this footprint is based in the sea, with minimal use of land for minor connection infrastructure. To generate a similar scale of power from a land-based gas to power plant, the footprint would be approximately four times larger. This Project being linked to socio economic development and energy security, therefore supportive of spatial developments.
2.1.3.	Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.), and	<u>Nelson Mandela Bay Metropolitan Spatial Development Framework (MSDF), 2015</u> The NMBM MSDF notes that the Coega SEZ is a critical vehicle for the economic development of the NMBM. It notes that investment in the energy sector, with the purpose of feeding into the electrical grid is an important priority for the SEZ, and that these investments should focus on renewable energy, peaking power generation capacity, base load, and associated beneficiation opportunities. The MSDF also notes, that the

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		Coega SEZ is well positioned to establish a Liquefied Natural Gas handling facility and associated power generation facilities. The proposed development of infrastructure for the provision of electricity is in line with the permitted uses within the Harbour land use. The ports of South Africa are hubs of the economy, maintaining crucial connection between sea and land transport as well as imports and exports. Ports are closely associated with the IDZs/ Special Economic Zones (SEZ) in terms of the Special Economic Zones Act 16 of 2014, so called as they are specifically designed to allow for related industries to be based in an Industrial Zone. Transnet has been actively involved over an extended period of time with the identification of gas to energy options to be established within the Ports e.g. “Transnet preparations for gas infrastructure in South Africa” as part of the South Africa Gas Options Conference held on September 2015 in Cape Town. The future planning of the port is steering towards a multi-purpose port. The Port is also making provision for Liquid Natural Gas (LNG), which further establishes the Port as an energy hub (National Port Plan, 2019). Leading technological innovation is evident in the implementation of an Integrated Port Monitoring System (IMPS) and Automated Mooring System (AMS) that aim to enhance productivity, safety, and efficiency within the port (National Port Plan, 2019).
2.1.4.	Municipal Economic Development Strategy (“LED Strategy”).	The Eastern Cape PEDS seeks to create a clear, long-term vision and strategy for the growth and development of the Eastern Cape by building on the strength and opportunities of the province, while at the same time addressing its weaknesses and threats. The gas industry finds expression in two of these high potential economic sectors – Ocean economy and

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		Sustainable Energy. In terms of the ocean economy, the document notes the need to establish a provincial oil and gas working group to support the development of the industry and the establishment of a 100 MW LNG gas power station at Coega.
2.2.	Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area?	Karpowership is committed to supporting Local Economic Transformation processes and as such, once the project has achieved Financial Close (FC), it will finalise our local jobs and local procurement procedures. Currently, the project is still being finalised and all Local Economic commitments such as jobs and procurement will need to be approved by the Independent Power Producers Office (IPPPO) of the South African Department of Minerals Resources and Energy (DMRE). A comprehensive and transparent Community and Stakeholder Engagement process will be implemented once the project is confirmed. This will include engagements via local media such as the local newspaper, local radio stations and through whatever local communication channels exist. All businesses will have the opportunity to apply for tenders, provided that they meet the necessary criteria and all persons will have the opportunity to apply for jobs provided they have the necessary skill. Skills development and transfer will also take place, however the implementation time-frame of this is yet to be confirmed. The same applies to enterprise and supplier development opportunities. Karpowership projects create significant direct and indirect employment, driving knowledge and skills transfer across a broad spectrum of disciplines including some that are unique to floating power plants. Karpowership also emphasizes youth development as the future of our business, industry, and the local economy. As a globally recognized leader with 260 000+ direct employees , 10000 + indirect employees they
2.2.1.	Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	
2.3.	How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?	
2.4.	Will the development result in equitable (intra- and inter-generational) impact distribution, in the short-and long-term? Will the impact be socially and economically sustainable in the short- and long-term?	

Ref No:	Question	Response
		provide an opportunity for South Africans, which will make up the majority of their personnel, to develop specific skills and knowhow which will ultimately benefit the South African economy. They will also be provided with the opportunity to become part of an internationally diverse team, gaining and sharing experience and knowledge either locally or worldwide alongside industry leading colleagues. There will be a significant number of local employees for both the construction (excluding vessels) operation period which will exceed the Economic Development criteria that must be met in terms of the RMIPPPP. They also believe that the job creation, including within the power generation function, will be comparatively more than a renewable energy project should the project be selected to proceed. Considering all the above, Karpowership SA has committed to invest at least R18 billion directly into local economies. This R18 billion investment includes contributions to skills transfer and socio economic, local supplier, SME and women empowered enterprise development. Aside from the above positive effects, the project will contribute to skills development in the country, increase government revenue, as well as raising household earnings by R115.9 million. The increase in household earnings is also likely to improve the standards of living of the affected households albeit temporarily. In addition, government revenue will rise, electricity supply will be increased, and various socio-economic and enterprise development initiatives will be undertaken from the revenue generated by the development. These funds will be allocated towards socio-economic development in the area and are expected to bring a significant benefit to local communities.

Ref No:	Question	Response
		The assessment of the Powerships and their associated infrastructure, or its net effect from a socio-economic perspective, indicates that the development would generate greater socio-economic benefits during both the construction and operational phases than the potential losses that could occur as a result of their establishment. Refer to the Appendix 9 – D1 SEIA, Nov 2022 – ED Plan.
2.5.	In terms of location, describe how the placement of the proposed development will	
2.5.1.	result in the creation of residential and employment opportunities in close proximity to or integrated with each other	The development will create employment opportunities during the construction and operational phase, and will provide employment opportunities to the local communities. The Port of Nqgura has direct access to the N2 via Neptune Road. The route does not pass any sensitive land uses, hence there is no traffic or social impacts.
2.5.2.	reduce the need for transport of people and goods	During the operational phase will reside on the ship and will not require the transportation of people. The LNG will be delivered via an LNG Carrier and due to the volumes via ship and will be only acquired once in every 20-30 days – contributing approx. 1% in marine traffic.
2.5.3.	result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms of public transport)	
2.5.4.	compliment other uses in the area,	Compliment port activities and provision of electricity into the national grid, support socio-economic activities
2.5.5.	be in line with the planning for the area	The proposed development of the site is in line with the Municipality's Spatial Development Framework, the CDC services infrastructure and Port's Plans
2.5.6.	for urban related development, make use of underutilised land available with the urban edge,	This project has limited usage of land and this positive aspect of the project as land within the CDC and urban edge is retained for development and future port planning can be supported in terms of the technology employed.
2.5.7.	optimise the use of existing resources and infrastructure,	Existing infrastructure from the Port and ESKOM is utlised together with existing services servitude for the evacuation of power such as the

Ref No:	Question	Response
		breakwater and disturbed areas have been selected for use as far as possible
2.5.8.	opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g. not aligned with the bulk infrastructure planning for the settlement that reflects the spatial reconstruction priorities of the settlement),	No bulk services will be required or constructed as part of the development.
2.5.9.	discourage "urban sprawl" and contribute to compaction/densification,	The location within the CDC and Port ensures optimum development with the SEZ.
2.5.10.	contribute to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of current needs,	
2.5.11.	encourage environmentally sustainable land development practices and processes,	
2.5.12.	take into account special locational factors that might favour the specific location (e.g. the location of a strategic mineral resource, access to the port, access to rail, etc.),	The Project ensures the optimum location within the Port providing for efficient delivery of LNG via LNG Carrier and secure evacuation of power via the CDC services servitude to the existing Dedisa substation.
2.5.13.	the investment in the settlement or area in question will generate the highest socio-economic returns (i.e. an area with high economic potential),	Positive socio-economic impacts in the form of employment creation and the indirect benefits of economic growth are anticipated in the construction and operational phases. Refer to the Appendix 9 – D1 SEIA, Nov 2022 – ED Plan.
2.5.14.	impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area, and	The proposed development has been assessed and will not impact significantly on any heritage resources and the visual assessment has deemed the impacts of low significance.
2.5.15.	in terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?	The nature, scale and location of the development does not directly create a more integrated settlement, but rather consider natural gas attractive as a potential ‘bridge’ or transitional fuel in the global shift toward renewable energy. Considering gas as a transitionary fuel on our path to decarbonisation of the South Africa’s economy.
2.6.	How were a risk-averse and cautious approach applied in terms of socio-economic impacts?	

