



KAAP AGULHAS MUNISIPALITEIT  
CAPE AGULHAS MUNICIPALITY  
U MASIPALA WASECAPE AGULHAS

## REPORT

ON

# MASTER PLAN FOR THE MV (11kV) DISTRIBUTION NETWORK AT WAENHUISKRANS

REPORT NO: G/10264/E/R4

Dated: 30 JUNE 2017

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## 1.0 **INTRODUCTION**

This report has been compiled on the instruction of the Manager of the Electrical Department, Mr Steve Cooper, to prepare a master plan for the Medium Voltage (MV – 11kV) distribution network for Waenhuiskrans.

The purpose of the master plan can be summarised as follows:

- 1.1 To identify the network components which need to be augmented to address immediate problems and to cater for long term load growth, i.e. 20 years, and new developments.
- 1.2 To serve as a basis for any new construction work so that it can be carried-out in a planned and phased manner, thus minimizing any abortive work due to a lack of insight into the future requirements.
- 1.3 To cost and programme the augmentation work to form part of a business plan for the implementation thereof.

The report contains sufficient information for forward planning to cater for full development of presently serviced areas and known new developments, which together, will generate a total load in the order of 1,5 MVA over the next ten (10) years.

It must be pointed out that load growth patterns will change and it is recommended that the window for the technical issues related to the master plan not be longer than two (2) years, but for financial planning it can be made up to five (5) years.

This report focusses more on the financial rather than the technical issues, which are depicted in detail on the master plan drawings and have previously been discussed and agreed with the Manager of the Electrical Department.

## 2.0 **BASIS OF REPORT**

The report is based on the following:

- (i) Information received from Mr Steve Cooper from the Municipality's Electrical Department and Mr Gerrit van Rooyen from Eskom during meetings and telephone conversations in 2017.
- (ii) Drawings of the existing municipal MV Network.
- (iii) Information received from the Municipality's Town Planning and Housing Departments regarding possible future developments in the area.

## 3.0 **DRAWINGS**

Reference should also be made to the following drawings, of which a copy of each is issued separately:

### Existing Network

- Drawing No. 10264/E4/01: - Waenhuiskrans: Existing MV (11kV) Plan Layout  
Drawing No. 10264/E4/02: - Waenhuiskrans: Existing MV (11kV) Schematic Diagram

### Master Plan Network

- Drawing No. 10264/E4/03: - Waenhuiskrans: Master MV (11kV) Plan Layout  
Drawing No. 10264/E4/04: - Waenhuiskrans: Master MV (11kV) Schematic Diagram

The master plan drawings show the existing network in blue and the upgrading and extension measures required in red. This method has been adopted to avoid having to refer to two sets of drawings.

#### 4.0 **LOAD, DESIGN CRITERIA AND 20 YEAR GROWTH FORECAST**

The load figures, i.e Town's peak kVA demand and the connected kVA load of the existing network (diversity factors ranging from 50% to 70% were used), and future load depicted on the master plan have been used to assess the loading in the various areas as a basis to evaluate the present and future capacity of the existing network components and to determine the upgrading and extension measures required.

The maximum voltage regulation is taken at  $\pm 2,5\%$  in the MV networks,  $\pm 2,5\%$  across distribution substations and  $\pm 7\%$  across the LV network.

The Town's peak kVA demands over the last sixteen (16) years were obtained from Mr Steve Cooper, as measured at the Eskom Bulk Metering Point and included in Annexure A. This annexure also depicts the Town's load growth for the next twenty (20) years. Annexure B depicts a graph of a best fit exponential curve depicting the projected load growth.

The design of the system is based on the system being able to supply the full load demand in an area, or areas, after the loss of any one feeder while the voltage regulation remains within reasonable limits at the furthest point of the network. It is not considered necessary to base planning on the loss of more than one feeder at the same time.

It is to be noted that the proposed network improvement is a concept design only and should not be considered as a final detailed planning. It provides a concept to guide actual detail planning and also acts as a guide to such planning to ensure general compliance with the spirit of the overall network master plan, without dictating rigid adherence to the order of priority given. The development within an area may occur earlier or later than is presently envisaged requiring a re-allocation of the order of the work.

