

ENG-TENE-005 20221108

CLIENT: PRINCE ALBERT MUNICIPALITY

MASTER PLAN REPORT 2024

FOR

PROJECT NO 24062EG

PROJECT NAME : ELECTRICAL 22kV INFRASTRUCTURE OF PRINCE ALBERT

DATE: JUNE 2024

Compiled for :

Prince Albert Local Municipality
Private Bag X53
Prince Albert
6930

Prepared by :

Neil Lyners & Associates (Pty) Ltd
P O Box 4901
TYGERVALLEY
7536
Tel: (021) 914 0300
Contact: Theo Potgieter
Email: theo@lyners.co.za

REPORT DETAILS :

Lyners Reference No:	24062EG – Volume 1
Client:	Prince Albert Local Municipality
Report prepared by:	Theo Potgieter, Jacques van Zyl, Jurgens Daniel
Client representative:	Thembisile Tukani
Keywords:	Master plan, electrical infrastructure
Revision record and date:	Rev 0 – June 2024

Date	Revision	Status	Format	Issued to:
June 2024	0	Draft	pdf	Thembisile Tukani

EXECUTIVE SUMMARY

A master plan is an evolving, long term planning document that establishes the framework and key elements of a specific network with a clear vision of the required outcomes. It furthermore defines a realistic plan for the implementation of short-, medium- and long-term system betterment actions, with the purpose of ensuring a predictable and reliable electrical system.

With the above in mind, a master plan study was done for the 22kV infrastructure in Prince Albert.

Information contained in previous reports done by CVW Consulting Engineers was updated, amended and re-used as applicable.

The as-built information of the 22kV infrastructure was updated as applicable. Asset information, including photos, technical details and serial numbers of equipment, was captured on-site.

The impact of new developments and normal growth on the existing infrastructure was verified as part of a complete load flow study, and recommendations made for system betterment, thereby ensuring that the electricity supply for the town remains reliable and of acceptable quality. For purposes of proposed new developments, the latest Spatial Development Framework as compiled in May 2021 was used as guiding tool.

In the last 24 months, Government has changed the requirements for investors to make the process for developing renewable energy project less bureaucratic in terms of legislation. This coupled with the apparent interest shown by financiers to support the green energy drive, there is numerous opportunities for independent power producers (IPP) to develop and operate installations that is feeding into the grids of Municipalities

Contents

ANNEXURES

1. INTRODUCTION

Neil Lyners & Associates (RF) (Pty) Ltd was appointed by Prince Albert Municipality to update the master plans for the 22kV electricity infrastructure in Prince Albert. These studies were done with the assistance of specialist consulting firm PJ Technologies, and were envisaged to have the following components:

- Updating and verification of 22kV as-built information, and amendment of layouts, as necessary.
- Visual inspections on site to gather applicable information on equipment installed since the previous updating of the master plans.
- Load flow studies on the 22kV networks, current scenario and also with predicted future load growth. (For these load flow studies the SKM PowerTools load flow software was used)
- Recommendations for betterment of the current networks, and proposals for network strengthening in the future.

The Prince Albert Municipality electricity distribution area (NERSA approved) consists of the electrical network in Prince Albert, Klaarstroom and Leeu Gamka. Although Klaarstroom and Leeu Gamka fall within the Municipal boundaries, the users are supplied by Eskom and no change is envisaged in the medium term.

The time frames and load representation were for:

a) Base year (2024)

b) Short-term (2024 to 2029)

c) Medium-term (2030 to 2034)

2. ELECTRICAL DISTRIBUTION MASTERPLAN

Neil Lyners and Associates (Pty) Ltd investigated the MV Masterplan for Prince Albert Municipality's electricity distribution area, the upgrading of the electrical network to accommodate the load growth in the area. Included in the investigation is to determine the grid capacity as currently defined by statuary and regulating authorities being NERSA, Eskom, SANS, NRS standards and various government departments.

The Prince Albert Municipality electricity distribution area consists of the electrical network in Prince Albert.

The planning area encompasses the Municipality's existing and future boundaries based on the spatial development framework (SDF), completed in May 2021 and this report is in use for the current planning processes.

This investigation report is in response to the previous masterplan and is intended to provide specific details on the requirements for the MV network reinforcements based on the constraints identified in the masterplan. For this purpose, the licensing area is envisaged not to expand but the following growth areas need to be factored in:

i. the following growth areas have been identified:

   - Specific housing projects that will impact the distribution network on the medium term (Project of 208 houses in the planning stage);

The areas identified above need to be serviced by the existing networks and should the MV networks become overloaded or un-economical, then new HV and MV infrastructure need to be considered.

3. ABBREVIATIONS AND DEFINITIONS

The table below is a summary of the technical terms and definitions used in this masterplan.

3.1 Technical terms and abbreviations

Refer to NRS -34-0 for definitions

PUC – **Point of utility connection** also known as point of supply

POS – **Point of supply**: The point at which electricity is supplied to any premises by a supplier.

[Regulation R1, OHS Act] (NRS 016)

- ***Point of supply**, means either a single point of supply, or a specific group of points of supply on Utility's System, from where electricity is supplied to the customer by Utility, or from where the customer supplies electricity to Utility's System located within a single substation, at which electricity is supplied/delivered to the customer at the same declared voltage and tariff. (Courtesy of Eskom definitions)*

POM – **Point of metering (refer to NRS 040)** is the point in the network where the total energy of the POS will be measured and an utility bill can be generated from. At this point the metering equipment is to be installed that is exclusively for the customers electrical consumption.

POC – **Point of control**: The point at which the electrical installation on or in any premises can be switched off by a user or lessor from the electricity supplied from the point of supply. [Regulation R1, OHS Act] (NRS 040-1)

- ***Point of control*** *is the point in the network where the control of the network can be done by the consumer. This will be the MCB in the Main DB (LV) or a MV switch which is part of the consumers network (Incomer on MV panel)*

NMD - **Notified maximum demand** means the contracted maximum demand, notified in writing by the customer and accepted by Eskom (or Municipality) per POD/point of supply.

- *Note: The notification of demand shall be governed by the NMD and MEC rules.*

- *NMD and MEC rules means the rules approved by NERSA/ Local Authority and as amended from time to time for the notification of demand or maximum export capacity or changes to or the exceeding / violation of the NMD or MEC (refer to Eskom's document on the rules for NMD & MEC)*

3.2 Technical limitations that must be complied with when evaluation the grid:

The two major standards that must be complied with in any application of EG on the grid are:

3.2.1 NRS 048 (Quality of supply)

- **Part 2: Voltage characteristics, compatibility levels, limits and assessment methods**

The following are the minimum standards that must be complied with on the grid for any electrical connection and the impact thereof.

a) The magnitude of supply voltage shall be within ±10% for voltage levels <500 V and ±5% for voltage levels >500 V.

b) The compatibility level for voltage unbalance on LV, MV and HV three-phase networks is 2%. On LV networks, a compatibility level of 3% may be applied.

3.2.2 NRS 048-4 (Electricity supply – quality of supply)

- **Part 4: Application practices for licensees**

a) The indicative planning level for the rapid voltage change as percentage of the nominal voltage $\Delta U/U_n$ is 3-6% at MV level depending on the repetition rate of changes in a period.

b) The above documents do not specify a limit for rapid voltage change (due to switching on embedded generators) at LV level. Other international standards (i.e. VDE AR-N-4105) recommended a limit of 3% and this will be the basis for evaluating any LV connected EG.

4. PLANNING CRITERIA FOR ELECTRICAL MASTER PLAN

The components of the planning of such a system study constituted the following aspects:

i. Obtain the existing data of the network, i.e. the transformers and the distribution network

ii. Statistical metering data of the network and the seasonal loading of the equipment;

iii. Determine the load growth and create a forecast model for the network;

iv. Do the following network analysis to determine the basic electrical requirements of the equipment that need to be specified.

   a) Load flow analysis of the model and determine the factors that can affect the reliability of the network;

   b) Investigate the effect of power factor correction (PFC) on the system and the impact it will have on the demand of the system and do recommendations for future implementation;

   c) Fault levels : To determine the fault levels that can be expected in the network and;

   d) Arc flash study where the risk of electrical flashes will be investigated and recommendation for operating in these conditions;

v. Recommend upgrade policies

vi. Effect of the proposed load in different stages;

vii. Effect of transferring load between substations;

viii. Optimising of the networks in terms of reliability and network losses

4.1 Method

The following method was used in the analysis and planning of the networks:

i. The 22 kV primary network was modelled using the SKM PowerTools load flow package. The results of the analysis were compared with available data and the present configuration. Adjustments were made to model a typical load profile during the maximum demand period.

ii. The system will then be optimised and the various network reinforcements will be considered and recommendations shall be made. At the stage of reporting on the investigation, statistical information of the network is not available and it must be assumed that the Municipal Engineers will provide confirmation on the accuracy of the modelling.

5. EXISTING NETWORK & HISTORICAL INFORMATION

Prince Albert Municipality, who is responsible for the 22 kV network, purchases electricity in bulk from Eskom at 22 kV and are metered at the main intake substation. The Municipality distributes the power at 22 kV from the Eskom substations to the nodes in the network.

The following table summarizes the intake point and the electrical capacity thereof.

SITE	DESCRIPTION	CAPACITY/ NMD OF THE INFEED POINT
Prince Albert Main substation	The substation is supplied with one 22kV Farmers feeder from Leeu Gamka 132 / 22 substations. The metering is done at 22 kV	3500 kVA

Table 5.1: 22 kV Feeder network details

The reticulation in Prince Albert is done primarily with overhead lines in the town.

6. NETWORK DATA

The following is the basic network data used in the modelling of the 22kV system of Prince Albert:

6.1 Eskom supply point

The following table is a summary of the substation in the Municipal area under investigation:

Prince Albert Main substation (22 Kv) **Eskom supply, Notified demand = 3.5MVA** **Installed transformer capacity : 2x 132/ 22 kV transformers at the Leeu Gamka traction substation** **Firm capacity: system is fed of a radial Eskom farmers system.**

Table 6.1: Basic network and substation details

6.2 Prince Albert distribution area

This network is configured as follows:

a) Prince Albert main substation, 22 kV: Fed of a non-firm supply with a NMD rated at 3500 kVA

b) It must be noted that at the T-off to Prince Albert Municipality the Eskom Farmers feeders 2 and 3 can be interconnected , giving the Municipality a backup supply in the event of network constraints on the side of Eskom. The details of the alternative supply, Leeu Gamka farmers 3 feeder is not available at the time of this investigation.

6.2.1 Main 22 kV substation

The load is reticulated from the Main substation to three Primary radial overhead systems. The distributors are made of overhead lines with minimal MV cables. In this configuration, the control of the network is at the Main substation with no other sectionalisers of fuses.

Switching is done in the Main substation on the respective feeders breaker with no backup supply to any of the three radial systems (refer to single line diagram 24062EG-03 in Annexure C).

6.2.2 Maximum demand recorded

The table below is a summary of the maximum current recorded at the substation, which is representative of the highest loading of the network. It must be noted that the information was extracted from the Eskom utility account and no detailed recordings are available and therefore the contribution is estimated to have similar power factors.

PRINCE ALBERT - MINFLEX 22kV	Maximum Demand	Notified demand	Capacity utilisation	Load factor	Energy consumption	Reactive energy
Month	kVA	kVA	%	%	kWh	kVArh
Jun-2020	2222	3500	63%	50%	838 172	331 814.56
Jul-2020	2298	3500	66%	50%	866 912	-
Aug-2020	2445	3500	70%	51%	897 132	304 106.72
Sep-2020	2319	3500	66%	51%	878 822	311 549.84
Oct-2020	2021	3500	58%	58%	829 416	341 218.90
Nov-2020	2060	3500	59%	56%	866 950	52 417.56
Dec-2020	1874	3500	54%	62%	838 303	3 230.14
Jan-2021	2057	3500	59%	64%	990 130	15 672.20
Feb-2021	2055	3500	59%	60%	932 001	12 530.70
Mar-2021	2201	3500	63%	54%	799 356	5 052.62
Apr-2021	1922	3500	55%	61%	885 928	4 255.80
May-2021	1876	3500	54%	62%	841 624	2 002.52
Jun-2021	2073	3500	59%	0%	864 982	90 260.15
Jul-2021	2270	3501	65%	54%	888 340	178 517.77

Table 6.2: Prince Albert 22 kV substation loading details (2020/ 2021)

PRINCE ALBERT - MINFLEX 22kV	Maximum Demand	Notified demand	Capacity utilisation	Load factor	Energy consumption	Reactive energy
Month	kVA	kVA	%	%	kWh	kVArh
Jun-2023	2647	3500	76%	39%	784 191	132 351.25
Jul-2023	2744	3500	78%	41%	823 935	195 121.50
Aug-2023	2474	3500	71%	43%	793 735	163 776.45
Sep-2023	2273	3500	65%	43%	726 887	110 865.40
Oct-2023	2218	3500	63%	46%	738 947	101 822.35
Nov-2023	2076	3500	59%	49%	762 628	30 118.10
Dec-2023	2113	3500	60%	47%	720 286	3 686.40
Jan-2024	2035	3500	58%	57%	867 002	3 044.55
Feb-2024	2008	3500	57%	36%	542 768	10 160.55
Mar-2024	1981	3500	57%	57%	753 452	344 964.20
Apr-2024	1996	3500	57%	53%	783 161	310 252.05
May-2024	1742	3500	50%	59%	748 842	122 025.05

Table 6.3: Prince Albert 22 kV substation loading details (2023/ 2024)

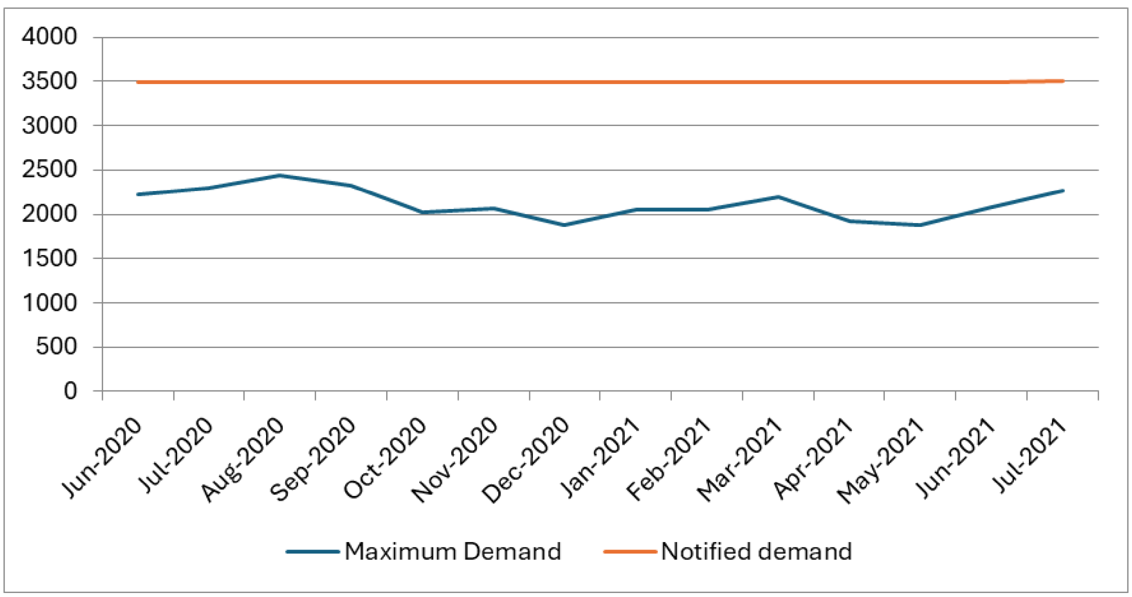


Figure 6.1: Prince Albert 22 kV substation loading details (2020/ 2021) – Registered demand

