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LOAD CONNECTION CAPACITY ASSESSMENT OF SOUTH AFRICAN NATIONAL PORTS

IMPRINT

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Pretoria, September 2025

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CLN	Customer Load Network
GCCA	Grid Connection Capacity Assessment
MTS	Main Transmission Substation
NMD	Notified Maximum Demand
NTCSA	National Transmission Company South Africa
PE	Port Elizabeth
TDP	Transmission Development Plan
TNPA	Transnet National Port Authority
TOSM	Time of System Minimum

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Executive Summary

South Africa operates the ports of Saldanha Bay, Cape Town, Mossel Bay, Gqeberha/Port Elisabeth, Coega/Ngqura, East London, Durban and Richards Bay. It is envisaged to supply the vessels docking at these ports with power from the shore electricity network. This switch to grid power will increase the demand for electricity at the national ports. Hence, the objective of this study is to assess the available connection capacity to serve additional electrical demand at the national ports.

This pre-feasibility assessment indicates where there is spare load capacity and the potential to increase the demand on the existing electrical infrastructure. The Port of Cape Town and the Port of Saldanha are an exception, since they show low spare capacity levels. A ranking list is provided, which ranks the ports in terms of maximum spare capacity and lowest connection risk. This ranking list can be used to prioritise the grid connection technical studies. If the planned shore power requirements exceed this spare load capacity, the municipality or Eskom must be consulted to ascertain the requirements to unlock additional load capacity. A load application to the supply authority must follow to ascertain the grid connection prospects during the feasibility phase of the project.

Ranking	Port	Estimated Spare Capacity (MVA)	Estimated Spare Capacity* (MW)	Connection Risk
1	Port of Ngqura	19	17.1	Low
2	Port of East London	18	16.2	Low
3	Port of Gqeberha	15	13.5	Low
4	Port of Richards Bay	11.5	10.35	Low
5	Port of Mossel Bay	7	6.3	Medium
6	Port of Durban	4	3.6	Medium
7	Port of Cape Town	0	0	High
8	Port of Saldanha	0	0	High

1. Introduction

South Africa operates eight commercial ports, namely Saldanha Bay, Cape Town, Mossel Bay, Gqeberha/Port Elisabeth (PE), Coega/Ngqura, East London, Durban and Richards Bay. Vessels docking at the national ports of South Africa make use of diesel generators to power their operations. As part of the quest to reduce emissions from the diesel generators, it is proposed to supply these vessels with power from the local electricity network. This switch to grid power will increase the demand for electricity at the national ports. Therefore, it is vital to assess the available load connection capacity of the existing transmission and distribution grid.

2. Study Objectives

The objective of this study is to assess the available connection capacity to serve additional electrical demand at the national ports in South Africa.

3. Methodology

The study entails data collection and assessment of electricity demand and consumption patterns for the following national ports: Saldanha Bay, Cape Town, Mossel Bay, Gqeberha/PE, Coega/Ngqura, East London, Durban and Richards Bay. The assessment of the existing network capacities at the ports is informed by Eskom Transmission and Distribution infrastructure as well as that of the Municipalities. These following data sources are consulted in the assessment: Transmission Development Plan, Grid Connection Capacity Assessment, municipal electricity plans, Transnet electricity plans, etc.

The grid connection capacity assessment for increasing the load shall be conducted following a bottom-up approach. It begins with an assessment of the local electrical network at the port level, then proceeds to the distribution network supplier by either Eskom or the Municipality. Finally, the transmission network serving the port which is managed by the NTCSA is assessed for its capacity to meet additional demand.

Figure 1 illustrates the grid connection assessment levels considered in the study. This desktop level study is envisaged to be a 4-step process as follows:

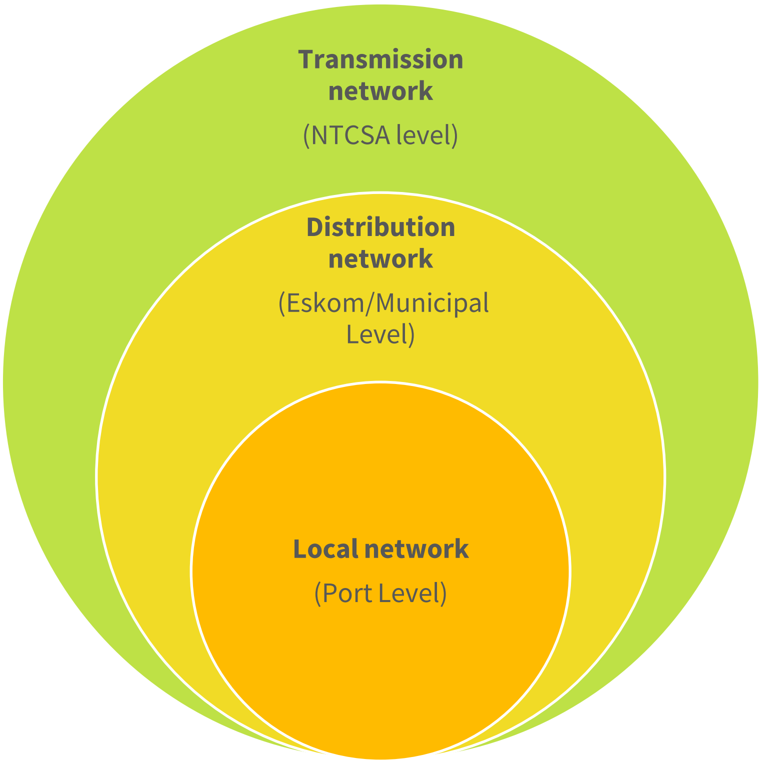
Step 1: Identify the peak electricity demand.

Step 2: Assess the future demand growth.

Step 3: Assess the location and the installed capacity of the substations.

Step 4: Estimate the available load connection capacity.

Figure 1. Overview of the grid connection assessment levels



The Notified Maximum Demand (NMD) per port supplied by Eskom / Local Municipality is as follows:

Table 1: List of TNPA ports and associated Notified Maximum Demand (NMD)

Port	NMD
Saldanha	21 MVA
Cape Town	18 MVA
Mossel Bay	3 MVA
Port Elizabeth	5 MVA
Ngqura	6 MVA
East London	2 MVA
Durban	13 MVA
Richards Bay	11 MVA

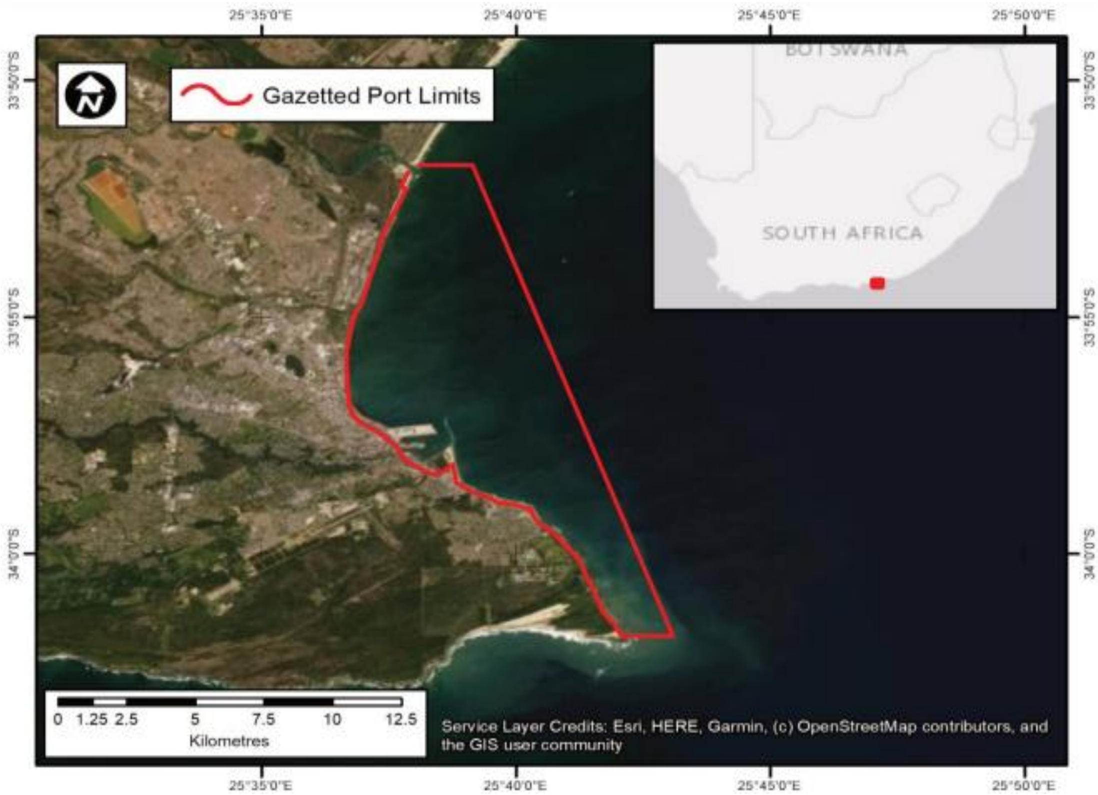
The findings will indicate available connection capacity at the ports and where there is limited connection capacity. Recommendations for the required electricity infrastructure upgrades are provided.

4. Results

4.1. Port of Gqeberha

The Port of Gqeberha, formerly known as Port Elizabeth, is in the central region of South Africa, in the Eastern Cape province, and currently handles containers, manganese ore, liquid bulk, automotive products, palletised fruit, and general cargo. The port serves the Nelson Mandela Bay Metro, the Eastern Cape interior, and the hinterland [1]. The layout of the port is shown in Figure 2.

Figure 2: Port of Gqeberha layout [1]



Source: Transnet National Port Authority Port Development Framework Plans 2022

4.1.1. Electricity demand characteristics

The Port of Gqeberha/Port Elizabeth is under the Nelson Mandela Bay Municipality and has a firm power supply of 20 MVA that is distributed at 22/11/6.6/0.4 kV voltage levels. At the local distribution level, the Port Notified Maximum Demand (NMD) is 5 MVA. In the absence of the peak load for the port, the NMD is used to represent at peak load. This indicates that there is sufficient capacity to connect additional load at the port. The available spare capacity is determined to be 15 MVA. Load requirements exceeding 15 MVA necessitate a dedicated 22kV feeder from the supply substation. The port and associated distribution network data is summarised in Table 2.