Ref No:	Question	Response
2.6.1.	What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated	Numerous independent specialists' studies were commissioned in terms of ecological as well socio-economic environments. These include local (micro) aspects as per IDP, TNPA and CDC plans, small-scale fishers, tourism and macro aspects on e.g tourism and the economic aspects of load shedding and social economic considerations of LNG and renewables. The extent of these studies and these conclusions enabled informed decisions on the need and desirability of the project
2.6.2.	What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge?	This Project as a risk mitigation project is to redress the unacceptable level of risk experienced by all citizens as a result energy crisis and extensive levels of load shedding. It is especially the poor that is vulnerable as they do not have the financial resources to provide alternatives in the form of generators and solar to provide for livelihood and wellbeing. The potential impact on small scale fishers and tourism as well as heritage and visual impacts were thoroughly investigated by various specialists together with ecological aspects (integrative) and all risks were deemed acceptable. The benefits of project clearly demonstrated the overall risk reduction to the vulnerable and society at large.
2.6.3.	Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	The cautious approach include collaborative partnerships, participation in TNPA and CDC forums with monitoring and reporting in accordance with the EMPr and landowner requirements.
2.7.	How will the socio-economic impacts resulting from this development impact on people's environmental right in terms following:	
2.7.1.	Negative impacts: e.g. health (e.g. HIV-Aids), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	The Powership is designed to use Natural Gas, a cleaner burning fuel for the generation of power, as opposed to coal or diesel-fired power generation. The Project is situated within the Port and CDC with secured access and high safety measures.

Ref No:	Question	Response
		The EMPr specifies conditions for social impacts typically associated with construction, power generation projects.
2.7.2.	Positive impacts. What measures were taken to enhance positive impacts?	Providing dispatchable power at scale into the South African grid. Transporting gas into the country which has been accepted by developed nations as a transitional fuel to provide dispatchable, reliable grid connected generation capacity, as it has a lower greenhouse gas impact than coal, diesel and other similar alternatives. The alleviation load shedding by providing readily available and on-demand produced power will benefit the entire country. Operational phase and establish contracts with suppliers to provide sustainable supplies, ensuring continued employment. Tourism opportunities may be created as per the concept of industrial tourism where people may be attracted to visit the area in order to view this unique technology, similar too people visiting the harbours to view ships and harbor activities. The indirect impact on tourism of alleviating load shedding is positive, as tourism requires reliable energy and tourists with money to spend. Establish contracts with competent companies during the construction phase to maximize local employment. The following SED projects have been identified as priority areas within the NMBMM, and will be the first SED Projects to be rolled out:- ▪ Primary and secondary school focus on building educator and learner capacity in (Science, Technology, Engineering and Math) STEM; ▪ Scholarships/Bursary Programme

Ref No:	Question	Response
		▪ Installation of Energy Efficient systems ▪ Environmental sustainability ▪ Support to Vulnerable Communities; and ▪ Sports and Recreation Consideration for this projected Provincial spend will be in line with the sustainability of enterprises which have been established or developed within the Local Beneficiary Communities. For example, where a business has received beneficiation and now needs to expand its distribution chain or improve its supply chain from outside of the immediate communities. The strategy has further been defined to include the following focus areas: ▪ Vendor Kiosks for SMME's; ▪ Tourism and Hospitality ▪ Youth Enterprise Development; and ▪ Enterprise Development short term funding Refer to the Appendix 9 – D1 SEIA, Nov 2022 – ED Plan.
2.8.	Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socio-economic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	Given the tech and location within the Port and CDC, is it not anticipated, socio economic aspects will result in ecological impacts The ED plan may look at capacitating the small scale fishers which may encourage fishing in excess of available quotas and increased small craft in the area may impact on local fauna. Awareness of legal and local requirements will form part the ED Plan. Refer to the Appendix 9 – D1 SEIA, Nov 2022 – ED Plan.
2.9.	What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?	In terms of the Powership positioning, it allows for normal port activities that support social requirements and the economy that support the intent of SEZ. Similarly the evacuation route was selected within the existing authorised services servitude and

Ref No:	Question	Response
		outside the Bontveld, allowing optimizing of future development within the CDC.
2.10.	What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)? Considering the need for social equity and justice, do the alternatives identified, allow the "best practicable environmental option" to be selected, or is there a need for other alternatives to be considered	The positioning of the Powership in the Port and the associated transmission route via the CDC services servitude will ensure the availability of dispatchable power via the ESKOM substation in an equitable manner. As per the various specialist studies, there is no unfair discrimination against any person or vulnerable and disadvantaged persons. This project will particularly benefit the vulnerable and disadvantaged communities that does not have the financial means to provide generators with fuel or solar solutions to minimise the effects of frequent load shedding. In addition, work opportunities will be provided to the immediate communities for e.g. Motherwell, Wells Estate, Bluewater Bay & St Georges Strand etc. as per the ED plan benefits will also accrue to these local communities.
2.11.	What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination	The power will be evacuated to ESKOM which will be equitable be distributed to the South African citizens and businesses. Please refer to the ED Plan that will provide access to resources and improved services.
2.12.	What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the development has been addressed throughout the development's life cycle	Specialist studies considered health and safety. This included the Air Emissions Impact Report as well as Major Hazardous Installation. These reports show the impacts to be of low significance. In addition, being situated within the Port and CDC, the relevant TNPA, CDC and SAMSA requirements will be adhered to.
2.13.	What measures were taken to:	
2.13.1.	ensure the participation of all interested and affected parties,	Refer to Section 5 of this report, describing the enhanced public participation process undertaken for the proposed project which complies with the NEMA, EIA Regulations 2014 as (as amended) and DEA (2017), Guideline on

Ref No:	Question	Response
		Need and Desirability, Department of Environmental Affairs.
2.13.2.	provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation,	Refer to Section 5 of this report, describing the public participation process undertaken for the proposed project. The BID, advertisements, knock and drop flyers, radio announcements, notification letter and site notices have been made available in English, Afrikaans, isiXhosa and Sesotho to assist in understanding of the project. In addition the EIA report executive summary will be made available in all four of these languages. Further public consultation will be held during the review period of the EIA report for the project. Capacity building included the development of a flyer as well as specific stakeholder workshops inclusive of the small-scale fishers. In addition, the Applicant distributed a booklet containing the company and project information.
2.13.3.	ensure participation by vulnerable and disadvantaged persons,	
2.13.4.	promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means	
2.13.5.	ensure openness and transparency, and access to information in terms of the process	
2.13.6.	ensure that the interests, needs and values of all interested and affected parties were taken into account, and that adequate recognition were given to all forms of knowledge, including traditional and ordinary knowledge	
2.13.7.	ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein were be promoted	Capacity building, which forms part of the public participation process, is seen as an ongoing, multi-pronged approach to improve the abilities and skill of marginalised, vulnerable and previously disadvantaged groups to understand the proposed project. By utilising capacity building and participatory techniques, marginalised, vulnerable and previously disadvantaged groups are better equipped to meaningfully contribute to engagements and the wider public participation process. Capacity building therefore is an approach to PP which seeks to involve communities and people who do not have access to resources or have not been afforded the opportunity to higher levels of education. Steps were taken to take information to the I&APs personally via door-to-door distribution and in-person discussions and at a level more understandable for the relevant I&AP. This is done with the goal of promoting equitable and effective participation across different sectors and communities in society. KSA undertook

Ref No:	Question	Response
		various steps in addition to the formal PP arranged by the EAP, in order to commence fostering relationships with I&APs and to further add to the steps with capacity building: The Applicant appointed two community liaison officers (CLO's), one being a woman, from the local communities in order to facilitate engagement and further build capacity within the community. Distributions of information leaflets and booklets were also completed. As per the Socio, ED and EMPr "woman in youth" were identified / recognized and employment and capacity building promoted.
2.14.	Considering the interests, needs and values of all the interested and affected parties, describe how the development will allow for opportunities for all the segments of the community (e.g.. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)?	The nature of this project is to combat the debilitating effects of load shedding from all segments of society and sectors (e.g. business, tourism, entertainment, households). It is especially the marginalized and disadvantage that will benefit as the option of alternative energy is not financially feasible.
2.15.	What measures have been taken to ensure that current and/or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work, and what measures have been taken to ensure that the right of workers to refuse such work will be respected and protected	The EMPr included compliance with applicable legislation such as Occupational Health and Safety Act as well as environmental awareness and monitoring.
2.16.	Describe how the development will impact on job creation in terms of, amongst other aspects	The proposed project will have a positive impact on job creation during the construction and operational phases. In addition, indirect job creation will be created as result of the implementation of the ED plan and support to local suppliers. Refer to the Appendix 9 – D1 SEIA, Nov 2022 – ED Plan.

Ref No:	Question	Response
2.16.1.	the number of temporary versus permanent jobs that will be created,	Karpowership projects create significant direct and indirect employment, driving knowledge and skills transfer across a broad spectrum of disciplines including some that are unique to floating power plants. Karpowership also emphasizes youth development as the future of our business, industry, and the local economy. As a globally recognized leader with 260 000+ direct employees , 10000 + indirect employees they provide an opportunity for South Africans, which will make up the majority of their personnel, to develop specific skills and knowhow which will ultimately benefit the South African economy. They will also be provided with the opportunity to become part of an internationally diverse team, gaining and sharing experience and knowledge either locally or worldwide alongside industry leading colleagues. There will be a significant number of local employees for both the construction (excluding vessels) operation period which will exceed the Economic Development criteria that must be met in terms of the RMIPPPP. They also believe that the job creation, including within the power generation function, will be comparatively more than a renewable energy project should the project be selected to proceed. Considering all the above, Karpowership SA has committed to invest at least R18 billion directly into local economies. This R18 billion investment includes contributions to skills transfer and socio economic, local supplier, SME and women empowered enterprise development. Aside from the above positive effects, the project will contribute to skills development in the country, increase government revenue, as well as raising household earnings by R115.9 million. The increase in household earnings is also likely to improve the standards of living of the affected households albeit temporarily.
2.16.2.	whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area),	
2.16.3.	the distance from where labourers will have to travel	
2.16.4.	the location of jobs opportunities versus the location of impacts (i.e. equitable distribution of costs and benefits), and	
2.16.5.	the opportunity costs in terms of job creation (e.g. a mine might create 100 jobs, but impact on 1000 agricultural jobs, etc.).	

