CIVIL ENGINEERING SERVICES REPORT

FOR

TOWNSHIP ESTABLISHMENT OF IPELEGENG EXTENSION 12

April 2021

(Revision 00)

Prepared for :

Maxim Planning Solutions
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Executive Summary

Moedi Consulting Engineers (Pty) Ltd. has been appointed to investigate and report on the Bulk Civil Engineering services requirements for the proclamation of Ipelegeng Extension 12. The proposed development consists of approximately **2 300** stands.

Ipelegeng forms part of the Mamusa Local Municipality under the jurisdiction of Dr Ruth Segomotsi Mompati District Municipality. According to Stats. SA, the town of Schweizer-Reneke consists of 9 829 households and an estimated population of 41 226 people. It is estimated that the future population of the settlement can theoretically increase to 86 772 persons or 21 061 stands. The estimated indigent households of the MLM amounts to 62.7 %.

The estimated current Average Annual Daily Demand (water) equates to 5.9 Mℓ / day. The Proposed Development could increase the water demand to 8.8 Mℓ/day. The existing 6 Mℓ/day WTP will not be able to meet the future water demand. However, the capacity shortfall of the WTP can be mitigated by augmenting the supply volume of the Mamusa bulk water pipeline. The current bulk water storage reservoirs do not have sufficient capacity to accommodate the development. It is proposed that the storage capacity be increased to compensate for the storage shortfalls in future.

In addition, it is proposed that a new bulk supply main be constructed to provide potable water to the development from the Massouwskop reservoirs.

The estimated current wastewater generation equates to 5.7 Mℓ / day. The Proposed Development could increase the wastewater generation to 8.6 Mℓ / day. The existing WWTW will have capacity to accommodate the increased wastewater loading. In order to convey wastewater generated by the development to the WWTW, it is proposed that a new sewer pumping station be constructed as well as a new rising main and bulk outfall sewer line.

Primary access to the Proposed Development will be provided from the R34 road (Vryburg - Schweizer-Reneke). The provincial road was recently constructed and provision was made for an intersection to the proposed development.

The Proposed Development will theoretically increase the estimated total Municipal Solid Waste (MSW) of the town to 97.7 tons per day. The estimated increase in MSW will amount to 10.2 m^3 per day. The proposed development will be affected by the 1-in-100-year flood line – determination of which by others.

1 Introduction

Moedi Consulting Engineers (Pty) Ltd. has been appointed by Maxim Planning Solutions to investigate and report on the Bulk Civil Engineering services requirements for the proposed township establishment. The proposed proclamation of Ipelegeng Extension 12 will hereafter be referred to as the "Proposed Development".

It is envisaged that the proclamation of Ipelegeng Extension 12 will lead to the servicing of approximately **2 300** stands.

1.1 Locality

Schweizer-Reneke and Ipelegeng form part of the Mamusa Local Municipality (MLM) which falls under the jurisdiction of Dr Ruth Segomotsi Mompati District Municipality (DRSM) which is the Water Services Authority (WSA).

According to South African History Online, *The Town was named after Captain C.A. Schweizer and Field Cornet C.M. Reneke, both of whom died in the battle against the Korannas.* The name Mamusa could be derived from the name of the Kora Chief, Mosweu, who initially collaborated with the Boers against the Tswana/Thlaping, and then was killed in the battle between the Boers and the Kora. According to the historian, H.P. Maree *the name "Mamusa" comes from the sound made by the wind when blowing through the reeds - "Maa-moe-saa!*".

On a district level, the DRSM is one of the 4 districts in the North West province of South Africa. This vast district has a very scattered rural settlement pattern. The district is located in the barren north-western side of the country, far away from the large towns and cities in the North West Province. It shares its borders with the Free State province to the South, the Northern Cape Province to the West and the Republic of Botswana to the North. The DRSM [DC 39] is approximately 43 700 km² in size (41.67% of the total area of the North West province) and has an estimated population of 480 456 people (13.97% of the total population of the North West province). DRSM has the smallest population of all the district municipalities of the North West province. The DRSM comprises of five local municipalities namely:

- Naledi Local Municipality (NW392)
- ***Mamusa Local Municipality*** ***(NW393)***
- Greater Taung Local Municipality (NW394)
- Lekwa-Teemane Local Municipality (NW396)
- Kagisano Molopo Local Municipality (NW397)

The MLM is a Category B municipality and spans over an approximate area of 3 681 km² which equates to 7.8 % of the DRSM region. The town of Schweizer-Reneke is located 66 km south-east of Vryburg and 71 km west of Wolmaransstad. Schweizer-Reneke/ Ipelegeng is situated in the Harts River Valley. The MLM district is considered rural in nature with agriculture scattered all over the region. The municipal structure consists of five distinct nodes situated on prominent trade routes. The respective urban nodes are:

- **Schweizer-Reneke / Ipelegeng / Charon**
- Amalia / Molatswanene
- Glodina
- Migdol
- Avonster

The township of Ipelegeng is located on the western outskirts of Schweizer-Reneke. The location of the MLM is displayed in Figure No 1. The location of the Proposed Development in relation to Schweizer-Reneke / Ipelegeng is indicated in Figure 2. Figure No. 3 illustrates the topography of the focus area by means of a thematic map.

Figure No.1: Locality of the Mamusa Local Municipality

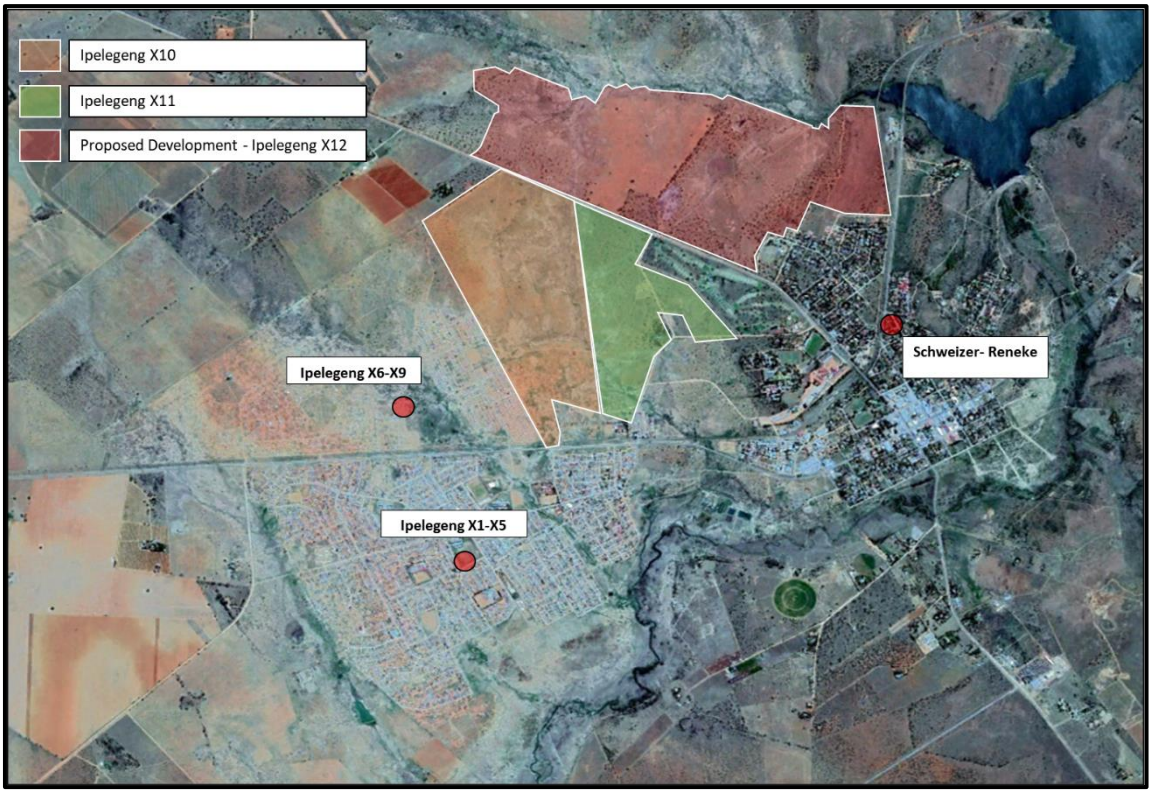

Figure No.2: Schweizer-Reneke/ Ipelegeng (Google Earth)

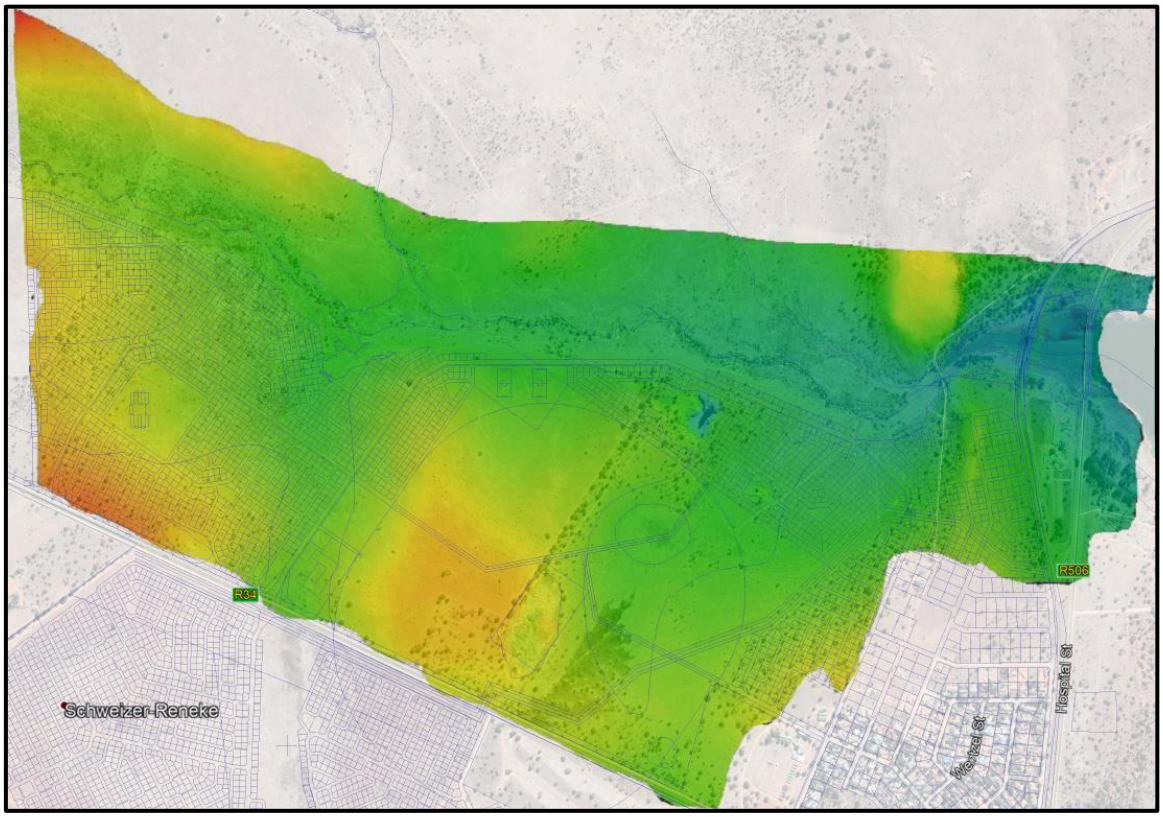

Figure No.3: Proposed Development Ipelegeng Ext. 12 - Thematic Map (Google Earth)