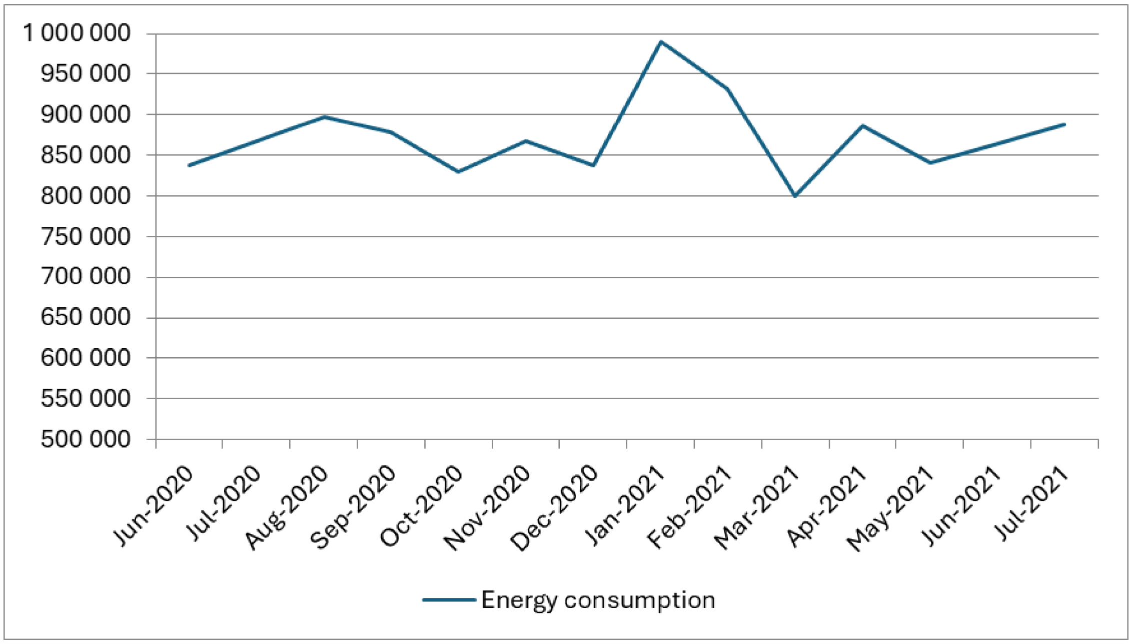


Figure 6.2: Prince Albert 22 kV substation loading details (2020/ 2021) – Energy Consumption

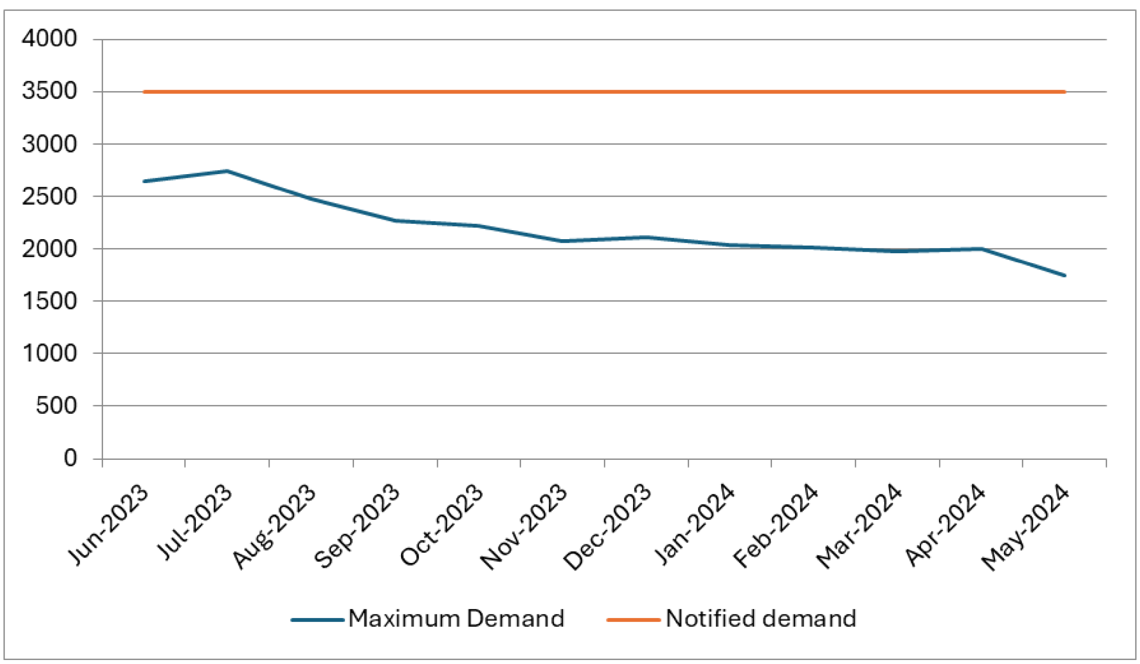


Figure 6.3: Prince Albert 22 kV substation loading details (2023/ 2024) – Registered demand

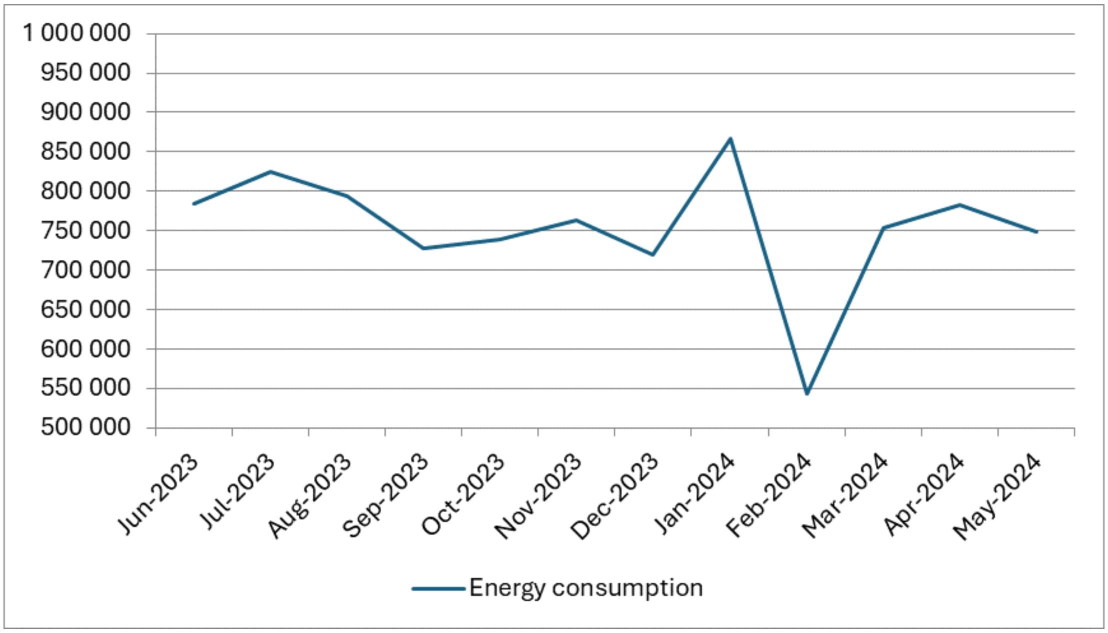


Figure 6.4: Prince Albert 22 kV substation loading details (2023/ 2024) – Energy Consumption

The following must be noted from the Eskom data:

i. There is no upgrading envisaged for this substation in the medium term.

ii. In the data from Eskom, the recorded MD was at 78% (July 2023) of the notified demand.

iii. The increase in demand for the two time series were determined to be 12.2% or on average 4.1% per annum. This is significant as the increase in demand is not due to the additional load but also the impact of load shedding.

iv. The energy in the same period of analysis show a decline of 13.8% or 4.6% average per annum in energy usage and this can be attributed to the following factors:

a) Load shedding: The impact of load shedding has there is a reduction in the energy usage registered by users and this is clear in the first quarter of 2024;

b) Renewable energy: The penetration of solar power and combined with a battery storage system (Hybrid) shall reduce the energy usage of consumers and have a direct impact on the total energy purchased from Eskom.

6.3 Load shedding and the impact on the Eskom supply point

Each distributor is subject to the impact of the national load shedding which is implemented by Eskom since 2014. The following figures are from the CRSES report, Visualisation of South African Energy Data centre[1], at the Stellenbosch University and summarises the hours of load shedding in each period.

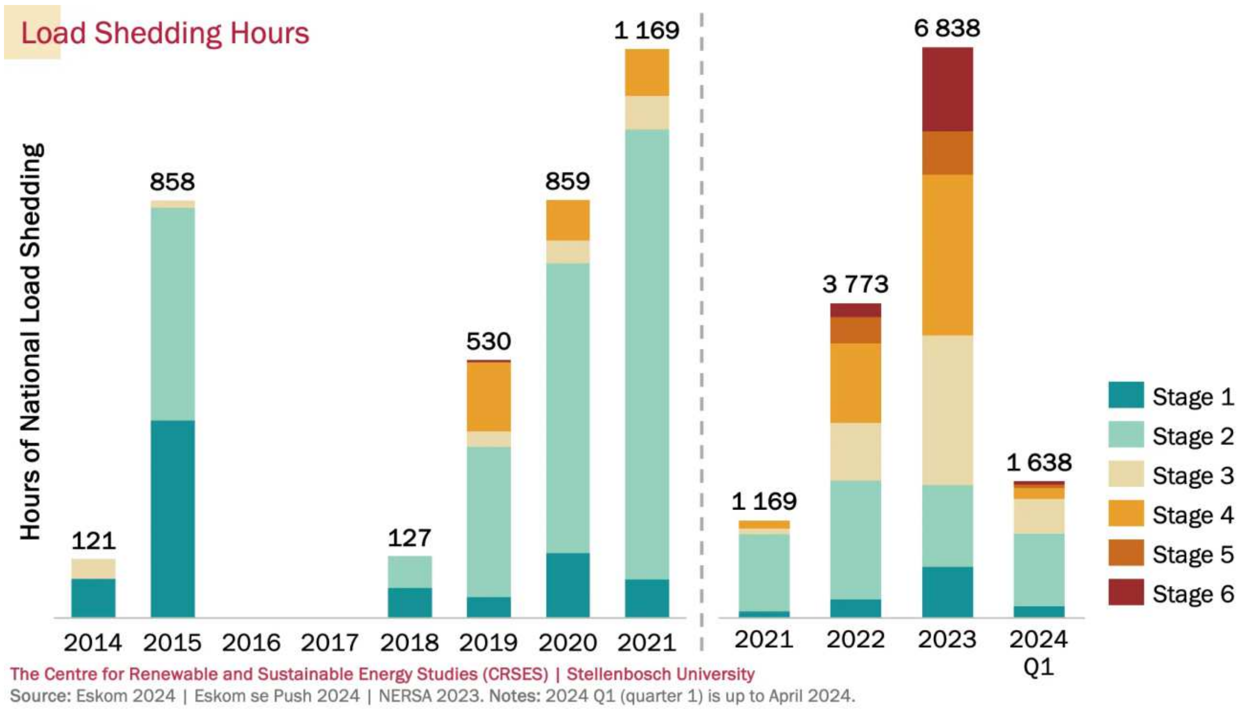


Figure 6.5: Number of hours and stages of load shedding that was implemented nationally by Eskom

[1] Source: CRSES Website Energy Stats Document, Visualisation of South African Energy Data, April 2024

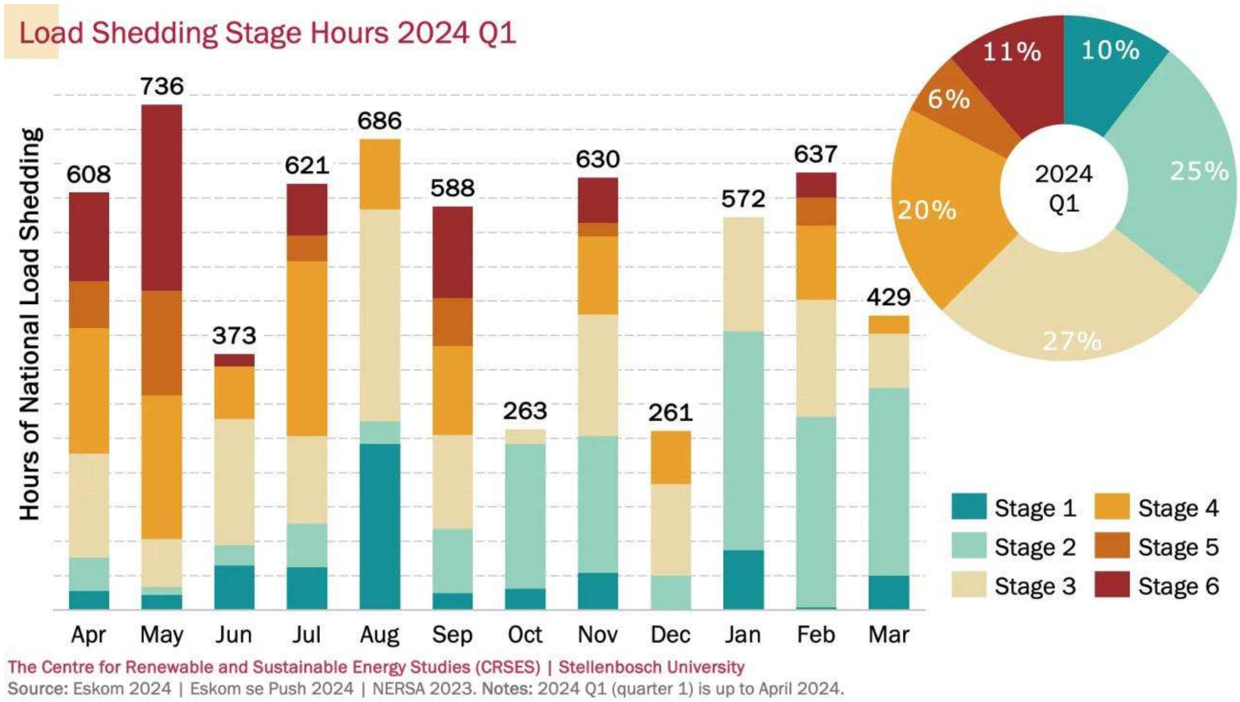


Figure 6.6: Number of hours and stages of load shedding for the last 12 months as implemented nationally by Eskom.

Based on the figures, it is clear that in 2023, the average load shedding was in excess of 570 hours average per month as seen in figure 6.6.

6.4 Impact of load shedding and EG on the supply to a Municipal grid

The current configuration of a typical network supplied by Eskom is that the metering point is supplied in bulk and energy is reticulated from the Main substation to the primary and secondary MV substations using the internal MV feeders (cables and/ or overhead lines) and this enables the Municipality to transfer loads.

The following is the typical characteristics of such a network:

i. There is one supply from Eskom to the Main Intake substation.

ii. The capacity of the incomer is limited to the contractual notified demand;

iii. The internal network configuration is operated and maintained and the connected consumers have supply agreements with the Distributor/ Municipality;

iv. Revenue collection is done by the Distributor/ Municipality

v. Data that is available is the monthly consumption for a 20 year period from 2003 to 2023..

6.4.1 Impact of Impact of load shedding and EG on the Maximum demand

In the figures below is a typical example of the daily profiles for a June and December periods. In this graph, the following trends can clearly be noticed:

i. The typical daily load profile of the network is easily distinguished;

ii. Super imposed on it is the impact of the load shedding and in this case the increased demand due to "cold load pickup" of the network;

