

Our ref: P 1793-00

31 March 2021

The Project Manager
SiVEST Environmental Division
Durban

Attention: Ms Michelle Guy

email: michelleg@sivest.co.za

UPGRADE OF AMAOTI INFORMAL SETTLEMENTS: CIVIL ENGINEERING DESIGN DETAILS

Herewith please find the civil engineering design details for the scoping report. The Status-Quo reports will all be updated for design and submitted to the municipality together with the design drawings for approval prior to construction.

The proposed development encloses the area of approximately 1236ha for the proposed yield of 25 357 units. The proposed services will be designed to incorporate the expected low to medium income type of level of service. The standard for all services is in accordance with the Municipal Design Guidelines and the Neighbourhood Planning and Design Guide (Red Book). Where a potential conflict arises between any guidelines, the minimum standard required by eThekweni Municipality will be adhered to.

All the designs and selection of material will be done in conjunction with the Geotechnical Investigation reports.

An application to construct any structures and to install any pipes in the vicinity or across any existing servitudes will be submitted to relevant authorities prior to construction.

1. Roads

The existing internal roads network will be upgraded in line with the demands of the development and the proposed traffic assessments and are expected to carry high traffic volume and will therefore be asphalt and paved surfacing. The recommendations contained in the following guidelines will be adhered for the design:

- Technical Recommendations for Highways (TRH1) for Prime Coats and Bituminous Curing Membrane.
- Draft TRH4 (Technical Recommendations for Highways) - Structural Design of Flexible Pavements for Inter Urban and Rural Roads.

- Technical Recommendations for Highways (TRH14) for Guidelines for Road Construction Material.
- UTG2 (Urban Transport Guidelines) - Structural Design of Asphalt Surfaced Roads for South Africa will be applied where required.
- Urban Transport Guidelines (UTG3) for Structural Design of Urban Roads for South Africa.

2. Stormwater Drainage

The existing stormwater drainage will be upgraded in line with the requirements of the development. In stormwater management a distinction can be made between two types of storms, namely storms of low and high severity. For storms of low severity, which occur frequently, underground pipes, catch-pits, concrete-lined channels and soak-away pits system will be provided to avoid the frequent problems resulting from overland flow. This system is called minor system.

By considering the effects of the less frequent storms, a major system can be identified which supports the minor system. The major system may include attenuation ponds, larger conduits and natural or artificial channels. The major system would frequently make use of the road system to convey excess water to suitable points of discharge.

The stormwater from the development will drain towards the natural streams located within the development, incorporating the 100-year flood-lines.

The following will be considered during the design of stormwater drainage:

- Stormwater catch-pits are provided at approximately 100m intervals.
- Outlet structures are designed as stilling basins to reduce and limit the discharge velocity to 1m/s.
- Minimum pipe size will be 450mm diameter and will vary up to 1200mm diameter.
- The bridges will be designed to incorporate the 100-year flood-line.

3. Water Supply

The existing water supply reticulation will be upgraded in line with the requirements of the development.

Water Demand

The water demand will be as calculated below:

Land use	AADD	Unit	No of Units	kl/day
Residential 1	0.75	kl/day/unit	21 035	15 776.25
High Density Residential 3	0.6	kl/day/unit	4 322	2 593.20
Total Annual Average Daily Demand				18 369.45

The Total Water Demand for the development will be 18 369.45kl/day.

Firefighting

The provision for firefighting will be as per standards set by the Municipal Emergency Services.

Pipeline Design

The following will be considered during the detailed design of water network:

- Hydraulic design of the pipeline network will be done to achieve a minimum head of 24m under peak demand and maximum head of 60m.
- Velocities in pipes will generally not exceed the following under peak demand: 3.5m/sec for pipe diameters less or equal to 150mm and 2.5m/sec for pipe diameter greater or equal to 200mm.
- Isolating valves will be provided to isolate any section of pipeline with not more than 4 valves and so that the total length of main included in an isolated section does not exceed a nominal 600 m. No more than 60 dwellings will be isolated at a given time.
- Pressure reducing valves will be provided to reduce pressure where required.
- Minimum pipe size in the network will be 75mm diameter and vary up to 355mm diameter.
- Pipe material will be Class 12uPVC/mPVC with spigot and socket couplings and engineered restraints, SABS 966 approved.
- Fire demand: Group 1, low risk with 8m residual head at peak flow.
- Hydrants spaced at no more than 240m to be installed in lieu of scour and air release devices at low and high points in the network, on 75mm diameter pipes and larger pipes.
- Pipes will be laid in the road reserve.
- Trenching, bedding, and backfilling shall conform to SANS 1200 LB and SANS 1200 DB and to Class B bedding, backfilled to 93% of Mod. AASHTO density.
- House connections will consist of 40mm diameter class 12 HDPE pipes, reducing to 25mm dia.
- Peak factor will be 4.

Reservoir and Water Tower

The proposed development is situated in undulating topography and there are areas without sufficient water pressure. For the proposed medium income level of service, it will be necessary for the reservoirs and water towers to be erected in the area.

It is expected that both the structures will be made constructed above the ground and will be constructed of 35MPa reinforced concrete. Reservoirs will be designed in circular shape and will vary from 5M³ to 20M³ in volume approximately 6m above the ground. Water towers will be designed in circular shape approximately 35m above the ground and will vary from 0.5M³ to 2M³ in volume. The above will be confirmed upon the completion of the Bulk Investigation and the designs.

4. Sanitation

The existing water supply reticulation will be upgraded in line with the requirements of the development.

