REPORT

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PRE-FEASIBILITY STUDY REPORT

For: Port of Richards Bay

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PREFACE

This pre-Feasibility Study (PFS) is a precursor to a Feasibility Study (FS). The purpose of this document is to document the scope, procedure and outcomes of FEL-2 in a clear and consistent manner, in order to facilitate the quick and accurate review and evaluation of those outcomes. It also provides a detailed summary of the process and various actions taken for record purposes.

This pre-feasibility study is intended to investigate a range of options for any required upgrades to the bulk services and, after evaluating each option, to report and document the preferred option(s).

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EXECUTIVE SUMMARY

i. Introduction

As part of the Independent Power Producer (IPP) Procurement Programme, a gas to power (G2P) project has been launched by the South African Department of Energy (DoE) to address the electricity supply shortages in South Africa. The aim of the project is to develop and operate Liquefied Natural Gas (LNG) fired power stations at key locations in South Africa.

The pre-feasibility study for the Port of Richards Bay identified two preferred sites for the location of the LNG import facility and it was subsequently decided that Berth 207 should be adopted as the single preferred site. PRDW were subsequently appointed by TNPA to complete a pre-feasibility study for the supply of the required bulk services to the Phase 1 development of the LNG import facility which consists of a floating storage and regasification solution.

ii. Study Methodology

The main items of the pre-feasibility study methodology can be summarised as follows:

- Assess bulk services requirements for proposed LNG facility
- Assess existing bulk services systems
- Options assessment and multi-criteria assessment
- Pre-feasibility design of the bulk services infrastructure upgrades

iii. Options Identified and Preferred Option

Two options were identified for the required upgrades to the fire-fighting, electrical supply and potable water bulk services. No upgrades are required to the sewage and stormwater systems. The preferred options for the required upgrades are:

- Fire-fighting: Deluge system supplied from a new seawater pump station and a new foam pump station on shore adjacent to existing pump station.
- Electrical supply: Small power requirements and general lighting to the berth supplied directly from Berth 209 Substation at 400 V. The pumps will be supplied directly from the Berth 209 substation.
- Potable water supply: Install a second supply line from the M14 "Chemical Berth" take off.

iv. Risks

A preliminary project-wide risk register was developed to identify risks which may impact on the implementation or feasibility of the project. A total of 17 potential risks were identified.

A Hazard and Operability (HAZOP) Study was completed which identified a total of 13 hazards, 2 of them being classified as 'High' risk. Specific actions have been assigned to the FEL3 Designer, Terminal Operator and Port Engineer to mitigate these risks during future design phases and during operation.

v. Recommendations

The following recommendations are drawn from this study:

- The FEL3 phase should only proceed once there is certainty over the Gas-to-Power Programme and preferably once the Terminal Operator, responsible for the design and build of the LNG import facility, is appointed so that the specific Terminal Operator requirements can be accommodated.
- The feasibility of connecting the new fire-fighting supply system to the existing fire-fighting system be investigated to provide redundancy to the fire-fighting systems for Berth 207, 208 and 209.
- Opportunities for efficiently managing maintenance costs are to be specifically addressed in the FEL3 engineering stage.
- The emergency response time, and the possibility of developing a satellite fire station within the South Dunes Precinct, should be assessed during the Terminal Operator's detail design phase for the facility to ensure compliance with the requirements of SANS 10090.

1. INTRODUCTION

1.1. Background

As part of the Independent Power Producer (IPP) Procurement Programme, a gas to power (G2P) project has been launched by the South African Department of Energy (DoE) to address the electricity supply shortages in South Africa. The aim of the project is to develop and operate Liquefied Natural Gas (LNG) fired power stations at key locations in South Africa.

The DoE, in collaboration with Transnet SOC Ltd, and specifically its operating division Transnet National Ports Authority (TNPA), has undertaken a Pre-feasibility (FEL2) Study for LNG import projects at the Ports of Richards Bay, Ngqura and Saldanha Bay. The provision of bulk services was excluded from the FEL2 stage of the IPP project as this work was identified as being the direct responsibility of TNPA.

The pre-feasibility study for the Port of Richards Bay identified two preferred sites for the location of the LNG import facility, namely Berth 207 and the dig-out basin in the South Dunes area. The pre-feasibility study presented two distinct phases for the development of the LNG import facility – Phase 1 which consists of a floating storage and regasification solution and Phase 2 which consist of a land-based storage and regasification solution.

At the close-out workshop, held in the Port of Richards Bay on 20 September 2016, it was agreed that Berth 207 should be adopted as the single preferred site. PRDW were subsequently appointed by TNPA to complete a pre-feasibility study for the supply of the required bulk services to the Phase 1 facility at Berth 207.

1.2. Location of Project

The site for the proposed facility is located at the site identified in the Transnet Port Development Framework Plan (Transnet, 2015) for the development of Berth 207, adjacent to Berth 208. The proposed location and layout of the Phase 1 LNG import facility is illustrated in Figure 1-1 below.

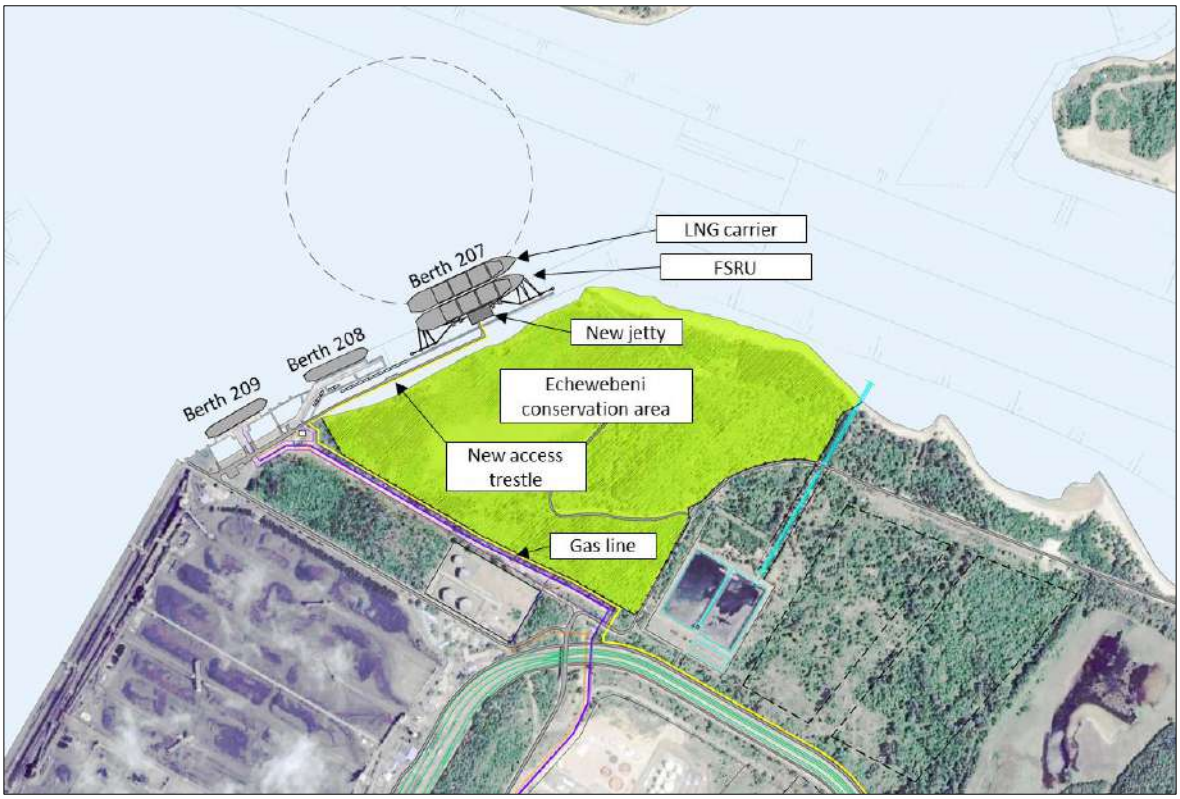

Figure 1-1: Location of the proposed LNG import facility

1.3. Pre-feasibility Study Scope of Work

The scope of work for this pre-feasibility study (FEL2) comprises an assessment of the bulk services requirements for the proposed LNG facility and the identification and assessment of options for upgrading the bulk services infrastructure where required. A multi-criteria analysis (MCA) was used to select the preferred options which will then be carried forward to the FEL3 phase.

A high-level summary of the scope of works required for this FEL2 study is as follows:

- Study coordination
- Assess bulk services requirements for proposed LNG facility
- Assess existing bulk services systems
  - Collate and review available (existing and planned) services information
  - Identify capacity constraints
  - Review impact of proposed LNG facility on the existing infrastructure
- Options assessment
  - Identify options for upgrading capacity (if applicable)
  - Complete high-level MCA to select preferred option
- Design bulk services infrastructure upgrades for preferred option
  - FEL2 design of required upgrades
  - Drawing development

- High-level environmental assessment
- Reporting
- Attend Gate Review

1.4. Pre-feasibility Study Participants

PRDW's key members on the project team were as follows:

Resource	Project Role	Position
Sahil Patel	Project Director	Director
Darren Cloete	Project Leader	Senior Engineer
Kenneth Pedersen	Bulk Services Technical Lead	Technical Director
Ryan Abrey	Bulk Services Engineer	Engineer
Craig Hinde	Quantity Surveyor Lead	Technical Director

1.5. Pre-feasibility Study Methodology

The following methodology was employed to fulfil the scope of works defined in Section 1.3:

- **Assess bulk services requirements for proposed LNG facility**

  For this study, operators of existing LNG import terminals were approached to provide input regarding the typical bulk services requirements for LNG facilities. However, as no responses were received from the operators, the bulk services requirements for the facility were rather based on typical demands identified from literature and previous project experience.

- **Assess existing bulk services systems**

  The capacity of the existing bulk services infrastructure within the South Dunes area was based on the available infrastructure drawings and Master Plans provided by the Port. A site visit was also conducted to assess the condition of the existing infrastructure and to identify any constraints on the existing facilities.

  The projected bulk requirements for the LNG import facility were then compared against the capacities of the existing bulk services infrastructure to identify areas where upgrades to the infrastructure may be required.

- **Options assessment and multi-criteria assessment**

  Multiple options were identified for each of the areas where upgrades to the existing bulk services infrastructure is required. These options were then assessed in in a multi-criteria assessment to objectively assess each option. The criteria for the assessment were weighted based on their importance and overall contribution to the assessment and each option was then scored against the assessment criteria to identify the preferred option.

- **Pre-feasibility design of the bulk services infrastructure upgrades**

  The designs of the preferred option, as identified by the MCA, were developed to a sufficient level of detail to allow for the completion of a level 2 capital cost estimate within the required accuracy levels (-20% to +30%).

- **Environmental assessment**

  SRK Consulting South Africa (Pty) Ltd (SRK) was appointed to undertake a high-level environmental assessment of the proposed bulk services upgrades. The assessment included assessment review of existing relevant literature and previous studies, identification of fatal flaws and key environmental considerations, input into the MCA for the upgrade options, identification of the required specialist studies and potential environmental offsets and scoping of the Environmental Impact Assessment.

The study battery limits extend from the from the site of the proposed LNG facility to the closest connection point into the existing bulk services infrastructure within the South Dunes area.

This study focuses on the additional capacity requirements for the development of the Phase 1 (floating storage and regasification) LNG facility and does not consider the additional requirements the future land-based storage and regasification facility or for any other proposed developments within the South Dunes area.

2. OPTIONS IDENTIFICATION

The requirements for upgrading the bulk services infrastructure, and the associated options for doing so, were determined through an assessment of the existing bulk services infrastructure and the bulk services demand for the proposed LNG facility. This Section of the report summarises the identification of the options while full details of the assessment are presented in the Bulk Services Capacity Assessment, Demand Forecast and Options Identification technical note (PRDW, 2018a), included as Appendix A of this report.

2.1. Bulk Services Requirements

Floating Storage Regasification Unit (FSRU) vessels are typically designed to be self-sufficient such that they can operate both within a port (at a berth) or offshore (berthed at either a single point mooring or a multi-buoy mooring). Additional bulk services may however be required to support complementary infrastructure at the terminal (control tower, loading equipment, lighting, etc.).

As part of this study, multiple FSRU operators were contacted to provide typical bulk services requirements for LNG facilities. Since no feedback was received from the FSRU operators, the bulk services requirements were estimated based on a literature review and previous experience on projects of a similar nature.

2.2. Proposed Upgrade Options for Bulk Services

The following options were identified for the required upgrades to the existing bulk services infrastructure:

Bulk Service	Option 1	Option 2
Firefighting	Deluge system supplied from a new seawater pump station on shore adjacent to existing pump station. Foam supplied by the existing foam pump station.	Deluge system supplied from pumps on the access trestle near the new berth. Foam tanks accommodated along the access trestle.
Electrical Supply*	Small power requirements and general lighting to the berth supplied directly from Berth 209 Substation at 400 V. The sea water pumps will be supplied directly from the Berth 209 substation.	Miniature substation provided at new berth to accommodate sea water pump requirements at 11 kV as well as the small power requirements and lighting at 400 V.
Sewage	No bulk services upgrade required.	
Potable Water	Install a second supply line from the M14 "Chemical Berth" take off.	Construct a booster pump station to provide the pressure required at the proposed LNG berth utilising the existing pipeline.
Storm water	No bulk services upgrade required.	

*depending on fire-fighting requirements.

Table 2-1: Upgrade options summary

3. OPTIONS EVALUATION

A Multi-criteria Assessment (MCA) was completed to select a single preferred option for the required system upgrades for each category of bulk services (fire-fighting, electrical supply and potable water systems). The methodology and outcomes of the assessment are summarised in the following sections while full details of the assessment are presented in the Options Evaluation technical note (PRDW, 2018b), included as Appendix B of this report.

3.1. Evaluation Criteria

The criteria considered in the MCA are described in Table 3-1 below.

Main Criteria	Sub-criteria	Description
Inherent Safety	Safety of personnel	Safety of personnel during construction and operation and the inherent system redundancy.
	Redundancy implications for existing services	
Accessibility	Safe access for operation and maintenance	Ease of access for maintenance and operation of the facility.
Implementation	Availability of skills and materials	Ease of implementation or construction considering both the technical aspects during construction and the interface between the Port and the Private Terminal Operators during construction and operation.
	Speed of construction	
	Risk of delays during construction	
	Interface between port & terminal operators	
Maintainability	Localisation and repairability of damage	Ease of maintaining the infrastructure for the duration of its operational life.
	Special maintenance requirements (e.g. anodes, painting, etc.)	
Value and Cost	Capital cost	Relative quantitative assessment of the envisaged capital and operational costs associated with the facility.
	Operating and maintenance cost	
Environmental	Construction footprint and marine abstraction impacts as applicable	Relative assessment of the envisaged environmental impacts during construction or operation.

Table 3-1: Multi-criteria assessment criteria

For all criteria, other than value and cost, the options were assigned qualitative scores, relevant to the other options being considered, according to the scoring guideline outlined in Table 3-2 below.

Score	Comment
10	Good
5	Average
1	Bad

Table 3-2: Multi-criteria assessment – scoring guideline

The value and cost criteria were assigned quantitative scores, based on the concept-level cost estimates. The quantitative scores were assigned according to the following formula:

$$Assigned\ score = \frac{Minimum\ value\ for\ all\ options}{Value\ for\ the\ option\ considered} \times 10$$

3.2. Criteria Weighting

The options were assessed against base weightings for the MCA criteria after which a sensitivity analysis was also completed to assess the sensitivity of the MCA to the criteria weightings. The criteria weightings for the various scenarios considered in the MCA are presented in Table 3-3 below.

Main Criteria	Base Case	Sensitivity Analysis Weighting Bias						
		Equal	Inherent Safety	Accessibility	Implementation	Maintainability	Value and Cost	Environmental
Inherent Safety	20%	17%	50%	10%	10%	10%	10%	10%
Accessibility	15%	17%	10%	50%	10%	10%	10%	10%
Implementation	10%	16%	10%	10%	50%	10%	10%	10%
Maintainability	10%	16%	10%	10%	10%	50%	10%	10%
Value and Cost	25%	17%	10%	10%	10%	10%	50%	10%
Environmental	20%	17%	10%	10%	10%	10%	10%	50%
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 3-3: Multi-criteria assessment – criteria weightings

3.3. MCA Results

The outcomes of the MCA, indicating the overall option scores (as a percentage of the maximum possible score) for both the base weighting and sensitivity analysis criteria weightings, are summarised in Table 3-4 below.

Weighting Bias	Fire-fighting		Potable Water	
	Option 1: New pump station adjacent to existing pump station.	*Option 2: New pumps on the access trestle near the proposed berth.*	*Option 1: Second supply pipeline from chemical berth take-off.*	*Option 2: New booster pump station on existing supply line.*
Base Case	91%	64%	77%	68%
Equal	91%	60%	77%	69%
Inherent Safety	94%	56%	77%	62%
Accessibility	94%	56%	67%	62%
Implementation	84%	60%	83%	68%
Maintainability	90%	56%	87%	78%
Value and Cost	86%	76%	87%	66%
Environmental	94%	56%	67%	82%

Table 3-4: Multi-criteria assessment results

For the fire-fighting requirements Option 1 scores consistently higher than Option 2 due to the benefits that will be realised by constructing the pump station adjacent to the existing pump stations. From an environmental perspective, it is also preferable to combine the seawater extraction point with the existing pump station's extraction point.

For the potable water requirements Option 1 scores higher than Option 2 for all criteria except for the environmental criteria primarily due to the simplicity of installing an additional pipeline and the associated safety, implementation, maintenance and cost benefits when compared to installing a booster pump station.

From an environmental perspective, Option 1 scores relatively poorly due to the length of trenching required to install the additional pipeline. It is however noted that the entire area affected by the excavations is already disturbed from its natural state and therefore the potential environmental impacts should be marginal.

As noted in Table 2-1, the selection of the preferred option for the electrical supply to the proposed berth is dependent on the preferred fire-fighting option and therefore no MCA was completed for the electrical supply options.

3.4. Preferred Options

The preferred option for each bulk service upgrade is presented in Table 3-5.

Bulk Service	Preferred Option
Fire-fighting	**Option 1:** Deluge system supplied from a new seawater pump station on shore adjacent to existing pump station. Foam supplied by the existing foam pump station.
Electrical Supply	**Option 1:** Small power requirements and general lighting to the berth supplied directly from Berth 209 Substation at 400 V. The sea water pumps will be supplied directly from the Berth 209 substation.
Sewage	*No bulk services upgrade required.*
Potable Water	**Option 1:** Install a second supply line from the M14 "Chemical Berth" take off.
Storm water	*No bulk services upgrade required.*

Table 3-5: Preferred options

The preferred options were carried through to the preliminary engineering phase to advance the concepts to an FEL2 level of development.

4. PRE-FEASIBILITY DESIGN FOR THE PREFERRED OPTIONS

This section of the report summarises the design outcomes for the bulk services upgrades that are required for the new Berth 207. Full details of the engineering development, as well as the associated drawings, are provided in the Bulk Services Upgrade Design technical note, included as Appendix C of this report.

4.1. Fire-fighting

A seawater pump station and a foam pump station are required to supply the new berth with sea water and foam water. The design of the fire-fighting system was based on the duty flow rates for the existing Berth 208 fire-fighting system.

It is noted that both the Options Identification Report (PRDW, 2018a) and the Options Evaluation Report (PRDW, 2018b) assumed that the additional foam requirements could be accommodated at the existing foam pump station. Further engineering development during this pre-feasibility design phase has indicated that the existing foam pump station cannot accommodate the additional requirements and that a new foam pump station building will be required. The optimum location for this pump station is adjacent to the existing facility as a large holding tank is required.

The requirement for the additional foam pump station building further reinforces the outcome of the options assessment (PRDW, 2018a). The alternative option would involve constructing this foam pump station on the access trestle which is not considered to practical or cost effective.

The new pump stations are to be located near the existing pump stations with the sea water and foam water pipelines routed along the access trestle to Berth 207. Similar to the existing seawater pump installation, it is envisaged that the new firewater pumps will be large vertical turbine multi-stage pumps: one electrically driven duty pump and one diesel driven standby pump. The diesel standby pump will allow for operation should the main electrical supply to the pump station be faulty or when maintenance of the duty pump is in progress. A similar duty/standby pump configuration is required for the smaller foam pump installation.

To address the high maintenance costs associated with the existing Berth 208 fire-fighting pump installation, it is recommended that opportunities for efficiently managing maintenance costs be specifically addressed in the FEL3 engineering stage.

It is noted that the new fire-fighting supply system could possibly be connected to the existing fire-fighting system to also supply Berths 208 and 209, if considered to be a worthwhile additional risk mitigation measure. The technicalities of this possibility have not been assessed in this study but could be addressed in the next engineering stage, if required.

The following berth fire-fighting equipment, based on the existing equipment installed for Berth 208, is envisaged for Berth 207:

- 12 No. Seawater Fire Hydrants;
  - 10 No. Hydrants along the access trestle (1 No. every 50 m);
  - 2 No. Hydrants on the berth platform;
- 2 No. Oscillating Monitors;

- 2 No. Remote Control Monitors;
- 3 No. Bund Pourers; and
- 3 No. Quay Pourers.

4.2. Electrical Supply

The electrical supply requirements are based on a power demand of up to 60 kVA for small quayside power requirements and general lighting at LNG Berth 207. It is envisaged that this power will be provided at 400 volts from the existing Berth 208 substation along a cable installed on cable trays fixed to the underside of the quay structure and typically feeding two distribution kiosks. All small power (including quick release hooks) and lighting requirements for the berth will be supplied from these distribution kiosks.

Power to the sea water and foam pump stations (estimated to be 1 200 kW) will also be provided from the existing Berth 208 substation along an underground cable to the proposed new pump station location adjacent to the existing pump station building.

The following electrical equipment is envisaged for the bulk electrical supply upgrade:

- 27 No. Light Pole with 250 W HPS Fitting;
- 2 No. Light Mast Equipped with 400 W HPS Floodlight; and
- 1 No. Distribution Kiosk.

4.3. Potable Water

The preferred installation of a second uPVC supply pipeline from the M14 "Chemical Berth" take-off to the proposed Berth 207 requires that a new supply line is buried in a trench for approximately 265 m, parallel to the existing supply line, before routing the pipeline an additional 600 m along the new access trestle to the proposed Berth 207.

The following berth potable water fire-fighting equipment, based on the existing equipment provided for Berth 208, is envisaged for Berth 208:

- 12 No. Potable Water Fire Hydrants
  - 10 No. Hydrants along the access trestle (1 No. every 50 m); and
  - 2 No. Hydrants on the berth platform.

5. COST ESTIMATE

5.1. Capital Cost Estimate

5.1.1. Capital Cost Basis

The capital cost estimate for the upgrading the bulk services (fire-fighting, potable water and electrical infrastructure) within the Richards bay Port to provide facilities to the new LNG, have been prepared considering the layouts and basic engineering information presented in this report. Additional considerations include:

- The Estimate Class: The estimate is set at an AACE Class 4 / FEL2 level with an agreed level of accuracy of -20 % to +30 %
- The estimate has been derived using a combination of measured preliminary quantities and corresponding current or escalated unit rates largely based upon PRDW's internal rates database supported by indicative market related pricing information received from specialist contractors and suppliers. Built-up rates and prices have been used where no relevant rates or prices were available.

The estimate is subject to the following assumptions and exclusions:

Assumptions:

- Cost base dated as at January 2018
- Exchange Rate (Dollar) – $ 1.00 : R 12.20
- Exchange Rate (Euro) – 1.00 € : R 14.90

Exclusions:

- Upgrading of the storm water and bulk sewage system
- Purchase/lease of land and/or relocation, restitution costs
- Local or other authority approvals
- Allowance for compensation to third parties
- Allowance for market adjustment due to local and international demand, availability of skills, resources and materials
- Environmental, EIA and EMP costs
- Allowance in respect of post contract contingencies (10% recommended)
- Allowance in respect of pre-and post-contract escalation
- Rate of exchange adjustments
- Owners costs and Construction supervision costs
- Value Added Tax or other foreign or South African taxes, royalties and dues

5.1.2. Preliminary and General Cost Allowance

An allowance for the contractor's Preliminary and General (P&G) costs has been included as part of the base capital cost estimate for each cost element. The P&G allowance is dependent on the nature

of the works a P&G allowance of 20% been included as a percentage of the total value of construction work.

5.1.3. Design Development Allowance

A design development allowance of 15%, has been included to cover design and pricing uncertainties due to the level of design information available at this FEL 2 stage of the project. The design development allowance is included in the base capital cost estimate as a percentage of the total value of construction work, including P&G's.

5.1.4. Professional Fee Allowance

In addition to the P&G's and design development allowances, a professional fee allowance of 8% has been included to cover engineering fees.

5.1.5. Capital Cost Summary

The estimated capital costs for the upgrading the LNG Terminal bulk services, subject to the assumptions and exclusions as listed above, as summarised in Table 5-1 below. The detailed capital cost estimate is included as Appendix D of this report.

Description	Fire-fighting Infrastructure	Potable Water Infrastructure	Electrical Infrastructure
Base Capital Cost	R 34 030 000	R 810 000	R 1 920 000
Preliminary and General costs	R 6 800 000	R 160 000	R 390 000
Design Development Allowance	R 6 130 000	R 150 000	R 340 000
Professional Design Fees	R 3 750 000	R 90 000	R 220 000
ESTIMATED CAPITAL COSTS	**R 50 710 000**	**R 1 210 000**	**R 2 870 000**

Table 5-1: Capital cost estimate summary

5.2. Annual Operational Cost Estimate

5.2.1. Operational Cost Basis

The operational cost estimate has been prepared considering the layouts and basic engineering information presented in this report. The basis of the operational cost estimate is as follows:

- The estimate is set at an AACE Class 4 / FEL 2 level with an agreed level of accuracy of -30 % to +50 %.
- The estimate for the annual maintenance of the infrastructure is based on PRDW's internal rates database. The infrastructure requires regular maintenance checks to ensure that these items remain fit for purpose.

The operational cost estimate is subject to the following main assumptions and exclusions:

Assumptions:

- Cost base and exchange rates as per the capital cost estimate (Section 5.1.1)

Exclusions:

- Storm water and sewage bulk services operational costs
- Allowance for market adjustment due to local and international demand, availability of skills, resources and materials
- Environmental, EIA and EMP maintenance costs
- Insurances
- Utility costs, royalties and municipal fees
- Value Added Tax or other foreign or South African taxes, royalties and duties

A detailed list of assumptions and exclusions is included in the cost estimate summary sheets, included as Appendix D of this report.

5.2.2. Operational Cost Summary

The estimated annual operational and maintenance costs for the bulk services for the LNG terminal, subject to the assumptions and exclusions as listed above, are summarised in Table 5-2. The detailed operational and maintenance cost breakdown is included in Appendix D of this report.

Description	Fire-fighting Infrastructure	Potable Water Infrastructure	Electrical Infrastructure
Estimated Operational Costs	R 2 350 000	R 60 000	R 130 000

Table 5-2: Operational cost estimate summary

6. PROJECT SCHEDULE

The implementation schedule for the provision of the required bulk services is summarised in Figure 6-1 below. A detailed implementation schedule for the works in included as Appendix E of this report.

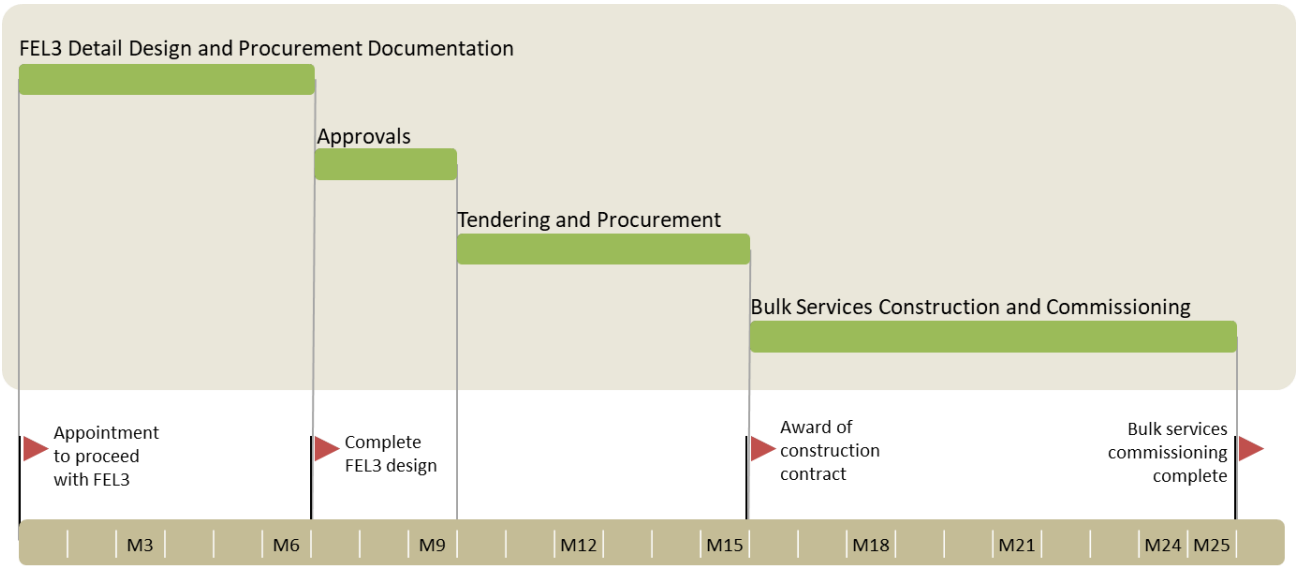

Figure 6-1: High-level implementation schedule

It is noted that a decision to proceed to FEL3 should only be taken once there is certainty over the Gas-to-Power Programme and preferably once the Terminal Operator, responsible for the design and build of the LNG import facility, is appointed so that the specific Terminal Operator requirements can be accommodated. Installation of the bulk services to the berth relies on the berth and access trestle being commissioned in parallel with the bulk services infrastructure.