1.2 Proposed Development Area

The proposed development will be established northeast of the existing Ipelegeng Extension 9 township and northwest of the Schweizer-Reneke town. The R34 provincial road (Vryburg - Schweizer-Reneke) borders the Proposed Development to the south and a natural watercourse to the north. The Proposed Development will be established on the following portion of land:

Chief Surveyor Cadastral Spatial Data	
Farm Name	Schweizer-Reneke Town & Townlands 62 H
Parcel Number	RE/1/62
21 Digit Code or LPI	T0HO00000000006200000
Geometry Area	59 252 135.62 m²

Table No. 1 Cadastral Spatial Data (ArcGIS Web Application, 2020)

The above is illustrated on Figure 4 below, obtained from the Chief Surveyor General's electronic records (Cadastral Spatial Data Viewer):

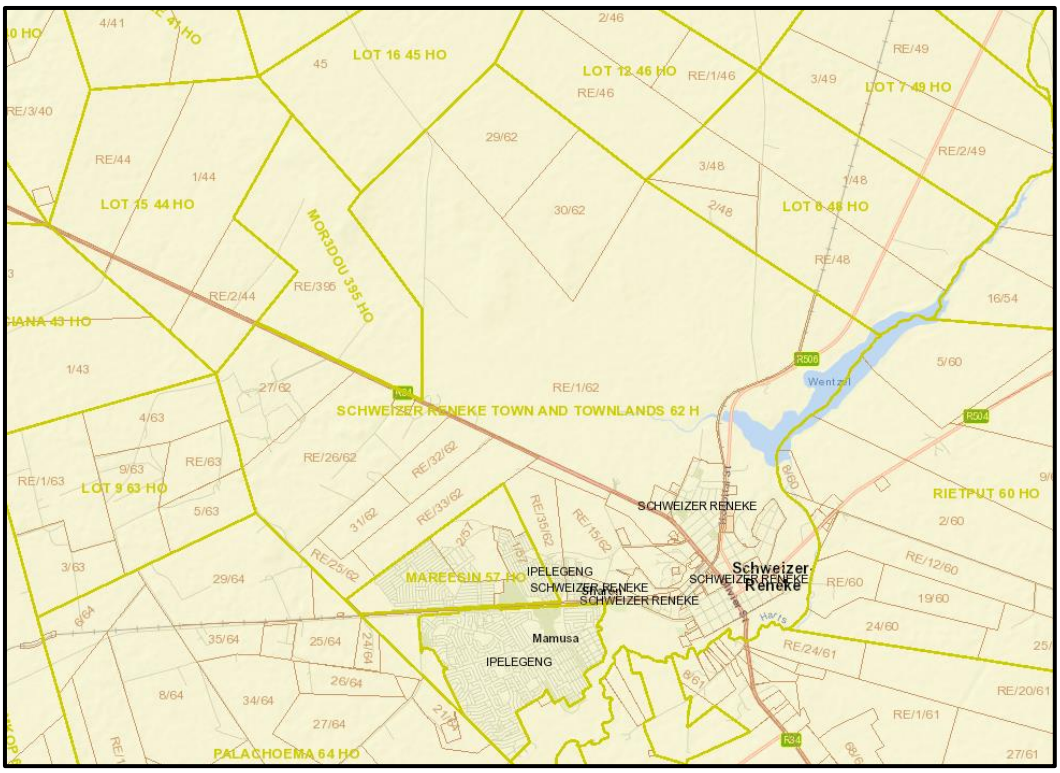

Figure No.4: Cadastral Spatial Data (ArcGIS Web Application, 2020)

The proposed development consists of 2 513 households on 2300 stands. The footprint area of the proposed development is approximately 292.9318ha. The average residential erven size is approximately 400m² with street reserves ranging from 10 meters to 20 meters. The proposed layout of Ipelegeng Extension 12 is illustrated in the image hereafter:

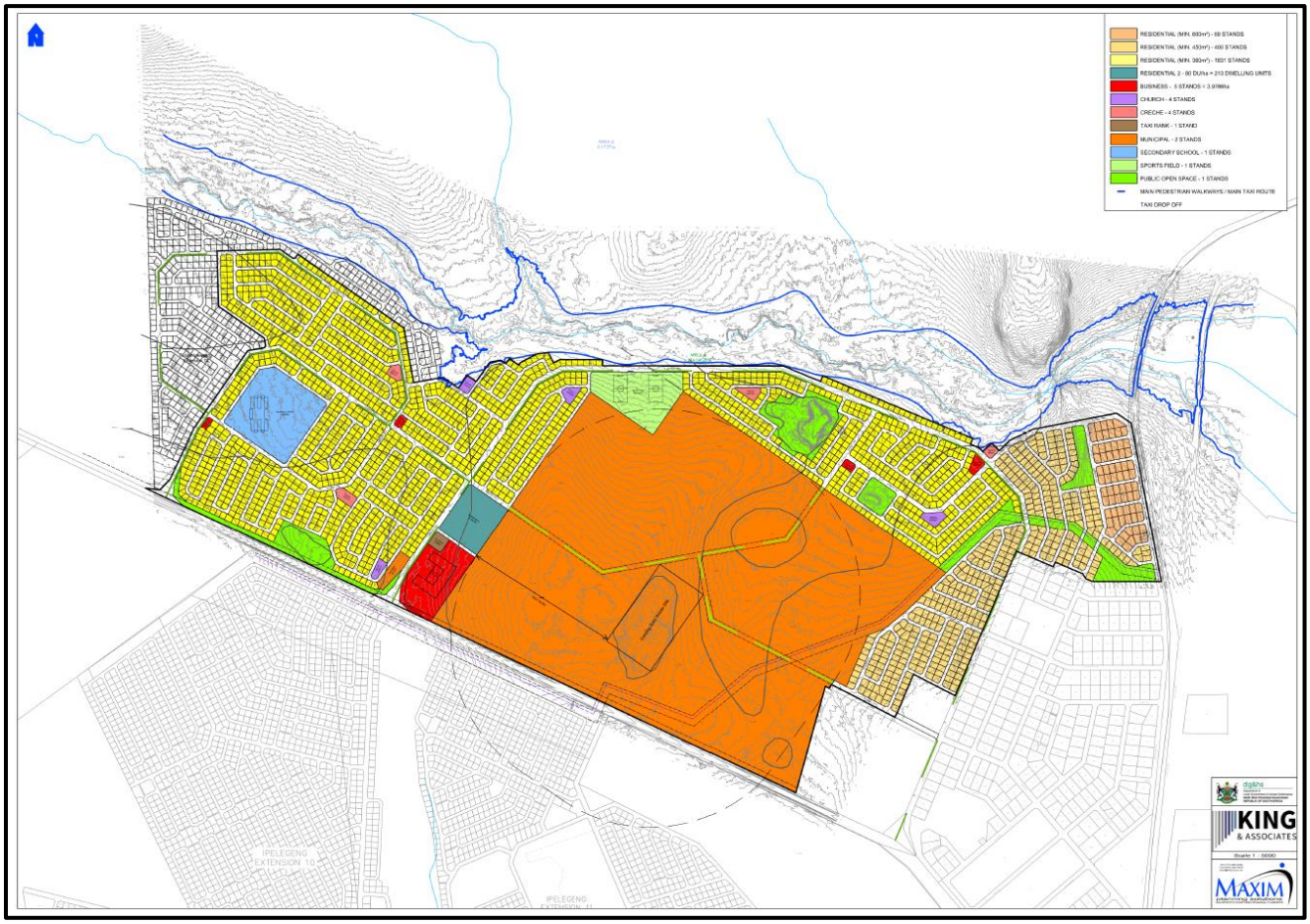

Figure No.5: Layout of Proposed Development (Maxim)

The proposed land use composition of the development (excluding public open space & streets) are as follows:

- 1 831 x Stands (Residential Minimum 360 m²)
- 400 x Stands (Residential Minimum 450 m²)
- 69 x Stands (Residential Minimum 600 m²)
- 213 x Dwelling units (Residential 2 – 80DU/ha)
- 5 x Business Stands (Business)
- 3 x Institutional (Church)
- 2 x Authority (Municipal)
- 4 x Institutional (Creche)
- 1 x Institutional (Taxi Rank)
- 1 x Institutional (Secondary School)

In addition to the natural occurrences (dongas etc.) the development area is reduced by the location of the existing landfill site.

The landfill site obtained a permit to operate as a **G:S:B -** municipal landfill site on the 1st of October 2001 in accordance with '*Section 20 of the Environment Conservation Act,1989 (Act 73 of 1989)*'. According to the above-mentioned permit, the Schweizer-Reneke landfill site requires a 500 m buffer zone severely affecting the available area for urban development.

1.3 Climate

The town has an average elevation of 1 320m above mean sea level and experiences a hot climate in summer with very low temperatures in winter. Frost generally occurs during the months of May to July. The average annual precipitation for the region ranges from 400 to 600 mm and the average evaporation rate is between 1 800 to 2 000 mm.

The highest monthly rainfall is experienced in February at an average of 65mm. A record rainfall year was experienced in 1974. The local weather station recorded a total annual precipitation of 759 mm. The average temperatures in MLM vary between 18.7°C in June to 32.5°C in January. The lowest night temperatures are experienced in July when the mercury drops to 0.7°C.