#### 5.0 **IMPACT OF RENEWABLES ON THE MASTER PLAN**

Renewable energy is energy that is generated from natural processes that are continuously replenished. This includes sunlight, geothermal heat, wind, tides, water, and various forms of biomass. This energy cannot be exhausted and is constantly renewed. Since it is, however, not be possible to exactly determine the extent of the afore-mentioned natural processes in the area it has been decided not to take the impact of any renewable technologies in consideration in the electricity master planning for the town.

#### 6.0 **EXISTING NETWORK AND PROPOSED CHANGES**

The layout and schematic diagram of the existing MV network are shown on Drawing No.'s 10264/E4/01 and 10264/E4/02 respectively.

##### 6.1 Eskom Supply:

The supply is provided from a 66/11kV Eskom substation, via an 11kV overhead radial line (no firm supply) and underground cable with capacities of 2,13MVA and 2,28MVA respectively to the main intake substation, i.e. "Main Sub", situated on the Northern side of Waenhuiskrans.

The current notified maximum demand with Eskom is 1 200 kVA and the maximum actual kVA demand was measured in January 2011 at 1 315 kVA. From the graph under Annexure B it is clear that the load requirement from 2011 has dropped significantly to below 930 kVA in 2017.

The estimated maximum demand in the next 10 years is about 1,5 MVA, which means that the existing supply cable and overhead line will be sufficient to cater for the expected load requirements. It is estimated that the town will reach its notified demand in 2019.

Eskom, however, indicated that they will only be able to increase the Notified Demand of the town by 2021 after they have strengthened their 66kV network, or introduced a new 132kV/66kV substation to the area. It is therefore critical that demand side management systems be investigated, i.e. geaser control, etc. to ensure that the load requirement of the town be kept below 1,2 MVA as long as possible.

## 6.2 MV Feeders:

The existing main MV reticulation network consists of a radial Rabbit ACSR overhead line feeding a 35mm<sup>2</sup> underground cable. Said overhead line is connected to the main intake substation, i.e. "Main Sub". The afore-mentioned line and underground cable are connected to a various number of ground mounted transformer substations, ring main unit and switching station. The loads on the system conductors are well within the current capacities of the conductors, but additional underground inter-connecting cables are required to ensure that all future erven are electrically supplied and existing transformer substations / new miniature substations on a ring feed supply as further discussed below. It is proposed that a 70mm<sup>2</sup> underground cable be installed between "Main Sub", "GMT Hawe Sub", "RMU Commando" and "Sentrale Sub" to cater for the long term load demand in town.

## 6.3 Substations:

The two main switching stations, i.e. "Main Sub" and "Sentrale Sub" consists of ring main units which must urgently be replaced with switchgear, equipped with the appropriate protection relays.

Ring main unit "RMU 1Ste & Hardic" consist of two isolators and a fuse switch. This ring main unit must be replaced in future with a three way isolator switch when the load requirement of the town reaches approximately 1,7 MVA, i.e the load capacity of the fuse switch. It is, however, expected not to happen in the next ten (10) years.

Provision has been made for a ring main unit "RMU Commando" on the main network as depicted on the drawings which will increase the switching possibilities of said network.

A number of ground mounted transformer substations, which are fed from the overhead line and underground cable via radial underground cables, must be replaced with miniature substations equipped with ring main units as depicted on the master plan drawings. Provision has been made for additional miniature substations within the urban edge to cater for the future load and to ensure that the voltage regulation on the LV networks is within the allowable limits.

Currently there is not a power factor correction capacitor bank in the main intake substation, i.e. "Main Sub", and we propose that this matter be further investigated to determine if there will be a financial benefit to the Municipality by installing same.

From our inspection it was noted that some of the ring main units were wrongly labeled. We propose that all switchgear and equipment be labeled according to the drawings.

#### 6.4 Condition:

There is quite a number of switchgear at the aforementioned substations and pole mounted transformers which are very old, i.e. 30 years and older. Regular inspections and tests are needed to ensure that all components are working safely.

The following equipment was highlighted during the survey that needs attention: (Note that this equipment is not highlighted on the drawings)

- (a) Ground Mounted Transformer Substation: "GMT Hawe-Sub", "GMT Hardick & 4<sup>th</sup> Str" and "GMT Pratt Str."

### 7.0 **Upgrading of the MV Network**

In order to overcome the immediate and ten year load growth problems, the systematic strengthening of the internal reticulation system is recommended. An ongoing commitment to regular maintenance is also a pre-requisite to the provision of a quality supply to the town's consumers.