7. HEALTH, SAFETY AND ENVIRONMENTAL DESIGN CONSIDERATIONS

7.1. Health and Safety Design Considerations

7.1.1. Access to services

Access to the services along the berth will be via the access trestle to be constructed as part of the proposed Berth 207 development. The proposed access trestle, developed as part of the pre-feasibility study for the LNG import infrastructure (PRDW, 2016), consists of a single lane roadway for vehicular and pedestrian access. A dedicated pedestrian access route has not been provided due to the low volume of traffic envisaged for the access route and the associated low risk to personnel.

7.1.2. Emergency Response

Under emergency situations, the access route is to be declared 'pedestrian only' to allow for personnel to evacuate. It is assumed that the emergency will be managed by emergency personnel on the berth or remotely until the berth is evacuated, after which emergency vehicles can be deployed to the berth. Emergency fire-fighting equipment will be controlled remotely.

While the development of the facility is outside of the scope of this study, it is prudent to note the fire-fighting response requirements for the facility. Owing to the nature of the proposed LNG import facility, coupled with the operations of the surrounding facilities within the South Dunes Precinct, the

development is likely to be classified as a Category A development (extremely high property and life risk) according to SANS 10090. In accordance with the requirements of SANS 10090, the required emergency response time to Category A development is less than 8 minutes.

Due to the distance from the port entrance to the South Dunes Precinct, it is recommended that the emergency response time, and the possibility of developing a satellite fire station within the South Dunes Precinct, be assessed during the Operator's detail design phase for the facility.

7.1.3. Redundancy

As per the Options Identification Report (PRDW, 2018a) it is noted that the existing seawater pumps are unable to supply both existing Berths 208 and 209 simultaneously. It is therefore recommended that the feasibility of providing redundancy by connecting the new Berth 207 fire-fighting supply system to the existing system be assessed as part of the FEL3 study.

7.1.4. Lighting

Provision has been made for lighting to provide sufficient light for safe operation of the facilities.

7.2. Environmental Design Considerations

SRK Consulting (South Africa) (Pty) Ltd (SRK) were appointed to undertake a high-level environmental assessment of the required bulk services for the proposed LNG Terminal.

The assessment indicates that in terms of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) the South African Heritage Resource Agency (SAHRA) will need to be notified of the project due to the proposed construction of the potable water pipeline which will exceed 300m in length. Following the submission of an initial online application, SAHRA may require additional Heritage studies to be undertaken by a suitably qualified heritage consultant.

Barring the SAHRA requirements, no additional environmental authorisations, permits or approvals should be required.

Full details of the assessment are outlined in the environmental screening report, included as Appendix F of this report.

8. RISK ANALYSIS

8.1. Project Risks

A preliminary project-wide risk register was developed to identify risks which may impact on the implementation or feasibility of the project. The project risk register considered potential risks across the categories, and associated sub-categories, presented in Table 8-1 below.

Category	Sub-category
Business Environment	Legislation
	Taxation
	Economy
	Government Policy
Construction Industry	Workforce
	Market conditions
	Material suppliers
Client Risks	Business Plan
	Definition of need
	Business case
	Client delivery
	Land 'conditions'
Project Risks	User Requirements
	Project Team
	Site Investigations
	Design
	External approvals
	Design compliance
	Project Controls
	Procurement
	Construction

Table 8-1: Project-wide risk categories

Each identified risk was assigned a qualitative risk ranking to produce a project-wide risk profile. The resultant risk profile is shown in Table 8-2 below while the full details risk identification and ranking is presented in the FEL2 risk register, included as Appendix G of this report.

CONSEQUENCE RATING	LIKELIHOOD RATING: Almost Certain	Likely	Possible	Unlikely	Rare
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	1	0	1
4	0	0	2	0	0
5	0	2	6	0	0
6	0	1	0	1	0
7	0	4	0	0	0
TOTALS	0	1	12	5	0

Table 8-2: Project-wide risk profile

It is recommended that the project risk register be kept 'live' to capture and monitor all risks to the project during the FEL3 design and implementation phases. A full risk management strategy should be developed during the FEL3 design phase.

8.2. Risks During Construction and Operation

A Hazard and Operability (HAZOP) Study was completed in accordance with TNPA's HAZOP Study Methodology for each category of bulk services to identify potential hazards during construction and operation of the preferred options and to determine whether these hazards could be mitigated by practical design modifications.

It should be noted that the HAZOP study focused on the technical aspects of the design which were available at the FEL2 stage of project definition. The HAZOP study will need to be updated during the FEL3 study, once the Terminal Operator has been appointed, to identify any specific operational risks associated with the operator's proposed operational methodology.

A total of 13 hazards were identified during this study, two (2) of them being classified as 'High' risk. Specific actions have been assigned to the FEL3 Designer, Terminal Operator and Port Engineer to mitigate these risks during future design phases and during operation.

The risk ranking distribution of the identified hazards is summarised in Table 8-3 below while the full details of the assessment and the risks identified are provided in the HAZOP Study report, included as Appendix H of this report.

Risk Ranking	Number of Hazards Identified
High	2
Medium	7
Low	4

Table 8-3: Construction and operational risk ranking distribution

9. FRAMEWORK FOR FEL3

Based on the findings of this FEL2 study it is recommended that this project move into the FEL3 with the preferred options as identified in this report. It is however recommended that the FEL3 phase only proceeds once there is certainty over the Gas-to-Power Programme and preferably once the Terminal Operator, responsible for the design and build of the LNG import facility, is appointed so that the specific Terminal Operator requirements can be accommodated.

9.1. FEL3 Project Scope

It is envisaged that the FEL3 scope of work will consist of the primary activities described below:

- Project Management and Coordination
  - Meet the Client to develop and discuss the basis of design
  - Engage with the Terminal Operator to identify their specific requirements
  - Formalise scope of project and agreements with TNPA
  - Kick-off meeting, monthly progress meetings, workshops, gate review meeting
  - General project administration
- FEL 3 Engineering
  - Prepare a design basis for the Client's approval
  - Front end engineering design
    - Potable water
    - Fire-fighting
    - Electrical supply
  - Review available site information
  - Specify all mechanical and electrical equipment
  - Indicative method of construction;
  - Develop capital and operational cost estimate
  - Develop implementation schedule
- Environmental Assessment
  - Review possible deviations for FEL2 scoping study
  - Update scoping study as required and identify relevant authorities
- Tender Documentation and Procurement

  - Prepare the scope of works, specifications, bill of quantities, pricing instructions, tender drawings and site information for the tender documents.
  - Attend a tender clarification meeting, preparation of notices to tenders and evaluation of the tenders
  - Technical review input into the tender evaluation report
  - Input into the TNPA project execution plan (PEP)
  - Input into the Clients Procurement documentation including works information, tender data, returnable schedules and contract data
- FEL3 Gate review meeting
- Attend a risk assessment workshop
- FEL3 Deliverables
  - Design Basis
  - FEL3 Design Report
  - FEL 3 Design – 40% to 70% of total engineering
  - Capital and operational cost estimate (-10% to +15% level of accuracy)
  - Level 3 schedule
  - Tender Documentation (Works Information, Specifications, BOQ, Pricing Assumptions, Site Information, Tender Drawings)

9.2. FEL3 Schedule

It is envisioned that the FEL 3 Study duration will be 6 months.

10. CONCLUSION AND RECOMMENDATIONS

The study assessed the bulk services requirements for the proposed LNG facility and options for upgrading the bulk services infrastructure where required. A multi-criteria analysis (MCA) was used to select the preferred options. The following conclusions and recommendations are drawn from this study:

10.1. Conclusions

- Two options were identified for the required upgrades to the fire-fighting, electrical supply and potable water bulk services. No upgrades are required to the sewage and stormwater systems.
- The preferred options for the required upgrades are:
  - Fire-fighting: Deluge system supplied from a new seawater pump station and a new foam pump station on shore adjacent to existing pump station.
  - Electrical supply: Small power requirements and general lighting to the berth supplied directly from Berth 209 Substation at 400 V. The pumps will be supplied directly from the Berth 209 substation.
  - Potable water supply: Install a second supply line from the M14 "Chemical Berth" take off.
- The capital costs for the upgrades to the fire-fighting, electrical supply and potable water supply systems are estimated to be R50.7 million, R1.2 million and R2.9 million respectively.

- The annual operational costs for the upgrades to the fire-fighting, electrical supply and potable water supply systems are estimated to be R2.35 million, R0.06 million and R0.01 million respectively.
- The project schedule allows for a period of 25 months, after appointment of the FEL3 designer, for detail design, approvals, procurement, construction and commissioning of the bulk services upgrades.
- The results of the high-level environmental assessment indicate that, barring notifying the South African Heritage Resource Agency (SAHRA) of construction of the pipeline, no additional environmental authorisations, permits or approvals should be required.
- A preliminary project-wide risk register was developed to identify risks which may impact on the implementation or feasibility of the project. A total of 17 potential risks were identified.
- A preliminary Hazard and Operability (HAZOP) Study was completed which identified a total of 13 hazards, two (2) of them being classified as 'High' risk. Specific actions have been assigned to the FEL3 Designer, Terminal Operator and Port Engineer to mitigate these risks during future design phases and during operation.

10.2. Recommendations

- The FEL3 phase should only proceed once there is certainty over the Gas-to-Power Programme and preferably once the Terminal Operator, responsible for the design and build of the LNG import facility, is appointed so that the specific Terminal Operator requirements can be accommodated.
- The feasibility of connecting the new fire-fighting supply system to the existing fire-fighting system be investigated to provide redundancy to the fir-fighting systems for Berth 207, 208 and 209.
- Opportunities for efficiently managing maintenance costs ate to be specifically addressed in the FEL3 engineering stage.
- The emergency response time, and the possibility of developing a satellite fire station within the South Dunes Precinct, should be assessed during the Terminal Operator's detail design phase for the facility to ensure compliance with the requirements of SANS 10090.

11. REFERENCES

PRDW. (2016). SA Gas to Power Medium-term Programme: Richards Bay, Pre-feasibility Study Report. PRDW Report No. S2018-3-RP-GA-001. Cape Town: PRDW.

PRDW. (2018a). Richards Bay LNG *Terminal Bulk Services Study - Bulk Services Capacity Assessment, Demand Forecast and Options Identification. PRDW Study Report No. S2069-1-TN-GA-001-R1.* Cape Town: PRDW.

PRDW. (2018b). Richards Bay LNG Terminal Bulk Services Study - Bulk Services Options Evaluation. PRDW Study Report No. S2069-1-TN-GA-002-R1. Cape Town: PRDW.

Transnet. (2015). Transnet Long *Term Planning Framework 2015. Chapter 4, Port Development Plan.* Johannesburg: Transnet.

APPENDICES

Note: In all cases check against online version for the latest revision prior to use

The following appendices are included with this report:

APPENDIX A: BULK SERVICES OPTIONS IDENTIFICATION

APPENDIX B: BULK SERVICES OPTIONS EVALUATION

APPENDIX C: BULK SERVICES UPGRADE DESIGN – TECHNCIAL NOTE

APPENDIX D: CAPITAL AND OPERATIONAL COST ESTIMATE

APPENDIX E: IMPLEMENTATION SCHEDULE

APPENDIX F: ENVIRONMENTAL ASSESSMENT

APPENDIX G: RISK REGISTER

APPENDIX H: HAZARD AND OPERABILITY ANALYSIS (HAZOP)

Note: In all cases check against online version for the latest revision prior to use

APPENDIX A:
BULK SERVICES OPTIONS IDENTIFICATION

REPORT

Note: In all cases check against online version for the latest revision prior to use

BULK SERVICES CAPACITY ASSESSMENT,
DEMAND FORECAST AND OPTIONS IDENTIFICATION

For: Port of Richards Bay

Project Name: Richards Bay LNG Terminal Bulk Services Study
Project Number: TBA

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Owner:	Transnet
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Project Sponsor:	Preston Khomo
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1. INTRODUCTION

1.1. Background

As part of the Independent Power Producer (IPP) programme, a Gas to Power (G2P) project has been launched by the South African Department of Energy (DoE) to address the electricity supply shortages in South Africa. The aim of the project is to develop and operate Liquefied Natural Gas (LNG) fired power stations at key locations in South Africa.

The DoE, in collaboration with Transnet SOC Ltd, and specifically its operating division Transnet National Ports Authority (TNPA), has undertaken a Pre-feasibility (FEL2) Study for LNG import projects in the Ports of Richards Bay.

The pre-feasibility study for the Port of Richards Bay identified two preferred sites for the location of the LNG import facility, namely Berth 207 (layout 2) and the dig-out basin (layout 1) in the South Dunes area as seen in Figure 1-1 below. At the close-out workshop, held in the Port of Richards Bay on 20 September 2016, it was agreed that Berth 207 should be adopted as the single preferred site for the LNG import facility.

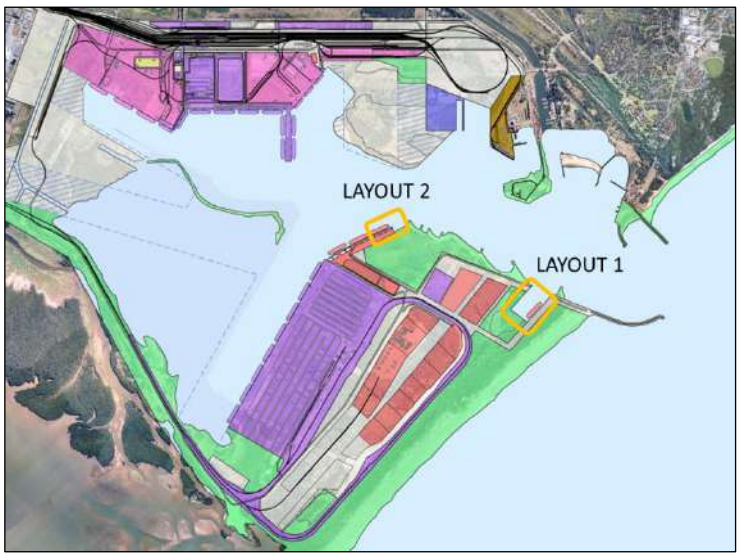

Figure 1-1: Pre-Feasibility Study Preferred Site Locations

The provision of bulk services was excluded from the FEL2 stage of the IPP project as it was identified as being the direct responsibility of TNPA. This study aims to assess the bulk services requirements at a pre-feasibility (FEL2) level of project development.

1.2. Bulk Services Study Introduction

A review of the bulk services required by the FSRU, as well as for the associated berth facility, has been undertaken in this study. The following services requirements have been considered:

- Power supply;
- Sewage;
- Potable water;
- Fire-fighting; and
- Storm water.

The upper and lower limits for the FSRU bulk services requirements have been estimated and the existing bulk service systems assessed to identify any associated bulk services capacity constraints.

2. FSRU BULK SERVICES REQUIREMENTS

Although Floating Storage Regasification Unit (FSRU) vessels are typically designed to be self-sufficient such that they can operate both within a port (at a berth) or offshore (berthed at either a single point mooring or a multi-buoy mooring), FSRU operators were contacted and requested to provide details of any bulk services required for the FSRU at the proposed berth in Richards Bay. Since no feedback was received from the FSRU operators, best practise was determined by reviewing available resources on the Internet.

This section outlines the bulk services requirements specific to the FSRU vessel.

2.1. Electrical Supply

The vessel is typically powered by an on-board power plant using fuel gas and oil (Songhurst, 2017). Therefore, an external electrical power supply is not deemed necessary.

Bunkering may be required to supply the vessel with fuel gas and oil.

2.2. Sewage

Sewage will most likely be treated on the vessel using an on-board plant, such as a membrane bioreactor. However, concentrated sludge will need to be removed periodically from the settling holding tank and disposed of at a suitable onshore sewage treatment plant.

2.3. Potable Water

A reverse osmosis plant on the vessel will typically provide the potable water requirements for the vessel. Therefore, an external potable water supply is not deemed necessary.

2.4. Fire-fighting

The vessel will be equipped with its own seawater intake for fighting fires on board the vessel. Therefore, it is anticipated that only fire-fighting requirements for the berth itself need to be considered.

2.5. Storm Water

Any storm water on the vessel is expected to be routed back to sea. Therefore, it is not expected that any onshore storm water handling will be required.

2.6. Summary

It is noted that the literature review did not identify any bulk services requirements for the FSRU and the project bulk services requirements will therefore be governed by the requirements for the berth and associated support infrastructure.

3. INSPECTION OF EXISTING BULK SERVICES INFRASTRUCTURE

3.1. Overview

PRDW visited the site on 11 October 2017. The purpose of the site visit was to inspect the existing services at Berths 208/209 and to gain a thorough understanding of the current status and operation of existing bulk services infrastructure from discussions with TNPA personnel.

Only two bulk services, namely electrical power supply and potable water, extend to the proposed location of the FSRU (Berth 207 at the South Dunes area of the port). Other services requirements on site are addressed as follows:

- Sewage from the existing control room is treated in a septic tank;
- Stormwater is routed via oil traps and then disposed of via soakaway pits on site; and
- Seawater is abstracted for fire-fighting purposes, the fire-fighting pump house is located between Berths 208 and 209. Electricity to the pump station is supplied from the Berth 209 substation.

3.2. Facility Inspections

3.2.1. Electrical Sub-Station

An 11 kV/400 V brick-built substation exists at Berth 209. This substation is fed from the TNPA Hydra Intake Substation via 2 x 240 mm^2 cables and has a firm capacity of 5 MVA.

TNPA confirmed that spare capacity available at the Berth 209 substation is 1.5 MVA.

Figure 3-1: MCC & electrical panels in berth sub-station

3.2.2. Fire-fighting Pump House

For the fire-fighting pump house, seawater is abstracted from a sump using vertical turbine multi stage pumps, namely one electrically driven duty pump and one diesel driven standby pump. A similar pump arrangement is provided for the foam pumps. A spare pump base is available in the foam pump room for additional foam concentrate capacity upgrades.

The electrically driven seawater pump has an 800 kW motor which is supplied at a voltage of 3.3 kV.

PRDW was informed by TNPA personnel that the existing seawater pumps are not able to supply both Berths 208 and 209 if fires were to take place at both berths simultaneously.

Figure 3-2: Foam pump station and spare base

Figure 3-3: Seawater pump station

Figure 3-4: Intake sump showing multistage pump

At the entrance to the fire-fighting pump house (refer to Figure 3-5 below), take-off manifolds from the Foam Water line (blue) as well as the Fresh Water line (Green) are above ground level. From this point to Berth 208, the pipelines run below ground level.

Figure 3-5: Pipe manifolds located outside of the foam pump station

3.2.3. Potable Water

Potable water is supplied from the M14 "Chemical Berth" take-off through a 160 mm diameter UPVC pipeline. The take-off manifold is located near the fire-fighting pump house (refer to Figure 3-5 above).

TNPA personnel noted that due to water saving initiatives within the port, the demand for water has decreased over the past few years, as seen in Figure 3-6 below. Notably in the South Dunes location, boreholes have been drilled to supply the coal berths which has reduced the demand on the water supply network in this area. The existing 160 mm diameter uPVC pipeline is only capable of simultaneously supplying 1200 l/min of water (at 3 bar as per S.A.N.S requirements) to the last fire hydrant on Berth 208, at the current municipal supply pressure to the chemical berth (4 bar) from the main reticulation network (Transnet Projects Design, 2007).

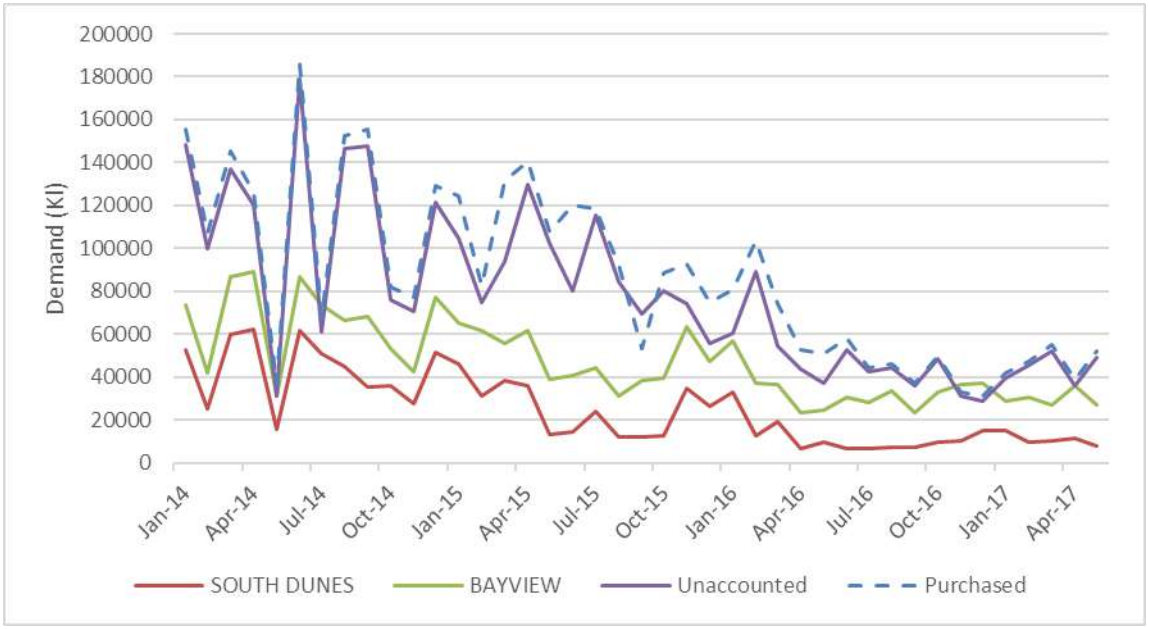

Figure 3-6: Water Demand for the Port of Richards Bay (Transnet Projects Design, 2007)

3.2.4. Stormwater Effluent and Oil Trap

Stormwater at Berth 208 is routed via an oil trap and is then disposed of via a soakaway pit.

The oil collection/skimming mechanism within the oil trap (refer to Figure 3-7 below) has been decommissioned since this mechanism was found to be ineffective. It is however presumed that the stormwater from the berth is still pumped to the trap and soak away pit.

During the site inspection, it was observed that the water within the oil trap sump contained little to no oil. The water level in the oil trap sump was at the level of the outlet, indicating that either the effluent discharge pipe was clear and that the soakaway pit was in operation, or that the stormwater pumps on the berth are not in operation. It should be noted that the area had received heavy rains the day before the site inspection and no notable ponding was seen on the deck of Berth 208.

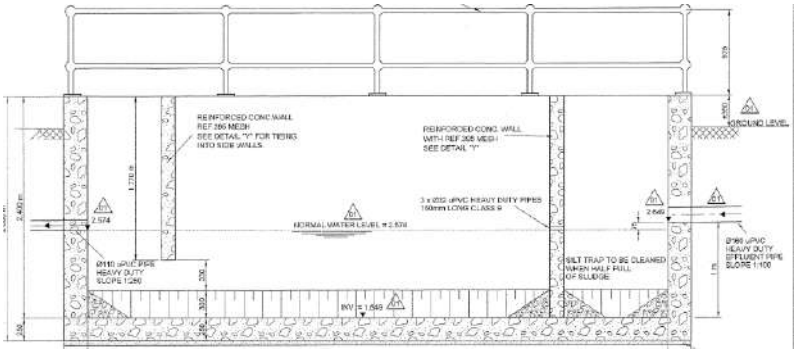

Figure 3-7: Section through Oil Trap

Figure 3-8: Oil Trap Sump and Collection/Skimming Mechanism

Figure 3-9: Water found within the Oil Trap

The stormwater inlet on Berth 208 appeared to be free from debris and the sump/deck did not show signs of excessive water pooling. However, the access manhole to the pump station sump chamber could not be opened on the day of the site inspection. TNPA was requested to arrange for the sump chamber to be opened, to take photographs of the sump and then send this information to PRDW. In addition, TNPA would check that the submerged pump is in working order.

Figure 3-10: State of deck on Berth 208

Figure 3-11: Stormwater Pump Sump

3.2.5. Pipe Rack and Access Walkway

An access walkway has been installed over the pipe rack between Berth 208 and the control tower. The services for the new berth will be required to run under the pipe rack similar to the existing services for Berth 208.

Figure 3-12: Access Walkway over Pipe Rack

3.2.6. Control Tower

The control panel in the existing control tower has one station available for an additional berth.

Figure 3-13: Existing Control Panel

The view to the proposed LNG berth, which is approximately 600 m away from the existing control room, is obscured by a tree as shown in Figure 3-14 below.

Figure 3-14: View of Berth 208 and proposed Berth 207 from control room

4. ADDITIONAL BULK SERVICES REQUIREMENTS

As noted in Section 2, no specific bulk service requirements were identified for the FSRU and the project bulk services requirements will therefore be governed by the requirements for the berth and associated support infrastructure. These requirements are presented below.

4.1. Electrical Supply

Electrical supply will be required for the seawater pumps (for fire-fighting purposes) and for small quayside power requirements and general lighting. Lighting on the access trestle and berth will generally replicate the existing Berth 208 mast mounted lighting installation.

Note that the electrical supply requirements are governed by the selection of the preferred fire-fighting option and the associated location of the seawater pumps.

4.2. Sewage

Since it is envisaged that sewage will be treated on-board the FSRU, no bulk sewage services requirements are anticipated for this vessel. Should the LNG berth facility require an additional control tower, the sewage flows from the toilet facilities in this building would be handled in a similar manner to that of the existing control tower facilities (i.e. installation of a septic tank and soakaway pit system).

4.3. Potable Water Supply

Since the FSRU would be equipped with its own desalination plant, potable water for the proposed LNG facility would arguably only be required if a new control tower were to be constructed.

The existing potable water supply could also be used for wash-down water for berth maintenance cleaning.

4.4. Fire-fighting

A deluge system is required to protect the manifold and piping on the deck of the new berth during a fire. This deluge system will be supplied from a seawater pump station using two pipelines, namely one pipeline for seawater only and a second pipeline for seawater with foam compound added. In addition, fire hydrants along the berth structure would also be installed off the three water supply pipelines, including the potable water line.

Figure 4-1: Automatic Oscillating Monitor at Berth 208

4.5. Stormwater

As stormwater is treated locally, there is no additional demand on existing bulk services.

5. PROPOSED UPGRADE OPTIONS FOR BULK SERVICES

5.1. Electrical Supply

The options identified for the required upgrades to the electrical supply are summarised below while the layout figures for the options are included as Appendix A of this report.

- Option 1:

  Option 1 is applicable if the seawater pumps for the fire-fighting system are installed adjacent to the existing seawater pump station. For this option the power demand at the berth is of the order of 60 kVA, only to cater for small quayside power requirements and general lighting. This option therefore considers a power supply at 400 V directly from the Berth 209 Substation along the access trestle to distribution kiosks located on the proposed Berth 207. All small power and lighting requirements for the berth will be supplied from these distribution kiosks.

  The power supply to the seawater pump station will be supplied by an 11 kV cable directly from the nearby Berth 209 Substation in a buried cable under the road.

  The total power demand for this option (i.e. catering for fire-fighting pumps adjacent to the existing seawater pump station as well as for small quayside power and lighting) will be larger than for Option 2, predominantly due to the increased pumping head requirements associated with a longer pipeline.

- Option 2:

  Option 2 is applicable if the seawater pumps for the fire-fighting system are installed on the access trestle to Berth 207. For this option the power demand cannot be supplied directly from the Berth 209 substation at 400 volts and therefore it is proposed that a suitably sized miniature substation (approximately 1 200 kVA, 11 kV/400 V) be installed at the new berth.

The miniature substation will be supplied at 11 kV, directly from the Berth 209 Substation along an 11 kV cable installed on cable trays fixed to the underside of the quay structure. The fire pumps and lighting and small power kiosks will then be supplied at 400 V, directly from the miniature substations.

5.2. Sewage

No upgrade to bulk services is required as sewage is treated locally. It is assumed that sufficient sludge handling vehicles are available to service the proposed facility.

It is noted that additional septic tanks will be required should an additional control tower or administration building be required to support the proposed facility.

5.3. Potable Water

The options identified for the required upgrades to the potable water supply system are summarised below while the layout figures for the options are included as Appendix B of this report.

- Option 1:

  Option 1 considers the installation of a second uPVC supply pipeline from the M14 "Chemical Berth" take-off to the proposed Berth 207. The new supply line would be trenched for approximately 265 m, parallel to the existing supply line, before routing along the new access trestle to the proposed Berth 207.

- Option 2:

  Option 2 involves the construction of a booster pump station on the existing supply line to provide the pressure required at the proposed LNG berth. A new supply line would then be installed along the new access trestle to the proposed Berth 207.

5.4. Fire-fighting

The existing seawater supply system is inadequate to supply both the proposed Berth 207 and the existing Berth 208 simultaneously and additional pumping capacity would therefore be required to service the new berth. The options for supplying the new pumping capacity are summarised below while the layout figures for the options are included as Appendix C of this report.

- Option 1:

  Option 1 considers housing the new pumps in a new seawater pump station, similar to that of the existing fire-fighting pump house. Foam would be supplied by the existing foam pump station. This option would reduce the power demand at the berth as the new pump station would be supplied directly from the existing Berth 209 substation.

- Option 2:

  Options 2 locates the pumps along the access trestle to the new berth. While this option would reduce the pumping distance to the berth, it results in an associated increase in the electrical

demand at the berth in order to supply the pump station (refer to Section 5.1). Bulky foam tanks would also have to be accommodated along the access trestle for this option.

5.5. Stormwater

As per Berth 208, any stormwater runoff from the deck of the proposed berth structure needs to be collected in sumps and pumped to shore where the flow is then passed through an oil trap prior to draining out through a soak-away pit.

5.6. Summary

A summary of the above-mentioned upgrade options is provided in Table 5-1 below.

