water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

# THEMBISILE HANI LOCAL MUNICIPALITY

## CONSTRUCTION OF
## LUTHULI WASTE WATER TREATMENT WORKS

## PROJECT NO:
## THLM/SCM10/2022-23/TCS01

# TECHNICAL REPORT

**(DRAFT – AUGUST 2023)**


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*Disclaimer:* ***The report has been prepared in accordance with AFI Consult Quality Management System.***

## LIST OF ANNEXURES

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## LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| BNR | : | Biological Nutrient Removal |
| BOD | : | Biological Oxygen Demand |
| COD | : | Chemical Oxygen Demand |
| CCTV | : | Closed Circuit Television |
| DARDLEA | : | Department of Agricultural, Rural Development, Land and Environmental Affairs |
| DWS | : | Department Water and Sanitation |
| EC | : | Electrical Conductivity |
| IDP | : | Infrastructure Development Plan |
| SS | : | Suspended Solids |
| THLM | : | Thembisile Hani Local Municipality |
| TKN | : | Total Kjeldahl Nitrogen |
| WSDP | : | Water Services Development Plan |
| WSIG | : | Water Services Infrastructure Grant |
| WWTW | : | Waste Water Treatment Works |
| WULA | : | Water Use License Application |

# 1. EXECUTIVE SUMMARY

The Thembisile Hani Local Municipality initiated a project for the planning, design, construction and commissioning of a New Waste Water Treatment Works for a number of communities within their area of jurisdiction. The WWTW forms part of a Master Plan for the provision of bulk sewer infrastructure which will include bulk and internal reticulation networks.

The provision of the infrastructure is scheduled to be implemented over a period of 20 years subject to the order of priority as identified by the Municipality as governed by the needs from their local communities. Planning has been done to allow for parallel development of bulk and internal infrastructure to ensure that new infrastructure can be utilized with immediate effect as part of an integrated system and that no infrastructure will be redundant.

The total cost of implementation for this project amounts to a net present value of approximately ***R676M*** over a period of 20 years. It is anticipated that funding be made available by the Water Services Infrastructure Grant (WSIG) programme.

The provision of a formalized waterborne sanitation network and treatment facility to the various communities described in this report will enhance the living standards of these communities, thereby contributing to improved health and hygiene conditions in the communities and dignity to the people.

# 2. INTRODUCTION

## 2.1 Purpose and Objectives

The purpose of this project is to provide Bulk Sewer Infrastructure to serve various communities within the jurisdiction of the Thembisile Hani Local Municipality to enable safe and appropriate treatment of sewage.

The objectives of the project are to upgrade the existing on-site sanitation system as part of a Bulk Sewer Master Plan to a waterborne system with a centralized Waste Water Treatment Facility. The provision of this infrastructure will serve extensive areas within the Municipality with the aim to:

- Providing a higher level of service.
- Serving households with upgraded infrastructure.
- Improve health and hygiene conditions within the communities; and
- Upgrade standard of living.

## 2.2 General Description of Target Community and Location

### 2.2.1 Brief Project Description

The project covers an area of approximately 83km². The area falls within the middle Olifants River drainage region of Quarternary B31D. The area drains from South-East to North-West. A total of twelve (12) communities have been identified as contributors to this drainage area which include the following:

- Kwamahlanga A, B & C;
- Leratong;
- Zakheni;
- Leratong SP;
- Phola Park;
- Luthuli Village SP;
- Kameelpoortnek A & C;

- Enkeldoornoog A; and
- Sheldon

The approach to this project allows for the development of a Bulk Sewer Master Plan to serve the identified communities which will inter alia include internal sewer reticulation and outfall sewers to a centralized Waste Water Treatment facility. Master Planning has been done in such a way to allow for implementation in phases. This will enable sufficient time for approval of secondary phases, funding applications and allow for systematic provision of infrastructure in a structured manner.

### 2.2.2 Project Location

The project is located in Mpumalanga Province within the jurisdiction area of the THLM. The area is accessible via the R573 from Moloto to Marble Hall. The proposed position of the new WWTW is on the North-Western outskirts of the drainage area (Ward 22) at the following approximate position:

- 25º23'19.66"S
- 28º40'58.23"E

Refer to ***Annexure A*** for the Locality Plan.

### 2.2.3 Drainage Zones

The natural topography of the area dictates the drainage direction. The project area has been grouped into five (5) main drainage zones (A, B, C, D & E), as determined by the natural watersheds which predominantly drains in a North-Western direction towards the proposed location of the new WWTW. The main drainage zones have been divided into 18 sub-zones which allows for the drainage of smaller areas and subsequent breakdown of the area in workable packages. These work packages will be implemented in a phased approach in order of priority as identified by the THLM.

Refer to ***Annexure B and C*** *for the Main- and Sub-drainage Zones*.

## 2.3 Macro-planning Basis

The Thembisile Hani Local Municipality has identified the need for the formalization of a Bulk Sewer Master Plan. This Master Plan will facilitate the structured planning and provision of Bulk and Internal Sanitation Infrastructure in a coordinated way.

As part of their Intergraded Development Planning (IDP) and Sector Planning for Water and Sanitation Services, the Municipality has identified the need for a centralized Waste Water Treatment Facility.

The planning and development for such a facility will be done in parallel with the planning and development of Bulk and Internal Infrastructure to allow for implementation in a phased approach over a 20-year period.

This project is thus part of a multi-year project which will extend to **2046** with the implementation of 13 project phases. **Table 1** and **Figure 1** here below provides a summary of the proposed phasing.

***Table 1: Proposed Phasing***

| Phase | Outfall Sewer | Estimated Cost (Present Value) | Reticulation Area | Estimated Cost (Present Value) | Estimated Flow/Day | Cumulative Flow Mℓ/day | WWTW module Mℓ/day | Estimated Cost (Present Value) | Total Estimated Cost (Present Value) | Proposed Phasing (Year) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PD9;PD8;PD7 | R 27 026 718.39 | AD8 | R 3 500 000.00 | 0.32 | 0.32 | 3.0 | R 69 947 608.66 | R 100 474 327.04 | 2024/25/26 |
| 2 | PD6;PD5;PD4; | R 5 874 980.26 | AD6;AD3;AD7 | R 25 238 610.85 | 2.12 | 2.44 | | | R 31 113 591.11 | 2027 |
| 3 | PE3;PE2;PE1 | R 7 131 744.25 | AE1 | R - | 0.41 | 2.85 | 3.0 | R 69 947 608.66 | R 77 079 352.90 | 2028/29/30 |
| 4 | PD3;PD2 | R 4 960 337.96 | AD4;AD5 | R 19 443 991.31 | 0.97 | 3.82 | | | R 24 404 329.27 | 2031 |
| 5 | PD1 | R 1 539 995.53 | AD1 | R 15 954 504.99 | 0.74 | 4.55 | | | R 17 494 500.53 | 2032 |
| 6 | PB5;PC1 | R 2 281 806.65 | AC1 | R 12 848 464.99 | 0.61 | 5.16 | | | R 15 130 271.64 | 2033 |
| 7 | PB4;PB3 | R 4 267 029.63 | AB3;AB4 | R 19 371 882.22 | 0.90 | 6.06 | 3.0 | R 69 947 608.66 | R 93 586 520.51 | 2034/35/36 |
| 8 | PB1;PB2 | R 3 908 825.66 | AB1;AB2 | R 23 360 928.44 | 1.05 | 7.11 | | | R 27 269 754.09 | 2037 |
| 9 | PA3;PA2(0.5) | R 8 070 147.37 | AA3;AA4 | R 15 625 505.58 | 0.82 | 7.93 | | | R 23 695 652.94 | 2038 |
| 10 | PA2(0.5);PA1 | R 6 184 105.55 | AA5;AA1 | R 39 554 281.76 | 2.26 | 10.19 | 3.0 | R 69 947 608.66 | R 115 685 995.96 | 2039/40/41 |
| 11 | PC2 | R 1 698 429.44 | AC2; AA2 | R 17 347 989.62 | 0.80 | 10.99 | | | R 19 046 419.07 | 2042 |
| 12 | PD11 | R 1 419 570.40 | AD2;AD9 | R 36 580 389.15 | 1.97 | 12.97 | 3.0 | R 69 947 608.66 | R 107 947 568.21 | 2043/44/45 |
| 13 | PD10 | R 1 544 026.77 | AD10;AE2 | R 22 295 317.35 | 1.55 | 14.52 | | | R 23 839 344.12 | 2046 |
| | | **R 75 907 717.86** | | **R 251 121 984.68** | **14.516** | | **15.0** | **R 349 738 043.28** | **R 676 767 627.39** | |