Total Sewer Discharge

The estimated Annual Average Dry Weather Flow will be as follows:

Total AADD	18 369.45 kL/day
Annual Average Weather Flow (80%)	14 695.56 kL/day
Infiltration rate (15%)	2 204.33 kL/day
Total Residential Sewer Design Flow	16 899.89 kL/day

Total Sewer Design Flow for the Development is 16 899.89 kL/day.

Pipeline Design

The following will be considered during the detailed design of sewer network:

- Hydraulic design of the sewers will be done to ensure full-borne with minimum and maximum velocity of 0.7m/s and 2.5m/s respectively.
- The pipe slopes will be:
 - ✓ 1 : 80 at head.
 - ✓ 1 : 80 for 160mm dia pipe.
 - ✓ 1 : 120 for 200mm dia pipe.
 - ✓ 1 : 1600 for 250mm dia pipe.
 - ✓ 1 : 200 for 300mm dia pipe.
- Inspection manholes will be placed at convenient positions.
- Maximum distance between manholes will be 80m.
- Minimum manhole diameter will be 1 250mm.
- Minimum pipe size for the main will be 160mm diameter and will vary up to 600mm diameter.
- Pipe material will be Maincore Class 400uPVC pipes.
- Pipes will be laid both in the road reserve and mid-block.
- Infiltration of ground water and stormwater will be limited by ensuring watertight manholes and pipeline construction and testing thereof.
- Stormwater infiltration for 150mm diameter pipe is 0.012 litres per second per 100m.
- Peak factor will be 2.3.

We trust that you find the above favourable and should you require any additional information it will be provided with pleasure.

Yours faithfully



Tshweu Mokoena

Director

SCIP Engineering Group [Pty] Ltd

Project: P 1793-L17 Civil engineering design details

DECLARATION OF INTEREST BY SPECIALIST



KWAZULU-NATAL PROVINCE

ECONOMIC DEVELOPMENT, TOURISM
AND ENVIRONMENTAL AFFAIRS
REPUBLIC OF SOUTH AFRICA

Provincial Reference Number:	(For official use only)
NEAS Reference Number:	KZN / EIA /
Waste Management Licence Number (if applicable):	
Date Received by Department:	

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

Submitted in terms of section 24(2) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) or for a waste management licence in terms of section 20(b) of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008).

KINDLY NOTE:

1. This form is current as of **May 2021**. It is the responsibility of the Applicant / Environmental Assessment Practitioner ("EAP") to ascertain whether subsequent versions of the form have been released by the Department.

PROJECT TITLE

Upgrade of informal settlements in Amaoti

DISTRICT MUNICIPALITY

eThekweni Municipality

1. SPECIALIST INFORMATION

Specialist name:	SCIP Engineering Group. [Appointed as civil engineers	
Contact person:	Marco Faurie	
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Professional affiliation(s) (if any)	ECSA, SAICE	

Project Consultant / EAP: Project Consultant (Civil Engineering)

Department of Economic Development, Tourism & Environmental Affairs, KwaZulu-Natal	Details of the Specialist and Declaration of Interest	May 2021 V1
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DECLARATION OF INTEREST BY SPECIALIST

Contact person:

Postal address:

Postal code:

Telephone:

E-mail:


Tshwen Mokoena		
P.O. Box 4850, Roosevelt Park.		
2129	Cell:	-
011 888 1421	Fax:	N/A
Tshwen@scip.co.za		

2. DECLARATION BY THE SPECIALIST

I, Marco Ferris are that --

General declaration:

- I act as the independent specialist in this application;
- do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of sub-regulation 48(1) (a)-(e) is liable to the penalties as contemplated in section 49B(1) of the National Environmental Management Act, 1998 (Act 107 of 1998).



 Signature of the specialist:

SCIP Engineering Group.

 Name of company:

26 Oct 2021

 Date:

Department of Economic Development, Tourism & Environmental Affairs, KwaZulu-Natal	Details of the Specialist and Declaration of Interest	May 2021 V1
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Our Ref: 1793 02



human settlements

Department:
Human Settlements
PROVINCE OF KWAZULU-NATAL



STATUS-QUO REPORT

for the

UPGRADE OF INFORMAL SETTLEMENTS IN AMAOTI

STORMWATER

PREPARED BY:

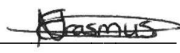




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Date: April 2020

FIRST ISSUE

ISO COMPLIANCE

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	Signed: 	Signed: 	Signed:  Pr. Tech. Eng.: <u>2018300271</u>
	Date: April 2020	Date: April 2020	Date: April 2020
P 1793-Status Quo Report Stormwater-NE-First Issue.docx			

APPROVAL

DIVISION	APPROVED BY	COMMENTS	
KwaZulu Natal Department of Human Settlements Senior Manager Development Control	Name:		
	Signature: _____		
	Date:		

Executive Summary

The report outlines the existing civil infrastructure conditions in Amaoti and the surrounding areas, in the northern region of Durban. Furthermore, it will highlight key issues expected during the proposed upgrade of Amaoti Informal Settlements.

The project intends to formalise Amaoti Informal Settlements with civil engineering services, while mitigating relocation of existing occupants.

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1. INTRODUCTION

SCIP Engineering Group (trading as SCIP) was appointed by KwaZulu Natal Department of Human Settlements (the client) as the Civil and Traffic Engineers for the **Upgrading of Informal Settlements in Amaoti**.

1.1 PROJECT NAME

The proposed development will be referred to as **Amaoti Informal Settlements**.