Table 5-1: Upgrade Option Summary

Bulk Service	Option 1	Option 2
Fire-fighting	Deluge system supplied from a new seawater pump station on shore adjacent to existing pump station. Foam supplied by the existing foam pump station.	Deluge system supplied from pumps on the access trestle near the new berth. Foam tanks accommodated along the access trestle.
Electrical Supply*	Small power requirements and general lighting to the berth supplied directly from Berth 209 Substation at 400 V. The seawater pumps will be supplied directly from the Berth 209 substation.	Miniature substation provided at new berth to accommodate sea water pump requirements at 11 kV as well as the small power requirements and lighting at 400 V.
Sewage	No bulk services upgrade required.	
Potable Water	Install a second supply line from the M14 "Chemical Berth" take off.	Construct a booster pump station to provide the pressure required at the proposed LNG berth utilising the existing pipeline.
Storm water	No bulk services upgrade required.	

*depending on fire-fighting requirements.

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APPENDICES

Note: In all cases check against online version for the latest revision prior to use

The following appendices are included with this report:

APPENDIX A: Electrical Supply Layouts – Options 1 and 2

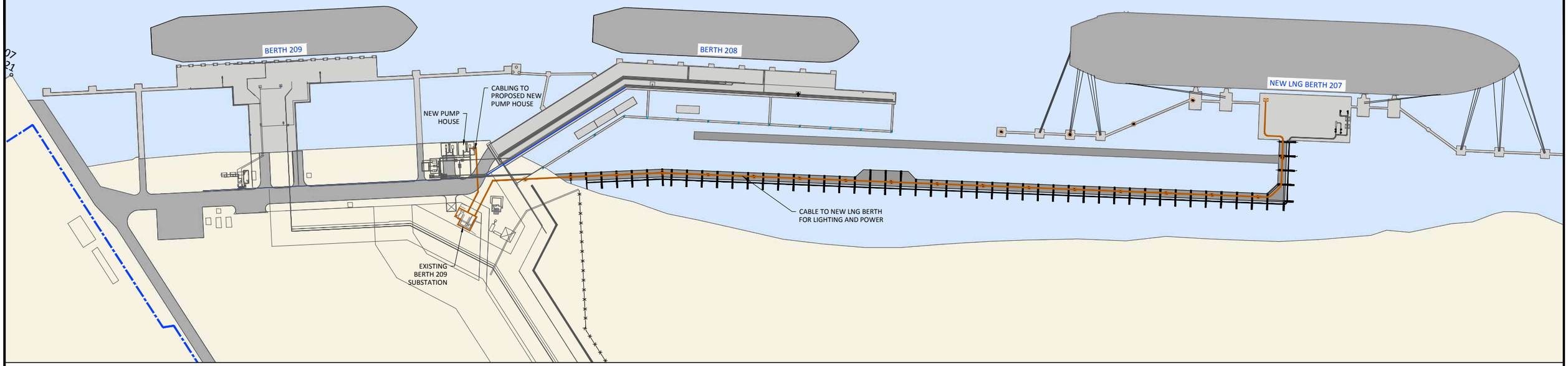
APPENDIX B: Potable Water Layouts – Options 1 and 2

APPENDIX C: Fire-fighting Layouts – Options 1 and 2

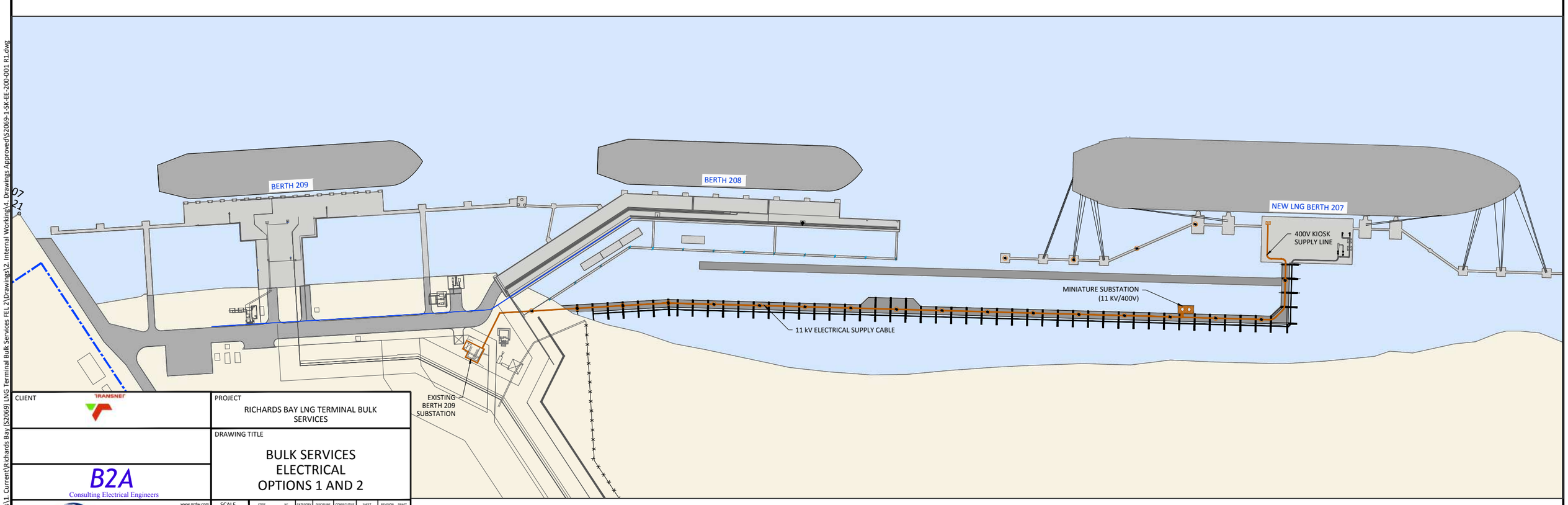
Note: In all cases check against online version for the latest revision prior to use

APPENDIX A: Electrical Supply Layouts – Options 1 and 2

A1 DO NOT SCALE - IF IN DOUBT ASK



OPTION 1



OPTION 2

CLIENT TRANSNET

PROJECT
RICHARDS BAY LNG TERMINAL BULK SERVICES

DRAWING TITLE
BULK SERVICES ELECTRICAL OPTIONS 1 AND 2

B2A
Consulting Electrical Engineers

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Consulting Port and Coastal Engineers

SCALE

CODE	N°	CATEGORY	DISCIPLINE	CONSECUTIVE	SHEET	REVISION	DRAFT
S2069	1	SK	EE	200	001	R1	

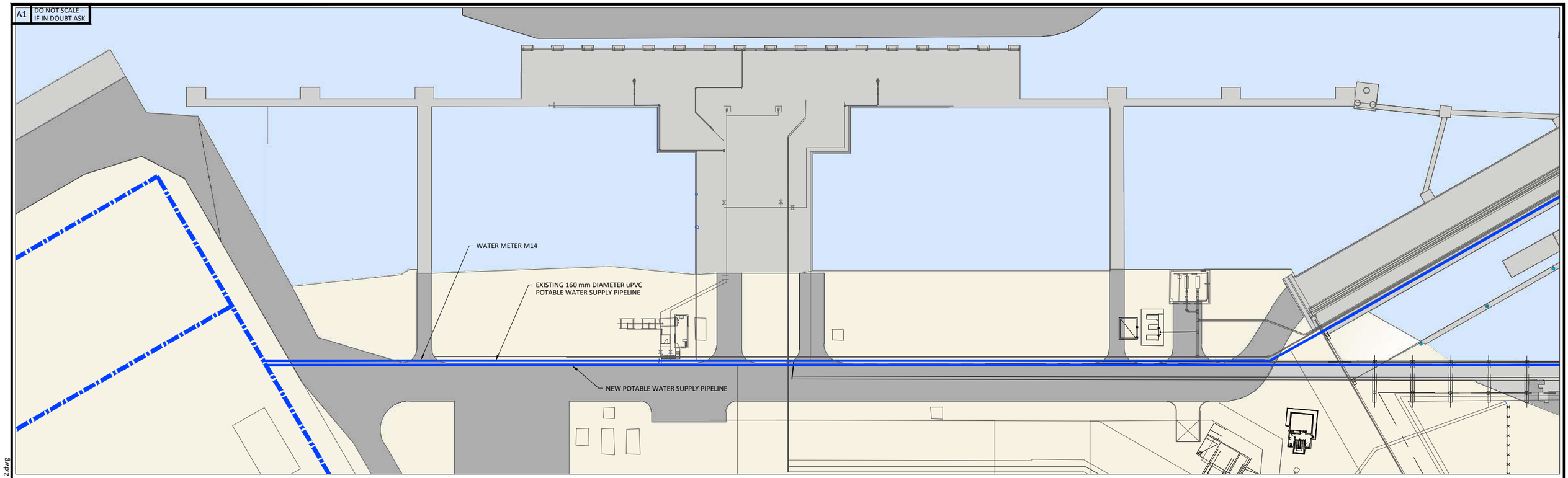
CLIENT NUMBER

X:\1. Projects\1. Current\Richards Bay (S2069) LNG Terminal Bulk Services FEL 2\Drawings\2. Internal Working\4. Drawings Approved\S2069-1-SK-EE-200-001 R1.dwg

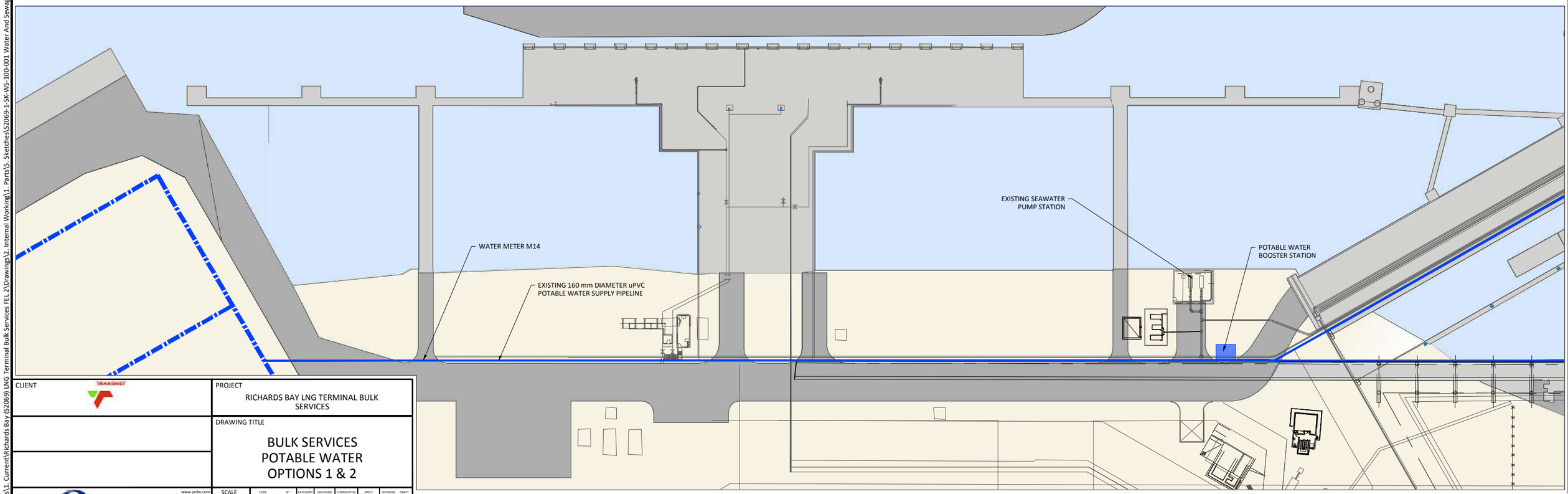
Note: In all cases check against online version for the latest revision prior to use

APPENDIX B: Potable Water Layouts – Options 1 and 2

A1 DO NOT SCALE - IF IN DOUBT ASK



OPTION 1
INSTALL NEW SUPPLY LINE FROM RING MAIN



OPTION 2
WITH BOOSTER PUMP STATION

CLIENT: TRANSNET

PROJECT: RICHARDS BAY LNG TERMINAL BULK SERVICES

DRAWING TITLE: BULK SERVICES POTABLE WATER OPTIONS 1 & 2

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SCALE

CODE	N°	CATEGORY	DISCIPLINE	CONSECUTIVE	SHEET	REVISION	DRAFT
S2069 - 1 - SK - WS - 100 - 001 -						R0	

CLIENT NUMBER

X:\1. Projects\1. Current\Richards Bay (S2069) LNG Terminal Bulk Services FEL 2\Drawings\2. Internal Working\1. Parts\5. Sketches\S2069-1-SK-WS-100-001 Water And Sewage - Options 1 & 2.dwg

Note: In all cases check against online version for the latest revision prior to use

APPENDIX C: Fire-fighting Layouts – Options 1 and 2

A1 DO NOT SCALE - IF IN DOUBT ASK

TRUE NORTH

0.0 KM — 100

SCALE BAR

BERTH 209

BERTH 208

NEW LNG BERTH 207

PROPOSED SEAWATER PUMP STATION

SEAWATER AND FOAM PIPELINES

EXISTING SEAWATER PUMP HOUSE

PROPOSED SEAWATER PUMP STATION

EXISTING FOAM PUMP HOUSE

CLIENT

TRANSNET

PROJECT

RICHARDS BAY LNG TERMINAL BULK SERVICES

DRAWING TITLE

BULK SERVICES FIRE FIGHTING OPTION 1

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SCALE

CODE	N°	CATEGORY	DISCIPLINE	CONSECUTIVE	SHEET	REVISION	DRAFT
S2069	- 1 -	SK	- PI -	300	- 001 -	R0	

CLIENT NUMBER

X:\1. Projects\1. Current\Richards Bay (S2069) LNG Terminal Bulk Services FEL 2\Drawings\2. Internal Working\1. Parts\5. Sketches\S2069-1-SK-PI-300-001 R1.dwg

A1 DO NOT SCALE - IF IN DOUBT ASK

TRUE NORTH

0.0 METRES — 100

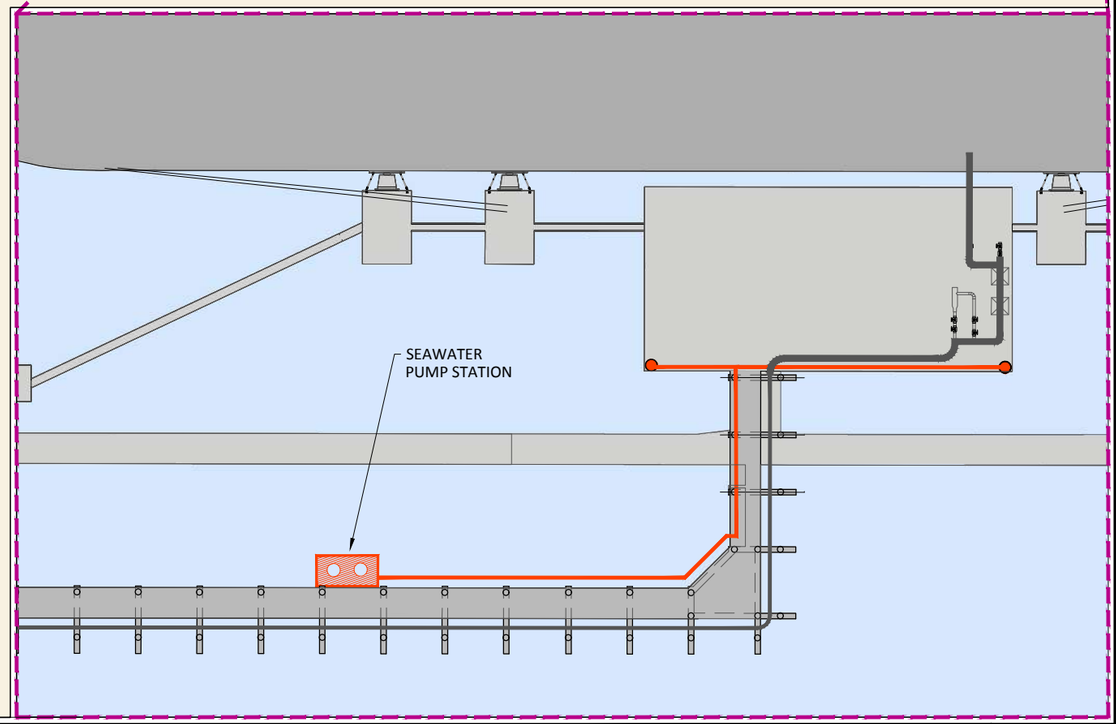
SCALE BAR

BERTH 209

BERTH 208

NEW LNG BERTH 207

SEAWATER PUMP STATION



X:\1. Projects\1. Current\Richards Bay (S2069) LNG Terminal Bulk Services FEL 2\Drawings\2. Internal Working\1. Parts\5. Sketches\S2069-1-SK-PI-300-002 R0.dwg

CLIENT TRANSNET

PROJECT
RICHARDS BAY LNG TERMINAL BULK SERVICES

DRAWING TITLE
BULK SERVICES
FIRE FIGHTING
OPTION 2

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SCALE

CODE	N°	CATEGORY	DISCIPLINE	CONSECUTIVE	SHEET	REVISION	DRAFT
S2069	1	SK	PI	300	002	R0	

CLIENT NUMBER

Note: In all cases check against online version for the latest revision prior to use

APPENDIX B:
BULK SERVICES OPTIONS EVALUATION

REPORT

Note: In all cases check against online version for the latest revision prior to use

BULK SERVICES OPTIONS EVALUATION

For: Port of Richards Bay

Project Name: Richards Bay LNG Terminal Bulk Services Study
Project Number: TBA

Author:	PRDW
Owner:	Transnet
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Project Sponsor:	Preston Khomo
Project Manager:	Ashveer Sathanund
Revision Number:	01
Approved by:	
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Distribution	
Name	Location

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1. INTRODUCTION

1.1. Background

As part of the Independent Power Producer (IPP) Procurement Programme, a gas to power (G2P) project has been launched by the South African Department of Energy (DoE) to address the electricity supply shortages in South Africa. The aim of the project is to develop and operate Liquefied Natural Gas (LNG) fired power stations at key locations in South Africa.

The DoE, in collaboration with Transnet SOC Ltd, and specifically its operating division Transnet National Ports Authority (TNPA), has undertaken a Pre-feasibility (FEL2) Study for LNG import projects at the Ports of Richards Bay, Ngqura and Saldanha Bay. The provision of bulk services was excluded from the FEL2 stage of the IPP project as this work was identified as being the direct responsibility of TNPA.

The pre-feasibility study for the Port of Richards Bay identified two preferred sites for the location of the LNG import facility, namely Berth 207 and the dig-out basin in the South Dunes area. The pre-feasibility study presented two distinct phases for the development of the LNG import facility – Phase 1 which consists of a floating storage and regasification solution and Phase 2 which consist of a land-based storage and regasification solution.

At the close-out workshop, held in the Port of Richards Bay on 20 September 2016, it was agreed that Berth 207 should be adopted as the single preferred site. PRDW were subsequently appointed by TNPA to complete a pre-feasibility study for the supply of the required bulk services to the Phase 1 facility at Berth 207.

1.2. Options Identification and Evaluation

The Capacity Assessment, Demand Forecast and Options Identification report (PRDW, 2018) identified the following options for the required bulk services upgrades:

Bulk Service	Option 1	Option 2
Fire-fighting	Deluge system supplied from a new seawater pump station on shore adjacent to existing pump station. Foam supplied by the existing foam pump station.	Deluge system supplied from pumps on the access trestle near the new berth. Foam tanks accommodated along the access trestle.
Electrical Supply*	Small power requirements and general lighting to the berth supplied directly from Berth 209 Substation at 400 V. The seawater pumps will be supplied directly from the Berth 209 substation.	Miniature substation provided at new berth to accommodate sea water pump requirements at 11 kV as well as the small power requirements and lighting at 400 V.
Sewage	No bulk services upgrade required.	
Potable Water	Install a second supply line from the M14 "Chemical Berth" take off.	Construct a booster pump station to provide the pressure required at the proposed LNG berth utilising the existing pipeline.
Storm water	No bulk services upgrade required.	

*depending on fire-fighting requirements.

Table 1-1: Upgrade Options Summary

This technical note presents the assessment of the above-mentioned options and identifies the preferred option for each of the required upgrades to the fire-fighting, electrical supply and potable water systems.

2. METHODOLOGY

A Multi-criteria Assessment (MCA) was completed to select a single preferred option for the required system upgrades for each category of bulk services (fire-fighting, electrical supply and potable water systems). The criteria, the associated criteria weightings and the scoring approach for the MCA are presented in the following sections.

2.1. Criteria

The criteria considered in the MCA are described briefly in Table 2-1 below.

Main Criteria	Sub-criteria	Description
Inherent Safety	Safety of personnel	Safety of personnel during construction and operation and the inherent system redundancy.
	Redundancy implications for existing services	
Accessibility	Safe access for operation and maintenance	Ease of access for maintenance and operation of the facility.
Implementation	Availability of skills and materials	Ease of implementation or construction considering both the technical aspects during construction and the interface between the Port and the Private Terminal Operators during construction and operation.
	Speed of construction	
	Risk of delays during construction	
	Interface between port & terminal operators	
Maintainability	Localisation and repairability of damage	Ease of maintaining the infrastructure for the duration of its operational life.
	Special maintenance requirements (e.g. anodes, painting, etc.)	
Value and Cost	Capital cost	Relative quantitative assessment of the envisaged capital and operational costs associated with the facility.
	Operating and maintenance cost	
Environmental	Construction footprint and marine abstraction impacts as applicable	Relative assessment of the envisaged environmental impacts during construction or operation.

Table 2-1: Multi-criteria Assessment Criteria

2.2. Criteria Weightings

The base weightings for the MCA criteria, as used by PRDW for the options evaluation, are presented in

Main Criteria	Criteria Weighting
Inherent Safety	20%
Accessibility	15%
Implementation	10%
Maintainability	10%
Value and Cost	25%
Environmental	20%
TOTAL	**100%**

Table 2-2 below.

Main Criteria	Criteria Weighting
Inherent Safety	20%
Accessibility	15%
Implementation	10%
Maintainability	10%
Value and Cost	25%
Environmental	20%
TOTAL	**100%**

Table 2-2: Multi-criteria Assessment – Base Case Weightings

A sensitivity analysis was also completed to assess the sensitivity of the MCA to the criteria weightings. The criteria weightings for the various scenarios considered in the sensitivity analysis are presented in Table 2-3 below.

Main Criteria			Weighting Bias				
	Equal	Inherent Safety	Accessibility	Implementation	Maintainability	Value and Cost	Environmental
Inherent Safety	17%	50%	10%	10%	10%	10%	10%
Accessibility	17%	10%	50%	10%	10%	10%	10%
Implementation	16%	10%	10%	50%	10%	10%	10%
Maintainability	16%	10%	10%	10%	50%	10%	10%
Value and Cost	17%	10%	10%	10%	10%	50%	10%
Environmental	17%	10%	10%	10%	10%	10%	50%
TOTAL	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Table 2-3: Multi-criteria Assessment – Sensitivity Analysis Weightings

2.3. Scoring

For all criteria, other than value and cost, the options were assigned qualitative scores, relevant to the other options being considered, according to the scoring guideline outlined in Table 2-4.

Score	Comment
10	Good
5	Average
1	Bad

Table 2-4: Multi-criteria Assessment – Scoring Guideline

The value and cost criteria were assigned quantitative scores, based on the concept-level cost estimates presented in Section 3. The quantitative scores were assigned according to the following formula:

$$Assigned\ score = \frac{Minimum\ value\ for\ all\ options}{Value\ for\ the\ option\ considered} \times 10$$

3. CONCEPT-LEVEL COST ESTIMATE

3.1. Capital Cost Estimate

3.1.1. Basis of estimate

The capital cost estimate has been prepared considering the options presented in the Capacity Assessment, Demand Forecast and Options Identification report (PRDW, 2018). The basis of the capital cost estimate is as follows:

- The concept cost estimate targets a level of accuracy of +50% to -50%.
- The estimate has been derived using a combination of measured preliminary quantities and corresponding current or escalated unit rates largely based upon PRDW's internal rates database. Built-up rates and prices have been used where no relevant rates or prices were available.
- The capital cost estimate includes an allowance for the contractor's Preliminary and General (P&G) costs, a design development allowance to cover design and pricing uncertainties associated with the level of design information available at this stage of the project and a professional fee allowance to cover engineering and project management fees.
- The estimate excludes costs related to environmental, EIA and EMP costs, pre-tender and post contract escalation, project wide contingency (10% recommended) and construction site supervision costs.

3.1.2. Capital cost summary

The estimated capital costs for the options considered, excluding VAT, are summarised in Table 3-1 below.

Item No.	Description	Amount (ZAR)	
		Option 1	Option 2
1	**Fire fighting**		
1.1	Pump station superstructure	R 2 100 000	R 2 100 000
1.2	Pump station foundations	R 1 600 000	R 2 400 000
1.3	Pumps and pipework	R 21 900 000	R 21 900 000
1.4	Pressure pipeline from pump station to berth	R 11 400 000	R 3 000 000
1.5	Fire-fighting sundries (incl. valves and fittings)	R 3 600 000	R 2 600 000
	Total: Fire fighting	R 40 600 000	R 32 000 000
2	**Electrical Supply**		
2.1	Electrical work (incl. cabling, kiosks and lighting)	R 2 800 000	R 3 100 000
2.2	Mini sub station	R -	R 300 000
	Total: Electrical supply	R 2 800 000	R 3 400 000
3	**Potable Water**		
3.1	Potable water pipeline	R 1 200 000	R 800 000
3.2	Booster pump, pipework and valves	R -	R 1 000 000
3.3	Pump station	R -	R 200 000
	Total: Potable water	R 1 200 000	R 2 000 000

Table 3-1: Capital Cost Estimate (Excl. VAT)

3.2. Operational Cost Estimate

3.2.1. Basis of estimate

The operational cost estimate for the upgrade options has been calculated as a percentage of the capital cost estimate. The percentage, based on previous projects of a similar nature, is intended to illustrate the relative operational cost for the options and has been set at 5% of the capital cost estimate.

3.2.2. Operational cost summary

The estimated annual operational costs for the options considered, excluding VAT, are summarised in Table 3-2.

Item No.	Description	Amount (ZAR)	
		Option 1	Option 2
1	Fire fighting	R 2 030 000	R 1 600 000
2	Electrical Supply	R 140 000	R 170 000
3	Potable Water	R 60 000	R 100 000

Table 3-2: Annual Operational Cost Estimate (Excl. VAT)

4. MCA RESULTS – FIRE-FIGHTING

4.1. Base-case Weighting

The assigned scores for each criterion and the MCA outcome for the base weighting are presented in Table 4-1 below.

Total		**Option 1** - New onshore pump station adjacent to existing pump station; new seawater pipeline	**Option 2** - New pumps installed off access trestle at new berth
		91%	**64%**
Criteria	**Weighting**		
Inherent Safety	20%	20%	10%
Accessibility	15%	15%	8%
Implementation	10%	8%	6%
Maintainability	10%	9%	5%
Value and Cost	25%	20%	25%
Environmental	20%	20%	10%
Total	100%		
Criteria Breakdown	Weighting	Option 1	Option 2
Inherent Safety	100%	**10**	**5**
Safety of personnel	50%	10	5
		Option 2 scores lower than Option 1 due to the increased risks in working over water during the construction of the pump station on the trestle.	
Redundancy implications for existing services	50%	10	5
		Option 1 has the potential to integrate into the existing fire-fighting system for Berths 208 and 209 and could therefore provide redundancy for the existing system. Option 2 has no effect on the existing system, either positive or negative.	
Accessibility	100%	**10**	**5**
Safe access for operation and maintenance	100%	10	5
		Access to the pumps in a landside pump station is good and therefore Option 1 scores favourably. Option 2 scores lower due to the restricted access for pumps located on the trestle.	
Implementation	100%	**7.5**	**6**
Availability of skills and materials	30%	5	5
		No variation between options.	
Speed of construction	20%	5	10
		Option 1 scores lower than option 2 due to the addition time required to construct the pump station building.	
Risk of delays during construction	20%	10	5
		Option 2 scores lower than Option 1 due to the potential delays due to the interface between the construction of the trestle (operator responsibility) and the construction and installation of the pump facilities on the trestle (TNPA responsibility)	
Interface between port & terminal operators	30%	10	5
		As per Item 3.3, Option 2 scores lower than Option 1.	
Maintainability	100%	**9**	**5**
Localisation and repairability of damage	80%	10	5
		Option 2 scores lower than Option 1 due to the restricted access to pumps on the trestle and the potential for working over water during maintenance at the pump station.	
Special maintenance requirements	20%	5	5
		No variation between options - no special requirements for either option.	
Value and Cost	100%	**7.9**	**10**
Capital cost	75%	7.9	10.0
Concept-level capital cost estimate:		*R 40 600 000*	*R 32 000 000*
Operating and maintenance cost	25%	7.9	10.0
Concept-level annual operational cost estimate:		*R 2 030 000*	*R 1 600 000*
Environmental	100%	**10**	**5**
Marine abstraction impacts	100%	10	5
		Option 1 scores higher than Option 2 as the potential impacts of pumping water from the sea are already experienced at the existing pumping site.	

Table 4-1: MCA Base-case Scenario – Fire-fighting

The base-case scenario indicates that Option 1 scores higher than Option 2 due to the inherent safety, accessibility and maintainability practicalities that will be realised by constructing the required seawater and foam pump stations adjacent to the existing pump stations. From an environmental perspective, it is also preferable to combine the seawater extraction point with the existing pump station's extraction point.

4.2. Sensitivity Analysis on the Weightings

The sensitivity analysis on the criteria weighting is provided in Table 4-2.

Weighting Bias	Option 1	Option 2
Base Case	91%	64%
Equal	91%	60%
Inherent Safety	94%	56%
Accessibility	94%	56%
Implementation	84%	60%
Maintainability	90%	56%
Value and Cost	86%	76%
Environmental	94%	56%

Table 4-2: MCA Sensitivity Analysis – Fire-fighting

The sensitivity analysis indicates that the Option 1 scores consistently higher for all weighting scenarios.

4.3. Preferred Option

Based on the results on the MCA and the sensitivity analysis, Option 1 (the construction of a new onshore pump station adjacent to the existing pump station) was selected as the preferred option for meeting the fire-fighting requirements of the proposed berth.