The immediate urgent elements which must be attended to:

- (a) Replace the ring main units inside "Main Sub" and "Centrale Sub" with switchgear equipped with the appropriate protection relays.
- (b) Provide a ring feed supply to all the substations.
- (c) Commence / proceed with a maintenance programme.

The vision for the town in future is a ring main overhead / underground line / cable system which connects "Main Sub" with all the existing & future miniature substations, and pole mounted transformer substations.

The proposed improvements and extensions have been divided into three phases. Phase 1 covers the most urgent work which should be carried out within the period from present (2018) to 2019, followed by Phase 2 and Phase 3 each of four year work periods, i.e. 2020 to 2023 and 2024 to 2027. Phase 3 encompasses some items of work for which it is not practical to set a time period, as certain items may be required at any time from 2020 to 2027, depending on the rate of development.

#### 7.1 Phase 1 - (2018 to 2019):

- 7.1.1 Main Sub: Replace ring main units inside substation with circuit breaker panels, equipped with the appropriate protection relays.
- 7.1.2 Centrale Sub: Replace ring main units inside substation with circuit breaker panels, equipped with the appropriate protection relays.
- 7.1.3 General: Inspect and test equipment mentioned under Sub-Clause 6.4 of Clause 6.0 and replace with new or refurbish existing.

7.2 Phase 2 - 2020 to 2023:

- 7.2.1 Main Sub: Ensure that “GMT 1ste Laan Begraafplaas, GMT Arniston Hotel and “GMT Hawe Sub” are on a ring feed supply by installing a 70mm<sup>2</sup> underground cable between “Main Sub” and “GMT Hawe Sub”.
- 7.2.2 Sentrale Sub: Ensure that “Centrale Sub” is on a ring feed supply by installing a 70mm<sup>2</sup> underground cable between “Centrale Sub” and “RMU Commando”. “RMU Commando” to also be installed as part of this upgrading measure.
- 7.2.3 MS Hoofweg: Install “MS Hoofweg” to better the LV voltage regulation in the area.
- 7.2.4 General: Inspect and test equipment mentioned under item Sub-Clause 6.4 of Clause 6.0 and replace with new or refurbish existing.

7.3 Phase 3 - (2024 to 2027):

- 7.3.1 Main Sub: Ensure that “GMT Karavaanpark”, “GMT Pratt Str” and “GMT Uys & Du Preez” are on a ring feed supply by installing a 35mm<sup>2</sup> underground cable between “GMT Karavaanpark”, and “GMT Uys & Du Preez”.
- 7.3.2 MS Harbour: Install “MS Harbour” to better the LV voltage regulation in the area.
- 7.3.3 Ground Mounted Transformer Substations: Replace ground mounted transformer substation with miniature substation, incl., ring main unit.
- 7.3.4 General: Inspect and test equipment mentioned under item Sub-Clause 6.4 of Clause 6.0 and replace with new or refurbish existing.

Note that the new infrastructure required for new developments, i.e. the proposed low cost housing development near the Caravan Park, or any other smaller developments in town, have not been priced, since it has been assumed that said infrastructure will be financed by the respective developers.

8.0 **PROPOSED CHANGES WITH COST ESTIMATES**

The proposed upgrading and extensions to the MV network, together with the cost estimates & proposed order of priority, is given hereafter.

It is to be noted that the cost estimates exclude VAT, escalation and planning fees. Escalation can be added at approximately 1,25% per month. The cost estimates are order of magnitude values and must be refined the year before implementation after a more detailed design has been carried-out.

8.1 Phase 1 - (2018 to 2019):

- 8.1.1 Main Sub: Replace ring main units inside substation with circuit breaker panels, equipped with the appropriate protection relays.