Ref No:	Question	Response
		Refer to the Appendix 9 – D1 SEIA, Nov 2022 – ED Plan.
2.17.	What measures were taken to ensure:	
2.17.1.	that there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment, and	The EIA Process requires governmental departments to communicate regarding any application. In addition, all relevant departments are notified at various phases of the project by the EAP. The CDC convenes the ELC meeting on quarterly basis and presentations will be made and discussions will be undertaken regarding the project planned for the 17 November 2022.
2.17.2.	that actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures?	
2.18.	What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage	The EIA process, including the public participation that is an integral and ongoing part of an EIA, is a means of managing potential impacts on environmental resources and determining whether the proposed use of resources is in the public interest. Furthermore, the project is that of the Risk Mitigation Independent Power Producer Procurement Programme (RMIPPPP), as a complement of the country's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) to generate electricity and ensure dispatchable energy (reliability) to the national grid. This will ensure the citizens right to electricity, as per the Bill of Rights perspective, the cases show that the right to electricity, albeit not expressed in the text of the Constitution, is a condition for the exercise of other rights, including the rights to human dignity and access to adequate housing, water, and health care.
2.19.	Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?	
2.20.	What measures were taken to ensure that he costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects will be paid for by those responsible for harming the environment?	The applicant will be responsible for the rehabilitation of laydown areas and implementation as well as compliance with any authorisations which would take into account the appropriate mitigation measures included in the EMPr as assessed and recommended by the specialists and EAP.

Ref No:	Question	Response
2.21.	Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the best practicable environmental option in terms of socio-economic considerations	The preferred transmission alternative is located within the CDC existing, authorised services servitude and exclude development within the Bontveld. The proposed Powership and FSRU position allows for existing and future Port activities and the technology prevents discharge of pollutions to the marine environment. The Powership is designed to use Natural Gas, a cleaner burning fuel for the generation of power, as opposed to coal or diesel-fired power generation or LPG that is more flammable. The nature of this project is to combat the debilitating effects of load shedding and ensure dispatchable to the national grid that will benefit society at all levels. Refer to Section 3 – Alternatives and Section 8.3.
2.22.	Describe the positive and negative cumulative socio-economic impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and other planned developments in the area	The cumulative impacts of the project considered both the micro (e.g. visual, noise) as well macro components (e.g. climate change, socio-economic). As per Section 7 and all specialist reports, the negative cumulative impacts are acceptable can be adequately managed and reduced to lower significance ratings.

8.3.3 Conclusion

"In conclusion, the authors have approached this motivation regarding Need and Desirability by initially focussing on high level (macro) economic, social and environmental considerations relevant to the proposed project and then, as required by the Guideline on Need and Desirability, assessing fine grained (micro) impacts (both positive and negative). In doing so, the authors were obviously also guided by the contents of the various specialist reports and additional contributors referred to and annexed to the dEIAR.

All relevant impacts – social, economic and environmental - have been assessed as thoroughly as possible, although it is only possible in this section to summarise those that relate to the motivation of N&D. The result is a development in respect of which the socio-economic benefits far outweigh any adverse environmental impacts which in most, if not all cases, can be minimised considerably by the adherence to the stipulated mitigation measures propose in the dEIR and accompanying specialist reports.

All things considered, the authors are satisfied, using the wording from Section 1 of the "Guideline on Need and Desirability", that the development is ecologically sustainable and socially and economically justifiable – and that the project will result in the simultaneous achievement of the triple bottom-line. The authors invite the CA to find likewise that the proposed development is both necessary and desirable".

9 CONCLUDING STATEMENT AND RECOMMENDATIONS

9.1 KEY PROJECT COMPONENTS

9.1.1 Context of the Project

The proposed Project arose in response to the Request for Proposals (RFP) for new generation capacity of 2,000 megawatts of dispatchable power from a range of technologies, under the Risk Mitigation Independent Power Producer Procurement Program (RMI4P). This request was issued by the DMRE on 07 July 2020 to alleviate the immediate and future capacity deficit and the limited, unreliable and poorly diversified provision of power generating technology with its adverse environmental and economic impacts, as identified in the Integrated Resource Plan (2019).

The energy crisis has had a significant impact on the South African economy over the past 15 years and is anticipated to continue well into the future without an adequate emergency risk response such as the RMI4P. Therefore, the RMI4P has been declared a Strategic Integrated Project (SIP) in terms of the Infrastructure Development Act 23 of 2014, by the Presidential Infrastructure Coordinating Commission Council on 24 July 2020 under SIP 20, as set out in Government Gazette 43547.

The RMI4P is different to the REI4P and the wider development of the electricity generation in South Africa in that it was established to address the current, and critical shortfall in electricity supply and grid instability which has resulted in South Africa's energy crisis. The procurement thus seeks to address the short-term deficit in electricity supply, rather than determining the future energy mix. It is part of an attempt by government to procure a net increase of more than 23 900 megawatts (MW) of energy over the next eight years (i.e., short term addition of capacity) during which time, and as assumed in the IRP 2019, Eskom will decommission 8000 MW of power from its coal fleet (Steenkamp & Weaver, 2022; Futuregrowth, 2021). The speed at which projects can come online after financial close is a critical consideration. The RMI4P is to satisfy the short-term electricity supply gap, ease the current electricity supply constraints and reduce the wide-scale usage of diesel-based peaking electrical generators using alternative energy technologies ((Steenkamp & Weaver, 2022; DMRE, 2021a).

The RFP stipulated stringent environmental, social and economic criteria, BBBEE criteria and skills development. In particular, the request for proposal contained mandatory Economic Development requirements (for enterprise development and local procurement) and thorough assessment of Value For Money, defined to mean that "the new generation capacity project results in a net benefit to the prospective buyer or to the Government having regard to cost, price, quality, quantity, risk, transfer, or a combination thereof".

The Value For Money requirement involved an assessment of multiple issues and considerations, none of which are dominant or pre-eminent to another. All issues and considerations were of importance in the assessment but might not necessarily bear equal weight.

Karpowership SA Pty Ltd was announced by the DMRE, as one of the eleven successful bids in 2021. Karpowership SA is a South African company that is 49% owned by a Black Empowered Company and 51% owned by Karpowership, a member of Karadeniz Energy Group that owns, operates and builds Powerships (floating power plants). Since 2010, 36 Powerships have been completed with total installed capacity exceeding 6000 MW globally with additional Powerships either under construction or in the pipeline in response to worldwide concerns on energy security. Impressively, at the time of publication, no environmental incidents have been reported in any of the countries where Powerships are operated.

Karpowership SA will provide 1220 megawatts of the total 2000 megawatts sought through the RMI4P, with the Ngqura Project making up 450MW of that total, for a contractual term of 20 years (a standard stipulation for all RMI4P projects), as-and-when required to support the national grid. This electricity will be generated by the fully integrated floating Powerships, fuelled by natural gas whilst being moored in the Port of Ngqura in the Eastern Cape.

The proposed technology for generation of electricity is natural gas-fired reciprocating engines and heat capture steam turbines designed to improve efficiency of energy generation. Construction is limited to transmission and gas supply lines as the ships are built internationally and arrive fully equipped in the Port, ready for operation.