5. MCA RESULTS – ELECTRICAL SUPPLY

As noted in The Capacity Assessment, Demand Forecast and Options Identification report (PRDW, 2018) and Table 1-1, the selection of the preferred option for the electrical supply to the proposed berth is dependent on the preferred fire-fighting option and therefore no MCA was required.

Based on the outcomes of the MCA for the fire-fighting supply (Section 4) Option 1, electrical supply directly from Berth 209 Substation, was selected as the preferred option for meeting the electrical requirements of the proposed berth.

6. MCA RESULTS – POTABLE WATER

6.1. Base-case Weighting

The assigned scores for each criterion and the MCA outcome for the base weighting is presented in Table 6-1 below.

Total		**Option 1** - Second pipeline from chemical berth take-off	**Option 2** - New booster station on existing supply pipeline
		77%	**68%**
Criteria	**Weighting**		
Inherent Safety	20%	15%	10%
Accessibility	15%	8%	8%
Implementation	10%	9%	7%
Maintainability	10%	10%	9%
Value and Cost	25%	25%	15%
Environmental	20%	10%	20%
Total	100%		
Criteria Breakdown	Weighting	Option 1	Option 2
Inherent Safety	100%	**7.5**	**5**
Safety of personnel	50%	10	5
		Option 1 scores higher than Option 2 due to the simplified nature of the construction and the limited maintenance required post construction.	
Redundancy implications for existing services	50%	5	5
		Neither option has any effect on the existing services, either positive or negative. Therefore both options are allocated a score of 5.	
Accessibility	100%	**5**	**5**
Safe access for operation and maintenance	100%	5	5
		No variation between options.	
Implementation	100%	**9**	**6.5**
Availability of skills and materials	30%	10	5
		Option 2 scores lower than Option 1 due to the additional procurement of the pumps and more complex nature of construction.	
Speed of construction	20%	5	5
		No variation between options.	
Risk of delays during construction	20%	10	5
		Option 2 scores lower than Option 1 due to the additional time required to install the booster station.	
Interface between port & terminal operators	30%	10	10
		Neither option interfaces directly with the construction of the berth and access trestle and therefore both options are assigned a score of 10.	
Maintainability	100%	**10**	**9**
Localisation and repairability of damage	80%	10	10
		No variation between options.	
Special maintenance requirements	20%	10	5
		Option 2 scores lower than Option 1 due to the additional maintenance associated with the booster pumps.	
Value and Cost	100%	**10**	**6.0**
Capital cost	75%	10.0	6.0
Concept-level capital cost estimate:		*R 1 200 000*	*R 2 000 000*
Operating and maintenance cost	25%	10.0	6.0
Concept-level annual operational cost estimate:		*R 60 000*	*R 100 000*
Environmental	100%	**5**	**10**
Construction Impacts	100%	5	10
		Option 1 scores lower than Option 2 due to the trenching required along the full length of the pipeline as opposed to the localised nature of the trenching required for the booster station for Option 2.	

Table 6-1: MCA Base-case Scenario – Potable Water

The base-case scenario indicates that Option 1 scores higher than Option 2 for all criteria except for the environmental criteria. Option 1 scores favourably primarily due to the simplicity of installing an

additional pipeline and the associated safety, implementation, maintenance and cost benefits when compared to installing a booster pump station.

From an environmental perspective, Option 1 scores relatively poorly due to the length of trenching required to install the additional pipeline. It is however noted that the entire area affected by the excavations is already disturbed from its natural state and therefore the potential environmental impacts should be marginal.

6.2. Sensitivity Analysis on the Weightings

The sensitivity analysis on the criteria weighting is provided in Table 6-2.

Weighting Bias	Option 1	Option 2
Base Case	77%	68%
Equal	77%	69%
Inherent Safety	77%	62%
Accessibility	67%	62%
Implementation	83%	68%
Maintainability	87%	78%
Value and Cost	87%	66%
Environmental	67%	82%

Table 6-2: MCA Sensitivity Analysis – Potable Water

The sensitivity analysis indicates that Option 1 scores consistently well for all weighting scenarios with Option 2 only being the preferred option when the weighting bias is towards environmental considerations.

6.3. Preferred Option

Based on the results of the MCA and the sensitivity analysis, Option 1 (the construction of an additional pipeline) was selected as the preferred option for meeting the potable requirements of the proposed berth.

7. CONCLUSIONS

This technical note has documented the outcomes of the multi-criteria assessment for the required bulk services upgrades. The preferred option for each bulk service is presented in Table 7-1.

Bulk Service	Preferred Option
Fire-fighting	**Option 1:** Deluge system supplied from a new seawater pump station on shore adjacent to existing pump station. Foam supplied by the existing foam pump station.
Electrical Supply	**Option 1:** Small power requirements and general lighting to the berth supplied directly from Berth 209 Substation at 400 V. The sea water pumps will be supplied directly from the Berth 209 substation.
Sewage	*No bulk services upgrade required.*
Potable Water	**Option 1:** Install a second supply line from the M14 "Chemical Berth" take off.
Storm water	*No bulk services upgrade required.*

Table 7-1: Preferred Options

8. REFERENCES

PRDW. (2018). Richards Bay LNG Terminal Bulk Services Study - Bulk Services Capacity Assessment, Demand Forecast and Options Identification. PRDW Study Report No. S2069-1-TN-GA-001-R1. Cape Town: PRDW.

Note: In all cases check against online version for the latest revision prior to use

APPENDIX C:
BULK SERVICES UPGRADE DESIGN – TECHNCIAL NOTE

REPORT

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Richards Bay LNG Terminal Bulk Services Study
Bulk Services FEL-2 Technical Note

For: Port of Richards Bay

Project Name: Richards Bay LNG Terminal Bulk Services Study
Project Number: TBA

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Owner:	Transnet
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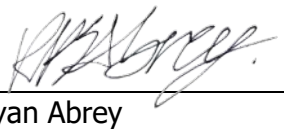
Prepared by:  09 / 02 / 2018
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Approved by:  09 / 02 / 2018
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1. INTRODUCTION

1.1. General

As part of the Independent Power Producer (IPP) programme, a Gas to Power (G2P) project has been launched by the South African Department of Energy (DoE) to address the electricity supply shortages in South Africa. The aim of the project is to develop and operate Liquefied Natural Gas (LNG) fired power stations at key locations in South Africa.

The DoE, in collaboration with Transnet SOC Ltd, and specifically its operating division Transnet National Ports Authority (TNPA), has undertaken a Pre-feasibility (FEL2) Study for LNG import projects in the Ports of Richards Bay.

The pre-feasibility study for the Port of Richards Bay identified two preferred sites for the location of the LNG import facility, namely Berth 207 (Layout 2) and the dig-out basin (Layout 1) in the South Dunes area as seen in Figure 1-1 below. At the close-out workshop, held in the Port of Richards Bay on 20 September 2016, it was agreed that Berth 207 should be adopted as the single preferred site for the LNG import facility.

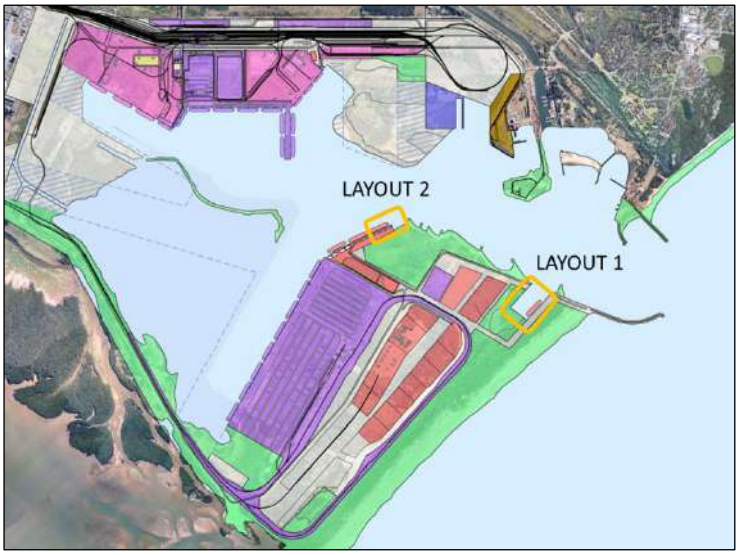

Figure 1-1: Pre-Feasibility Study Preferred Site Locations

The provision of bulk services was excluded from the FEL2 stage of the IPP project as it was identified as being the direct responsibility of TNPA. This study aims to assess the bulk services requirements at a pre-feasibility (FEL2) level of project development.

1.2. Bulk Services Study Introduction

The requirements for upgrading the bulk services infrastructure, and the associated alternatives for doing so, were determined through an assessment of the existing bulk services infrastructure and the bulk services demand for the proposed LNG facility (PRDW, 2018a). The following services requirements have been considered:

- Power supply;
- Sewage;
- Potable water;
- Fire-fighting; and
- Storm water.

A Multi-criteria Assessment (MCA) was subsequently completed to select the preferred options to be considered in the pre-feasibility design (PRDW, 2018b). The preferred option for each bulk service upgrade is presented in Table 1-1.

Bulk Service	Preferred Option
Fire-fighting	**Option 1:** Deluge system supplied from a new seawater pump station on shore adjacent to existing pump station.
Electrical Supply	**Option 1:** Small power requirements and general lighting to the berth supplied directly from Berth 208 Substation at 400 V. The sea water pumps will be supplied directly from the Berth 208 substation.
Sewage	*No bulk services upgrade required.*
Potable Water	**Option 1:** Install a second supply line from the M14 "Chemical Berth" take off.
Storm water	*No bulk services upgrade required.*

Table 1-1: Preferred Options

This technical note presents the outcomes of the pre-feasibility design of the preferred options.

2. BULK SERVICES REQUIREMENTS

The bulk service requirements to be used in this study are as follows:

2.1. Fire-fighting

Based on the duty flow rates for the existing Berth 208 fire-fighting system (Transnet Capital Projects, 2008), the seawater intake for the new pump station needs to be designed to supply approximately 26 300 l/min (437 l/s) which is then divided between the seawater pipeline and the foam pipeline (i.e. 7 200 l/min (118 l/s) for the firewater line and 19 100 l/min (318 l/s) for the foam line). These flow rates would need to be confirmed once the berth area and process requirements have been finalised to the Berth 207 Operator requirements as well as possible fire-fighting specialist inputs.

A foam pump station is required to inject the foam compound into the sea water to generate foam. It is noted that both the Options Identification Report (PRDW, 2018a) and the Options Evaluation Report (PRDW, 2018b) assumed that the additional foam requirements could be accommodated at the existing foam pump station. Further engineering development during this pre-feasibility design phase has indicated that the existing foam pump station cannot accommodate the additional

requirements and that a new foam pump station building will be required. The optimum location for this pump station is adjacent to the existing facility as a large holding tank is required.

The requirement for the additional foam pump station building further reinforces the outcome of the options assessment (PRDW, 2018a). The alternative option would involve constructing this foam pump station on the access trestle which is not considered to practical or cost effective.

The pressure required for the fire-fighting monitors at the end of the discharge pipeline is assumed to be 7 Bar in order to provide the required range and flow (Transnet Capital Projects, 2008).

2.2. Electrical Supply

No bulk electrical supply upgrades are required as there is 1.5 MVA available at the existing Berth 209 Substation which can supply electricity to the new sea water and foam pump stations as well as the small power and lighting requirements at the new berth.

2.3. Sewage System

No sewage requirements are considered at this stage.

It is noted that an additional septic tank may be required if an additional control tower or administration building is required to support the proposed facility.

2.4. Potable Water

The potable water system is to be able to supply 1 200 l/min of water (at 3 bar as per S.A.N.S requirements) to the furthest fire hydrant on the new Berth 207 (SABS, 2012).

2.5. Storm Water

As per Berth 208, any storm water runoff from the deck of the proposed berth structure needs to be collected in sumps and pumped to shore where the flow is then passed through an oil trap prior to draining out through a soak-away pit. A bulk services storm water upgrade is therefore not required.

As noted in the description of the existing system (PRDW, 2018a), the current oil trap is not currently in operation and an assessment of the oil trap requirements, including provision for storm water runoff from the deck of the berth, will be required as part of the design for the new Berth 207.

3. SYSTEM PARAMETERS

3.1. Water Characteristics

A maximum sea water density of 1 025 kg/m³ has been assumed.

3.2. Water Levels

For the purpose of hydraulic calculations, the following water levels have been used:

- High Water Level 2.10m CD (MHWS)
- Low Water Level 0.00m CD (LAT)

A summary of the full tidal range in the port of Richards Bay is provided in the table below:

Description	Level (m CD)
Highest Astronomical Tide (HAT)	2.47
Mean High Water Springs (MHWS)	2.11
Mean High Water Neaps (MHWN)	1.48
Mean Level (ML)	1.20
Land Levelling Datum (LLD)	1.015
Mean Low Water Springs (MLWS)	0.27
Mean Low Water Neaps (MLWN)	0.97
Lowest Astronomical Tide (LAT)	0.00

Table 3-1: Tidal characteristics Richards Bay (SANHO, 2018)

3.3. Pipe Roughness

Pipe friction losses have been calculated by using the following pipe wall roughness (K_0) characteristics for new and deteriorated pipes:

- New, smooth walled pipe: 0.003 mm
- Old, deteriorated pipe (worst case): 0.12 mm for uPVC (potable water system) and 0.15 mm for steel (fire-water pipeline).

4. ENGINEERING DEVELOPMENT

4.1. Fire-fighting

The existing seawater supply system does not have adequate capacity available to supply both the proposed Berth 207 and the existing Berth 208 simultaneously; therefore, additional pumping capacity is required to service the new berth with seawater for fire-fighting purposes.

The preferred option is to provide a new seawater pump station, similar to that of the existing fire-fighting pump house – refer to Figure 4-1 below.

In order to generate foam for the berth, a proportioner introduces a "foaming agent" from the storage tanks into the seawater at a required ratio. The proportioner is located just downstream of the seawater abstraction pumps where the foam water supply line splits from the seawater supply line. A new foam pump station and associated storage tank is required for the new Berth 207.

Similar to the existing seawater pump installation, it is envisaged that the new firewater pumps will be large vertical turbine multi stage pumps: one electrically driven duty pump and one diesel driven standby pump. The diesel standby pump will allow for operation should the main electrical supply to the pump station be faulty or when maintenance of the duty pump is in progress. A similar duty/standby pump configuration is required for the smaller foam pump installation.

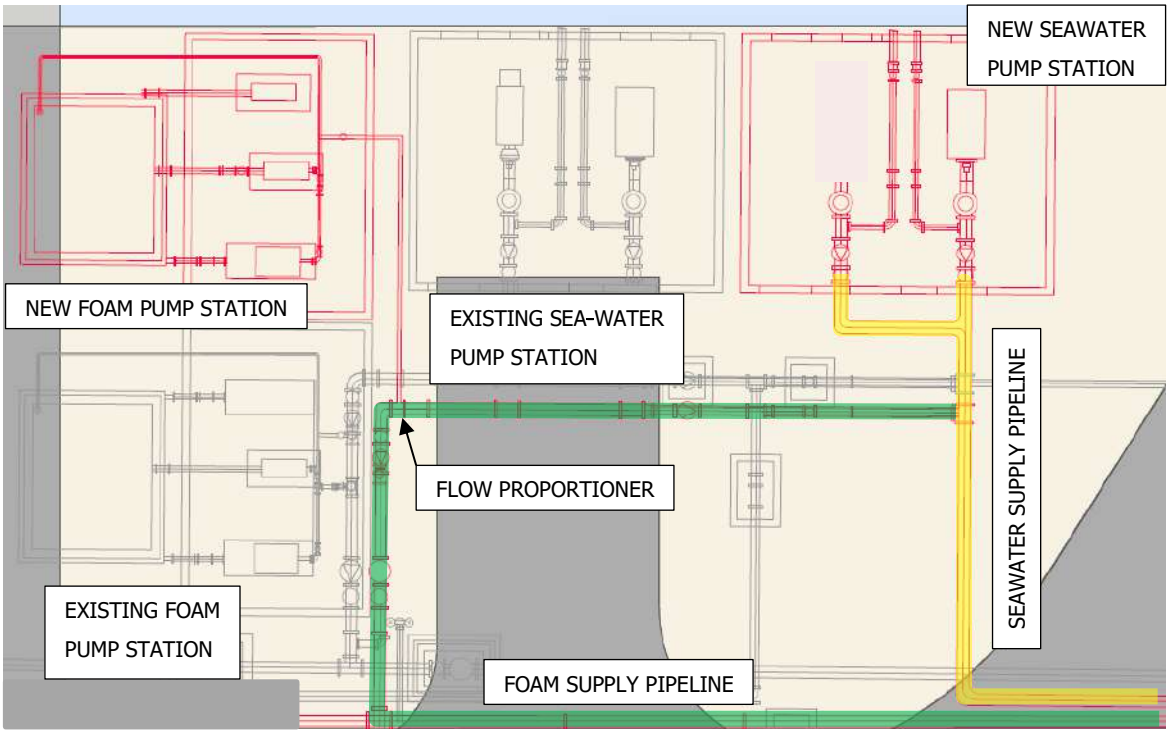

Figure 4-1: Existing and Proposed New Seawater and Foam Pump Facilities

To address the high maintenance costs associated with the existing Berth 208 fire-fighting pump installation, it is recommended that opportunities for efficiently managing maintenance costs be specifically addressed in the FEL-3 engineering stage. Such opportunities would possibly include the following:

- Selection and specification of materials suitable for the seawater application, for all mechanical and electrical components housed in the pump stations;
- Suitable design of HVAC system to minimize corrosive environment inside pump stations;
- Selection of a reputable pump manufacturer/supplier with a proven track record in similar marine installations;

- Ensuring that service and maintenance requirements recommended by the original equipment manufacturers (OEM), for pumps, motors, etc., are carried out at the recommended intervals;
- Consideration given to entering into a service agreement with the OEMs for servicing and maintenance of equipment.

For the purpose of this study, the following duty points have been used:

- Sea water pumps: 438 l/s at 140 m duty head; and
- Foam concentrate injection pumps: 20 l/s at 125 m head.

It is noted that the new fire-fighting supply system could possibly be connected to the existing fire-fighting system to also supply Berths 208 and 209, if considered to be a worthwhile additional risk mitigation measure. The technicalities of this possibility have not been assessed in this study but could be addressed in the next engineering stage, if required.

For the purpose of this study it is assumed that the pump installation will have a similar arrangement to that of the existing pump station; refer to Figure 4-2 below. Envisaged pipeline fittings and components such as bends, flow control valves, oscillating monitors, remote monitors and quay bund pourers, are shown in the drawings presented in Appendix A.

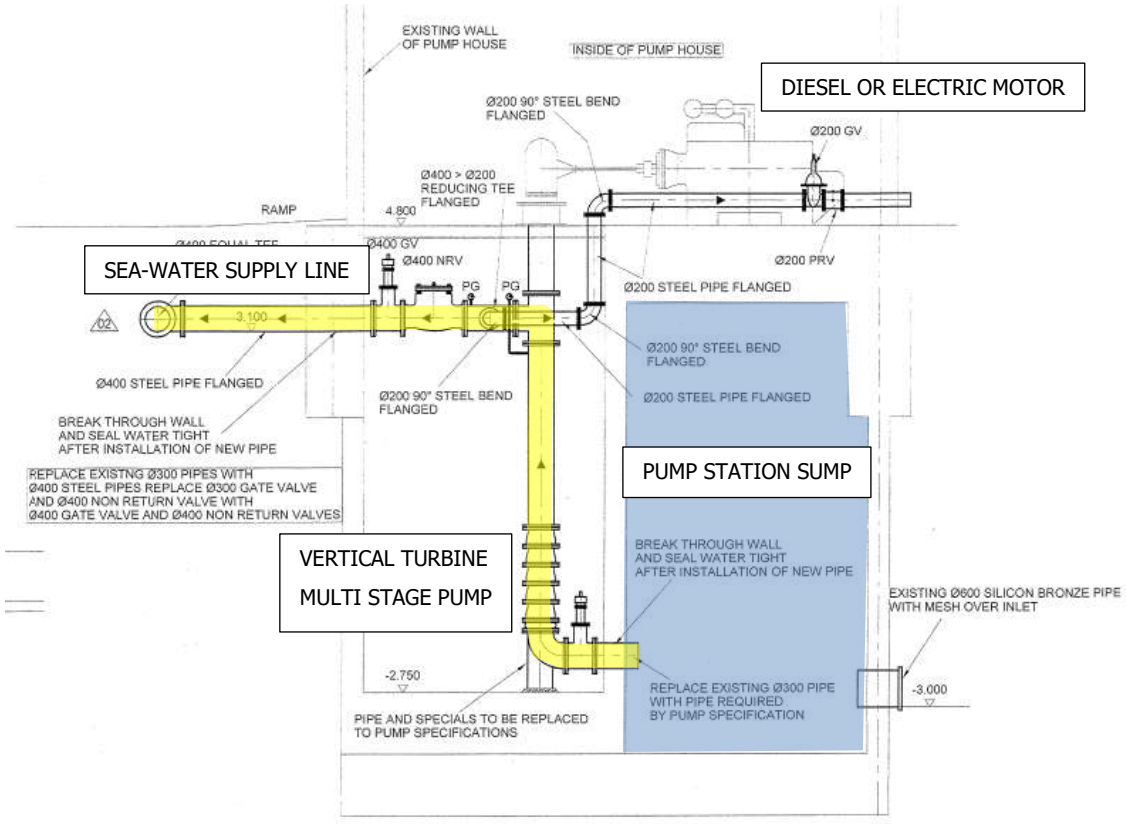

Figure 4-2: Section Through Existing Pump Station (Transnet Capital Projects, 2008)

The following berth fire-fighting equipment, based on the existing equipment installed for Berth 208, is envisaged for Berth 207:

- 12 No. Seawater Fire Hydrants;
  - 10 No. Hydrants along the access trestle (1 No. every 50 m);
  - 2 No. Hydrants on the berth platform;
- 2 No. Oscillating Monitors;
- 2 No. Remote Control Monitors;
- 3 No. Bund Pourers; and
- 3 No. Quay Pourers.

4.2. Electrical Supply

The electrical supply requirements are based on a power demand of up to 60 kVA for small quayside power requirements and general lighting at LNG Berth 207. It is envisaged that this power will be provided at 400 volts from the existing Berth 208 substation along a cable installed on cable trays fixed to the underside of the quay structure and typically feeding two distribution kiosks. All small power (including quick release hooks) and lighting requirements for the berth will be supplied from these distribution kiosks.

Power to the sea water and foam pump stations (estimated to be 1 200 kW) will also be provided from the existing Berth 208 substation along an underground cable to the proposed new pump station location adjacent to the existing pump station building.

The following electrical equipment is envisaged for the bulk electrical supply upgrade:

- 27 No. Light Pole with 250W HPS Fitting;
- 2 No. Light Mast Equipped with 400W HPS Floodlight; and
- 1 No. Distribution Kiosk.

4.3. Potable Water

The preferred installation of a second uPVC supply pipeline from the M14 "Chemical Berth" take-off to the proposed Berth 207 requires that a new supply line is buried in a trench for approximately 265 m, parallel to the existing supply line, before routing the pipeline an additional 600 m along the new access trestle to the proposed Berth 207.

The supply pressure at the connection point to the main reticulation network is 4 bar (Transnet Projects Design, 2007). Therefore, in order to ensure that the required 3 bar pressure is achieved at the furthest point in the extended potable water system, the head losses along this new pipeline will need to be less than 10 m (1 bar) when operating any of the fire hydrants (on its own) at its design flow rate.

A 160 mm diameter uPVC Class 16 pipeline (i.e. the same as the existing, shorter potable water pipeline to berth 208) would result in a worst-case head loss (for an old/deteriorated pipe, see section 3.3 above) of approximately 12.6 m; hence, a larger 200 mm diameter uPVC Class 16 pipe has been selected. The worst-case head loss for this pipe diameter is approximately 5.8 m. Refer to Figure 4-3 below.

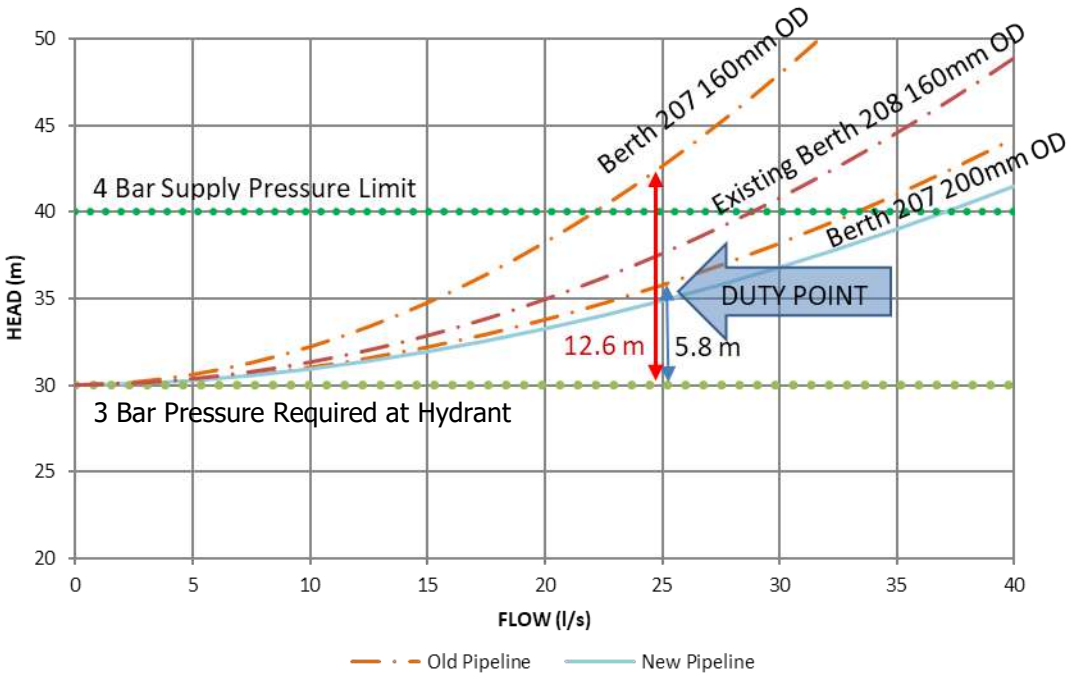

Figure 4-3: Potable Water System Curves

The following berth potable water fire-fighting equipment, based on the existing equipment provided for Berth 208, is envisaged for Berth 207:

- 12 No. Potable Water Fire Hydrants
  - 10 No. Hydrants along the access trestle (1 No. every 50 m); and
  - 2 No. Hydrants on the berth platform.

5. CONCLUSIONS

This study has concluded that the following bulk services are required for the new berth 207:

- A new seawater pump station, a new foam pump station and a new supply tank, similar to the existing fire-fighting installation, is required to supply the new berth with sea water and foam water.
- A new 200 mm diameter uPVC PN16 potable water pipeline, buried adjacent to the existing potable water supply pipeline which services berth 208. The new pipeline will connect to the existing water reticulation system at the M14 "Chemical Berth" take-off.

No upgrades are required for the electrical supply; the new sea water and foam pump stations can be supplied directly from the Berth 208 substation which currently has additional capacity available. Power supply from the existing substation would be via an 11 kV underground cable. Small power for the berth will also be supplied from this substation via a 400 V cable.

No upgrades to the bulk storm water or sewage systems are envisaged at this stage and any requirements, should these arise, will be handled locally at the berth.

6. RECOMMENDATIONS

It is recommended that the bulk services upgrade described in Section 5 above are carried forward to the next engineering stage (FEL-3).

In addition, it is recommended that the following tasks/studies are carried out prior to or as part of the FEL3 study:

- Assess the effectiveness of the existing storm water pump system and oil trap for Berth 208;
- Coordinate the fire-fighting system and electricity supply requirements to the new berth with the Berth 207 Operator's requirements;
- Specifically identify and address opportunities for efficiently managing maintenance costs in the detail design and specification of the fire-fighting system; and
- Assess the feasibility of connecting the new fire-fighting supply system to the existing system to provide redundancy.

7. REFERENCES

PRDW. (2018a). *Richards Bay LNG Terminal Bulk Services Study - Bulk Services Capacity Assessment, Demand Forecast and Options Identification. PRDW Study Report No. S2069-1-TN-GA-001-R1.* Cape Town: PRDW.

PRDW. (2018b). Richards Bay LNG Terminal Bulk Services Study - Bulk Services Options Evaluation. PRDW Study Report No. *S2069-1-TN-GA-002-R1. Cape* Town: PRDW.