1.4 Vegetation

According to the Spatial Development Framework (SDF) "*the vegetation of the study area is predominantly part of the so-called savanna biome. The major factor determining the nature of the vegetation is the rock, soil types and climate, which determines the nutrients and moisture available for the vegetation. The general occurrence of veldt fires leads to species adapted to fire. Even with severe burning, most of the species can re-sprout from the stem base. This leads to the fact that the tree layer rarely becomes dominant. This factor together with frequent fires and grazing, keeps the grass layer dominant over large areas the broad physiographical of the municipal area which falls within the Eastern Kalahari Bushveld Region".* The vegetation sub-regions of the MLM region consist of the following:

- Kimberley Thornveldt
- Ghaap Plateau Vaalbosveldt
- Western Highveld
- Sandy Grassland
- Highveld Alluvial

1.5 Geomorphology & Geology

By using the Wellington (1955) classification, the region geomorphology can be divided into four regions, Southern Kalahari, Cape Middleveld, Highveld - Pre Karoo surface and Ghaap Plateau.

The Southern Kalahari and Highveld - Pre Karoo are the most dominant derivative of this region. The Southern Kalahari region forms part of the greater northern inland of the Republic of South Africa. This geomorphology region is characterised by calcareous deposits covered by aeolian sand. The Highveld Pre-Karoo region is located towards the southern boundary of the MLM and consists mostly of the Ventersdorp Supergroup.

According to the SDF, "*banded ironstone, chert, quartzite, greywacke, grit and schist, amphibolites, andesitic and riolithic lava, tuff and pyroclastic breccias of the Swazian Erathem are found to the west as well as the Allanridge Formation and the upper Platberg Group. The area to the east of Schweizer-Reneke is dominated by the Vryheid Formation (sandstones and shales) of the Karoo Supergroup. Small outcrops of tertiary calcrete are found in the extreme south east of the district as well as in small patches along the Harts River. Young Aeolian sand covers most of the south eastern portion of the district. Fluvial sediments border most of the areas adjacent to the Harts River".*

1.6 Demographics

Demographics is the study of a population based on factors such as age, race, and sex. Demographic data refers to socio-economic information expressed statistically including employment, education, income, marriage rates, birth and death rates and other factors. The following tables illustrate the general demographics of the MLM as per Census 2011:

Education (aged 20 +)	Census 2011
No Schooling	28.0 %
Some Primary	24.2 %
Completed Primary	5.9 %
Some Secondary	21.2 %
Matric	14.5 %
Higher Education	6.3 %

Table No. 2: Education (Statistics SA, 2011)

Employment Status	Census 2011
Employed	10 952
Unemployed	5 934
Discouraged Work Seeker	2 518
Not Economically Active	15 884

Table No. 3: Employment Status (Statistics SA, 2011)

Household Dynamics	Census 2011
Average household size	4.1
Female headed households	40.9 %
Formal dwellings	84.2 %
Housing owned	60.6%

Table No. 4: Household Dynamics (Statistics SA, 2011)

Household Services	Census 2011
Flush toilet connected to sewerage	83.2 %
Weekly refuse removal	52.6 %
Piped water inside dwelling	24.1 %
Electricity for lighting	84 %

Table No. 5: Household Services (Statistics SA, 2011)

1.7 Household income distribution

Main economic activities in the area include farming, diamond mining and various smaller businesses and industries. The North West Province is known for extreme poverty and deprivation especially in the DRSM region. The Greater Taung area is recorded as the most deprived community within the DRSM jurisdiction. The MLM is ranked as the third most deprived settlement within the DRSM region. The following table indicates the annual household income distribution for the MLM as per Census 2011:

Income	Percentage
No Income	15.6 %
R1 - R4,800	5.4 %
R4,801 - R9,600	10.6 %
R9,601 - R19,600	21.9 %
R19,601 - R38,200	21.6 %
R38,201 - R76,4000	11.9 %
R76,401 - R153,800	6.5 %
R153,801 - R307,600	4.1 %
R307,601 - R614,400	1.7 %
R614,001 - R1,228,800	0.4 %
R1,228,801 - R2,457,600	0.1 %
R2,457,601+	0.2 %

Table No.6: MLM – Household Income Distribution

1.7.1 Indigent Households

According to the MLM Indigent Support Policy, the term indigent is defined as follows:

'*Lacking the necessities of life. In interpreting this for the purpose of this policy a position has to be taken on the necessities of life in a South African context. The Constitution provides a guide in this regard, leading to the view that the following goods and services are considered as necessities for an individual to survive: Sufficient water, Basic Sanitation, refuse removal in denser settlements, Environmental health, Basic energy, Health care, Housing, Food and clothing" Anyone who does not have access to these goods and services is considered indigent'.*

The total number of indigent households can be derived from several sources. Either from the MLM indigent register or a surrogate can be calculated from Census 2011 data. The municipal indigent register is considered as inaccurate because there is no incentive for the beneficiaries to register, a rural household often receives free basic services regardless of their indigent status.

Calculating a surrogate indigent household population based on Census 2011 data will, in essence, be a more realistic reflection of the socio-economic demography of Ipelegeng. The estimated indigent households of the MLM is calculated as 62.7 % of the population.

It must be noted that the 2011 national census did not differentiate between the income of Schweizer-Reneke and Ipelegeng and the actual number of indigent households could be significantly higher.

2 Population

2.1 Current Population

According to Statistics South Africa, the town of Schweizer-Reneke consists of 9 829 households and an estimated population of 41 226 people (Stats SA – Census 2011).

The estimated population growth rate for the MLM is published as 2.21 % by Statistics South Africa however, Ipelegeng has experienced rapid growth since the 2011 Census was conducted.

The townships of Ipelegeng Extension 7,8 & 9 have since 2011 been populated. The Department of Human Settlements: North West has implemented several projects to fully service Ipelegeng Extension 7,8 & 9. Thus, the overall population of the town must be amended to include additional households.

The estimated current population of Ipelegeng (including Extension 7,8 & 9) was determined by multiplying the number of stands by the average household size. According to Stats SA, the average household size is 4.1 persons per dwelling. The table hereafter indicates the estimated current population of Ipelegeng inclusive of Ipelegeng Extension 7,8 & 9:

Urban Concentration	Stands	Population	Persons / Dwelling	Growth rate
Schweizer-Reneke & Roshunville	969	3 973	4.1	2.21
Charon	251	1 029	4.1	2.21
Ipelegeng X1 – X3	4977	20 406	4.1	2.21
Ipelegeng X4 – X5	2065	8 467	4.1	2.21
Ipelegeng X6	1085	4 449	4.1	2.21
Ipelegeng X7	979	4 014	4.1	2.21
Ipelegeng X8	1162	4 764	4.1	2.21
Ipelegeng X9	1022	4 190	4.1	2.21
Total	**12 510**	**51 291**		

Table No. 7 Population – Adjusted from Census 2011

It is estimated that the proclamation of Ipelegeng Extension 12 could potentially increase the population with 9 856 inhabitants. Parallel to the proclamation of the Proposed Development the Department of Human Settlements: North West intends to facilitate the township establishment of Ipelegeng Extension 10 & 11. Thus, the estimated future population has to include the aforementioned townships.

The following table illustrates the estimated future population upon completion of the Proposed Development:

Urban Concentration	Stands	Population	Persons / Dwelling	Growth rate
Schweizer-Reneke & Roshunville	969	3 973	4.1	2.21
Charon	251	1 029	4.1	2.21
Ipelegeng X1 – X3	4977	20 406	4.1	2.21
Ipelegeng X4 – X5	2065	8 467	4.1	2.21
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Ipelegeng X7	979	4 014	4.1	2.21
Ipelegeng X8	1162	4 764	4.1	2.21
Ipelegeng X9	1022	4 190	4.1	2.21
Ipelegeng X10 & X11	3 460*	14 186*	4.1	2.21
Ipelegeng X12 (Res 1)	2 300	9 430	4.1	2.21
Ipelegeng X12 (Res 2)	1	426	2	2.21
Total	**21 061**	**86 772**		

Table No. 8 Post Development Population

It is estimated that the future population of the settlement can theoretically increase with the proclamation of Ipelegeng Extension 10,11 & 12 to 86 772 persons or 21 061 stands as derived from Census 2011 data.

3 Bulk Water

3.1 Current Water Demand

Information with regard to actual water consumption is either not available or unreliable due to the infrequent reading of bulk meters and large-scale water leakages. Several of the bulk meters are out of order and are not repaired or replaced due to financial constraints. There are currently minimal bulk meters installed on supply lines. The MLM does not have the appropriate infrastructure components and management systems in place to measure the extent of such water losses and actual consumer demand.

Due to the lack of the afore-mentioned, the most probable theoretical water demand for the study area is calculated using a rational approach based on water consumption figures derived from the Guidelines for Human Settlement Planning and Design ("Red Book") published by the CSIR. The following table indicates the derived theoretical current water demand:

Area	Population	Water Demand (ℓ/c/d)	AADD (kℓ/d)	AADD (Mℓ/year)	GAADD (kℓ/d)	GAADD (Mℓ/year)
Schweizer-Reneke & Roshunville	3 973	250	993	363	1093	399
Charon	1 029	250	257	94	283	103
Ipelegeng X1 – X3	20 406	130	2 653	968	2918	1065
Ipelegeng X4 – X5	8 467	80	677	247	745	272
Ipelegeng X6	4 449	80	356	130	391	143
Ipelegeng X7	4 014	80	321	117	353	129
Ipelegeng X8	4 764	80	381	139	419	153
Ipelegeng X9	4 190	80	335	122	369	135
Total	**51 291**		**5 974**	**2 180**	**6 571**	**2 399**

Table 9: Current Water Demand - Red Book

Table Notes

**AADD - Average Annual Daily Demand*

***GAADD - Gross Average Annual Daily Demand (AADD x 1.1)*

The publication by the Water Research Commission (WRC) - *Water Consumption Levels In Selected South African Cities* (Van Zyl et al., 2007) was utilised to determine the water demand with an alternative method. The method is a rational approach by considering the socio-economic status of the user and applying the unit consumption rate of the distinct usage activity to an established frequency. The Van Zyl method yielded an '*Average Annual Daily Demand'* of 4,8 Mℓ / day for the settlement.

In summary, the 5.9 Mℓ / day determined by the CSIR method can be considered as the upper consumption limits and the 4,8 Mℓ / day established by the Van Zyl method as the lower daily usage. For this development, figures derived from the CSIR (Red Book) will be assumed to provide sufficient accuracy.