In the South African context, and as presented in the IRP 2019, provision has been made for gas in the energy mix. Coupled with the urgent need to respond to the energy crisis it is clear that due consideration is to be made for the Karpowership SA Project. The Project has significant relevance given the following, as described by the report by Steenkamp and Weaver (2022) on the Economic Impacts of Loadshedding:

- The Karpowership fleet can be deployed immediately, and Karpowership project can reach commercial operation in 12 months given the infrastructural requirements on the landside. This allows for additional generation capacity coming online timeously, given the urgency to resolve loadshedding.
- Karpowership can provide baseload, mid-merit and peaking power and because Karpowership provides flexible electricity generation, it can respond in minutes when the energy supply is under strain.
- Given the nature of the RMI4P, and the associated purchase agreements, Karpowership will only generate electricity after being issued a dispatch instruction by the system operator. In other words, Karpowership will operate only when required to do so.
- The Karpowership project has a contract duration of 20-years, as per the standard stipulation of the RMI4P, and will therefore be a temporary power generator in the energy mix in South Africa.
- Because Karpowership is a floating power solution, there is little risk of stranded assets or lengthy decommissioning timeframes.
- The Karpowership SA project will create thousands of new jobs over the construction and operational phases of the project. During the operational phase the Karpowership will also contribute to skills and capacity development which will benefit locals and contribute to South Africa’s just transition.
- The Karpowership SA project will produce less than half the GHG emissions, and a fraction of the particulate and other emissions to that of coal and diesel. It is therefore expected to directly result in more emissions avoided (from coal-fired plants) than it will contribute to the global stock of greenhouse gas emission and will have a positive climate change impact by supporting the deployment of renewable energy in the country (Promethium Carbon, 2022).
- The Powerships should not be considered a replacement for renewable energy, but rather a complementary technology to renewable energy, which supports the transition away from coal. A full transition to renewable energy will require a significant increase in battery manufacturing and deployment – a 44 times increase internationally by 2030 (IEA, 2022) is required to achieve renewable energy providing baseload. This significant increase in demand is highly likely to see developed, richer countries, out bidding and securing battery capacity ahead of developing countries. The Powerships provide a highly feasible alternative through its ability to provide rapidly electricity generation which can make up any shortfalls in renewable energy’s intermittent electricity production which might arise.

- Development of a gas industry in South Africa is already underway, and will continue, and thus the skills, supply, and enterprise development undertaken by Karpowership will further contribute to establishing a more efficient and viable domestic industry. Ultimately this will lead to increased job creation activities.

9.1.2 Project Description

The Project entails the generation of electricity by two Powerships moored in the Port of Ngqura, fed with natural gas from a third ship, a Floating Storage & Regasification Unit (FSRU). The three ships will be moored in the port for the Project's anticipated 20-year lifespan. A Liquefied Natural Gas Carrier (LNGC) will bring in liquefied natural gas (LNG) and offload it to the FSRU approximately once every 20 to 30 days, dependent on power demand which is determined by the buyer, ESKOM. The FSRU stores the LNG onboard and turns the liquid form into gaseous form (Natural Gas) upon demand from the Powership (Regasification). Natural gas will be transferred from the FSRU to the Powerships via a subsea gas pipeline. The Project's design capacity is 540MW. Electricity will be generated on Powerships by 27 reciprocating engines, each having a heat input in excess of 10MW (design capacity of 18.32MW each at full capacity). Heat generated by operation of the reciprocating engines is captured, and that energy is used to create steam to drive three steam turbines that each have a heat input of circa 15.45MW. The contracted capacity of 450MW, which cannot be exceeded under the terms of the RMI4P, will be evacuated via a 132kV transmission line over a distance of approximately 7.4km, from the Port of Ngqura's tie-in point to the Eskom line, at a connection point (necessitating a new switching station located adjacent to Klub Road near Port Control) in proximity to the existing Dedisa Substation, which feeds electricity into the national grid.

The main components and infrastructure associated with the project comprise:

- LNG will be delivered every 20-30 days via an LNG Carrier to be docked adjacent the moored FSRU;
- LNG is transferred from the LNG Carrier to the FSRU;
- LNG to be stored on FSRU and converted to Natural Gas (NG) as per requirements;
- NG to be provided to the Powerships via a gas pipeline;
- Gas pipeline will traverse the seabed and cross the onshore beach environment before being connected to the Powerships;
- Power to be generated on the Powership via reciprocating engines and efficiency improved as per steam turbines;
- Seawater abstraction and discharge; and
- Evacuation of electricity via 132kV transmission lines comprising overhead monopole transmission towers, from the Powerships to the proposed switching station to the existing Dedisa Substation network.

The Powership operates a once through cooling system, which abstracts seawater directly for cooling and then discharges it into the sea with no chemicals or other additives used. The total intake/outlet flow rates at 100% load are 8.49 m^3/s. The temperature of the discharged seawater (ΔT) ranges from 10.0 to 15.0°C. A smaller footprint of ΔT is achieved when discharging at a depth 8 m below the water surface. Discharges will operate continuously while the ships generate power as per dispatchable instruction, and no other constituents, such as biocides or brine, will be added to the cooling water discharge.

The Powerships and the FSRU are assembled off-site and delivered fully equipped and operational to the Port of Port of Ngqura, whereas the gas and powerlines will need to be constructed.

9.2 MITIGATION HIERARCHY

In accordance with 3(1)(n) in Appendix 3 of GN 982 ("the EIA Regulations") the mitigation hierarchy (avoid, reduce, rehabilitate and offset impacts) was implemented to arrive at the final proposed alternatives with impact management measures and mitigation as follows:

9.2.1 Avoid

The following key measures were implemented or formed part of the technology to avoid specific impacts:

- Screening out of Transmission Line Alternative 3:
    - Detrimental to several watercourses and associated systems;
    - Traverses some undisturbed thicket areas that form important habitats for fauna, many of which are themselves protected species.
- The gas pipeline alternative selected the route in relation to the Preferred Powership position. The position of the Powerships as per Alternative 2 in relation to the shore is feasible but somewhat more challenging from a technical engineering perspective and potential risk is added to navigating vessels from running the evacuation line across the Admin Craft Basin entrance.
- The preferred alternative transmission line based within the services servitude of the CDC and the CDC's preferred position. The services servitude within the industrial zoned area, as per environmental authorisation, provides for the establishing of inter alia a 132kV powerline. In addition, the alignment of the powerlines outside the protected Bonteveld Open Space System.
- The use of cooling water systems that exclude the use of biocides and chlorine and thus prevent any potential pollution within the marine environment.

9.2.2 Reduce

The following key mitigation measures are intended to reduce specific impacts:

- The design of the Powerships provide for built-in noise mitigation e.g., double hull and anti-vibration mounting systems.
- Management of water intake velocities, physical block cages around intakes and placement of intake outside the benthic environment to reduce impacts within the marine ecosystem from ingress into the system.
- Navigational simulations (full bridge simulations with Harbour Masters and tug operators) and TNPA agreements on FSRU and Powership positions ensured the optimal position of the vessels to avoid marine traffic safety issues and align with TNPA Port planning.
- Various measures were stipulated as per the EMPr for the construction and operational phase to reduce impacts.

9.2.3 Rehabilitate

Rehabilitation is stipulated for any areas disturbed during construction as per the measures provided in the EMPr. The EMPr also provides for the maintenance of areas to prevent degradations during the operational phase.

9.2.4 Offset

Given the locations as well as specialist findings and recommendations, no offset was applicable to the proposed alternatives.

9.3 ALTERNATIVES

The project alternatives were considered in Chapter 3 and assessed in Chapter 7 based on technical and environmental aspects informed by technical information and input as well as specialist studies. These alternatives included site, layout, technology and no-go alternatives and are summarised as per Table 9-1 below:

Table 9-1: Summary of Alternatives

Alternative	**Description**	**Status**	**Key reasoning**	**Report Section**
Site Alternatives within Eastern Cape Province	Port of East London,	Screened out	This not a feasible alternative.	Section 3.1.1
	Port of Elizabeth	Screened out	This not a feasible alternative.	Section 3.1.1
	Port of Ngqura	Assessed in EIA	This is a feasible and preferred alternative. Aligned with Port and CDC energy hub activities, sufficient depth and available grid infrastructure via existing CDC services servitude with connection to Dedisa Substation.	Section 3.1.2
Layout Alternative Powership	Alternative 1: Two Powerships adjacent to the admin craft basin and the FSRU along the eastern breakwater	Assessed in EIA	This is a feasible and preferred alternative.	Section 3.2.1
	Alternative 2: Two Powerships closer to the liquid bulk terminal and the FSRU along the curved portion of the eastern breakwater.	Assessed in EIA	This is a feasible alternative.	Section 3.2.1
Layout Alternative Gas Pipeline	Alternative 1: Onshore pipeline is routed around the ACB admin buildings and across the dune field via the shore crossing and along the seabed to the location of the Powership PLEM.	Assessed in EIA	This is a feasible and preferred alternative.	Section 3.2.2
	Alternative 2: Gas pipeline connecting the FSRU to the Powerships will be routed along the edge of the existing eastern breakwater	Assessed in EIA	This is a feasible alternative.	Section 3.2.2

Alternative	**Description**	**Status**	**Key reasoning**	**Report Section**
Layout Alternative: Transmission Lines	Alternative 1: Western alignment in the authorised services servitude	Assessed in EIA	This is a feasible and preferred alternative.	Section 3.2.3
	Alternative 2: Eastern alignment in the authorised services servitude	Assessed in EIA	This is a feasible alternative.	Section 3.2.3
	Alternative 3: north-westerly route which crosses several watercourses and adjacent to the transformed Ngqura River	Screened out	This not a feasible alternative. ▪ Detrimental to several watercourses and associated systems; ▪ Traverses some undisturbed thicket areas that form important habitats for fauna, many of which are themselves protected species.	Section 3.2.3
Design Alternative: Transmission Lines	Lattice	Screened out	This is a feasible alternative but not preferred. ▪ larger excavations for their foundation; ▪ larger clearing of vegetation; ▪ Less visually appealing; ▪ higher vertical risk area to flying birds.	Section 3.2.4
	Monopole	Assessed in EIA	This is a feasible and preferred alternative.	Section 3.2.4
Technology Alternatives: Fuel	Natural Gas	Assessed in EIA	This is a feasible and preferred alternative.	Section 3.2.5
	Hydrogen	Not assessed in EIA	This is not a current feasible option; however, it is not an excluded option over the 20 years timeframe of the project. When commercially viable for implementation on the utility scale of the Project, the relevant environmental processes will be completed as required.	Section 3.2.5