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APPENDICES

Note: In all cases check against online version for the latest revision prior to use

The following appendix is included with this report:

APPENDIX A: DRAWINGS

Note: In all cases check against online version for the latest revision prior to use

APPENDIX A: DRAWINGS

S2069-1-SK-WS-100-002	Bulk Services – Potable Water – General Arrangement
S2069-1-SK-PI-200-002	Bulk Services – Electrical – General Arrangement
S2069-1-SK-PI-300-003	Bulk Services – Fire Water – Pump Houses
S2069-1-SK-PI-300-004	Bulk Services – Fire Water – Quayside Details

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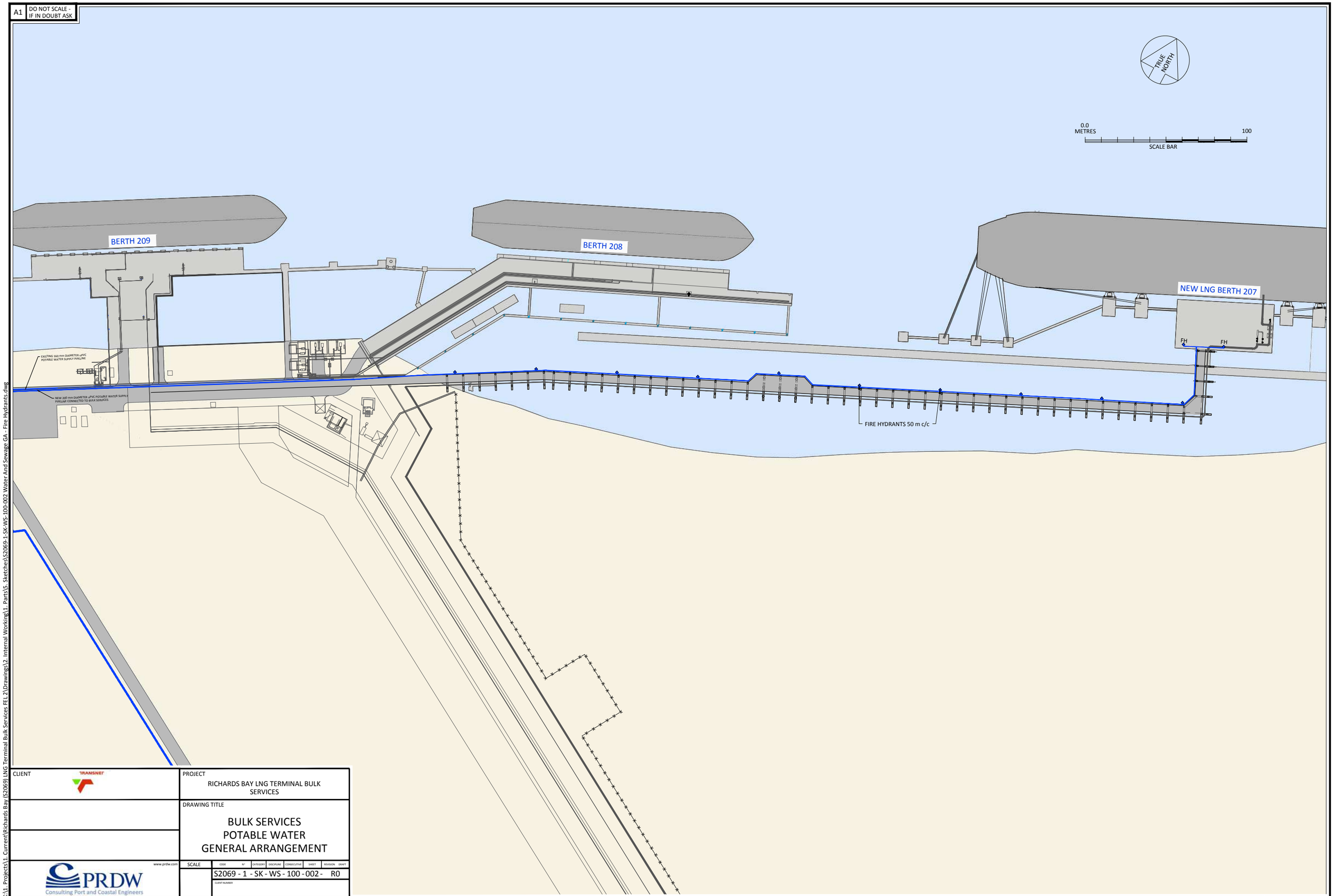

CLIENT TRANSNET

PROJECT
RICHARDS BAY LNG TERMINAL BULK SERVICES

DRAWING TITLE
BULK SERVICES
POTABLE WATER
GENERAL ARRANGEMENT

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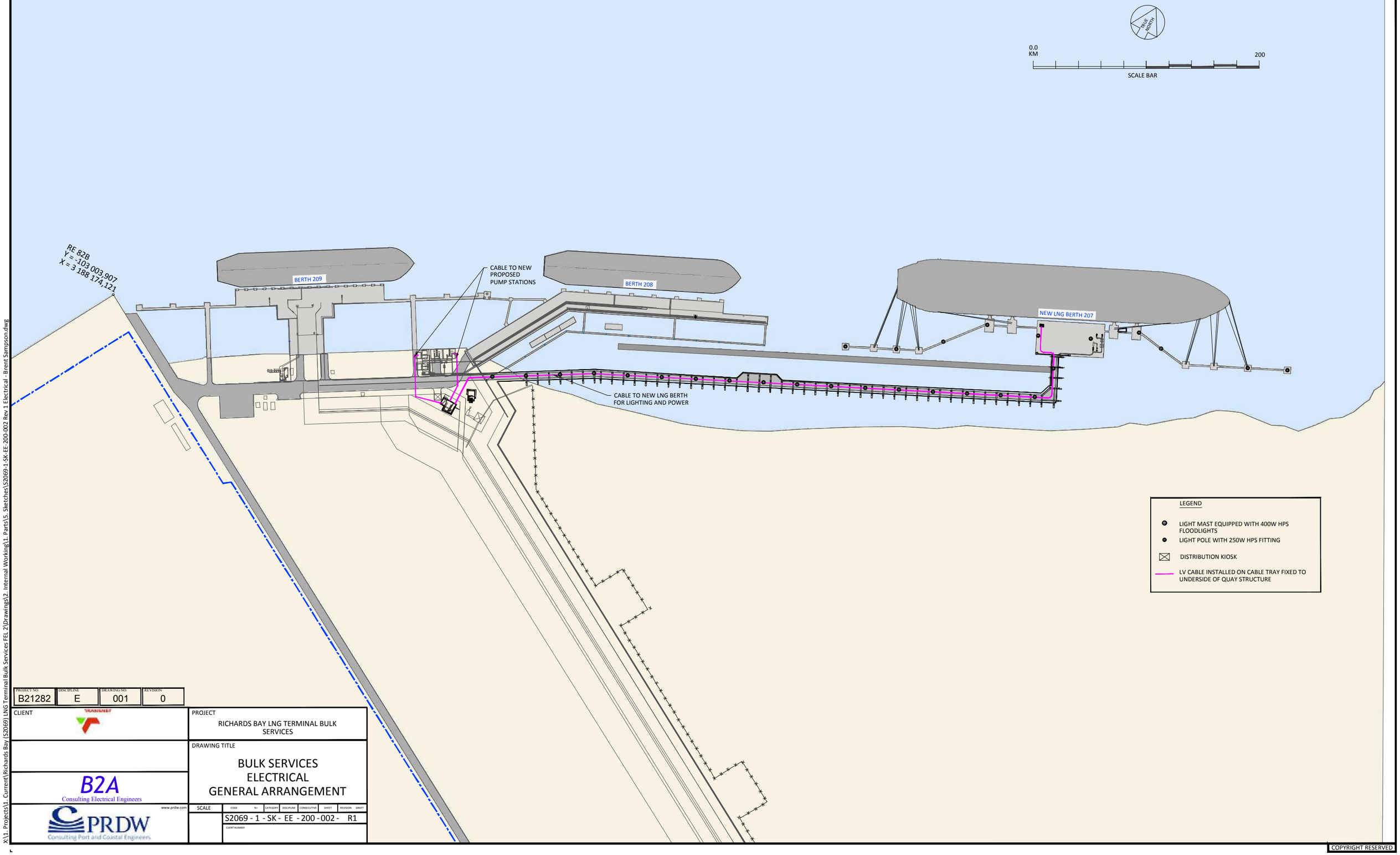

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PROJECT NO	DISCIPLINE	DRAWING NO	REVISION
B21282	E	001	0

CLIENT: TRANSNET

PROJECT: RICHARDS BAY LNG TERMINAL BULK SERVICES

DRAWING TITLE: BULK SERVICES ELECTRICAL GENERAL ARRANGEMENT

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CLIENT NUMBER

A1 DO NOT SCALE - IF IN DOUBT ASK

TRUE NORTH

0.0 KM — 10

SCALE BAR

LEGEND	
BV	BUTTERFLY VALVE
DM	DIESEL MOTOR
BPFP	BALANCE VALVE WITH VARIABLE FLOW PROPORTIONER
PRV	PRESSURE-RELIEF VALVE
EM	ELECTRIC MOTOR
GV	GATE VALVE
PG	PRESSURE GAUGE
NRV	NON RETURN VALVE
STR	STRAINER
RCV	REMOTE CONTROL VALVE

PROPOSED FOAM PUMP HOUSE

FOAM TANK

BV STR

EM

BV

BV STR

DM

NRV

BV

NRV

GV

BPFP

EXISTING SEAWATER PUMP HOUSE

EXISTING SEAWATER PUMP HOUSE

NRV

GV

EXISTING SEAWATER PUMP HOUSE

PRV

GV

PROPOSED SEAWATER PUMP HOUSE

DIESEL-POWERED STANDBY PUMP

DM

MOTOR CONTROL CENTRE

ELECTRICALLY POWERED DUTY PUMP

EM

PG

NRV

GV

NRV

GV

GV

11 kV ELECTRICAL SUPPLY LINE (BURIED)

NRV

250 NB STEEL PIPELINE (SEAWATER)

EXISTING BERTH 208

NEW BERTH 207

400 NB STEEL PIPELINE (SEAWATER)

LAYDOWN AREA

EDGE ROAD

CLIENT	PROJECT: RICHARDS BAY LNG TERMINAL BULK SERVICES
	DRAWING TITLE: BULK SERVICES FIRE FIGHTING PUMP HOUSES
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CODE	Nº	CATEGORY	DISCIPLINE	CONSECUTIVE	SHEET	REVISION	DRAFT
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A1 DO NOT SCALE - IF IN DOUBT ASK

TRUE NORTH

0.0 KM

100

SCALE BAR

NEW LNG BERTH 207

QUAY POURER

300 NB FOAM

BUND POURER

FH

FH

REMOTE MONITOR

REMOTE MONITOR

400 NB FOAM PIPELINE

250 NB SEAWATER PIPELINE

FIRE HYDRANTS 50 m c/c

OSCILLATING MONITOR

250 NB SEAWATER PIPELINE

OSCILLATING MONITOR

CLIENT

TRANSNET

PROJECT

RICHARDS BAY LNG TERMINAL BULK SERVICES

DRAWING TITLE

BULK SERVICES
FIRE FIGHTING
QUAYSIDE DETAILS

www.prdw.com

PRDW Consulting Port and Coastal Engineers

SCALE

CODE	N°	CATEGORY	DISCIPLINE	CONSECUTIVE	SHEET	REVISION	DRAFT
S2069	1	SK	PI	300	004	R0	

CLIENT NUMBER

X:\1. Projects\1. Current\Richards Bay (S2069) LNG Terminal Bulk Services FEL 2\Drawings\2. Internal Working\1. Parts\5. Sketches\S2069-1-SK-PI-300-004 Fire Fighting - Quayside Details.dwg

Note: In all cases check against online version for the latest revision prior to use

APPENDIX D:
CAPITAL AND OPERATIONAL COST ESTIMATE

PRDW
Consulting Port and Coastal Engineers

TRANSNET

1 **PROJECT NO.**
S2069

2 **TITLE**
Richards Bay Terminal Bulk Services

3 **ESTIMATE PREPARED BY:** **DATE:**
PRDW **Jan-18**

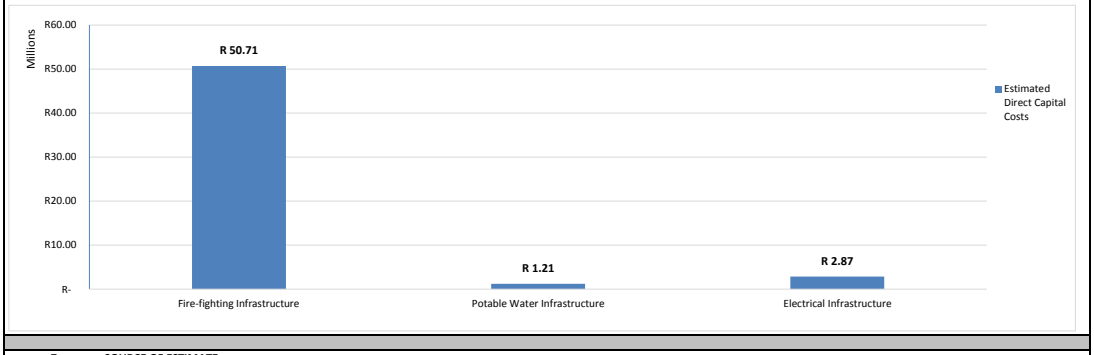
4 **SCOPE**
Scope Items & Description
Capital cost estimate for bulk services required for the LNG Berth include:
- Fire-fighting infrastructure - Sea water supplied from a new pump station
- Electrical infrastructure -Small power requirements and general lighting supplied directly from Berth 209 Substation at 400 V.
- Potable water infrastructure -A secondary pipeline installed from the M14 Chemical berth take off to the proposed LNG berth

5 **ASSUMPTIONS AND EXCLUSIONS**
Assumptions
Cost base as at Jan 2018
Exchange Rate (Dollar) - $ 1.00 R 12.20
Exchange Rate (Euro) - € 1.00 R 14.90

Exclusions
Upgrading of the storm water and sewage bulk services
Purchase/lease of land and/or relocation, restitution costs
Local or other authority approvals
Allowance for compensation to third parties
Allowance for market adjustment due to local and international demand, availability of skills, resources and materials
Environmental, EIA and EMP costs
Pre-tender and post contract escalation
Project wide contingency (10% recommended)
Rate of exchange adjustment
Owners costs and Construction Site Supervision Costs
Value Added Tax or other foreign or South African taxes, royalties and duties

6 **CAPEX (Including P&G's, Design Development Allowance and Professional Fees)**

Item	Description	Fire-fighting Infrastructure	Potable Water Infrastructure	Electrical Infrastructure
	Base Capital Cost	R 34 030 000	R 810 000	R 1 920 000
	Preliminary and General costs	R 6 800 000	R 160 000	R 390 000
	Design Development Allowance	R 6 130 000	R 150 000	R 340 000
	Professional Design Fees	R 3 750 000	R 90 000	R 220 000
ESTIMATED CAPITAL COSTS		**R 50 710 000**	**R 1 210 000**	**R 2 870 000**



7 **SOURCE OF ESTIMATE**
Rates are largely based upon PRDW's internal rates data base

8 **LEVEL OF ACCURACY**

Rough Order of Magnitude FEL 1		Pre-feasibility /Conceptual FEL 2		Feasibility / Budget FEL 3		Definitive Control Budget FEL 4		Definitive Control Budget FEL 5	
Accuracy -30% to +50%		Accuracy -25% to +30%	✓	Accuracy -15% to +20%		Accuracy -10% to +15%		Accuracy -5% to +15%	
(No Dwg, No BoM), Thumb suck		Basis Captured on GA Dwgs		Detailed Design Dwgs 30%, Construction Dwgs, Site investigations		Construction Started		Construction Started	

9 **RISKS IDENTIFIED AND COMMENTS**

Project:	**Richards Bay Terminal Bulk Services**		**Jan-18**
Project No.:	**S2069**		
Title:	**Capital cost estimate for bulk services required for the LNG Berth include:**		
Element:	**Richards Bay Terminal Bulk Services**		

ITEM	REF	DESCRIPTION	UNIT	QTY	RATE	AMOUNT	COMMENTS
		Richards Bay Terminal Bulk Services					
1		Fire-fighting Infrastructure					
1.1		Pumps	sum	1	17 580 000	R 17 580 000.00	
1.2		Pump Stations	sum	1	7 240 000	R 7 240 000.00	
1.3		Pipework and pipe sundries	sum	1	9 210 000	R 9 210 000.00	
2		Potable Water Infrastructure	sum	1	810 000	R 810 000.00	
3		Electrical Infrastructure	sum	1	1 920 000	R 1 920 000.00	
		SUB-TOTAL:				**R 36 760 000.00**	
		P&G Allowance	20%			R 7 350 000.00	
		Design Development Allowance	15%			R 6 620 000.00	
		Professional Fee Allowance	8%			R 4 060 000.00	
		SUB-TOTAL CARRIED FORWARD TO SUMMARY:	Rounded			**R 54 790 000.00**	

PRDW
Consulting Port and Coastal Engineers

TRANSNET

1 **PROJECT NO.**
S2069

2 **TITLE**
Richards Bay Terminal Bulk Services

3 **ESTIMATE PREPARED BY:** **DATE:**
PRDW **Jan-18**

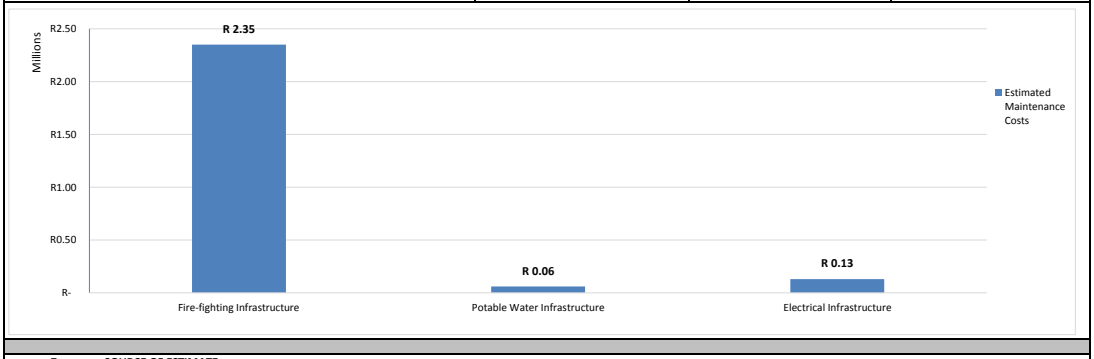
4 **SCOPE**
Scope Items & Description
Annual infrastructure maintenance and repairs cost estimate for bulk services required for the LNG Berth include:
- Fire-fighting infrastructure - Sea water supplied from a new pump station
- Electrical infrastructure -Small power requirements and general lighting supplied directly from Berth 209 Substation at 400 V.
- Potable water infrastructure -A secondary pipeline installed from the M14 Chemical berth take off to the proposed LNG berth

5 **ASSUMPTIONS AND EXCLUSIONS**
Assumptions
Cost base as at Jan 2018
Exchange Rate (Dollar) - $ 1.00 R 12.20
Exchange Rate (Euro) - € 1.00 R 14.90

Exclusions
Storm water and sewage bulk services operational costs
Allowance for market adjustment due to local and international demand, availability of skills, resources and materials
Environmental, EIA and EMP maintenance costs
Insurances
Utility costs, royalties and municipal fees
Value Added Tax or other foreign or South African taxes, royalties and duties

6 **OPEX**

Item	Description	Fire-fighting Infrastructure	Potable Water Infrastructure	Electrical Infrastructure
	Infrastructure maintenance and repairs	R 2 350 000	R 60 000	R 130 000
ESTIMATED CAPITAL COSTS		**R 2 350 000**	**R 60 000**	**R 130 000**



7 **SOURCE OF ESTIMATE**
Rates are largely based upon PRDW's internal rates data base

8 **LEVEL OF ACCURACY**

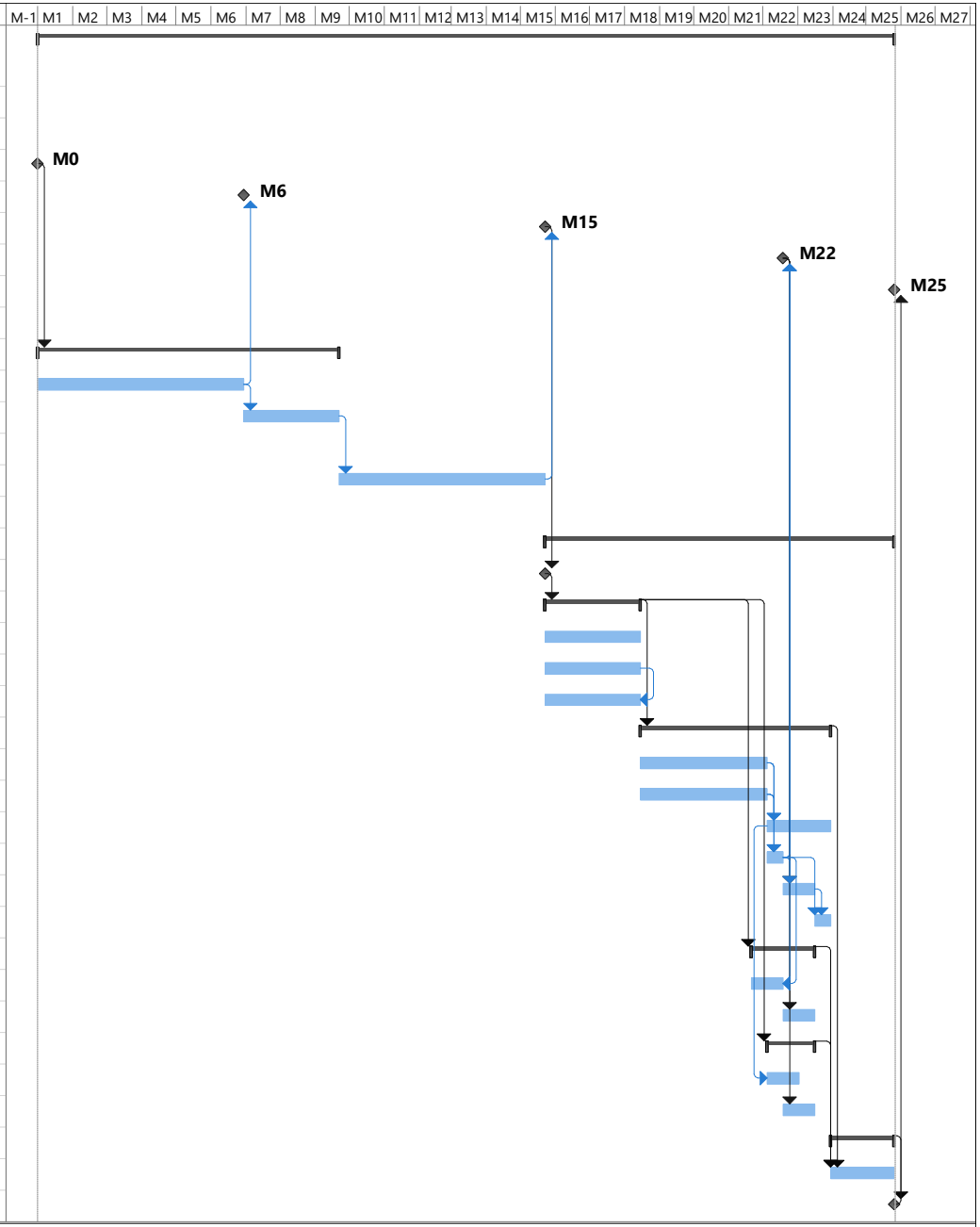
Rough Order of Magnitude FEL 1		Pre-feasibility /Conceptual FEL 2		Feasibility / Budget FEL 3		Definitive Control Budget FEL 4		Definitive Control Budget FEL 5	
Accuracy -30% to +50%	✓	Accuracy -25% to +30%		Accuracy -15% to +20%		Accuracy -10% to +15%		Accuracy -5% to +15%	
(No Dwg, No BoM), Thumb suck		Basis Captured on GA Dwgs		Detailed Design Dwgs 30%, Construction Dwgs, Site investigations		Construction Started		Construction Started	

9 **RISKS IDENTIFIED AND COMMENTS**

Note: In all cases check against online version for the latest revision prior to use

APPENDIX E:
IMPLEMENTATION SCHEDULE

ID	Task Name	Duration
1	**RICHARDS BAY LNG TERMINAL BULK SERVICES: HIGH-LEVEL IMPLEMENTATION SCHEDULE**	**108.05 wks**
2		
3	**MILESTONES**	
4	Decision to proceed with FEL3 & Appointment of Terminal Operator	0 wks
5	Complete FEL3 design	0 wks
6	Award of construction contract	0 wks
7	Terminal Operator provides access to trestle and berth for installation of services	0 wks
8	Bulk services commissioning complete	0 wks
9		
10	**DESIGN ACTIVITIES & APPROVALS**	**38 wks**
11	FEL 3: Detailed Design & Procurement Documentation	26 wks
12	Financial and economic assessment and approvals	12 wks
13		
14	**TENDERING AND PROCUREMENT**	**26 wks**
15		
16	**BULK SERVICES CONSTRUCTION**	**44 wks**
17	Award of construction contract	0 days
18	**Establishment & Site Facilities**	**12 wks**
19	Site establishment	12 wks
20	Procurement of long lead items: pumps and fire-fighting equipment	12 wks
21	Procurement of long lead items: pipelines	12 wks
22	**Fire-fighting**	**24 wks**
23	Construct seawater intake pump station and pipeline	16 wks
24	Construction foam pump station	16 wks
25	Installation of pumps and equipment	8 wks
26	Pipeline to root of access trestle	2 wks
27	Pipeline from root of access trestle to berth	4 wks
28	Installation of fire-fighting equipment	2 wks
29	**Potable Water**	**8 wks**
30	Pipeline from take-off to root of access trestle	4 wks
31	Pipeline from root of access trestle to berth	4 wks
32	**Electrical Supply**	**6 wks**
33	Supply from existing substation to pump stations	4 wks
34	Supply from existing substation to berth and trestle	4 wks
35	**Commissioning**	**8 wks**
36	Testing and comissioning of bulk services and equipment	8 wks
37	**Bulk Services Commissioning Complete**	0 days



Note: In all cases check against online version for the latest revision prior to use

APPENDIX F:
ENVIRONMENTAL ASSESSMENT

Screening Report:

High-level Environmental Assessment of Bulk Services for the Liquefied Natural Gas Terminal, Port of Richards Bay

Report Prepared for

PRDW Consulting Port and Coastal Engineers

Report Number 525451/SR-02

Report Prepared by

srk consulting

January 2018

Screening Report:

High-level Environmental Assessment of Bulk Services for the Liquefied Natural Gas Terminal, Port of Richards Bay

PRDW Consulting Port and Coastal Engineers

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SRK Project Number 525451

January 2018

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Executive Summary

Background

As part of the Independent Power Producer (IPP) programme, a Gas to Power (G2P) project has been launched by the South African Department of Energy (DoE) to address the electricity supply shortages in South Africa. The aim of the project is to develop and operate Liquefied Natural Gas (LNG) fired power stations at key locations in South Africa.

A Pre-Feasibility (FEL2) Study for LNG import projects in the Port of Richards Bay was undertaken in which two preferred sites for the location of the LNG import facility were identified. At a close-out workshop for the study it was agreed that Berth 207 would be the preferred site for the LNG import facility.

The provision of bulk services for the Floating Storage Regasification Unit (FSRU) was excluded from the FEL2 stage of the IPP project. A review of the existing bulk services and those required by the FSRU, as well as the associated Berth 207 facility, was undertaken by PRDW in November 2017. PRDW thereafter estimated the upper and lower limits for the FSRU bulk services requirements and assessed the existing bulk service systems to identify any associated bulk services capacity constraints.

SRK Consulting (South Africa) (Pty) Ltd (SRK) has been appointed by PRDW Consulting Port and Coastal Engineers (PRDW) to assist with a high-level environmental assessment of the required bulk services for the LNG Terminal. SRK's scope includes the preparation of an environmental screening report (this report) to identify all environmental permitting, approval and regulatory requirements.

Summary of findings

The following upgrades were identified by PRDW:

- **Fire-fighting** – Sea water will be supplied from a new pump station onshore. The pump station will be located adjacent to the existing pump station and will run an approximately 615m long pipeline along the trestle to the new LNG Berth 207.
- **Electrical Supply** – Because the new water pump station for fire-fighting is to be located adjacent to the existing pump station, there will be small power requirements and general lighting needs. The 400V of power required will be sourced directly from the Berth 209 Substation.
- **Potable Water** – A second uPVC supply pipeline will be constructed from the M14 "Chemical Berth" take-off.

To determine whether the site includes sensitive terrestrial and aquatic habitats, three data sets (refer to Table ES-1) where considered.

Table ES-1: Presence of sensitive terrestrial and aquatic habitats

Dataset	Study Area
Ezemvelo KZN Wildlife Terrestrial Systematic Conservation Plan (TSCP)	100% transformed
South African National Biodiversity Institute (SANBI) National Biodiversity Assessment: Terrestrial Habitats	Entire Port of Richards Bay and surrounding area classified as Least Threatened
National Freshwater Ecosystem Priority Area (NFEPA)	Entire Port of Richards Bay classified as a National Freshwater Ecosystem Priority Area Estuary

Legal Review

The review of environmental legislation identified the following legislation as relevant to the proposed upgrades:

- National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and the Environmental Impact Assessment (EIA) Regulations (2014) promulgated in terms of the NEMA; and
- National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA).

Conclusions

Based on SRK's understanding of the project and the screening assessment undertaken, SAHRA will need to be notified of the project and provided with information. Thereafter SAHRA will indicate their requirements in terms of compliance with the NHRA.

Barring the SAHRA requirements, no additional environmental authorisations, permits or approvals have been identified.

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Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (South Africa) (Pty) Ltd (SRK) by PRDW Consulting Port and Coastal Engineers (PRDW). The opinions in this Report are provided in response to a specific request from PRDW to do so. SRK has exercised all due care in reviewing the supplied information. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

1 Introduction and Background

1.1 Port of Richards Bay

The Port of Richards Bay is South Africa's largest port. It occupies 2,157 ha of land area and 1,495 ha of water area. It was built in 1976 for the export of coal from South Africa to international markets. Prior to the construction of the harbour the area was a natural lagoon. Since its construction the Port has grown to include the following infrastructure:

- **Liquid Bulk Terminal** – this terminal consists of two berths that service two bulk liquid storage companies, namely Island View Storage (IVS) and Joint Bunker Services (JBS). The terminal has a current throughput of 1.4 million tonnes per year and a future throughput capacity of 2.7 million tonnes per year. Island View Storage, Bidvest Company, handles a wide range of bulk liquids, mainly chemicals and specialised liquefied gases. The terminal has a total storage capacity of 260 000 m^3. Joint Bunker Services operates what is referred to as the Bunker Terminal which also operates from the berths included in the Liquid Bulk Terminal. The capacity of the terminal for the storage of fuel is increased by the use of two bunker barges also operating in the Port. The proposed project lies within the liquid bulk terminal area of the Port.
- **Multipurpose Terminal** – this terminal resulted from merging the Bulk Metal and Combi Terminals. The terminal is now able to handle break bulk, neo-bulk and containers. The terminals covered storage has a capacity of 22 500 m^2 and open storage of 530 000m^2. It has 6 berths with and annual throughput of 7.2 million tonnes and a throughput capacity of 8.2 million tonnes for break bulk cargo. The terminal is operated by Transnet Port Terminals.
- **Dry Bulk Terminal** – this terminal handles various products via a conveyor system. No one part of the conveyor system is dedicated to a particular commodity and therefore to prevent contamination the belts, transfer points, rail trucks and vessel loaders/unloaders need to be thoroughly washed between handling of different commodities. The Dry Bulk Terminal has 7 berths that have varying depths ranging between 14.5 and 19m. The Dry Bulk Terminal currently handles in excess of 20 million tonnes of cargo annually and is operated by Transnet Port Terminals.
- **Coal Terminal** – The Port of Richards Bay was originally designed to export coal. When it opened on 1976 it had a capacity of 12 million tons per annum. This has grown to a current design capacity of 91 million tons per annum and an annual throughput of 70 million tonnes. This makes the coal terminal the largest export coal terminal in the world. The coal terminal is 276 ha in extent. It has 6 berths and four ship loaders. The coal terminal stockyard has a capacity of 8.2 million tons. The Coal terminal is privately operated by Richards Bay Coal Terminal Company Limited.
- **Support Infrastructure** – The Port has a dedicated railway line that connects the port to Gauteng and Mpumalanga. The line was designed specifically for coal handling. The port is also connected to Durban and Swaziland via rail networks. Trains of up to 200 wagons deliver coal to the Coal Terminal on a daily basis. Each payload averages 16,800 tonnes. The port is also supported by road networks.

