PORT OF RICHARDS BAY LNG TERMINAL

Technical Engineering Report

19 September 2022

Transnet National Ports Authority				
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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym		Description
CAPEX	:	Capital Expenditure
EPC	:	Engineering, Procurement and Construction
FSRU	:	Floating Storage and Regasification Unit
LNG	:	Liquified Natural Gas
LNGC	:	Liquified Natural Gas Carrier
OEM	:	Original Equipment Manufacturer
OPEX	:	Operational Expenditure
FEED	:	Front End Engineering Design
FSRB	:	Floating Storage Regasification Barge
FSU	:	Floating Storage Unit
JRU	:	Jetty Regasification Unit
PoRB		Port of Richards Bay
TNPA		Transnet National Ports Authority
PLC		Programmable Logic Controller

1. BACKGROUND

South Africa (SA) is the largest power market in Africa with nominal installed generation capacity of 44 GW. Despite it having the largest power sector in Africa, SA has been experiencing power shortages since 2007. This issue is still persistent in SA despite the wide recognition that energy availability is the key driver of economic growth.

To solve the energy challenge of overcoming power shortages, SA recognised that new power generation capacity needs to be procured from a variety of sources, including gas. The current ministerial determination includes 3,126 MW of new gas fired generation capacity. A Gas to Power Programme has been designed to procure this new generation capacity in South Africa.

A relative price comparison shows that imported Liquefied Natural Gas (LNG) is attractive for industrial and transport customers. That is, if adequate regulation and competition are built into the gas supply chain, natural gas has the potential to achieve competitive pricing against alternative sources of imported energy, notably liquefied petroleum gas (LPG), paraffin and diesel. The natural gas has the potential to displace higher cost alternative energy sources currently used in thermal industries and bulk transport and bring considerable cost benefits to these users.

With respect to the location of LNG import terminals in South Africa, the Port of Richards Bay (PoRB) is amongst three ports that have been identified as suitable for LNG importation. As part of the Gas to Power Programme, Transnet National Ports Authority (TNPA) intends to roll out the development of Port infrastructure (marine and landside) for an LNG Import Terminal through a Request for Proposal (RFP) procurement process. This report provides technical engineering specifications for use by prospective bidders. Bidders are required to submit a detailed Technical Proposal outlining how they will align with the technical requirements provided in this report.

2. BROAD DESCRIPTION OF THE PoRB LNG IMPORT TERMINAL PROJECT

2.1 Description of the Port of Richards Bay LNG Import Terminal Project

The Port of Richards Bay Liquified Natural Gas Import Terminal (PoRB-LNG Import Terminal) Project comprises:

(a) The development of an LNG Import Terminal that will enable the realisation of a minimum annual throughput of 1 million tons per annum (mtpa) with provision for expansion to 5 mtpa by the year 2036.

(b) The various components making up a complete PoRB-LNG Import Terminal Project are envisaged as follows:

(i) Provision of a floating, storage and regasification unit (FSRU),

(ii) Construction of a Gas Distribution Hub, complete with LNG Loading Arms, Metering stations,

(iii) The development of new Berth 207, with all associated statutory infrastructure inclusive of bollards, fenders, ladders, access trestles, bund walls, fire-fighting equipment, electrical and civil infrastructure, loading arms and pipe racks,

(iv) Provision of required pipeline and pipe racking infrastructure with associated machinery, equipment and instrumentation for end-to-end operations to support the proposed Terminal for handling LNG when it is discharged from the FSRU into the pipeline for import markets,

(v) All the requisite structures, both on the landside and quayside, necessary civil works, access and service roads and security fences; and

(vi) All the requisite bulk services (water, electricity, sewer, telecoms and ICT/Digital infrastructure), based on what is currently available. Transnet shall provide bulk services to the boundary of the Terminal, from which the Concessionaire shall connect to.

(vii) The deliverables will include Cold and Hot Commissioning of all the works, leading to the delivery of a complete and fully functional PoRB-LNG Import Terminal. Cold Commissioning shall involve testing the different elements of the PoRB-LNG Import Terminal to ensure they operate as specified as well as safely. Hot (live) Commissioning shall involve testing the entire facility by running LNG through it to prove the entire facility provides the specified effective, efficient and safe functionality.

2.2 Planned Project Operations

The main objective of the PoRB-LNG Import Terminal is to meet anticipated industrial gas demand and the Independent Power Producer (IPP) sector in South Africa. This has also been premised on the gas availability reduction for the existing customers in the region, with confirmation by Sasol that it will cease gas provision from 2026. The overall delivery mechanism is clarified in the sub-sections that follow.

2.2.1. Procurement of the LNG:

Prospective bidders are required to procure and transport the LNG through a Liquefied Natural Gas Carriers (LNGC) to the FSRU.

2.2.2. Regasification, transportation and delivery project:

This development will include but is not limited to application for environmental authorizations inclusive of Water Use License (WUL), if required, engineering, procurement, construction, commissioning, operation and maintenance of:

(a) A newly built FSRU;

(b) Terminal infrastructure including berth infrastructure and unloading facilities; and

(c) Natural gas pipeline infrastructure from the Berth to the Off-take point.

2.3 Site Location

(a) Port of Richards Bay

(i) **Figure 1 below** indicates the site location. Land has been set aside for the development of the PoRB LNG Import Terminal in the South Dunes Precinct of the PoRB. The coordinates of the area are 28°48'20.58"S and 32°03'34.61"E.