2. DEVELOPMENT OVERVIEW

The purpose of this Housing Catalytic Project is to:

- Formalise the informal settlements
 - ✓ Establishment of a township with formal services through which residents obtain formal security of tenure through which RDP houses are developed.
- Regularise the informal settlements:
 - ✓ To bring a level of security to residents within informal settlements other than through the long and often tedious formal township establishment processes.
 - ✓ To include all settlements into an appropriate regulatory framework for the purposes of health and safety and for creating an environment conducive to investment by the state and by private individuals.
 - ✓ To provide a framework for the incremental upgrading of services and quality of life.
 - ✓ To provide security of tenure through resolving issues of land ownership and providing individuals with a right to occupy, thus enabling the building of houses.
 - ✓ To resolve the illegality of land use through amendments to the town planning scheme.
 - ✓ To provide a basic regulatory framework to secure health and safety.
 - ✓ To introduce a simple settlement layout to facilitate the provision of services and infrastructure and also to demarcate flood plains.
 - ✓ To upgrade services incrementally (water, sewer, lighting, roads and stormwater).
- Relocate the existing informal settlements
 - ✓ Temporary relocation of informal settlements, where necessary, to enable the formalization and regularization of the settlement.

The proposed formalisation, regularisation and/or relocation will be carried out in conjunction with the Municipal Standards and Human Settlement Policies.

3. PROJECT BACKGROUND

The project was initially funded by eThekweni Municipality, but due to budgetary constraints the project was placed on hold. At the time the project was placed on hold certain engineering services were already completed, approved by the municipality, and implemented. These include

both internal and bulk services. The site is currently partially serviced with temporary civil and electrical services including roads, stormwater, water, sewer and electricity.

The following additional information was discussed during the project meeting (4 November 2019), which is included in **Table 1**.

TABLE 1: GENERAL PROJECT INFORMATION

ITEM	DESCRIPTION	COMMENTS	STATUS
1	Site Boundary Stretching over Number of Wards	6 Wards (Wards 52, 53, 56, 57, 59 and 102)	Noted
2	Current Number of Units	Approximately 20,000 The number of units may differ as the area is unregulated and there may be newly erected units in the vicinity.	Noted
3	Relocation of Structures	Should be limited as much as possible. Some informal units were already temporarily relocated.	Ongoing
4	Community Meetings	The municipality has periodic meetings to report to the community.	Ongoing
5	4 Phased Implementation Plan	<i>Phase 1:</i> 161 Houses (Completed), 5 Houses (Outstanding) <i>Phase 4:</i> Contractor was appointed for implementation. <i>Phase 2 & 3:</i> Needs to be implemented.	Noted
6	Municipal Master Plan for Infrastructure	Might be outdated.	Noted
7	Existing Civil and Electrical Services	Roads Stormwater Water Sewer Electrical	Received from Topographical survey & GIS Received from Topographical survey & GIS Received from eThekweni Municipality Received from eThekweni Municipality Received from Topographical survey

4. SCOPE OF WORKS

This report represents the Status-Quo Report (SQR) on Stormwater for Amaoti Informal Settlement. The purpose of the report is to provide a holistic overview of the completed designs, installed infrastructure and their condition to date. The following aspects will be discussed throughout this report:

- Key challenges relative to the present population and topography;
- Discuss natural water resources within the development area;
- Discuss existing services surrounding and within the development area; and
- Discuss already designed services surrounding and within the development area.

Reports relating to Roads, Water and Sanitation services will be presented in separate documents.

4.1 KEY ASSUMPTIONS

The SQR is submitted to KwaZulu Natal Department of Human Settlements on the assumption that the information provided by KwaZulu Natal Department of Human Settlements and eThekweni Municipality, as well as desktop studies conducted is relevant to the time of compilation. It should be noted that as the project progresses certain information in this report may be subject to change.

4.2 RELEVANT INFORMATION RECEIVED

The following documents and information, with regards to Amaoti Informal Settlements, was received from the appointed Project Managers (KwaZulu Natal Department of Human Settlements and eThekweni Municipality):

- Preliminary/High-Level Services Report: Preliminary findings indicate that Bulk Water and Sewer Infrastructure will be sufficient to enable the first part(s) of development and that there will be a requirement for the upgrade to realize the entire development,
- Project Boundary Shape-file;
- Development Framework;
- Preliminary Geotechnical Assessment: The majority of the site is classified as developable with precautions due to the characteristics of the soil and the thickness of the soil profile. The areas of a steep slope and drainage channels/floodplains is regarded as high risk due to the likelihood of flooding and seasonal perched water levels. Although the very steep slopes have been classified as developable with high risk, it is recommended that only place development in those areas as a matter of last resort;
- Biodiversity Assessment – Draft 3;
- Water Resources Report – Draft 3;
- Informal Settlement Upgrading Programme for City of Johannesburg Region C Phase 2 Draft Report Version 04 RS 2;
- Topographical Survey, dated February 2017;

- Cadastral Survey, dated February 2017;
- GIS data downloaded from eThekweni Municipality GIS Website, including existing stormwater and road networks; and
- Amaoti Flood Line Report, dated April 2020 by AIMH Civil Engineering (Pty) Ltd.

5. SITE DESCRIPTION

5.1 LOCALITY

The proposed site is located within the Northern eThekweni Municipal Planning Region (NMPR) in the province of KwaZulu Natal. Approximately 30km north-west of Durban Central, the proposed site spans roughly 1,236ha in extent.

The site can be accessed from the north through Main Road (M27), from the west through Mafukuzela Highway (M25) and from the south through Curniek Ndlovu Highway (M25), JG Champion Drive and Phoenix Highway.

Figure 1 indicates the spatial regions of eThekweni Municipality and Figures 2 and 3 illustrates a Site Locality Map and a Site Boundary Layout.