3.1.1 Post Development Water Demand

The following table illustrates the estimated water consumption upon completion of Ipelegeng Extension 10,11 & 12:

Area	Population	Water Demand (ℓ/c/d)	AADD (kℓ/d)	AADD (Mℓ/year)	GAADD (kℓ/d)	GAADD (Mℓ/year)
Schweizer-Reneke & Roshunville	3 973	250	993	363	1093	399
Charon	1 029	250	257	94	283	103
Ipelegeng X1 – X3	20 406	130	2653	968	2918	1065
Ipelegeng X4 – X5	8 467	80	677	247	745	272
Ipelegeng X6	4 449	80	356	130	391	143
Ipelegeng X7	4 014	80	321	117	353	129
Ipelegeng X8	4 764	80	381	139	419	153
Ipelegeng X9	4 190	80	335	122	369	135
Ipelegeng X10 & X11	25 625	80	1 135	414	1 248	456
Ipelegeng X12 (Res 1)	9 430	80	754	275	830	303
Ipelegeng X12 (Res 2)	426	80	34	12	37	14
Total	**86 772**		**8 812**	**3 217**	**9 694**	**3 538**

Table 10: Post Development Water Demand

The Van Zyl method yielded an '*Average Annual Daily Demand'* of 8.2 Mℓ / day for the settlement. In summary, the 8.8 Mℓ / day determined by the CSIR method can be considered as the upper consumption limits and the 8,2 Mℓ / day established by the Van Zyl method as the lower daily usage.

It must be noted that the theoretical water demand rates utilised to estimate the future water demand implies that the new consumers only use 80 ℓ/capita/day. The availably of ample drinking water tend to alter water consumption, this could substantially increase the water demand of the settlement. By implication, the new inhabitants could migrate from low volume water users to moderate water consumers. The migration will have a profound effect on the status quo as presented in this report.

3.1.2 Water Conservation & Wate Demand Management

There are currently no Water Conservation or Water Demand Management measures in place. By applying the standard IWA Water Balance model developed by Seago & Mckenzie and modified by the Department of Water Affairs to the Schweizer scenario. It is estimated that up to 3 Mℓ / day of potable water could be lost due to water leakages. Thus, it is critical to address this matter.

A funding application with motivation has been submitted for bulk water meters to be installed at strategic positions on the bulk supply lines as well as all existing supply tanks and reservoirs to apply early detection and management principles to water leakages.

3.2 Water Source

3.2.1 Ground Water & Wentzel dam

Raw water is obtained from four water sources namely the Wentzel dam, the Townlands Borehole Wellfield, the Palachoema boreholes and the Mareesin Farm Borehole Wellfield.

The Wentzel dam is the primary water source of Schweizer-Reneke/ Ipelegeng. The Harts River, which originates near Lichtenburg and flows for approximately 320 km before joining the Vaal River, is the main water source of the Wentzel Dam. The average long-term safe yield of the Wentzel Dam is 2.09 million m³/annum. The authorised uses from the dam equates to 1.624 million m³/annum (4.449 Mℓ/day).

Bulk water provision is supplemented in dry periods by the Townlands Borehole Scheme consisting of 15 boreholes with a supply potential of 1.3797 million m³/annum (3.78 Mℓ/day).

The Mareesin Farm Borehole Wellfield consists of six boreholes and has a supply potential of 0.63072 million m³/annum (1.728 Mℓ/day). The theoretical safe yield of the combined water sources equates to 9.957 Mℓ/day.

The El Niño phenomena induced a severe drought on arid communities of the North West Province from 2015 to 2018. The prolonged drought depleted surplus water in the Wentzel dam.

Borehole yields decreased over time as precipitation is the primary contributor to the resuscitation of aquifers. The volumetric yield of the borehole wellfields declined drastically until no water could be abstracted from any aquifers during the drought period. The below average precipitation left communities in the region on the verge of collapse during this period. The need for potable water led the inhabitants to drastic and in some cases criminal actions.

3.2.2 Mamusa Bulk Water Supply Scheme

The Mamusa Bulk Water Supply Scheme project entails water to be conveyed from the Vaal River to the Massouwskop reservoirs reducing the Mamusa community's dependence on unreliable groundwater.

Water is proposed to be abstracted from the Vaal River downstream of the Bloemhof Dam and pumped to Bloemhof WTW. Potable water will be pumped along the Bloemhof/Schweizer-Reneke road (58.5 km) to the Massouwskop Reservoirs.

Additionally, the hydraulic capacity of the Bloemhof abstraction works and water treatment works are proposed to be increased by the bulk project. The pipeline is due to deliver 1.721 million m^3 of water per annum in 2030. The project is implemented by DRSM and funded by the Regional Bulk Infrastructure Grant (RBIG) Programme. The Mamusa portion of the bulk water supply scheme project comprises of the following components:

- Bloemhof Pump Station
  Water will be abstracted from the clear water reservoir at the Bloemhof water treatment works and pumped to the elevated Olievenfontein storage tank.
- Pump line – (Bloemhof PS to Olievenfontein Reservoir)
  The pipeline will be a Ø 355 mm ND uPVC pipeline 25.1 km long.
- Olievenfontein pump station
  Water will be abstracted from the elevated Olievenfontein storage tank and pumped to the Vaalpoort storage tank (Ground Elevated).
- Pump line – (Olievenfontein Reservoir to Vaalpoort Reservoir)
  The pipeline will be a Ø 355 mm ND uPVC pipeline 22.9 km long.
- Vaalpoort storage tank
  Ground Elevated tank
- Supply Main – (Vaalpoort Reservoir to Massouwskop Reservoirs)
  Gravity pipeline will be a combination Ø 400 mm & Ø 355mm uPVC pipeline 11.3 km long

  The pipeline was estimated to be commissioned towards the end of 2021. However, the

global pandemic affected construction and will invariability delay the completion of the project.

3.3 Water Quality

Sedibeng Water has been appointed by DRSM for the Operations & Maintenance of the WTP. Water quality test results could not be obtained due to a confidentiality agreement between the water board and the DRSM.

The lobby group AfriForum conducted a national independent evaluation of water quality as well as the quality of WWTW's effluent in 2019. The project utilised the recognised water and wastewater standards to evaluate water quality. The independent report concluded that the drinking water produced by the WTP complied with SANS 241:1 water quality regulation. Recent water quality tests conducted on the water of the Mareesin Farm wellfield indicated that the abstracted water is fit for human consumption, class 0 (according to SANS 241:2006). No E.coli or Faecal coliforms were detected during microbiological determinant testing however, the test results for "Total Coliforms" exceeded the allowable concentration.

3.4 Bulk Water Infrastructure

The bulk water system of Schweizer-Reneke and Ipelegeng functions interrelated, however for the report purposes the dynamics of the systems will be explained individually. The basic components of the existing water infrastructure of the settlement are graphically illustrated in the figure below:

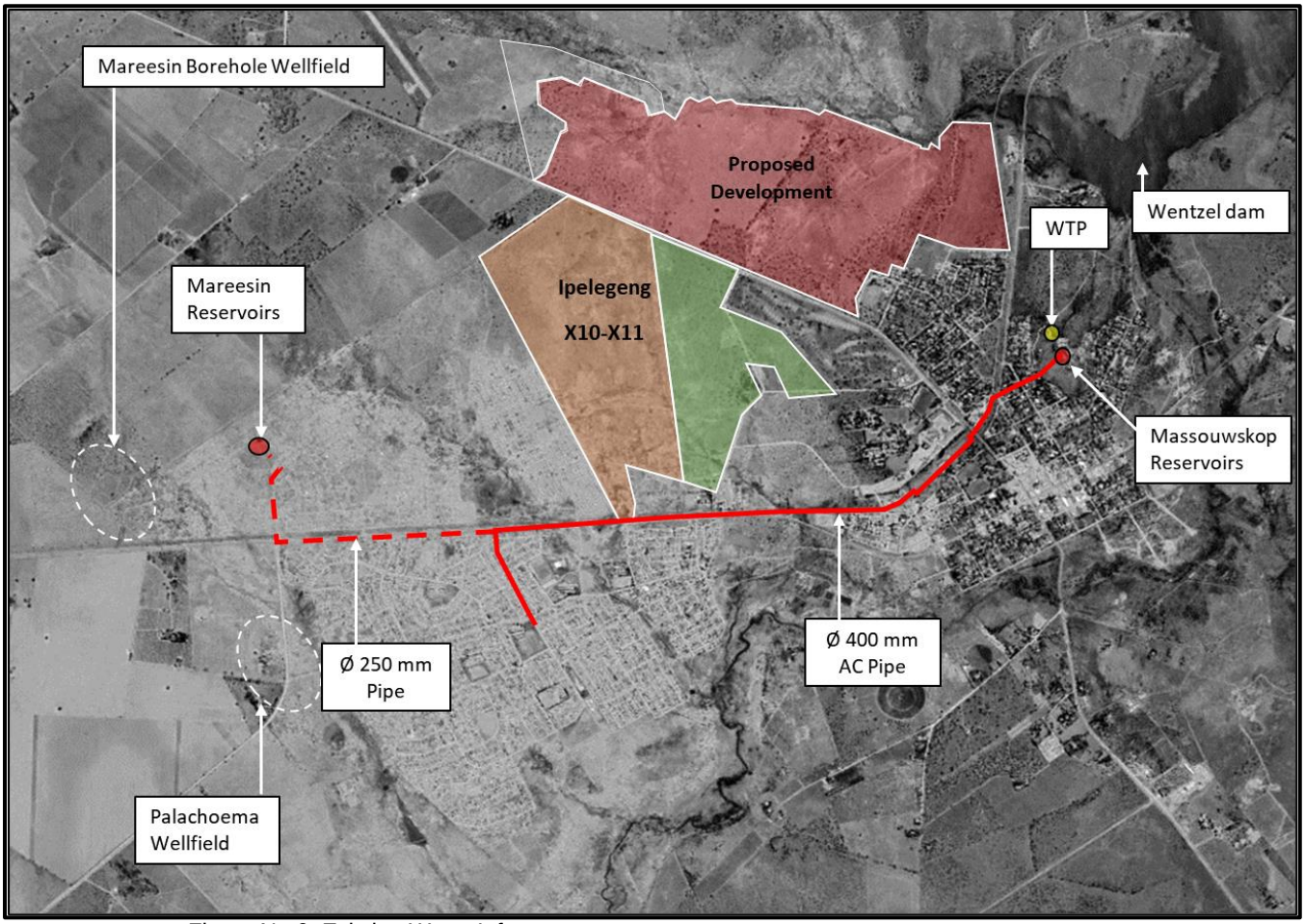

Figure No.6: Existing Water Infrastructure

The bulk water infrastructure of Schweizer-Reneke functions as follows:

- Raw water is abstracted from the Wentzel dam by means of two multi-stage water pumps located on the southern end of the dam wall and pumped to the WTP
- Additionally, groundwater is pumped from the Townlands Borehole Scheme to the WTP via a 300kℓ intermediate reservoir located in the vicinity of Wentzel dam
- Raw water is treated at the Schweizer-Reneke WTP and pumped into the Massouwskop reservoirs

- Treated water is distributed to the town of Schweizer-Reneke from the Massouwskop reservoirs

The bulk water infrastructure of Ipelegeng functions as follows:

- Treated water is supplied to Ipelegeng X1 – X5 from the Massouwskop reservoirs via a Ø 400 mm A/C pipeline.
- A Ø 250 mm pipeline is connected to the Ø 400 mm A/C line supplying limited water to the Mareesin Farm reservoirs.
- The Mareesin Farm reservoirs are supplemented with groundwater from the Mareesin Farm Borehole Wellfield as well as the Palachoema boreholes

3.4.1 Water Treatment Plant

The current 6Mℓ water treatment plant in Schweizer-Reneke was commissioned in 2004. The WTP utilises a combination of flocculation, sedimentation and filtration treatment techniques preceding chlorination to produce drinking water in compliance with SANS 241:1 water quality regulation. The WTP is designed to treat raw water with a varying degree of quality. The WTP can treat raw water which is highly eutrophic (algae infected) to water containing relatively high solid loads.