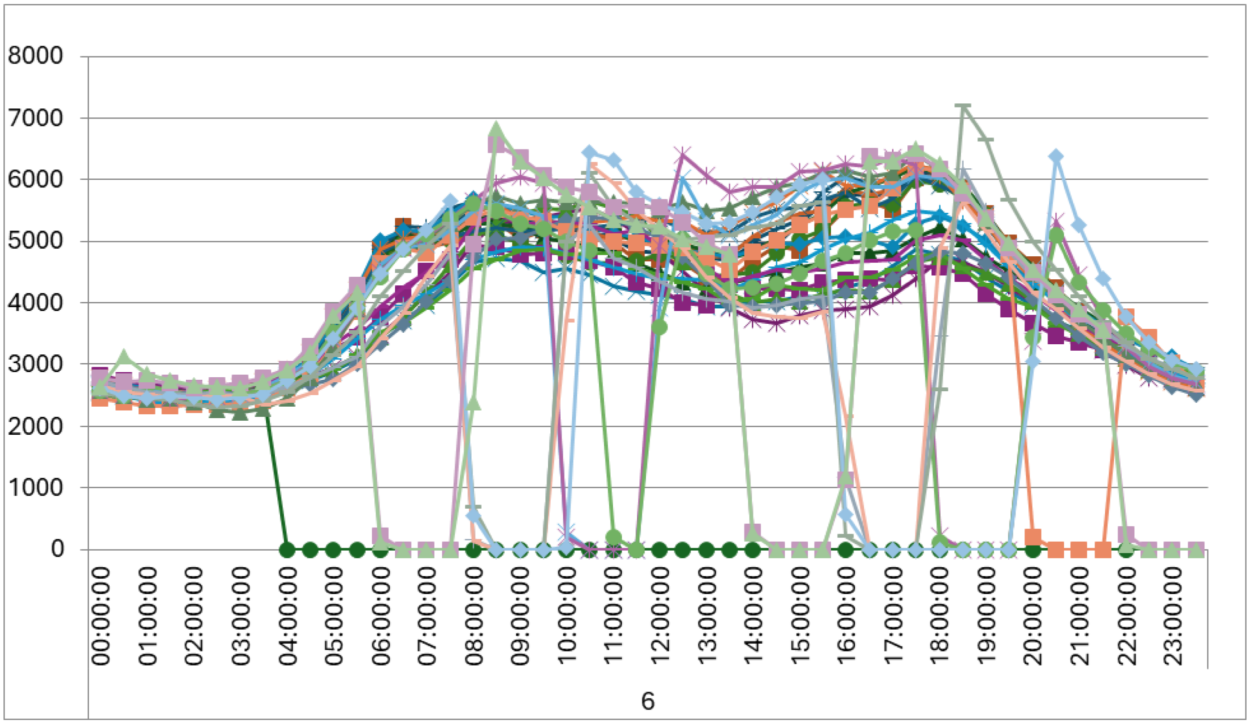


Figure 6.7: Impact of load shedding on network demand – winter month

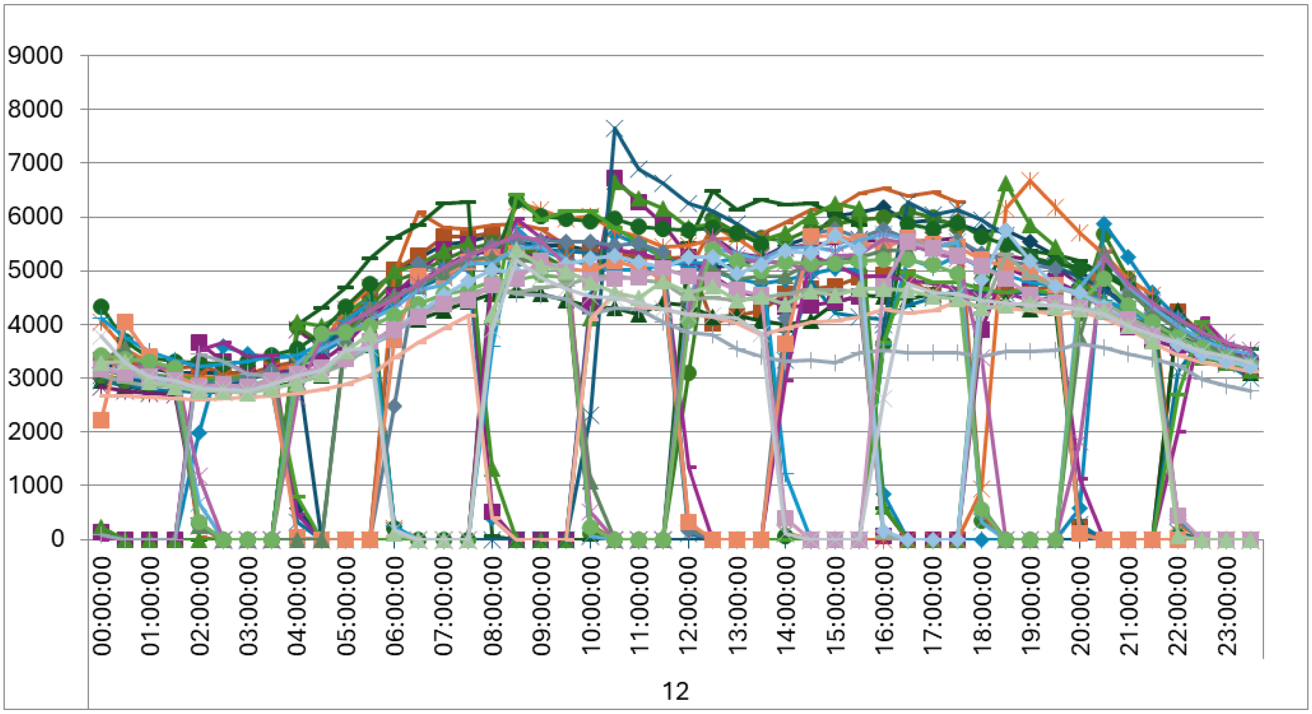


Figure 6.8: Impact of load shedding on network demand – summer month

In the graphs, the increase in demand varies from each month as the load shedding has different impacts and can be as much as +20% depending when the load restoration takes place.

With the impact of load shedding taking place from 2014, the actual demand recorded at the metering point can be trended and the graph below shows the monthly peak demand for a 20 year period.

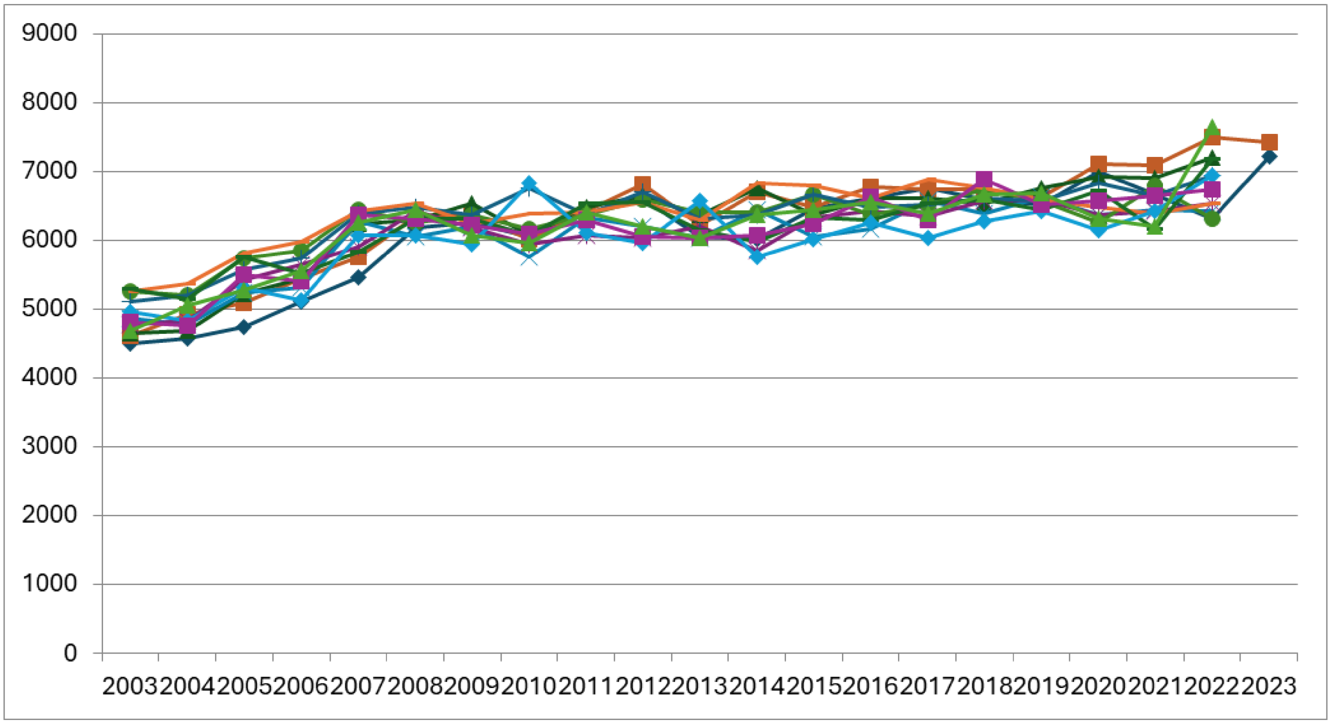


Figure 6.9: Historical monthly demand for the period 2003 to 2023

6.4.1.1 Findings on Maximum demand recorded

A. From the graph above it is clear the demand shows distinct time series:

a. Period 2003 to 2007: The demand grew by 19.8% (average of 5.0% per year);

b. Period 2008 to 2017: The demand grew by 5.6% (average of 0.6% per year);

c. Period 2018 to2023: The demand grew by 12.2% (average of 3.0% per year);

With this trend and taking into account the penetration of renewable energy in the supply area, and with this skewed growth in demand is expected to continue.

B. The period of low growth (2008 to 2017) is due to external macro-economic factors such as the international financial crisis and the domestic GDP that declined for the corresponding period.

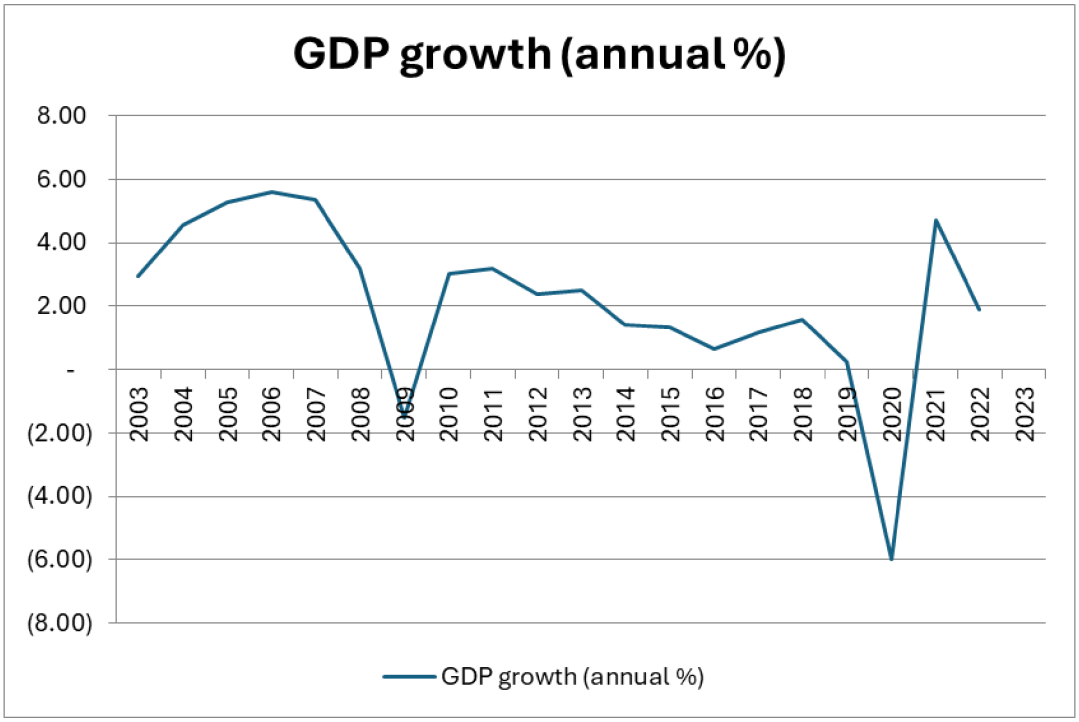
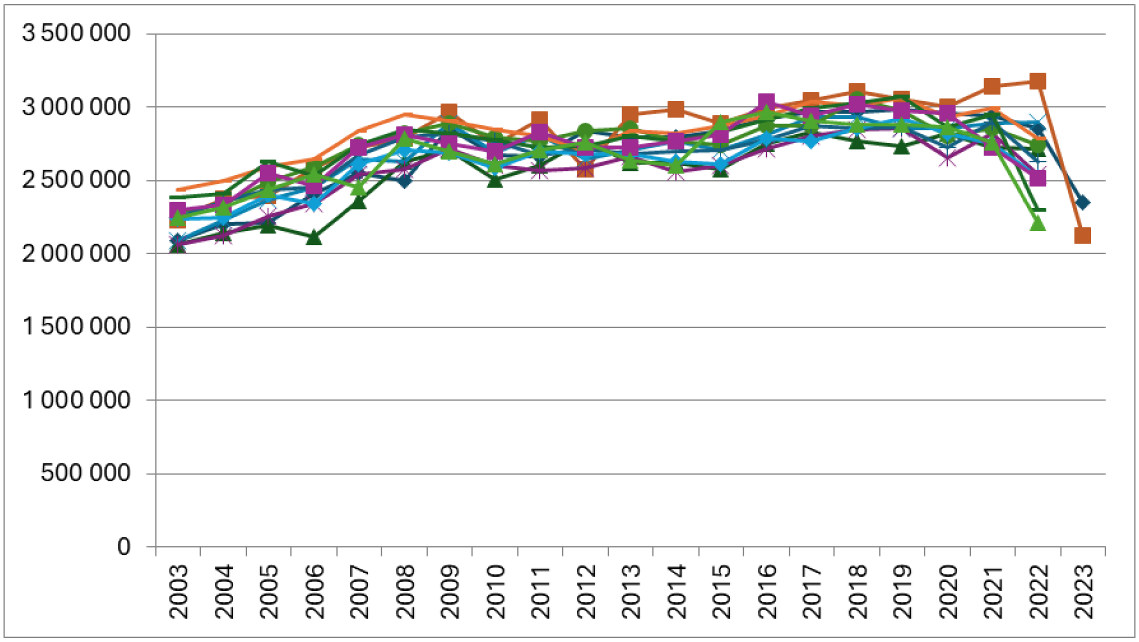


Figure 6.10: GDP growth for South Africa for the period 2003 to 2023

C. Since 2023, government has implemented incentive schemes for domestic solar and for commercial PV installation. The impact of this policy is that the trend in the demand is to accelerate until saturation levels has reached.

6.4.2 Energy consumption registered with Eskom

In the table below is the summary of the recorded energy consumption by the supply point for the period.



6.4.2.1 Findings on energy consumption

A. From the graph above it is clear that the energy consumption showed two distinct time series:

a. Period 2003 to 2018: In this period the energy consumption increased by 32.5% (average of 2.2% per year) or 8662 MWh for the 15 year period ;

b. Period 2018 to 2022: In this period the energy consumption declined by an average of 9.7% (average of 2.4% per year) or -3426 MWh for the 4 year period;

The factors that impacted the energy consumption were:

- Load shedding: In figure 6.5 above, the number of hours of load shedding the stage levels shall have a direct impact on the energy sold .

- Renewable energy installation: Since 2023, government has implemented incentive schemes for domestic solar and for commercial PV installation. The impact of this policy is that the negative trend in the energy consumption is to accelerate until saturation level has reached.

7. CURRENT NETWORK LOADING AND LOAD FORECASTING

This masterplan for the electrical distribution is being developed with no historical reference data and in this report, the current Eskom billing data will be used as a base load for the forecast that is developed. This forecast will also take into account historical load growth patterns and the regional demographic as reported on in the SDF of 2021.

The long term forecast was based on the information that was supplied by the Municipality and other growth factors and was directly used to simulate the growth on the MV and HV network.

7.1 Prince Albert 22 kV Point of Supply

The engineers have analysed the network based on the present system configuration and the analysis was done using the following data sets:

i. Using the current Maximum demand of each substation as provided by the Municipality (Eskom utility accounts) ;

ii. Details of the substations configuration and ;

iii. Network switching.

7.1.1 Load forecasting

This network is supplied by one metering point and is distributed with internal rings. In the information supplied

In the table below, the historical demand was forecasted using an annual growth of:

i.) Scenario 1: 1% (low growth);

ii.) Scenario 2: 2% (current network growth);

iii.) Scenario 3: 3% (high growth)

PRINCE ALBERT - MINFLEX 22kV	Notified MD		System Maximum demand forecasting		
	Existing NMD	New revised NMD	Low growth	Realistic Growth	High Growth
YEAR	KVA	KVA	KVA	KVA	KVA
2024	3 500	***3 500***	2 744	**2 744**	2 744
2025	3 500	***3 500***	2 771	**2 799**	2 826
2026	3 500	***3 500***	2 799	**2 855**	2 911
2027	3 500	***3 500***	2 827	**2 912**	2 999
2028	3 500	***3 500***	2 856	**2 970**	3 089
2029	3 500	***3 500***	2 884	**3 030**	3 181
2030	3 500	***3 500***	2 913	**3 090**	3 277
2031	3 500	***3 500***	2 942	**3 152**	3 375
2032	3 500	***3 600***	2 972	**3 215**	3 476
2033	3 500	***3 700***	3 002	**3 280**	3 581
2034	3 500	***3 700***	3 032	**3 345**	3 688
2035	3 500	***3 800***	3 062	**3 412**	3 799
Increase of loading after 10 years NMD		**300**	**318**	**668**	**1 055**

Table 7.1: Prince Albert 22 kV point of supply medium term load growth

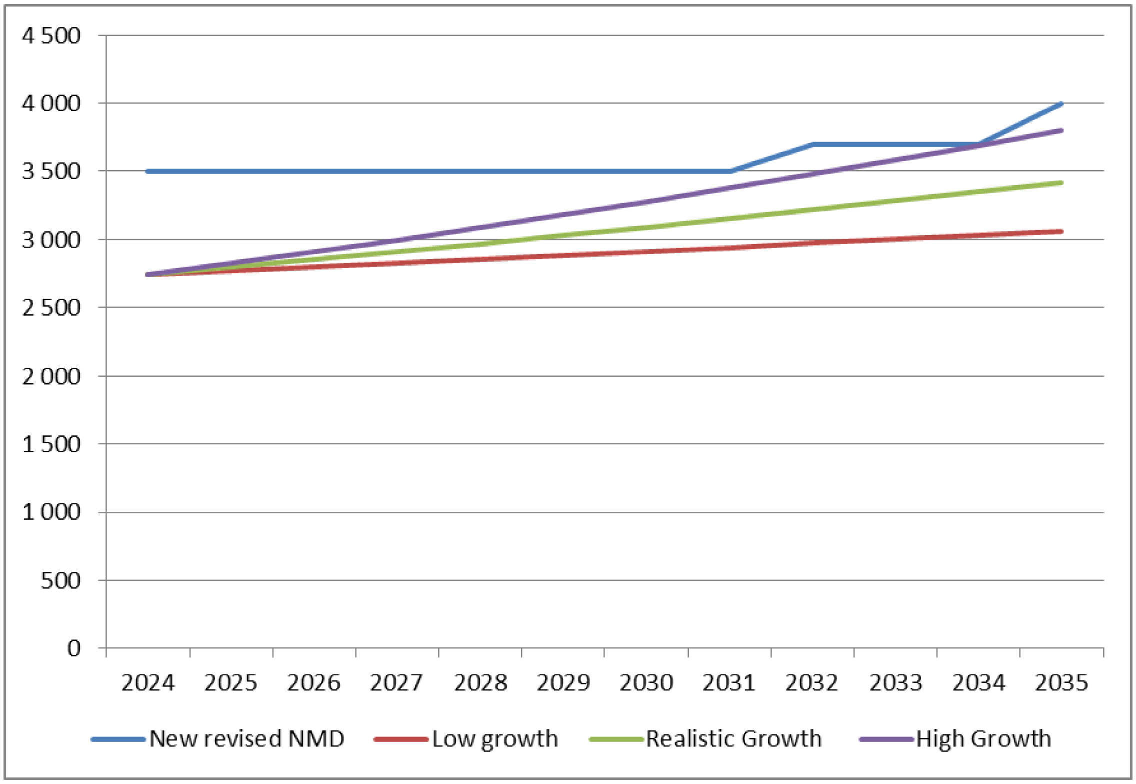


Figure 7.1: Prince Albert 22 kV point of supply: Various medium term load growth scenario's

7.1.2 Load forecasting with additional housing projects

In line with the SDF, the table below illustrate the impact of housing on the electrical demand inclusive of a typical growth of 1% per annum in the same period.