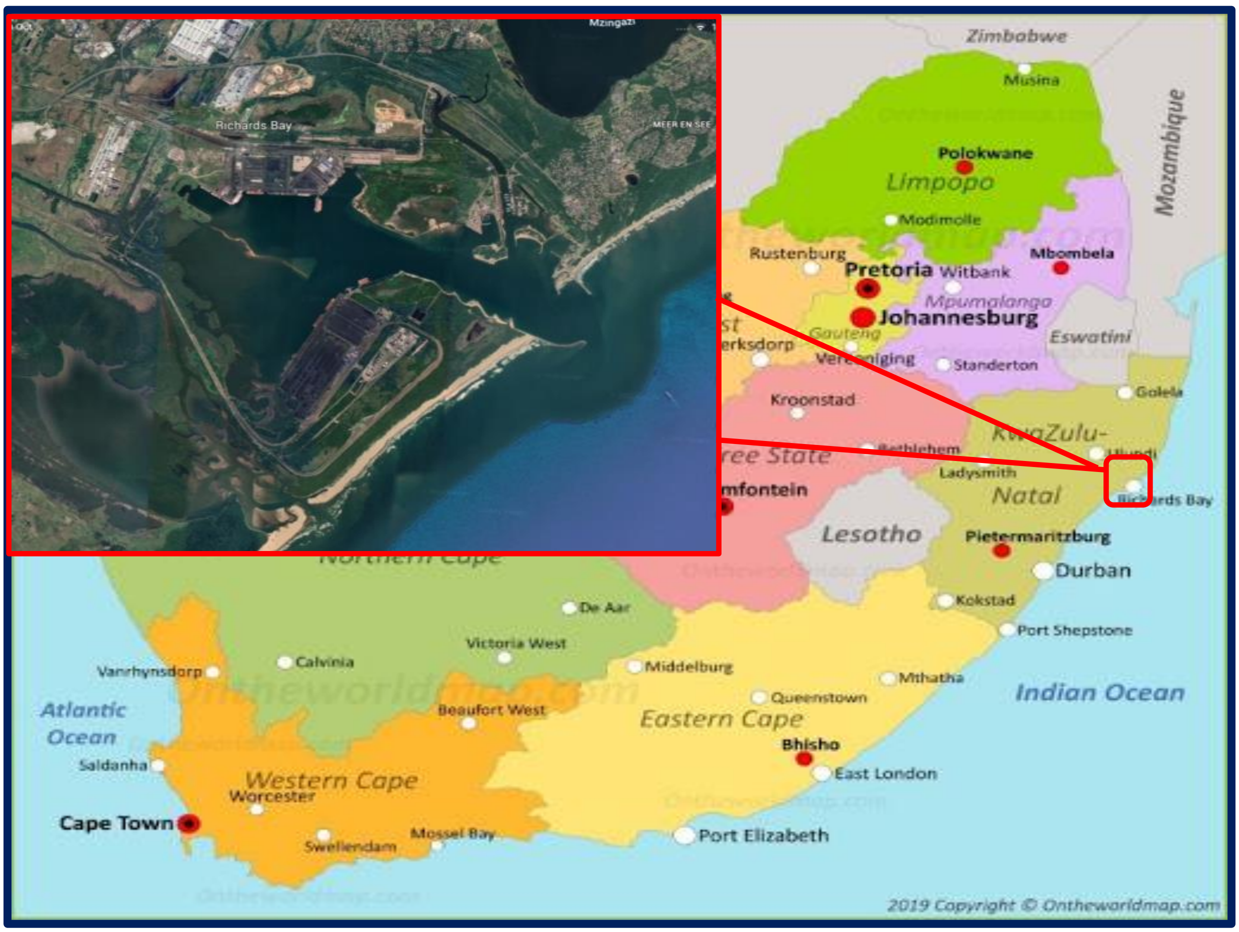


Figure 1: Locality of the site for the PoRB-LNG Import Terminal Project

(b) The Quayside

(i) The quayside is located at the Port of Richards Bay as per Figure 2 below

(ii) Proposed Berth 207 has been allocated for importing LNG.

(iii) Proposed Berth 207 is located to the north-eastern side of the South Dunes Precinct, adjacent to liquid bulk Berths 209 and 208.

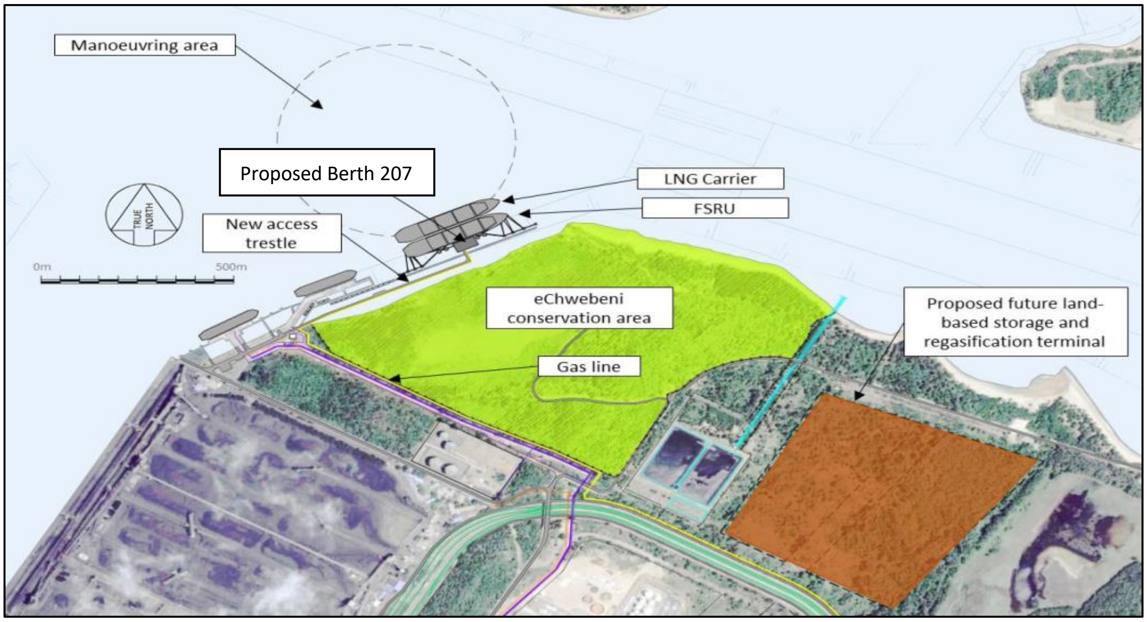


Figure 2: Chemical Berth Quayside

2.4 Existing Bulk Services

Existing bulk services are located in the South Dunes Precinct of the Port of Richards Bay, and shall be connected to the boundary of the PoRB-LNG Import Terminal. The detailed information on the capacity and location of the bulk services are documented in the Prefeasibility Bulk Services Study Report (S2069-1-RP-GA-001). A summary of the existing bulk services available in the South Dunes precinct are listed below:

(a) Potable water supply: Pressure between 400KPa and 600KPa

(b) Power supply (sub-stations): The power in South Dunes precinct is supplied from the uMhlathuze Municipality. The Hydra substation belongs to the Municipality and has a capacity of 40 MVA, with the bulk of this capacity (30MVA) being supplied to the Richards Bay Coal Terminal. TNPA has 4.4 MVA capacity from the Municipality, of which 3 MVA is currently allocated to existing TNPA customers and TNPA itself, as such there is approximately 1.4 MVA latent capacity. Any electrical power requirements beyond 1.4 MVA will require the concessionaire to approach the Municipality for the supply of electricity.

(c) Servitudes: TNPA has earmarked servitudes for pipeline infrastructure, however the concessionaire is required to develop the servitude (i.e. clear vegetation and provide pipe rack). The concessionaire must obtain all environmental authorizations required for the development of the servitude and requisite infrastructure.

(d) It must be noted that, there is no sewage and stormwater infrastructure installed in the South Dunes precinct. The existing South Dunes terminal operators have installed septic tanks at their respective facilities and the Concessionaire should consider this solution for the proposed LNG terminal.

3. DEFINED SCOPE OF WORK

3.1. Local and International Standards and Specifications

The list of standards that the Bidders shall abide to in the design and construction of the LNG terminal includes but is not limited to the following:

South African National Standards

Table 1: Applicable local codes and standards

Code	Description
SANS 10089-1	The petroleum industry Part 1: Storage and distribution of petroleum products in aboveground bulk installations
SANS 1128-1:2010	Firefighting equipment Part 1: Components of underground and above-ground hydrant systems
SANS 1128-2:2010	Firefighting equipment Part 2: Hose couplings, connectors, and branch pipe and nozzle connections
SANS 10160	Basis of structural design

SANS 10100-1	Structural use of concrete
SANS 10161	Design of foundations for buildings
SANS 10400	National Building Regulations
SANS 200-6166	Specification preparation of engineering fills and backfills
SANS 1921-3:2004	Construction and management requirements for works contracts, Part 3: Structural steelwork
SANS 1921-5	Construction and Management of works contracts: Part 5, Earthworks activities to be done by hand
SANS 2001	Construction Works (All applicable parts)
SANS 1200	Standard Specification for Civil Engineering Construction (All applicable parts)

International Best Practice

Table 2: Applicable international codes and standards

Code	Description
ISGOTT 6th Edition	International Safety Guide for Oil Tankers and Terminals.
BS EN IEC 60079-10-1:2021	Explosive atmospheres Classification of areas. Explosive gas atmospheres.
PIANC Guidelines	Design of small to mid-scale marine LNG terminals.
SIGTTO	Floating LNG Installations.
EN 1990:2002+A1: 2005	Eurocode Basis of structural design

DIN EN 1090	Execution of steel structures and aluminum structures
EN 1993-1-1: 2005	Eurocode 3 Design of steel structures General rules and rules for buildings
EN 1993-1-5: 2006	Eurocode 3 Design of steel structures; Part 1-5: Plated structural elements
EN 1993-1-6: 2006	Eurocode 3 Design of steel structures; Part 1-6: Strength and stability of Shell structures
EN 1993-1-8: 2005	Eurocode 3 Design of steel structures; Part 1-8: Design of joints
EN 1993-1-10: 2005	Eurocode 3 Design of steel structures; Part 1-10: Material toughness and through thickness properties
EN ISO 12944-1 to 8	Corrosion Protection of steel structures by protective paint systems
DIN 18 800 Part 1	Structural steel work: Design and construction
DIN EN 1998-1 Eurocode 8	Design of structures for earthquake resistance
EN 1991-1-4:2005+A 1 Eurocode 1	Actions on structures Part 1-4: General actions – Wind actions
	NERSA Regulatory Requirements for LNG Imports (Act 48 of 2001)

3.2. Operational philosophy and process flow sequence

The Bidder shall develop a terminal operations philosophy, which will in turn act as a basis to the subsequent design, construction and operation of the LNG terminal and distribution facility. The operational philosophy shall indicate the processes that occurs from the offloading phase of operations to the distribution of the product. The Bidder shall align the operational philosophy and design to the codes, standards and regulations indicated in Section 3.1.

3.3. LNG Carrier Considerations, Floating Storage and Regasification Unit (FSRU), Gas Pipelines, Gas Distribution Hub (including metering stations)

The Bidder shall procure and utilize a FSRU for the storage and distribution of LNG and shall also design and install the related gas distribution hub, pipelines, pipeline supports and metering solutions to meet the desired throughput projections.

3.4. LNG Marine Terminal and Transfer Pipelines

The LNG facility shall consist of a marine terminal, transfer pipelines, storage, regasification, a vapour handling system and associated infrastructure/support facilities including but not limited to:

- LNG transfer pipeline,
- PLC based control system,
- Emergency shutdown system,
- Hazard detection system,
- Security system and facilities,
- Fire response system,
- Control building,
- Other facilities as required to support safe, efficient, and reliable operation.

3.5. LNG Jetty and associated infrastructure

The proposed LNG terminal shall consider a T-jetty or L-jetty configuration with a view of potential expansion in the future. Berth structure to be designed to accommodate a 125 000 DWT LNGC and a 95 000 DWT FSRU. Berth structure to be designed to accommodate 40KPa vertical live loads over cargo handling area (to cater for mobile cranes) and 20KPa elsewhere

The quay apron should be sized to accommodate the cargo handling equipment expected at the berth and must provide enough space for the movement of mobile cranes on the berth, including outriggers.