Table 2: Overview of the Port Elizabeth Distribution System [2]

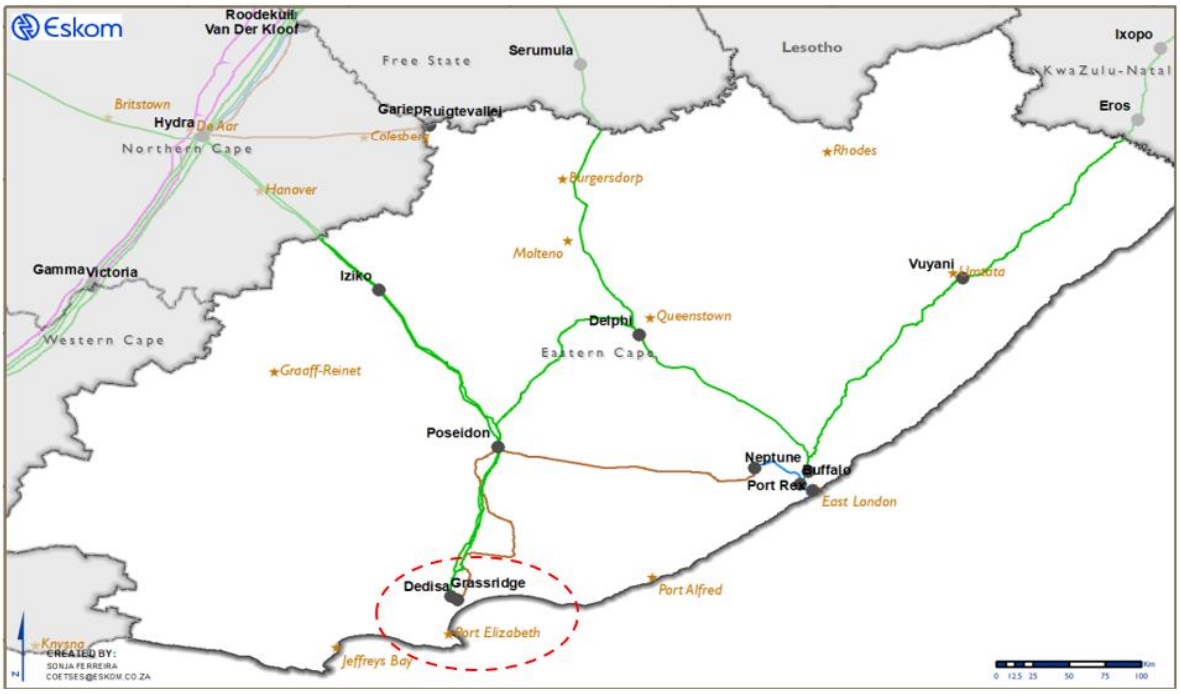
	Name	Port of Gqeberha (Port Elizabeth)
Port	Location	Longitude 25°37'57.0"E and Latitude 33°57'40.0"S
	Supply authority	Nelson Mandela Bay Municipality
	Peak load or NMDs of the substation	5 MVA
	Supply voltage	22/11/6.6/0.4kV
	Firm Supply Capacity	20 MVA
	Spare Load Capacity	15 MVA

4.1.2. Location and capacity of the transmission substations

The Nelson Mandela Bay Municipality falls under the Port Elizabeth Customer Load Network (CLN)/local area. This local area is supplied using three 400 kV Transmission lines and a single 220 kV line from the Poseidon Main Transmission System (MTS) substation.

Figure 3 shows the current Eastern Cape transmission network, highlighting the main transmission substations in Port Elizabeth CLN: Grassridge and Dedisa. The Gqeberha/Port Elizabeth supply area has a peak loading of about 856 MW as of 2025 and is projected to reach 1154 MW in 2034, as seen in Figure 4 [2]. This suggests that over the next 10 years, the NTCSA is planning for a load growth of approximately 300 MW. The transmission network data for Port Elizabeth CLN is summarised in Table 3.

Figure 3: Current Eastern Cape Transmission Network [2]

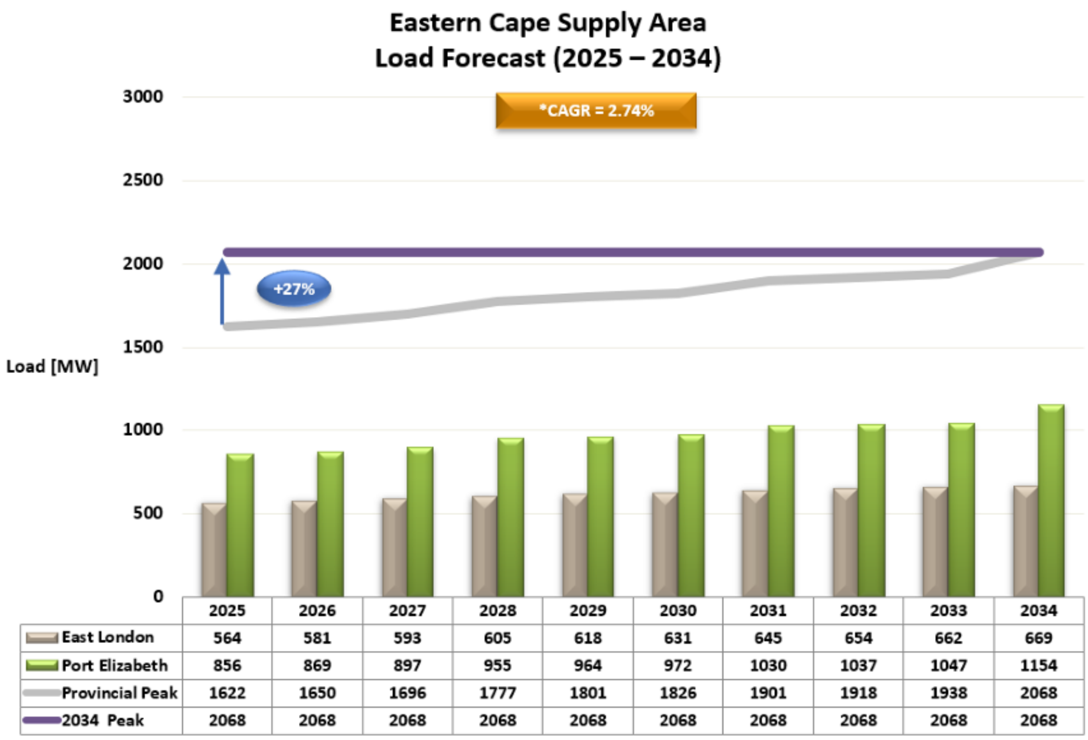


Source: Eskom Transmission Development Plan 2025 – 2034

Table 3: Overview of the Port Elizabeth Transmission System [3], [2]

	Customer Load Network/Local Area	Port Elizabeth CLN	Port Elizabeth CLN
Transmission	CLN Peak demand 2025	856 MW	856 MW
	CLN Forecasted demand 2034	1154 MW	1154 MW
	MTS name	Dedisa	Grassridge
	Installed capacity	2 x500 MVA	2 x 500 MVA 2 x 360 MVA
	Voltage levels	400/132 kV	400/132 kV 220/132 kV
	Time of System Minimum (TOSM) Demand	122 MW	302 MW

Figure 4: NTCSA Eastern Cape load forecast [2]



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
East London	564	581	593	605	618	631	645	654	662	669
Port Elizabeth	856	869	897	955	964	972	1030	1037	1047	1154
Provincial Peak	1622	1650	1696	1777	1801	1826	1901	1918	1938	2068
2034 Peak	2068	2068	2068	2068	2068	2068	2068	2068	2068	2068

Source: Eskom Transmission Development Plan 2025 – 2034

The Dedisa substation has an installed capacity of 1000 MVA; however, under the N-1 contingency criterion, Eskom's standard for ensuring system reliability, only 500 MVA is considered secure. Similarly, Grassridge substation has an installed capacity of 1720 MVA, with a secure capacity of 860 MVA under the same criterion. According to the 2024 GCCA, the Time of System Minimum (TOSM) demand recorded was 122 MW at Dedisa and 302 MW at Grassridge. Using peak load ratios of 0.6 and 0.3, respectively, the estimated peak demand ranges from 203 MW to 406 MW for Dedisa, and from 503 MW to 1006 MW for Grassridge. At Dedisa, the estimated peak demand remains within the N-1 secure capacity. However, at Grassridge, the upper bound of the peak range exceeds its secure capacity, indicating a potential reliability concern.

This suggests that the limiting factor will be transmission network constraints which reinforces the need for infrastructure upgrades as proposed in the Transmission Development Planning (TDP).

4.1.3. Recommendations for additional load connection capacity

There is currently 15 MVA of spare load capacity that could be used up at the port. Once that power supply is exhausted, adding a second dedicated 22 kV feeder could provide an additional 20 MVA supply to the Port of Gqeberha, provided the current municipal electricity distribution infrastructure allows for this intervention. There are no major load connection risks identified. However, it is noteworthy for this region, transmission grid planning has allowed for a load growth of 300 MW over the period 2025-2034. Any power requirements above this value will trigger upgrades at the transmission grid level.

4.2. Port of Mossel Bay

The Port of Mossel Bay is situated halfway between Cape Town and Gqeberha and is the only South African port that operates two offshore mooring points within port limits. The main commodities handled are petroleum products exported through the offshore moorings and fish products from the fishing industry of the region. It also serves as an offshore supply vessel base for one of its key clients, PetroSA. The port is capable of accommodating passenger and project vessels that call at the port. The port electricity supply is provided by the Mossel Bay municipality in the Western Cape.

4.2.1. Electricity demand characteristics

The Port of Mossel Bay has a firm power supply of 10 MVA at 11/0.4kV voltage levels. Table 4 shows electrical infrastructure information for the distribution substation serving the Port of Mossel Bay.

Table 4: Overview of electrical infrastructure near Port of Mossel Bay

	Name of port	Port of Mossel Bay
Port	Location of port	34° 10' S 22° 09 E
	Supply authority	Mossel Bay Municipality
	Peak Load or NMD of substation (s)	3 MVA
	Supply voltage	11/0.4kV
	Firm supply capacity	10 MVA
	Spare load capacity	7 MVA

At the local distribution level, the Port of Mossel Bay has a Notified Maximum Demand (NMD) of 3 MVA. In the absence of the peak load for the port, the NMD is used to represent the peak load. This indicates that there is sufficient capacity to connect additional load at the port. The available spare capacity is determined to be 7 MVA. Load requirements exceeding spare capacity necessitate an additional dedicated 11 kV feeder from the supply substation. This new supply upgrade may unlock an additional connection capacity of 10 MVA based on a distribution solution that replicates the existing firm supply design.

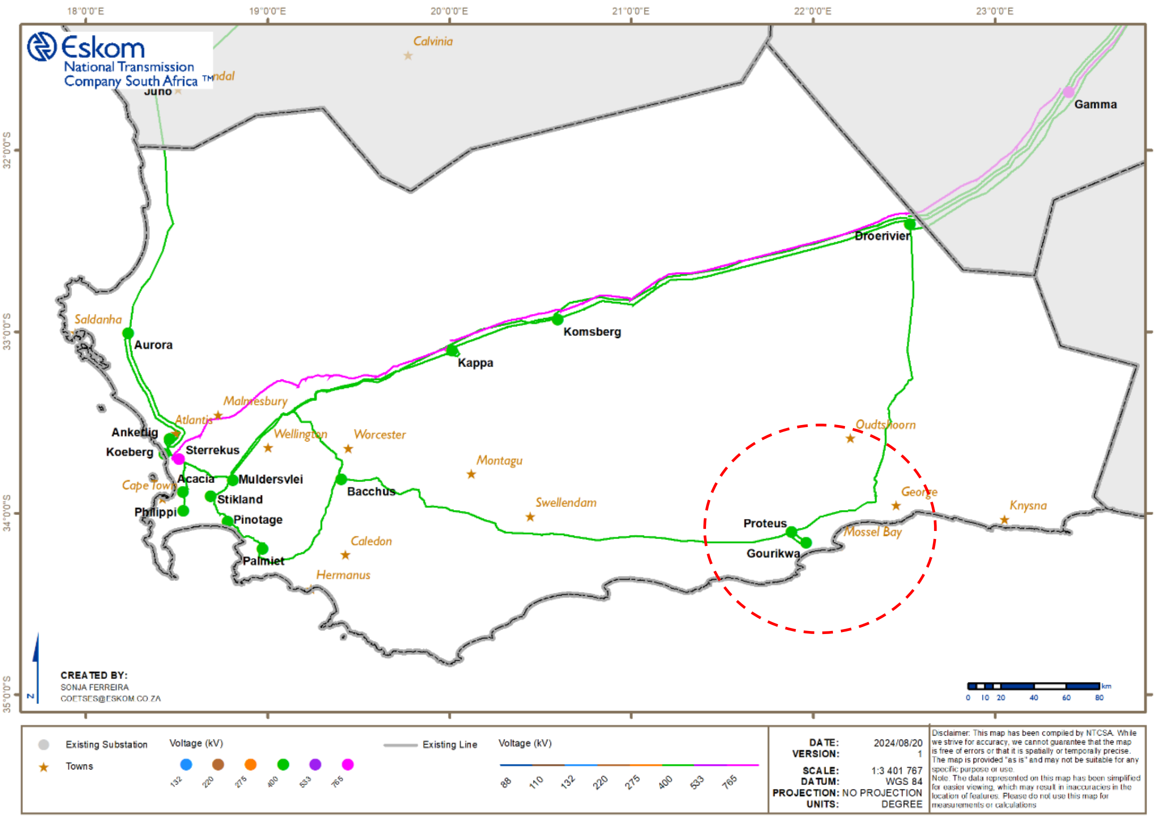
4.2.2. Location and capacity of the distribution substations

Mossel Bay municipality electricity is purchased from Eskom at six intake substations with a notified maximum demand of 77,5 MVA distributed at voltages ranging from 230V to 66 kV to various industrial, commercial and domestic customers. The peak maximum demand at this stage is 65,6 MVA and there is spare capacity of 11,9 MVA for future growth [3]. This suggests that the 7 MVA spare capacity at the Port of Mossel Bay can be accommodated by the greater Mossel Bay municipality electricity distribution system.