PRINCE ALBERT - MINFLEX 22kV	Notified MD		System Maximum demand forecasting		
	Existing NMD	New revised NMD	Low growth	Low cost housing	ADMD (Summated load)
YEAR	KVA	KVA	KVA	KVA	KVA
2024	3 500	***3 500***	**2 744**		2 744
2025	3 500	***3 500***	**2 771**		2 771
2026	3 500	***3 500***	**2 799**	109	2 865
2027	3 500	***3 500***	**2 827**	218	2 958
2028	3 500	***3 500***	**2 856**	328	3 052
2029	3 500	***3 500***	**2 884**	437	3 146
2030	3 500	***3 600***	**2 913**	546	3 241
2031	3 500	***3 700***	**2 942**	655	3 335
2032	3 500	***3 800***	**2 972**	764	3 430
2033	3 500	***3 900***	**3 002**	874	3 526
2034	3 500	***4 000***	**3 032**	983	3 621
2035	3 500	***4 100***	**3 062**	1 092	3 717
Increase of loading after 10 years NMD		**600**	**318**		**973**

Table 7.2: Prince Albert 22 kV point of supply with provision for low cost housing

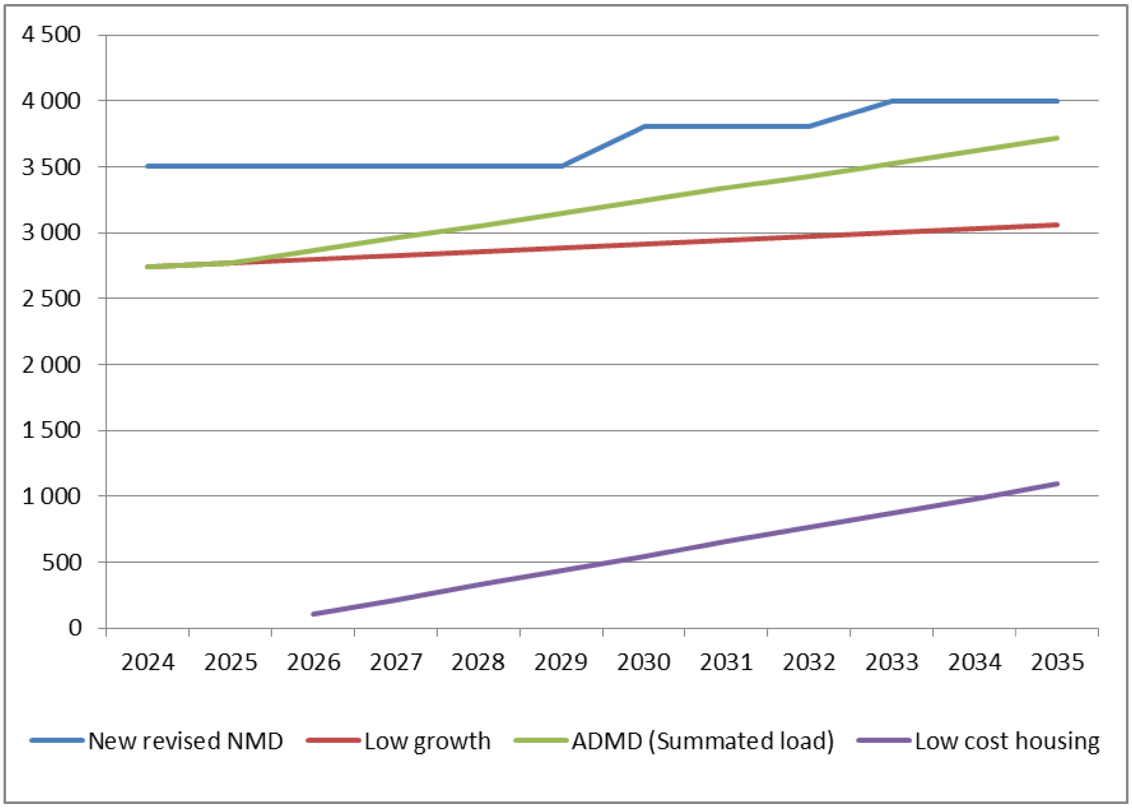


Figure 7.2: Prince Albert 22 kV point of supply: Various medium term load growth scenario's

7.1.3 Conclusions of the load forecasting

The following conclusions can be made:

i. Notified demand

a. In table 7.1, with normal load growth, the current demand at the metering point shall increase in the medium term by at least 0.7 MVA to 3.4 MVA

b. With normal load growth, the current notified demand at the metering point which is 3.5 MVA need to be increase to ≈ 4.0 MVA.

c. In table 7.2, with low load growth and with new consumer loads, the current notified demand at the metering point need to be increase to ≈ 4.0 MVA.

7.1.4 Fault levels calculated for the distribution network

The fault levels were computed for the network of Prince Albert and are based on the following information supplied by Eskom:

Station Name	Bus Name	Unom Unom [kV]	3-Phase I [kA]	3-Phase Angle [deg]	1-Phase I [kA]	1-Phase Angle [deg]	Phase-Phase I [kA]	Phase-Phase Angle [deg]	Positive Seq R [pu]	Positive Seq X [pu]	Zero Seq R0 [pu]	Zero Seq X0 [pu]	Ratio X0/X1 [-]	Ratio R0/X0 [-]	Ratio R0/X1 [-]
	PointTerm1198	22,0	0,7	-63,6	0,3	-74,9	0,7	-154,3	1,5425	3,3129	3,1341	18,1733	5,486	0,172	0,946

Table 7.3: Eskom fault levels supplied for the POS

With the above information, it was possible to determine the fault levels at key nodes and at the furthest MV nodes of the grid.

Component	Isc 3P (A)mps	Isc SLG (A)mps
MS DEURDRIF	636	286
MUNIC MAIN SUB	699	302
PMT KRONKEL WEG ONDER	653	289
PMT RIOOL WERKE	641	286
PMT TFR3	658	290
T-OFF KAREE PMT	680	297
TX MUNISIPALE POMPE	453	236
TX2 WATERKOP	598	277

Table 7.4: Network fault levels.

8. NETWORK REINFORCEMENT AND TECHNICAL EVALUATION

In order for the Municipality to operate safely with normal and abnormal conditions, recommendations for network reinforcements are made. These recommendations are crucial for network stability and reliable network operation.

The network analysis comprised of the following technical criteria’s

- Present thermal loading of all MV equipment;
- Voltage standards;
- And contingency planning for the network;
- Energy management of the electrical through load shedding and power factor correction.

8.1 Prince Albert Point of supply

The details of the Main substation have the following capabilities.

i. The substation is supplied with one 22kV feeder system, via a Farmers supply

ii. The source is at Leeu Gamka traction station with two 132/11 kV supply transformers;

iii. The firm capacity : It is a non-firm supply

   a. At the T-off to Prince Albert, Eskom has the ability to interconnect the Farmers 2 and Farmers 3 system. Details of the interconnection and any restrictions were not made available at the time of the report.

8.1.1 <u>Main substation</u>

The load forecast for the point of supply is an increase from 2.74 MVA to 3.7 MVA in the medium term. The load growth is expected in the subdivisions of properties and developments

- **For the medium term, it is envisaged that the notified demand must be increased to 4 MVA to cater for the additional loading.**

8.2 MV network (2024 loading)

The following are the feeders fed from the Main substations with their capacities (refer to drawing 24.648 e01, sheet 1 and the loadflow report in Annexure A):

i. Eskom Incomer (Mink overhead line, 260A rated): current loading 2.77 MVA

ii. Feeder 1 (Ferret overhead line, 190A rated): current loading 0.82 MVA

iii. Feeder 2 (Ferret overhead line, 190A rated): current loading 1.39 MVA

iv. Feeder 3 (Squirrel overhead line, 200A rated): current loading 0.65 MVA

v. Feeder 4: power factor correction (nominal rating of 600kVAr)

8.3 MV network (2034 loading)

The following are the feeders fed from the Main substations with their capacities (refer to drawing 24.648 e02, sheet 1 and the loadflow report in Annexure A):

i. Eskom Incomer (Mink overhead line, 260A rated): current loading 3.48 MVA

ii. Feeder 1 (Ferret overhead line, 190A rated): current loading 1.0 MVA

iii. Feeder 2 (Ferret overhead line, 190A rated): current loading 1.69 MVA

iv. Feeder 3 (Squirrel overhead line, 200A rated): current loading 0.79 MVA

v. Feeder 4: power factor correction (nominal rating of 600kVAr)

8.3.1 <u>Conclusions MV network analysis:</u>

The following conclusions are made based on the network analysis:

i. The feeders are within the thermal capacity of the feeders for the base case and the medium term load growth;

ii. The voltage at the source and at the furthest point on the feeders are within the required voltage limits of NRS 048;

iii. Network security: It is recommended that the network is upgraded to include a MV link between MS Meiring and PMT Hope. With this upgrade, it will be possible to ensure a firm supply to the section of the network.

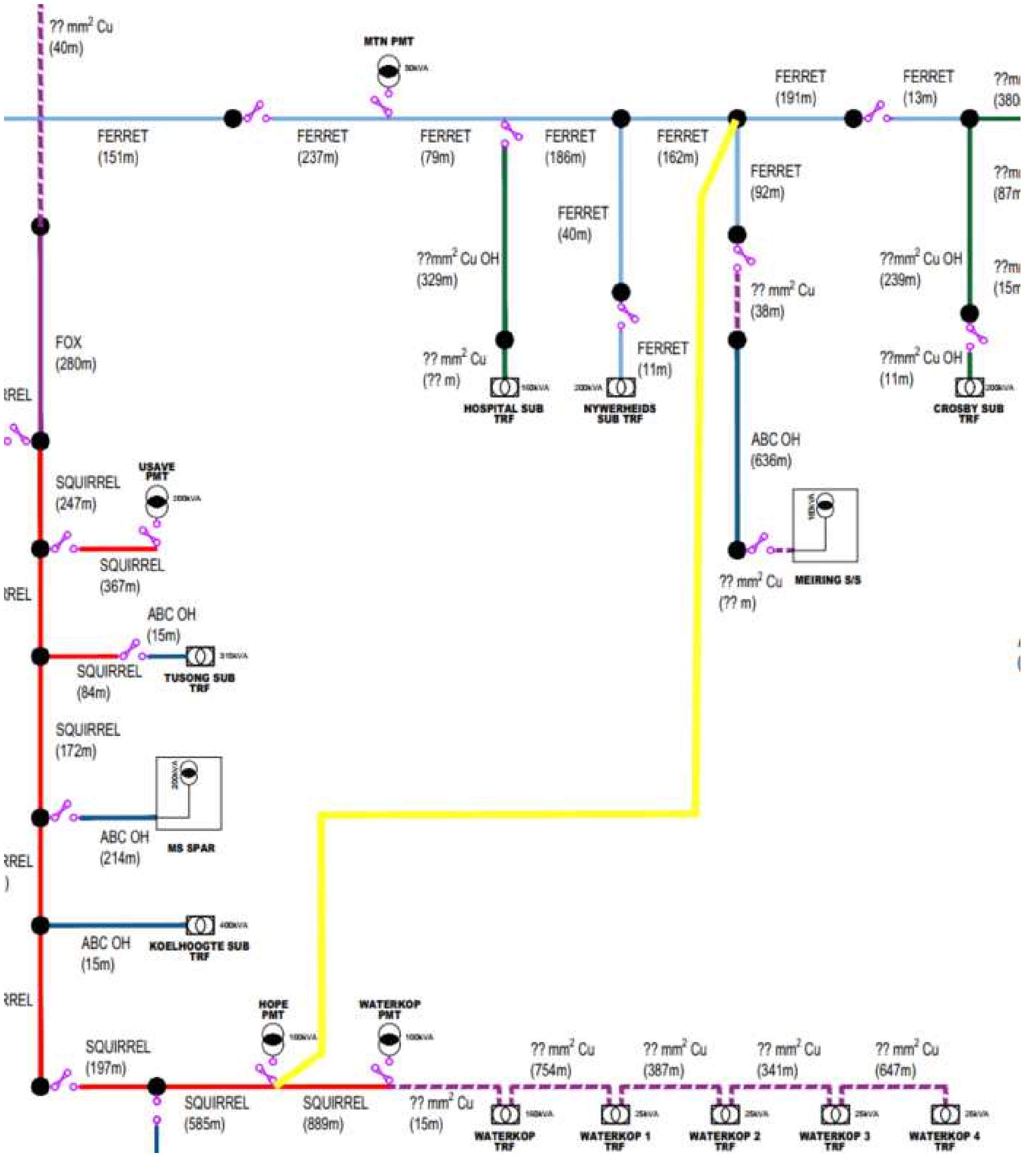


Figure 8.1: 22 kV network upgrading: Proposed MV link for increased network security.

9. ENERGY LOSSES

9.1 Background Objective Methodology

The transfer of electricity from generation to the end-users involves losses in energy volumes (electrical or technical losses) that reduce the amount of electricity volumes available for sale to end-customers.

In addition, other energy losses may also occur due to non-metered usage related to electricity theft (non-technical).

Energy loss is an intrinsic risk in the electricity business and utilities globally have the challenge to address this issue.

Technical losses in a distribution system include:

i. MV feeders: resistive losses of the primary feeders,

ii. Distribution transformer losses (resistive losses in windings and the core losses),

iii. LV Feeders: resistive losses in the secondary network, resistive losses in service cables and losses in and due to kWh meter accuracy.

Losses are inherent to the distribution of electricity and cannot be eliminated.

The calculation of technical losses can be done using various approaches with different degrees of accuracy. Technical losses in distribution systems are directly related to consumers' load curves, which vary due to seasonality and / or changes in load over the year. For the management of technical losses a balance between absolute calculation accuracy and the effort must prevail. Acceptable approaches to calculate technical losses of an electricity distribution network can be divided into two groups. These are the full accuracy methods and methods of representative load profiles

9.2 LV Feeders Losses

In order to determine the losses on the LV distribution system, it needs to be evaluated in detail with network statistics which is representative of the load profiles as the sum of all load and no load losses. At the time of this report, no such research information was made available for inclusion in the report.

For this masterplan, the investigation was done modelling the MV network up to the LV terminals distribution transformers using the SKM PowerTools software suit. From the results it will be possible to determine the losses of the network excluding the LV feeder losses.

9.3 Prince Albert technical Losses

The MV and distribution transformer system losses are based on the masterplan studies which was done in consultation with the professional team and the client.

The table below summarises the contribution of each element in the network to the total technical loss:

PRINCE ALBERT - MINIFLEX 22kV	kW Loss	Estimated average kWh loss per month	% of Load flow kW
Transformer no load losses (iron losses)	23.2	16 960.4	0.84%
Transformer Load losses (copper losses)	33.1	12 525.6	1.19%
MV feeders - load losses	4.0	-	0.15%
LV feeders - load losses (not included in calculations)	-	-	-
Total losses (kW)	**60.3**	**29 486.0**	**2.18%**

Table 9.1: Technical losses calculated for the distribution network.