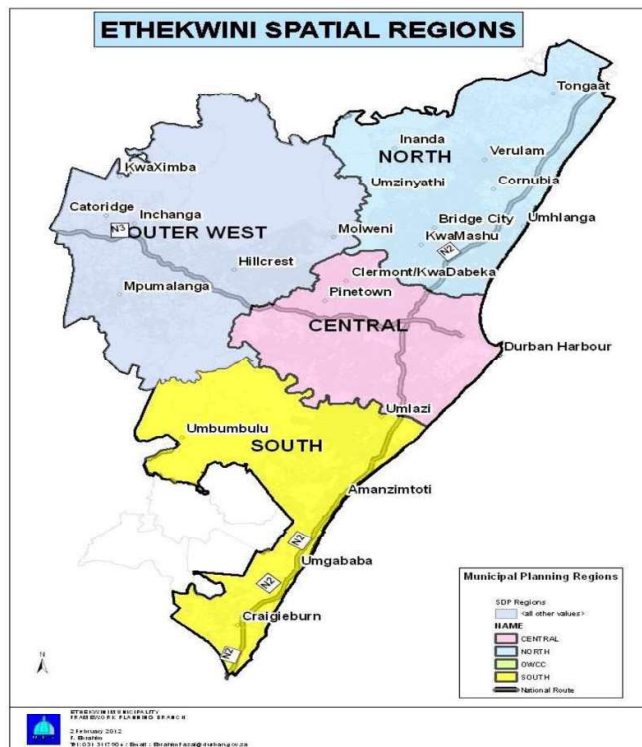


FIGURE 1: ETHEKWINI SPATIAL REGIONS (IMAGE FROM 2019/2020 IDP REPORT)

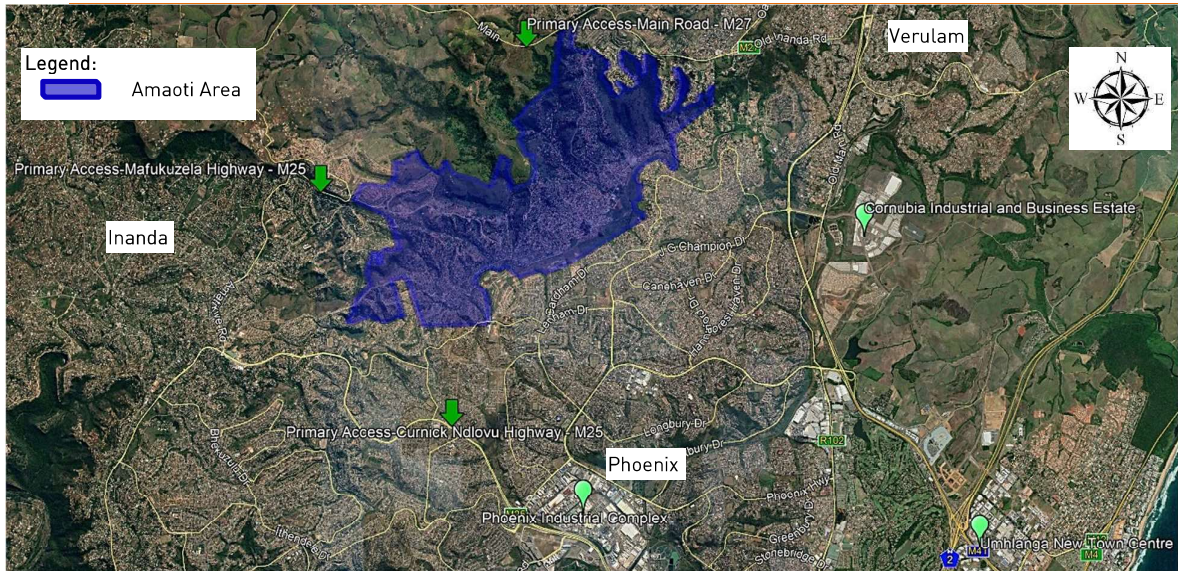


FIGURE 2: SITE LOCALITY MAP (GOOGLE EARTH VIEW)