4.2.3. Location and capacity of the transmission substations

Figure 5 shows the map of the current Western Cape transmission grid and where the Port of Mossel Bay is located. The nearest MTS to the Port of Mossel Bay appears to be Eskom Proteus MTS as shown in
Figure 5. The installed Proteus MTS capacity is about 1000 MVA with a time of system minimum (TOSM) demand of 110 MW as shown in Table 5. With reference to the TOSM, the estimated peak demand is in the range of 183 MW to 366 MW by applying minimum to peak ratios of 0.6 and 0.3, respectively. This suggests that there is sufficient capacity to increase the load downstream of Proteus MTS. It is envisaged that the transmission network will not be a constraint to load growth in and around the Port of Mossel Bay.

Figure 5: Map of the current Western Cape transmission grid



Source: Eskom Transmission Development Plan 2025 – 2034

Table 5: Overview of transmission grid near Port of Mossel Bay

	TDP Area CLN	Outeniqua
Transmission	Peak demand 2025	965 MW
	Forecasted demand 2029	863 MW
	MTS Name	Proteus
	Installed capacity	2 x 80MVA, 2 x 500MVA
	TOSM demand 2025	110 MW

4.2.4. Recommendations for additional load connection capacity

It is recommended to utilise the 7 MVA spare load capacity and maximise the usage of existing 10 MVA firm supply to the Port of Mossel Bay. Once that power supply is exhausted, adding a second dedicated 11 kV feeder could provide an additional 10 MVA supply to the Port of Mossel Bay. There are no major load connection risks identified, especially considering that the Mossel Bay municipality electricity distribution system indicates a 11,9 MVA spare capacity.

4.3. Port of East London

The Port of East London is located approximately 460 km south of Durban on the Eastern seaboard of South Africa and 950 km to the east of Cape town. It is the only commercial river port on the South African coastline and offers a diversified cargo handling facilities for automotives, bulk liquids, containers, general breakbulk and dry bulk free flowing grain [4].

4.3.1. Electricity demand characteristics

At the Port of East London, the firm supply is 20 MVA at distribution voltages of 11/0.4 kV. The NMD of the Port of East London is 2 MVA. In the absence of the peak load for the port, the NMD is used to represent at peak load. This yields a spare capacity of and 18 MVA at the port.

4.3.2. Location and capacity of distribution substations

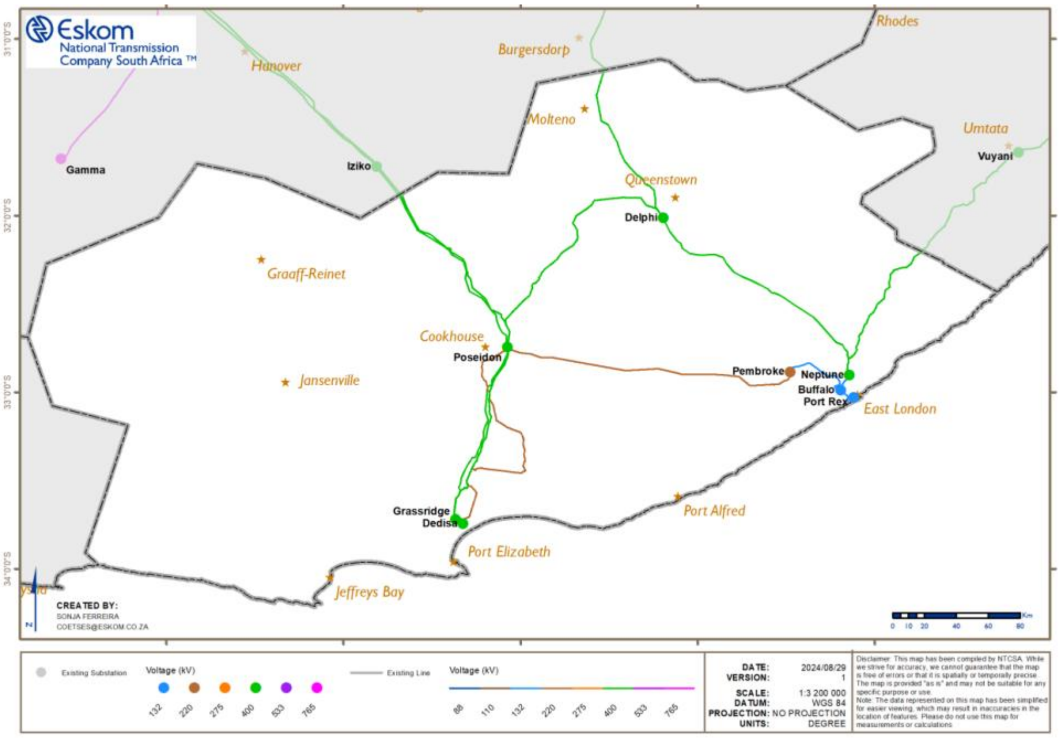
Buffalo city metropolitan municipality provides the primary energy supply to the port. However, it is not evident which municipal substations supply the Port of East London.

4.3.3. Location of transmission substations

East London is one of the major industrial centres in the Eastern Cape and the infeed for East London consists of three 400 kV lines and one 220 kV line into the capital city Bhisho. The current transmission network is shown in Figure 6 and the closest Main Transmission Substations appear to be Neptune, Buffalo and Pembroke. Neptune has two transformers with 500 MVA capacity and the transformation is 400/132 kV. Pembroke has two transformers with 250 MVA capacity each and the transformation is 220/132 kV. Buffalo substation is at 400/132 kV. The Buffalo substation appears to have interconnections to Neptune and Pembroke.

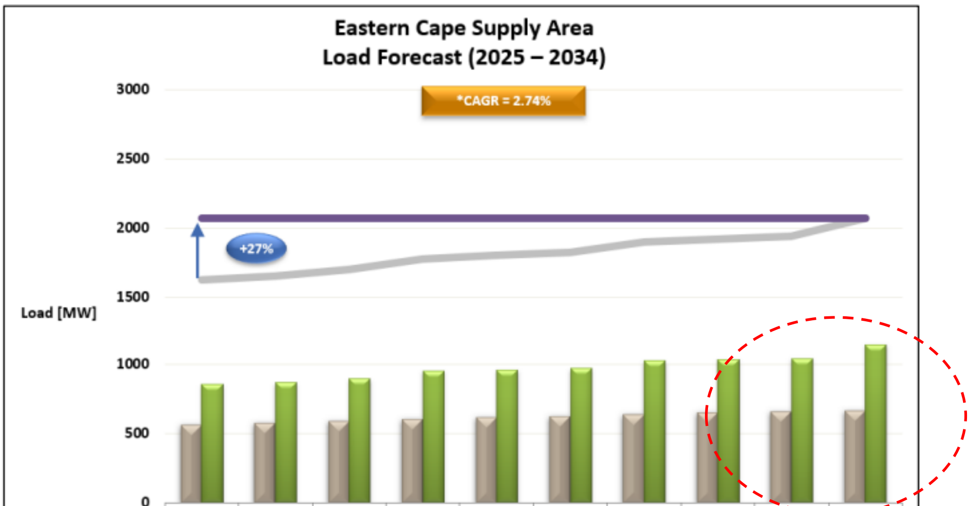
The load forecast for the Eastern Cape is shown in Figure 7. The Eastern Cape load for 2025 is 564 MW. If an assumption is made that the transmission substations mentioned (Neptune, Buffalo and Pembroke) all carry the Eastern Cape load collectively, then it is unlikely that there will be transmission bottlenecks as there is capacity for more load if the collective capacity is considered.

Figure 6: Current Eastern Cape Transmission network [2]



Source: Eskom Transmission Development Plan 2025 – 2034

Figure 7: Load forecast of the Eastern Cape as per TDP 2024 [2] [2]



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
East London	564	581	593	605	618	631	645	654	662	669
Port Elizabeth	856	869	897	955	964	972	1030	1037	1047	1154
Provincial Peak	1622	1650	1696	1777	1801	1826	1901	1918	1938	2068
2034 Peak	2068	2068	2068	2068	2068	2068	2068	2068	2068	2068

Source: Eskom Transmission Development Plan 2025 – 2034

4.3.4. Recommendations for additional load connection capacity

It is recommended to utilise the 18 MVA spare load capacity and maximise the usage of existing 20 MVA firm supply to the Port of East London. Once that power supply is exhausted, adding a second dedicated 11 kV feeder could provide an additional 20 MVA supply to the Port of East London. There are no major load connection risks identified.

4.4. Port of Ngqura

The Port of Ngqura was established in 2009 and is the newest of the South African ports as a world-class deeper container transshipment hub. The port is specifically geared to serve West and East African, European, and Asian trade routes. The port is situated within the Coega Special Economic Zone (SEZ) in Algoa Bay, 20 km north-east of Port Elizabeth, midway between Durban and Cape Town [1]. The layout of the port is shown in Figure 8.