9.4 ENVIRONMENTAL IMPACT STATEMENT

In accordance with 3(1)(l) in Appendix 3 of GN326, this section contains:

(i) *A summary of the key findings of the environmental impact assessment (refer Section 9.4.2 – 9.4.4 below).*

(ii) *A map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred development footprint on the approved site as contemplated in the accepted scoping report indicating any areas that should be avoided, including buffers (refer to Section 9.2.1, Figure 9-1 and Appendix 1).*

(iii) *A summary of the positive and negative impacts and risks of the proposed activity and identified alternatives (refer Section 9.2.2 below).*

9.4.1 Sensitivity Map

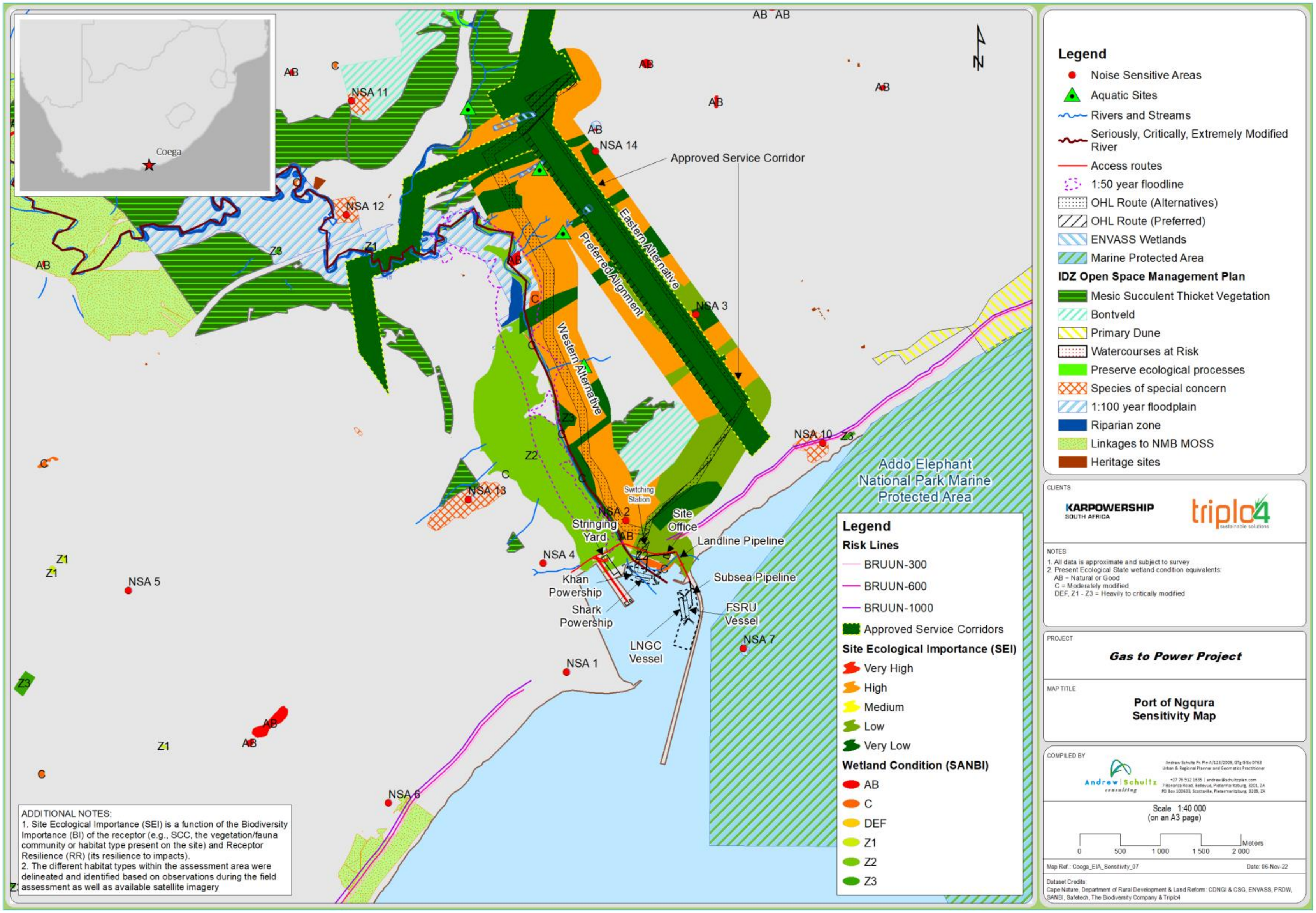

Figure 9-1: Sensitivity Map depicting sensitive environmental features in relation to the proposed activity in the Port of Nqgura

9.4.2 Summary of Positive, Negative Impacts and Risks (of the proposed activity and alternatives)

9.4.2.1 Summary of Specialist Assessments

The table below provides a summary of the positive and negative impacts and risks of the proposed activities and identified alternatives as identified by the Specialists. It must be noted that the Specialist approached the assessments interactively.

Where not specifically indicated in the table, the risks and impacts are the same for the alternatives.

Table 9-2: Summary of Positive, Negative Impacts and Risks (Proposed Activity and Alternatives)

Potential Impacts and Risk	Significance	
	Pre-Mitigation	Post Mitigation
Hydrology Impacts		
Disturbing vadose zone during soil excavations/construction activities.	Neutral/ Negligible	Neutral/ Negligible
Exposure of soils, increased the potential for sedimentation of the watercourses. Soil compaction; and Soil erosion.	Low – negative	Neutral/ Negligible
Surface water contamination and sedimentation	Low – negative	Neutral/ Negligible
Transmission line installation areas that were backfilled with collapsible soils may cause soil subsidence	Neutral/ Negligible	Neutral/ Negligible
Switching station spillages (incidents only)	Neutral/ Negligible	Neutral/ Negligible
Leakages from vehicles occurring during transmission line maintenance	Neutral/ Negligible	Neutral/ Negligible
Aquatic Impacts		
No impacts		
Hydropedology Impacts		
Site preparation impacting on soil interflow processes, soil quality, soil structure and land capability	Neutral/ Negligible	Neutral/ Negligible
Disturbing vadose zone during soil excavations / infilling activities	Low – negative	Neutral/ Negligible
In-situ placement of new soils, altering existing soil-flow processes impacting on soil interflow processes, soil quality, soil structure and land capability	Low – negative	Neutral/ Negligible
Vegetation clearing & soil stockpiling impacting on soil interflow processes, soil quality, soil structure and land capability	Low – negative	Neutral/ Negligible
Surface water (wetland) quality	Low – negative	Neutral/ Negligible
Soil quality	Low – negative	Neutral/ Negligible
Excavation will disturb soil interflow processes	Low – negative	Neutral/ Negligible
Oil & fuel spills impacting on soil quality	Low – negative	Neutral/ Negligible
Geohydrology Impacts		
Disturbing vadose zone during soil excavations / construction activities	Neutral/ Negligible	Neutral/ Negligible
Hydrocarbon contamination of the vadose zone (construction phase)	Low – negative	Neutral/ Negligible
Surface water contamination and sedimentation	Low – negative	Neutral/ Negligible
Impacts to downstream groundwater users	Neutral/ Negligible	Neutral impact. No mitigation required.