The jetty must be equipped with all relevant infrastructure that will enable safe operation of the terminal and shall meet the local and international safety criteria as stated in Section 3.1.

The associated infrastructure and services must include the following items:

- Fenders,
    - High Spec Fenders, the spacing of fenders and their protrusion from the quay should be adequate to prevent any part of the vessel from contacting the quay structure when the fenders are fully compressed. A maximum berthing angle of 10˚ is usually accepted for a tug-assisted berthing operation.
- Bollards,
    - Bollard pull of 150 ton at 20m intervals
- Aids to navigation,
- Safety equipment,
    - E.g., Stainless steel wharf access ladders at 80m intervals
- Walkways,
- Jetty lighting,
- Loading arms and manifolds,
    - Jetty design should include provision for up to 5 Loading arms in future.
- Pipe racks,
- Containment area and sumps,
- Services (drainage, potable water and stormwater),
- Firefighting and prevention equipment.

The jetty shall also be equipped with appropriate gas detection and fire suppression technology with a fire pumphouse preferably located on the landside.

3.6. Shoreline protection

The methods prescribed in the design and construction of the LNG terminal will have to ensure that the shoreline behind the jetty is always protected during the construction and operation of the facility. The floating pontoons constructed in the region, forms a breakwater that dissipates the resultant wave energy and thus protects the shoreline. The pontoons will have to be removed during the construction of the new LNG terminal; therefore, the successful bidder shall provide an alternate method of shore protection that fall within the environmental constraints or reinstate the existing shore protection.

3.7. LNG Terminal technology selection

The Concessionaire shall specify, procure, and install LNG terminal technology that is compatible with current Transnet infrastructure capabilities while meeting best practice and current industry standards.

3.8. Battery Limits

Transnet will provide servitudes within the Port boundary for pipeline installation. The concessionaire must seek approval from respective landowners for any servitudes outside of Port limits. Transnet shall provide bulk services to the boundary of the Terminal.

3.9. Marine Works and Associated Infrastructure

The Concessionaire shall undertake the design and construction of the necessary shore protection, which adheres to environmental regulations as well as undertake any capital dredging that may arise from the works. The scope shall include the design and construction of scour protection for the berth pocket.

3.10. Land Infrastructure

The Concessionaire shall design and construct the required pipe rack and pipeline infrastructure that leads from the proposed jetty to the designated off-take point. The pipe rack system shall be within the Transnet provided servitude as indicated below in Figure 3.

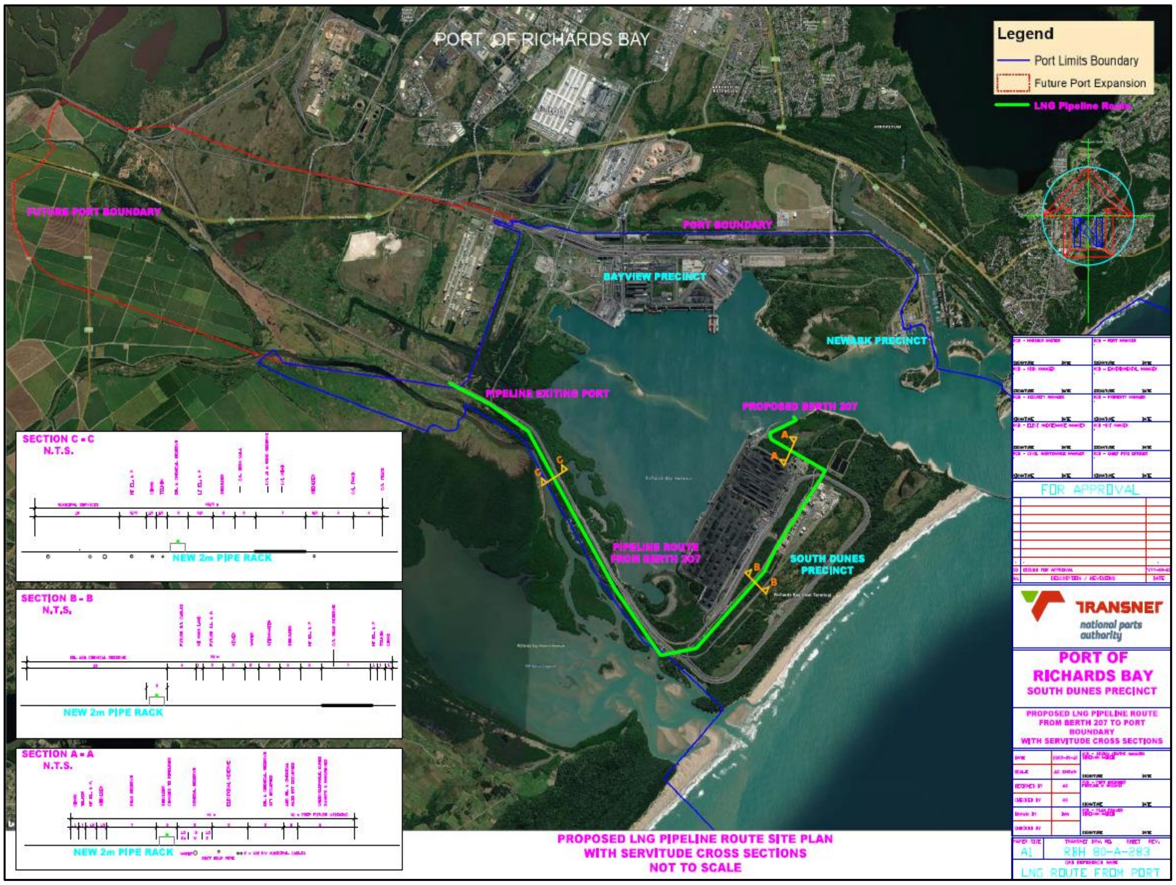


Figure 3: Proposed pipeline evacuation servitude from berth 207 to Port boundary

Land within the South Dunes precinct has been earmarked for future LNG storage. This land could potentially be developed into a truck loading facility within the Port boundary as a short-term solution (Figure 4). This solution considers the design and installation of a gas pipeline from proposed berth 207 to the proposed site.