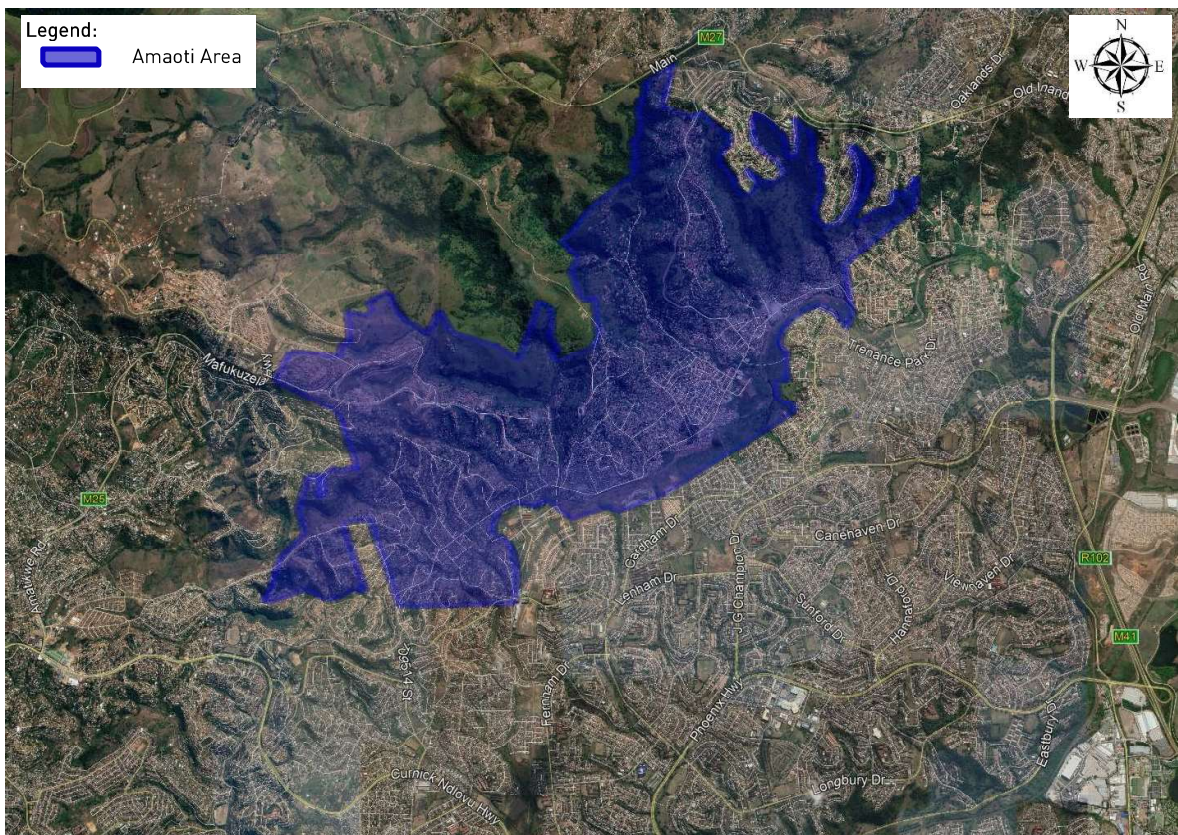


FIGURE 3: SITE BOUNDARY LAYOUT (GOOGLE EARTH VIEW)

5.2 PRESENT POPULATION

The settlements comprise of dense informal settlements (both temporary and permanent dwellings) and formalised settlements (residential areas with municipal facilities and amenities).

The average density of the eThekweni Municipality ranges from 4du/ha to 40du/ha, (eThekweni Municipality, 2019). Therefore, based on the above, it's been determined that approximately 20 000 informal dwelling are located within the site. Unfortunately, the population within the area is constantly growing, making it nearly impossible to provide accurate figures.

5.3 TOPOGRAPHY

The relative altitudes are 180 meters above sea level with undulating topographies. The study area is located on the southward facing upper-middle and lower hillslopes, as well as on the valley floor and in many cases are located within the floodplain of the streams. The stream draining from west to east is a high order tributary of the Umgeni River. It is drained by the small tributaries which lead to the Umgeni River. Overall, the area is characterized by gentle and steeply sloping topography, with slopes between 5% and 35% grade. The current urban development is concentrated on the floodplain, lower hillslope and the shallower mid-slope and hilltop areas. **Figure 4** indicates the typical topography of Amaoti Informal Settlements.



FIGURE 4: TYPICAL TOPOGRAPHY OF THE SITE

Topographical factors have a major influence on the pattern of urban settlement. Significant areas where there are very steep slopes, the area is subjected to high erosion risk and areas of concentrated seepage may be considered potentially unstable. **Figure 5** indicates the topographical elevation heat map.