Refer to Figure 1-1 for the location of the various components of the Port of Richards Bay.

N

Legend

- TNPA Boundary

Richards Bay

- Dry Bulk
- Liquid Bulk
- MPT
- Open Space
- Richards Bay Coal Terminal
- TNPA Other

Data Source:	
Scale 1:65 000	
Projection:	Datum: HH94
Central Meridian/Zone:	

srk consulting

SCREENING REPORT - BULK SERVICES FOR THE LNG TERMINAL, PORT OF RICHARDS BAY

LOCATION OF THE PORT OF RICHARDS BAY COMPONENTS

Date: 19/11/2012	Compiled by: REEL
Project No. 525451	Fig No. 1-1

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Revision: B Date: 27 11 2017

1.2 Project background

As part of the Independent Power Producer (IPP) programme, a Gas to Power (G2P) project has been launched by the South African Department of Energy (DoE) to address the electricity supply shortages in South Africa. The aim of the project is to develop and operate Liquefied Natural Gas (LNG) fired power stations at key locations in South Africa.

A Pre-feasibility (FEL2) Study for LNG import projects in the Port of Richards Bay was undertaken in which two preferred sites for the location of the LNG import facility were identified. At the close-out workshop (held on 20 September 2016) it was agreed that Berth 207 would be the preferred site for the LNG import facility.

The provision of bulk services for the Floating Storage Regasification Unit (FSRU) was excluded from the FEL2 stage of the IPP project. This study aims to assess the bulk services requirements at a pre-feasibility (FEL2) level of project development.

SRK Consulting (South Africa) (Pty) Ltd (SRK) has been appointed by PRDW Consulting Port and Coastal Engineers (PRDW) to assist with a high-level environmental assessment of the required bulk services for the LNG Terminal. SRK's scope includes the preparation of a screening report (this report) to identify all environmental permitting, approval and regulatory requirements.

1.3 Assumptions and limitations to the report

SRK's screening assessment is subject to the following assumptions and limitations:

- The required approvals for the construction and fixing of the trestle and associated new LNG Berth 207 have been obtained in a separate process and therefore fall outside of the scope of this environmental screening assessment.
- No bulk services providing an interaction between the FSRU and the berth have been identified and therefore have been excluded from the scope of this environmental screening assessment.
- Any infrastructure and service requirements falling outside of the bulk service provision are excluded from the scope of this environmental screening assessment.

2 Approach

SRK undertook the following steps in determining the environmental permits, approvals and regulatory requirements for the project:

- Develop an understanding of the project, which included:
  - Initiation meeting with PRDW;
  - Review of the Bulk Services Capacity Assessment, Demand Forecast and Options Identification report prepared by PRDW; and
  - Review of the options identified for each bulk service.
- Develop an understanding of baseline environment through review of existing maps to identify sensitive environmental features on site and surrounding the site. This included a review of available information and historical reports available for the site;
- Undertake an environmental legal review to determine potential authorisations, permits and licenses required; and
- Compile a Screening Report, this report, that provides:
  - An overview of SRK's understanding of the proposed project;
  - An understanding of what potential environmental permits and/or licences will be required for the site; and
  - A description of the site baseline that underpins the legal requirements, based on existing information.

3 Understanding of the project

3.1 Review of existing bulk services and future requirements

A review of the existing bulk services and those required by the FSRU, as well as the associated Berth 207 facility, was undertaken by PRDW in November 2017. The existing services and the required services for the operation of the LNG berth are detailed in the sub-sections that follow.

3.1.1 Fire-fighting

The FSRU will be equipped with its own seawater intake for fighting fires on board the vessel. Therefore, it is anticipated that only fire-fighting requirements for the berth itself need to be considered.

3.1.2 Potable water

A bulk water pipeline currently extends to the proposed location of the FSRU at Berth 207 and a reverse osmosis plant on the vessel will typically provide the potable water requirements for the vessel. An additional potable water pipeline will be needed to supply the fire hydrants at Berth 207 as described in Section 3.1.1 above.

3.1.3 Power supply

The FSRU is typically powered by an on-board power plant using fuel gas and oil and therefore, an external electrical power supply for the FSRU is not deemed necessary. For the purposes of this assessment it has been assumed that no bunkering to supply the vessel with fuel gas and oil will be required.

Bulk electrical power supply currently extends to the Berth 209 substation. Additional bulk electrical power supply will be required from the substation to the fire-fighting pump station and along the new Berth 207 trestle to the berth for lighting etc.

The only bulk electrical power required is for the fire-fighting pump station.

3.1.4 Sewage

Sewage will most likely be treated on the vessel using an on-board plant, such as a membrane bioreactor. Therefore, no bulk sewage services requirements are anticipated for the vessel. However, concentrated sludge will need to be removed periodically from the settling holding tank and disposed of at a suitable onshore sewage treatment plant. For the purposes of this assessment it has been assumed that the current process undertaken at the other Berths (i.e. use of sludge handling vehicles to remove sludge from the quayside) will be implemented and as such no additional bulk sewage services will be required.

In terms of the Berth 207 requirements, should an additional control tower be required the sewage flows from the toilet facilities in this building would be handled in a similar manner to that of the existing control tower facilities (i.e. installation of a septic tank and soakaway pit system). The need for an additional control tower is, however, unlikely as the existing tower has capacity for an additional berth. As such, for the purposes of this assessment it has been assumed that no additional bulk sewage services will be required for the Berth.

3.1.5 Storm water

Any storm water on the vessel is expected to be routed back to sea. Therefore, it is not expected that any onshore storm water handling will be required for the FSRU.

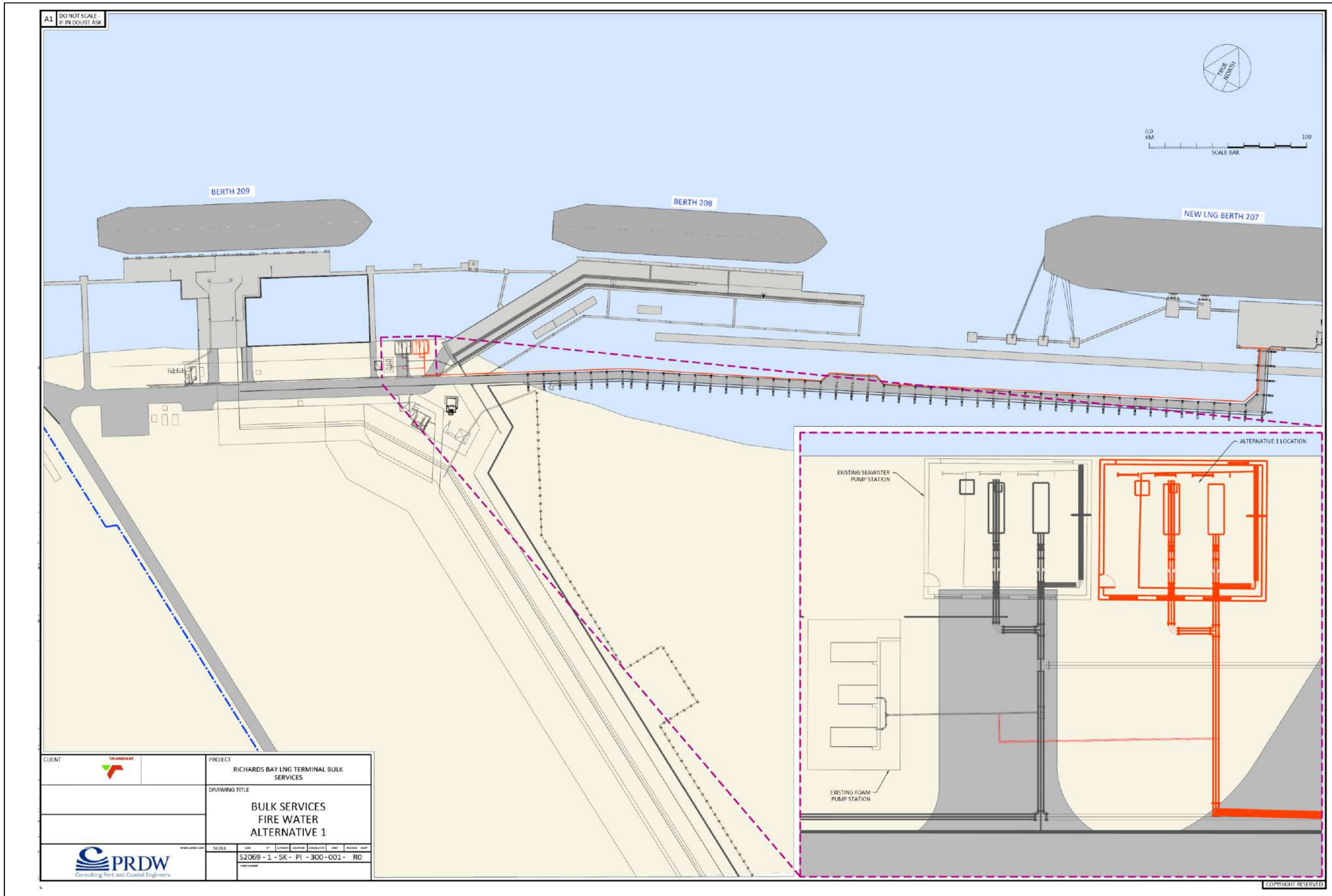
As is done for Berth 208, any storm water runoff from the deck of the proposed berth structure will need to be collected in sumps and pumped to shore where the flow is then passed through an oil trap prior to draining out through a soak-away pit. Therefore in terms of the storm water for the berth, this is treated locally and as such there is no additional demand on existing bulk services.

3.2 Proposed upgrades to bulk services

PRDW estimated the upper and lower limits for the FSRU bulk services requirements and assessed the existing bulk service systems to identify any associated bulk services capacity constraints. PRDW identified the need to upgrade the fire-fighting, electrical supply and potable water supply services. PRDW identified options to meet the bulk service requirements. SRK reviewed the options and provided environmental input. Once the input was received PRDW presented the options to Transnet National Ports Authority (TNPA) and Option 1 was selected as the preferred option for all three bulk services. The proposed upgrade options and SRK's environmental are detailed in Table 3-1.

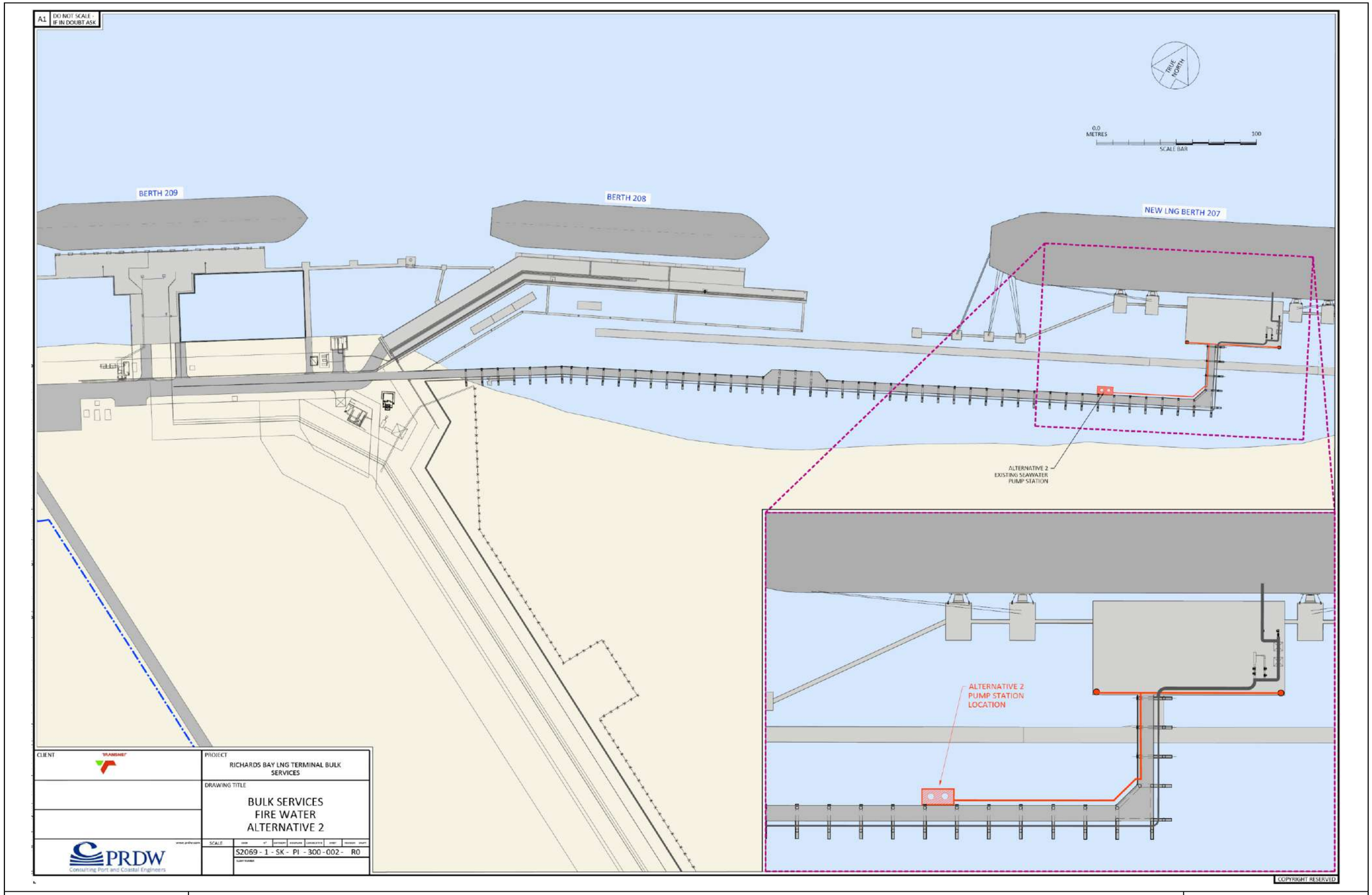
Table 3-1: Upgrade options summary

Bulk Service	Option 1	Option 2
Fire Fighting	Sea water will be supplied from a new pump station onshore. The pump station will be located adjacent to the existing pump station and will run an approximately 615m long pipeline along the trestle to the new LNG Berth 207 (refer to Figure 3-1). In terms of potential environmental impact, this is the marginally preferred option as the potential impacts of pumping water from the sea are already experienced at the existing pumping site and it is assumed the required scour protection is in place. Option 1 has been confirmed in the PRDW *Bulk Services Options Evaluation Report* as the final upgrade option.	Sea water will be supplied from a new pump station located on the access trestle near the new LNG Berth 207. An approximately 100m long pipeline will be installed along the underside of the trestle (refer to Figure 3-2). This option will require the installation of a pump within the sea. There is some uncertainty at this stage as to how far down the pump will go and the depth of the sea floor. Should the sea floor be close to the abstraction point then this could potentially impact the benthos of the sea floor.
Electrical Supply [NOTE: the electrical supply options are dependent on the fire fighting options]	Should the new water pump station for fire-fighting be located adjacent to the existing pump station then there will be small power requirements and general lighting needs. The 400V of power required will be sourced directly from the Berth 209 substation. Option 1 has been confirmed in the PRDW *Bulk Services Options Evaluation Report* as the final upgrade option.	Should the new pump station for fire-fighting be located near the new LNG Berth 207 then a miniature substation will need to be installed at the new LNG Berth 207 to accommodate sea water pump requirements of 11kV. This option will also include small power requirements and lighting of 400V, however, an 11kV powerline will be required from the miniature substation to the pump station. Additional infrastructure will be required, albeit with a negligible environmental impact, and as such Option 1 is marginally preferred.
Potable Water	A second uPVC supply pipeline would need to be constructed from the M14 "Chemical Berth" take-off (refer to Figure 3-3). This option will involve trenching along a stretch of land to the west of the water pump station and therefore may have more construction phase impacts than that of Option 2. Option 1 has been confirmed in the PRDW *Bulk Services Options Evaluation Report* as the final upgrade option.	The existing pump station does not have sufficient pressure for the additional water requirements and as such a new booster pump station will be constructed in order to provide the required pressure at the proposed new LNG Berth 207 (refer to Figure 3-3). This option involves excavations that will be localised to the pump station site as opposed to extending over a stretch of land. As such, this is marginally the preferred option in terms of environmental impact.



srk consulting	**SCREENING REPORT: HIGH-LEVEL ENVIRONMENTAL ASSESSMENT OF BULK SERVICES FOR THE LNG TERMINAL, PORT OF RICHARDS BAY** PROVISION OF FIRE WATER – OPTION 1	Project No. 525451

Figure 3-1: Provision of fire water – Option 1 (Note: the red indicates the proposed new infrastructure)



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SCREENING REPORT: HIGH-LEVEL ENVIRONMENTAL ASSESSMENT OF BULK SERVICES FOR THE LNG TERMINAL, PORT OF RICHARDS BAY
PROVISION OF FIRE WATER – OPTION 2

Project No. 525451

Figure 3-2: Provision of fire water – Option 2 (Note: the red indicates the proposed new infrastructure)

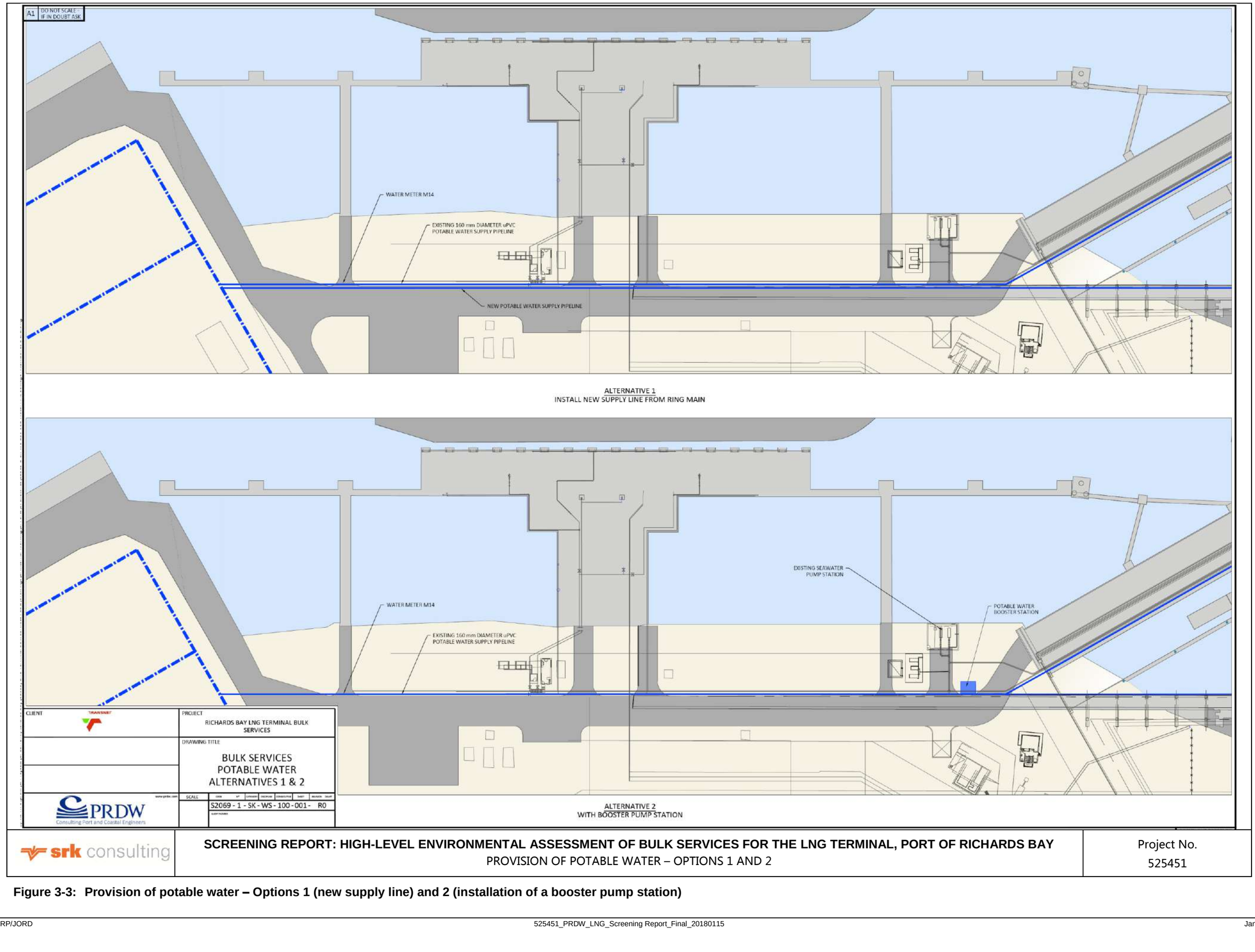

Figure 3-3: Provision of potable water – Options 1 (new supply line) and 2 (installation of a booster pump station)

Legend

Bulk Services Upgrade

- Potable Water
- Fire Fighting
- Roads
- TNPA Port Boundary
- Project Study Area

Data Source:	
Scale: 1:5 000	
Projection: TM	Datum: HH94
Central Meridian/Zone: Lo31	
Date: 09/11/2017	Compiled by: STBOD
Project No: 525451	Fig No: 3-4

Revision: A Date: 09 11 2017

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SCREENING ASSESSMENT: BULK SERVICES LNG BERTH

PROPOSED BULK SERVICE UPGRADES

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4 Baseline description of the project area

According to the National Ports Plan 2016 Update, the Port of Richards Bay is divided into three Precincts, namely the Bayvue Precinct, Newark Precinct and South Dunes Precinct. The proposed project falls within the South Dunes Precinct (Figure 4-1).

srk consulting | SCREENING ASSESSMENT: BULK SERVICES FOR LNG BERTH
PRECINCTS & BERTH LAYOUT OF THE PORT OF RICHARDS | Project No. 525451

Figure 4-1: Precincts and berth layout of the Port of Richards Bay (extracted from the National Ports Plan 2016 Update)

To determine whether the site includes sensitive terrestrial and aquatic habitats, the following data sets where considered:

- **Ezemvelo KwaZulu-Natal Wildlife (EKZNW) (2011) KZN Terrestrial Systematic Conservation Plan (TSCP) database of priority conservation areas (also referred to as C-Plan):** EKZNW uses the C-Plan programme as part of its TSCP to identify a provincial reserve system for KZN that satisfies specified conservation targets for biodiversity features. The C-Plan is an effective conservation tool when determining priority areas at a regional level and is used in KZN to identify areas of high conservation value. As indicated in Figure 4-2, large sections of the South Dunes Precinct lies within the area classified as '100% Transformed'. In spite of this, ground truth surveys indicate that certain ecosystems have recovered sufficiently to be regarded as highly valuable assets to conservation of plant communities and suitable habitat for faunal species of conservation concern. This is evident with Red Data species and plants specially protected under provincial legislation having been recorded in the South Dunes Precinct (SAS *et. al.,* 2017). The project study area, however, occurs within a completely transformed site and all proposed infrastructure will be within the confines of existing infrastructure.
- South African National Biodiversity Institute (SANBI) (2011) National Biodiversity Assessment Terrestrial Habitats: The National Biodiversity Assessment (NBA), led by SANBI (2011) assigned 4 categories of sensitivity to various habitat types, namely: Critically Endangered, Endangered,

Vulnerable and Least Threatened. As indicated Figure 4-3, the project study area lies within the Least Threatened category.

- National Freshwater Ecosystem Priority Areas (NFEPA) wetlands and estuaries (2011): The NFEPA project aims to: Identify Freshwater Ecosystem Priority Areas (FEPAs) to meet national biodiversity goals for freshwater ecosystems; and develop a basis for enabling effective implementation of measures to protect FEPAs, including free flowing rivers. The NFEPA project responds to the high levels of threat prevalent in river, wetland and estuary ecosystems of South Africa (Driver et al. 2005) and provides strategic spatial priorities for conserving the country's freshwater ecosystems and supporting sustainable use of water resources. As indicated in Figure 4-4, the entire Port is considered to be a NFEPA estuary.

Legend

Bulk Services Upgrade

- Potable Water
- Fire Fighting
- Roads
- Project Study Area

eKZNW Priority Conservation Areas

- Conservation Areas
- 100% Transformed

Data Source: eKZNW C-Plan 2010	
Scale: 1:12 000	
Projection: TM	Datum: HH94
Central Meridian/Zone: Lo31	
Date: 09/11/2017	Compiled by: STBOD
Project No: 525451	Fig No: 4-2

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SCREENING ASSESSMENT: BULK SERVICES LNG BERTH

MAP SHOWING EKZNW PRIORITY CONSERVATION AREAS

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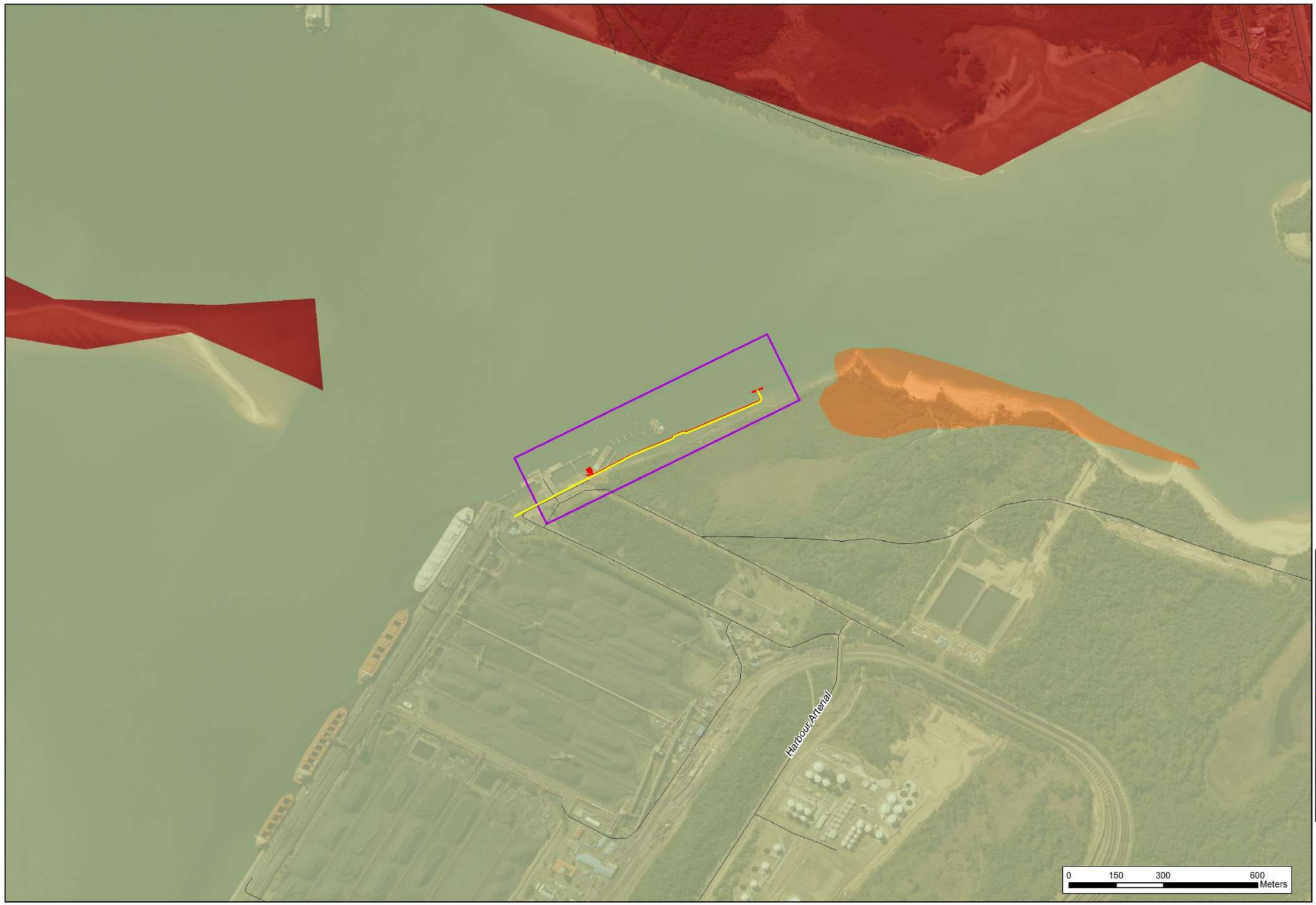
Revision: A Date: 09 11 2017



Data Source: NBA 2011: Vegetation Map

Scale: 1:12 000

Projection: TM | Datum: HH94

Central Meridian/Zone: Lo31

Date: 09/11/2017 | Compiled by: STBOD

Project No: 525451 | Fig No: 4-3

Revision: A Date: 09 11 2017

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SCREENING ASSESSMENT: BULK SERVICES LNG BERTH

MAP SHOWING SANBI NBA TERRESTRIAL HABITATS

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N

Harbour Arterial

0 150 300 600 Meters

Legend

Bulk Services Upgrade

- Potable Water
- Fire Fighting
- Roads
- Project Study Area
- NFEPA Wetlands and Estuaries

Data Source: NFEPA Wetlands 2011	
Scale: 1:12 000	
Projection: TM	Datum: HH94
Central Meridian/Zone: Lo31	
Date: 09/11/2017	Compiled by: STBOD
Project No: 525451	Fig No: 4-4

Revision: A Date: 09 11 2017

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SCREENING ASSESSMENT: BULK SERVICES LNG BERTH

MAP SHOWING NFEPA WETLANDS AND ESTUARIES

Path: G:\525451_PRDW_LNG_RBAY_PORT_SCREEN\8GIS\GISPROJ\MXD\Alternative 1_Final\525451_F4_4_PRDW_Alt1_NFEPA_A3L_11092017.mxd

5 Legal review

Key legislation that regulates environmental matters in relation to development projects (i.e. where environmental authorisations, permits or licences may be required) are discussed in terms of their applicability to the proposed project below.