The bidder must however note the following:

- The South Dunes Road infrastructure may need to be upgraded based on the additional truck volumes that may be realized due to this solution. The bidder must inform TNPA of the anticipated trucks volumes (peak flow). A traffic management plan will be required.

Figure 4: Proposed site for truck loading facility

3.11. Environmental Impact Assessments

The successful Bidder will be required to comply with all environmental legislation and regulations and shall obtain Environmental Authorisation for the project. Environmental requirements must be incorporated in the design to obtain approval for the project.

4. TECHNICAL SPECIFICATIONS

4.1. Site Conditions

(a) Boundary limits,

Figure 5 indicates the land and marine Port limits for the Port of Richards Bay. The Port Development Framework Plan (PDFP) makes provision for Port Expansion in future; however, the planned Port expansion does not affect the proposed position of Berth 207.

Figure 5: Port Limits for the Port of Richards Bay

(b) Port channel layout

The channels at the Port of Richards Bay range from -21.9m CD at the entrance channel (outer) to -14.5m CD at the Multi-Purpose Terminal (MPT) berths, as depicted in Figure 6.

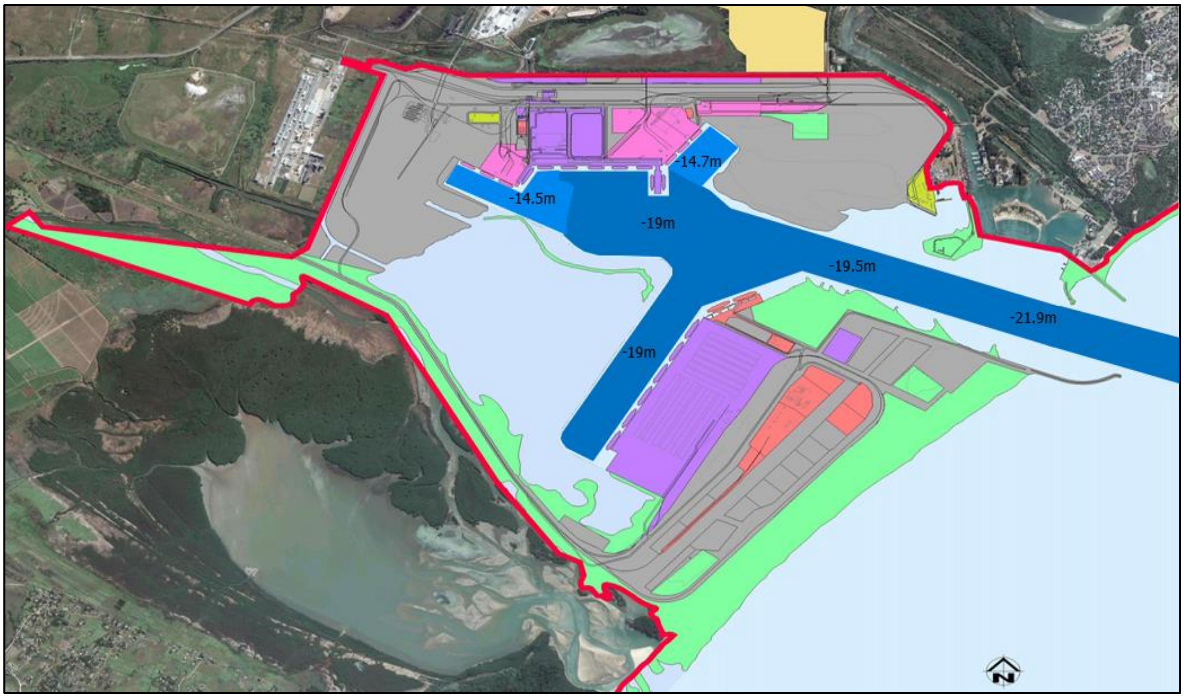


Figure 6: Port Limits for the Port of Richards Bay

The Port entrance channel existing site conditions are depicted in Table 3.

Table 3: Channel Site Conditions

Vessel Speed:	Maximum 6 knots (minimum 10 knots at approach channel)
Cross winds:	Predominantly South Easterly, 28 knots on average
Cross Currents:	Relatively minor between breakwater head and headland. Cross currents in other channels are generally generated by passing small craft vessels and Tugs
Navigation Aids	Leading lights and Buoy markers from entrance channel to inner channels
Depth	Approach channel depth is -23.9m CD, whilst the Entrance Channel depth ranges from -21.9m CD (Outer channel) to -19.5m CD (Inner channel).
Width	Entrance channel width is 300m and allows for one-way traffic with larger Panamax vessels and Cape Size vessels. It allows for two-way traffic movement with smaller vessels only (Handymax & small Panamax vessels).
Channel Bed	The approach and entrance channel (basin) bed is mainly composed of sand and silt

Berth access channels site conditions are depicted in Table 4 below.

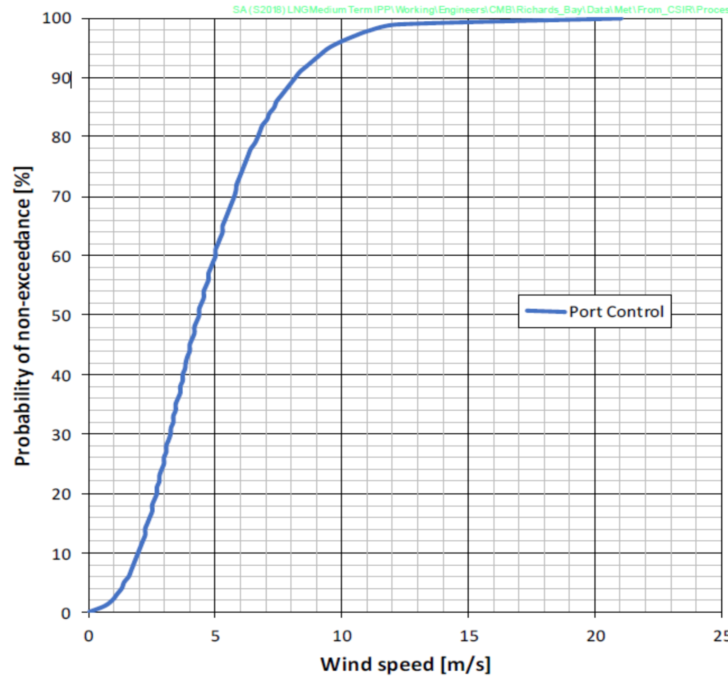
Table 4: Berth Access Channel Site Conditions