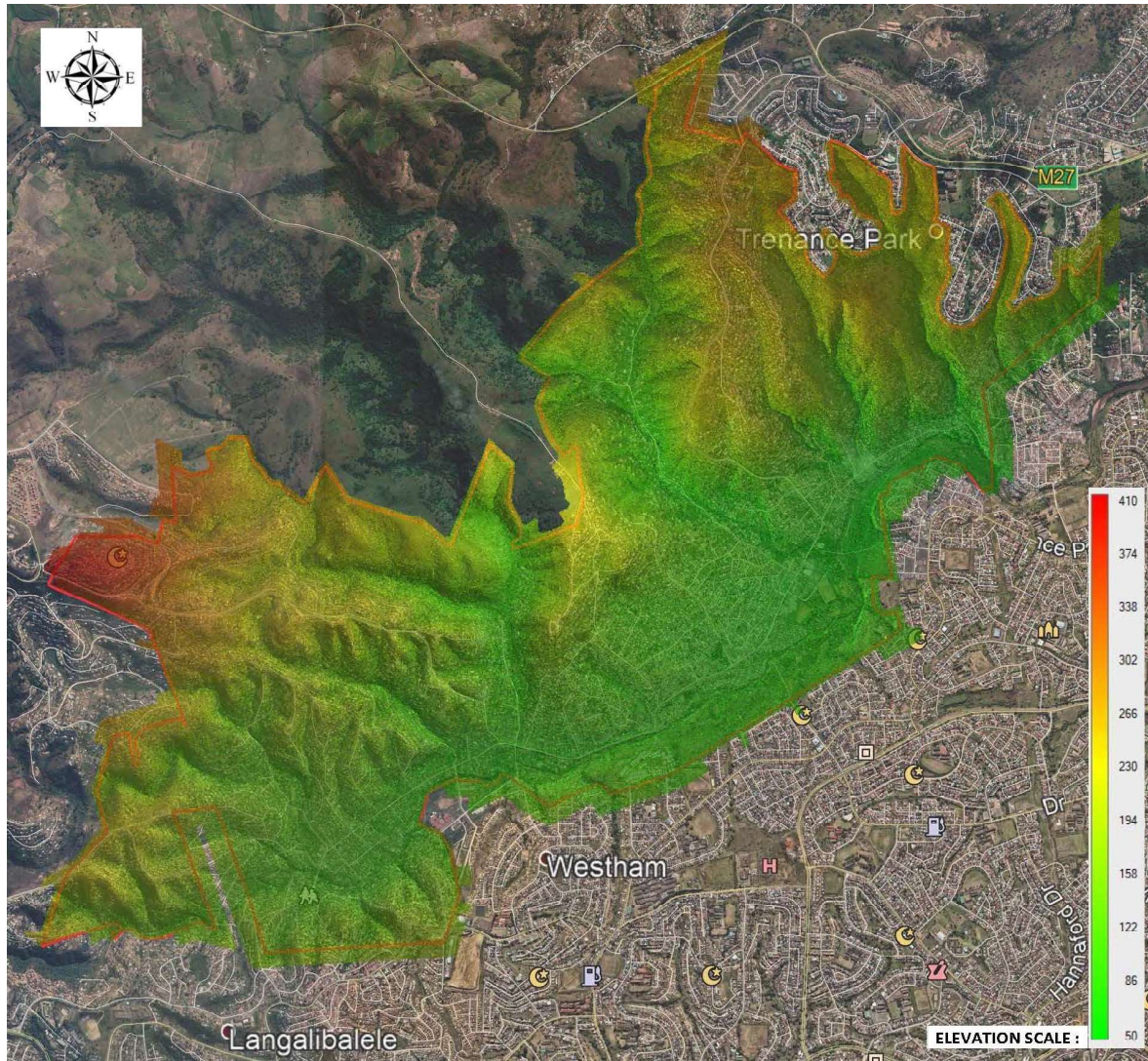


FIGURE 5: TOPOGRAPHICAL ELEVATION HEAT MAP.

5.4 INFRASTRUCTURE DELIVERY

The infrastructure delivery plan for the upgrading of the informal settlements in Amaoti have been investigated thoroughly and some key issues have been identified by eThekweni Municipality which may cause some delays during the progress of the project (eThekweni Municipality, 2019) :

- Limited access to basic household and community services especially in informal settlements;
- Limited funding available to deal with big backlogs;
- Ageing infrastructure and need for a budget to maintain appropriate standards;
- Topography makes service delivery in parts of the municipality challenging; and
- Fragmented spatial patterns do not support the efficient delivery of bulk services

A vital component for the development and growth of the Northern region of eThekweni Municipality is the bulk engineering services which will be influenced by the anticipated numbers and locations of new houses to be constructed.

5.5 SERVITUDES

The area is subjected to various servitudes namely:

- Municipal services (roads, stormwater, water, sewer, electrical, etc.).
- Formalised areas (schools, police station, clinics, residential areas, etc.).
- Informal structures (temporary and permanent structures).
- Multiple natural watercourses.

Applications for wayleaves will be submitted to the relevant municipal departments and other authorities prior to the implementation stage.

6. STORMWATER

Climate change is expected to impact vulnerable communities, such as informal settlements. This is due to the potential, sudden increased of water-runoff causing flash floods, throughout a development. It is therefore essential that floods be managed as far as possible to mitigate the risk of disasters.

Managing stormwater will be a key priority in mitigating flooding throughout the development. This will be done by determining 1-in-100 year flood lines of the existing watercourses, and designing the internal stormwater reticulation based on historic rainfall data and set standards by eThekweni Municipality.

6.1 EXISTING BULK STORMWATER

6.1.1 Climate

Amaoti's climate has been derived from data recorded in the Northern eThekweni, which lies approximately between 100m and 200m above sea level. The region's climate is classified by Köppen-Geiger as humid subtropical (Cfa), with an average annual temperature of 24 °C (*Climate-Data, 2020*), and a Mean Annual Precipitation (MAP) of 1 000mm. The region receives rainfall throughout the year, with the driest months receiving 31mm and the wettest months 131mm. A graphical representation is shown in **Figure 6**.

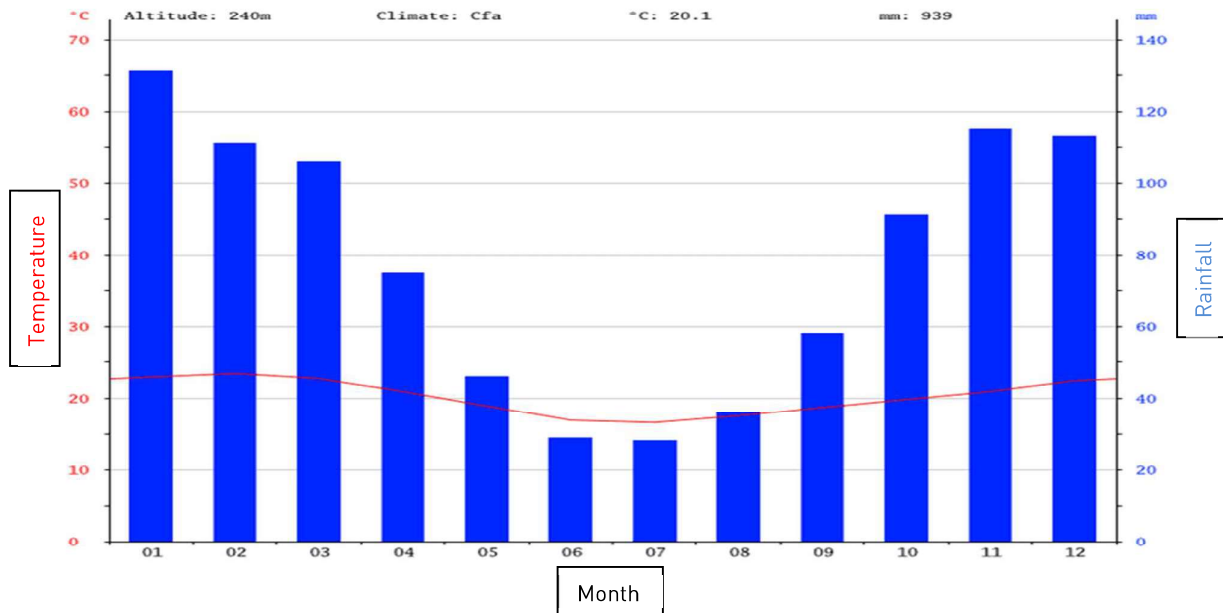


FIGURE 6: CLIMATE GRAPH FOR DURBAN (EN-CLIMATE-DATA.ORG)