Perched water table dewatering	Neutral/ Negligible	Neutral/ Negligible
Hydrocarbon contamination of the vadose zone (operational phase)	Neutral/ Negligible	Neutral/ Negligible
Impacts to downstream groundwater users (operational phase)	Neutral/ Negligible	No monitoring is proposed. Impact probability is neutral.
Wetland		
Catchment modifications (land cover and surface runoff)	Low	Very Low
Water Quality (Pollution)	Low	Very Low
Archaeology Impacts		
No impacts.		
Palaeontology Impacts		
Loss of shells of other fossils during excavation of pylon foundations	Low	Very Low
Terrestrial Biodiversity Impacts (Transmission)		
Loss of strandveld (Preferred Alternative 1 and Alternative 2)	Medium-Low	Low
Loss of intact bontveld (Preferred Alternative 1)	Medium-High	Medium
Loss of intact bontveld (Alternative 2)	Medium-High	Medium-Low
Loss of degraded bontveld (Preferred Alternative 1 and Alternative 2)	Medium-Low	Low
Loss of Flora SCC (Preferred Alternative 1 and Alternative 2)	Medium-High	Low
Loss of Fauna SCC (Preferred Alternative 1 and Alternative 2)	Medium-Low	Low
Loss of biodiversity in general (Preferred Alternative 1 and Alternative 2)	Medium-High	Medium-Low
Ecosystem function and process (Preferred Alternative 1 and Alternative 2)	Medium-High	Medium-Low
Loss of strandveld (Preferred Alternative 1 and Alternative 2)	Medium	Low
Loss of intact bontveld (Preferred Alternative 1 and Alternative 2)	Medium	Low
Loss of degraded bontveld (Preferred Alternative 1 and Alternative 2)	Medium-Low	Low
Loss of Species of Special Concern and Biodiversity (Preferred Alternative 1 and Alternative 2)	Low	Very Low
Ecosystem function and process (Preferred Alternative 1 and Alternative 2)	Low	Very Low
Avifauna Impacts		
Physical Disturbance of terrestrial avifauna habitat by Site establishment, Powerships, FSRU, LNG Carrier, gas pipelines (Preferred Alternative 1)	Low	Low
Physical Disturbance of terrestrial avifauna habitat by Site establishment, Powerships, FSRU, LNG Carrier, gas pipelines (Alternative 2)	Low	Very Low
Disturbance to terrestrial avifauna by atmospheric noise and light (Powerships, FSRU) (Preferred Alternative 1 and Alternative 2)	Medium-High	Medium
Impact on terrestrial avifauna due to emergency events (Powerships, FSRU, LNG Carrier, gas pipelines, gales, swells, flooding and marine traffic accidents) (Preferred Alternative 1 and Alternative 2)	Low	Very Low
Transmission lines: Impact on avifauna due to habitat disturbance and fragmentation (Preferred Alternative 1 and Alternative 2)	Medium-Low	Very Low
Transmission lines: Impact on avifauna due to collisions and electrocution (Preferred Alternative 1 and Alternative 2)	Medium -High	Low
Underwater Noise Impacts		
Impact of underwater noise on marine mammals and fish	Low	Very Low
Underwater Archaeology Impacts		
No impacts to underwater heritage resources		
Marine Ecology and Marine Avifauna Impacts		

The effects of increased noise levels from construction on the surrounding marine ecology – construction phase	Medium-Low	Low
The effects of increased noise levels from construction on the surrounding marine ecology– construction phase	Medium-Low	Medium-Low
The effects of construction impacts on ecosystem services– construction phase	Medium-Low	Medium-Low
The effects of the intake of cooling water on marine organisms in the surrounding water body – operational phase	Medium	Medium-Low
The effects of the discharge of cooling water on the marine ecology in the receiving water body– operational phase	Medium -High	Medium
The effects of increased noise and vibration levels on the surrounding marine ecology	Medium -High	Medium
The effects of the combined operational impacts on ecosystem services– operational phase	Medium	Medium
Coastal and Estuary Impacts		
Effect on habitat as a result of construction within the estuarine functional zone – Site Office	Medium-Low	Medium-Low
Effect on habitat as a result of construction within the estuarine functional zone – Gas Line Preferred Alternative 1 and Terminal Tower	Medium	Medium-Low
Effect on habitat as a result of construction within the estuarine functional zone - Gas Line Alternative 2	Neutral/ Negligible	Neutral/ Negligible
Effect on estuarine/beach fauna as a result of construction activities and noise – Site Office & Gas Line Alternative 2	Low	Low
Effect on estuarine/beach fauna as a result of construction activities and noise - Gas Line Preferred Alternative 1	Medium -High	Medium-Low
Effect on estuarine/beach fauna as a result of construction activities and noise - Terminal tower	Medium -High	Medium
Effect on terrestrial and estuarine avifauna as a result of construction activities and noise (Powerships: Preferred Alternative 1 and Alternative 2)	Very Low	Very Low
Effect of solid waste pollution & chemical pollution arising from construction related spills of hazardous substances	High	Medium-Low
Effect on estuarine and terrestrial avifauna due to collisions and electrocutions at the powerlines (Transmission: (Preferred & Alternative 2)	Medium	Low
Affect on terrestrial and estuarine avifauna due to atmospheric noise and light (Powerships: Preferred Alternative 1 and Alternative 2)	Medium	Medium-Low
Effect of cooling water discharge on estuarine/marine ecology (Powerships: Preferred Alternative 1 and Alternative 2)	Medium -High	Medium
Effect of underwater noise on marine ecology (Powerships: Preferred Alternative 1 and Alternative 2)	Medium -High	Medium
Effect on coastal/estuarine associated fauna and habitat destruction due to fires and explosion (Powerships: Preferred Alternative 1 and Alternative 2)	Very Low	Very Low
Effect on coastal/estuarine associated fauna and habitat destruction due to fires and explosion	High	Low
Effect on/of dynamic coastal processes (Transmission Preferred Alternative 1)	Low	Low
Effect on/of dynamic coastal processes (Site Office & Stringing Yard)	Low	Very Low

Effect on/of dynamic coastal processes (Gas Line Preferred Alternative 1)	Medium-Low	Low
Effect on/of dynamic coastal processes (Gas Line Alternative 2)	Low	Low
Atmospheric Impacts & Risks		
SO_2, NO_2, PM_{10}	Low	Low
Terrestrial Noise Impacts & Risks		
Noise impacts from construction & operational activities	Medium-Low	Low
Climate Change Impacts and Risks		
Contribution to climate change	Low **(Positive)**	Low **(Positive)**
Socio-Economic Impacts and Risks		
Temporary increase in the GDP and production of the national and local economies during construction	High **(Positive)**	High **(Positive)**
Temporary increase in employment in local and national economies	High **(Positive)**	High **(Positive)**
Contribution to skills development in the country and in the local economy	Medium-Low **(Positive)**	Medium **(Positive)**
Temporary improvement of the standard of living of the positively affected households	Medium **(Positive)**	Medium **(Positive)**
Temporary increase in government revenue	Medium **(Positive)**	Medium **(Positive)**
Temporary increase in social conflicts associated with the influx of construction workers and job seekers to the area and Added pressure on economic and social infrastructure during construction as a result of increase in local traffic and in migration of construction workers	Medium (Low)	Low
Impact on the sense of place experienced by the local community as a result of visual and noise effects that appear during the construction phase	Low	Low
Temporary increase in the GDP and production of the national and local economies during construction	High **(Positive)**	High **(Positive)**
Creation of sustainable employment positions nationally and locally	High **(Positive)**	High **(Positive)**
Skills development of permanently employed workers during operations phase	Medium (Low) **(Positive)**	Medium **(Positive)**
Improved standard of living for benefitting households	High **(Positive)**	High **(Positive)**
Sustainable increase in national and local government revenue	Medium-High **(Positive)**	Medium-High **(Positive)**
Provision of electricity for future development during operations phase	High **(Positive)**	High **(Positive)**
Local community and social development benefits derived from the project's operations	Medium **(Positive)**	Medium-High **(Positive)**
Impact on the sense of place experienced by the local community as a result of visual and noise effects that appear during the operational phase	Low	Low
Tourism Impacts and Risks		
Noise impacts on marine tourism activities	Low	N/A
Visual and noise impacts on tourism	Low	N/A
Electricity provision on the hospitality and tourism industry Nelson Mandela Bay	Very High **(Positive)**	Very High **(Positive)**
Energy and Industrial Tourism at Port of Nqgura	Low **(Positive)**	Low **(Positive)**
Traffic Impacts		
No impacts		
Visual Impacts		
Change the character and sense of place: of the landscape setting (Landscape Change);	Low	N/A

as seen from urban areas and particularly the coastal settlements of St George's Strand and Bluewater Bay; roads particularly the N2 the southeast on the seaward side of the coastal dune close to of St George's Strand and Bluewater Bay Conservation areas including the Addo Elephant Park and the Swartkops Valley Local Nature Reserve operational, safety and security lighting of the facility at night on observers. (Powership, FSRU)		
Change the character and sense of place of the landscape setting (Landscape Change); urban areas and particularly the coastal settlements of St George's Strand and Bluewater Bay roads particularly the N2 southeast on the seaward side of the coastal dune close to of St George's Strand and Bluewater Bay. (Transmission Line: (Preferred Alternative 1 & 2)	Low	Low
Major Hazard Installation Risks		
No impacts		
Marine Traffic Impacts and Risk		
No impacts		

Based on the above Specialist Studies, the following conclusions were reached on impacts and risk post mitigation:

Specialist studies found 'No significant or negligible' impacts or risks were identified for specialist studies conducted in terms of traffic, marine traffic, major hazard installation, hydrology, geohydrology, hydropedology, aquatic, tourism and visual aspects.

Impacts and risks of very low and low significance were identified for wetlands, archaeology, underwater archaeology, atmospheric emissions, terrestrial noise, tourism and visual impacts and socio-economic. Terrestrial biodiversity impacts ranged from very low to medium low.