5.1 National Environmental Management Act

The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) provides for co-operative governance by establishing decision-making principles on matters affecting the environment including:

a) Sustainable development;
b) Integrated environmental management;
c) Polluter pays principle;
d) Cradle-to-grave responsibility;
e) Precautionary principle;
f) Involvement of stakeholders in decision making.

NEMA provides for the management and protection of environmental resources through *inter alia* the imposition of Environmental Authorisation requirements. Section 49 of NEMA outlines offences in terms of NEMA that include commencing with an activity without first having obtained Environmental Authorisation as detailed below. Section 49 of NEMA also details the penalties associated with offences that include fines, imprisonment or both.

The Competent Authority responsible for the administration and enforcement of the NEMA for Parastals such as TNPA is the National Department of Environmental Affairs (DEA).

5.1.1 Environmental Impact Assessment Regulations

NEMA identifies activities that require Environmental Authorisation. Activities listed in Listing Notice 1[1] and Listing Notice 3[2] require a Basic Assessment (BA) process, while activities listed in Listing Notice 2[3] require Scoping and Environmental Impact Reporting (S&EIR, interchangeably referred to as a "full" EIA). The Listing Notices were reviewed in order to identify potential listed activities triggered and it was established that no listed activities will be triggered. As such, no environmental authorisation will be required for this project.

A review of the listed activities potentially triggered by this project, together with an explanation of whether SRK believe these activities to be applicable or not is provided in Table 1 of Appendix A.

5.2 National Heritage Resources Act

The National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) requires that for certain categories of development, including "*The construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length*" (Section 38(1)(a)), the responsible heritage resources authority must be notified as early as possible and provided with information about the location, nature and extent of the proposed development. The responsible authority may require that a Heritage Impact Assessment (including archaeology and palaeontology) must be conducted prior to providing approval in terms of the NHRA.

[1] Government Notice (GN) R983 of 2014, as amended by GN 327 of 2017
[2] GN R985 of 2014, as amended by GN 325 of 2017
[3] GN R984 of 2014, as amended by GN 324 of 2017

The construction of the additional water pipeline for the fire-fighting equipment will exceed 300m in length and as such the responsible heritage resources authority, namely the South African Heritage Resource Agency (SAHRA), will need to be notified and provided with information on the project. Following the submission of an initial online application, SAHRA may require additional Heritage studies to be undertaken by a suitably qualified heritage consultant.

5.3 Additional applicable legislation

The following additional legislation was reviewed to determine whether it may be applicable to the project:

- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM: WA);
- National Environmental Management: Air Quality Act, 2004 (Act. No. No 39 of 2004) (NEM: AQA);
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM: BA);
- National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008) (NEM: ICMA);
- National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA); and
- KwaZulu-Natal Heritage Act, 1997 (Act No. 10 of 1997) (KZNHA).

No additional permits and/or licenses were identified as being required.

A brief summary of additional legislation reviewed is provided in Table 2 in Appendix A. Please note that this is not intended to be definitive or exhaustive, and serves to highlight key environmental legislation and requirements only. Although other legislation may be applicable to the proposed development, the list provided has been limited to those laws which require application processes that can be included in the scope of works covered in this proposal.

6 Conclusions and recommendations

Based on SRK's understanding of the project and the screening assessment undertaken, SAHRA will need to be notified of the project and provided with information. Thereafter SAHRA will indicate their requirements in terms of compliance with the NHRA.

Barring the SAHRA requirements, no additional environmental authorisations, permits or approvals should be required. In addition to legal requirements, the TNPA Policy requires adherence to certain Environmental Management documents. The conditions and requirements of these documents will need to be factored into the construction phase of the project. Based on SRK's experience, it is anticipated that the requirements will include the preparation of an EMPr based on the TNPA generic EMPr and the implementation thereof. Further some auditing of compliance with the EMPr is usually required by TNPA. SRK recommends that these requirements be confirmed with TNPA.

Prepared by

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Senior Environmental Scientist

Mrs. P. Burmeister Pr. Sci. Nat.

Principal Environmental Scientist

Reviewed by

Mr. W. Jordaan Pr. Sci. Nat.

Partner

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

7 References

SAS and SRK Consulting (2017), *Terrestrial and Wetland Ecosystem Trade Off Definition and Implementation Plan as well as Biodiversity Management Framework for the Transnet Port of Richards Bay South Dunes Precinct, Richards Bay, Kwazulu-Natal, South Africa*, prepared for Transnet National Ports Authority.

PRDW (2017), *Bulk Services Capacity Assessment, Demand Forecast and Options Identification,* prepared for Transnet National Ports Authority.

SRK (2013), *Strategic Environmental Assessment of the Transnet Long Term Planning Framework*, prepared for Transnet Capital Projects.

Appendices

Appendix A: Detailed Legal Review

Table 1: Listed Activities potentially triggered by the project

No.	Listed Activity	Comment
Listing Notice 1 (GN R983)		
9	The development of infrastructure exceeding 1 000m in length for the bulk transportation of water or storm water— (i) with an internal diameter of 0,36m or more; or (ii) with a peak throughput of 120L per second or more; excluding where— (a) such infrastructure is for bulk transportation of water or storm water or storm water drainage inside a road reserve or railway line reserve; or (b) where such development will occur within an urban area.	The installation of a new bulk water pipeline to supply the fire-fighting equipment at the Berth will be required. This Listing Activity is, however, not applicable as the length of the pipeline is approximately 615m, which will not exceed 1 000m. ***Finding: Not applicable***
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.	Power supply from the substation at Berth 209 to the new pump station situated adjacent to the existing pump station will be required. This Listing Activity is, however, not applicable as only 400V will be required which falls well below the threshold. ***Finding: Not applicable***
12	The development of— (ii) infrastructure or structures with a physical footprint of 100m^2 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—	The combined footprint area of the proposed project will exceed 100m^2. This Listed Activity is, however, not applicable as the development will not occur within a watercourse and falls behind the development setback line. Furthermore, the infrastructure will be constructed within an existing port and will not result in an increase in the development footprint of the Port. ***Finding: Not applicable***

No.	Listed Activity	Comment
	(aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; (ee) where such development occurs within existing roads, road reserves or railway line reserves; or (ff) the development of temporary infrastructure or structures where such infrastructure or structures will be removed within 6 weeks of the commencement of development and where indigenous vegetation will not be cleared.	
15	The development of structures in the coastal public property where the development footprint is bigger than 50m^2, excluding— (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; (iv) activities listed in activity 14 in Listing Notice 2 of 2014, in which case that activity applies.	The combined footprint area of the proposed project will exceed 50m^2. This Listed Activity is, however, not applicable as the Port is not considered Coastal Public Property. ***Finding: Not applicable***
17	Development— (ii) in an estuary; in respect of— (e) infrastructure or structures with a development footprint of 50m^2 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	According to NFEPA the site is considered to be an estuary and the proposed infrastructure will exceed 50m^2 in extent. This Listed Activity is, however, not applicable as the development occurs within an existing Port and the development footprint of the Port will not be increased. ***Finding: Not applicable***

No.	Listed Activity	Comment
	development and where coral or indigenous vegetation will not be cleared; or (dd) where such development occurs within an urban area.	
48	The expansion of— (i) infrastructure or structures where the physical footprint is expanded by 100m^2 or more where such expansion 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— (aa) the expansion of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such expansion activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such expansion occurs within an urban area; or (ee) where such expansion occurs within existing roads, road reserves or railway line reserves.	The combined footprint area of the proposed project will exceed 100m^2. This Listed Activity is, however, not applicable as the development will not occur within a watercourse and falls behind the development setback line. Furthermore, the infrastructure will be constructed within an existing port and will not result in an increase in the development footprint of the Port. ***Finding: Not applicable***
52	The expansion of structures in the coastal public property where the development footprint will be increased by more than 50m^2, excluding such expansions within existing ports or harbours where there will be no increase in the development footprint of the port or harbour and excluding activities listed in activity 23 in Listing Notice 3 of 2014, in which case that activity applies.	The combined footprint area of the proposed project will exceed 50m^2. This Listed Activity is, however, not applicable as the Port is not considered Coastal Public Property. ***Finding: Not applicable***
54	The expansion of facilities— (ii) in an estuary; in respect of— (e) infrastructure or structures where the development footprint is expanded by 50m^2 or more,	According to NFEPA the site is considered to be an estuary and the proposed infrastructure will exceed 50m^2 in extent. This Listed Activity is, however, not applicable as the development occurs within an existing Port and the development footprint of the Port will not be increased. ***Finding: Not applicable***

No.	Listed Activity	Comment
	but excluding— (aa) the expansion of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; or (bb) where such expansion occurs within an urban area.	
Listing Notice 2		
No potential Listed Activities were identified.		
Listing Notice 3		
No potential Listed Activities were identified.		

Table 2: Additional legislation and requirements

Legislation	Overview and Requirements
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) **(NEM: WA)**	Section 20(b): A Waste Management Licence (WML) must be obtained from the competent authority for projects that trigger activities listed in GN 921 of 2013. All applications must conform to the requirements of NEMA, with additional requirements with respect to stakeholder engagement (advertising) and the application must be accompanied by "such documentation and information as may be required by the licensing authority". Waste management activities listed in Category A require a BA process, while Category B activities require an S&EIR process conducted in terms of NEMA. A separate application form must be submitted with the application for EA, and additional stakeholder engagement (advertising) applies to an EIA process for a WML application. The competent authority for WML applications is the National DEA for applications involving Parastatals. **Requirements for this project:** A WML is not required for this project as any material to be disposed of will be temporarily stored on site during construction then disposed of at a registered landfill site.
National Environmental Management: Air Quality Act, 2004 (Act. No. No 39 of 2004) **(NEM: AQA)**	Section 21: Provides for the listing of activities that result in atmospheric emissions that have or may have a significant detrimental effect on the environment. An Atmospheric Emission License (AEL) from the licensing authority is required for these activities, which are listed in GN 893 of 2013 and include a range of combustion, manufacturing, petrochemical, carbonisation, metallurgical, mineral processing/handling, chemical, thermal treatment and pulp processes. All applications must conform to the requirements of NEMA and the application must be accompanied by "such documentation and information as may be required by the licensing authority". A separate application form must be submitted at the beginning of the EIA process, and an Air Quality specialist study is likely to be required as part of the EIA. The licencing authority for AELs has an additional 60 days for decision making following the issue of the Environmental Authorisation. **Requirements for this project:** The project will not trigger any Listed Activities in terms of the NEM: AQA and will therefore not require an AEL.
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) **(NEM: BA)**	The purpose of NEM: BA is to provide for the management and conservation of South Africa's biodiversity and the protection of species and ecosystems that warrant national protection. Threatened or Protected Species (TOPS) Regulations (2007) and a National List of Ecosystems that are Threatened and in Need of Protection (2011) have been promulgated in terms of NEM: BA. **Requirements for this project:** The proposed upgrades are limited to highly transformed areas and will not involve the removal or disturbance of protected species or ecosystems and will therefore not require a permit or license.
National Environmental Management: Integrated Coastal Management Act, 2008 (Act No. 24 of 2008) **(NEM: ICMA)**	The NEM: ICMA provides for the integrated management of the coastal zone, including the promotion of social equity and best economic use, while protecting the coastal environment. The enforcing authority is the Department of Environmental Affairs: Oceans and Coasts (DEA: O&C). **Requirements for this project:** The proposed upgrades will not trigger the NEM: ICMA.
National Water Act 36 of 1998 **(NWA)**	Section 21: Specifies a number of water uses that require Water Use Authorisation (WUA) – either via a Water Use Licence (WUL) or General Authorisation (GA) (issued in terms of Section 39 of the NWA) through a registration and application process – in terms of Section 22(1) of the Act. A WUA process must be conducted to obtain authorisation for any of these activities, unless the specific use is listed in Schedule 1 of the NWA or is an existing lawful use. The competent authority for WUAs is the Department of Water and Sanitation (DWS). For a WUL, DWS require an application, registration as a water user and the completion of a Technical Report which addresses all water uses in accordance with the requirements of Section 28 and Section 29 of the NWA, including a Section 27 motivation for the water uses. For GA, DWS require an application, registration as a water user and may require the completion of a Technical Report depending on the nature of the water use. In March 2017, DWS gazetted regulations stipulating the WULA process and timeframes. A pre-application enquiry meeting with DWS is required, and DWS must take a decision within

Legislation	Overview and Requirements
	300 days of application. Similar to the EIA process, a considerable quantum of work will be required before formal submission of an application. **Requirements for this project:** The proposed project will be undertaken in an estuary, however, because the site is within a Port it falls outside of the jurisdiction of the NWA and therefore a WULA is not required.
Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA)	The MPRDA makes provision for equitable access to and sustainable development of South Africa's mineral and petroleum resources and aims to, *inter alia*, provide for security of tenure in respect of prospecting, exploration, mining and production operations. The fundamental principles of the MPRDA are: • Petroleum resources are non-renewable; • Petroleum resources belong to the nation and the State is the custodian; • Protection of the environment for present and future generations to ensure sustainable development of the resources by promoting economic and social development; • Promotion of local and rural development of affected communities; • Reformation of the industry to bring about equitable access to the resources and eradicating discriminatory practices; and • Guaranteed security of tenure. **Requirements for this project:** The proposed upgrades will not trigger the MPRDA.
KwaZulu-Natal Heritage Act, 1997 (Act No. 10 of 1997) **(KZNHA)**	The aim of the KZNHA is "*To provide for the conservation, protection and administration of both the physical and the living or intangible heritage resources of the Province of KwaZulu-Natal; to establish a statutory Council to administer heritage conservation in the Province; to determine the objects, powers, duties and functions of the Council; to determine the manner in which the Council is to be managed, governed, staffed and financed; to establish Metro and District Heritage Forums to assist the Council in facilitating and ensuring the involvement of local communities in the administration and conservation of heritage in the Province; and to provide for matters connected therewith*". This Act is implemented by Amafa aKwaZulu-Natali/Heritage KwaZulu-Natal, the provincial heritage resources authority charged to provide for the conservation, protection and administration of both the physical and the living or intangible heritage resources of the province; along with a statutory Council to administer heritage conservation in the Province. Permission from the heritage authority, (national and/or provincial), will be required in appropriate circumstances, which may include the issue of the heritage resources identified and whether any formal protections under the statutes have been assigned to any resources which are located in the project area. **Requirements for this project:** This Act will only apply should the National HRA not apply.

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APPENDIX G:
RISK REGISTER

PROJECT INFORMATION

Project: Richards Bay LNG Terminal Bulk Services Study

Owner: Transnet

Client: Basil Ngcobo

Project Sponsor: Preston Khomo

Project Manager: Ashveer Sathanund

Document No.: S2069-1-TN-HS-001

Revision No.: 0

Release Date: 2018/02/09

Print Date: 2018/02/09

Revision	Date	Distribution / Revision
0	2018/02/09	Initial Set-up

1. INTRODUCTION

OBJECTIVES

Risk management objectives	
1	Conduct suitably rigorous analysis of the risks associated with the project
2	Develop a risk register
3	Assign risk owners

RISK OWNERS

Assign potential risk owners	
1	All
2	Client
3	Project Management Team
4	Designer
5	Contractor
6	Environmental Consultant

ASSUMPTIONS

Risk management assumptions	
1	Pre-feasibility level study - FEL2
2	The proposed mitigation measures will be followed up by the risk owners in subsequent stages of the project

2. PROJECT RISK ASSESSMENT CRITERIA

LIKELIHOOD RATING

CONSEQUENCE RATING	Almost Certain	Likely	Possible	Unlikely	Rare
1	I	I	I	II	II
2	I	I	II	II	III
3	I	II	II	III	III
4	II	II	III	III	IV
5	II	III	III	IV	IV
6	III	III	IV	IV	V
7	III	IV	IV	V	V

Extreme	High	Medium	Medium - Low	Low

DEFINITION: RISK LIKELIHOOD RATING

Almost Certain	Very high probability of occurrence could occur several times per year. Has occurred several times on similar projects at this location.
Likely	High probability, likely to approximately once per year. Similar event has occurred several times per year on similar projects for this organisation.
Possible	Possible, reasonable probability that it may occur at least once in a 1 to 10 year period. A similar event has occurred at some time on other similar projects for this organisation
Unlikely	Plausible, unlikely to occur during the project, could occur over the next 10 to 40 years. A similar event has occurred on other similar projects in this industry
Rare	Very low likelihood but not impossible, unlikely to occur during the next 40 years. A similar event has occurred elsewhere in the world in this industry.

2. PROJECT RISK ASSESSMENT CRITERIA

DEFINITION: RISK CONSEQUENCE RATING

	Project Cost (ZAR)	*Project Schedule*	*Human Health & Safety*	*Environment and Community*	*Reputation and Brand*	*Compliance and Legal*
1	> 5 billion	Serious multi-year delays to the overall project schedule (2+ years). Likely with significant cost implications and reputational damage.	Multiple fatalities and/or very serious irreversible injury to > 100 people	Irreversible long-term environmental damage to a highly valued species or location. Large-scale prolonged class action.	Prolonged international condemnation. Transnet CE and/or Operating Divisions CEO departs and board is restructured. Public reprimand from Government. Transnet loses operating licence for an extended period.	Major litigation or prosecution with damages of R100m+ plus significant costs. Custodial sentence for company Executive. Long term closure of operations by authorities.
2	500 million - 4,9 billion	Major delay with to overall schedule with significant cost implications (1 - 2 years)	Multiple fatalities, and/or Significant irreversible injuries to up to 10 people	Irreversible long term environmental damage. Community outrage- potential for large-scale class action.	Prominent negative International and South African press reporting over many days Non-public reprimand by Government Senior executive departs and/or board is restructured. Operating licence is threatened	Major litigation or prosecution with damages of R50m+ plus significant costs. Custodial sentence for Manager Medium term closure of operations by authorities.
3	50 million - 499 million	Major delay with to overall schedule potentially significant cost implications (6 - 12 months)	Single fatality and/or severe irreversible effects to one or more people	Prolonged environmental impact. High-profile community concerns raised – requiring significant remediation measures and management attention	National press reporting over several days. Government caution. Pressure on Executives to leave. Implications for operating licence.	Major litigation costing R10m+. Investigation by regulatory body resulting in long term interruption to operations. Possibility of custodial sentence.
4	5 million - 49 million	Moderate delay to overall schedule (3 - 6 months).	Moderate irreversible disability or impairment to one or more people	Major spill or release leading to off-site impact. High potential for complaints from interested parties.	Local press reporting – over several days. Manager may be asked to leave. Government may be interested.	Major breach of regulation with punitive fine. Significant litigation involving many weeks of management time.
5	500 000 - 4.9 million	Small delay in construction (1 - 3 months). Likely to delay overall completion.	Objective but reversible disability requiring hospitalisation to several people	Medium term effect on environment / community. Required to inform environmental agencies.	Local press reporting. Disciplinary action likely.	Breach of regulation with investigation or report to authority with prosecution and/or moderate fine possible.
6	50 000 - 499 000	Small delay during construction (< 1 month). May be recoverable in overall schedule.	Objective but reversible disability requiring the medical treatment of one person	Small, unconfined spill or release. Short term transient environmental or community impact, remedial action needed.	No press reporting. Disciplinary action may be taken.	Minor legal issues, non-compliances and breaches of regulation.
7	< 50 000	Minor delay during implementation	Minor injury	Minor impact	No reputational impact	Minor breach only

3. RISK IDENTIFICATION

INITIAL RISK IDENTIFICATION TOOL

The objective of this risk identification tool is to act as a prompt for identifying potential project risks. A comprehensive list of potential risk areas has been developed and grouped under the following identifiers:

Category	*Reference*	*Risk Area Identifier*
Business Environment	1.1	Legislation
	1.2	Taxation
	1.3	Economy
	1.4	Government Policy
Construction Industry	2.1	Workforce
	2.2	Market conditions
	2.3	Material suppliers
Client Risks	3.1	Business Plan
	3.2	Definition of need
	3.3	Business case
	3.4	Client delivery
	3.5	Land 'conditions'
Project Risks	4.1	User Requirements
	4.2	Project Team
	4.3	Site Investigations
	4.4	Design
	4.5	External approvals
	4.6	Design compliance
	4.7	Project Controls
	4.8	Procurement
	4.9	Construction

3. RISK IDENTIFICATION

All potential project risks are evaluated for applicability as follows:

FEL2 Project Risk
Not a FEL2 Risk - Review at FEL3
Not a Project Risk

The risk areas identified using this tool are taken through to a risk assessment phase. In the risk assessment phase the identified risks will undergo a risk rating, mitigation assessment and impact assessment

3. RISK IDENTIFICATION

The outcomes of the initial risk identification are as follows:

REF	DESCRIPTION	APPLICABILITY	COMMENT
1	BUSINESS ENVIRONMENT		
1.1	**Legislation**		
1.1.1	SA National Building Reg's	Not a FEL2 Risk - Review at FEL3	No legislation change risks within project timeframe. Review during FEL3.
1.1.2	Environment	Not a FEL2 Risk - Review at FEL3	No legislation change risks within project timeframe. Review during FEL3.
1.1.3	SA National Building Standards	Not a FEL2 Risk - Review at FEL3	No legislation change risks within project timeframe. Review during FEL3.
1.1.4	Occupational and Safety Act (OHSA) 1993	Not a FEL2 Risk - Review at FEL3	No legislation change risks within project timeframe. Review during FEL3.
1.1.5	The Construction Regulations 2014	Not a FEL2 Risk - Review at FEL3	No legislation change risks within project timeframe. Review during FEL3.
1.2	**Taxation**		
1.2.1	Corporation Tax	Not a FEL2 Risk - Review at FEL3	No legislation change risks within project timeframe. Review during FEL3.
1.2.2	VAT	Not a FEL2 Risk - Review at FEL3	No legislation change risks within project timeframe. Review during FEL3.
1.2.3	PAYE	Not a FEL2 Risk - Review at FEL3	No legislation change risks within project timeframe. Review during FEL3.
1.2.4	Capital Gains	Not a FEL2 Risk - Review at FEL3	No legislation change risks within project timeframe. Review during FEL3.
1.2.5	Import duties	Not a FEL2 Risk - Review at FEL3	No legislation change risks within project timeframe. Review during FEL3.
1.3	**Economy**		
1.3.1	Inflation	FEL2 Project Risk	TNPA to allow for inflation in business case.
1.3.2	Interest Rates	Not a FEL2 Risk - Review at FEL3	Review interest rate environment during FEL3.
1.3.3	Exchange rates	Not a FEL2 Risk - Review at FEL3	Limited foreign currency exposure on materials - review at FEL3.
1.3.4	Government fiscal policy	Not a FEL2 Risk - Review at FEL3	

3. RISK IDENTIFICATION

The outcomes of the initial risk identification are as follows:

REF	DESCRIPTION	APPLICABILITY	COMMENT
1.3.5	Bank lending rate	Not a FEL2 Risk - Review at FEL3	
1.4	**Government Policy**		
1.4.1	Exports	Not a Project Risk	
1.4.2	Transportation	Not a Project Risk	
1.4.3	Employment - Suppler development	Not a FEL2 Risk - Review at FEL3	
1.4.4	Land	Not a Project Risk	All project land is owned by TNPA.
2	**CONSTRUCTION INDUSTRY**		
2.1	**Workforce**		
2.1.1	Trade Unions	Not a FEL2 Risk - Review at FEL3	Risk of delays due to industrial action to be reviewed during FEL3.
2.1.2	Skills base - availability / shortage	Not a FEL2 Risk - Review at FEL3	Suitable contractors available - similar work has been undertaken in the Port.
2.1.3	BBBEE	Not a FEL2 Risk - Review at FEL3	
2.1.4	Industrial Relations	Not a FEL2 Risk - Review at FEL3	
2.1.5	Skills Base	Not a FEL2 Risk - Review at FEL3	
2.1.6	Training	Not a FEL2 Risk - Review at FEL3	
2.2	**Market conditions**		
2.2.1	Degree of competition	Not a FEL2 Risk - Review at FEL3	Competitive tendering environment for civils works.
2.2.2	Available appropriate contractors	Not a FEL2 Risk - Review at FEL3	Suitable contractors available - similar work has been undertaken in the Port.
2.2.3	Volume of work in the market place (Contractor demand)	Not a FEL2 Risk - Review at FEL3	Relatively small civils project - numerous suitable contractors.

3. RISK IDENTIFICATION

The outcomes of the initial risk identification are as follows:

REF	DESCRIPTION	APPLICABILITY	COMMENT
2.2.4	Volume of work in the market place (Material demand)	Not a FEL2 Risk - Review at FEL3	Material volumes are low - review during FEL3.
2.2.5	Number of contractors in the market place	Not a Project Risk	Market players have been stable, no changes expected
2.2.6	Capacity of contractors	Not a FEL2 Risk - Review at FEL3	Relatively small civils project - numerous suitable contractors.
2.2.7	Number of contractors in sector	Not a Project Risk	Market players have been stable, no changes expected
2.3	**Material suppliers**		
2.3.1	Capacity	Not a Project Risk	Material volumes are low
2.3.2	Location / Transportation	Not a Project Risk	Transport routes to port well established.
2.3.3	Reliability / Experience	Not a Project Risk	Suppliers are capable - similar work has been undertaken in the Port
2.3.4	Management capability	Not a Project Risk	Suppliers are capable - similar work has been undertaken in the Port
2.3.5	Quality of products	Not a Project Risk	Suppliers are capable - similar work has been undertaken in the Port
2.3.6	Number of suppliers in sector	Not a Project Risk	Suppliers are capable - similar work has been undertaken in the Port
3	**CLIENT**		
3.1	**Business Plan**		
3.1.1	Mission	Not a FEL2 Risk - Review at FEL3	
3.1.2	Objectives	Not a FEL2 Risk - Review at FEL3	
3.1.3	Strategy	Not a FEL2 Risk - Review at FEL3	
3.1.4	Delivery plan	FEL2 Project Risk	Uncertainty over the Gas-to-Power Programme which is driving the delivery.
3.1.5	Delivery implementation	Not a FEL2 Risk - Review at FEL3	

3. RISK IDENTIFICATION

The outcomes of the initial risk identification are as follows:

REF	DESCRIPTION	APPLICABILITY	COMMENT
3.1.6	Monitoring of delivery	Not a FEL2 Risk - Review at FEL3	
3.2	**Definition of need**		
3.2.1	Clarity of objectives	Not a FEL2 Risk - Review at FEL3	
3.2.2	Objectives prioritised	Not a FEL2 Risk - Review at FEL3	
3.2.3	Consensus of need among business units	Not a FEL2 Risk - Review at FEL3	
3.2.4	Degree of completeness	Not a FEL2 Risk - Review at FEL3	
3.2.5	Recognition of stakeholder expectations	Not a FEL2 Risk - Review at FEL3	
3.3	**Business case**		
3.3.1	Revenue	Not a FEL2 Risk - Review at FEL3	
3.3.2	Capital Costs (CAPEX)	Not a FEL2 Risk - Review at FEL3	
3.3.3	Operating Costs (OPEX)	Not a FEL2 Risk - Review at FEL3	
3.3.4	Benefits / Disbenefits	Not a FEL2 Risk - Review at FEL3	
3.3.5	Tariff Agreements (funding and penalties)	Not a FEL2 Risk - Review at FEL3	
3.3.6	Taxation	Not a FEL2 Risk - Review at FEL3	
3.3.7	Price changes	Not a FEL2 Risk - Review at FEL3	
3.3.8	Inflation	Not a FEL2 Risk - Review at FEL3	
3.3.9	Demand	FEL2 Project Risk	Uncertainty over the Gas-to-Power Programme which is driving the demand for the project.
3.3.10	Potential operational constraints	Not a FEL2 Risk - Review at FEL3	

3. RISK IDENTIFICATION

The outcomes of the initial risk identification are as follows:

REF	DESCRIPTION	APPLICABILITY	COMMENT
3.4	**Client delivery**		
3.4.1	Funding	FEL2 Project Risk	Uncertainty over the Gas-to-Power Programme which is driving the project.
3.4.2	Appointment of Project Directors	Not a Project Risk	
3.4.3	Decision making - general client delivery	FEL2 Project Risk	Uncertainty over the Gas-to-Power Programme which is driving the project.
3.4.4	Land ownership / lease	Not a Project Risk	All project land is owned by TNPA.
3.4.5	Official / unofficial tenants	Not a Project Risk	
3.4.6	SLAs between Transnet Business Units	Not a Project Risk	No other Transnet Business Units involved.
3.4.7	Work Orders for internal appointments	Not a Project Risk	
3.4.8	Approvals	FEL2 Project Risk	Uncertainty over the Gas-to-Power Programme which is driving the project.
3.4.9	Contracts (Procurement strategy requirements)	Not a FEL2 Risk - Review at FEL3	
3.4.10	Public Relations	Not a FEL2 Risk - Review at FEL3	Minor civils project.
3.4.11	Stakeholder Management	Not a FEL2 Risk - Review at FEL3	Minor civils project.
3.4.12	Staff continuity	Not a FEL2 Risk - Review at FEL3	
3.4.13	Reputation	Not a FEL2 Risk - Review at FEL3	Delays in project may delay terminal operator commissioning.
3.5	**Land 'conditions'**		
3.5.1	Titles	Not a Project Risk	All project land is owned by TNPA.
3.5.2	Deeds	Not a Project Risk	All project land is owned by TNPA.
3.5.3	Easements	Not a Project Risk	All project land is owned by TNPA.