Traffic Movement	Channel width only allows for one-way traffic movement
Bed Composition	Basin bed composition mainly composed of sand and silt
Navigation Aid	Adequate navigation aid along route
Wave Response	Little or no wave response motions, due to sheltered waters
Cross winds	Cross winds along channel are 28 knots on average
Vessel Speed	Maximum 6 knots
Cross Currents	Relatively small cross currents caused by passing vessels
Depth	Access channel depth for the 200, 300 and 800 series berths are -19m CD as well as for berths 702 -705. Access channel depth for 600 series berths as well as berth 701 are -14.5m CD. Access channel depth for berths 706-708 are -14.7m CD.

(c) Site specific climatic data,

Wind

Measured wind data for the period 1993 to 2015 measured at Richards Bay Port Control was used to characterise operational and extreme wind conditions in the vicinity of the port and equates to 19.45 years of complete data. A non-exceedance plot of wind speed and a wind rose plot of the measured dataset are shown in Figure 7 and Figure 8 respectively.



Probability of non-exceedance [%]	Wind Speed [m/s]
10	1.95
20	2.69
30	3.23
40	3.71
50	4.36
60	5.01
70	5.75
80	6.67
90	8.16
95	9.47
99	12.24
100	21.04

Figure 7: Non-exceedance plot of 20-minute averaged wind speed at 10 m elevation measured at Richards Bay Port Control (28.79704°S 32.09915°E) for the period February 1993 to May 2015

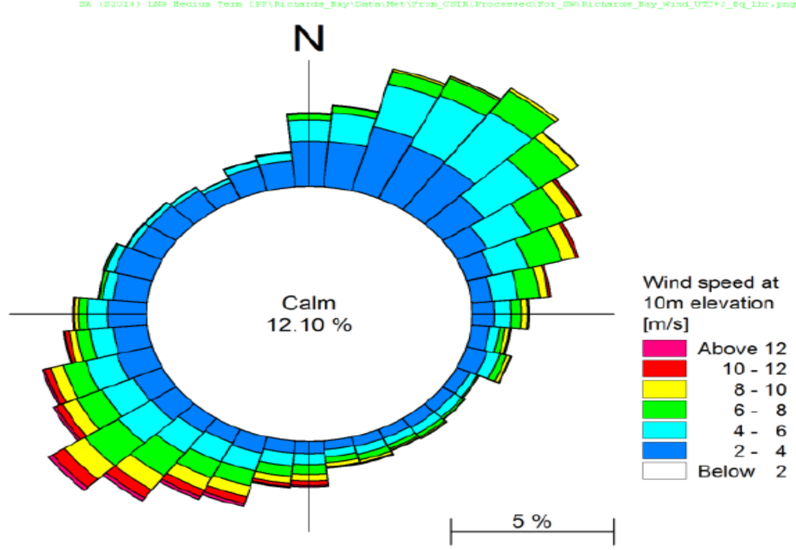


Figure 8: Wind rose for measured data at Richards Bay Port Control (32.09915°E, 28.79704°S) for the period February 1993 to May 2015

(d) Bathymetric survey information,

A bathymetric survey of the Port was conducted in 2016. Figure 9 below indicates the bathymetric survey of the 300 and 200 series berths. The bathymetric survey also includes the proposed site to accommodate berth 207. The depth in this vicinity starting from the Floating Breakwaters (Pontoons) to the access channel ranges from approximately -14m CD to -19m CD.