The overall impact of the Project on the Coega Estuary and coastal environment will be medium-low to low.

Medium impacts were specified regarding the effects on the marine ecology in the receiving water body due to discharge of cooling water or increased noise and vibration levels and the effects of impacts on ecosystem services during the operational phase.

Low to very high **positive** impacts were indicated for aspects related to the Tourism Industry and the socio-economic assessment indicated numerous positive impacts ranging from medium, medium-high to high positive.

A polycentric approach to the proposed project requires the holistic consideration of all relevant factors, inclusive of potential impacts that the proposed project could have on the local as well as the broader community. Section 2(4)(b) of NEMA states that *Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated, and it must take into account the effects of decisions on all aspects of the environment and all people in* the *environment by pursuing the selection of the best practicable environmental* *option.* Sustainable development as per NEMA requires the integration of social, economic, and environmental factors in the planning, implementation, and evaluation of proposed projects, to ensure that development serves the needs of present and future generations.

The independent sustainability specialist assessment therefore considered both the positive and negative impacts of actual and potential impacts on the geographical, physical, biological, social, economic, and cultural aspects of the environment in a polycentric and holistic approach that:

- Acknowledges that this environment is a complex and dynamic system
- Acknowledges the interrelated socio-ecological and socio-economic relationships
- Identifies the risks and consequences of alternatives and options for mitigation of activities, to minimise negative impacts, maximise benefits, and promote compliance with the principles of environmental management as set out in section 2 of NEMA.

9.4.3 Summary of key findings and potential shifts in the socio-ecological system

The systems map for the proposed project at the Port of Ngqura illustrates key shifts in the socio-ecological ecosystem as a result of the operation of the Powership operating in the Port. This understanding is based on fundamentals derived from definitions and methodologies developed under Complexity Science and Systems Thinking, which views the site and the proposed changes via the Karpowership SA Project as a complex adaptive system. The systems map illustrates cause-and-effect relationships to create understanding of complex systems and their interactions. The systems map provided below is intended to provide a simplified conceptual understanding of how the site may change as a consequence of the proposed project. This understanding allows for an enhanced perspective of the proposed project through the compound lens of the specialist assessment findings regarding how the site may be impacted. This perspective is further used for improved impact mitigation / management recommendations, with a focus on strengthening of adaptive management related recommendations at construction and operation phase.

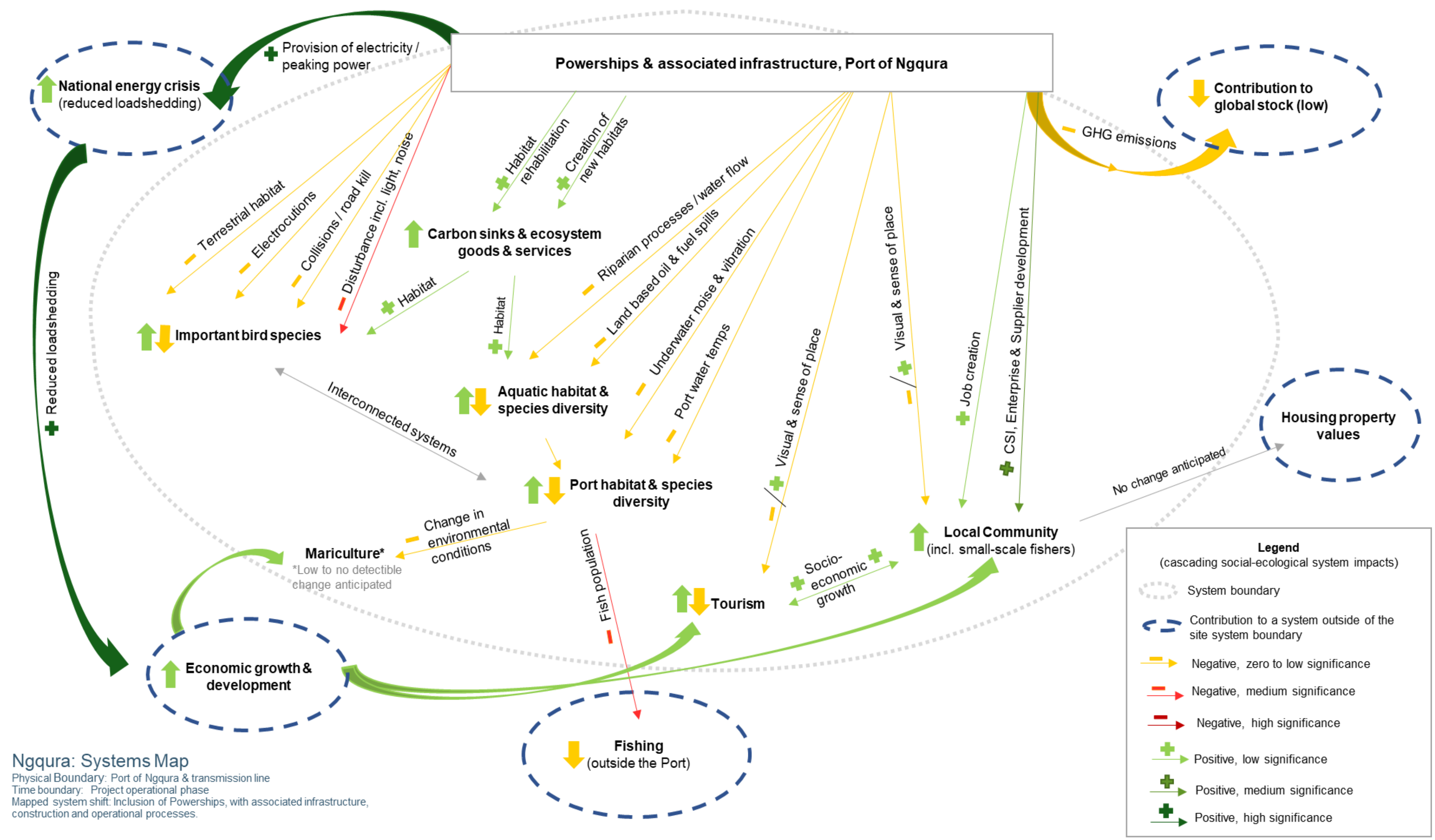

Figure 9-2: System map illustrating the anticipated shifts to the socio-ecology system following the inclusion of the Powership and associated infrastructure in Port Nqgura

9.4.4 Summary of key findings from the holistic assessment

From the integrative, polycentric perspective adopted in conducting the EIA, the following key findings gathered from the matrices regarding identified impacts, and the systems map regarding anticipated system shifts, include:

- The key contribution that the proposed project will provide, is to reduce the burden of loadshedding on the country. There are several consequences of this, including opportunities for economic recovery and transition to the energy mix as proposed in the IRP 2019. Please see the Economic Impacts of Loadshedding discussion paper and the Socio-Economic Impact Assessment Supplementary report for further details.
- There is opportunity for the small-scale fishers and the rest of the community to benefit from corporate social investments, skills development, and supplier and enterprise development because of Karpowership SA's local content commitments (medium-low impact). In addition, there will be jobs created associated with the construction and operational phases of the project (low impact). Please see the Socio-Economic Impact Assessment Supplementary report and the Enterprise and Supplier Development report for further details.
- There is industrial and value chain development potential for the gas industry through increased economies of agglomeration. Please see the Economic Impacts of Loadshedding discussion paper and the Socio-Economic Impact Assessment Supplementary report for further details.
- Underwater noise and the thermal plume associated with the operations of the Powership, will affect marine life in the port. While low impacts are anticipated associated with the mariculture, it is anticipated that marine mammals may be negatively impacted as a consequence of the long duration of the project (anticipated high overall environmental significance impact rating). A key concern is the impact on juvenile fish who make use of the port as a nursery (medium impact). Consequently, this may negatively affect fish populations, which are already under strain because of overfishing.
- The terrestrial noise caused by the Powership during electricity generation, should not extend into residential areas and therefore is not anticipated to affect local communities.
- In the 12,5km x 4km project area of influence 200 bird species have been recorded, including 21 species of conservation concern, this includes a small colony (usually 4 pairs) of critically endangered Damara Tern (not expected to be impact). The Coega Saltpans can hold >5000 waterbirds of more than 40 species, including >2000 flamingos who are at risk of collisions with overhead transmission lines. Light and noise pollution are anticipated to have medium impacts, while physical disturbances are anticipated to have very low impact at construction and operational phase.
- Construction and maintenance of the gas pipeline, transmission line and switching stations is anticipated to result in a loss of important fauna and flora. Both mitigation recommendations and rehabilitation have been proposed to limit the impacts to very low overall environmental significance, with mitigation.
- Tourism is not anticipated to be negatively affected by the presence of the Powership, and associated infrastructure. This is largely because the Powership will be located in the port and will blend in with other ships and port infrastructure. The tourism sector may further benefit from peaked interest in the Powerships, yielding 'energy tourism'. This may further stimulate maritime recreational themed economic opportunities.
- Tropical cyclones are typically high impact low probability hazards and are generally quite difficult to manage due to their unpredictable nature. This has been considered in the design of the project and impacts are anticipated to be low and not to affect core operations. However, these storms can have detrimental impacts as an environmental disaster that will impact surrounding communities and ecosystems.