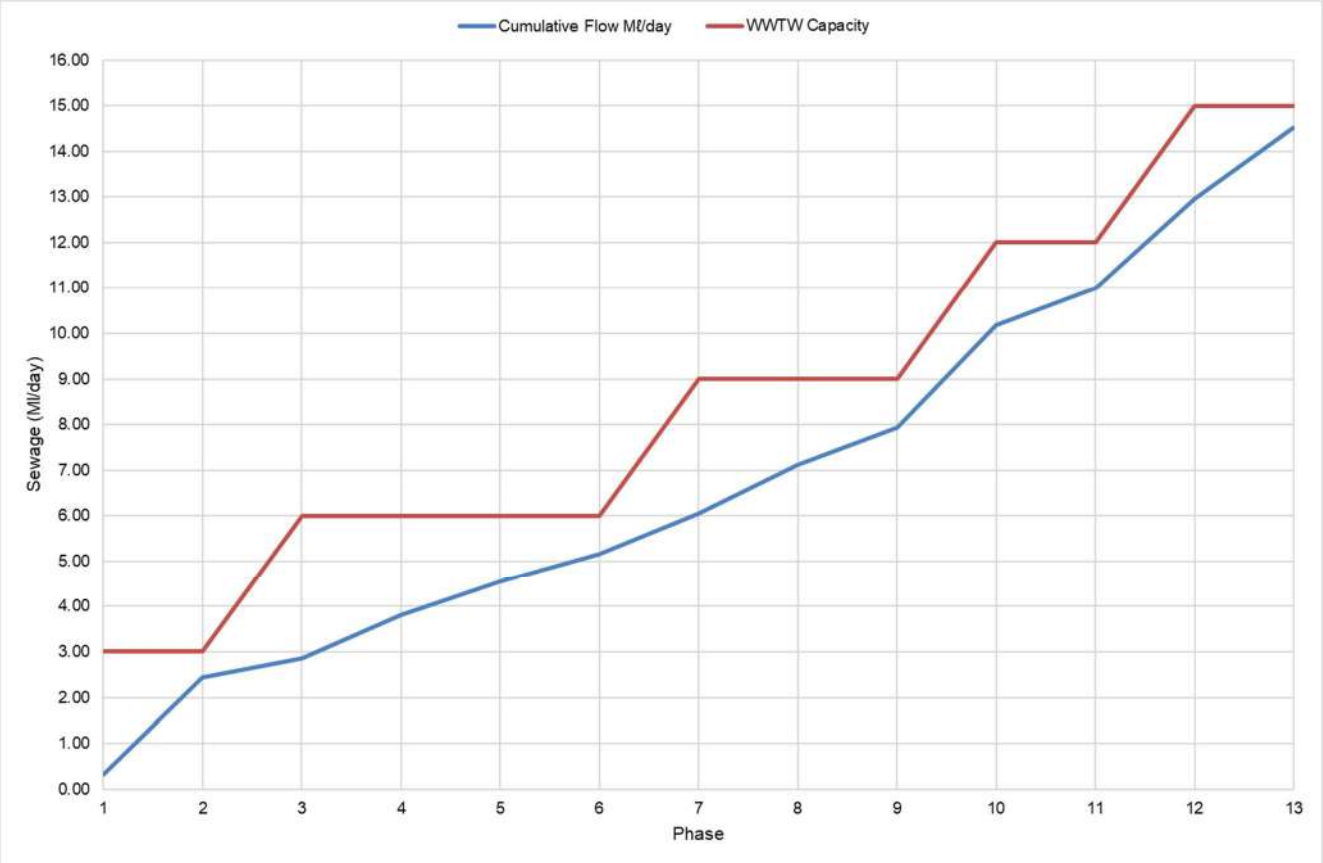



***Figure 1: Proposed Phasing – Cumulative Flow vs WWTW Capacity***

## 2.3.1 Population and Growth

The population figures were obtained from the Census 2011 database, Community Survey 2016 and the Local Municipality's Infrastructure Development Plan 2022-2027. A conservative approach was utilized to determine the growth projection and the expected population by the end of the approximate 20-year design period. The growth factor applied to calculate the latter averages to 1.42%.

The population and growth projections are summarized in **Table 2**.

***Table 2: Population and Growth***

| | Population | | | | | |
|---|---|---|---|---|---|---|
| | Census | Medium Growth (Average Rate - 1.42%) | | | | |
| **Village/Settlement** | **2011** | **2016** | **2019** | **2021** | **2030** | **2045** |
| KwaMhlanga A | 1821 | 1955 | 2051 | 2220 | 2315 | 2937 |
| KwaMhlanga B | 5294 | 5684 | 5961 | 6454 | 6730 | 8540 |
| Zakheni | 5098 | 5474 | 5741 | 6215 | 6481 | 8224 |
| Leratong | 5873 | 6306 | 6613 | 7160 | 7466 | 9474 |
| Leratong SP | 14032 | 15066 | 15801 | 17106 | 17839 | 22635 |
| PholaPark | 13505 | 14500 | 15207 | 16464 | 17169 | 21785 |
| LithuliVillage SP | 2557 | 2745 | 2879 | 3117 | 3251 | 4125 |
| Kameelpoortnek A | 9976 | 10711 | 11233 | 12162 | 12683 | 16092 |
| Kameelpoortnek C | 13864 | 14885 | 15611 | 16902 | 17626 | 22364 |
| Enkeldoornoog A | 13683 | 14691 | 15408 | 16681 | 17396 | 22072 |
| Kameelpoortnek F | 3500 | 3758 | 3941 | 4267 | 4450 | 5646 |
| KwaMhlanga C | 4200 | 4509 | 4729 | 5120 | 5340 | 6775 |
| Sheldon | 14800 | 15890 | 16665 | 18043 | 18816 | 23874 |
| **Total** | **108203** | **116175** | **121841** | **131910** | **137561** | **174543** |

## 3. CURRENT STATUS QUO OF THE PROJECT AREA

### 3.1 Types of Technologies

The communities of Kwamahlanga A & B are the best developed of all the communities with regards to potable water inside the dwelling and waterborne sanitation service levels.

There are currently two (2) operational oxidation pond facilities located on the Western and Eastern sides of Kwamahlanga A & B respectively. The pond systems are commonly referred to as the Western and Eastern Oxidation Ponds. The Western pond system treats sewage from the portion of Kwamahlanga A that has been serviced with waterborne sewer.

This system consists of a primary pond with a volume of approximately 8 940m³ followed by four (4) secondary ponds with a total volume of 5 090m³. Using a conservative detention period of 28 days the pond system can treat a flow of 500kℓ/d. The last Green Drop assessment of the Western Ponds logs the plant as a Class E plant with a design capacity of 500kℓ/d. Applying an average of 100ℓ/c/d sewage flow from a waterborne sewer system, the plant would be capable of treating effluent from 5 000 people.

The 2011 Census indicates that Kwamahlanga A consists of 519 households or 1 821 people, that is an average household size of 3.5 people per house. The system is thus sufficient for Kwamahlanga A. The Eastern Pond system treats sewage from the portion of Kwamahlanga B that has been serviced with waterborne sewer. This system consists of a primary pond with a volume of approximately 5 840m³ followed by four (4) secondary ponds with a total volume of 6 165m³.

Using a conservative detention period of 28 days the pond system can treat a flow of 430kℓ/d. The last Green Drop assessment of the Eastern Ponds logs the plant as a Class E plant with a design capacity of 500kℓ/d.

Applying an average of 100ℓ/c/d sewage flow from a waterborne sewer system, the plant would be capable of treating effluent from 4 300 people. The 2011 Census indicates that

Kwamahlanga B consists of 1 401 households or 5 294 people, that is an average household size of 3.8 people per house.

The system is thus slightly under capacity for Kwamahlanga B.

The neighboring communities of Tweefontein that falls in the adjacent drainage zone are served by an activated Sludge Treatment Plant. The treatment process allows for:

- Screening and grit removal.
- Biological Treatment.
- Clarification.
- Sludge handling; and
- Disinfection

### 3.2 Drainage Network

An existing drainage network has previously been installed. From the available data a total length of approximately 3.0km with a diameter of 160mm has been recorded. The condition of the existing system is unknown, and it will be advisable to conduct a detailed assessment on the system to evaluate its functionality in terms of capacity, level and alignment. This conditional survey to be conducted by a surveyor to confirm in-situ invert levels of all existing manholes in the system. From as-built survey data as well as estimated flows from the drainage area, hydraulic modelling of the system is advised to determine its functionality.

In addition, it is recommended that a CCTV inspection be conducted as part of the assessment to inform the condition of the pipelines. Should the system proof to be compliant to the normal design criteria, it must be incorporated into the Master Planning to form part of the proposed bulk drainage network.

### 3.3 Method of Disposal of Sewage Sludge (or pit latrine contents) and Grey Water

Most of the communities within the THLM use pit toilets, 20% have septic tanks and only 4% are serviced by waterborne system. (Thembisile Hani Local Municipality IDP 2022-2027). There are no sludge handling facilities at the Kwamhlanga East and West oxidation pond systems. Sludge handling at Tweefontein K WWTW allows for dewatering and drying on sludge drying beds. The dried sludge is used for filling of low laying areas or disposed of by incineration.

### 3.4 Operation and Maintenance

Operation and Maintenance on the existing systems are being conducted by the Engineering Services Department of the THLM. Any new sanitation infrastructure will sort under the same Department.

## 4. SCOPE OF NEW SANITATION PROJECT

### 4.1 Motivation for Selected Scheme

The provision of a WWTW has been identified by the Local Municipality as a priority, to provide formalized Waterborne Sanitation Infrastructure to the communities identified under Item 2.2 of the Report. These communities except for Kwamahlanga A and B do not have access to Waterborne Sanitation and still make use of on-site Sanitation Systems.

4.1.1 Influent Composition

Grab samples were taken at the inlet works of both Eastern and Western Pond systems to determine characteristics and strength of the influent in aid of determining a suitable process design. Characteristics of the influent are noted in Table 3.

***Table 3: Influent Composition***

| PHYSICAL & CHEMICAL DATA | SAMPLES | |
|---|---|---|
| **Analysis** | **West Pond Inlet** | **East Pond Inlet** |
| pH | 8.03 | 7.73 |
| Electrical Conductivity (EC) | 86.8 | 68.4 |
| Total Alkalinity | 263 | 227 |
| Chemical Oxygen Demand (COD) | 331 | 353 |
| Suspended Solids (SS) | 168 | 134 |
| Total Kjeldahl Nitrogen (TKN) | 35.0 | 30.0 |

4.1.2 Proposed Treatment Process

It is envisaged that effluent discharged by the proposed WWTW will be subject to the Special Limits prescribed by the DWS. A Biological Nutrient Removal (BNR) process is recommended. Various plant configurations for BNR technology exist and the final selection of appropriate technology will be informed by the test results from the composite sampling. The proposed process design allows for sewage with a high TKN:COD ratio, typically what would be expected of a mostly domestic effluent. Due to the small volume of influent generated by the current contributing communities and limited data on influent composition, the Engineer recommends utilization of design loading criteria for sewage with high domestic content.

The treatment process will typically allow for the following treatment units:

- Screenings and by-pass channel with mechanical manual screens respectively
- Grit channels
- Flow measuring
- Biological Reactor
- Final Clarifiers
- Was and RAS Pump Station
- Disinfection; and
- Sludge handling.

Refer to ***Annexure D*** attached hereto for the proposed process diagram.

4.1.3 General Plant Discussion

It is proposed that the Waste Water Works be planned, constructed and implemented in modular units of 3Ml/d treatment capacity. With the implementation of this approach, certain key components of the proposed works will be initially under-utilized but will provide sufficient spare capacity to accommodate growth in the projected sewage flows without unnecessary capital expenditure. These units will include the disinfection unit and the sludge drying facilities. Spare capacity in these units can be achieved with relatively low cost and can be utilized to offer buffer capacity.

The more costly components like the biological reactor and sedimentation tanks can be added to the system as and when the existing plant is utilized to an eighty percent capacity, allowing the remaining twenty percent to bridge the time required to procure the capital, design and implementation of the plant extensions.

Based on the projections, the first 3Ml/d unit will be constructed in 2024, the next unit in 2028 with a third unit in 2034. Projections after more than ten years become a matter for speculation and it is recommended that the report be reassessed after five to seven years, and the proposed implementation plan be revised accordingly.

The location of the plant in relation to the contributing drainage areas is important. The selection of the site is a function of land availability, drainage potential of future development as well as geological suitability of the proposed site.

Refer to ***Annexure E*** attached hereto for the Proposed Plant Layout.

## 4.2 Individual Components of the Proposed Sanitation Scheme

### 4.2.1 Sewer Drainage Networks

Preliminary planning allows for the drainage of the five (5) main drainage zones and eighteen (18) sub-drainage zones by means of outfall sewer lines which range in diameter from 160mm to 450mm. Pipe sizes have been calculated safe to the requirements of the design parameters as per Item 4.3 here below. The location of the outfall sewer lines allows for drainage under gravitational conditions and has been strategically placed to follow the natural topography.

The bulk infrastructure requirement for the five (5) main drainage zones is summarized in **Table 4** here below.