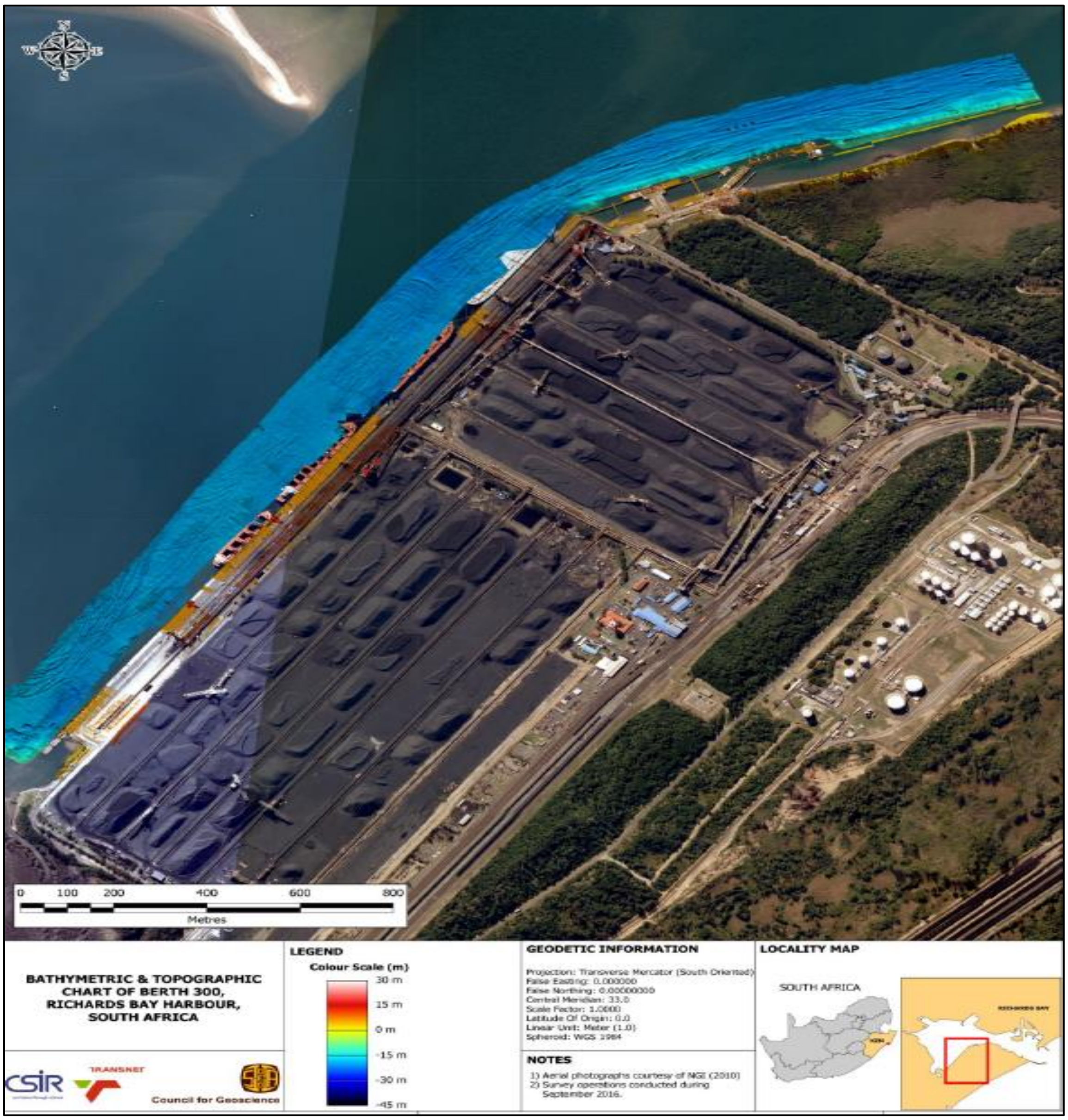
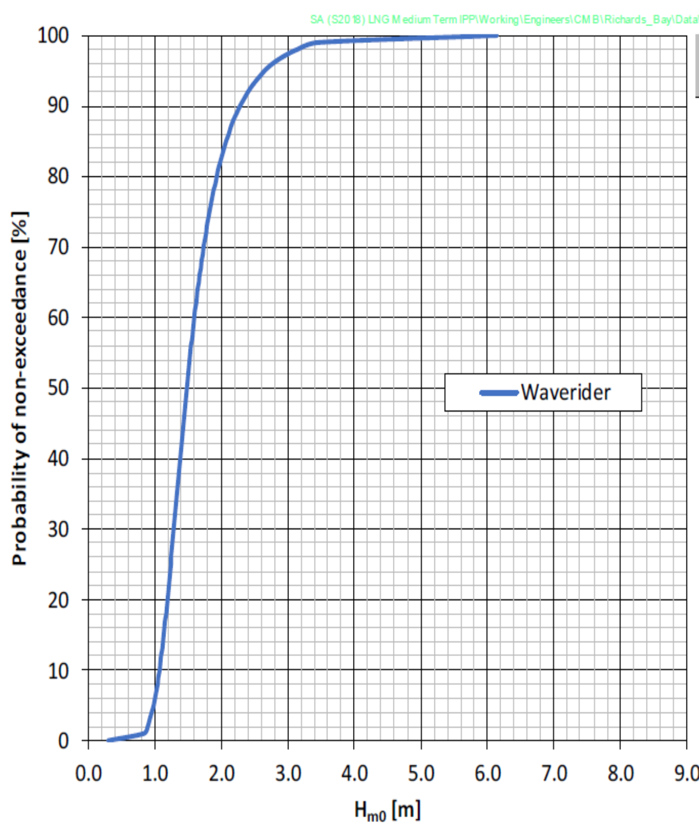


Figure 9: Bathymetric survey information

(e) Metocean data and <u>offshore waves</u>

Measured wave data is available at the offshore Waverider buoy in a water depth of 22m for the period January 1979 to May 2015 and equates to 23.7 years of complete data. Directional wave data is only available for the period November 2002 to May 2015 and equates to 12.1 years of complete data.

A non-exceedance plot of the significant wave height (Hm0) for the full available period is presented Figure 10. A wave rose and scatter plots of the directional wave data illustrating relationships between Hm0, peak wave period (Tp) is presented in Figure 11.



Probability of non-exceedance [%]	H_{m0} [m]
1	0.84
2	0.90
5	0.98
10	1.07
20	1.19
30	1.29
40	1.38
50	1.48
60	1.60
70	1.74
80	1.93
90	2.25
95	2.60
98	3.09
99	3.42
100	8.50

Figure 10: Non-exceedance plot of Hm0 measured at the Waverider buoy (28.8265°S, 32.104°E) for the period January 1979 to May 2015.

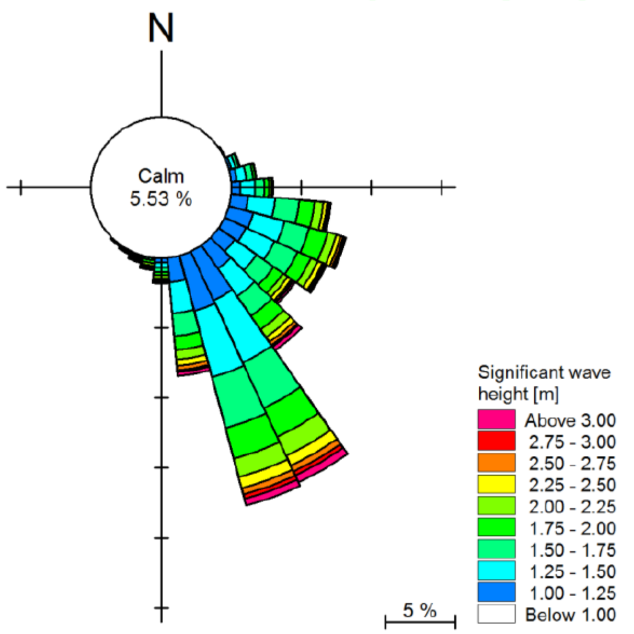


Figure 11: Wave rose of directional wave data measured at the Waverider buoy (28.8265°S, 32.104°E) for the period November 2002 to May 2015

The 23 year Waverider dataset was used to estimate the omni-directional extreme wave heights as presented in Table 5. Extreme wave heights have been increased by 12 % (in accordance with Section 2.2) to account for climate change. It is important to note that with a record length of 23.65 years, the uncertainty in the predicted extreme events increases significantly beyond the 70 year return period values.