3. RISK IDENTIFICATION

The outcomes of the initial risk identification are as follows:

REF	DESCRIPTION	APPLICABILITY	COMMENT
3.5.4	Covenants	Not a Project Risk	All project land is owned by TNPA.
3.5.5	Way leaves	Not a Project Risk	All project land is owned by TNPA.
3.5.6	Air Rights	Not a Project Risk	All project land is owned by TNPA.
3.5.7	Rights of Way	Not a Project Risk	All project land is owned by TNPA.
3.5.8	Freehold and lease agreements	Not a Project Risk	All project land is owned by TNPA.
4	**PROJECTS**		
4.1	**User Requirements**		
4.1.1	Dissemination	Not a FEL2 Risk - Review at FEL3	
4.1.2	Degree of completeness (e.g. reflect Tariff Agreement)	Not a FEL2 Risk - Review at FEL3	
4.1.3	Alignment with objectives	FEL2 Project Risk	User requirements can only be confirmed with certainty on the Gas-to-Power Programme.
4.1.4	Comprehension / Clarity	Not a FEL2 Risk - Review at FEL3	
4.1.5	Stakeholder requirements (post capture, dissemination, debate and alignment)	Not a FEL2 Risk - Review at FEL3	
4.1.6	Timelines	Not a FEL2 Risk - Review at FEL3	
4.1.7	Budget parameters	Not a FEL2 Risk - Review at FEL3	
4.1.8	Scope creep	Not a FEL2 Risk - Review at FEL3	
4.2	**Project Team**		
4.2.1	Culture of the team (working practices)	Not a FEL2 Risk - Review at FEL3	Not a risk at FEL2 level
4.2.2	Completeness of appointments	Not a FEL2 Risk - Review at FEL3	Not a risk at FEL2 level

3. RISK IDENTIFICATION

The outcomes of the initial risk identification are as follows:

REF	DESCRIPTION	APPLICABILITY	COMMENT
4.2.3	Communication	Not a FEL2 Risk - Review at FEL3	Not a risk at FEL2 level
4.2.4	Experience of team members	Not a FEL2 Risk - Review at FEL3	Not a risk at FEL2 level
4.2.5	Timing of appointments	Not a FEL2 Risk - Review at FEL3	Not a risk at FEL2 level
4.2.6	Rapport with Project Coordinator	Not a FEL2 Risk - Review at FEL3	Not a risk at FEL2 level
4.2.7	Staff continuity	Not a FEL2 Risk - Review at FEL3	Not a risk at FEL2 level
4.2.8	Adequacy of fees	Not a FEL2 Risk - Review at FEL3	Not a risk at FEL2 level
4.2.9	Clarity of appointments	Not a FEL2 Risk - Review at FEL3	Not a risk at FEL2 level
4.2.10	Co-ordination and compatibility of appointments	Not a FEL2 Risk - Review at FEL3	Not a risk at FEL2 level
4.2.11	Project Assurance processes	Not a FEL2 Risk - Review at FEL3	Not a risk at FEL2 level
4.2.12	Warranties and assignment	Not a FEL2 Risk - Review at FEL3	Not a risk at FEL2 level
4.2.13	Skills shortages	Not a FEL2 Risk - Review at FEL3	Not a risk at FEL2 level
4.3	**Site Investigations**		
4.3.1	Timing of site investigations	Not a Project Risk	No site investigations recommended.
4.3.2	Adequacy of information requested	Not a Project Risk	No site investigations recommended.
4.3.3	Budget availability	Not a Project Risk	No site investigations recommended.
4.3.4	Reliability / Accuracy	Not a Project Risk	No site investigations recommended.
4.3.5	Availability of resources to undertake site investigations	Not a Project Risk	No site investigations recommended.
4.3.6	Identification of requirements	Not a Project Risk	No site investigations recommended.

3. RISK IDENTIFICATION

The outcomes of the initial risk identification are as follows:

REF	DESCRIPTION	APPLICABILITY	COMMENT
4.4	**Design**		
4.4.1	Design freeze / optioneering	Not a FEL2 Risk - Review at FEL3	
4.4.2	Completeness (inclusion of stakeholder requirements including Operations)	FEL2 Project Risk	Uncertainty over IPP Office procurement and end-user specific requirements.
4.4.3	Undiscovered rework	FEL2 Project Risk	Interface with existing services. Possible presence of undocumented services.
4.4.4	Productivity rate	Not a FEL2 Risk - Review at FEL3	
4.4.5	Rapport with Client / Business Units	Not a FEL2 Risk - Review at FEL3	
4.4.6	Drivers (e.g. execution driven)	Not a FEL2 Risk - Review at FEL3	
4.4.7	Integration of sub-contractors designs	Not a Project Risk	
4.4.8	In-house capabilities / competencies	Not a Project Risk	
4.4.9	Recognition of Environment requirements	Not a FEL2 Risk - Review at FEL3	Minimum environmental requirements as per scoping report.
4.4.10	Design coordination	Not a FEL2 Risk - Review at FEL3	
4.4.11	Technical Assurance	Not a FEL2 Risk - Review at FEL3	
4.4.12	Direction / control of the Project Team	Not a FEL2 Risk - Review at FEL3	
4.4.13	Revisions due to new surveys or geotechnical information	Not a Project Risk	
4.5	**External approvals**		
4.5.1	SA Building Regulations	Not a Project Risk	
4.5.2	The Construction Regulations 2014	Not a Project Risk	
4.5.3	Occupational Safety Act 2003	Not a Project Risk	

3. RISK IDENTIFICATION

The outcomes of the initial risk identification are as follows:

REF	DESCRIPTION	APPLICABILITY	COMMENT
4.5.4	National Railway Safety Regulations 2002	Not a Project Risk	
4.5.5	Environmental legislation	Not a FEL2 Risk - Review at FEL3	
4.5.6	Opposition groups	Not a FEL2 Risk - Review at FEL3	
4.5.7	Statutory permits	Not a Project Risk	
4.5.8	Municipal approvals	Not a Project Risk	
4.6	**Design compliance**		
4.6.1	Adherence to User Requirements	Not a FEL2 Risk - Review at FEL3	To be reviewed during FEL3 once terminal operator is defined.
4.6.2	Adherence to budget	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.6.3	Adherence to planning approval	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.6.4	Adherence to legislation	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.6.5	Adherence to survey information	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.6.6	Adherence to Transnet Business Unit standards and updates	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.6.7	Adherence to standards / codes of practice	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.6.8	Adequacy of reviews	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.7	**Project Controls**		
4.7.1	Estimating	FEL2 Project Risk	Estimating accuracy.
4.7.2	Scheduling	FEL2 Project Risk	Schedule to be integrated with IPP Office Procurement Schedule.
4.7.3	Quality Management	Not a FEL2 Risk - Review at FEL3	

3. RISK IDENTIFICATION

The outcomes of the initial risk identification are as follows:

REF	DESCRIPTION	APPLICABILITY	COMMENT
4.7.4	Change control	Not a FEL2 Risk - Review at FEL3	
4.7.5	Risk Management	Not a FEL2 Risk - Review at FEL3	Risk process to continue through FEL3.
4.7.6	Value Management	Not a FEL2 Risk - Review at FEL3	
4.7.7	Earned Value	Not a FEL2 Risk - Review at FEL3	
4.7.8	Reporting	Not a FEL2 Risk - Review at FEL3	
4.7.9	Trend Management	Not a FEL2 Risk - Review at FEL3	
4.7.10	Life Cycle Management / Toll Gates	Not a FEL2 Risk - Review at FEL3	
4.7.11	Hierarchy of meetings	Not a FEL2 Risk - Review at FEL3	
4.7.12	Document control	Not a FEL2 Risk - Review at FEL3	
4.8	**Procurement**		
4.8.1	Clarity of risk attitude	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.8.2	Clarity of objectives	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.8.3	Understanding of alternative routes	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.8.4	Degree of contractor design	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.8.5	Package integration	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.8.6	Order of release of information	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.8.7	Overlap of design and construction	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.8.8	Tailoring of design information to suit procurement route / form of contract	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.

3. RISK IDENTIFICATION

The outcomes of the initial risk identification are as follows:

REF	DESCRIPTION	APPLICABILITY	COMMENT
4.8.9	Familiarity with chosen contract	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.8.10	Packaging of information	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.8.11	Clarity of benefits of risk ownership vs. risk transfer	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.8.12	Design information completeness / coordination	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.8.13	Framework agreements	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.8.14	Familiarity of contractors with procurement route / form of contract	Not a FEL2 Risk - Review at FEL3	FEL3 consideration.
4.9	**Construction**		
4.9.1	Material, plant and or labour sourcing / availability	Not a Project Risk	Covered above.
4.9.2	Free supply of materials (maintenance / capacity / default)	Not a Project Risk	No free supply of materials.
4.9.3	Site access	FEL2 Project Risk	Restricted access due to existing operations.
4.9.4	Interruption to services	Not a FEL2 Risk - Review at FEL3	Potential disruption to Berth 208 operations (interruption or services).
4.9.5	Accident / Fatality	FEL2 Project Risk	Risks amplified during trenching and working over and near water.
4.9.6	Ground conditions	Not a FEL2 Risk - Review at FEL3	
4.9.7	Ground obstructions (when piling)	Not a Project Risk	No piling envisaged.
4.9.8	Contamination of dredge material	Not a Project Risk	No dredging.
4.9.9	Archaeological finds	Not a Project Risk	
4.9.10	Design changes	Not a FEL2 Risk - Review at FEL3	To be reviewed during FEL3 once terminal operator is defined.
4.9.11	Workmanship / performance of Contractor and Subcontractors	Not a FEL2 Risk - Review at FEL3	

3. RISK IDENTIFICATION

The outcomes of the initial risk identification are as follows:

REF	DESCRIPTION	APPLICABILITY	COMMENT
4.9.12	Force Majeure	FEL2 Project Risk	Weather, fire, mass action, etc.
4.9.13	Supply chain	Not a FEL2 Risk - Review at FEL3	
4.9.14	Damage to existing buildings, services, plant and or machinery	FEL2 Project Risk	Existing services and operations - may be impact due to Construction.
4.9.15	Compensation events	FEL2 Project Risk	Delays of extra work due to undocumented services.
4.9.16	Adherence to the design	Not a FEL2 Risk - Review at FEL3	
4.9.17	Site constraints	FEL2 Project Risk	Schedule of work to accommodate existing operations.
4.9.18	Commissioning and Handover	Not a FEL2 Risk - Review at FEL3	
4.9.19	Labour relations	Not a FEL2 Risk - Review at FEL3	Covered above.
4.9.20	Removal/Demolish of Existing Structures	Not a Project Risk	

4. RISK ASSESSMENT

The identified risks have been assessed as follows:

DESCRIPTION			RISK ASSESSMENT				
Risk ID	**Category**	**Risk Name**	**Consequence**	**Likelihood**	**Risk Rating**	**Comment**	**Risk Owner**
001	Economy	Inflation	**5**	**Likely**	**III**	Impact on project cost. To be included in business plan.	Client
002	Business Plan	Delivery plan	**7**	**Likely**	**IV**	Potential delays due to uncertainty over Gas-to-Power Programme. This will affect project viability but will have limited schedule impact during implementation (decision to proceed will only be taken on finalisation of the Gas-to-Power Programme)	Client
003	Business case	Demand	**5**	**Possible**	**III**	Demand is driven by the requirements of the Gas-to-Power Programme. Should this not materialise the project may not proceed at all.	Client
004	Client delivery	Funding	**7**	**Likely**	**IV**	Uncertainty over Gas-to-Power Programme may delay funding and implementation. Limited impact post decision to proceed.	Client
005	Client delivery	Decision making - general client delivery	**7**	**Likely**	**IV**	Uncertainty over Gas-to-Power Programme may delay funding and implementation. Limited impact post decision to proceed.	Client
006	Client delivery	Approvals	**7**	**Likely**	**IV**	Uncertainty over Gas-to-Power Programme may delay funding and implementation. Limited impact post decision to proceed.	Client
007	User Requirements	Alignment with objectives	**5**	**Possible**	**III**	User requirements can only be defined once the terminal operator is appointed. Any additional requirements, not accounted for in the design, will have a cost and schedule implication.	Client
008	Design	Completeness (inclusion of stakeholder requirements including Operations)	**5**	**Possible**	**III**	Terminal operator requirements based on existing facilities. Specific terminal operator requirements may differ.	Client
009	Design	Undiscovered rework	**6**	**Likely**	**III**	Possible delays or cost implications due to undocumented or histroical services and pipelines.	All
010	Project Controls	Estimating	**5**	**Possible**	**III**	Poor estimating accuracy due to inexperienced FEL3 design team leading to increase in capital cost.	Project Management Team

4. RISK ASSESSMENT

The identified risks have been assessed as follows:

DESCRIPTION			RISK ASSESSMENT				
Risk ID	**Category**	**Risk Name**	**Consequence**	**Likelihood**	**Risk Rating**	**Comment**	**Risk Owner**
011	Project Controls	Scheduling	**5**	**Possible**	**III**	Poor scheduling accuracy due to inexperienced FEL3 design team leading to increase in schedule duration.	Project Management Team
012	Construction	Site access	**4**	**Possible**	**III**	Restricted access due to existing operations which may delay the implementation.	Project Management Team
013	Construction	Accident / Fatality	**3**	**Possible**	**II**	Risk of accident or fatality is amplified during trenching and working over and near to water. Proper H&S procedures to be in place during construction.	All
014	Construction	Force Majeure	**3**	**Rare**	**III**	Delays due to weather, fire, local disaster in the South Dunes area.	All
015	Construction	Damage to existing buildings, services, plant and or machinery	**4**	**Possible**	**III**	Damage to existing pipelines or services during trenching and construction.	All
016	Construction	Compensation events	**5**	**Possible**	**III**	Contractor or third party compenstation due to unforseen circumstances.	Project Management Team
017	Construction	Site constraints	**5**	**Likely**	**III**	Constraints imposed on construction activities due to existing facilities requiring uninterupted services and access.	Project Management Team

5. PROJECT QUALITATIVE RISK PROFILE

The risk profile for the identified risks, as assessed in Section 4, is summarised as follows:

CONSEQUENCE RATING	LIKELIHOOD RATING: Almost Certain	Likely	Possible	Unlikely	Rare
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	1	0	1
4	0	0	2	0	0
5	0	2	6	0	0
6	0	1	0	1	0
7	0	4	0	0	0
	0	1	12	5	0

Total number of risks: 18

Note: In all cases check against online version for the latest revision prior to use

APPENDIX H:
HAZARD AND OPERABILITY ANALYSIS (HAZOP)

REPORT

Note: In all cases check against online version for the latest revision prior to use

BULK SERVICES HAZARD AND OPERABILITY (HAZOP) STUDY

For: Port of Richards Bay

Project Name: Richards Bay LNG Terminal Bulk Services Study
Project Number: TBA

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1. INTRODUCTION

1.1. Background

As part of the Independent Power Producer (IPP) Procurement Programme, a gas to power (G2P) project has been launched by the South African Department of Energy (DoE) to address the electricity supply shortages in South Africa. The aim of the project is to develop and operate Liquefied Natural Gas (LNG) fired power stations at key locations in South Africa.

The DoE, in collaboration with Transnet SOC Ltd, and specifically its operating division Transnet National Ports Authority (TNPA), has undertaken a Pre-feasibility (FEL2) Study for LNG import projects at the Ports of Richards Bay, Ngqura and Saldanha Bay. The provision of bulk services was excluded from the FEL2 stage of the IPP project as this work was identified as being the direct responsibility of TNPA

The pre-feasibility study for the Port of Richards Bay identified two preferred sites for the location of the LNG import facility, namely Berth 207 and the dig-out basin in the South Dunes area. The pre-feasibility study presented two distinct phases for the development of the LNG import facility – Phase 1 which consists of a floating storage and regasification solution and Phase 2 which consist of a land-based storage and regasification solution.

At the close-out workshop, held in the Port of Richards Bay on 20 September 2016, it was agreed that Berth 207 should be adopted as the single preferred site. PRDW were subsequently appointed by TNPA to complete a pre-feasibility study for the supply of the required bulk services to the Phase 1 facility at Berth 207.

1.2. Hazard and Operability Study

The Bulk Services Options Evaluation report (PRDW, 2018) identified the following preferred development alternatives for the required bulk services upgrades:

Bulk Service	Preferred Option
Fire-fighting	Deluge system supplied from a new seawater pump station on shore adjacent to existing pump station.
Electrical Supply	Small power requirements and general lighting to the berth supplied directly from Berth 209 Substation at 400 V. The sea water pumps will be supplied directly from the Berth 209 substation.
Sewage	*No bulk services upgrade required.*
Potable Water	Install a second supply line from the M14 "Chemical Berth" take off.
Storm water	*No bulk services upgrade required.*

Table 1-1: Preferred Options

A preliminary Hazard and Operability (HAZOP) Study was carried out to identify potential hazards during construction and operation of the preferred options and to determine whether these hazards could be mitigated by practical design modifications. The focus of the HAZOP is related to the technical aspects of the design.

This report documents the methodology followed and the results of the study.

2. METHODOLOGY

A Hazard and Operability (HAZOP) Study was completed in accordance with TNPA's HAZOP Study Methodology for each category of bulk services (fire-fighting, electrical supply and potable water systems). TNPA's HAZOP Study Methodology is outlined in Figure 2-1 below.

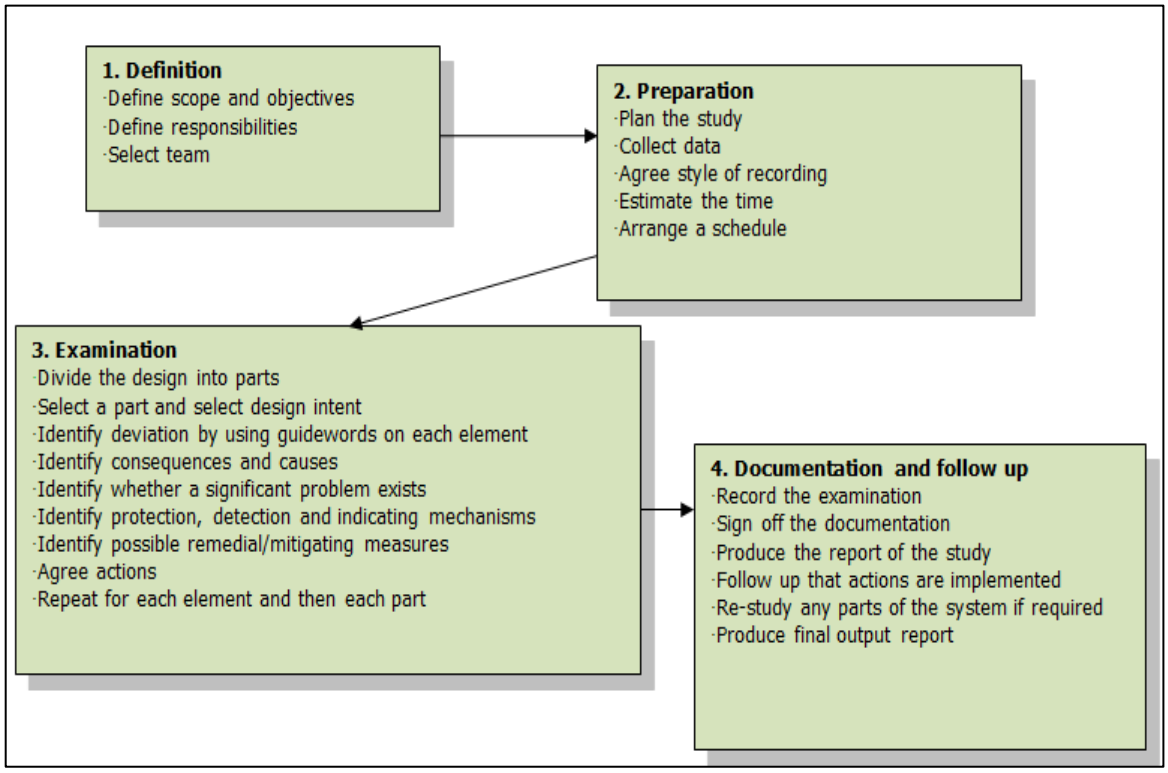

Figure 2-1: TNPA's HAZOP Study Methodology

The following steps were followed as part of the Hazard Study process:

1. The different aspects involved in the project where the split into 'Hazard Nodes' based on logical risk interfaces and consolidated functions of each system.

2. Each node was evaluated for possible deviations (hazards) which may occur during construction and/or operation. The identification of potential deviations was facilitated using guide words for each node.

3. The priority of each potential deviation (hazard) was then defined, based on the potential impact and likelihood of occurrence. The hazards were then analysed further to determine whether any preventative measures that could be put in place, to mitigate the likelihood or impact of the risk.

The hazard nodes and risk definition matrix are presented in the following sections.

2.1. Hazard Nodes

The following hazard nodes were identified:

Bulk Service	Hazard Node
Fire-fighting	Seawater pump station
	Foam pump station
	Pipelines and equipment
Electrical Supply	Electrical supply to pump stations
	Electrical supply to berth
Potable Water	Potable water supply line

Table 2-1: Hazard Nodes

2.2. Risk Definition

Risks were assigned a probability and severity as per the definitions presented in Table 2-2 in order to quantify each identified risk. Risk is defined as the product of the probability and severity.

Probability / Likelihood (P)		Severity / Impact (S)	
Rating	Description	Rating	Description
2	Rare, unlikely to happen in long term (>3years)	2	If risk occurs, there will be **no impact** on strategic, business/operational and process objectives.
4	Unlikely to happen in medium term (1-3years)	4	If risk occurs, there will be **low impact** on strategic, business/operational and process objectives. Minor inury.
6	Possible, risk could occur medium term (1- 3years)	6	If risk occurs, there will be **medium impact** on strategic, business/operational and process objectives. Risk of serious but reversible injury.
8	Probable, risk sure to occur short term (<1 year)	8	If risk occurs, there will be **high impact** on strategic, business/operational and process objectives. Risk of serious and/or irreversible injury.
10	Almost certain, pervasive and occurring regularly	10	**Catastrophic** If risk occurs, strategic, business / operational and process objectives will Not be achieved. Potential loss of life.

Risk Ranking (P x S)	
High	41 to 100
Medium	16 to 40
Low	1 to 15

Table 2-2: Risk Probability and Severity Rating

3. HAZOP RESULTS

A total of 13 hazards were identified during this study. The risk ranking distribution of the identified hazards is summarised in Table 3-1 below.

Risk Ranking	Number of Hazards Identified
High	2
Medium	7
Low	4

Table 3-1: Risk Ranking Distribution

A total of 13 hazards were identified during this study, two (2) of them being classified as 'High' risk. Specific actions have been assigned to the FEL3 Designer, Terminal Operator and Port Engineer to mitigate these risks during future design phases and during operation.

Refer to Appendix A for the full risk register and the recommendations for mitigating the potential risks.

4. CONCLUSIONS AND RECOMMENDATIONS

This HAZOP study has identified potential hazards associated with the preferred alternatives and suggests mitigation measures to reduce the risks associated with these hazards. The focus of this HAZOP study is limited to the technical aspects of the design and it is recommended to obtain the future Terminal Operator's inputs early on during the development of detail designs.

It is further recommended that the hazard scenarios be re-evaluated during the FEL3 phase of development to ensure that the risks are mitigated where possible and to determine the residual risk based on the additional mitigations.

5. REFERENCES

PRDW. (2018). Richards Bay LNG Terminal Bulk Services Study - Bulk Services Options Evaluation. PRDW Study Report No. S2069-1-TN-GA-002-R1. Cape Town: PRDW.

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APPENDIX A:
HAZOP STUDY RISK REGISTER

REPORTS

Note: In all cases check against online version for the latest revision prior to use

Hazard & Operability Analysis (HAZOP)

Project: Richards Bay LNG Terminal Bulk Services Study **Revision:** 0 **Date:** 2018/02/09

Bulk Service	Node	Hazard No.	Guide Word	Element	Deviation	Possible Causes	Consequences	Safeguards	Type	Probability	Severity	Priority	Comments	Actions Required	Actions Assigned to
Fire fighting	Seawater pump station	H-01	Low Flow	Intake screen / intake pumps	Low flow due to fouling of the intake screen / pump not maintained	1. Inadequate maintenance	1. Reduced flow or no flow to fire-fighting equipment 2. Damage to equipment 3. Potential injury or fatality if equipment is non-functional during emergency	None	N/A	6	10	H		1. Regular maintenance cleaning (screen) and maintenance/ servicing (pump system) 2. Consider connection of fire fighting pressure pipeline to Berth 208 and 209 pump stations for redundancy	FEL3 designer, Terminal Operator and Port Authority
	Seawater pump station	H-02	Slow Response	Overall system	Delayed response or slow to act in case of fire	1. Unmanned station 2. Lack of visibility from control tower	1. Damage to equipment 2. Potential injury or fatality	None	N/A	4	10	M		1. Ensure visibility to berth at all times - control vegetation 2. Address responsibilities in emergency response plan 3. Regular fire drills	FEL3 designer, Terminal Operator and Port Authority
	Seawater pump station	H-03	Over pressurisation	Pump control system	Over pressurisation of system due to starting up too fast	1. Manual operation (overriding safety features) 2. Failure of control system components	1. Potential damage to equipment and pipeline 2. Potential injury or fatality if the system cannot function during emergency due to over pressurisation	Control system with redundancy	N/A	2	10	M		1. Regular fire drills 2. Design system so that safety features cannot be overridden	FEL3 designer, Terminal Operator and Port Authority
	Seawater pump station	H-04	Start-up / Operation	Standby diesel pump	No fuel leading to failure in start-up or during operation	1. Theft 2. Inadequate maintenance 3. Leaks 4. Unavailability of fuel supply	1. Loss of redundancy	Regular checking and recording of fuel level in diesel tank (e.g. fuel level sensor)	N/A	2	4	L		1. Maintenance manuals and schedules to be implemented 2. Maintain full back-up fuel supply at all times	FEL3 designer and Terminal Operator
	Foam pump station	H-05	Low level (foam)	Foam tank	Foam tank runs empty leading to inadequate fire-fighting capability (no foam supply)	1. Leak in tank 2. Inadequate maintenance	1. Damage to equipment	Level sensor and warning alarm	N/A	2	8	M	Seawater will still be discharged to fight fire but without the foam compound.	1. Maintenance manuals and schedules to be implemented 2. Link system to Berth 208 and 209 pump stations for redundancy	FEL3 designer, Terminal Operator and port authority
	Foam pump station	H-06	Low Flow	Foam pumps and injection fittings	No foam to fire-fighting equipment	1. Inadequate maintenance	1. Damage to equipment	None	N/A	2	8	M	Seawater will still be discharged to fight fire but without the foam compound.	1. Maintenance manuals and schedules to be implemented 2. Consider connection of fire fighting pressure pipeline to Berth 208 and 209 pump stations for redundancy	FEL3 designer, Terminal Operator and Port Authority

REPORTS

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Hazard & Operability Analysis (HAZOP)

Project: Richards Bay LNG Terminal Bulk Services Study **Revision:** 0 **Date:** 2018/02/09

Bulk Service	Node	Hazard No.	Guide Word	Element	Deviation	Possible Causes	Consequences	Safeguards	Type	Probability	Severity	Priority	Comments	Actions Required	Actions Assigned to
	Foam pump station	H-07	Start-up / Operation	Standby diesel pump	No fuel leading to failure in start-up or during operation	1. Theft 2. Inadequate maintenance 3. Leaks 4. Unavailability of fuel supply	1. Loss of redundancy	Fuel level sensor	N/A	2	4	L		1. Maintenance manuals and schedules to be implemented 2. Maintain full back-up fuel supply at all times	FEL3 designer, Terminal Operator and Port Authority
	Pipelines and equipment	H-08	Low pressure / Low flow	Pipeline	Low pressure / no flow due to leaks in pipeline	1. Infrequent maintenance 2. Impact damage 3. Failure of pipe	1. Damage to equipment 2. Potential injury or fatality	None	N/A	6	10	H	Risk can be mitigated during FEL3 - to be incorporated into Terminal Operator's design of the trestle and berth	1. Regular fire drills 2. Impact barriers 3. Competent design	FEL3 designer, Terminal Operator and Port Authority
	Pipelines and equipment	H-09	Limited / Incorrect Operation	Monitors and valves	Limited functionality (i.e. monitors stuck in position, valves not opening)	1. Infrequent maintenance	1. Damage to equipment 2. Potential injury or fatality	Regular fire drills, maintenance	N/A	6	6	M		1. Maintenance manuals and schedules to be implemented 2. Regular fire drills	FEL3 designer, Terminal Operator and Port Authority
Electrical supply	Supply to pump stations	H-10	No or inadequate power supply	Bulk electrical supply	No or inadequate power supply	1. Failure or damage to supply network	1. Duty pump cannot operate	Standby diesel pump	N/A	6	4	M		1. Standby diesel pump to be maintained in an operation ready state	Port Authority
	Supply to pump stations	H-11	Electrocution	Electrical equipment	Electrocution	1. Working on equipment without proper lock-out procedure and or inadequate training	1. Serious injury or fatality	None	N/A	2	10	M		1. Maintenance manuals and schedules to be implemented 2. Adequate operator training 3. Lock-out procedure	FEL3 designer, Terminal Operator and Port Authority
	Supply to berth	H-12	No or inadequate power supply	Kiosks and lighting	No or inadequate power supply leading to inadequate visibility	1. Failure or damage to supply network	1. Potential limits to operation	Alternative lighting from FSRU	N/A	6	2	L		None	Terminal Operator
Potable water	Supply line	H-13	Low pressure / Low flow	Bulk water supply pipeline	Low pressure / no flow	Shutdown in bulk supply network Leaks/Breaks in pipeline	No potable water supply to berth	None	N/A	2	2	L	Foam and seawater supply lines will remain operational; therefore limited impact on fire-fighting ability	None	None