***Table 4: Bulk Infrastructure Requirement (Outfall Sewers)***

| DRAINAGE ZONE | Outfall Sewer | Diameter (mm) | Length (m) |
|---|---|---|---|
| DRAINAGE ZONE A | PA1 | 200 | 1250 |
| | PA2 | 315 | 7550 |
| | PA3 | 355 | 2100 |
| DRAINAGE ZONE B | PB1 | 160 | 1910 |
| | PB2 | 160 | 2900 |
| | PB3 | 200 | 1730 |
| | PB4 | 315 | 2000 |
| | PB5 | 315 | 420 |
| DRAINAGE ZONE C | PC1 | 160 | 2120 |
| | PC2 | 160 | 2090 |
| DRAINAGE ZONE D | PD1 | 250 | 1230 |
| | PD2 | 355 | 2370 |
| | PD3 | 355 | 1050 |
| | PD4 | 200 | 2050 |
| | PD5 | 250 | 810 |
| | PD6 | 355 | 2040 |
| | PD7 | 160 | 1910 |
| | PD8 | 400 | 1540 |
| | PD9 | 450 | 1220 |
| | PD10 | 160 | 1900 |
| | PD11 | 200 | 1530 |
| DRAINAGE ZONE E | PE1 | 160 | 5080 |
| | PE2 | 200 | 1240 |
| | PE3 | 250 | 1480 |
| **TOTALS** | | | **49520** |

4.2.2 Waste Water Treatment Works

The proposed WWTW is a BNR Plant with total treatment capacity of 15Mℓ/d implemented over a 20-year period. Planning allows for the extension of the plant in 3Mℓ/d units until full capacity is reached in 2045.

4.2.3 Serviceability of Infrastructure

The operation and maintenance tasks for the proposed new infrastructure will be the responsibility of the Local Municipality who is the Water Services Authority.

It is of critical importance that the proposed new infrastructure be included in a coordinated maintenance schedule to extend the life expectancy of the Bulk Infrastructure to optimize the operation of the system. The development of and implementation of a maintenance schedule will be prioritized by the Water Services Authority through their Water Services and Development Plan (WSDP) and Infrastructure Development Plan (IDP). The maintenance schedule will inter alia make provision for the following three categories with its associated staff requirements i.e.:

- Civil Components.
- Mechanical Components; and
- Electrical Components

## 4.3 Design Criteria

4.3.1 Design Parameters

The proposed bulk and internal sewer infrastructure was designed by utilizing the applicable design standards as per the Guidelines for Human Settlement, Planning and Design (Red Book). A summary of the most important parameters is recorded in **Table 5** here below:

***Table 5: Design Parameters***

| PARAMETER | GUIDELINE |
|---|---|
| Unit water demand | 100 – 200ℓ/c/d |
| Percentage sewage flow | 70% |
| Peak factor | 1.85 – 2.10 |
| Stormwater infiltration | 15% of design flow |
| Hydraulic calculations | Manning Equation with n = 0.010 – 0.013 |
| Pipe capacity | 70% at design flow |
| Velocity at full flow | Minimum: 0.7m/s<br>Maximum: 2.5m/s |

4.3.2 Water Demand and Sewage Volumes

The water demand was calculated by multiplying the population with the theoretical demand per capita (pending the income and level of service). A level of service between 100-200ℓ/c/d was utilized to calculate the water demand requirement for the project area.

The anticipated sewage flow volume was calculated as a percentage of the water demand. Due to the water demand being calculated based on the per capita demand for residential usage, the percentage allowance for sewage flow was calculated at 70%.

Two (2) scenarios were considered in calculating the current sewage flow volumes. ***Scenario 1*** allowed for the calculation of flows based on the current number of households which have access to flush toilets. This amounted to a current total sewage flow of approximately 1.1Mℓ/d.

***Scenario 2*** allowed for the calculation of flows based on the assumption that the entire number of households has access to a flush toilet. This amounted to a current total sewage flow of approximately 9Mℓ/d.

In calculating the capacity of a new WWTW over a 20-year design period, the flow calculated with ***Scenario 2*** was utilized as the base flow escalated at an average of 1.42% growth in intervals up until 2045. The total flow calculated at the end of the design period amounted to approximately 15Mℓ/d.

The estimated water demand and sewage volumes are summarized in **Table 6A** and **B** below.

***Table 6A: Water Demand and Sewage Volumes (Status Quo-2011)***

| Viilage/Settlement | Census 2011 Population | Households | Ave Household Size | Ave. Weighted Income (R/month) | Unit water demand (ℓ/c/day) | Household Flow (ℓ/house/day) | Sewage Flow (%) | Flush Toilets | Current Sewage Flow (kℓ/day) | Current Sewage Flow excl. KwaMhlanga (kℓ/day) | Fully Serviced Sewage Flow (kℓ/day) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| KwaMhlanga A | 1 821 | 519 | 3.5 | R 298 137.79 | 200 | 700.0 | 70% | 516 | 252.84 | 0.00 | 254.31 |
| KwaMhlanga B | 5 294 | 1 401 | 3.8 | R 247 898.93 | 180 | 684.0 | 70% | 1 395 | 667.93 | 667.93 | 670.80 |
| Zakheni | 5 098 | 1 380 | 3.7 | R 38 872.79 | 120 | 444.0 | 70% | 135 | 41.96 | 41.96 | 428.90 |
| Leratong | 5 873 | 1 605 | 3.7 | R 40 470.39 | 100 | 370.0 | 70% | 33 | 8.55 | 8.55 | 415.70 |
| Leratong SP | 14 032 | 3 771 | 3.7 | R 46 522.15 | 120 | 444.0 | 70% | 135 | 41.96 | 41.96 | 1172.03 |
| PholaPark | 13 505 | 3 513 | 3.8 | R 37 463.87 | 100 | 380.0 | 70% | 111 | 29.53 | 29.53 | 934.46 |
| LithuliVillage SP | 2 557 | 582 | 4.4 | R 44 360.75 | 120 | 528.0 | 70% | 27 | 9.98 | 9.98 | 215.11 |
| Kameelpoortnek A | 9 976 | 2 553 | 3.9 | R 40 397.41 | 100 | 390.0 | 70% | 111 | 30.30 | 30.30 | 696.97 |
| Kameelpoortnek C | 13 864 | 3 711 | 3.7 | R 41 180.42 | 100 | 370.0 | 70% | 195 | 50.51 | 50.51 | 961.15 |
| Enkeldoornoog A | 13 683 | 3 240 | 4.2 | R 36 807.04 | 100 | 420.0 | 70% | 183 | 53.80 | 53.80 | 952.56 |
| Kameelpoortnek F | 3 500 | 1 000 | 3.5 | n/a | 180 | 630.0 | 70% | n/a | n/a | n/a | 441.00 |
| KwaMhlanga C | 4 200 | 1 200 | 3.5 | n/a | 200 | 700.0 | 70% | n/a | n/a | n/a | 588.00 |
| Sheldon | 14 800 | 4 000 | 3.7 | n/a | 120 | 444.0 | 70% | n/a | n/a | n/a | 1243.20 |
| **Total** | **108 203** | **28 475** | | | | | | **2 841** | **1187.34** | **934.50** | **8974.18** |

***Table 6B: Sewage Volumes (Future Projections)***

| Village/Settlement | Census 2011 Population | Fully Serviced Sewage Flow (kℓ/day) | 2016 Population (1.4319% Growth) | Fully Serviced Sewage Flow (kℓ/day) | 2019 Population (1.6% Growth) | Fully Serviced Sewage Flow (kℓ/day) | 2021 Population (4.05% Growth) | Fully Serviced Sewage Flow (kℓ/day) | 2030 Population (0.4672% Growth) | Fully Serviced Sewage Flow (kℓ/day) | 2045 Population (1.6% Growth) | Fully Serviced Sewage Flow (kℓ/day) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KwaMhlanga A | 1 821 | 254.31 | 1955 | 273.72 | 2051 | 287.07 | 2220 | 310.80 | 2315 | 324.11 | 2937 | 411.24 |
| KwaMhlanga B | 5 294 | 670.80 | 5684 | 716.19 | 5961 | 751.12 | 6454 | 813.19 | 6730 | 848.03 | 8540 | 1076.01 |
| Zakheni | 5 098 | 428.90 | 5474 | 459.78 | 5741 | 482.21 | 6215 | 522.06 | 6481 | 544.42 | 8224 | 690.78 |
| Leratong | 5 873 | 415.70 | 6306 | 441.40 | 6613 | 462.93 | 7160 | 501.18 | 7466 | 522.65 | 9474 | 663.16 |
| Leratong SP | 14 032 | 1 172.03 | 15066 | 1265.53 | 15801 | 1327.25 | 17106 | 1436.93 | 17839 | 1498.50 | 22635 | 1901.35 |
| PholaPark | 13 505 | 934.46 | 14500 | 1015.00 | 15207 | 1064.50 | 16464 | 1152.47 | 17169 | 1201.85 | 21785 | 1524.95 |
| LithuliVillage SP | 2 557 | 215.11 | 2745 | 230.61 | 2879 | 241.86 | 3117 | 261.85 | 3251 | 273.07 | 4125 | 346.48 |
| Kameelpoortnek A | 9 976 | 696.97 | 10711 | 749.77 | 11233 | 786.34 | 12162 | 851.32 | 12683 | 887.79 | 16092 | 1126.46 |
| Kameelpoortnek C | 13 864 | 961.15 | 14885 | 1041.98 | 15611 | 1092.80 | 16902 | 1183.11 | 17626 | 1233.80 | 22364 | 1565.49 |
| Enkeldoornoog A | 13 683 | 952.56 | 14691 | 1028.38 | 15408 | 1078.53 | 16681 | 1167.66 | 17396 | 1217.69 | 22072 | 1545.05 |
| Kameelpoortnek F | 3 500 | 441.00 | 3758 | 473.49 | 3941 | 496.58 | 4267 | 537.62 | 4450 | 560.65 | 5646 | 711.38 |
| KwaMhlanga C | 4 200 | 588.00 | 4509 | 631.32 | 4729 | 662.11 | 5120 | 716.83 | 5340 | 747.54 | 6775 | 948.51 |
| Sheldon | 14 800 | 1 243.20 | 15890 | 1334.79 | 16665 | 1399.89 | 18043 | 1515.58 | 18816 | 1580.51 | 23874 | 2005.41 |
| **Total** | **108 203** | **8 974.18** | **116 175** | **9661.96** | **121 841** | **10133.19** | **131 910** | **10970.60** | **137 561** | **11440.61** | **174 543** | **14516.26** |

### 4.3.3 Special Design Considerations

#### 4.3.3.1 Land Availability

A Land Deed Survey was conducted by the Engineer on the identified area, and it was confirmed by the Provincial Deeds Office that the site is located on the Farm Kwamhlanga 617JR. The owner of the land is recorded as the Republic of South Africa thus informing State owned property. The current land user is recorded as the Manala (Mbongo) Tribal Authority who has jurisdiction over the land.