As time has passed, some components of the WTP aged due to normal wear and tear. The local municipality that previously operated the plant has kept the plant operating to the best of their ability given the limited financial resources. Substantial refurbishment of the plant has been completed by a previously implemented WSIG funded project implemented in the 2016/2017 financial year.

As previously noted, operation & maintenance of the plant has since been taken over by Sedibeng Water who has been appointed by the DRSM to oversee all bulk infrastructure in the district. Sedibeng has identified some operational challenges and deficiencies on the plant as well as Health & Safety requirements.

A business plan with the motivation to install new bulk water meters was submitted for the project. The project is implementation ready – awaiting funding approval.

3.4.2 Bulk Water Storage

The water reserves of Ipelegeng and Schweizer-Reneke are stored at two reservoir complexes. The Massouwskop Reservoirs complex consists of a 10 Mℓ, 5 Mℓ and 2.5 Mℓ circular concrete

reservoirs respectively. Water is supplied from the 10 Mℓ reservoir to Ipelegeng. The 5 Mℓ and 2.5 Mℓ reservoirs serve as storage nodes for the town of Schweizer-Reneke.

The theoretical water demand (AADD) for the Schweizer-Reneke supply region amounts to 0.993 Mℓ /day and the 4-hour instantaneous peak demand equates to 662 kℓ.

The Mareesin Farm Reservoirs is situated in Ipelegeng Extension 9 and consists of two 0.6 Mℓ steel press tanks constructed on 24 m high tank stands. One of the 0.6 Mℓ steel press tanks have collapsed in March 2021 damaging the stand of the other tank. Thus, currently no water can be stored in either of the reservoirs.

3.4.3 Water Distribution System

Ipelegeng Extensions 1 to 9 regularly experiences water shortages resulting in trickle flow at best. The water shortages in the area are the consequence of a combination of factors as briefly discussed below:

- The low water pressures and resulting water shortages in Ipelegeng can be contributed to the inability of the Mareesin Farm Reservoirs to supply water to Ipelegeng Extensions 4 - 9. The unreliable water source (Mareesin Farm Borehole Wellfield) is the root of the water related problems in Ipelegeng. The borehole wellfield does not have adequate capacity to supply the water demand of the supply region.

- The bulk Ø 400 mm AC distribution main supplying water to Ipelegeng has two major leaks causing excessive losses of potable water on a daily basis. Apart from the fact that the pipeline has reached the end of its design lifetime, asbestos cement is considered as a redundant material due to the negative health connotation.

- Ipelegeng Extensions 1 to 5 regularly experiences water shortages resulting in trickle flow at best. The lack of water in the area can be attributed to the problematic Ø 400 mm A/C distribution main as well as the topography of the township. As a result of the frequent water shortages, Ipelegeng Extensions 4 and 5 experience regular blockages and overflows on the sewer network.

Consultants have been appointed by the DRSM to implement a bulk project to rectify the above-mentioned challenges. A technical report was submitted for the project. The project is implementation ready – awaiting funding approval.

The proposed project entails upgrading of the bulk water infrastructure of the greater Schweizer-Reneke aimed at improving the water supply to Ipelegeng Extensions 4 - 9. This will involve the installation of bulk water pipelines of varying diameters as well as the construction of a new water pump station.

Changes to the existing configuration of pipework will also resolve pressure and supply problems experienced in Ipelegeng Extensions 1 - 3.

3.5 System Analysis

3.5.1 Water Balance

Based on the information derived from sub-sections above, the total potential bulk water supply to the settlement from existing and new infrastructure projects currently under construction is summarised as follows:

Ground Water - Townlands Borehole Scheme	=	3.78 Mℓ/day	(A)
Ground Water - Mareesin Farm Borehole Wellfield	=	1.73 Mℓ/day	(B)
Surface Water - Wentzel Dam	=	4.45 Mℓ/day	(C)
Mamusa Bulk Water Supply Scheme	=	4.72 Mℓ/day	(D)
Total	**=**	**14.68 Mℓ/day**	**(E)**

From the above, it is evident that adequate potential bulk water supply is theoretically available. However, it must be noted that in reality the actual supply potential will be considerably less than suggested by the figures above. Upon consultation with MLM staff, the report seeks to establish a more realistic estimate of the actual delivery of each water source. The following table presents an estimated actual volumetric supply of each source:

Water Source	Delivery Potential (Mℓ/d)	Estimated Source Exploitation	Estimated Potential (Mℓ/d)
Townlands Borehole Scheme	3.78	35 %	1.323
Mareesin Farm Borehole Wellfield	1.73	20 %	0.346
Wentzel Dam	4.45	65 %	2.893
Mamusa Bulk Water Supply Scheme	4.72	90 %	4.248
Total	**14.68**		**8.801**

Table 12: Estimated Available Bulk Water

As stated previously, the Proposed Development will increase the total water demand to 8.8 Mℓ/day (AADD). In the event that the respective water sources can meet the estimated potential (8.8 Mℓ/day) the increased water demand can theoretically be accommodated.

3.5.2 WTP Capacity Analysis

The Current AADD equates to 5.9 Mℓ/d and future AADD could increase to 8.8 Mℓ/day (Development of Ipelegeng X10, X11 & X12). The capacity of the WTP is 6 Mℓ/d. The WTP will not be able to meet the future water demand as is evident from the calculations below:

WTP Capacity (Current AADD)

= Design Capacity – Water Demand

= 6 – 5.9

= + 0.1 Mℓ/d

WTP Capacity (Future AADD)

= Design Capacity – Future Water Demand

= 6 – 8.8

= - 2.8 Mℓ/d

The Mamusa Bulk Water Supply Scheme will supply treated water to the Massouwskop Reservoirs. Thus, the capacity shortfall of the WTP can be mitigated by the Mamusa bulk water project.

3.5.3 Reservoir Capacity Analysis

In accordance with the Guidelines for Human Settlement Planning and Design (Red Book), the required storage capacity provided should comply with the water demand (AADD) for 48 hours.

Reservoir Capacity Analysis - **Current**

= Existing Storage - (AADD x 2)

= (10.0 + 5.0 + 2.5) – (5.9 x 2)

= 5.7 Mℓ

Reservoir Capacity Analysis - **Future** Water Demand (Ipelegeng X10, X11 & X12)

= Existing Storage - (AADD x 2)

= (10.0 + 5.0 + 2.5) – (8.8 x 2)

= - 0.1 Mℓ

As is evident from the above the Proposed Development will severely impact the bulk water balance of the settlement. It must be noted that although the reservoir capacity shortfall is only 0.1 Mℓ, the water balance was conducted on a low water consumption figure (80 ℓ/capita/day). The availability of abundant potable water could alter the water demand patterns. By implication, the water demand could escalate by as much as 3 Mℓ per day, resulting in a reservoir capacity shortfall of an estimated 6 Mℓ. Remedial actions will be addressed hereafter.

3.5.4 Proposed Water Infrastructure Augmentation

The success of the Proposed Development is dependent on the provision of adequate water to the proposed new townships by integrating the required new bulk water infrastructure into the existing supply system.

It is evident from the “Reservoir Capacity Analysis” section that the total reservoir capacity does not comply with the prescribed guidelines in terms of total storage. The inability of the bulk water system to comply with the prescribed guidelines could have a detrimental effect on the settlement due to numerous negative implications. The area designated for the proposed development is located northwest of the “New town” township of Schweizer-Reneke. The existing adjacent water reticulation network does not have the hydraulic capacity to accommodate the water demand of the proposed development. Thus new dedicated water infrastructure has to be constructed for the Proposed Development.

It is proposed that the total storage capacity be increased to compensate for the storage shortfalls by constructing a new reservoir on Massouwskop. The construction of a new concrete reservoir will have an excessive cost implication. Thus, it is proposed in the interim that the supply volume of the Mamusa Bulk Water Supply Scheme be augmented from existing sources to supplement for the capacity shortfall of the Massouwskop reservoirs. A dynamic hydraulic analysis must be conducted to establish the most economic tank configuration and required capacity.