Figure 8: Port of Ngqura layout [5]

Source: Transnet National Port Authority Request for Proposal TNPA/2024/01/0019/55247/REP

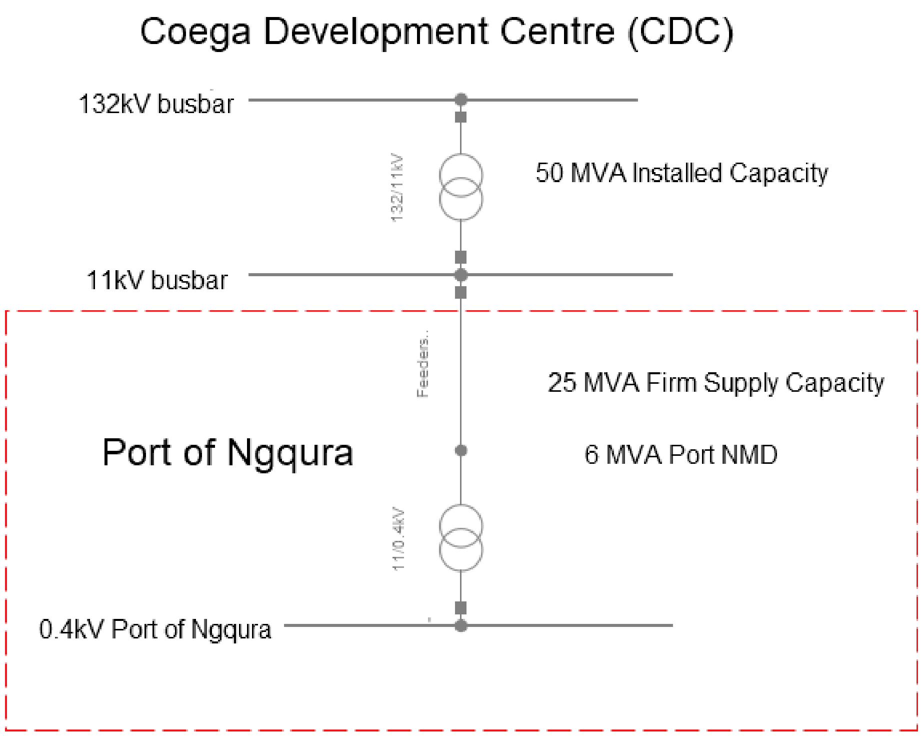
4.4.1. Electricity demand characteristics

The Port of Ngqura is within Nelson Mandela Bay Municipality and has a firm power supply of 25 MVA distributed at 11/0.4 kV voltage levels, and an NMD of 6 MVA. In the absence of the peak load for the port, the NMD is used to represent at peak load. This suggests that the port currently has a spare load capacity of 19 MVA, indicating that there is sufficient capacity to connect additional load at the port. Furthermore, Transnet National Ports Authority (TNPA) has initiated plans for a 7 MW hybrid renewable energy plant with 6 MWh of battery storage at the Port of Ngqura, aligned with Transnet's broader strategy to decarbonise port operations and enhance power reliability [6]. The facility will combine solar PV and vertical-axis wind turbines with battery energy storage to ensure a stable, resilient energy supply. This intervention is expected to improve the availability of power and unlock additional load capacity for port operations and future development within the Coega SEZ. As of June 2024, the project remains in the procurement phase, with tenders closed and under evaluation [5].

4.4.2. Location and capacity of distribution substations

The Port of Ngqura receives its power from the 132/11 kV substation within the Coega Development Centre (CDC) as seen in the simplified distribution network highlighted in Figure 9 [5]. The substation has an installed capacity of 50 MVA and a firm supply of 25 MVA.

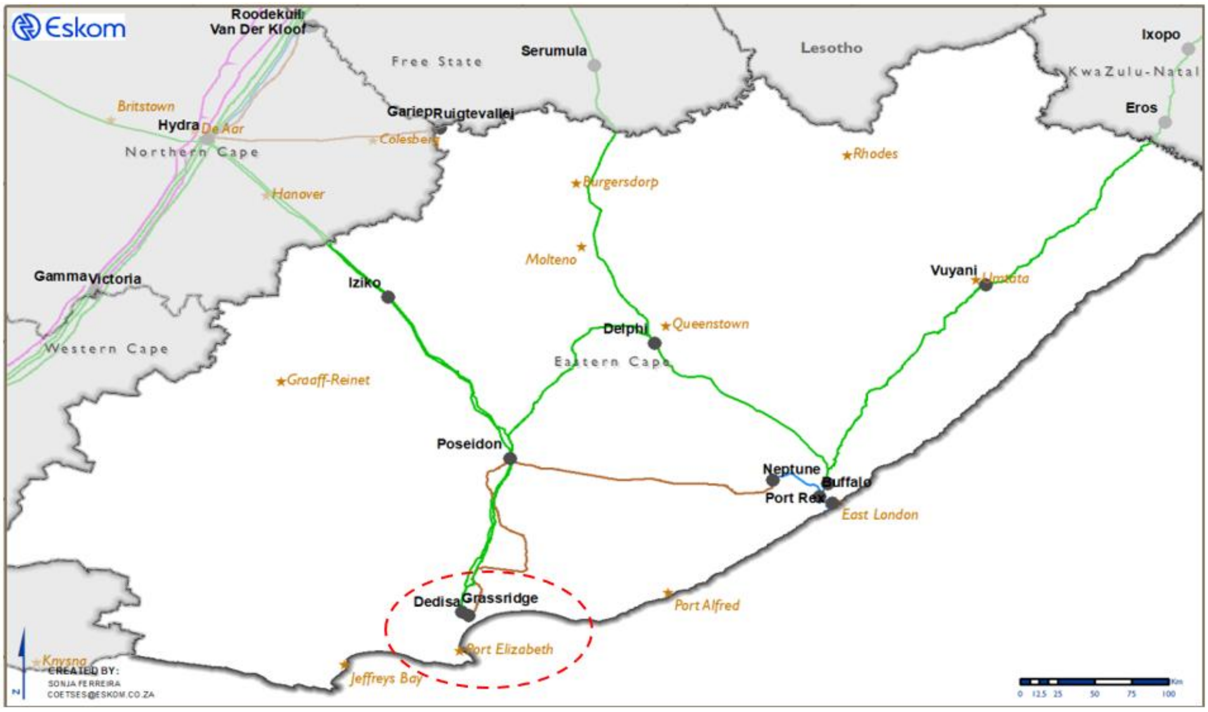
Figure 9: Port of Ngqura simplified distribution network [5]



4.4.3. Location and capacity of transmission substations

The Nelson Mandela Bay Municipality falls under the Port Elizabeth Customer Load Network (CLN)/local area. This local area is supplied using three 400 kV Transmission lines and a single 220 kV line from the Poseidon Main Transmission System (MTS) substation. Figure 10 shows the current Eastern Cape transmission network, highlighting the main transmission substations in PE: Grassridge and Dedisa. Gqeberha/Port Elizabeth local area has a peak loading of about 856 MW as of 2025 and is projected to reach 1154 MW in 2034 according to the Transmission Development Plan (TDP) 2025-2034 [2], as shown in Figure 11 [2]. This suggests that over the next 10 years, the NTCSA is planning for a load growth of approximately 300 MW. The transmission network data for Port Elizabeth CLN is summarised in Table 6.

Figure 10: Current Eastern Cape Transmission Network [2]



Source: Eskom Transmission Development Plan 2025 – 2034

Table 6: Overview of the Port Elizabeth Transmission System [2], [3]

	Customer Load Network	Port Elizabeth CLN	Port Elizabeth CLN
Transmission	CLN Peak demand 2025	856 MW	856 MW
	CLN Forecasted demand 2029	1154 MW	1154 MW
	MTS name	Dedisa	Grassridge
	Installed capacity	2 x500 MVA	2 x 500 MVA 2 x 360 MVA
	Voltage levels	400/132 kV	400/132 kV 220/132 kV
	Time of System Minimum (TOSM) Demand	122 MW	302 MW

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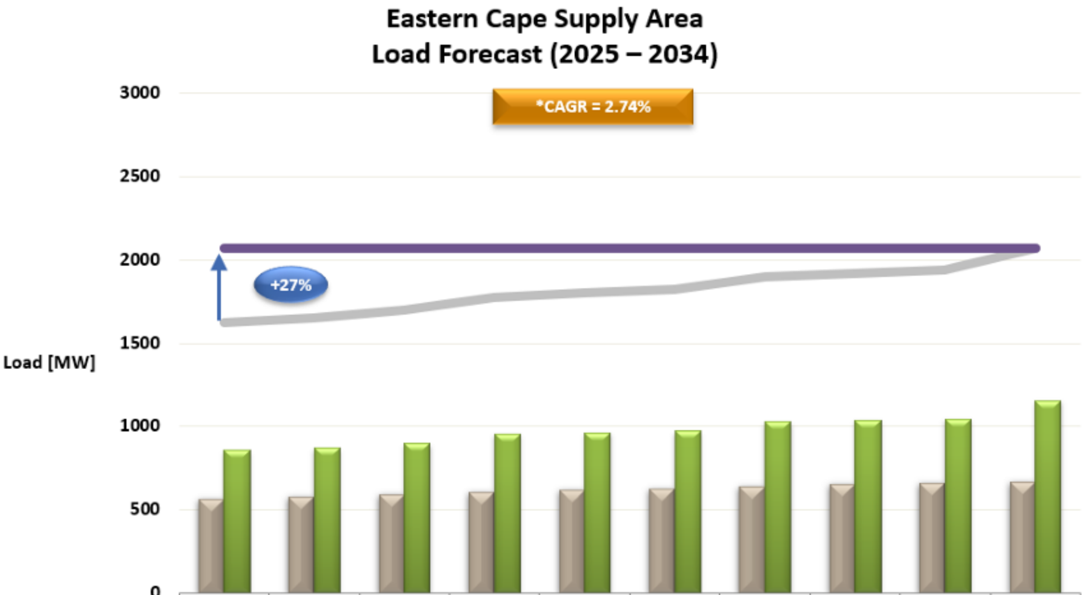
Figure 11: NTCSA Eastern Cape load forecast [2]



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
East London	564	581	593	605	618	631	645	654	662	669
Port Elizabeth	856	869	897	955	964	972	1030	1037	1047	1154
Provincial Peak	1622	1650	1696	1777	1801	1826	1901	1918	1938	2068
2034 Peak	2068	2068	2068	2068	2068	2068	2068	2068	2068	2068

Source: Eskom Transmission Development Plan 2025 – 2034

Dedisa substation has an installed capacity of 1000 MVA; however, under the N-1 contingency criterion, Eskom's standard for ensuring system reliability, only 500 MVA is considered secure. Similarly, the Grassridge substation has an installed capacity of 1720 MVA, with a secure capacity of 860 MVA under the same criterion. According to the 2024 GCCA [7], the Time of System Minimum (TOSM) demand recorded was 122 MW at Dedisa and 302 MW at Grassridge. Using peak load ratios of 0.6 and 0.3, respectively, the estimated peak demand ranges from 203 MW to 406 MW for Dedisa and from 503 MW to 1006 MW for Grassridge. At Dedisa, the estimated peak demand remains within the N-1 secure capacity. However, at Grassridge, the upper bound of the peak range exceeds its secure capacity, indicating a potential reliability concern. This reinforces the need for infrastructure upgrades, such as the addition of transformers, as proposed in the Transmission Planning Development (TPD) plan.

4.4.4. Recommendations for additional load connection capacity

The Port of Ngqura currently has a firm supply capacity of 25 MVA and a Notified Maximum Demand (NMD) of 6 MVA, indicating approximately 19 MVA of spare capacity available for immediate use. Furthermore, the planned 7 MW hybrid renewable energy plant will supplement the port's power supply and support future expansion.

4.5. Port of Saldanha

The Port of Saldanha is the deepest and largest natural port in Southern Africa, the largest iron ore exporting facility in Africa [8] and is situated 60 nautical miles north of Cape Town with the coordinates of 33° 02' S 17° 58' E. It was developed from a fishing harbour to a deep-water port in the early 1970s. It is primarily used for exporting iron ore from ore fields in the Northern Cape. The layout of the port of Saldanha is shown in Figure 12.

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Figure 12: Layout of Port of Saldanha Bay [9]

Source: TMS-Port-of-Saldanha-Bay-General-Information

4.5.1. Electricity demand characteristics

The Port of Saldanha has a firm supply of 20 MVA with a future 40 MVA planned and an upgrade available up to 80 MVA [10]. The port gets supplied by the Eskom utility and the Saldanha Bay Municipality. The supply for shore power would likely come one of the voltage levels 11/3.3/0.4 kV [10]. The NMD at the port of Saldanha is 21 MVA. There is currently 40 MVA available capacity to supply the Saldanha area and Vredenburg area collectively, and their combined demand is 36.4 MVA. This leaves spare capacity of 3.6 MVA on the network [11].