R 832 000

- 8.1.2 Sentrale Sub: Replace ring main units inside substation with circuit breaker panels, equipped with the appropriate protection relays. R 895 000
- 8.1.3 General: Inspect and test equipment mentioned under Sub-Clause 6.4 of Clause 6.0 and replace with new or refurbish existing. R 600 000 R2 327 000
- 8.2 Phase 2 - 2020 to 2023:
- 8.2.1 Main Sub: Ensure that "GMT 1ste Laan Begraafplaas, GMT Arniston Hotel and "GMT Hawe Sub" are on a ring feed supply by installing a 70mm<sup>2</sup> underground cable between "Main Sub" and "GMT Hawe Sub". R 930 000
- 8.2.2 Sentrale Sub: Ensure that "Sentrale Sub" is on a ring feed supply by installing a 70mm<sup>2</sup> underground cable between "Sentrale Sub" and "RMU Commando". "RMU Commando" to also be installed as part of this upgrading measure. R 785 000
- 8.2.3 Ground Mounted Transformer Substations: Replace all ground mounted transformer substations with miniature substations, incl., ring main unit. (Replace two transformers, i.e. 2 x R 600 000-00/each) R1 200 000
- 8.2.4 General: Inspect and test equipment mentioned under item Sub-Clause 6.4 of Clause 6.0 and replace with new or refurbish existing. R 600 000 R 3 515 000
- 8.3 Phase 3 - (2024 to 2027):
- 8.3.1 Main Sub: Ensure that "GMT Karavaanpark", "GMT Pratt Str" and "GMT Uys & Du Preez" are on a ring feed supply by installing a 35mm<sup>2</sup> underground cable between "GMT Karavaanpark", and "GMT Uys & Du Preez". R 370 000
- 8.3.2 MS Harbour: Install "MS Harbour" to better the LV voltage regulation in the area. R 905 000
- 8.3.3 Ground Mounted Transformer Substations: Replace ground mounted transformer substation with miniature substation, incl., ring main unit. (Replace two transformers, i.e. 2 x R 600 000-00/each) R 1200 000



8.3.4	<u>General:</u> Inspect and test equipment mentioned under item Sub-Clause 6.4 of Clause 6.0 and replace with new or refurbish existing.	R 600 000	<u>R 3 075 000</u>
	Total, excl. VAT		R 8 917 000

## 9.0 **FUNDING**

It is only viable to implement the capital expenditure proposed under Clause 8.0 if suitable income sources can be found to fund such expenditure. These income sources can be as follows:

- (i) A portion of the income from the sales of electricity to fund External Loans.
- (ii) Contribution by developers in the form of:
  - (a) Augmentation Levies that will become Internal Funds.
  - (b) Direct payments for the supply and installation of external or main MV network components necessary to supply specific new developments.
- (iii) Grants from example the Department of Energy (DoE) for the electrification of sub-economy housing, schools, etc, and MIG funding from Provincial Government for mainly streetlighting projects.

It is recognised that in the case of External Loans, although it could be financially justified and increased year by year in relation to the increased income from electricity sales, there are other considerations in terms of the Municipality's overall budget, the availability of loans, etc, that finally determines the value thereof. The income from this source should therefore be determined by the Municipality's treasury department in consultation with the electrical department.

## 10.0 **CONCLUSION**

It is recommended that adequate financial provision be made in the budgets for ongoing upgrading to the network as set out above. We would recommend that at least R 800 000-00 to R 900 000-00 per year be budgeted for upgrading of the network.

It is believed that the terms of reference have been covered, but we hold ourselves available if clarification is required on any of the items or points raised within this report, and to possibly assist with the discussions with the treasury department to determine the allocation of the expenditure in terms of the Municipality's overall budget.

## 11.0 **ACKNOWLEDGEMENT**

The assistance of Mr Steve Cooper is gratefully acknowledged and we would like to thank the Municipality for entrusting this commission to us.

We present our report for your consideration and await your further instructions.