10. CAPITAL REQUIREMENTS AND FINANCIAL EVALUATION

10.1 Background

One of the main criteria evaluating system alternatives is the extent of capital outlay. Not only must the solutions to the network problems be technically viable, but they must also be financially sound. The capital and financial analysis conducted on the network aims to set up a Short and Long term capital program which offers the Municipality an acceptable return on investment. The following aspects apply:

In order to perform a financial analysis, a basic capital program is compiled containing capital requirements for each proposed project,

Financial analysis tests the viability of the capital expenditure in terms of:

i. The impact on future cash flows,

ii. Net present worth of the investments, and

iii. The Internal Rate of Return (IRR).

The financial analysis should ensure that the envisaged capital expenditure program is affordable to Prince Albert Municipality.

10.2 Costing of Capital Projects

Capital projects were identified through analysis and assessment of the following aspects:

i. Expansion requirements, and

ii. Refurbishment requirements.

The capital program was developed by using standard equipment cost, contained in an equipment library. The capital program should allow for:

i. Distribution network Development and optimization

ii. Refurbishment requirements

The following is the basic layout out the substations that was used in the preparation of the budget for the Masterplan.

10.2.1 Main substation

This configuration is based on the principle that the substation is upgraded with an additional feeder that can be used to interconnect a utility scale embedded generator.

10.2.1.1 22kV section:

i. One feeder bay with the required automation and protection for the grid code requirement of a grid connected embedded generator.

10.2.2 MV network:

i. Upgrade the MV network between MS Meiring and PMT Hope for network security.

    a. Switching equipment that is associated with the upgrade can be a ring main unit or pole mounted gang operated links.

ii. Replacement / Refurbishment of MV network assets

    a. During the site verification, it was established that some of the assets are damaged or past their lifespan and will have to be refurbished or replaced.

11. GENERAL

This report is intended for the interpretation of the electrical installation and with the following proviso's:

i. All information presented in this report is for review, approval, interpretation and application by a registered engineer only. Neil Lyners and Associates (Pty) Ltd disclaims any responsibility and liability resulting of the use and the interpretation of the information.

ii. The reader of this report is also familiar with the case file.

iii. It has been assumed that the reader of this report is familiar with the concepts of electrical loading, wiring of premises, electrical testing and the terminology of V, A, Ohm, kW, kVAr, kVA and the principles of polyphase metering.

iv. The reader of this report is also fully conversant with the requirements of SANS 10142-1; -2 and NRS048-2 (Quality of Supply).

12. RECOMMENDATIONS

By taking all the recommendations for system betterment into account, a table of these recommendations and associated estimated cost is shown in the table below.

Component	Size (kVA)	Manufacture Date	Condition	Comments	Current Estimated Cost (Excl VAT)
Ground Standing Transformers					
Depressie Hoogte Sub TRF	200	1999	Replace / Refurbish	Past the 25 year life span	R300 000
Klip Sub TRF	400	1980	Replace / Refurbish	Past the 25 year life span	R500 000
Crosby Sub TRF	200	1984	Replace / Refurbish	Past the 25 year life span	R300 000
Hospital TRF	160	1976	Replace / Refurbish	Past the 25 year life span	R300 000
Bo Dorp Sub TRF	100	1964	Replace / Refurbish	Past the 25 year life span; Leaks oil	R180 000
Andries Sub TRF	200	1976	Replace / Refurbish	Past the 25 year life span	R300 000
Koelhoogte Sub TFR	400	1985	Replace / Refurbish	Past the 25 year life span	R500 000
Depressie Hoogte Sub TRF	200	1999	Replace / Refurbish	Past the 25 year life span	R300 000
Klip Sub TRF	400	1980	Replace / Refurbish	Past the 25 year life span	R500 000
Crosby Sub TRF	200	1984	Replace / Refurbish	Past the 25 year life span	R300 000
Hospital TRF	160	1976	Replace / Refurbish	Past the 25 year life span	R300 000
Pole Mounted Transformers					
Bushman Valley PMT	100	1999	Replace / Refurbish	Past the 25 year life span	R150 000
Botterblom Street 2 PMT	200	1996	Replace / Refurbish	Past the 25 year life span; Leaks oil	R280 000
Botterblom Street 1 PMT	25	1997	Replace / Refurbish	Past the 25 year life span	R70 000
Doringboom Sub PMT - Kronkel Weg Onder PMT	100	1981	Replace / Refurbish	Past the 25 year life span; Leaks oil	R150 000

Kronkel Weg Bo PMT	200	1983	Replace / Refurbish	Past the 25 year life span; Leaks oil	R280 000
Karee PMT	200	1993	Replace / Refurbish	Past the 25 year life span; Leaks oil	R280 000
Sewer Works 1 PMT	25	1997	Replace / Refurbish	Past the 25 year life span	R70 000
Water Treatment PMT	50	1991	Replace / Refurbish	Past the 25 year life span	R100 000
Pomp 6 PMT	25	1998	Replace / Refurbish	Past the 25 year life span	R70 000
Pomp 5 PMT	25	1998	Replace / Refurbish	Past the 25 year life span; Leaks oil	R70 000
Miniature Substations (Without RMU)					
Jan Louw MS	315	1999	Replace / Refurbish	Past the 25 year life span	R960 000
De Beer SS	315	1986	Replace / Refurbish	Past the 25 year life span	R960 000
Nieuwe MS	400	1982	Replace / Refurbish	Past the 25 year life span	R1 100 000
Deurdrif SS	160	1986	Replace / Refurbish	Past the 25 year life span	R800 000
Meiring SS	160	1986	Replace / Refurbish	Past the 25 year life span	R800 000
MS Spar - O.K. MS	200	1996	Replace / Refurbish	Past the 25 year life span	R880 000
MS Loopstraat	315	1980	Replace / Refurbish	Past the 25 year life span	R960 000
Upgrade the MV network between MS Meiring and PMT Hope					R300 000
Additional Feeder Bay inside 22kV Main Substation for addition of PV Plant				Install as part of PV Plant	R700 000

Table 12.1: Recommended system betterments.

The priorities of the individual recommendations might change from time to time, some of which might move out or even fall away in totality based on new circumstances and must therefore closely be monitored and recommendations amended as necessary.

It is important to take note that although these costs for system upgrading might be high, the works will eventually have to be executed in order to ensure safe and reliable networks in the Prince Albert Municipal area. It is recommended that when large upgrading projects be scheduled for which funding might be outside the normal budgeting capacity, loans for such work be taken up from the DBSA or similar institutions to finance this expenditure.

The following general recommendations are made :

- The Bulk Infrastructure Contributions Policy be revised.
- It is recommended that the Master Plan reports for the Prince Albert Municipal area and associated recommendations be updated and amended preferably every two to three years, and be re-done every five (5) years during which the ten (10) year window can also be adjusted. All recommendations made are based on current available information which might change in future and which therefore must be verified each time that this report is re-done.
- It is recommended that the LV Network also be included in the Master Plan
- It is recommended that a GIS platform be developed for 22kV and LV Networks, including updating of it at least once a year, or each time that a significant change is made in the networks.

13. CONCLUSION

The main focus of this project was the updating of the masterplans for the 22kV infrastructure in Prince Albert, based on verified and accurate as-built information, complete with discussions on the existing networks and recommendations for system upgrading and betterment as necessary.

The short, medium and long term impact of load growth on these networks were determined and recommendations were made for system betterment and to make sure that the integrity and the reliability of the electrical network in the future remains steady and healthy.

THEO POTGIETER Pr Eng
Head of Department: Electrical
for LYNERS

ANNEXURE A : EXISTING SYSTEM DATA

A. Eskom billing data

PRINCE ALBERT - MINFLEX 22kV	Maximum Demand	Notified demand	Capacity utilisation	Load factor	Energy consumption	Reactive energy	Excess reactive energy
Month	kVA	kVA	%	%	kWh	kVArh	kVArh
Jun-2020	2222	3500	63%	50%	838 172	331 814.56	37 754.46
Jul-2020	2298	3500	66%	50%	866 912	-	33 822.00
Aug-2020	2445	3500	70%	51%	897 132	304 106.72	34 967.05
Sep-2020	2319	3500	66%	51%	878 822	311 549.84	12 043.53
Oct-2020	2021	3500	58%	58%	829 416	341 218.90	-
Nov-2020	2060	3500	59%	56%	866 950	52 417.56	-
Dec-2020	1874	3500	54%	62%	838 303	3 230.14	-
Jan-2021	2057	3500	59%	64%	990 130	15 672.20	-
Feb-2021	2055	3500	59%	60%	932 001	12 530.70	-
Mar-2021	2201	3500	63%	54%	799 356	5 052.62	-
Apr-2021	1922	3500	55%	61%	885 928	4 255.80	-
May-2021	1876	3500	54%	62%	841 624	2 002.52	-
Jun-2021	2073	3500	59%	56%	864 982	90 260.15	-
Jul-2021	2270	3501	65%	54%	888 340	178 517.77	-
12 month average	**2445**	**3500**	**70%**	**57%**	**874 296**	**95 191**	**6 736**

Table A1: 22 kV POS : Historical billing data (2020/ 2021)

PRINCE ALBERT - MINFLEX 22kV	Maximum Demand	Notified demand	Capacity utilisation	Load factor	Energy consumption	Reactive energy	Excess reactive energy
Month	kVA	kVA	%	%	kWh	kVArh	kVArh
Jun-2023	2647	3500	76%	39%	784 191	132 351.25	-
Jul-2023	2744	3500	78%	41%	823 935	195 121.50	-
Aug-2023	2474	3500	71%	43%	793 735	163 776.45	-
Sep-2023	2273	3500	65%	43%	726 887	110 865.40	-
Oct-2023	2218	3500	63%	46%	738 947	101 822.35	-
Nov-2023	2076	3500	59%	49%	762 628	30 118.10	-
Dec-2023	2113	3500	60%	47%	720 286	3 686.40	-
Jan-2024	2035	3500	58%	57%	867 002	3 044.55	-
Feb-2024	2008	3500	57%	36%	542 768	10 160.55	-
Mar-2024	1981	3500	57%	57%	753 452	344 964.20	-
Apr-2024	1996	3500	57%	53%	783 161	310 252.05	-
May-2024	1742	3500	50%	59%	748 842	122 025.05	-
12 month average	**2744**	**3500**	**78%**	**48%**	**753 819.63**	**127 348.99**	

Table A2: 22 kV POS : Historical billing data (2023/ 2024)

ANNEXURE B : TECHNICAL LOSS CALCULATION SHEET

ANNEXURE B1: DISTRIBUTION NETWORK SUMMARY AND BREAKDOWN

A. Summary of distribution transformers and large power users

		PER TFR GROUP				SUMMATED LOSSES	
Tfr sizes	Number of Tfr	Installed capacity	Load Flow	No load losses	Full load losses	No load losses	Full load losses
25	5	125	56.00	0.18	1.00	0.90	0.89
50	3	150	68.00	0.30	1.70	0.90	0.99
100	3	300	138.00	0.41	2.20	1.23	-
160	4	640	297.60	0.62	3.25	2.48	3.66
200	13	2 600	1 122.00	0.72	3.80	9.36	11.29
315	4	1 260	557.55	1.10	5.40	4.40	6.40
400	3	1 200	540.00	1.30	6.40	3.90	9.08
	35	**6275.00**	**2 779.15**	**Summated losses**		**23.17**	**32.31**

Table B1: Loading of distribution transformers and associated losses

B. Summary of load categories and load flow

Load category group	Qty of Nodes in load category	Load Flow kW
DOMESTIC <1.5KVA	9	804.3
DOMESTIC <4KVA	15	1 649.3
DOMESTIC <1.5KVA RU	1	10.0
DOMESTIC <4KVA RUR	2	30.0
COMMERCIAL <100KVA	2	124.8
INDUSTRIAL SMALL	6	160.8
Summated loads per load category	**35**	**2 779.2**

Table B2: Distribution loading categories and load flow

C. Summary of system maximum demand, load flow and technical losses

a. Calculated load flow at Maximum demand

PRINCE ALBERT - MINIFLEX 22kV	Load Flow kVA	Load Flow kW	Peak Eskom MD (kVA)	Average annual load factor
Eskom Incomer	2 769.2	2 767.3	2 744.0	47.5%
	2 769.2	**2 767.3**	**2 744.0**	**47.5%**

Number of Distribution transformers	**35.0**	
Capacity of transformers installed	**6 275.0**	kVA
Maximum demand as % of installed kVA	**44.1%**	
Average peak demand recorded at POM	**2 744.0**	kVA
Average energy used recorded at POM	**753 819.6**	kWh

Table B3: Network summary of energy flow

ANNEXURE B2: DISTRIBUTION NETWORK: TECHNICAL LOSS CALCULATIONS

PRINCE ALBERT - MINIFLEX 22kV	kW Loss	Estimated average kWh loss	% of Load flow kW
Transformer no load losses (iron losses)	23.2	16 960.4	0.84%
Transformer Load losses (copper losses)	33.1	12 525.6	1.19%
MV feeders - load losses	4.0	-	0.15%
LV feeders - load losses (not included in calculations)	-	-	-
Total losses (kW)	**60.3**	**29 486.0**	**2.18%**

Table B4: Summary of network losses (2024 loading)

ANNEXURE C : LOAD FLOW REPORTS AND NETWORK DRAWINGS

SUMMARY OF INVESTIGATION REPORTS

Prince Albert 2024 MP Y0 - current load flow
Prince Albert 2024 MP Y10 - future load flow
Prince Albert 2024 MP Y0 – Fault levels

SUMMARY OF DRAWINGS

24062EG-01	MV distribution with network layout shown
24062EG-03	Single line diagram of MV distribution
24.648 e01 r0	Prince Albert 2024 MP Y0 - current load flow
24.648 e02 r0	Prince Albert 2024 MP Y10 - future load flow

THREE PHASE AND SINGLE LINE TO GROUND FAULT LEVELS

Source impedance and basic information

22kV Fault Level at Point of Supply, Prince Albert

Three phase fault level: ±700A, X/R ratio ≈2.15 [*1]

Single line to ground fault level: ±300A, X/R ratio ≈ 5.8 [*2]

NOTES ON ESKOM FAULT LEVELS

1. *The data is based on values supplied by Eskom for the POS.*

Component	Isc 3P (A)mps	Isc SLG (A)mps
MS DEURDRIF	636	286
MUNIC MAIN SUB	699	302
PMT KRONKEL WEG ONDER	653	289
PMT RIOOL WERKE	641	286
PMT TFR3	658	290
T-OFF KAREE PMT	680	297
TX MUNISIPALE POMPE	453	236
TX2 WATERKOP	598	277

Project: Prince Albert 2024 MP Y0 1.02pu

Load Flow Summary Report

Load Flow Study Settings

Include Source Impedance	Yes	**Load Acceleration Factor**	1.00
Solution Method	Exact (Iterative)	**Bus Voltage Drop %**	5.00
Load Specification	Demand Load	**Branch Voltage Drop %**	3.00
Generation Acceleration Factor	1.00		

Swing Generators

Source	In/Out Service	Vpu	Angle	kW	kvar	VD%	Utility Impedance
GRID-0003	In	1.08	0.00	2,755.4	73.1	-1.53	2.19 +j 3.04

PQ Generators

Participation PQ Source	In/Out Service	VD %	Vp.u.	KW	KVAR
PGEN-0001	Out	100.00	0.000	0.0	0.0

Buses

Bus Name	In/Out Service	Design Volts	LF Volts	Angle Degree	PU Volts	%VD
BUS-0021	In	22,000	22,303	-4.34	1.01	-1.38
MS DEURDRIF	In	22,000	22,251	-4.35	1.01	-1.14
MUNIC MAIN SUB	In	22,000	22,333	-4.31	1.02	-1.51
PMT KRONKEL WEG (	In	22,000	22,300	-4.34	1.01	-1.36
PMT RIOOL WERKE	In	22,000	22,303	-4.34	1.01	-1.38
PMT TFR3	In	22,000	22,301	-4.34	1.01	-1.37
T-OFF KAREE PMT	In	22,000	22,313	-4.33	1.01	-1.42
TX MUNISIPALE POM	In	22,000	22,215	-4.36	1.01	-0.98
TX2 WATERKOP	In	22,000	22,294	-4.32	1.01	-1.34

Cables

From Bus To Bus	Component Name	In/Out Service	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0015 MUNIC MAIN S	CBL-MUNIC MAI	In	0.00	2,755.0 0.1	72.9 0.0	2,755.9 0.1	71.2 36.5	1.00
BUS-0051 BUS-0121	CBL-MS MEIRIN	In	0.01	71.1 0.0	18.8 0.0	73.6 0.0	1.9 1.3	0.97
BUS-0073 MUNIC MAIN S	CBL-MUNIC MAI	Out	0.00	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.00
MUNIC MAIN S BUS-0017	CBL-MUNIC MAI	In	0.00	817.8 0.0	173.4 0.0	836.0 0.0	21.6 11.1	0.98
MUNIC MAIN S BUS-0026	CBL-MUNIC MAI	In	0.00	617.7 0.0	165.0 0.0	639.3 0.0	16.5 8.5	0.97