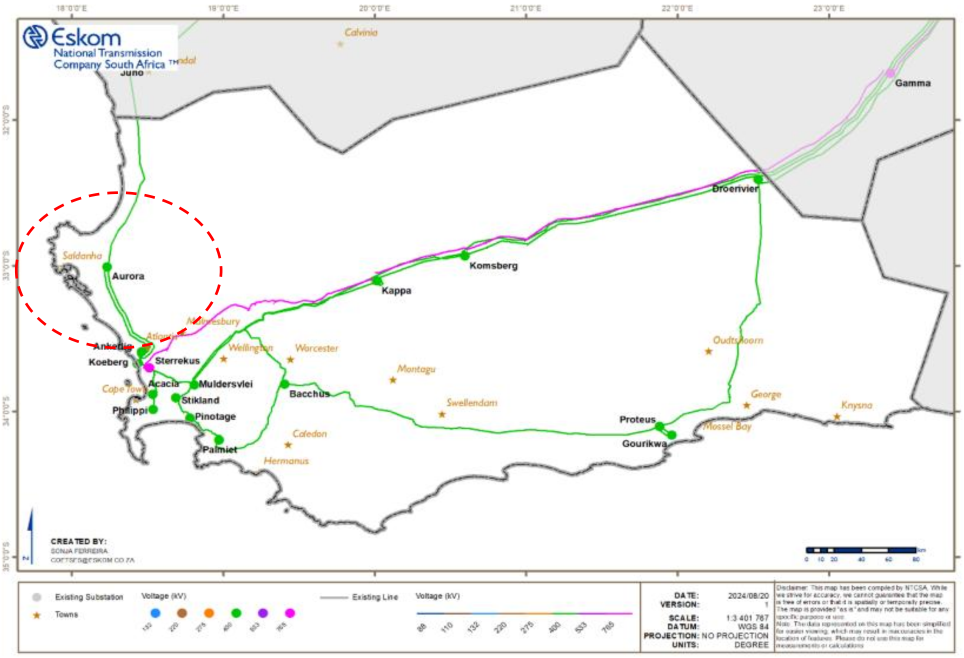
4.5.2. Location and capacity of distribution substations

Bulk supply to Saldanha bay is via 400 kV Aurora substation. Aurora supplies Blouwater substation at 132 kV which then services the Saldanha bay area. There is also supply from Eskom Duferco 66 kV substation to Saldanha area via a 66 kV feeder [11]. There is a second supply point from Duferco to Saldanha at 11 kV.

4.5.3. Location and capacity of transmission substations

The closest Main Transmission Substation (MTS) to the Port of Saldanha currently is Aurora located approximately 28 km east of Saldanha Bay [12] as shown in Figure 13.

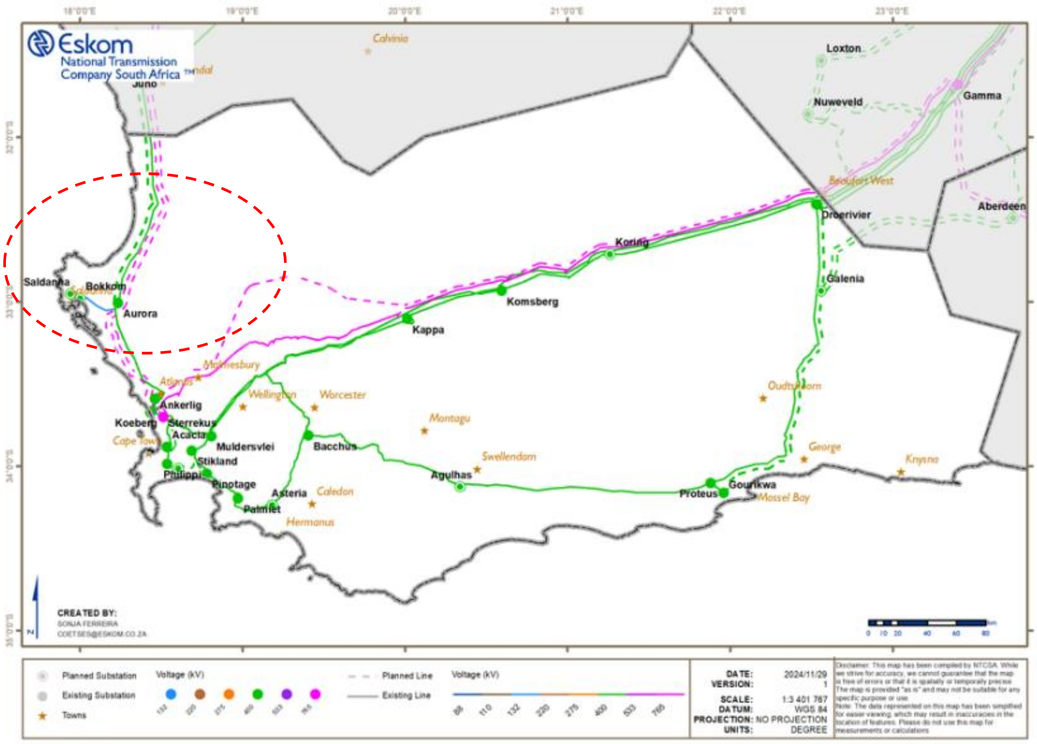
Figure 13: Current transmission network of Western Cape [2]



Source: Eskom Transmission Development Plan 2025 – 2034

The capacity at Aurora substation is 2 x 250 MVA at 400/132 kV. Aurora supplies the Blouwater (132/66 kV), Saldanha Steel and Smelter distribution substations [12]. Blouwater is approximately 5.5 km from the port and Aurora is approximately 22 km from the port. As per the Transmission Development Plant (TDP) of 2024, there are two phases planned for strengthening of the Saldanha Bay network up to the year 2028 [2]. The future transmission network is shown in Figure 14.

Figure 14: Future transmission network of Western Cape [2]

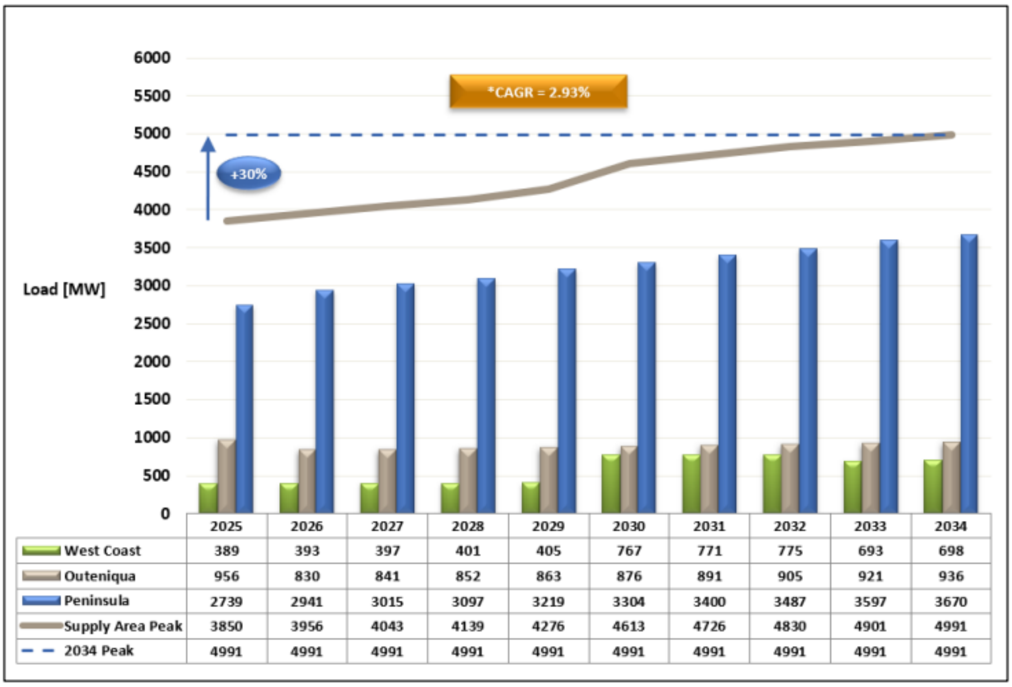


Source: Eskom Transmission Development Plan 2025 – 2034

The Western Cape is made up of four local supply areas which are Outeniqua, Peninsula, Greater Komsberg and West Coast. Saldanha is part of the West Coast. The Peninsula makes up 67% of the load while the West Coast and Outeniqua is about 33 %. The load forecast for the areas is shown in Figure 15. The West Coast load forecast in 2025 is 389 MW.

The West Coast is served by two MTSs, which are Aurora and Sterrekus (2000 MVA 765/400 kV transformers). The capacity at Aurora substation is 500 MVA at 400/132 kV. Assuming the worst case, that Aurora MTS supplies the West Coast area load of 389 MW totally and none comes from Sterrekus, it means that it would leave approximately 100 MW to be connected to the substation currently, so there would be room to accommodate the shore power supply. If the network upgrades in phase 2 of the Saldanha bay strengthening takes place, it means additional capacity may be available from closer to 2030 through Bokkom substation.

Figure 15: Western Cape load forecast as per TDP [2]



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
West Coast	389	393	397	401	405	767	771	775	693	698
Outeniqua	956	830	841	852	863	876	891	905	921	936
Peninsula	2739	2941	3015	3097	3219	3304	3400	3487	3597	3670
Supply Area Peak	3850	3956	4043	4139	4276	4613	4726	4830	4901	4991
2034 Peak	4991	4991	4991	4991	4991	4991	4991	4991	4991	4991

Source: Eskom Transmission Development Plan 2025 – 2034

4.5.4. Recommendations for additional load connection capacity

From information obtained from the distribution network, 36.4 MVA is the current demand for the Saldanha bay area (including the port) and Vredenburg area and the capacity available for both is 40 MVA, considering the NMD of the Port of Saldanha bay is 21 MVA. This potentially leaves 3.6 MVA available for shore power. From the electrical infrastructure around the Port of Saldanha, in the immediate term (within the next 2-3 years) prior to the commissioning of Bokkom, Aurora MTS via Blouwater distribution is the recommended choice for power supply. Currently, there appears to capacity available at transmission level, when considering the load forecast of the West Coast (where a worst case assumption is made that Aurora solely serves the West Coast), which leaves approximately 100 MW available from the substation.

4.6. Port of Richards Bay

The port of Richards Bay is situated in the northern industrial hub of Kwa Zulu Natal and accessible via rail and road. This is a deep-sea water port boasting 13 berths, the terminal handles dry bulk ores, minerals and break bulk consignments with a draft that easily accommodates Cape size and panamax vessels. This port is situated in the Umhlathuze municipality in Kwa-Zulu Natal.

4.6.1. Electricity demand characteristics

The Port of Richards Bay has three power intake points with a firm power supply of 20 MVA, 15 MVA, and 15 MVA respectively at each point of supply [13]. The power supply is distributed at the 11/3.3/0.4 kV voltage levels. Table 7 shows electrical infrastructure information for the distribution and transmission substations serving the Port of Richards Bay. The Port of Richards Bay has a Notified Maximum Demand (NMD) of 14 MVA, 3.5 MVA and 4.4 MVA across its three points of supply [13]. With reference to the firm's supply capacities, these NMDs suggest that any load increases at the Port of Richards Bay can be accommodated by the available spare capacity.