In addition, it is proposed that a new bulk supply main be constructed to provide sufficient potable water to Ipelegeng Extension 10 to 12 from the Massouwskop reservoirs. It is proposed that the new supply main be routed along the R34 provincial road (Vryburg - Schweizer-Reneke). A portion of the pipeline will transect the “New town” township affecting several infrastructure components (Railway, roads, pipes, etc.). Water will be conveyed by means of gravity eliminating the need for a pumping station. The required bulk water infrastructure components are graphically illustrated below:

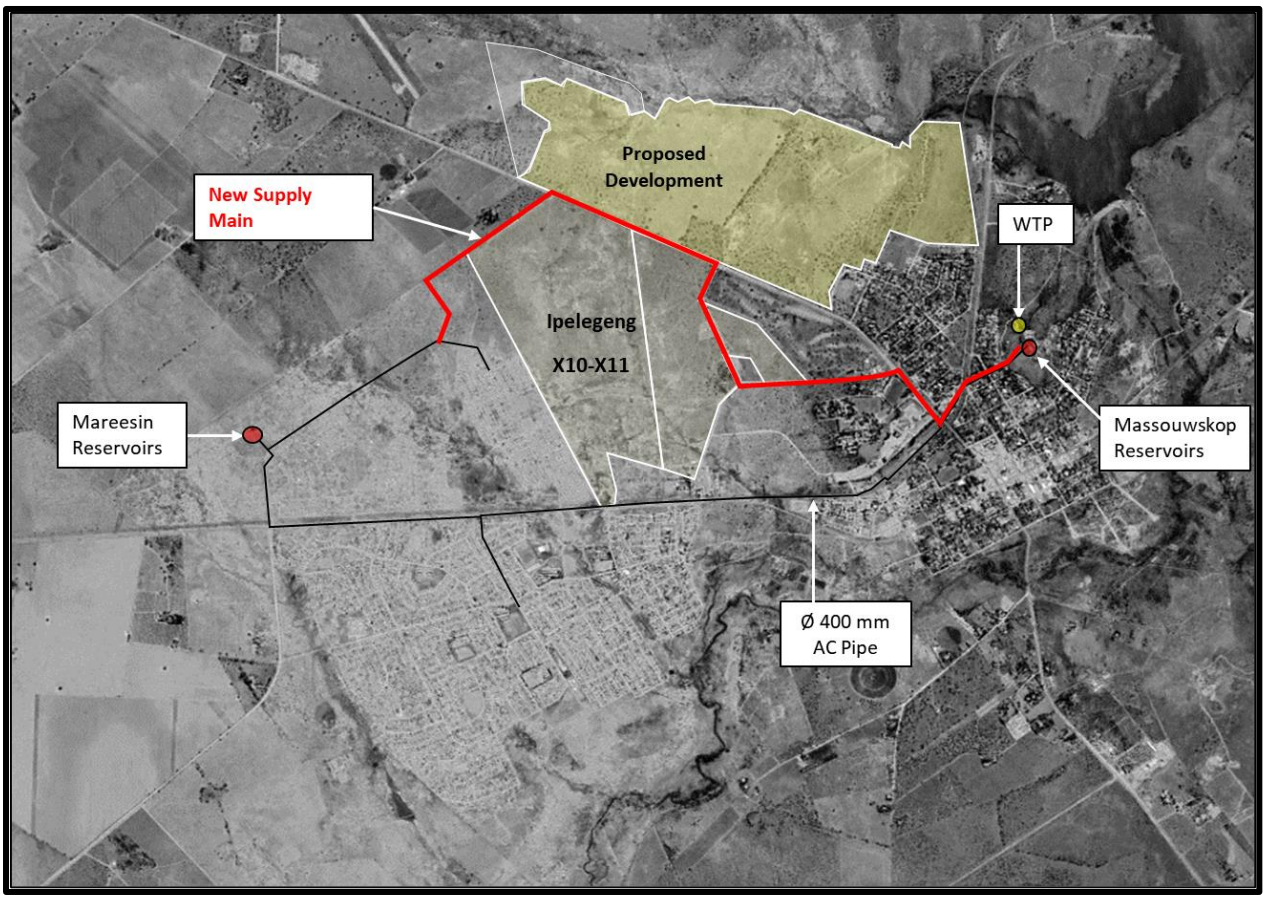

Figure 7. Proposed Bulk Water Infrastructure Augmentation

4 Wastewater

4.1 Current Wastewater Generation

Information regarding actual sewer volumes currently generated could not be obtained due to the absence of recorded influent flow data from the Waste Water Treatment Works (WWTW)

Due to the lack of the afore-mentioned, the most probable theoretical wastewater generation for the study area is calculated using a rational approach based on water consumption figures derived from the Guidelines for Human Settlement Planning and Design ("Red Book") published by the CSIR. The following table indicates the derived theoretical current wastewater generation:

Area	Population	Wastewater Generation (ℓ/c/d)	ADWF * *(kℓ/day)*	AWWF** *(kℓ/day)*	IPWWF*** *(ℓ/s)*
Schweizer-Reneke & Roshunville	3 973	125	497	571	17
Charon	1 029	125	129	148	5
Ipelegeng X1 – X3	20 406	125	2551	2 933	73
Ipelegeng X4 – X5	8 467	71	601	691	19
Ipelegeng X6	4 449	71	316	363	10
Ipelegeng X7	4 014	71	285	328	9
Ipelegeng X8	4 764	71	338	389	11
Ipelegeng X9	4 190	71	298	342	10
Total	**51 291**		**5 014**	**5 766**	**154**

Table 13: Current Wastewater Generation - Red Book

ADWF - Average Dry Weather Flow

AWWF - Average Wet Weather Flow (ADWF x 1.15)

IPWWF – Instantaneous Peak Wet Weather Flow

The previously mentioned WRC publication was utilised to establish wastewater generation with an alternative method. The method is a rational approach by considering the socio-economic status of the user and applying the applicable unit generation rate. The Van Zyl method yielded an '*Average Wet Weather Flow'* of 4,4 Mℓ / day for the settlement. In summary, the 5.7 Mℓ / day determined by the CSIR method can be considered as the upper daily wastewater generation limit and the 4,4 Mℓ / day established by the Van Zyl method as the lower wastewater generation volume.

For this development, figures derived from the Red Book (CSIR) will be assumed to provide sufficient accuracy.

4.1.1 Post Development Wastewater Generation

The following table indicates the calculated future wastewater quantities:

Area	Population	Wastewater Generation (ℓ/c/d)	ADWF * *(kℓ/day)*	AWWF** *(kℓ/day)*	IPWWF*** *(ℓ/s)*
Schweizer-Reneke & Roshunville	3 973	125	497	571	17
Charon	1 029	125	129	148	5
Ipelegeng X1 – X3	20 406	125	2551	2 933	73
Ipelegeng X4 – X5	8 467	71	601	691	19
Ipelegeng X6	4 449	71	316	363	10
Ipelegeng X7	4 014	71	285	328	9
Ipelegeng X8	4 764	71	338	389	11
Ipelegeng X9	4 190	71	298	342	10
Ipelegeng X10 & X11	14 186	71	1 007	1 158	30
Ipelegeng X12 (Res 1)	9 430	71	670	770	21
Ipelegeng X12 (Res 2)	426	71	30	35	1
Total	**86 772**		**7 533**	**8 663**	**205**

Table 14: Future Wastewater Generation - Red Book

The Van Zyl method yielded an '*Average Wet Weather Flow'* of 7,5 Mℓ / day for the settlement. In summary, the 8.6 Mℓ / day determined by the CSIR method can be considered as the upper daily wastewater generation limit and the 7,5 Mℓ / day established by the Van Zyl method as the lower wastewater generation volume.

4.2 Bulk Sewer Infrastructure

4.2.1 Waste Water Treatment Works

The total hydraulic capacity of the Schweizer-Reneke WWTW is 9 Mℓ//day. The WWTW comprises of two individual biological nutrient removal (BNR) plants that share an inlet works and all the generated sludge is pumped to an anaerobic lagoon scheme. The WWTW implements conventional treatment techniques to reduce the anthropogenic impact and produce an effluent complying with the "Allowable general limits", as required by the National Water Act, No. 36 of 1998.

Wastewater received by the WWTW tends to be of a low pH resulting in alkaline influent. The low alkalinity has several negative effects on the treatment process. Sedibeng Water has been appointed by DRSM for the Operation & Maintenance of bulk infrastructure in the district. The water board is reluctant to take over the WWTW mainly due to Health & Safety risks on the treatment facility.

Wastewater enters the treatment plant by means of an inlet works consisting of an Archimedean screw pump, mechanical screen, pista trap and venturi flume with an electronic flow meter. Hereafter wastewater flows into the biological reactor. The primary function of the reactor is to remove the biodegradable fraction of biological oxygen demand (BOD), Phosphorus compounds and Nitrogen. The reactor comprises of an anaerobic zone followed by an anoxic zone, aerobic zone, secondary anoxic zone and secondary aeration zone.

Mixed liquor flows from the biological reactor into a secondary clarifier where the treatment process is designed to remove biological growth and humus from the wastewater.

Settleable solids accumulate at the bottom of the structure and form a substance referred to as sludge. Fundamentally, the secondary clarifier separates wastewater (mixed liquor) and settleable solids (sludge). The effluent flows over the lander and gravitates towards the chlorination tank sump.

Activated sludge flows from the secondary clarifier via the flow control chamber to a sump adjacent to the pumping station. The returned activated sludge (RAS) is pumped from the sump by two RAS pumps to the biological reactor for recirculation.

Activated sludge flows from the biological reactor to a sump adjacent to the pumping station. The process is utilised to convey sludge to the sludge lagoons. The waste activated sludge (WAS) is pumped from the sump by two WAS pumps to the sludge lagoons.

Chlorine is applied to the effluent from the secondary clarifier to kill pathogenic micro-organisms before the final effluent discharge into the maturation lagoons. Chlorinated wastewater flows into the maturation lagoons from the contact tank before discharging into the Harts River.

The fundamental purpose of the maturation lagoons is to provide additional treatment in terms of BOD removal and disinfection in the form of exposure to ultraviolet rays to a lesser degree.

4.2.2 Wastewater Reticulation Network

As discussed earlier in the report, Schweizer-Reneke and Ipelegeng consist of a fully waterborne sewer system with the network installed in either midblock or street front position. The estimated length of the sewer lines installed in the two towns amounts to 139.1 km (Ipelegeng = 110.4 km & Schweizer-Reneke = 28.7km).