6.1.2 Project Region Hydrology

A preliminary geotechnical investigation was done by Worley Parsons Pty Ltd (WP) on the 26th of May 2017. The findings indicate that the groundwater depth, varies with the local topographical conditions, ranging from 12 to 25m and averaging 18m below the ground surface. Shallow groundwater condition and seepage (ranging from 0.6 to 1.6m) were encountered in some of the exploration pits

The majority of the development, consists of natural watercourses due to the development's topography. This contributes to additional challenges with flood lines and buffer zones which are encroaching land for residential development. **Figure 7** illustrates a Google Earth capture representing the 1-in-100 year flood line, recently determined by AIMH Civil Engineering (Pty) Ltd, for the Ohlanga River and its tributaries.

The received flood lines, indicates that some residents of the development are exposed to flooding as they are residing within the floodplain. A thorough flood line study needs to be performed for the current conditions and incorporate other internal streams and tributaries affecting the proposed settlement. Control measures must be put in place to mitigate the risks of floods due to uncontrolled discharge.

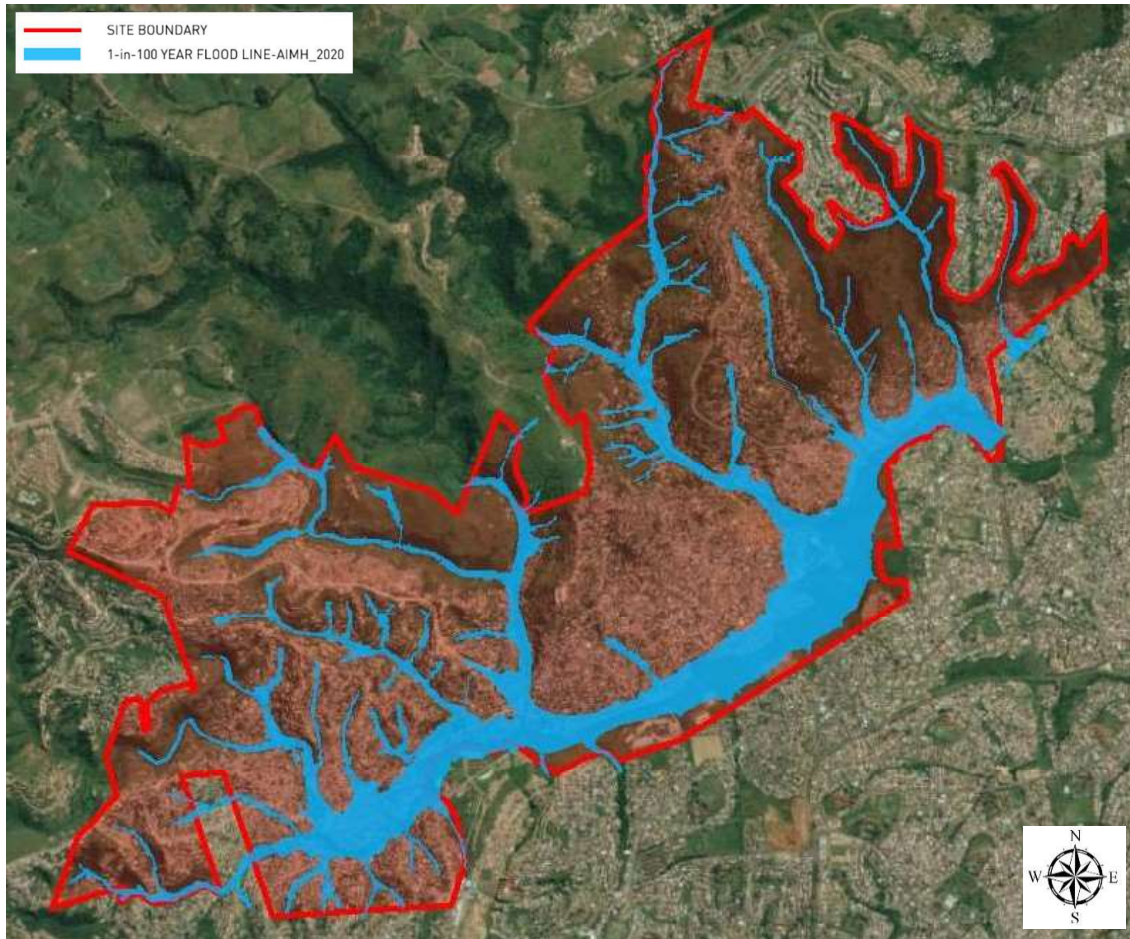


FIGURE 7: 100 YEAR FLOODPLAIN FOR AMAOTI (GOOGLE EARTH VIEW)

6.1.3 Natural Watercourses

The drainage basin within the boundary of the upgrading of Amaoti Informal Settlements is approximately 1 235.6 Hectare and includes an estimated distance of 69km of natural watercourses. The streams and gullies all connect to the Ohlanga River which ultimately discharges into the Indian Ocean just north of Umhlanga, KwaZulu-Natal. Figure 8 represent the natural watercourses within the area of the development, which was obtained from eThekweni GIS website.