Table 7: Overview of electrical infrastructure near the Port of Richards Bay

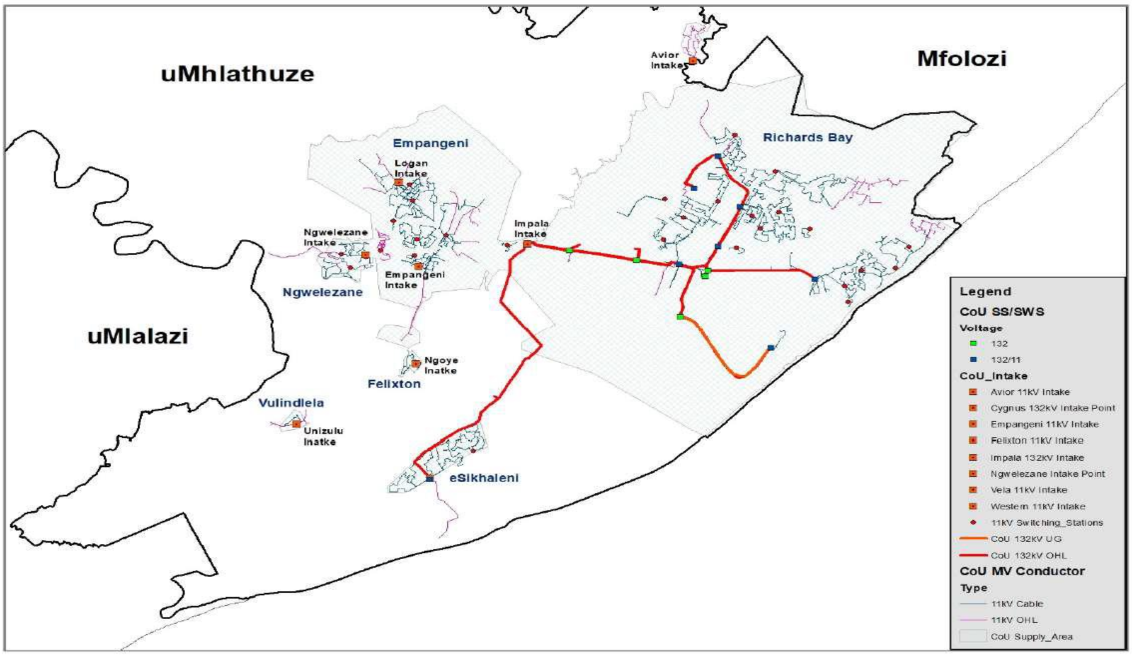
	Name of port	Port of Richards Bay	Port of Richards Bay	Port of Richards Bay
Port	Location of port	28°47'27.8"S 32°02'11.1"E	28°47'27.8"S 32°02'11.1"E	28°47'27.8"S 32°02'11.1"E
Distribution	Substation Name	Supply One	Supply Two	Supply Three
	Supply authority	Umhlathuze Municipality	Umhlathuze Municipality	Umhlathuze Municipality
	Peak Load or NMD of substation(s)	14 MVA	3.5 MVA	4.4 MVA
	Supply voltage	11/0.4kV	11/0.4kV	11/0.4kV
	Firm supply capacity	20 MVA	15 MVA	15 MVA
	Spare load capacity	6 MVA	12.5 MVA	10.6 MVA

Assuming the Port of Richards Bay peak demand matches the NMD, there is spare capacity of up to 6 MVA, 12.5 MVA and 10.6 MVA for the three points of supply. This additional loading will use up the spare capacity and may necessitate substation upgrades to restore or maintain the required spare capacity for future developments, especially if the substations are shared with other customers.

4.6.2. Location and capacity of the distribution substations

The City of uMhlathuze receives supply from eight Eskom Point of Supplies and distributes to customers. There is a total of 43 substations with 12 132 kV substations and 31 11 kV substations as indicated in Figure 16. Transnet National Ports Authority (TNPA) port of Richards Bay is supplied at 132kV voltage level. Overall, the load growth in CoU Area of Supply (AOS) has decreased in recent years due to the decreasing economic activity within the region.

Figure 16: Bulk Electricity Distribution Infrastructure [14]



Source: Eskom Transmission Development Plan 2025 – 2034

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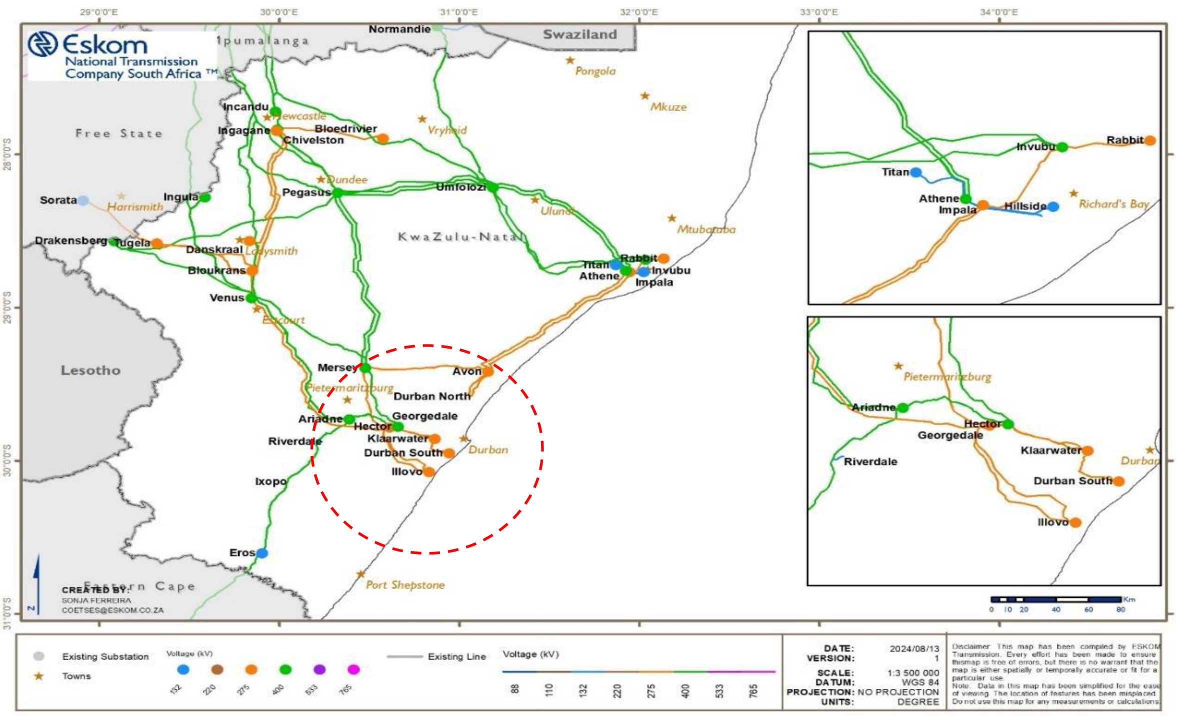
4.6.3. Location and capacity of the transmission substations

The Port of Richards Bay is based in the Empangeni CLN in Kwa-Zulu Natal. Significant load growth is expected in the Pinetown and Empangeni local areas due to industrial, commercial, and residential developments.Figure 17 shows the map of the current Kwa-Zulu Natal transmission grid and where the Port of Richards Bay is located.

Figure 17: Map of the current Kwa-Zulu Natal transmission grid



Source: Eskom Transmission Development Plan 2025 – 2034

Table 8: Overview of transmission grid capacity near Port of Richards Bay

	TDP Area CLN	Empangeni CLN
Transmission	Peak demand 2025	2101 MW
	Forecasted demand 2029	2298 MW
	MTS Name	Impala
	Installed capacity	4 x 250MVA
	TOSM demand 2025	211 MW

The closest MTS to the Port of Richards Bay appears to be Eskom Impala MTS. The Impala MTS installed capacity is about 1000 MVA with a time of system minimum demand (TOSM) of 211 MW. Based on Table 8, with reference to the TOSM, the estimated peak demand is in the range of 350 MW to 700 MW by applying minimum to peak ratios of 0.6 and 0.3, respectively. This suggests that there is sufficient capacity to increase the load downstream of Impala MTS.

4.6.4. Recommendations for additional load connection capacity

It is recommended to utilise the spare load capacity and maximise the usage of existing firm supply to the Port of Richards Bay. The spare capacity estimated for the three points of supply are 6 MVA, 12.5 MVA and 10.6 MVA, respectively. There are no major load connection risks identified, especially considering that the load growth in the City of uMhlathuze Area of Supply (AOS) has decreased in recent years due to the decreasing economic activity within the region.

4.7. Port of Cape Town

The Port of Cape Town is situated in Table Bay at Longitude 18° 26′ E and Latitude 33° 54′ S and lies 223 kilometers northwest of Cape Agulhas (the most southerly point in Africa) [15]. Cape Town forms part of the City of Cape Town Metropolitan Municipality, a Category A metropolitan municipality in the Western Cape province of South Africa. It is governed as a single, unified urban entity, the same municipality that includes surrounding areas such as Mitchells Plain, Khayelitsha, Bellville, and Somerset West [16]. The port of Cape Town layout is shown in Figure 18.

Figure 18: Port of Cape Town

Sourcec: Wikimedia Commons, available:
https://upload.wikimedia.org/wikipedia/commons/c/cb/Port_of_Cape_Town.jpg

4.7.1. Electricity demand characteristics

The Port of Cape Town has a firm supply of 18 MVA and is distributed at the 11/0.4 kV voltage levels. The port has an NMD of 18 MVA. In the absence of the peak load for the port, the NMD is used to represent at peak load. This suggests that there is no spare capacity currently. Table 9 shows the summary of the associated distribution network data.

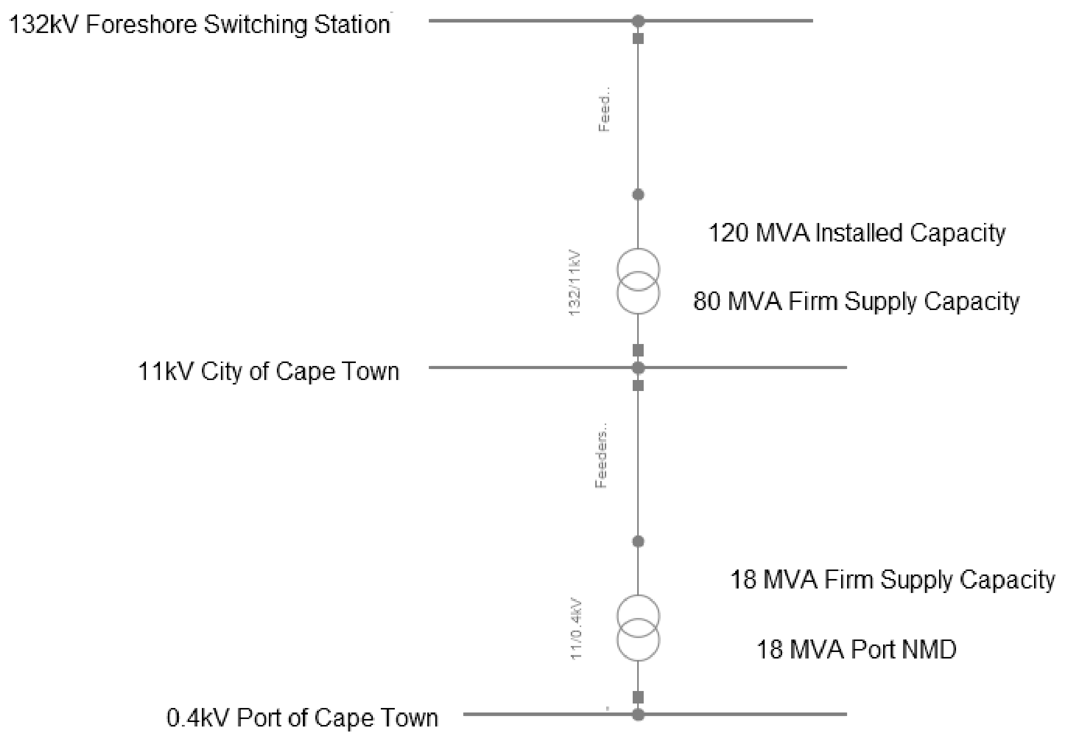
Table 9: Overview of the Port of Cape Town Distribution System

	Name of port	Port of Cape Town
Port	Location of port	Longitude 18° 26′ E and Latitude 33° 54′ S
Distribution	Substation Name	Foreshore 132kV Switching Station 132/11kV CoCT
	Supply authority	City of Cape Town
	Peak Load or NMD of substation (s)	18 MVA
	Supply voltage	132/11/0.4kV
	Firm supply capacity	18 MVA
	Spare load capacity	0 MVA

4.7.2. Location and capacity of the distribution substations

The City of Cape Town receives its power from the Foreshore switching station via the 132kV feeders. The power is then distributed at 132/11/0.4kV voltage levels. The 132/11kV transformers have a combined installed capacity of 120 MVA and a firm capacity of 80 MVA [17]. The simplified representation of the distribution network from the switching station to the port is shown in Figure 19.