The Municipality's Planning Department informed that the property needs to be procured from the State (Department of Rural Development) prior to the development of any infrastructure. Status of the procurement to be confirmed by THLM's Planning Department. Protocol needs to

be followed to inform the Tribal Authority of the proposed project and procurement of land to obtain permission for the construction of new infrastructure on the property. This protocol needs to be confirmed and facilitated by the THLM through the office of the Mayor. Upon permission from the Tribal Authority the landowner should be informed accordingly. Written consent from the Department of Rural Development (being the property owner) needs to be obtained as part of an application to the Department of Agricultural, Rural Development, Land and Environmental Affairs (DARDLEA) to register the project in terms of the requirements of the Environmental Impact Regulations, 2014.

4.3.3.2 River and Stream Crossings

Several river and stream crossings were identified along the proposed pipeline routes. These crossings will necessitate pipe bridges or alternatively trench excavation with concrete encasing through the river/stream sections.

These river crossings will together with the effluent discharged from the WWTW require a Water Use License to be issued by the Department of Water and Sanitation (DWS). The provision of Outfall Sewers to drain the already reticulated areas of Kwamhlanga A and B will be implemented as Phase 1 of the project. It is therefore important that provision be made in the current financial year's (2023/24) budget for the Water Use License Application (WULA) in order to facilitate the timeous submission of the application.

4.3.3.3 Flood Line Determination

A flood line analysis needs to be conducted on the Enkeldoornspruit to guide the final position of the WWTW. Further flood line analysis will be conducted on all tributaries of the Enkeldoornspruit where pipeline crossings are anticipated. All new infrastructures will be located above the 1:100-year floodlines.

4.3.3.4 Geotechnical Survey

A geotechnical investigation will be required at the proposed site of the WWTW and the pipeline routes. The purpose of the investigation will be to provide sufficient information on sub-surface geotechnical conditions to inform suitable engineering design practices with regards to foundations and structural design of the new WWTW modules. The investigation will further inform the excavatability and usability of material along the proposed pipeline routes and advise on possible problem areas in terms of perched water tables, collapsible soils, excavation stability and workability.

4.3.3.5 Power Supply

The power requirements for a 15Mℓ/d Waste Water Facility will be approximately 1MW. An application to that effect needs to be lodged with Eskom for the provision of transmission power lines to the new Waste Water Treatment Works.

It is advisable that the application to Eskom allows for the total kV requirement of the power transmission lines to ensure that bulk power supply infrastructure is in place for the total power requirement of the plant. In that regard the capacity of bulk supply lines (22kV/11kV). The application for transformers can be done in conjunction with the plant extensions in 3Mℓ modules of which the first module transformer requirement will form part of the initial application.

4.3.3.6 Servitudes

The proposed pipeline routes will traverse residential, open areas and natural water courses. It is recommended that a 10m wide permanent servitude be registered along the proposed pipeline routes to allow for construction activities and access for future maintenance.

4.3.3.7 Wayleave Application

Wayleave applications will be submitted to all the relevant service authorities to obtain the following nl:

- Location of their existing services.
- Comment on the proposed WWTW and outfall sewer; and
- To obtain their requirements that need to be adhered to during construction.

This process will can facilitated by the Engineer as an Additional Service subject to agreement with the THLM.

## 4.4 Health and Hygiene Education

Health and Hygiene Education will be conducted under the auspices of the Municipal Health Services Portfolio. An education programme will be presented to the communities through the local community structures, which will entail the establishment of Health Committees in the relevant community wards. These committees will be trained as Health and Hygiene Community Workers and will be equipped to present field days on Health and Hygiene within their respective communities. Local schools will be included in the education programme and will facilitate the presentation of programs through their relevant life skills education subjects as part of their curriculum.

## 4.5 Proposed Job Creation Programme

Refer to **Table 7** below for the Proposed Job Creation Programme.

***Table 7: Training, facilitation, and capacity building scope of work***

| Module | Nature of Training | Methodology | Target beneficiaries | Proposed Training and Skills Development | Local Economic Development | Health & Hygiene Promotion |
|---|---|---|---|---|---|---|
| Pipe Laying Outfall Sewer | Excavation | Where hand excavation is required, in-field training will be conducted by principle contractor. | Skilled & unskilled local labour:<br>• Male<br>• Female<br>• Youth | Basic procedures:<br>• Trench width;<br>• Trench depth; and<br>• Trench Alignment | • Income generated;<br>• Sustainable income for project duration. | • Improved living standard is a direct result of income generated.<br>• Positive impact on overall health and hygiene. |
| | Bedding & Backfilling | In field training by principal contractor's skilled labour. | Skilled & unskilled local labour:<br>• Male<br>• Female<br>• Youth | Basic knowledge on excavation principles.<br>• Material classification;<br>• Compaction methods; and<br>• Test procedures. | • Income generated;<br>• Sustainable income for project duration. | • Improved living standard is a direct result of income generated.<br>• Positive impact on overall health and hygiene. |
| | Pipe Laying | In field training on correct pipe laying procedures. | Skilled & unskilled local labour:<br>• Male<br>• Female<br>• Youth | • Pipe laying procedures;<br>• Classification of pipe material<br>• Quality control procedures<br>• Installation of pipe accessories including valves, pipe specials etc.<br>• Pressure testing<br>• Minor concrete works i.e.: anchor blocks, chambers, etc. | • Income generated;<br>• Sustainable income for project duration. | • Improved living standard is a direct result of income generated.<br>• Positive impact on overall health and hygiene |
| Waste Water Treatment Works | Earthworks | Infield training by principal contractor and sub-contractors. | Local residents: (unskilled)<br>• Male<br>• Female<br>• Youth | • Basic Earthworks principals<br>• Operation of basic survey equipment<br>• Material properties and classification;<br>• Basic test procedures on materials;<br>• Operation of basic plant i.e.: LDV, TLB, Bomacs etc. | • Income generated;<br>• Sustainable income for project duration. | • Improved living standard is a direct result of income generated.<br>• Positive impact on overall health and hygiene. |
| | Concrete Works | In field training by principal contractor's skilled labour. | Skilled & unskilled local labour:<br>• Male<br>• Female<br>• Youth | • Training on formwork and carpentry;<br>• Steel piping and<br>• Sampling of test procedures<br>• Operation of basic plant ie: mixers, vibrator's, level equipment. | • Income generated;<br>• Sustainable income for project duration. | • Improved living standard is a direct result of income generated.<br>• Positive impact on overall health and hygiene. |

| Module | Nature of Training | Methodology | Target Beneficiaries | Proposed Training and Skills Development | Local Economic Development | Health & Hygiene Promotion |
|---|---|---|---|---|---|---|
| Administration | Bookkeeper | In field training by principal contractor's and nominated sub-contractors. | Skilled & unskilled local labour:<br>• Male<br>• Female<br>• Youth | Oversee all financial activities, collection of funds, banking, wage register, VAT etc.:<br>• Record keeping;<br>• Reporting;<br>• Liaison with Auditor's<br>• Liaison with funding organizations; and<br>• Stock control. | • Income generated;<br>• Sustainable income for project duration. | • Improved living standards is a direct result of income generated;<br>• Positive impact on overall health and hygiene. |
| | Administration Clerks | Infield training by principal contractor's and nominated sub-contractors. | Skilled & unskilled local labour:<br>• Male<br>• Female<br>• Youth | • Record of consumer base;<br>• Customer care;<br>• Quotations;<br>• Billing;<br>• Receiving payments;<br>• Issuing water accounts;<br>• Recording meter readings. | • Income generated;<br>• Sustainable income for project duration. | • Improved living standards is a direct result of income generated;<br>• Positive impact on overall health and hygiene. |
| | Maintenance Officers | In field training by principal contractor's and nominated sub-contractors. | Skilled & unskilled local labour:<br>• Male<br>• Female<br>• Youth | • Preventative maintenance on reticulation network;<br>• Repairs on reticulation;<br>• Ordering of materials; and<br>• Installation of household connections. | • Income generated;<br>• Sustainable income for project duration. | • Improved living standards is a direct result of income generated;<br>• Positive impact on overall health and hygiene. |

## 4.6 Operation and Maintenance

In considering the main components of the scheme as described under item 4.2 the following maintenance schedule is proposed.

***Table 8: Operational and Maintenance Schedules***

| ITEM | Hourly | Daily | Weekly | Monthly | Annually | Responsible Person |
|---|---|---|---|---|---|---|
| **Drainage Network** | | | | | | |
| • Attend to line blockages when reported | | X | | | | Maintenance Team |
| • Inspect manholes on the systems for boundaries and covers | | | X | | | Maintenance Team |
| • Monitor and repair settlement of material on pipe trenches | | | | X | | Maintenance Team |
| • Investigate pipeline routes for signs of leakage of breaks | | | | X | | Maintenance Team |
| **Administrative duties/activities** | | | | | | |
| • Record incoming flow readings in log sheets | | X | | X | | Operator/Manager Technical Servises |
| • Record average dosing of chlorine in log sheet | | X | | | | Operator |
| • Record hour meter readings of all pumps on site in log sheets | | X | | | | Operator |
| • Record Storage dam levels and record irrigation pump readings in logsheets | | X | | | | Operator |
| **Inlet works** | | | | | | |
| • Use rake to remove screenings from hand-raked screen bars | X | | | | | Operator |
| • Remove dry screenings from dry-bed and dump into container | | X | | | | Operator Maintenance Team |
| • Remove all silt and grit from inlet channels | X | | | | | Operator |
| • Remove/burn/bury all grit and dry screenings | | X | | | | Operator Maintenance Team |
| • Check operation of Flow Measurement system | | X | | | | Operator |
| • Check operation of Flow Data Recorder | | X | | | | Operator/Manager Technical Servises |
| **Pump stations** | | | | | | |
| • Check all overflow and connector pipe work for blockages | | X | | | | Operator Maintenance Team |
| • Check for any leakages on pipe work | | X | | | | Operator |
| • Listen for any abnormal noise coming from pumps and electrical motors | | X | | | | Operator |
| • Record pump meter readings and electrical AMP readings in shift logsheet | | X | | | | Operator |
| • Remove weeds around the pump station and water fringes | | | X | | | Operator Maintenance Team |
| • Collect screenings in wheelbarrow and place in bin | | | X | | | Operator Maintenance Team |
| • Check if the pumps operate on manual | | X | | | | Operator |
| • Check if the alarm system is working | | | | X | | Operator |
| **Biological Reactor** | | | | | | |
| • Check and remove any restrictions from the inlet and outlet weir | | X | | | | Operator |
| • Remove floating debris | | X | | | | Operator |
| • Visually check if the aerators are functioning properly and that the sludge is mixed effectively | X | | | | | Operator & Supervisor |
| • Check for excessive scum | | X | | | | Operator |