From Bus To Bus	Component Name	In/Out Service	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
MUNIC MAIN S BUS-0046	CBL-MUNIC MAI	In	0.00	1,319.4 0.0	352.8 0.0	1,365.7 0.0	35.3 18.1	0.97
MUNIC MAIN S BUS-0095	CBL-MUNIC MAI	In	0.00	0.0 0.0	-618.3 0.0	618.3 0.0	16.0 10.0	0.00

2-Winding Transformers

From Bus To Bus	Component Name	In/Out Service	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0019 BUS-0144	TX1 BOTTERBLOM	In	0.93	83.6 1.0	18.2 1.3	85.6 1.7	2.0 42.2	0.98
BUS-0024 BUS-0104	TX1 KRONKEL WE	In	0.93	83.6 1.0	18.2 1.3	85.5 1.7	2.0 42.2	0.98
BUS-0027 BUS-0103	TX1 TFR2	In	0.93	83.6 1.0	18.2 1.3	85.5 1.7	2.0 42.2	0.98
BUS-0037 BUS-0105	TX1 KRONKEL WE	In	0.93	83.6 1.0	18.2 1.3	85.5 1.7	2.0 42.2	0.98
BUS-0037 BUS-0107	TX2 LOOPSTRAAT M	In	0.84	131.7 1.5	28.7 2.1	134.8 2.6	3.0 42.2	0.98
BUS-0039 BUS-0118	TX2 ANDRIES	In	1.06	88.6 1.1	23.6 1.5	91.7 1.9	2.0 45.2	0.97
BUS-0040 BUS-0110	TX1 TUSONG	In	0.97	139.5 1.6	37.2 2.4	144.4 2.9	4.0 45.2	0.97
BUS-0041 BUS-0111	TX2 L-MS O.K.	In	0.47	89.2 1.2	23.1 0.8	92.1 1.5	2.0 22.7	0.97

From Bus To Bus	Component Name	In/Out Service	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0042 BUS-0116	TX2 KOELHOOGTE	In	0.94	177.1 1.9	47.3 3.1	183.3 3.7	5.0 45.2	0.97
BUS-0043 BUS-0117	TX1 HOPE	In	0.53	44.5 0.7	11.5 0.4	46.0 0.8	1.0 22.7	0.97
BUS-0048 BUS-0119	TX2 HOSPITAL	In	1.24	73.7 0.9	25.4 1.4	78.0 1.7	2.0 48.1	0.95
BUS-0049 BUS-0123	TX2 NYWERHEIDS	In	1.46	46.0 0.7	15.7 0.8	48.6 1.1	1.0 47.5	0.95
BUS-0055 BUS-0120	TX2 CROSBY	In	1.06	88.3 1.1	23.5 1.5	91.4 1.9	2.0 45.1	0.97
BUS-0058 BUS-0124	TX2 NIEUWE	In	0.94	176.4 1.9	47.1 3.1	182.6 3.7	5.0 45.1	0.97
BUS-0059 BUS-0125	TX2 DEURDRIF	In	1.06	88.1 1.1	23.4 1.5	91.1 1.9	2.0 45.0	0.97
BUS-0060 BUS-0127	TX2 DE BEER	In	0.97	138.8 1.6	37.0 2.4	143.6 2.9	4.0 45.1	0.97
BUS-0060 BUS-0128	TX2 JAN LOUW	In	0.97	138.8 1.6	37.0 2.4	143.6 2.9	4.0 45.1	0.97
BUS-0062 BUS-0129	TX2 KLIP	In	0.93	176.3 1.9	47.1 3.1	182.5 3.7	5.0 45.1	0.97
BUS-0063 BUS-0130	TX2 DE PRESSIE HO	In	1.06	88.0 1.1	23.4 1.5	91.0 1.9	2.0 45.0	0.97
BUS-0064 BUS-0131	TX2 BO DORP	In	0.53	44.3 0.7	11.4 0.4	45.7 0.8	1.0 22.6	0.97
BUS-0065 BUS-0132	TX1 OOM SAS	In	1.15	9.8 0.2	2.5 0.1	10.1 0.2	0.0 40.0	0.97

From Bus To Bus	Component Name	In/Out Service	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0066 BUS-0133	TX1 WATERWERKE	In	1.35	23.0 0.4	7.8 0.3	24.3 0.5	1.0 48.2	0.95
BUS-0067 BUS-0134	TX1 POMP 6	In	1.45	11.5 0.2	3.9 0.2	12.2 0.2	0.0 48.2	0.95
BUS-0068 BUS-0135	TX1 POMP 5	In	1.45	11.5 0.2	3.9 0.2	12.2 0.2	0.0 48.2	0.95
BUS-0069 BUS-0136	TX1BUSHMAN VAL	In	1.09	19.3 0.3	5.8 0.2	20.2 0.4	1.0 40.0	0.96
BUS-0070 BUS-0137	TX1 SCHOLZKLOO	In	1.17	9.7 0.2	2.9 0.1	10.1 0.2	0.0 39.9	0.96
BUS-0121 BUS-0122	TX2 MEIRING	In	1.06	70.7 0.9	18.8 1.2	73.2 1.5	2.0 45.1	0.97
BUS-0139 BUS-0140	TX1 KAREE	In	0.93	83.6 1.0	18.2 1.3	85.6 1.7	2.0 42.2	0.98
BUS-0141 BUS-0142	TX1 3de LAAN	In	0.93	83.6 1.0	18.2 1.3	85.6 1.7	2.0 42.2	0.98
MS DEURDRI BUS-0126	TX2 DEURDRIF1	In	1.06	70.4 0.9	18.7 1.2	72.9 1.5	2.0 45.0	0.97
PMT RIOOL W BUS-0106	TX1 RIOOL WERKE	In	1.44	11.5 0.2	3.9 0.2	12.2 0.2	0.0 48.0	0.95
PMT TFR1 BUS-0102	TX1 TFR1	In	0.93	83.6 1.0	18.2 1.3	85.5 1.7	2.0 42.2	0.98
PMT TFR3 BUS-0101	TX1 TFR3	In	0.93	83.6 1.0	18.2 1.3	85.5 1.7	2.0 42.2	0.98
TX MUNISIPA BUS-0138	TX1 MUNISIPALE P	In	1.35	23.0 0.4	7.8 0.3	24.3 0.5	1.0 48.2	0.95

From Bus To Bus	Component Name	In/Out Service	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
TX2 WATERK(BUS-0072	TX2-WATERKOP	In	2.00	74.0 1.3	25.8 1.8	78.3 2.2	2.0 77.3	0.94

Transmission Lines

From Bus To Bus	Component Name	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0019 T-OFF KAREE P	XLN-0015	0.03	-648.7 0.2	-138.5 -0.3	663.3 0.3	17.2 8.2	0.98
BUS-0021 BUS-0019	XLN-0016	0.02	-564.5 0.1	-120.6 -0.2	577.2 0.2	14.9 7.1	0.98
T-OFF KAREE P BUS-0139	XLN-0017	0.01	168.3 0.0	35.8 -0.3	172.1 0.3	4.5 3.4	0.98
BUS-0021 BUS-0024	XLN-0018	0.01	300.7 0.0	64.3 -0.3	307.4 0.3	8.0 3.8	0.98
BUS-0022 BUS-0021	XLN-0019	0.00	-11.6 0.0	-3.6 -1.2	12.1 1.2	0.3 0.1	0.95
BUS-0022 PMT RIOOL WE	XLN-0020	0.00	11.6 0.0	3.6 -0.3	12.1 0.3	0.3 0.2	0.95
PMT TFR1 BUS-0021	XLN-0021	0.00	-252.2 0.0	-53.9 -0.1	257.9 0.1	6.7 3.2	0.98
BUS-0139 BUS-0141	XLN-0022	0.01	84.1 0.0	17.8 -0.4	86.0 0.4	2.2 1.7	0.98

From Bus To Bus	Component Name	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0024 BUS-0037	XLN-0032	 0.01	216.6 0.0	46.3 -0.3	221.5 0.3	5.7 2.7	0.98
BUS-0037 PMT KRONKEL	XLN-0033	 0.00	0.0 0.0	-0.3 -0.3	0.3 0.3	0.0 0.0	0.00
BUS-0039 BUS-0040	XLN-0034	 0.05	528.3 0.3	141.7 -0.4	547.0 0.5	14.1 10.9	0.97
BUS-0040 BUS-0041	XLN-0035	 0.02	387.7 0.1	104.9 -0.2	401.7 0.2	10.4 8.0	0.97
BUS-0041 BUS-0042	XLN-0036	 0.02	297.5 0.1	82.0 -0.3	308.6 0.3	8.0 6.1	0.96
BUS-0042 BUS-0043	XLN-0037	 0.03	119.3 0.0	35.0 -1.1	124.3 1.1	3.2 2.5	0.96
BUS-0043 TX2 WATERKO	XLN-0038	 0.02	74.2 0.0	24.6 -1.2	78.2 1.2	2.0 1.6	0.95
BUS-0047 BUS-0048	XLN-0040	 0.02	1,318.4 0.3	352.7 0.0	1,364.7 0.3	35.3 16.8	0.97
BUS-0048 BUS-0049	XLN-0041	 0.04	1,244.0 0.4	327.3 0.0	1,286.3 0.4	33.3 15.9	0.97
BUS-0049 BUS-0050	XLN-0042	 0.02	1,197.3 0.2	311.5 0.0	1,237.2 0.2	32.0 16.9	0.97
BUS-0050 BUS-0051	XLN-0043	 0.00	71.1 0.0	18.8 -0.1	73.6 0.1	1.9 1.0	0.97
BUS-0050 BUS-0055	XLN-0044	 0.05	1,126.0 0.5	292.8 -0.1	1,163.5 0.5	30.1 14.3	0.97
BUS-0055 BUS-0056	XLN-0045	 0.09	1,036.7 0.9	269.4 -0.1	1,071.2 0.9	27.7 13.2	0.97

From Bus To Bus	Component Name	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0027 PMT TFR1	XLN-0046	 0.00	-168.1 0.0	-36.0 -0.3	172.0 0.3	4.5 2.1	0.98
PMT TFR3 BUS-0027	XLN-0047	 0.00	-84.1 0.0	-18.2 -0.3	86.0 0.3	2.2 1.1	0.98
BUS-0056 BUS-0057	XLN-0048	 0.01	1,035.8 0.1	269.5 0.0	1,070.3 0.1	27.8 14.6	0.97
BUS-0057 BUS-0058	XLN-0049	 0.02	616.2 0.1	162.5 -0.1	637.3 0.1	16.5 8.7	0.97
BUS-0058 BUS-0059	XLN-0050	 0.03	438.7 0.1	115.5 -0.3	453.7 0.3	11.8 6.2	0.97
BUS-0059 BUS-0060	XLN-0051	 0.01	350.0 0.0	92.4 -0.2	362.0 0.2	9.4 4.9	0.97
BUS-0060 MS DEURDRIF	XLN-0052	 0.00	70.8 0.0	18.5 -0.2	73.2 0.2	1.9 1.0	0.97
BUS-0057 BUS-0062	XLN-0054	 0.05	419.5 0.2	107.0 -0.5	432.9 0.6	11.2 5.3	0.97
BUS-0062 BUS-0063	XLN-0055	 0.05	242.0 0.1	60.4 -1.0	249.4 1.0	6.5 3.1	0.97
BUS-0063 BUS-0064	XLN-0056	 0.05	153.4 0.1	38.1 -1.5	158.0 1.5	4.1 3.2	0.97
BUS-0064 BUS-0065	XLN-0057	 0.02	108.6 0.0	28.1 -0.9	112.1 0.9	2.9 2.2	0.97
BUS-0065 BUS-0066	XLN-0058	 0.00	98.7 0.0	26.5 -0.2	102.2 0.2	2.7 2.0	0.97
BUS-0066 BUS-0067	XLN-0059	 0.01	75.5 0.0	18.9 -0.7	77.9 0.7	2.0 1.6	0.97

From Bus To Bus	Component Name	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0067 BUS-0068	XLN-0060	 0.01	63.9 0.0	15.7 -0.4	65.8 0.4	1.7 1.3	0.97
BUS-0068 BUS-0069	XLN-0061	 0.01	52.3 0.0	12.1 -0.8	53.7 0.8	1.4 1.1	0.97
BUS-0069 BUS-0070	XLN-0062	 0.01	32.9 0.0	7.1 -1.8	33.6 1.8	0.9 0.7	0.98
BUS-0070 TX MUNISIPAL	XLN-0063	 0.01	23.2 0.0	6.0 -1.8	23.9 1.8	0.6 0.5	0.97
BUS-0014 BUS-0015	XLN-MUNIC	 0.02	2,755.4 0.4	73.1 0.3	2,756.4 0.5	71.2 27.4	1.00
T-OFF KAREE P BUS-0017	XLN-MUNIC	 0.09	-817.1 0.7	-174.0 -0.6	835.5 0.9	21.6 10.3	0.98
BUS-0046 BUS-0047	XLN-MUNIC	 0.08	1,319.4 1.0	352.8 0.0	1,365.7 1.0	35.3 16.8	0.97
BUS-0026 BUS-0039	XLN-MUNIC	 0.03	617.7 0.2	165.0 -0.3	639.3 0.4	16.5 8.7	0.97

Project: Prince Albert 2024 MP Y0 1.04pu

Load Flow Summary Report

Load Flow Study Settings

Include Source Impedance	Yes	**Load Acceleration Factor**	1.00
Solution Method	Exact (Iterative)	**Bus Voltage Drop %**	5.00
Load Specification	Demand Load	**Branch Voltage Drop %**	3.00
Generation Acceleration Factor	1.00		

Swing Generators

Source	In/Out Service	Vpu	Angle	kW	kvar	VD%	Utility Impedance
GRID-0003	In	1.10	0.00	3,559.3	303.0	-0.90	2.19 +*j* 3.04

PQ Generators

Participation PQ Source	In/Out Service	VD %	Vp.u.	KW	KVAR
PGEN-0001	Out	100.00	0.000	0.0	0.0

Buses

Bus Name	In/Out Service	Design Volts	LF Volts	Angle Degree	PU Volts	%VD
BUS-0021	In	22,000	22,151	-5.30	1.01	-0.69
MS DEURDRIF	In	22,000	22,087	-5.32	1.00	-0.40
MUNIC MAIN SUB	In	22,000	22,192	-5.26	1.01	-0.87
PMT KRONKEL WEG (	In	22,000	22,146	-5.31	1.01	-0.67
PMT RIOOL WERKE	In	22,000	22,151	-5.30	1.01	-0.68
PMT TFR3	In	22,000	22,149	-5.30	1.01	-0.68
T-OFF KAREE PMT	In	22,000	22,164	-5.29	1.01	-0.75
TX MUNISIPALE POM	In	22,000	22,046	-5.33	1.00	-0.21
TX2 WATERKOP	In	22,000	22,143	-5.27	1.01	-0.65

Cables

From Bus To Bus	Component Name	In/Out Service	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0015 MUNIC MAIN S	CBL-MUNIC MAI	In	0.00	3,558.6 0.2	302.4 0.1	3,571.4 0.2	92.9 47.6	1.00
BUS-0051 BUS-0121	CBL-MS MEIRIN	In	0.01	91.5 0.0	24.7 0.0	94.7 0.0	2.5 1.7	0.97
BUS-0073 MUNIC MAIN S	CBL-MUNIC MAI	Out	0.00	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.00
MUNIC MAIN S BUS-0017	CBL-MUNIC MAI	In	0.00	1,105.2 0.0	242.6 0.0	1,131.5 0.0	29.4 15.1	0.98
MUNIC MAIN S BUS-0026	CBL-MUNIC MAI	In	0.00	784.8 0.0	213.6 0.0	813.3 0.0	21.2 10.9	0.96

From Bus To Bus	Component Name	In/Out Service	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
MUNIC MAIN S BUS-0046	CBL-MUNIC MAI	In	0.00	1,668.4 0.0	456.7 0.0	1,729.8 0.0	45.0 23.1	0.96
MUNIC MAIN S BUS-0095	CBL-MUNIC MAI	In	0.00	0.0 0.0	-610.5 0.0	610.5 0.0	15.9 9.9	0.00

2-Winding Transformers

From Bus To Bus	Component Name	In/Out Service	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0019 BUS-0144	TX1 BOTTERBLOM	In	1.28	113.4 1.5	25.3 2.5	116.2 2.9	3.0 57.7	0.98
BUS-0024 BUS-0104	TX1 KRONKEL WE	In	1.28	113.3 1.5	25.3 2.5	116.1 2.9	3.0 57.7	0.98
BUS-0027 BUS-0103	TX1 TFR2	In	1.28	113.3 1.5	25.3 2.5	116.1 2.9	3.0 57.7	0.98
BUS-0037 BUS-0105	TX1 KRONKEL WE	In	1.28	113.3 1.5	25.3 2.5	116.1 2.9	3.0 57.6	0.98
BUS-0037 BUS-0107	TX2 LOOPSTRAAT M	In	1.16	178.6 2.1	40.0 4.0	183.0 4.5	5.0 57.7	0.98
BUS-0039 BUS-0118	TX2 ANDRIES	In	1.38	114.2 1.5	30.9 2.6	118.3 3.0	3.0 58.7	0.97
BUS-0040 BUS-0110	TX1 TUSONG	In	1.27	179.8 2.1	48.9 4.1	186.3 4.6	5.0 58.7	0.97
BUS-0041 BUS-0111	TX2 L-MS O.K.	In	0.61	115.1 1.4	30.1 1.3	119.0 1.9	3.0 29.5	0.97