Figure 19: Simplified representation of the CoCT Dx network [17]



Source: City of Cape Town, "Open Data Portal," City of Cape Town, 2020. [Online]. Available: https://www.capetown.gov.za/City-Connect/All-City-online-services/open-data-portal/DatasetDetail. [Accessed 27 06 2025].

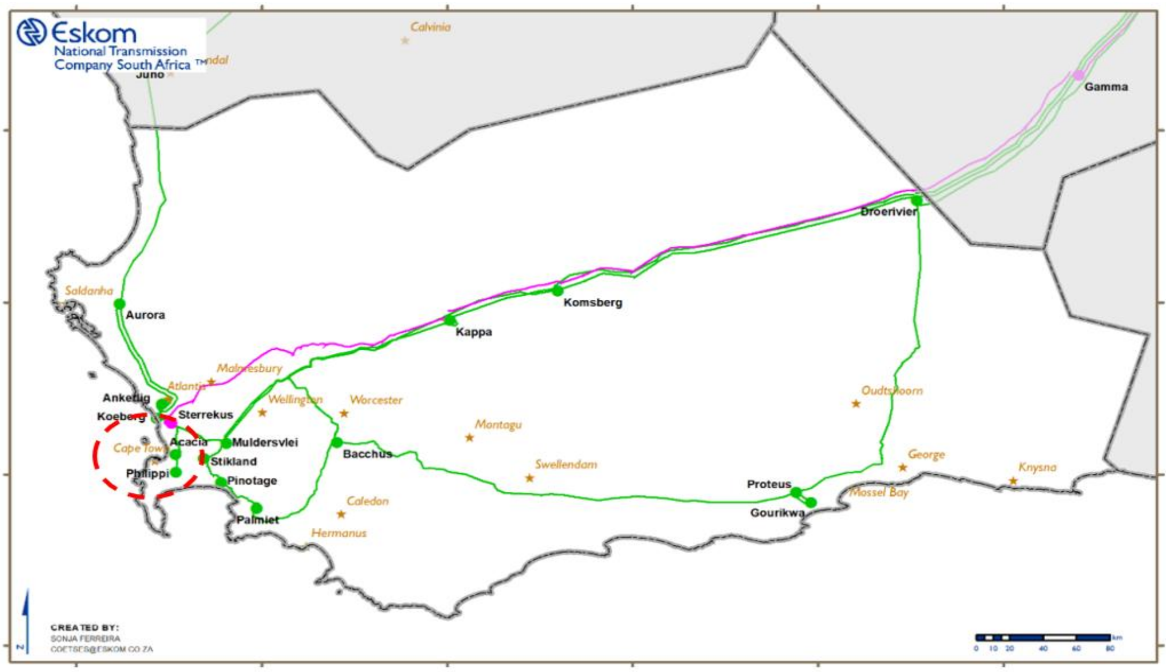
4.7.3. Location and capacity of the transmission substations

The City of Cape Town falls within the Greater Peninsula Customer Load Network (CLN), which is supplied via multiple main transmission substations (MTSs), including Stikland, Aurora, Acacia, Pinotage, Muldersvlei, Bacchus, Sterrekus, and Phillipi [7]. The closest MTS supplying the CoCT is Acacia. The summary of the transmission network and the current Western Cape transmission network from the TDP 2025-2034 [2] is shown inTable 10 and Figure 20, respectively.

Table 10: Overview of the Port of Cape Town Transmission System [2] [3]

	Customer Load Network/Local Area	Peninsula CLN
Transmission	Peak demand 2025	3192 MW
	Forecasted demand 2029	3336 MW
	MTS name/s	Acacia
	Installed capacity	3 x 500 MVA
	Voltage level	400/132 kV
	Substation Load (min)	346 MW

Figure 20: Current Western Cape Transmission Network [2]



Source: Eskom Transmission Development Plan 2025 – 2034

At the transmission level, Acacia MTS has a total installed capacity of 1500 MVA. However, under the N-1 contingency criterion, which is a standard reliability measure in Eskom's transmission planning, only 750 MVA of capacity is considered secure. According to the GCCA 2024, the Time of System Minimum (TOSM) Demand recorded in 2024 was 364 MW. Applying peak ratios of 0.6 and 0.3, the estimated peak demand ranges from approximately 606 MW to 1213 MW, respectively. The upper bound of this range exceeds the N-1 secure capacity of Acacia MTS, suggesting that if the peak loading is indeed near 1213 MW, there is insufficient secure capacity. This highlights the need for infrastructure upgrades, such as the addition of a transformer at Acacia, to unlock further capacity and accommodate future demand growth.

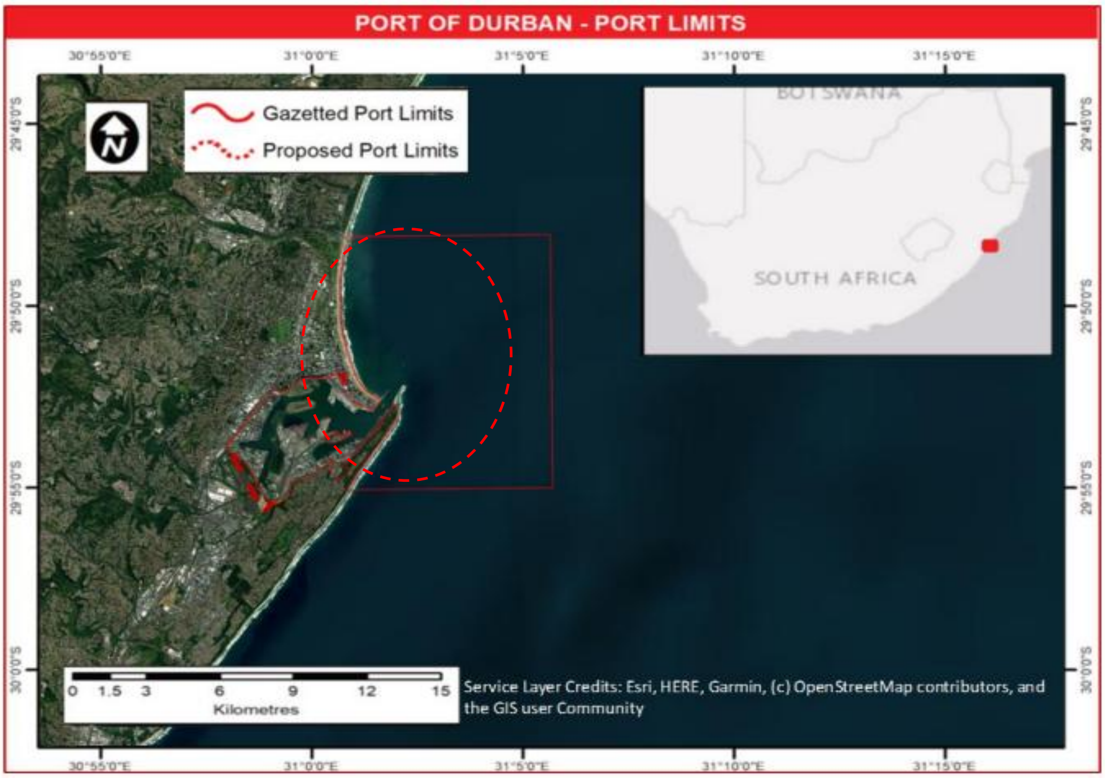
4.7.4. Recommendations for additional load connection capacity

To accommodate additional load at the port, a dedicated 11kV feeder from the City of Cape Town (CoCT) 11kV busbar to the port is proposed. A type 2 11kV feeder can handle up to 13 MVA, according to the authors [18]. Based on the installed capacity of 120 MVA and a firm supply of 80 MVA in the upstream network, as illustrated in Figure 19, up to 40 MVA of extra load can be supported downstream without requiring further infrastructure upgrades beyond the 11kV busbar. This means that to unlock the entire 40 MVA of capacity, multiple 11kV feeders will need to be constructed. However, if the load requirement exceeds 40 MVA, a dedicated feeder from the 132 kV Foreshore switching station is recommended. In such a case, the available transmission capacity at Acacia would become a limiting factor, particularly when applying the N-1 contingency criterion.

4.8. Port of Durban

The Port of Durban is situated on the east coast of South Africa as shown in Figure 21. It is the main container port on the South African coastline. It is 680 nautical miles northwest of Cape Agulhas and 625 nautical miles southwest of the port of Maputo [19]. The GPS coordinates are S 29.8689 and E 31.0617. It handles about 60 % of South Africa's container traffics. Areas served by the port are Gauteng, KwaZulu-Natal and a large portion of the Southern African hinterland [10].

Figure 21: Geographical location of the port of Durban [10]



Source: Transnet National Ports Authority, "Port Development Framework plans 2022 update," 2022.

4.8.1. Electricity demand characteristics

At local distribution level, the Port of Durban has a firm supply of 17 MVA and given that the NMD of the Port of Durban is 13 MVA, this means that 4 MVA would be spare capacity at the Port of Durban.

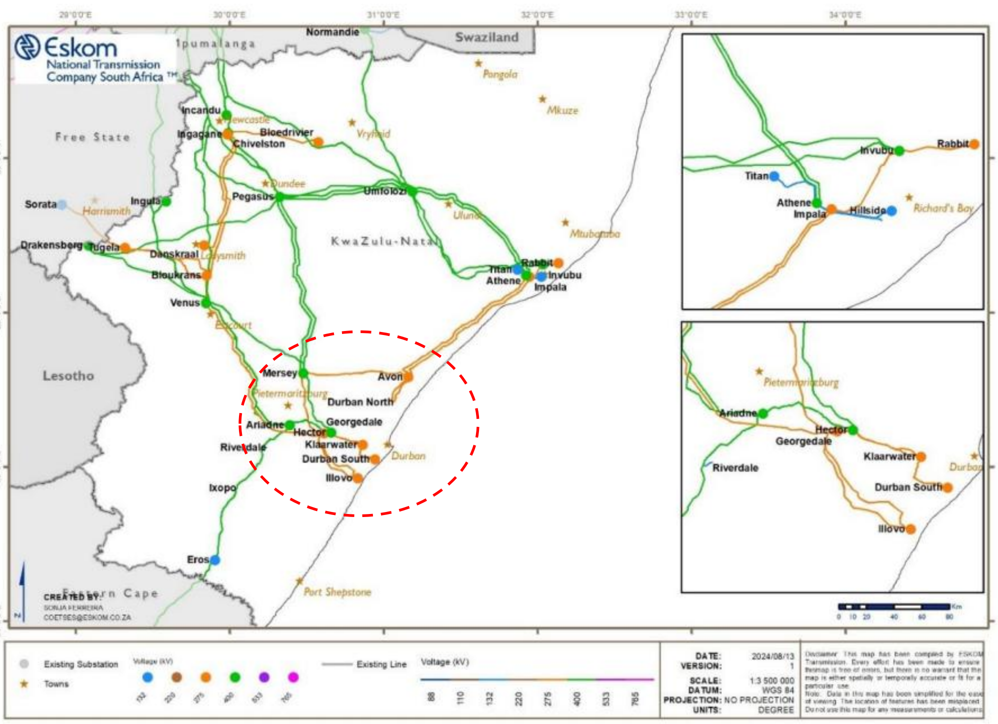
4.8.2. Location and capacity of distribution substations

The Edwin Swales substation is the likely POC, which is 5 km from the port [20]. It is a 132 kV switching station. The firm supply voltages are 33/11/6.6/0.4 kV.