| ITEM | Hourly | Daily | Weekly | Monthly | Annually | Responsible Person |
|---|---|---|---|---|---|---|
| • Check for unusual noises and oil leaks from the motors and gearboxes | X | | | | | Operator & Supervisor |
| • Perform sludge tests | | X | | | | Operator & Supervisor |
| **Sedimentation Tanks / Clarifiers** | | | | | | |
| • Check that bridge is rotating | X | | | | | Operator & Supervisor |
| • Check that surface skimming mechanism is working | X | | | | | Operator |
| • Check that there are no loose plates in the tanks | | X | | | | Operator |
| • Skim floating debris from the surface | | X | | | | Operator |
| • De-sludge (If not automatic) | X | | | | | Operator & Supervisor |
| • Hose stilling box areas to reduce scum | | X | | | | Operator |
| **Sludge Digesters** | | | | | | |
| • Check for supernatant at all supernatant withdrawal points | X | | | | | Operator |
| • De-sludge towards drying beds | X | | | | | Operator & Supervisor |
| • Sludge mixing | | X | | | | Operator |
| **Sludge Drying Beds** | | | | | | |
| • Check that sludge is wasted to required depth | | X | | | | Operator |
| • Check that splash tabs are in place | | X | | | | Operator |
| • Sprinkle Lime to discourage flies | | X | | | | Operator |
| • Check that the media if filtering clear liquid by inspecting the flow from the under-drainage system | | X | | | | Operator |
| • Check when sludge is dry and ready for removal | | X | | | | Operator & Supervisor |
| • Communicate to responsible party the dried sludge can be removed | | X | | | | Operator & Supervisor |
| **Disinfection** | | | | | | |
| • Check the status and working of the alarm and test | | | | X | | Operator |
| • Check the availability of the correct Personal Protective Equipment [PPE] and their condition | | | | X | | Operator |
| • Check and test the working of the extruder fan | | | | X | | Operator |
| • Check and record the dosing rate of chlorine on the shift report | | X | | | | Operator |
| • Check the level of chlorine available in chlorine cylinder | | X | | | | Operator |
| • Check that enough full containers are available | | | | X | | Operator & Supervisor |
| • Check the condition of the building and doors | | | | X | | Operator & Supervisor |
| **General** | | | | | | |
| • Check and patrol the security fence and access gates | | X | | | | Operator |
| • Check the working of all electrical lights and plugs | | | X | | | Operator |
| • Check and inspect all buildings for any damages | | X | | | | Operator |
| • Check and repair access roads and internal roads in WWTW | | | | | X | Supervisor |

## 4.7 Cost Estimate

4.7.1 Capital Cost and economic analyses

Macro planning informs the project to be implemented in 13 phases over a period of 20 years. The total preliminary estimated cost for all 13 phases amounts to a direct cost of approximately ***R676 Million*** excluding VAT, professional and additional services.

Proposed costing for professional and additional services, operation and maintenance as well as economic evaluation of the project will be developed in conjunction with THLM as part of the project concept development stage.

# 5. STATUTORY REQUIREMENTS

## 5.1 Environmental Authorization

A Basic Environmental Assessment previous commissioned by the THLM informed the following:

- A wetland is located within 500m of the proposed site and effluent from the WWTW will be discharged into this system.
- The proposed outfall sewer lines will cross or be located within 500m of the Enkeldoorn Spruit and associated wetland.
- The proposed WWTW site borders an existing graveyard. The status of and future plans in terms of development of the graveyard needs to be established and confirmed by the THLM's Town Planning Department and the owner of the graveyard will have to be informed of the proposed project.

A Water Use License Application (WULA) will have to be compiled and submitted to the Department of Water and Sanitation (DWS) for approval. As part of the WULA, the following specialist studies will have to be commissioned nl:

- An aquatic study; and
- A wetland study.

These studies should form part of the Basic Assessment Report to inform the Department of Agriculture, Rural Development, Land and Environmental Affairs of the potential impact on the stream and associated wetlands.

## 6. REPORT APPROVAL

The project for the provision of Bulk Infrastructure comprising of a new water treatment works and the associated bulk and internal sewer infrastructure was approved by the full Council of the Thembisile Hani Local Municipality at its meeting dated ……., by way of a resolution taken on Item ……..

**PROJECT NAME:** Construction of Luthuli Wate Water Treatment Works

**PROJECT NUMBER:** THLM/SCM10/2022-23/TSC01

**PROFESSIONAL SERVICE PROVIDER:** AFI CONSULT (PTY) LTD

---

Mr. AD Watts

| Name (Print) | Signature | Date |
|---|---|---|

**For AFI Consult (Pty) Ltd**

| Name (Print) | Signature | Date |
|---|---|---|

**For Thembisile Hani Local Municipality**

**Project Management Unit (PMU)**

| Name (Print) | Signature | Date |
|---|---|---|

**For Thembisile Hani Local Municipality**

**Infrastructure and Technical Services Department (ITS)**

| Name (Print) | Signature | Date |
|---|---|---|

**For DWS National Resources Planning Department**

**THEMBISILE HANI LOCAL MUNICIPALITY**

**CONSTRUCTION OF LUTHULI WASTE WATER TREATMENT WORKS**

**PROJECT NO: THLMSCM102022-23TCS01**

# ANNEXURE A

## LOCALITY PLAN

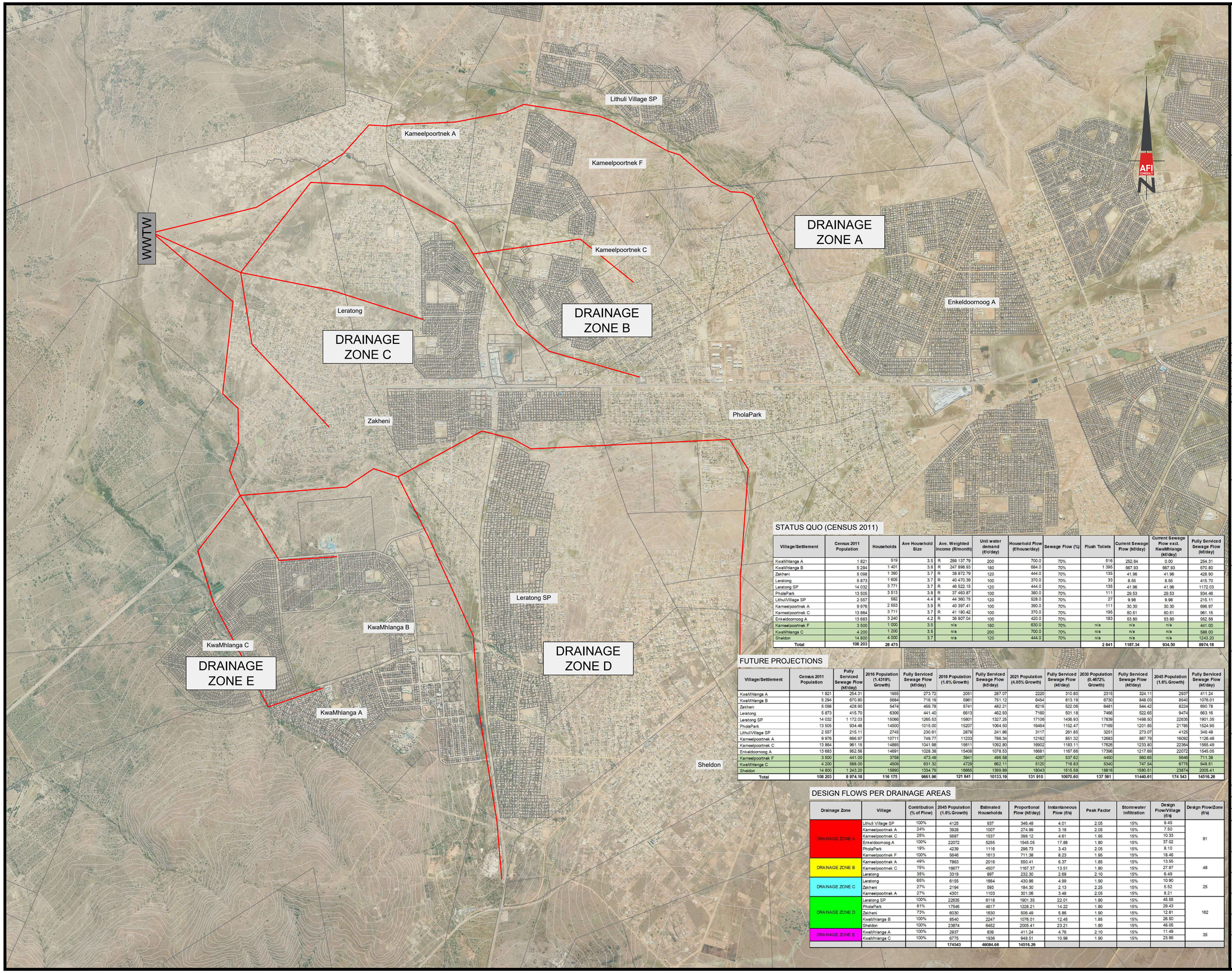
**THEMBISILE HANI LOCAL MUNICIPALITY**

**CONSTRUCTION OF LUTHULI WASTE WATER TREATMENT WORKS**

**PROJECT NO: THLMSCM102022-23TCS01**

# ANNEXURE B

## MAIN-DRAINAGE ZONES




NOTES

LEGEND

- DRAINAGE ZONE A
- DRAINAGE ZONE B
- DRAINAGE ZONE C
- DRAINAGE ZONE D
- DRAINAGE ZONE E
- VILLAGE BOUDARY
- OUTFALL SEWER



AMENDMENTS

| NO./CODE | DATE | INITIALS | DESCRIPTION |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

CLIENT

**THEMBISILE HANI LOCAL MUNICIPALITY**


PRIVATE BAG X4041
EMPUMALANGA,
0458
TEL: (013) 986 9100
FAX: (013) 986 0995
e-MAIL : info@thembisilehanilm.gov.za