From Bus To Bus	Component Name	In/Out Service	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0042 BUS-0116	TX2 KOELHOOGTE	In	1.22	228.2 2.6	62.1 5.3	236.5 5.9	6.0 58.7	0.96
BUS-0043 BUS-0117	TX1 HOPE	In	0.69	57.5 0.8	15.0 0.6	59.4 1.0	2.0 29.5	0.97
BUS-0048 BUS-0119	TX2 HOSPITAL	In	1.54	90.6 1.2	31.6 2.1	95.9 2.4	2.0 59.5	0.94
BUS-0049 BUS-0123	TX2 NYWERHEIDS	In	1.81	56.5 1.0	19.5 1.2	59.7 1.5	2.0 58.7	0.95
BUS-0055 BUS-0120	TX2 CROSBY	In	1.38	113.7 1.5	30.8 2.6	117.8 3.0	3.0 58.5	0.97
BUS-0058 BUS-0124	TX2 NIEUWE	In	1.22	227.0 2.6	61.8 5.3	235.3 5.9	6.0 58.5	0.96
BUS-0059 BUS-0125	TX2 DEURDRIF	In	1.38	113.3 1.5	30.7 2.5	117.4 3.0	3.0 58.4	0.97
BUS-0060 BUS-0127	TX2 DE BEER	In	1.26	178.5 2.1	48.5 4.1	185.0 4.6	5.0 58.5	0.97
BUS-0060 BUS-0128	TX2 JAN LOUW	In	1.26	178.5 2.1	48.5 4.1	185.0 4.6	5.0 58.5	0.97
BUS-0062 BUS-0129	TX2 KLIP	In	1.22	226.8 2.6	61.7 5.2	235.1 5.8	6.0 58.5	0.96
BUS-0063 BUS-0130	TX2 DE PRESSIE HO	In	1.38	113.1 1.5	30.6 2.5	117.2 2.9	3.0 58.4	0.97
BUS-0064 BUS-0131	TX2 BO DORP	In	0.69	57.0 0.8	14.9 0.6	58.9 1.0	2.0 29.4	0.97
BUS-0065 BUS-0132	TX1 OOM SAS	In	1.14	9.6 0.2	2.5 0.1	9.9 0.2	0.0 39.7	0.97

From Bus To Bus	Component Name	In/Out Service	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0066 BUS-0133	TX1 WATERWERKE	In	1.57	26.4 0.4	9.0 0.4	27.9 0.6	1.0 55.7	0.95
BUS-0067 BUS-0134	TX1 POMP 6	In	1.68	13.2 0.2	4.5 0.2	14.0 0.3	0.0 55.8	0.95
BUS-0068 BUS-0135	TX1 POMP 5	In	1.68	13.2 0.2	4.5 0.2	14.0 0.3	0.0 55.8	0.95
BUS-0069 BUS-0136	TX1BUSHMAN VAL	In	1.08	19.0 0.3	5.7 0.2	19.9 0.4	1.0 39.7	0.96
BUS-0070 BUS-0137	TX1 SCHOLZKLOO	In	1.17	9.5 0.2	2.9 0.1	9.9 0.2	0.0 39.6	0.96
BUS-0121 BUS-0122	TX2 MEIRING	In	1.38	91.0 1.2	24.7 2.0	94.3 2.4	2.0 58.6	0.97
BUS-0139 BUS-0140	TX1 KAREE	In	1.28	113.4 1.5	25.3 2.5	116.2 2.9	3.0 57.7	0.98
BUS-0141 BUS-0142	TX1 3de LAAN	In	1.28	113.4 1.5	25.3 2.5	116.2 2.9	3.0 57.7	0.98
MS DEURDRI BUS-0126	TX2 DEURDRIF1	In	1.38	90.6 1.2	24.5 2.0	93.8 2.4	2.0 58.4	0.97
PMT RIOOL W BUS-0106	TX1 RIOOL WERKE	In	1.67	13.2 0.2	4.5 0.2	14.0 0.3	0.0 55.5	0.95
PMT TFR1 BUS-0102	TX1 TFR1	In	1.28	113.3 1.5	25.3 2.5	116.1 2.9	3.0 57.7	0.98
PMT TFR3 BUS-0101	TX1 TFR3	In	1.28	113.3 1.5	25.3 2.5	116.1 2.9	3.0 57.7	0.98
TX MUNISIPA BUS-0138	TX1 MUNISIPALE P	In	1.57	26.4 0.4	9.0 0.4	27.9 0.6	1.0 55.8	0.95

From Bus To Bus	Component Name	In/Out Service	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
TX2 WATERK(BUS-0072	TX2-WATERKOP	In	2.32	85.0 1.6	29.9 2.5	90.1 2.9	2.0 89.5	0.94

Transmission Lines

From Bus To Bus	Component Name	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0019 T-OFF KAREE P	XLN-0015	0.04	-875.8 0.3	-193.1 -0.2	896.8 0.4	23.4 11.1	0.98
BUS-0021 BUS-0019	XLN-0016	0.02	-761.8 0.2	-168.0 -0.2	780.1 0.2	20.3 9.7	0.98
T-OFF KAREE P BUS-0139	XLN-0017	0.01	227.9 0.0	50.0 -0.3	233.3 0.3	6.1 4.7	0.98
BUS-0021 BUS-0024	XLN-0018	0.01	407.0 0.0	89.7 -0.3	416.8 0.3	10.9 5.2	0.98
BUS-0022 BUS-0021	XLN-0019	0.00	-13.3 0.0	-4.2 -1.2	14.0 1.2	0.4 0.2	0.95
BUS-0022 PMT RIOOL WE	XLN-0020	0.00	13.3 0.0	4.2 -0.3	14.0 0.3	0.4 0.3	0.95
PMT TFR1 BUS-0021	XLN-0021	0.00	-341.4 0.0	-75.2 -0.1	349.6 0.1	9.1 4.3	0.98
BUS-0139 BUS-0141	XLN-0022	0.01	113.9 0.0	25.0 -0.4	116.6 0.4	3.0 2.3	0.98

From Bus To Bus	Component Name	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0024	XLN-0032		293.2	64.7	300.2	7.8	0.98
BUS-0037		0.01	0.0	-0.3	0.3	3.7	
BUS-0037	XLN-0033		0.0	-0.3	0.3	0.0	0.00
PMT KRONKEL		0.00	0.0	-0.3	0.3	0.0	
BUS-0039	XLN-0034		669.8	182.9	694.3	18.1	0.96
BUS-0040		0.07	0.4	-0.3	0.5	13.9	
BUS-0040	XLN-0035		488.8	134.3	506.9	13.2	0.96
BUS-0041		0.03	0.1	-0.2	0.2	10.2	
BUS-0041	XLN-0036		372.5	104.4	386.9	10.1	0.96
BUS-0042		0.02	0.1	-0.2	0.3	7.8	
BUS-0042	XLN-0037		143.2	42.6	149.5	3.9	0.96
BUS-0043		0.04	0.0	-1.1	1.1	3.0	
BUS-0043	XLN-0038		85.2	28.7	89.9	2.3	0.95
TX2 WATERKO		0.02	0.0	-1.2	1.2	1.8	
BUS-0047	XLN-0040		1,666.7	456.3	1,728.1	45.0	0.96
BUS-0048		0.03	0.4	0.1	0.4	21.4	
BUS-0048	XLN-0041		1,575.3	424.6	1,631.6	42.5	0.97
BUS-0049		0.05	0.7	0.1	0.7	20.2	
BUS-0049	XLN-0042		1,518.0	404.9	1,571.0	40.9	0.97
BUS-0050		0.02	0.3	0.1	0.3	21.6	
BUS-0050	XLN-0043		91.5	24.6	94.7	2.5	0.97
BUS-0051		0.00	0.0	-0.1	0.1	1.3	
BUS-0050	XLN-0044		1,426.2	380.2	1,476.1	38.5	0.97
BUS-0055		0.06	0.8	0.1	0.8	18.3	
BUS-0055	XLN-0045		1,311.3	349.4	1,357.0	35.4	0.97
BUS-0056		0.12	1.5	0.1	1.5	16.9	

From Bus To Bus	Component Name	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0027 PMT TFR1	XLN-0046	 0.01	-227.6 0.0	-50.2 -0.3	233.1 0.3	6.1 2.9	0.98
PMT TFR3 BUS-0027	XLN-0047	 0.00	-113.8 0.0	-25.3 -0.3	116.6 0.3	3.0 1.4	0.98
BUS-0056 BUS-0057	XLN-0048	 0.02	1,309.8 0.2	349.2 0.0	1,355.5 0.2	35.4 18.6	0.97
BUS-0057 BUS-0058	XLN-0049	 0.02	791.8 0.2	213.3 -0.1	820.0 0.2	21.4 11.3	0.97
BUS-0058 BUS-0059	XLN-0050	 0.03	563.6 0.2	151.6 -0.2	583.7 0.3	15.2 8.0	0.97
BUS-0059 BUS-0060	XLN-0051	 0.02	449.7 0.1	121.2 -0.2	465.7 0.2	12.2 6.4	0.97
BUS-0060 MS DEURDRIF	XLN-0052	 0.00	91.0 0.0	24.3 -0.2	94.2 0.2	2.5 1.3	0.97
BUS-0057 BUS-0062	XLN-0054	 0.06	517.8 0.3	135.9 -0.5	535.3 0.6	14.0 6.7	0.97
BUS-0062 BUS-0063	XLN-0055	 0.06	289.6 0.2	74.7 -1.0	299.1 1.0	7.8 3.7	0.97
BUS-0063 BUS-0064	XLN-0056	 0.06	175.8 0.1	45.1 -1.5	181.5 1.5	4.7 3.7	0.97
BUS-0064 BUS-0065	XLN-0057	 0.02	118.2 0.0	31.7 -0.9	122.4 0.9	3.2 2.5	0.97
BUS-0065 BUS-0066	XLN-0058	 0.01	108.5 0.0	30.1 -0.2	112.6 0.2	2.9 2.3	0.96
BUS-0066 BUS-0067	XLN-0059	 0.01	81.9 0.0	21.3 -0.6	84.6 0.6	2.2 1.7	0.97

From Bus To Bus	Component Name	%VD	kW Loss	kvar Loss	kVA Loss	LF Amps Rating %	PF
BUS-0067	XLN-0060		68.6	17.4	70.8	1.9	0.97
BUS-0068		0.01	0.0	-0.4	0.4	1.4	
BUS-0068	XLN-0061		55.3	13.3	56.9	1.5	0.97
BUS-0069		0.01	0.0	-0.8	0.8	1.1	
BUS-0069	XLN-0062		36.1	8.3	37.1	1.0	0.97
BUS-0070		0.01	0.0	-1.8	1.8	0.7	
BUS-0070	XLN-0063		26.6	7.3	27.5	0.7	0.96
TX MUNISIPAL		0.01	0.0	-1.8	1.8	0.6	
BUS-0014	XLN-MUNIC		3,559.3	303.0	3,572.2	92.9	1.00
BUS-0015		0.02	0.7	0.5	0.9	35.7	
T-OFF KAREE P	XLN-MUNIC		-1,104.0	-242.9	1,130.4	29.4	0.98
BUS-0017		0.12	1.2	-0.3	1.3	14.0	
BUS-0046	XLN-MUNIC		1,668.4	456.7	1,729.8	45.0	0.96
BUS-0047		0.11	1.6	0.4	1.7	21.4	
BUS-0026	XLN-MUNIC		784.8	213.5	813.3	21.2	0.96
BUS-0039		0.04	0.3	-0.3	0.4	11.1	

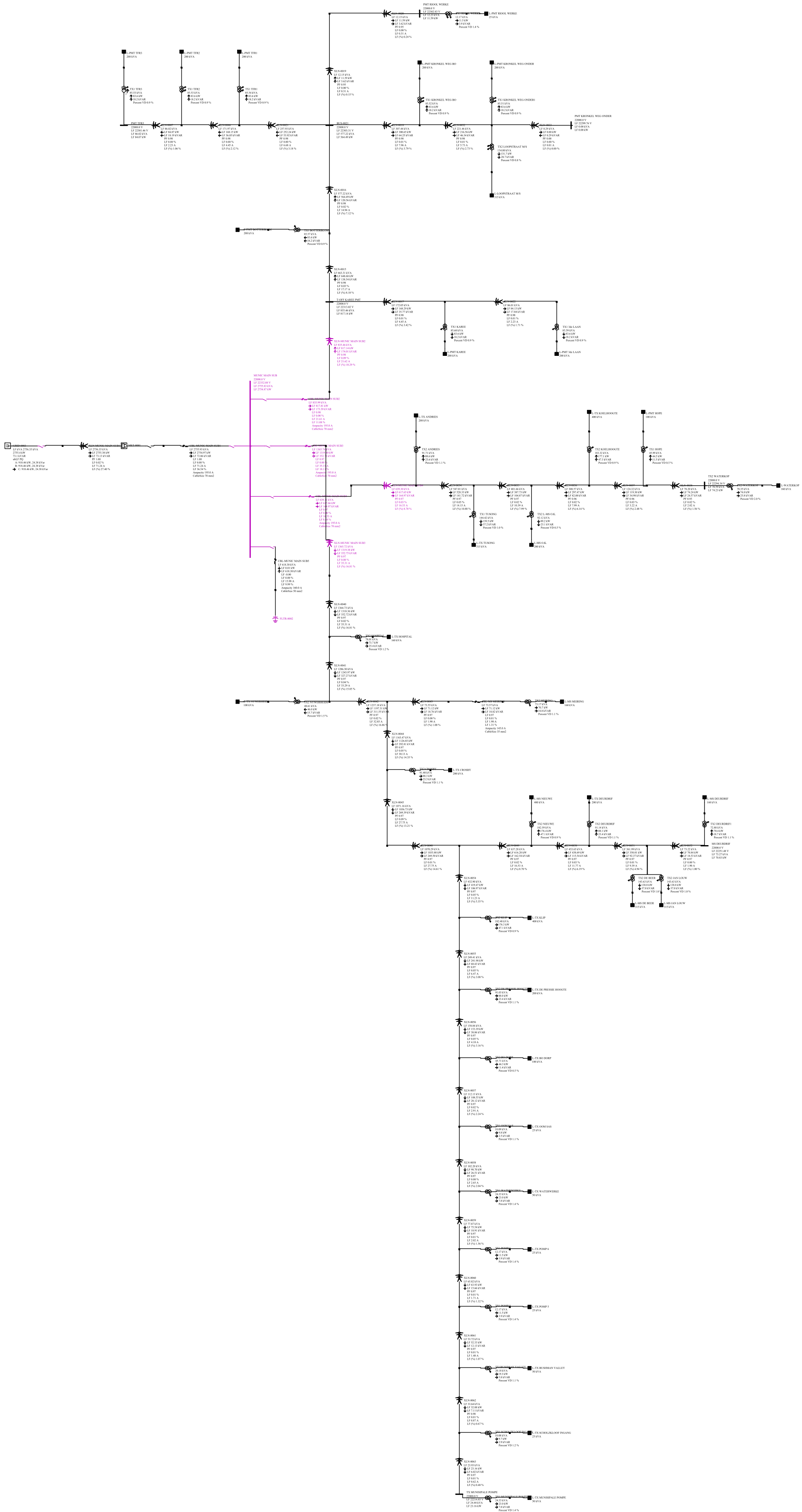
Rev	Description	Date
A	For approval	19.6.2024
B		

MV OVERHEAD LINES : CURRENT RATING			
TYPE	CODE NAME	SIZE (mm²)	CURRENT (A)
ACSR	GOPHER	25	150
ACSR	FOX	35	190
ACSR	RABBIT	50	240
ACSR	MINK	60	260
ACSR	HARE	100	360
AAAC	PINE	70	260
AAAC	OAK	110	350
COPPER	-	16	138
COPPER	-	25	184
COPPER	-	35	223
COPPER	-	50	279
COPPER	-	70	344

ACSR = Aluminium Conductor Steel Reinforced
AAAC = All Aluminium Alloy Conductor
Copper = Hard drawn copper wire

PRINCE ALBERT 2024 NETWORK CONDITIONS

a. EXISTING LOADFLOW - 2024



Rev	Description	Date
A	For approval	27.10.2020

PJ TECHNOLOGIES
CAPE TOWN
PO Box 4542, Tygervalley, 7536
(+27 21) 21-975-0016
pjt.cape@telkomsa.net
ELECTRICAL ENGINEERS & PROJECT MANAGERS