4.8.3. Location and capacity of transmission substations

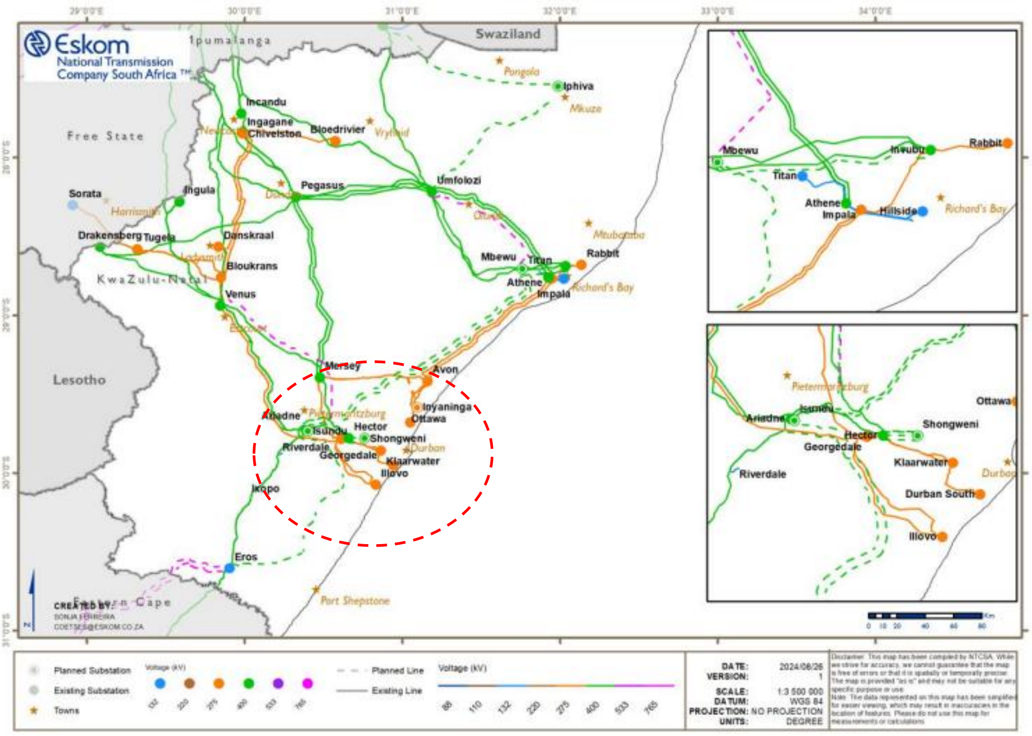
The closest transmission substations to the Port of Durban appear to be Klaarwater, Durban South and Illovo, which are at 275 kV voltage level as shown in Figure 22. The utility/municipality supplying the Port of Durban is eThekwini. According to the TDP 2025, eThekwini network is planned to undergo strengthening in the year 2033. The KwaZulu Natal supply area has five local areas which are Empangeni, Ladysmith, Newcastle, Pinetown and Mthatha. The two main load centres are Empangeni and Pinetown, which take up ~35 % and 51 % of the load respectively while Newcastle, Ladysmith and Mthatha make up the remaining 14 % of the load demand [2].

Figure 22: Current KwaZulu Natal transmission network



Source: Eskom Transmission Development Plan 2025 – 2034

Figure 23: Future KwaZulu Natal transmission network [2]



Source: Eskom Transmission Development Plan 2025 – 2034

Substations with 400/275 kV transformation, according to the GCCA, supplying Pinetown are:

- Mersey – 3 x 800 MVA
- Hector – 2 x 800 MVA

Substations with 400/132 kV transformation, according to the GCCA, supplying Pinetown are:

- Ariadne – 2 x 500 MVA

Substations with 275/132 kV transformation, according to the GCCA, in Pinetown the substations at this level are:

- Avon – 3 x 250 MVA
- Georgedale – 1 x 250 MVA and 2 x 150 MVA
- Illovo – 2 x 250 MVA
- Klaarwater – 2 x 250 MVA and 2 x 315 MVA
- Mersey – 3 x 250 MVA
- Durban South – 4 x 315 MVA

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Figure 24: Simplified transmission capacity available for Pinetown

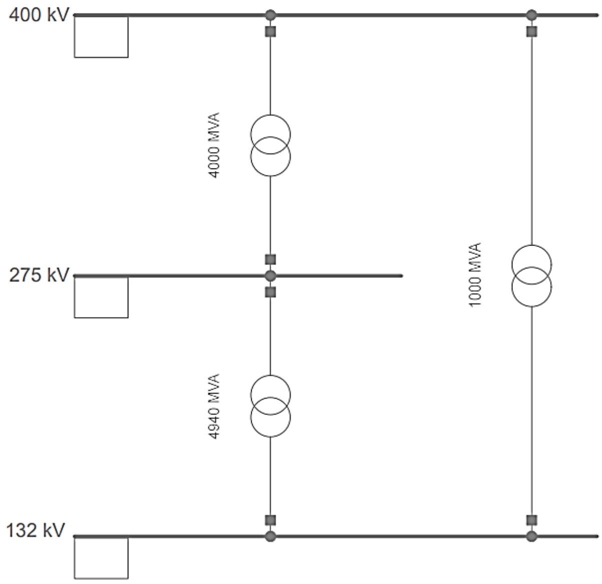
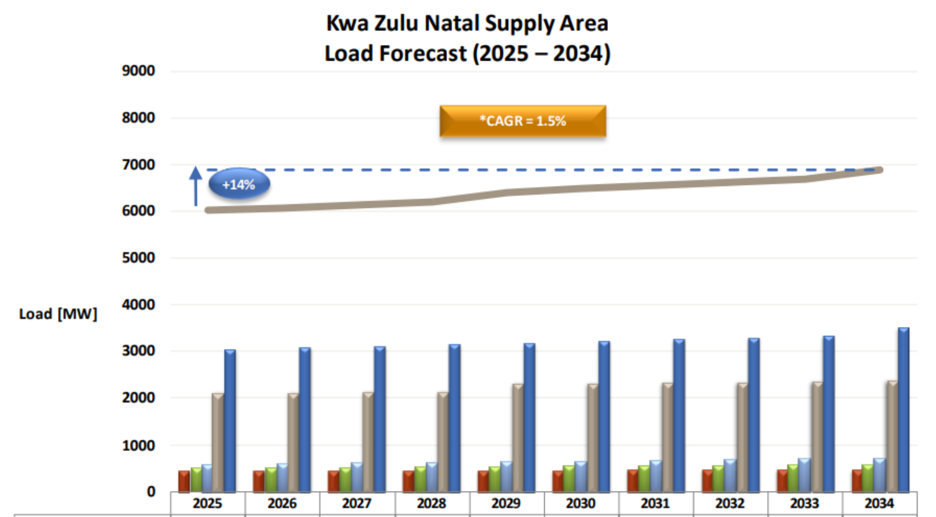


Figure 24 shows a schematic of the cumulative capacity at different voltage levels as per the information extracted from the GCCA 2025. The load forecast for Pinetown shown in Figure 25 is 3046 MVA. This can be served by the cumulative capacity shown in Figure 24; hence it shows that at transmission level it is unlikely that there will be bottlenecks in terms of capacity.

Figure 25: KwaZulu-Natal load forecast as per 2024 TDP [2]



	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034
Ladysmith	441	444	447	451	454	459	464	471	477	484
New castle	507	512	516	521	525	554	558	562	565	569
Mthatha	579	592	606	620	635	650	667	687	698	710
Empangeni	2101	2113	2126	2138	2298	2310	2322	2334	2347	2374
Pinetown	3046	3077	3108	3140	3177	3212	3250	3288	3316	3498
Supply Area Peak	6029	6086	6144	6203	6405	6491	6558	6630	6686	6895
2034 Peak	6895	6895	6895	6895	6895	6895	6895	6895	6895	6895

Source: Eskom Transmission Development Plan 2025 – 2034

4.8.4. Recommendations for additional load capacity

In the short term, it is recommended that the 4 MVA be used totally at one of the lower voltages of the firm supply being 11/6.6/0.4 kV before any supply upgrades are undertaken. If the required shore power is greater than 4 MVA, a second dedicated feeder may be required to supply shore power.

5. Discussion

A ranking list is provided that indicates the estimated spare load capacity and associated connection risk for the eight commercial South African ports assessed. The ranking list shown in Table 10 is organised from the largest to the smallest spare capacity available at the port's power intake points. It is evident that these ports have varying amounts of spare load capacity. The connection risk of low, medium and high is assigned to solely based on the estimated spare capacity and does not consider other factors such as substation space, accessibility, electrical servitudes and routing, grid connection requirements, etc.

It is noteworthy that the electrical distribution infrastructure is manged by municipalities or Eskom in the various jurisdictions where the ports are based. For this reason, it is challenging to compare the grid connection prospects across the various ports. This ranking list can aid in the selection and prioritising the processing of the load application at the various ports.

Table 10: Ranking of the port spare connection capacity and risk level

Ranking	Port	Spare Capacity (MVA)	Spare Capacity* (MW)	Connection Risk
1	Port of Ngqura	19	17.1	Low
2	Port of East London	18	16.2	Low
3	Port of Gqeberha	15	13.5	Low
4	Port of Richards Bay	11.5	10.35	Low
5	Port of Mossel Bay	7	6.3	Medium
6	Port of Durban	4	3.6	Medium
7	Port of Cape Town	0	0	High
8	Port of Saldanha	0	0	High

*Notes: The spare load capacity at substation in MW is estimated using this formula.

Spare Capacity = 0.9*(Firm Supply – Notified Maximum Demand)

A factor of 0.9 is applied to account for the power factor of the distribution load.

If the planned shore power requirements exceed these spare capacity estimates, the municipality or Eskom distribution network planners must be consulted to ascertain the constraints on the upstream network. Nevertheless, this analysis indicates that they may be spare load capacity upstream that can be accessed before major network strengthening is undertaken. The Port of Cape Town and the Port of Saldanha are an exception, since it is evident that they show low spare capacity levels and upstream network upgrades will be required.

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6. Conclusion

This is a high-level assessment of the spare load connection capacity at the national ports. The electrical capacity of the infrastructure supplying the ports such as the local substation, the distribution network and transmission grid were assessed. It is evident that the spare load capacity ranges from 0 to 19 MVA across the various ports assessed. On the one hand, this indicates that additional load capacity can be accessed without the need for strengthening network in the short term. On the other hand, ports showing no MVA spare load capacity will require network upgrades to unlock additional load connection capacity.

For this pre-feasibility study, a list is provided, which ranks the ports in terms of maximum spare capacity and lowest connection risk. This ranking list can be used to prioritise the grid connection technical studies. In the feasibility phase of the project, a load application to the supply authority is required to undertake further detailed power system studies to ascertain the grid connection prospects.

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