PROJECT

# CONSTRUCTION OF LUTHULI WASTE WATER TREATMENT WORKS

DRAWING TITLE

## DRAINAGE ZONES AND FLOWS

STATUS QUO (CENSUS 2011)

| Village/Settlement | Census 2011 Population | Households | Ave Household Size | Ave. Weighted Income (R/month) | Unit water demand (ℓ/c/day) | Household Flow (ℓ/house/day) | Sewage Flow (%) | Flush Toilets | Current Sewage Flow (kℓ/day) | Current Sewage Flow excl. KwaMhlanga (kℓ/day) | Fully Serviced Sewage Flow (kℓ/day) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| KwaMhlanga A | 1 821 | 519 | 3.5 | R 298 137.79 | 200 | 700.0 | 70% | 516 | 252.84 | 0.00 | 254.31 |
| KwaMhlanga B | 5 294 | 1 401 | 3.8 | R 247 898.93 | 180 | 684.0 | 70% | 1 395 | 667.93 | 667.93 | 670.80 |
| Zakheni | 5 098 | 1 380 | 3.7 | R 38 872.79 | 120 | 444.0 | 70% | 135 | 41.96 | 41.96 | 428.90 |
| Leratong | 5 873 | 1 605 | 3.7 | R 40 470.39 | 100 | 370.0 | 70% | 33 | 8.55 | 8.55 | 415.70 |
| Leratong SP | 14 032 | 3 771 | 3.7 | R 46 522.15 | 120 | 444.0 | 70% | 135 | 41.96 | 41.96 | 1172.03 |
| PholaPark | 13 505 | 3 513 | 3.8 | R 37 463.87 | 100 | 380.0 | 70% | 111 | 29.53 | 29.53 | 934.46 |
| LithuliVillage SP | 2 557 | 582 | 4.4 | R 44 360.75 | 120 | 528.0 | 70% | 27 | 9.98 | 9.98 | 215.11 |
| Kameelpoortnek A | 9 976 | 2 553 | 3.9 | R 40 397.41 | 100 | 390.0 | 70% | 111 | 30.30 | 30.30 | 696.97 |
| Kameelpoortnek C | 13 864 | 3 711 | 3.7 | R 41 180.42 | 100 | 370.0 | 70% | 195 | 50.51 | 50.51 | 961.15 |
| Enkeldoornoog A | 13 683 | 3 240 | 4.2 | R 36 807.04 | 100 | 420.0 | 70% | 183 | 53.80 | 53.80 | 952.56 |
| Kameelpoortnek F | 3 500 | 1 000 | 3.5 | n/a | 180 | 630.0 | 70% | n/a | n/a | n/a | 441.00 |
| KwaMhlanga C | 4 200 | 1 200 | 3.5 | n/a | 200 | 700.0 | 70% | n/a | n/a | n/a | 588.00 |
| Sheldon | 14 800 | 4 000 | 3.7 | n/a | 120 | 444.0 | 70% | n/a | n/a | n/a | 1243.20 |
| **Total** | **108 203** | **28 475** | | | | | | **2 841** | **1187.34** | **934.50** | **8974.18** |

FUTURE PROJECTIONS

| Village/Settlement | Census 2011 Population | Fully Serviced Sewage Flow (kℓ/day) | 2016 Population (1.4319% Growth) | Fully Serviced Sewage Flow (kℓ/day) | 2019 Population (1.6% Growth) | Fully Serviced Sewage Flow (kℓ/day) | 2021 Population (4.05% Growth) | Fully Serviced Sewage Flow (kℓ/day) | 2030 Population (0.4672% Growth) | Fully Serviced Sewage Flow (kℓ/day) | 2045 Population (1.6% Growth) | Fully Serviced Sewage Flow (kℓ/day) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KwaMhlanga A | 1 821 | 254.31 | 1955 | 273.72 | 2051 | 287.07 | 2220 | 310.80 | 2315 | 324.11 | 2937 | 411.24 |
| KwaMhlanga B | 5 294 | 670.80 | 5684 | 716.19 | 5961 | 751.12 | 6454 | 813.19 | 6730 | 848.03 | 8540 | 1076.01 |
| Zakheni | 5 098 | 428.90 | 5474 | 469.78 | 5741 | 482.21 | 6215 | 522.06 | 6481 | 544.42 | 8224 | 690.78 |
| Leratong | 5 873 | 415.70 | 6306 | 441.40 | 6613 | 462.93 | 7160 | 501.18 | 7466 | 522.65 | 9474 | 663.16 |
| Leratong SP | 14 032 | 1 172.03 | 15066 | 1265.53 | 15801 | 1327.25 | 17106 | 1436.93 | 17839 | 1498.50 | 22635 | 1901.35 |
| PholaPark | 13 505 | 934.46 | 14500 | 1015.00 | 15207 | 1064.50 | 16464 | 1152.47 | 17169 | 1201.85 | 21785 | 1524.95 |
| LithuliVillage SP | 2 557 | 215.11 | 2745 | 230.61 | 2879 | 241.86 | 3117 | 261.85 | 3251 | 273.07 | 4125 | 346.48 |
| Kameelpoortnek A | 9 976 | 696.97 | 10711 | 748.77 | 11233 | 785.34 | 12162 | 851.32 | 12683 | 887.79 | 16092 | 1126.46 |
| Kameelpoortnek C | 13 864 | 961.15 | 14885 | 1041.98 | 15611 | 1092.80 | 16902 | 1183.11 | 17626 | 1233.80 | 22364 | 1565.49 |
| Enkeldoornoog A | 13 683 | 952.56 | 14691 | 1028.38 | 15408 | 1078.53 | 16681 | 1167.66 | 17396 | 1217.69 | 22072 | 1545.05 |
| Kameelpoortnek F | 3 500 | 441.00 | 3758 | 473.49 | 3941 | 496.58 | 4267 | 537.62 | 4450 | 560.65 | 5646 | 711.38 |
| KwaMhlanga C | 4 200 | 588.00 | 4509 | 631.32 | 4729 | 662.11 | 5120 | 716.83 | 5340 | 747.54 | 6775 | 948.51 |
| Sheldon | 14 800 | 1 243.20 | 15890 | 1334.79 | 16665 | 1399.86 | 18043 | 1515.58 | 18816 | 1580.51 | 23874 | 2005.41 |
| **Total** | **108 203** | **8 974.18** | **116 175** | **9661.96** | **121 841** | **10133.19** | **131 910** | **10970.60** | **137 561** | **11440.61** | **174 543** | **14516.26** |

DESIGN FLOWS PER DRAINAGE AREAS

| Drainage Zone | Village | Contribution (% of Flow) | 2045 Population (1.6% Growth) | Estimated Households | Proportional Flow (kℓ/day) | Instantaneous Flow (ℓ/s) | Peak Factor | Stormwater Infiltration | Design Flow/Village (ℓ/s) | Design Flow/Zone (ℓ/s) |
|---|---|---|---|---|---|---|---|---|---|---|
| DRAINAGE ZONE A | Lithuli Village SP | 100% | 4125 | 937 | 346.48 | 4.01 | 2.05 | 15% | 9.45 | 91 |
| | Kameelpoortnek A | 24% | 3928 | 1007 | 274.99 | 3.18 | 2.05 | 15% | 7.50 | |
| | Kameelpoortnek C | 25% | 5687 | 1537 | 398.12 | 4.61 | 1.95 | 15% | 10.33 | |
| | Enkeldoornoog A | 100% | 22072 | 5255 | 1545.05 | 17.88 | 1.80 | 15% | 37.02 | |
| | PholaPark | 19% | 4236 | 1116 | 296.73 | 3.43 | 2.05 | 15% | 8.10 | |
| | Kameelpoortnek F | 100% | 5646 | 1613 | 711.38 | 8.23 | 1.95 | 15% | 18.46 | |
| DRAINAGE ZONE B | Kameelpoortnek A | 49% | 7863 | 2016 | 550.41 | 6.37 | 1.85 | 15% | 13.65 | 48 |
| | Kameelpoortnek C | 75% | 16677 | 4507 | 1167.37 | 13.51 | 1.80 | 15% | 27.97 | |
| | Leratong | 35% | 3319 | 897 | 232.30 | 2.69 | 2.10 | 15% | 6.49 | |
| DRAINAGE ZONE C | Leratong | 65% | 6155 | 1664 | 430.86 | 4.99 | 1.90 | 15% | 10.90 | 25 |
| | Zakheni | 27% | 2194 | 593 | 184.30 | 2.13 | 2.25 | 15% | 5.52 | |
| | Kameelpoortnek A | 27% | 4301 | 1103 | 301.06 | 3.48 | 2.05 | 15% | 8.21 | |
| DRAINAGE ZONE D | Leratong SP | 100% | 22635 | 6118 | 1901.35 | 22.01 | 1.80 | 15% | 45.55 | 162 |
| | PholaPark | 81% | 17546 | 4617 | 1228.21 | 14.22 | 1.80 | 15% | 29.43 | |
| | Zakheni | 73% | 6030 | 1630 | 506.49 | 5.86 | 1.90 | 15% | 12.81 | |
| | KwaMhlanga B | 100% | 8540 | 2247 | 1076.01 | 12.45 | 1.85 | 15% | 26.50 | |
| | Sheldon | 100% | 23874 | 6452 | 2005.41 | 23.21 | 1.80 | 15% | 48.05 | |
| DRAINAGE ZONE E | KwaMhlanga A | 100% | 2937 | 839 | 411.24 | 4.76 | 2.10 | 15% | 11.49 | 35 |
| | KwaMhlanga C | 100% | 6775 | 1936 | 948.51 | 10.98 | 1.90 | 15% | 23.99 | |
| | | | **174543** | **46084.66** | **14516.26** | | | | | |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APPROVED BY

FOR AFI CONSULT DATE

CONTRACT NUMBER
THLM/SCM10/2022-23-TSC01

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| SCALE | SHEET SIZE |
|---|---|
| NTS | A1 |
| DATE | REVISION |
| August 2023 | A |