PRINCE ALBERT MUNICIPALITY
Client

ELECTRICAL MASTERPLAN
Project description

Loadflow of exsting network
Normal loading (year 2024)
Drawing title

Drawn:	Checked:	Date:	Scale:
MS	JD		

SIGNED:
Pr. Eng number: 910310

Drawing & Plan no.: 24.648 e01 r0
Revision no.: sheet 1

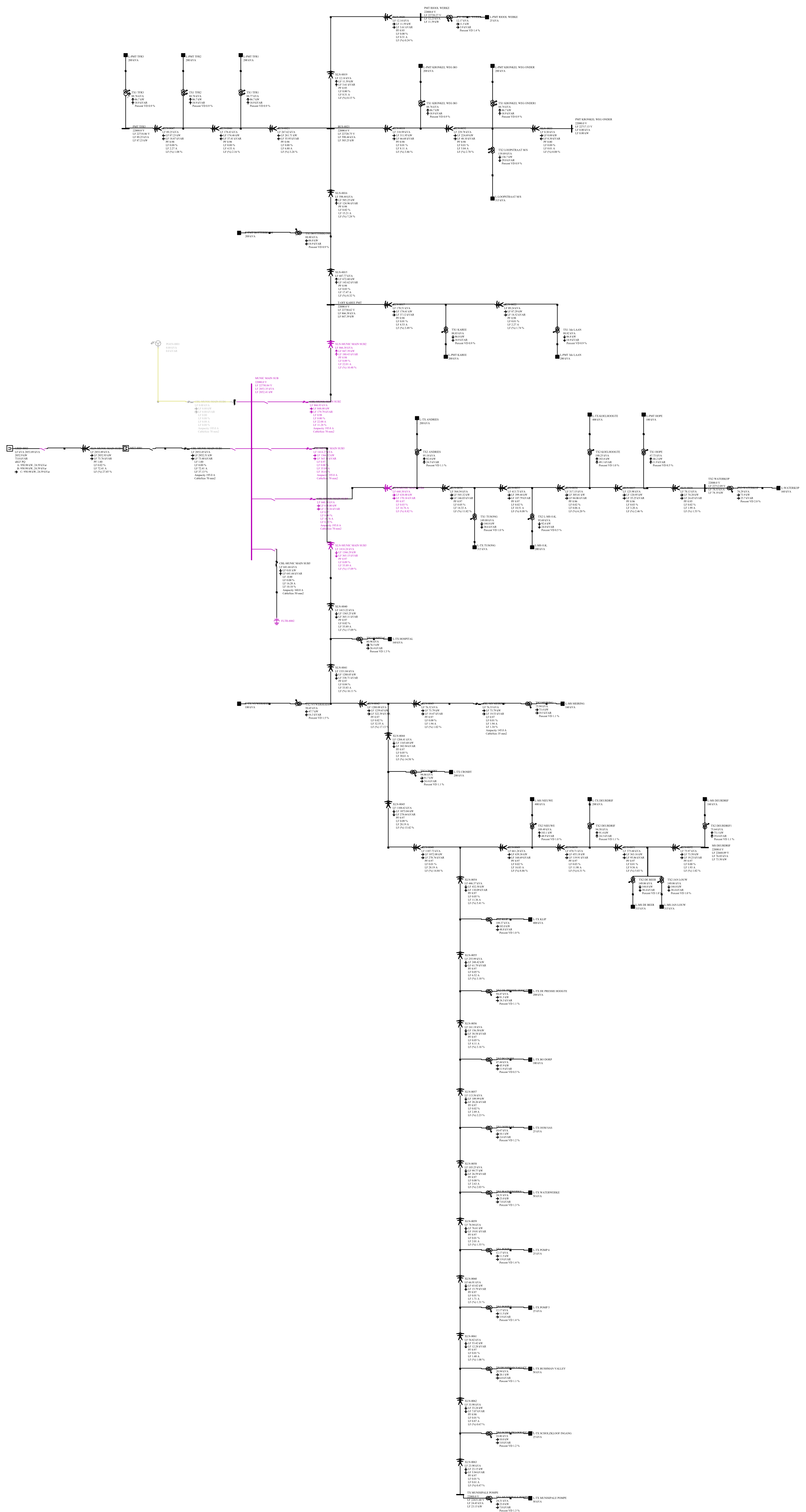
Rev	Description	Date
A	For approval	19.6.2024
B		

MV OVERHEAD LINES : CURRENT RATING			
TYPE	CODE NAME	SIZE (mm²)	CURRENT (A)
ACSR	GOPHER	25	150
ACSR	FOX	35	190
ACSR	RABBIT	50	240
ACSR	MINK	60	260
ACSR	HARE	100	360
AAAC	PINE	70	260
AAAC	OAK	110	350
COPPER	-	16	138
COPPER	-	25	184
COPPER	-	35	223
COPPER	-	50	279
COPPER	-	70	344

ACSR = Aluminium Conductor Steel Reinforced
AAAC = All Aluminium Alloy Conductor
Copper = Hard drawn copper wire

PRINCE ALBERT 2034 NETWORK CONDITIONS

a. FUTURE LOADFLOW - 2034



Rev	Description	Date
A	For approval	27.10.2020

PJ TECHNOLOGIES
CAPE TOWN
PO Box 4542, Tygervalley, 7536
(+27 21) 21-975-0016
pjt.cape@telkomsa.net
ELECTRICAL ENGINEERS & PROJECT MANAGERS

PRINCE ALBERT MUNICIPALITY
Client

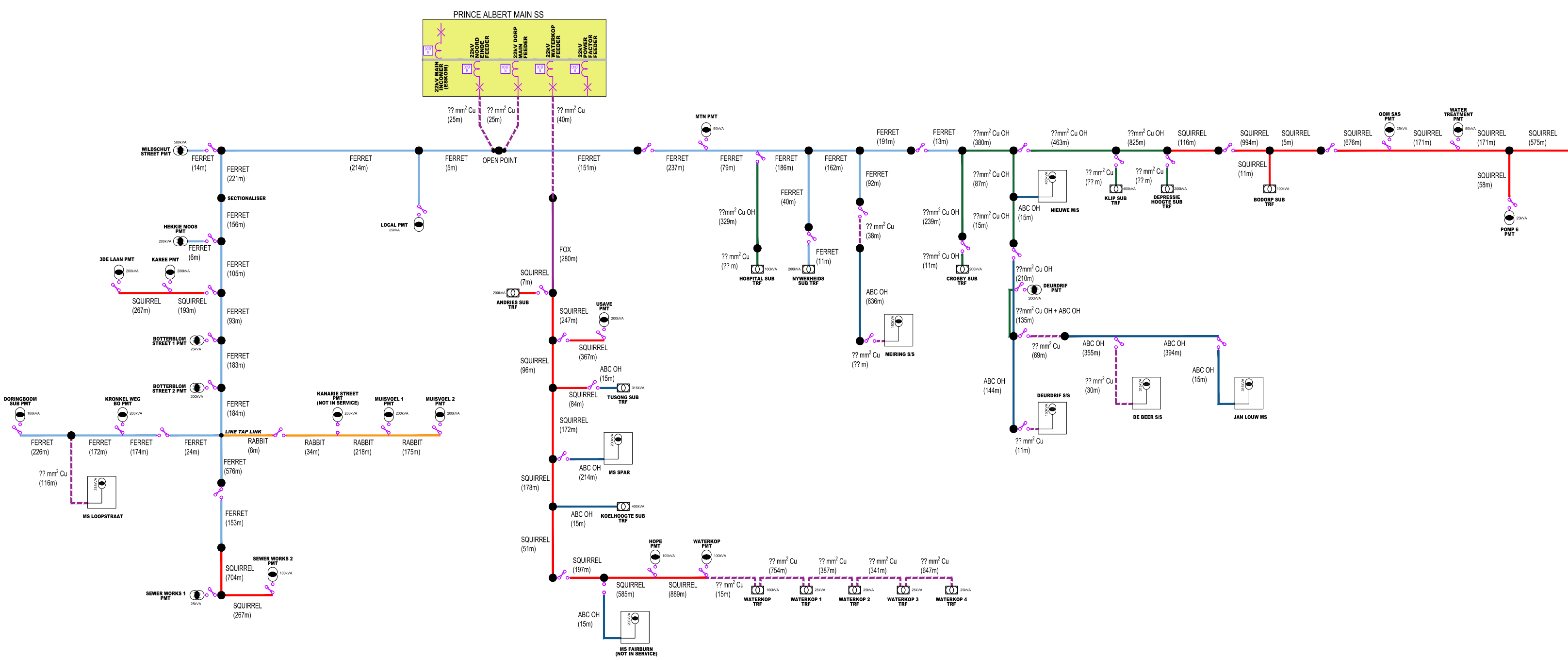
ELECTRICAL MASTERPLAN
Project description

Loadflow of exsting network
Future loading (year 2034)
Drawing title

Drawn:	Checked:	Date:	Scale:
MS	JD		

SIGNED:
Pr. Eng number: 910310

Drawing & Plan no.: 24.648 e02 r0
Revision no.: sheet 1



MEDIUM VOLTAGE LEGEND	
DESCRIPTION	EXISTING
MINIATURE SUBSTATION	
POLE MOUNTED TRANSFORMER	
GROUND MOUNTED TRANSFORMER	
RING MAIN UNIT (RMU)	
SQUIRREL OVERHEAD LINE	
FERRET OVERHEAD LINE	
RABBIT OVERHEAD LINE	
FOX OVERHEAD LINE	
GOPHER OVERHEAD LINE	
ABC OVERHEAD LINE	
COPPER OVERHEAD LINE	
ABC UNDERGROUND	
COPPER UNDERGROUND CABLE	
INTERDAC UNDERGROUND CABLE	
DROP-OUT FUSES	
11m TRANSMISSION POLE	
STAY WIRE	
STRUT POLE	

NOTES:

The reference made to Engineer will also refer to Employer's Agent for GCC 2015 Contracts

REV	DESCRIPTION	DATE	REV BY	CHKD
A	FOR INFORMATION	'24-06	AL	AK

REVISIONS

SCALEBAR: N.T.S

DESIGNED

DRAWN

CHECKED

CONSULTING ENGINEERS
LYNERS
PO Box 4901
TYGERVALLEY
7530
Tel: 021 914 0300/Fax: 021 914 0437
email: bellville@lyners.co.za

APPROVED
ENGINEERS:
DATE: 2024-06-20

APPROVED
CLIENT:
DATE:

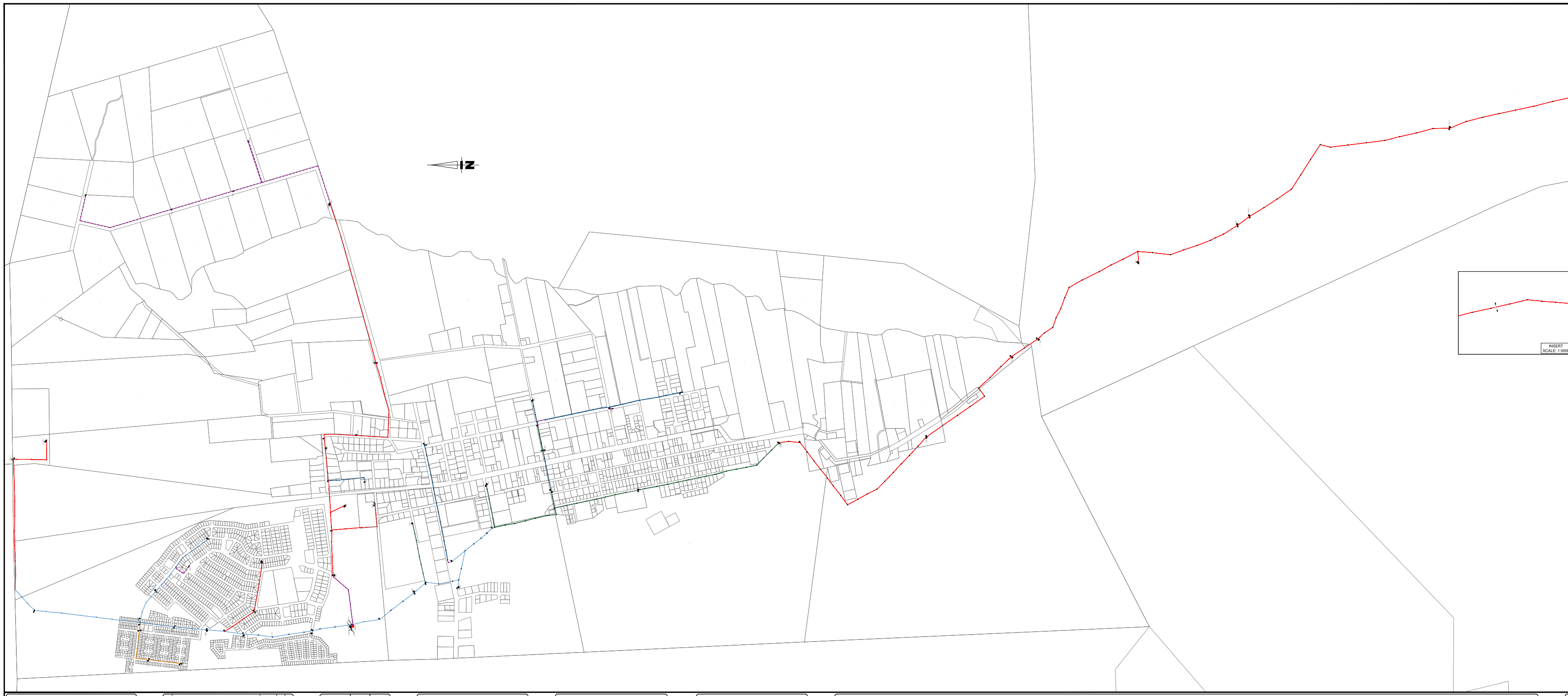
CLIENT
PRINCE ALBERT MUNICIPALITY

PROJECT
ELECTRICAL MASTERPLAN REVIEW AND UPDATE

TITLE
PRINCE ALBERT SINGLE LINE DIAGRAM

SCALE on A1: AS SHOWN
SHEET: 1 OF 1
CONTRACT No.
PROJECT No.: 24062EG
DRAWING No.: 24062EG - 106
REV: A
COORDINATE SYSTEM: WGS84 / Lo?°

iso full bleed a1 (841.00 x 594.00 mm) Lyners_AutoCAD.ctb 2024-06-20 U:\WERKE\2400\24062 EG - PRINCE ALBERT MUN - ELECTRICAL MASTERPLAN REVIEW AND UPDATE\DRAWINGS\1.2 ACTIVE\24062EG-03 - SLD 18-06-2024.DWG



MEDIUM VOLTAGE LEGEND	
DESCRIPTION	EXISTING
MINIATURE SUBSTATION	
POLE MOUNTED TRANSFORMER	
GROUND MOUNTED TRANSFORMER	
RING MAIN UNIT (RMU)	
SQUIRREL OVERHEAD LINE	
FERRET OVERHEAD LINE	
RABBIT OVERHEAD LINE	
FOX OVERHEAD LINE	
GOPHER OVERHEAD LINE	
ABC OVERHEAD LINE	
COPPER OVERHEAD LINE	
ABC UNDERGROUND	
COPPER UNDERGROUND CABLE	
INTERDAC UNDERGROUND CABLE	
DROP-OUT FUSES	
11m TRANSMISSION POLE	
STAY WIRE	
STRUT POLE	
NOTES:	

SCALEBAR

All dimensions must be verified on site before the works commence. Refer any discrepancies to the Engineer.

REV	DESCRIPTION	DATE	REV BY	CHKD
Z	AS_INSTALLED	24-06-14	AK	DJH

REVISIONS

DESIGNED	TP	'24/06
DRAWN	AK	'24/06
CHECKED	TP	'24/06

CONSULTING ENGINEERS
LYNERS
PO Box 4901
TYGERVALLEY
7530
Tel: 021 914 0300 / Fax: 021 914 0437
email: bellville@lyners.co.za

APPROVED
ENGINEER:
DATE: 2024-06-20

APPROVED
CLIENT:
DATE:

CLIENT
PRINCE ALBERT MUNICIPALITY

PROJECT
PRINCE_ALBERT_MUNICIPALITY
MASTERPLANNING

TITLE
EXISTING_22KV_NETWORK_(AS_BUILT)

SCALE on A0: 1:5000	SHEET: AS_SHOWN
CONTRACT No.	PROJECT No.: 24062EG
DRAWING No.: 24062EG-101	REV: Z
COORDINATE SYSTEM: COORDSYSTEM	

previous paper size (841.00 x 1860.00 mm) Lyners_AutoCAD.ctb 2024-06-20 U:\WERKE\2400\24062 EG - PRINCE ALBERT MUN - ELECTICAL MASTERPLAN REVIEW AND UPDATE\DRAWINGS\1.2 ACTIVE\24062EG-01 - ELECTRICAL NETWORK.DWG