Table 5: Omni-directional extreme value analysis of measured wave heights at the Waverider buoy (28.8265 °S, 32.104 °E) for the period January 1979 to May 2015 (including climate change).

Return Period [years]	H_{m0} [m]	
	Best estimate	Upper 95% confidence
1	4.9	5.1
10	6.6	7.6
20	7.5	9.0
50	8.9	11.3
100	10.1	13.6

(f) Existing geotechnical information.

Various geotechnical and geophysical surveys have been completed as part of previous studies. The extent of these site investigations is shown in Figure 12 .

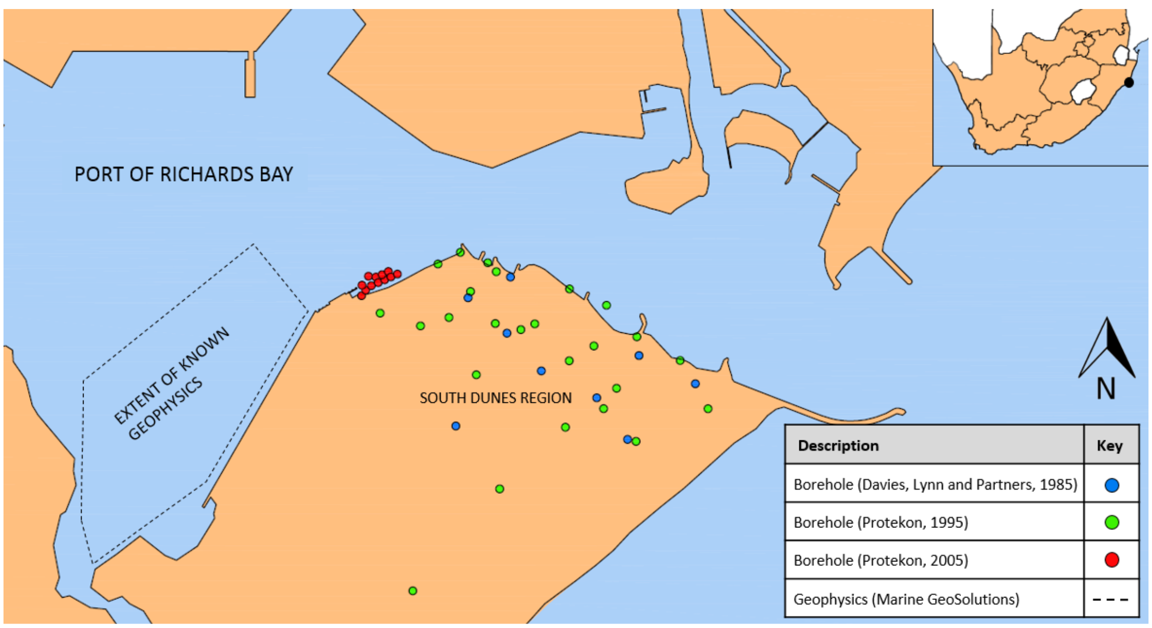


Figure 12: Extent of site investigations

The previous geotechnical surveys within the study area indicate that the area under investigation is a coastal dune area (beach and dune sands) underlain by cretaceous siltstone bedrock of the St Lucia formation beneath younger, largely unconsolidated aeolian and estuarine deposits.

The lagoonal/harbour deposits consist of varying layer thicknesses of sands, clays and silts, which exist in a matrix of varying compositions. The residual cretaceous siltstone layer is relatively thin and isolated across the study area and is underlain by the cretaceous siltstone bedrock across the entire study area. The typical geology stratigraphy across the study area is shown below in Table 6 below:

Table 6: Typical Geology Stratigraphy

Description	Group / Suite
Beach and Sand Dunes	Modern Deposits
Lagoonal Deposits (Harbour Beds)	Harbour Beds
Residual Siltstone	St Lucia Formation/Richards Bay Formation
Siltstone	St Lucia Formation/Richards Bay Formation

Currently the geotechnical information relating to the study area is limited to studies conducted for adjacent facilities and as such, no detailed site-specific geotechnical information is available for the proposed development site. As the stratigraphy across the site is highly variable, it is recommended that additional geotechnical site investigations be conducted.

4.2. Specialist Studies

The specialist studies that may be required for the project include but is not limited to the following:

(a) Navigation / Vessel manoeuvrings report including full bridge simulation,
(b) Mooring study/analysis,
(c) Geotechnical investigations,
(d) Wave propagation analysis, including long wave assessment.

5. DEFINED PERFORMANCE REQUIREMENTS

5.1. PoRB LNG Terminal Capacity

1 million tons per annum (mtpa) with provision for expansion to 5 mtpa by the year 2036.

5.2. PoRB LNG Terminal Design Life

In line with best international practice, the marine infrastructure design life shall be 50 years

5.3. Terminal Availability

The Terminal availability target shall be 99.5%

6. TECHNICAL PROPOSAL

Bidders' Technical proposals shall consider all requirements and information provided in this report. The entire scope as outlined above should be included in the technical proposal. The areas to be covered in the proposal shall include, but not limited to the following:

(a) Process flow diagrams,
(b) Terminal operation philosophy (from import terminal to offtake point),
(c) Terminal concept design,
(d) Jetty concept design,
(e) Details of plant and equipment,
(f) Detailed project schedule,
(g) Technical resources,
(h) Risk assessment and mitigatory actions,
(i) Shore protection strategy,
(j) Traffic management concept,
(k) Firefighting requirements and concept layouts.