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2023/05/01-L01

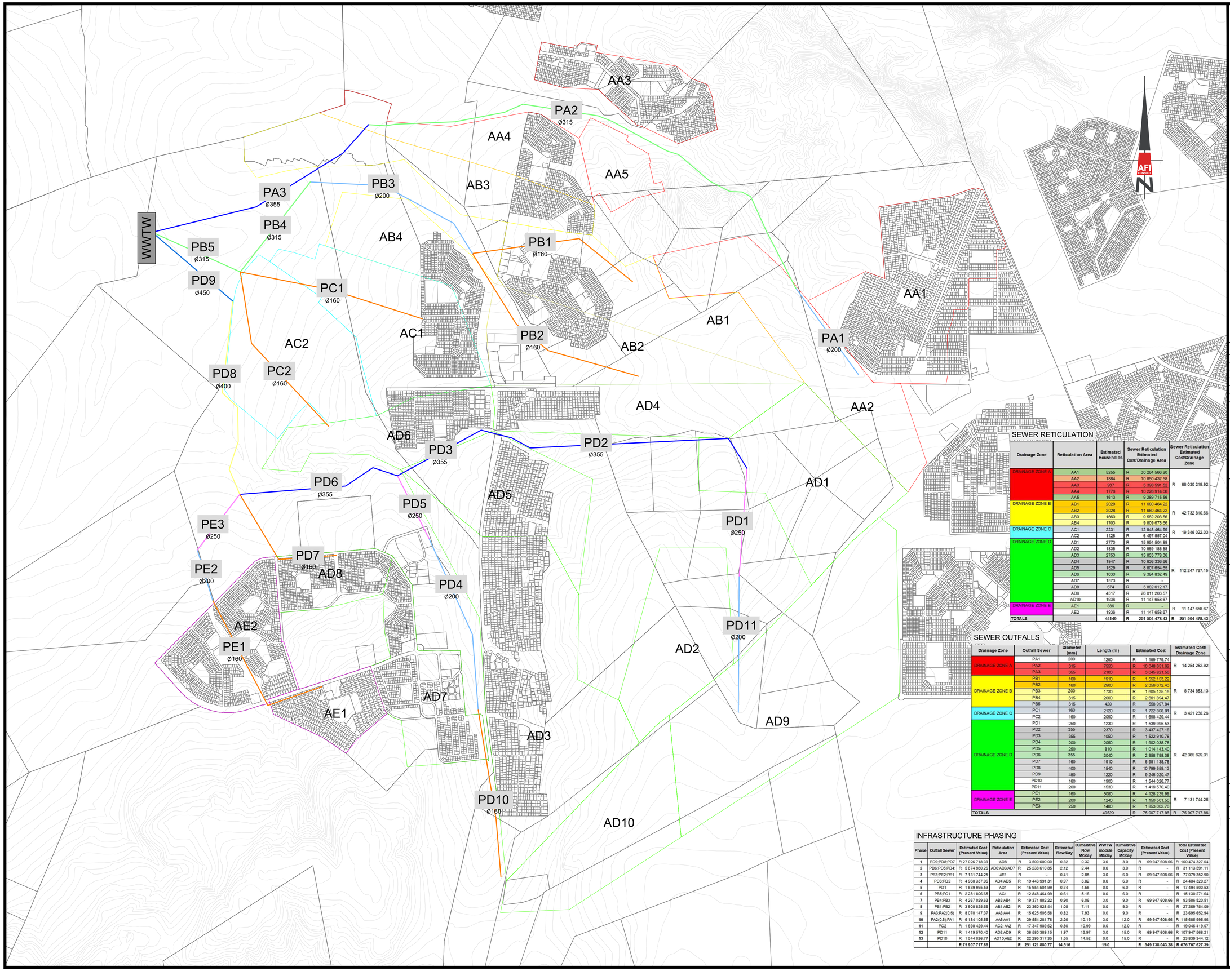
**THEMBISILE HANI LOCAL MUNICIPALITY**

**CONSTRUCTION OF LUTHULI WASTE WATER TREATMENT WORKS**

**PROJECT NO: THLMSCM102022-23TCS01**

# ANNEXURE C

## SUB-DRAINAGE ZONES




LEGEND

- DRAINAGE ZONE A
- DRAINAGE ZONE B
- DRAINAGE ZONE C
- DRAINAGE ZONE D
- DRAINAGE ZONE E
- 160mm Ø OUTFALL
- 200mm Ø OUTFALL
- 250mm Ø OUTFALL
- 315mm Ø OUTFALL
- 355mm Ø OUTFALL
- 400mm Ø OUTFALL
- 450mm Ø OUTFALL

SEWER RETICULATION

| Drainage Zone | Reticulation Area | Estimated Households | Sewer Reticulation Estimated Cost/Drainage Area | Sewer Reticulation Estimated Cost/Drainage Zone |
|---|---|---|---|---|
| DRAINAGE ZONE A | AA1 | 5255 | R 30 264 566.20 | |
| | AA2 | 1884 | R 10 850 432.58 | |
| | AA3 | 937 | R 5 398 591.52 | R 66 030 219.92 |
| | AA4 | 1775 | R 10 226 914.06 | |
| | AA5 | 1613 | R 9 289 715.56 | |
| DRAINAGE ZONE B | AB1 | 2028 | R 11 680 464.22 | |
| | AB2 | 2028 | R 11 680 464.22 | R 42 732 810.66 |
| | AB3 | 1660 | R 9 562 203.56 | |
| | AB4 | 1703 | R 9 809 678.66 | |
| DRAINAGE ZONE C | AC1 | 2231 | R 12 848 464.99 | R 19 346 022.03 |
| | AC2 | 1128 | R 6 497 557.04 | |
| DRAINAGE ZONE D | AD1 | 2770 | R 15 954 504.99 | |
| | AD2 | 1835 | R 10 569 185.58 | |
| | AD3 | 2753 | R 15 853 778.36 | |
| | AD4 | 1847 | R 10 636 336.66 | |
| | AD5 | 1529 | R 8 807 854.65 | R 112 247 787.15 |
| | AD6 | 1630 | R 9 384 832.49 | |
| | AD7 | 1573 | R - | |
| | AD8 | 674 | R 3 882 612.17 | |
| | AD9 | 4517 | R 26 011 203.57 | |
| | AD10 | 1936 | R 11 147 658.67 | |
| DRAINAGE ZONE E | AE1 | 839 | R - | R 11 147 658.67 |
| | AE2 | 1936 | R 11 147 658.67 | |
| TOTALS | | 44149 | R 251 504 478.43 | R 251 504 478.43 |

SEWER OUTFALLS

| Drainage Zone | Outfall Sewer | Diameter (mm) | Length (m) | Estimated Cost | Estimated Cost/ Drainage Zone |
|---|---|---|---|---|---|
| DRAINAGE ZONE A | PA1 | 200 | 1250 | R 1 159 779.74 | |
| | PA2 | 315 | 7550 | R 10 048 651.62 | R 14 254 252.92 |
| | PA3 | 355 | 2100 | R 3 045 821.56 | |
| DRAINAGE ZONE B | PB1 | 160 | 1910 | R 1 552 153.22 | |
| | PB2 | 160 | 2600 | R 2 356 672.43 | |
| | PB3 | 200 | 1730 | R 1 606 136.18 | R 8 734 853.13 |
| | PB4 | 315 | 2000 | R 2 661 894.47 | |
| | PB5 | 315 | 420 | R 558 997.84 | |
| DRAINAGE ZONE C | PC1 | 160 | 2120 | R 1 722 808.81 | R 3 421 238.26 |
| | PC2 | 160 | 2090 | R 1 698 429.44 | |
| DRAINAGE ZONE D | PD1 | 250 | 1230 | R 1 539 995.53 | |
| | PD2 | 355 | 2370 | R 3 457 427.18 | |
| | PD3 | 355 | 1050 | R 1 522 910.78 | |
| | PD4 | 200 | 2050 | R 1 902 038.78 | |
| | PD5 | 250 | 810 | R 1 014 143.40 | |
| | PD6 | 355 | 2040 | R 2 958 798.08 | R 42 365 629.31 |
| | PD7 | 160 | 1910 | R 6 981 138.78 | |
| | PD8 | 400 | 1540 | R 10 799 559.13 | |
| | PD9 | 450 | 1220 | R 9 246 020.47 | |
| | PD10 | 160 | 1900 | R 1 544 026.77 | |
| | PD11 | 200 | 1530 | R 1 419 570.40 | |
| DRAINAGE ZONE E | PE1 | 160 | 5080 | R 4 128 239.99 | |
| | PE2 | 200 | 1240 | R 1 150 501.50 | R 7 131 744.25 |
| | PE3 | 250 | 1480 | R 1 853 002.76 | |
| TOTALS | | | 49520 | R 75 907 717.86 | R 75 907 717.86 |

INFRASTRUCTURE PHASING

| Phase | Outfall Sewer | Estimated Cost (Present Value) | Reticulation Area | Estimated Cost (Present Value) | Estimated Flow/Day | Cumulative Flow MI/day | WWTW module MI/day | Cumulative Capacity MI/day | Estimated Cost (Present Value) | Total Estimated Cost (Present Value) |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PD9;PD8;PD7 | R 27 026 718.39 | AD8 | R 3 500 000.00 | 0.32 | 0.32 | 3.0 | 3.0 | R 69 947 608.66 | R 100 474 327.04 |
| 2 | PD6;PD5;PD4 | R 5 874 980.26 | AD6;AD3;AD7 | R 25 238 610.85 | 2.12 | 2.44 | 0.0 | 3.0 | R - | R 31 113 591.11 |
| 3 | PE3;PE2;PE1 | R 7 131 744.25 | AE1 | R - | 0.41 | 2.85 | 3.0 | 6.0 | R 69 947 608.66 | R 77 079 352.90 |
| 4 | PD3;PD2 | R 4 960 337.96 | AD4;AD5 | R 19 443 991.31 | 0.97 | 3.82 | 0.0 | 6.0 | R - | R 24 404 329.27 |
| 5 | PD1 | R 1 539 995.53 | AD1 | R 15 954 504.99 | 0.74 | 4.55 | 0.0 | 6.0 | R - | R 17 494 500.53 |
| 6 | PB5;PC1 | R 2 281 806.65 | AC1 | R 12 848 464.99 | 0.61 | 5.16 | 0.0 | 6.0 | R - | R 15 130 271.64 |
| 7 | PB4;PB3 | R 4 267 029.63 | AB3;AB4 | R 19 371 882.22 | 0.90 | 6.06 | 3.0 | 9.0 | R 69 947 608.66 | R 93 586 520.51 |
| 8 | PB1;PB2 | R 3 908 825.66 | AB1;AB2 | R 23 360 928.44 | 1.05 | 7.11 | 0.0 | 9.0 | R - | R 27 269 754.09 |
| 9 | PA3;PA2(0.5) | R 8 070 147.37 | AA3;AA4 | R 15 625 505.58 | 0.82 | 7.93 | 0.0 | 9.0 | R - | R 23 695 652.94 |
| 10 | PA2(0.5);PA1 | R 5 184 105.55 | AA5;AA1 | R 39 554 281.76 | 2.26 | 10.19 | 3.0 | 12.0 | R 69 947 608.66 | R 115 685 995.96 |
| 11 | PC2 | R 1 698 429.44 | AC2; AA2 | R 17 347 989.62 | 0.80 | 10.99 | 0.0 | 12.0 | R - | R 19 046 419.07 |
| 12 | PD11 | R 1 419 570.40 | AD2;AD9 | R 36 680 389.16 | 1.97 | 12.97 | 3.0 | 15.0 | R 69 947 608.66 | R 107 947 568.21 |
| 13 | PD10 | R 1 544 026.77 | AD10;AE2 | R 22 295 317.36 | 1.56 | 14.52 | 0.0 | 15.0 | R - | R 23 839 344.12 |
| | | **R 75 907 717.86** | | **R 251 121 880.77** | **14.516** | | **15.0** | | **R 349 738 043.26** | **R 676 767 627.39** |



AMENDMENTS

| NO./CODE | DATE | INITIALS | DESCRIPTION |
|---|---|---|---|
| | | | |

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PROJECT
# CONSTRUCTION OF LUTHULI WASTE WATER TREATMENT WORKS

DRAWING TITLE
SUB-DRAINAGE ZONES

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| DESIGN CHECKED | N/A | DRAWING CHECKED | M.K.C. |