All wastewater generated gravitate towards nine strategically positioned pumping stations (three located in Schweizer-Reneke & six situated in Ipelegeng) from where sewer is pumped to the treatment works. The flowing figure illustrates the locality of the respective wastewater pumping stations:

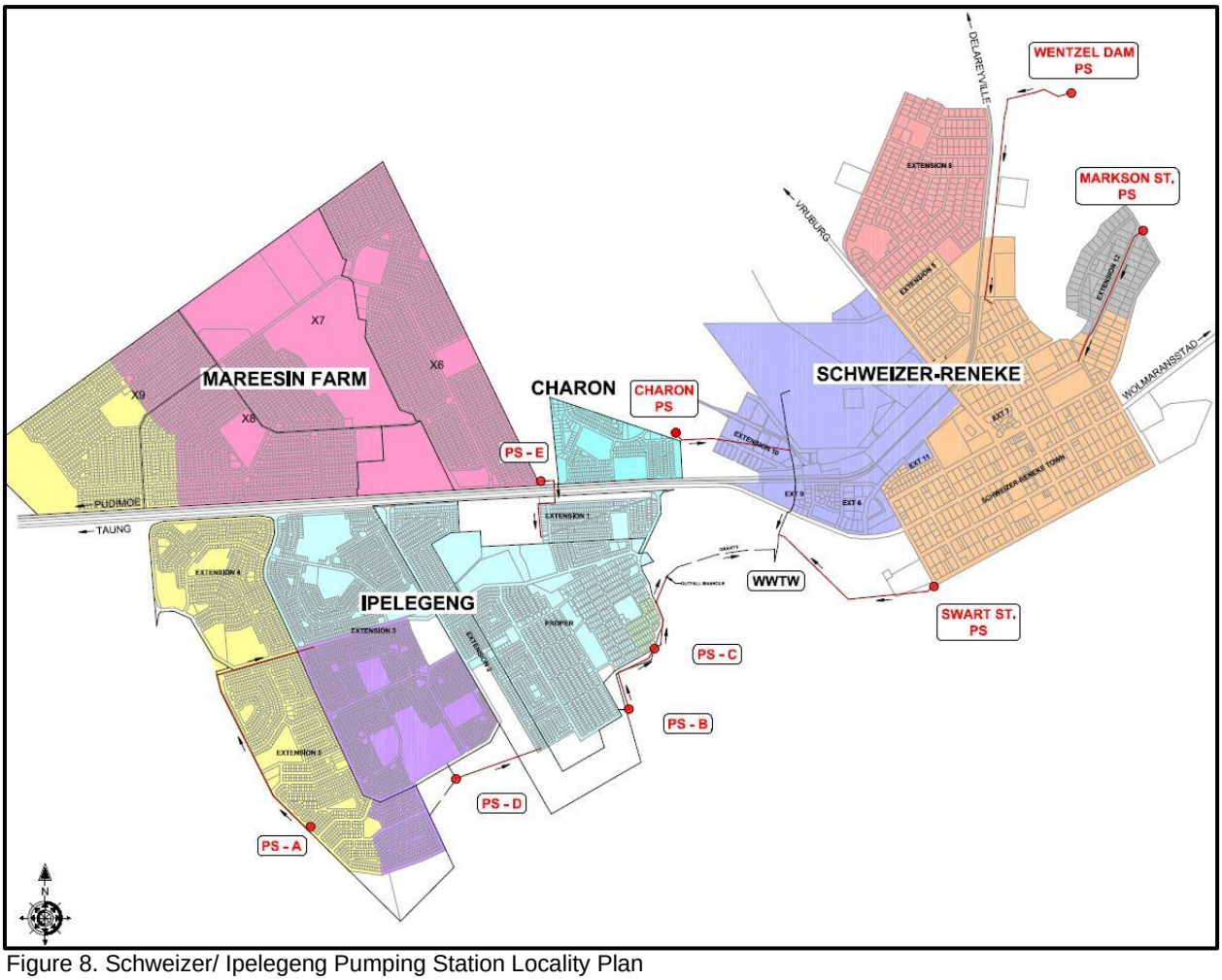

Figure 8. Schweizer/ Ipelegeng Pumping Station Locality Plan

4.2.3 Capacity Analysis of the WWTW

The existing WWTW has a combined treatment capacity of 9 Mℓ/day. As previously stated, the current theoretical wastewater generation of the settlement equates to 5.0 Mℓ/day and will increase to 8.6 Mℓ/day. The existing WWTW will have ample capacity to accommodate the increased wastewater loading induced by the Proposed Development as evident from the calculations below:

Existing WWTW Capacity – Future Sewer Generation

= Design Capacity – Existing Sewer Inflow

= 9 – 8.6

= 0 .4 Mℓ/d (4 % Remaining Capacity)

4.3 Proposed Bulk Sewer Infrastructure Augmentation

The successful implementation of the Proposed Development requires effective integration with the existing and new bulk sewer infrastructure. The natural topography of the demarcated area slopes in a northern direction towards the natural watercourse. The proposed internal wastewater network will follow the natural contours of the site. The topographical low point of the area is located on the north-eastern boundary of the site.

Due to the natural contours, the proposed new internal wastewater network cannot be integrated into the existing sewer infrastructure. The inability to integrate the wastewater network will require the establishment of several bulk sewer infrastructure components to achieve the successful development of the township.

It is proposed that a new sewer pumping station be constructed on the north-eastern boundary of the site. Additionally, it is proposed that a new rising main as well as a new outfall sewer line be constructed to convey wastewater to the existing WWTW. The afore mentioned outfall sewer will be utilised to convey generated wastewater of Ipelegeng Extension 10 & 11 as well.

The proposed new wastewater infrastructure components are graphically illustrated hereafter:

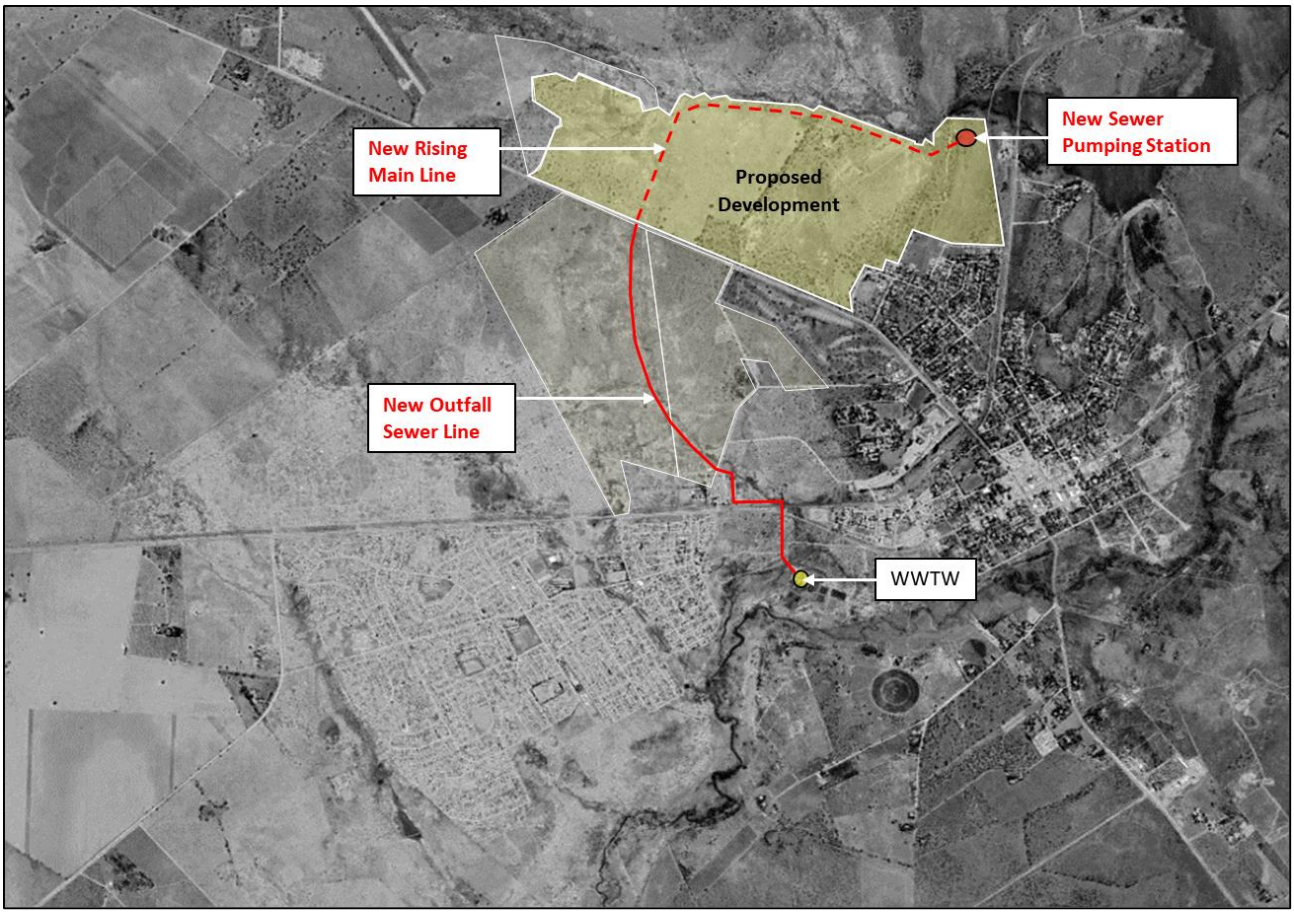

Figure 9. Proposed New Wastewater Infrastructure

5 Access

The Proposed Development is located north of the R34 road (Vryburg - Schweizer-Reneke). Primary access to the Proposed Development will be from the R34 road which was recently reconstructed where provision was made for an intersection as indicated in the figure below:

Figure No.10 Access to Proposed Development (Google,2020)

6 Storm Water

The Proposed Development is located in a valley with a natural stormwater low-point dividing the eastern and western portions of the development. The natural topography of the area slopes towards the storm water low-point and a watercourse to the north. Due to the natural topography, the area may be prone to stormwater erosion. Urbanisation of the demarcated area will increase the peak storm-water runoff (1-in-2 years recurrence interval) from 4.8 m^3/s to 11.3 m^3/s. The following figure indicates the direction of stormwater flow:

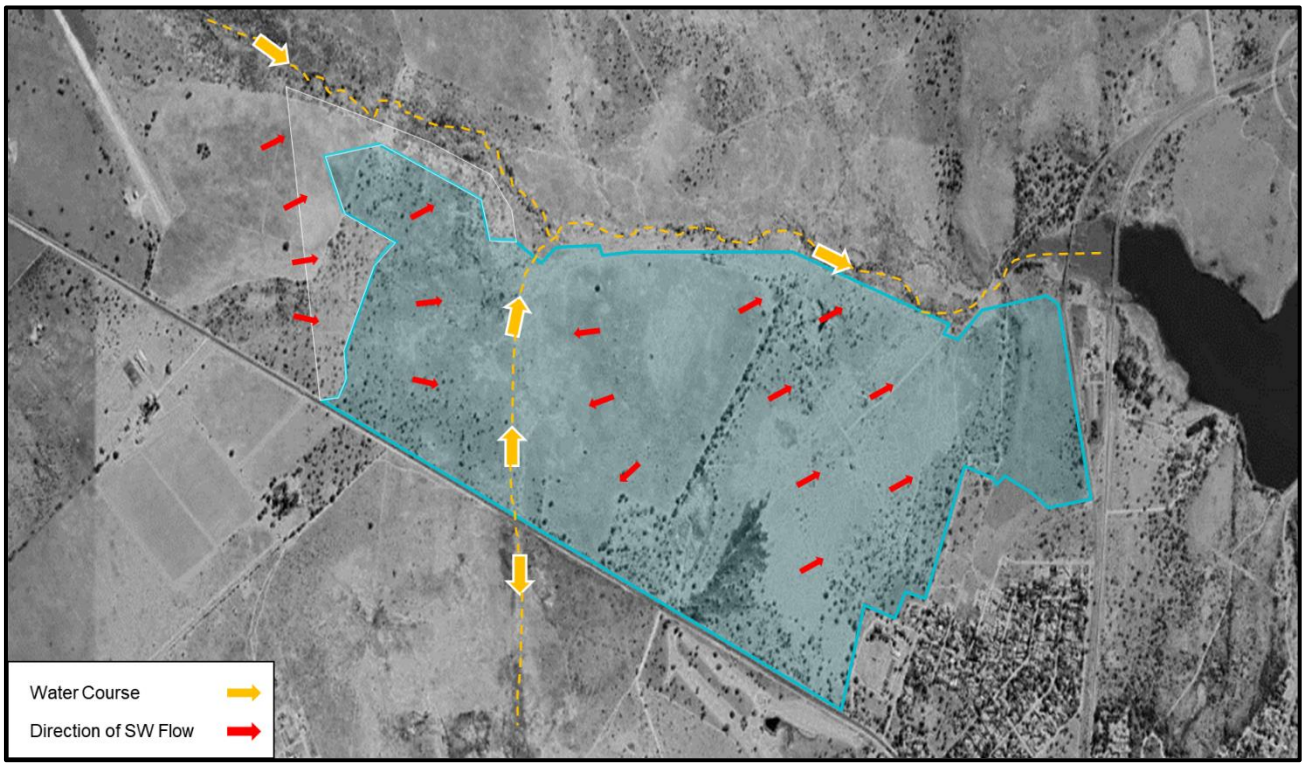

Figure No.11 Direction of Storm-water Flow (Google,2020)

Stormwater infrastructure will be designed to accommodate runoff as surface flow in an open system. This will be achieved by designing internal roadways to disperse stormwater towards the watercourses. Comprehensive information on stormwater attenuation should be presented in the detailed design report of internal services for approval by the municipality.

7 Municipal Solid Waste

Municipal Solid Waste (MSW) removal is a function of the Waste & Environmental Management Division of the MLM. According to the SDF: "*a black bag system is used and a special refuse truck. Large containers are also used in the industrial and business areas"* to facilitate MSW removal.

The community currently theoretically generates an estimated MSW volume of 89.9 tons per day. The Proposed Development will theoretically increase the estimated total MSW to 97.7 tons per day. The estimated increase in MSW will amount to 10.2m³ per day. The encouragement of an integrated waste management system will dramatically reduce MSW and promote Reduce, Reuse and Recycle practices.

As previously mentioned, the existing landfill site is located within the Proposed Development and operate as a G:S:B - municipal landfill site. According to the permit conditions the Schweizer-Reneke landfill site requires a 500 m buffer zone. It is proposed that the capacity of the current landfill site must be established and evaluated. The following figure graphically illustrates the landfill site and buffer zone:

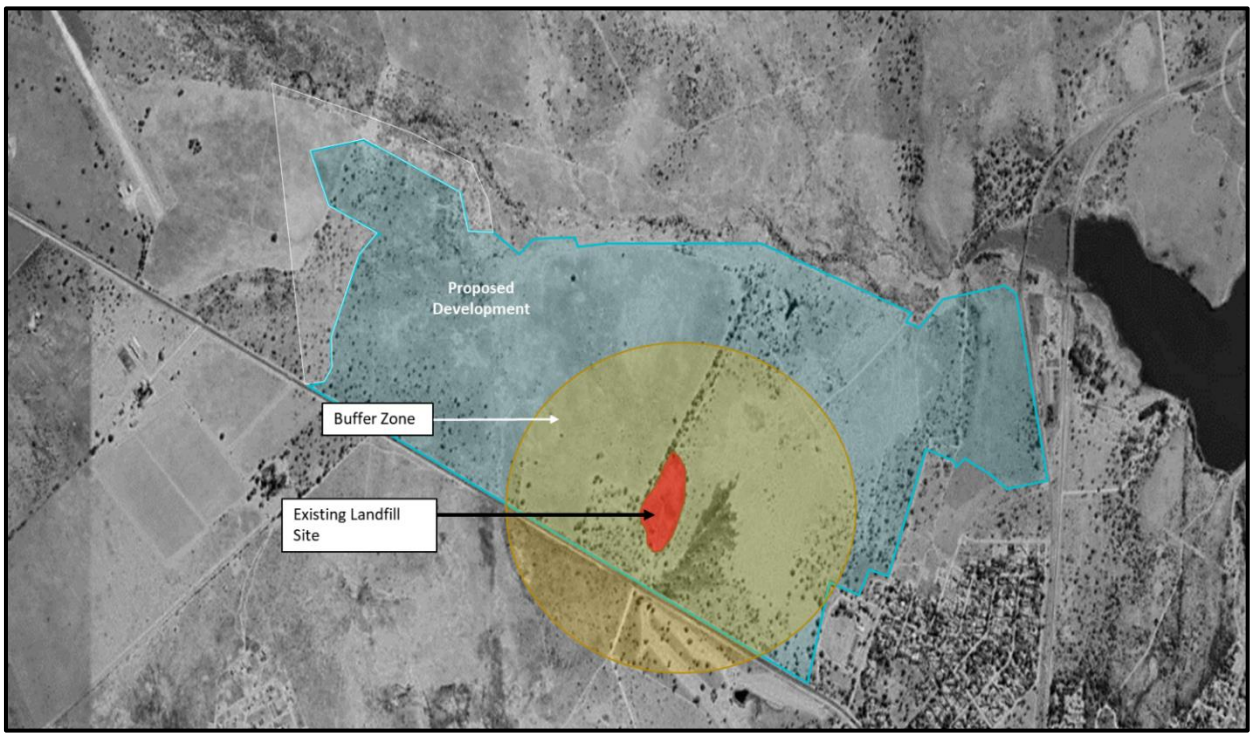

Figure No.12: Landfill (Google,2020)

8 Internal Services

8.1 Water

The design of internal services will be dependent on the final proposed development layout. The following design guidelines will be followed:

- The internal water supply network will consist of uPVC and/or HDPE pipes of varying diameter according to designs of the Civil Engineer.
- Sufficient storage capacity for water demand and fire water supply.
- Provision of isolating valves, air release valves and fire hydrants to comply with the requirements of the Local Authority and Building Regulations.
- Cognisance will be taken of pipe diameters and water pressure for firefighting purposes.

8.2 Sewer

Depending on the future development layout, an internal sewer network of Ø 110mm and Ø 160mm pipes with related Y-junction connections and inspection eyes will be installed to comply with the minimum specifications stipulated in the SANS 10400 Building Regulations. Manholes and rodding eyes will be constructed at necessary positions to allow for effective maintenance.

The internal sewer network will be connected to the new gravity outfall sewer as explained in Section 4.3 above.

8.3 Roads & Storm Water

The design of the internal access roads shall provide for an appropriate road surface with cross sections designed to accommodate the channelling of storm water generated on the development area.

Where storm intensity calculations dictate, sufficiently designed concrete channels will be constructed as part of the road cross section to channel storm water as described in the relevant section above.

Roads and storm water infrastructure will generally be designed to follow the natural runoff patterns to avoid ponding and flooding of properties with associated damage.

8.4 Refuse Removal

Refuse removal is currently conducted by the MLM and their services will be extended to the proposed development. Refuse shall be removed by the Municipality at regular intervals as required.

9 1-in-100 year Flood Line

The proposed development is affected by the 1-in-100-year flood line. Determination and certification of flood lines for the establishment of the Township is the responsibility of the appointed Specialist.

10 Operation and Maintenance of Services

All municipal services namely water, sewer, roads and stormwater, electricity infrastructure as well as refuse removal functions shall remain the function of the MLM which is responsible for the operation and maintenance thereof.

JWB HATTINGH (Pr Eng)

MOEDI CONSULTING ENGINEERS (PTY) LTD

ANNEXURE A

Services Drawing

J:\3890 Ipelegeng X12\Drgs\TP\IpelegengX12- Chandre.dwg

NOTES

- PROPOSED DEVELOPMENT
- NEW BULK SUPPLY MAIN
- NEW RISING MAIN
- NEW OUTFALL SEWER LINE

R34 TO VRYBURG

NEW RISING MAIN

PROPOSED DEVELOPMENT
IPELEGENG EXTENSION 12

NEW BULK SUPPLY MAIN

BULK WATER CONNECTION

WENTZEL DAM PUMPING STATION

NEW SEWER PUMPING STATION

IPELEGENG X10

CONNECTION TO EXISTING WATER NETWORK

MARKSON ST. PUMPING STATION

SCHWEIZER-RENEKE

MASSOUWKOP RESERVOIR

IPELEGENG X11

IPELEGENG X6

EXISTING WATER LINE

NEW OUTFALL SEWER LINE

MAREESIN FARM RESERVOIR

IPELEGENG X7-X9

R504 TO AMALIA

PUMPING STATION - E

EXISTING WWTW

IPELEGEN X1-X5

PUMPING STATION - C

REVISIONS

No.	DATE	BY	DESCRIPTION

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CLIENT

SIGNATURE

DATE

ARCHITECT
--

PROJECT

TOWNSHIP ESTABLISHMENT OF IPELEGENG EXTENSION 12

DRAWING TITLE

CIVIL ENGINEERING WATER AND SEWER

RESPONSIBLE PERSON		DATE	PROFFESIONAL ENGINEER
DESIGNED	--	--	JWB HATTINGH
DRAWN	FH DE BEER	07/20	PR No: 20170282
SURVEY	--	--	
CHECKED	JWB HATTINGH	07/20	
CONTACT	NARDUS HATTINGH		SIGNATURE

DRAWING PURPOSE	
PRELIMINARY	FOR TENDER
FOR APPROVAL	FOR CONSTRUCTION
REPORT	RECORD DRAWING

PRINT ISSUED ON 12/4/2021

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