J.S. de Villiers Pr Tech Eng  
**CLINKSCALES MAUGHAN-BROWN**

June 2017

# **ANNEXURE A**

## **LOAD FIGURES**

**SCHEDULE A**

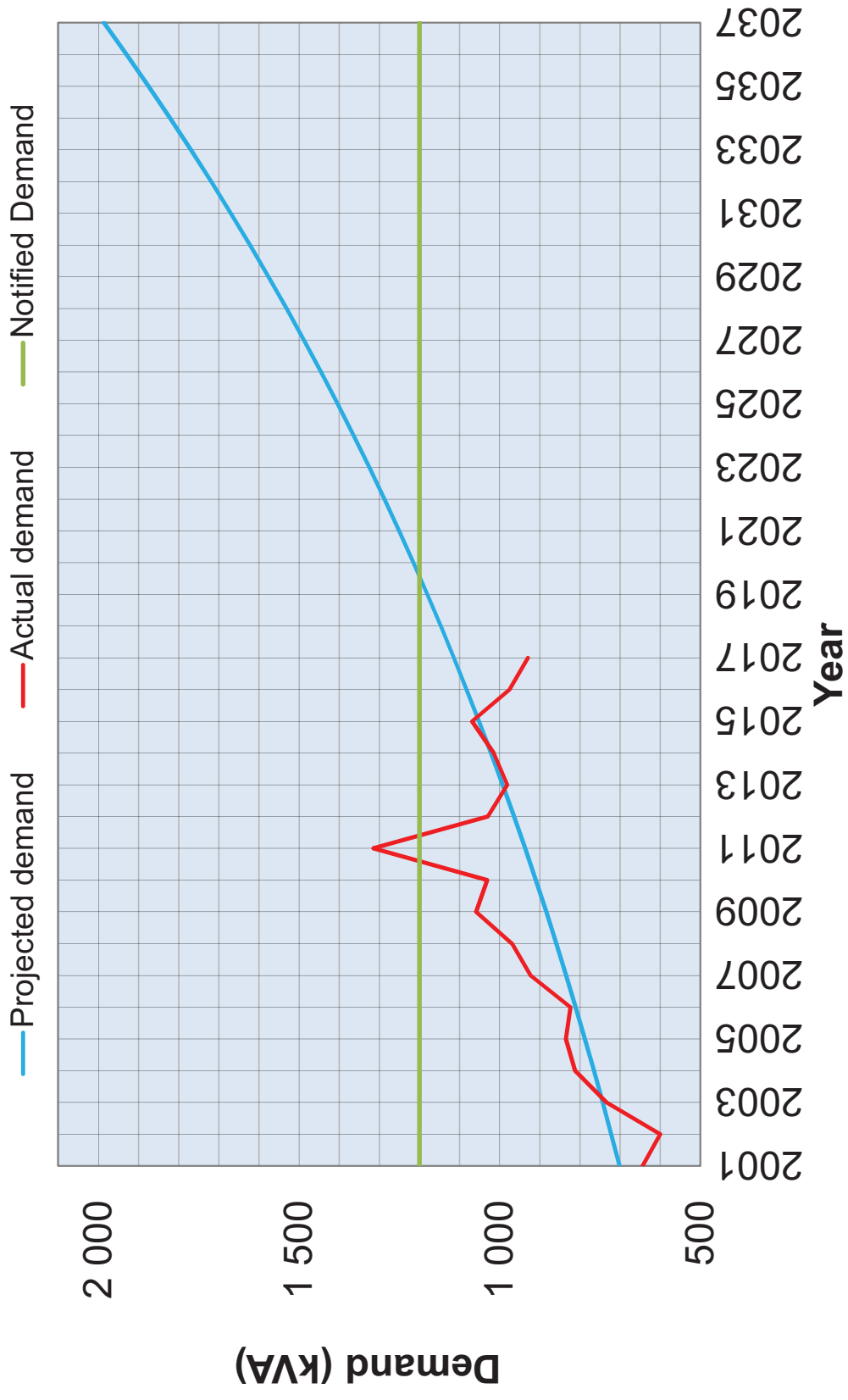
**WAENHUISKRANS'S PEAK DEMAND (kVA) SINCE 2007 AND PROJECTED LOAD GROWTH FOR THE NEXT 20 YEARS**

<b>Year</b>	<b>Actual Peak kVA</b>	<b>Actual % Growth</b>	<b>Approx Projected Peak kVA</b>
2001	644		
2002	600	-6,83	
2003	734	22,33	
2004	812	10,63	
2005	835	2,83	
2006	824	-1,32	
2007	923	12,01	
2008	969	4,98	
2009	1 059	9,29	
2010	1 031	-2,64	
2011	1 315	27,55	
2012	1 030	-21,67	
2013	981	-4,76	
2014	1 015	3,47	
2015	1 069	5,32	
2016	976	-8,70	
2017	930	-4,71	
2018			1 147
2019			1 180
2020			1 215
2021			1 251
2022			1 287
2023			1 325
2024			1 364
2025			1 404
2026			1 445
2027			1 488
2028			1 531
2029			1 576
2030			1 622
2031			1 670
2032			1 719
2033			1 769
2034			1 821
2035			1 874
2036			1 929
2037			1 986

# **ANNEXURE B**

## **PROJECTED GROWTH GRAPH**

# Waenhuiskrans: Projected Load Growth



# **ANNEXURE C**

## **DRAWINGS**