APPROVED BY

FOR AFI CONSULT DATE

CONTRACT NUMBER
THLM/SCM10/2022-23-TSC01

FILE NUMBER
2023-05-01_L01-L02_RevA.dwg

| SCALE | SHEET SIZE |
|---|---|
| NTS | A1 |
| DATE | REVISION |
| August 2023 | A |

DRAWING NUMBER
2023/05/01-L02

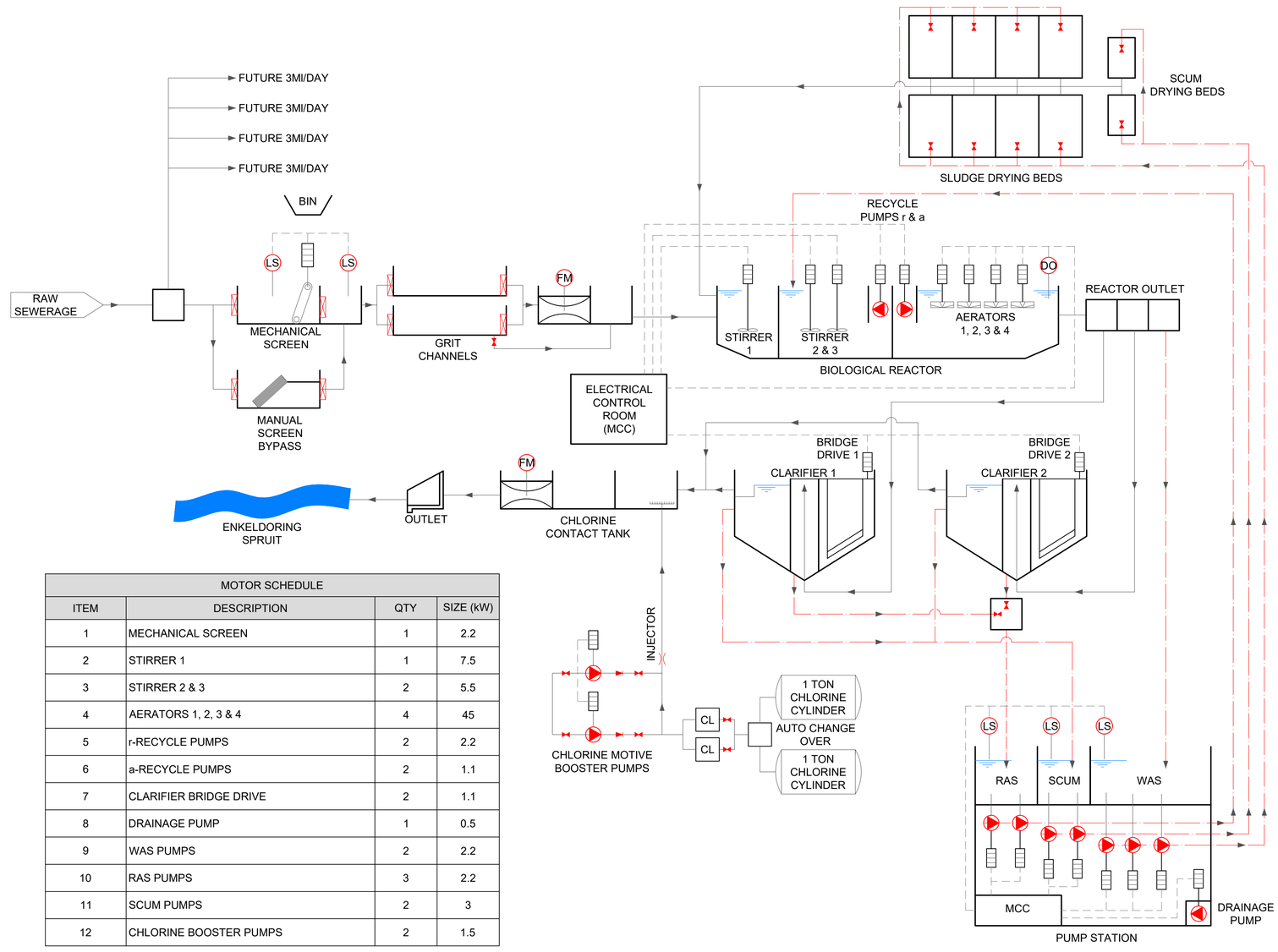
**THEMBISILE HANI LOCAL MUNICIPALITY**

**CONSTRUCTION OF LUTHULI WASTE WATER TREATMENT WORKS**

**PROJECT NO: THLMSCM102022-23TCS01**

# ANNEXURE D

## PROPOSED PROCESS DIAGRAM




| MOTOR SCHEDULE | | | |
|---|---|---|---|
| ITEM | DESCRIPTION | QTY | SIZE (kW) |
| 1 | MECHANICAL SCREEN | 1 | 2.2 |
| 2 | STIRRER 1 | 1 | 7.5 |
| 3 | STIRRER 2 & 3 | 2 | 5.5 |
| 4 | AERATORS 1, 2, 3 & 4 | 4 | 45 |
| 5 | r-RECYCLE PUMPS | 2 | 2.2 |
| 6 | a-RECYCLE PUMPS | 2 | 1.1 |
| 7 | CLARIFIER BRIDGE DRIVE | 2 | 1.1 |
| 8 | DRAINAGE PUMP | 1 | 0.5 |
| 9 | WAS PUMPS | 2 | 2.2 |
| 10 | RAS PUMPS | 3 | 2.2 |
| 11 | SCUM PUMPS | 2 | 3 |
| 12 | CHLORINE BOOSTER PUMPS | 2 | 1.5 |

LEGEND

- ELECTRICAL MOTOR
- PUMP
- VALVE
- CHECK VALVE
- PENSTOCK / HAND STOP
- LC LEVEL CONTROL
- FM FLOW MEASUREMENT
- DO DISSOLVED OXYGEN METER
- SEWERAGE / EFFLUENT / SUPERNATANT
- SLUDGE / SCUM
- ELECTRICAL / SIGNAL CABLE



AMENDMENTS

| NO./CODE | DATE | INITIALS | DESCRIPTION |
|---|---|---|---|
| | | | |
| | | | |
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PROJECT

CONSTRUCTION OF LUTHULI WASTE WATER TREATMENT WORKS

DRAWING TITLE

PROPOSED BNR PROCESS DIAGRAM

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APPROVED BY

FOR AFI CONSULT DATE

CONTRACT NUMBER
THLM/SCM10/2022-23-TSC01

FILE NUMBER
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| SCALE | SHEET SIZE |
|---|---|
| NTS | A1 |
| DATE | REVISION |
| August 2023 | A |

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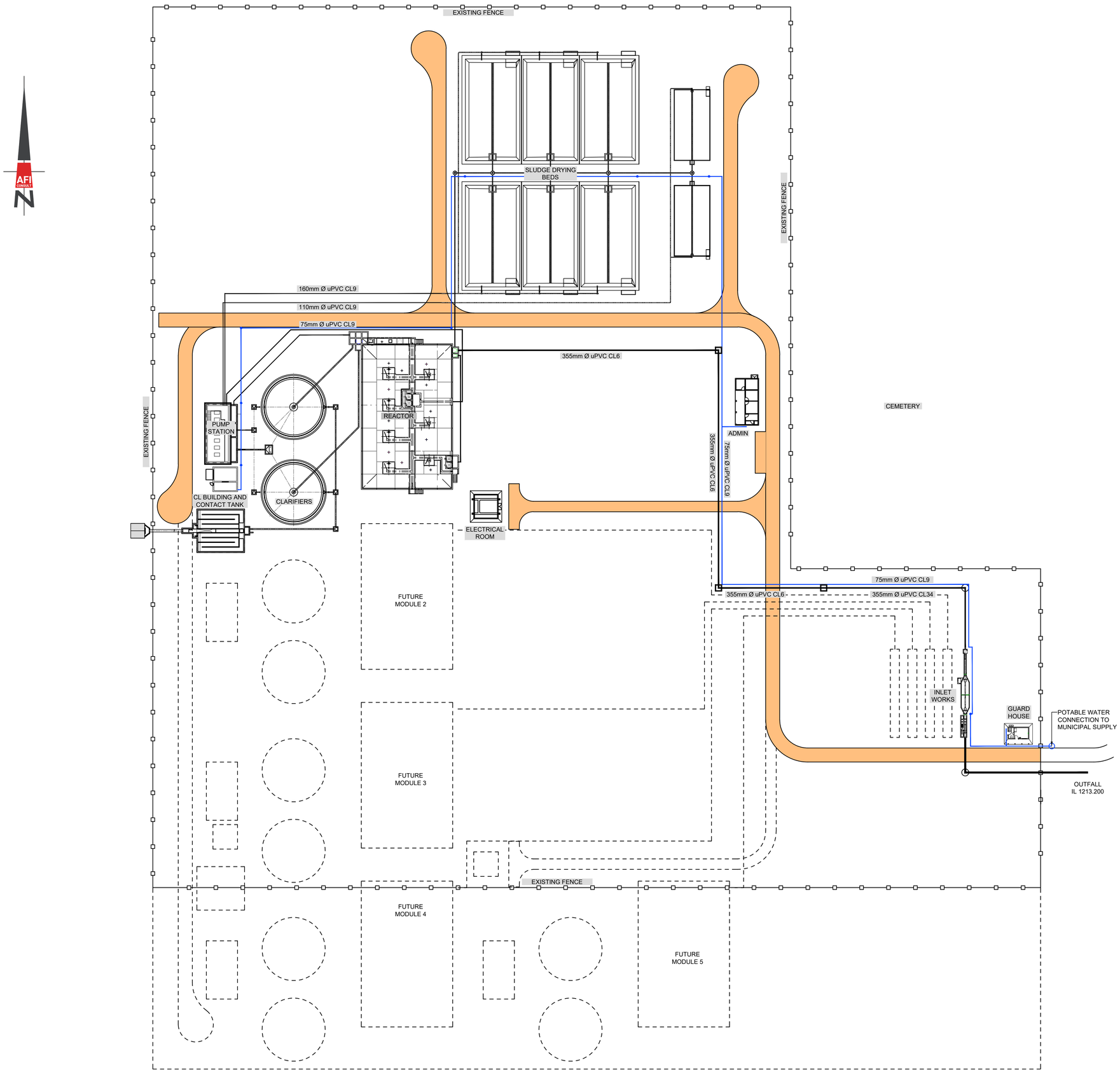
**THEMBISILE HANI LOCAL MUNICIPALITY**

**LUTHULI WASTE WATER TREATMENT WORKS**

**PROJECT NO: THLM/S2/02/2013/14**

# ANNEXURE E

## PROPOSED PLANT LAYOUT




NOTES

LEGEND

INTERNAL WATER RETICULATION WITH STAND TAP



AMENDMENTS

| NO./CODE | DATE | INITIALS | DESCRIPTION |
|---|---|---|---|
| | | | |
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PROJECT

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DRAWING TITLE

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| DESIGN CHECKED | N/A | DRAWING CHECKED | M.K.C. |

APPROVED BY

FOR AFI CONSULT DATE

CONTRACT NUMBER

FILE NUMBER
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| SCALE | SHEET SIZE |
|---|---|
| NTS | A1 |
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