- Operation of the Powerships will contribute only marginally to the global GHG stock. Operation of the Powership cannot directly be tied to the experience of climate change impacts at this site, as this is a dynamic function of the global climate system and GHG stock.
- Major hazards were identified around fire risks associated with gas leaks - which was also found to be normal, and operation can continue with appropriate mitigation and emergency responses. This could also provide opportunity for skills development in the area relating to monitoring and evaluation as well as emergency risk response.
- It is not anticipated that ambient SO_2 and NO_2 particulate concentrations will exceed NAAQS, and therefore is not anticipated to impact on the local community.
- Underwater archaeology will not be affected if underwater archaeology mitigation measures are followed in the case of an archaeological find. It is however, not anticipated that there will be a find. However, an archaeologist should be on site during the construction phase.
- Riparian zones provide a range of ecological goods and services to communities, fortunately no impact is anticipated on any watercourse because of the Powership.
- No heritage and palaeontology impacts are anticipated.
- No significant findings were noted regarding impacts to geohydrology and hydropedology.
- There is potential for the Karpowership SA project to contribute positively to natural habitats through creation of habitats and rehabilitation, although marginal. This could include removal and management of alien invasive plant species; and mooring structures may provide hard structures for benthic communities to colonise. There is also further potential that may be identified through corporate social investment programmes.

9.5 NEED AND DESIRABILITY

The Karpowership project has arisen in response to the need to address the current energy crisis experienced in South Africa. It is in response to a bid issued by DMRE as part of the RMI4P. The RMI4P is to satisfy the short-term electricity supply gap, ease the current electricity supply constraints and reduce the wide-scale usage of diesel-based peaking electrical generators using alternative energy technologies ((Steenkamp & Weaver, 2022; DMRE, 2021a). Loadshedding is currently estimated to cost our economy between R500 million and R4 billion per day of Stage 1-6 Loadshedding implementation. The energy generated through the Karpowership project will contribute towards alleviating the loadshedding burden and resultant negative socio-economic impacts by providing much needed dispatchable energy, which can be provided at baseload, mid-merit and peaking from the Project on demand.

The RMI4P, declared a Strategic Integrated Project, is an important response to the energy crisis, and in line with the mandate of the State to provide services that ensure socio-economic growth and well-being for the benefit of all of society. Karpowership SA's proposed Project is in accordance with the IRP 2019 where provision has been made for gas in the energy mix. Powerships should not be considered a replacement of renewable energy, but rather a complementary technology to renewable energy, which supports the transition away from coal and a reduction in the negative environmental impacts associated with coal and overuse of diesel peaking plants. Coupled with the urgent need to respond to the energy crisis, Karpowership SA's project offers a solution where electricity can be dispatched on instruction when the energy supply is under strain.

In addition, the Project will result in positive multiplier impacts on the local economy during both the construction and operational phases. Karpowership will play a positive role in the local economy through skills-, enterprise- and supplier development programmes. The direct, indirect, and induced economic impacts of the project on employment, income generation, new production and economic value will be positive. This will include skills development and capacity development towards the realisation of a just transition in South Africa. It is therefore anticipated that the Karpowership project will result in an overall positive socio-economic impact (refer to Appendix 9 – D1 SEIA, Nov 2022 and the ED Plan) when considering the host of economic and environmental impacts.

It is worth reiterating that the Karpowership project is in an active port, and the Coega Special Economic Zone, which is considered a key growth node. In addition, several gas-to-power projects are currently earmarked for implementation in this special economic zone.

However, a responsible and sustainable approach to the proposed project is still required, in line with the requirements of NEMA and the environmental management Acts Policies and Guidelines. In addition, a duty of care must be observed. Therefore, numerous multidisciplinary specialist impact assessments have been undertaken as part of the EIA process, integration of specialist findings was ensured and a polycentric view to the impact assessment was applied. Negative and positive impacts have been identified, and as far as possible all negative impacts have been avoided or mitigated to reduce the impact, and further management recommendations provided for as per the EMPr. All Specialists support the project and no fatal flaws were identified. The polycentric approach gave consideration to all relevant factors, inclusive of potential impacts that the proposed project could have on the local as well as the broader community. There is further positive opportunity for scientific research and monitoring programmes to inform adaptive management through the life cycle of this Project, and for similar port-based projects. The Sustainability Specialist, based on Specialists' inputs, independently assessed the project’s geographical, physical, biological, social, economic and cultural aspect of the environment through the application of three methods that assisted with synthesizing and conceptualizing technical information for decision making purposes. The following conclusion was reached: *“Given that the professionals who undertook the specialist studies have supported the granting of the environmental authorisation, with various requirements for mitigation and management, I support that this project be granted the environmental authorisation, provided the necessary mitigation and management recommendations are upheld. The recommendations provided in this report offer further opportunity to reduce the negative impacts of this project on the environment and enhance the positive contributions and legacy that Karpowership SA can contribute to this community.”*

9.6 REASONED OPINION

In accordance with Regulation 3(1)(q) in Appendix 3 of GN 982 (“the NEMA EIA Regulations”), this section provides a reasoned opinion as to whether the proposed activity should or should not be authorised and if the opinion is that it should be authorised, the conditions in respect of such authorisation.

It is the opinion of the EIA project team, incorporating the signatories below, that all components of this application, including the EIR with attached independent specialist reports, EMPr, public participation process and supporting documentation, comply with the relevant guidelines and contain all the required information in terms of GN 982 of the EIA Regulations to enable an informed decision by the competent authority.

It is the reasoned opinion of the EAP that the Gas to Power Powership project is acceptable, will not create unacceptable environmental impacts and can be reasonably authorised subject to the implementation of the mitigations and management measures set out in the EMPr. This opinion was reached with due consideration of:

- the independent specialist studies, with each and every specialist concluding their assessment with a supportive statement for the proposed development (i.e., no fatal flaws were identified),
- the independent contributions to the need and desirability assessment,
- the impacts identified from a macro, micro, cumulative and polycentric (integrative) assessment perspective in terms of the geographical, physical, biological, social, economic and cultural aspect of the environment,
- the potential to avoid or minimise negative impacts and maximise positive impacts through inter alia the socio-economic development plan and reduced loadshedding,

9.7 CONDITIONS OF AUTHORISATION

In accordance with 3(m, r and o) in Appendix 3 of GN 982 it is recommended that the following key management and mitigation conditions, as included in the EMPr, also be incorporated into the authorisation for the project:

- The recommended alternatives to be implemented.
- All mitigation measures specified within the EMPr (Appendix 6) are to be implemented.
- The EMPr (Appendix 6 and its appendices) for this EIA Report must be a binding document between Karpowership SA (Pty) Ltd and the appointed contactor(s) for construction, operations and maintenance, to ensure compliance with environmental specifications and management measures. This must be a living document to be updated based on monitoring and auditing recommendations.
- It is recommended that external EMPr monitoring takes place by an independent Environmental Control Officer (ECO) with appropriate environmental qualifications and relevant experience.
- Construction on the project must commence within 18 months of the date of the granting of the authorisation, the date of any related appeal to the Minister or the date of the final judgment of a competent Court, if the granting of the authorisation is taken on review, whichever date is the latest.
- The authorisation will last for a period of twenty (20) years from the date of the first commercial generation and supply of electricity by the applicant to ESKOM.

9.8 EAP DECLARATION AND UNDERSTANDING

In accordance with 3(1)(s) in Appendix 3 of GN 982, Triplo4 and the EAPs managing this project hereby affirm that

- To the best of our knowledge the information provided in the report is correct. Reference is made to the Disclaimer regarding Independent Specialists, Service Providers and Contributors information provided as well as technical input from the technical teams on the project and the client.
- All effort was made to provide an accurate reflection of the information, including the summarising of specialist studies and recommendations as captured in the report and EMPr. Where wording was changed, or paraphrased in summaries, this was intended to ensure clarity and enforceability without deviating from the original meanings.
- With respect to the EIA Report, Triplo4 took account of interested and affected parties' comments and, insofar as comments are relevant and practicable, these were considered during the Impact Assessment and Public Participation Process.
- Comments and inputs from and to stakeholders and interested and affected parties are included in this report as per the Public Participation Section Summary and Appendices as well as descriptions within relevant sections of the report. All comments received from I&APs with responses thereto are to be included in the final EIA in the form of a comments and responses report submitted to DFFE.

Any comments and inputs subsequent to the submission of this report for public participation will be captured and submitted with the Final EIR Report to DFFE.

Signature of EAP

Signature of EAP

08 November 2022
Date

Kindly refer to the Declaration of Interests and Undertaking under Oath attached in Appendix 5.

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