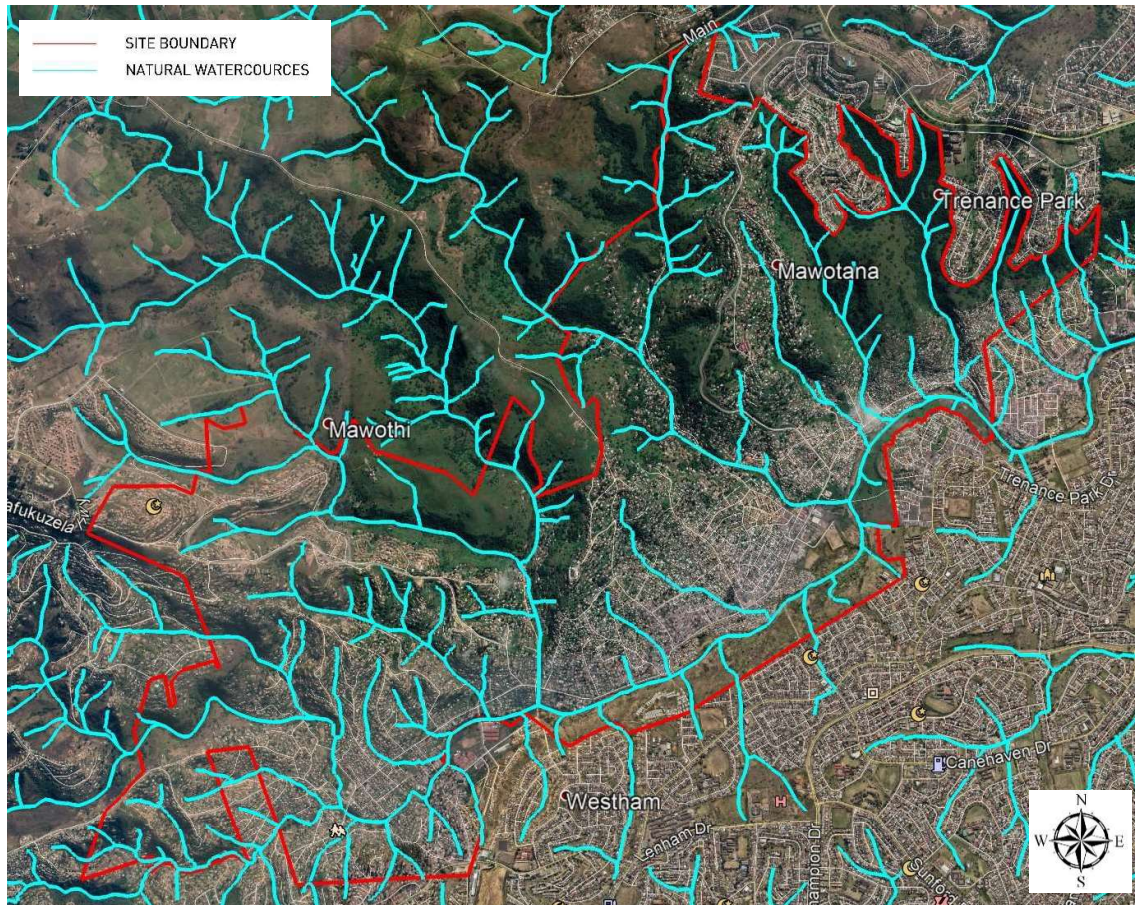


FIGURE 8: NATURAL WATERCOURSES

6.1.4 Wetlands

A wetland is typically a flooded area, either permanently or seasonally. Wetlands are not only critical for reducing the impacts of floods but also providing habitats for animals and plants. As part of the ecosystem, it delivers a range of important goods and services to society such as water purification, water storage and natural pollination of crops.

The Biodiversity Company conducted a wetland study and identified twenty-five (25) hydrogeomorphic (HGM) units which were combined into the following wetland classification groups: *(The Biodiversity Company, 2017 (Updated 2019))*

- Channelled Valley Bottom – Upper Catchment (HGM A);
- Channelled Valley Bottom – Lower Catchment (HGM B);
- Unchanneled Valley Bottom (HGM C);
- Floodplain (HGM D); and
- Hillslope Seep (HGM E).

Descriptions of each wetland classification group item are indicated in Table 2 (The Biodiversity Company, 2017 (Updated 2019)):

TABLE 2: GROUPING OF 25 HYDROGEOMORPHIC (HGM) UNITS

ITEM	DESCRIPTION	FINDINGS
(HGM A) Channelled Valley Bottom – Upper Catchment	A valley-bottom wetland with a river channel running through it.	The channelled valley bottoms of the upper catchment where in relatively good condition with the surrounding developments not having too much of an impact as yet. The dominant vegetation in the wetlands where stands of <i>Typha capensis</i> and <i>Phragmites sp.</i>
(HGM B) Channelled Valley Bottom – Lower Catchment		The channelled valley bottoms in the lower catchment have been engulfed by the informal settlements and the impacts are significant with waste (construction, general, and organic waste being dumped into the wetland. Erosion has started occurring and the vegetation is dominated by alien species. There are small patches of <i>Typha capensis</i> and <i>Phragmites sp.</i>
(HGM C) Unchannelled Valley Bottom	A valley-bottom wetland without a river channel running through it.	The unchannelled valley bottoms where in relatively good condition with the surrounding developments not having too much of an impact as yet. The dominant vegetation in the wetlands where stands of <i>Typha capensis</i> and <i>Phragmites sp.</i>
(HGM D) Floodplain	The mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank.	The floodplain has been significantly impacted upon by the settlement. The floodplain has been converted to fields for crops in places, sites for dumping. The dominant vegetation was <i>Typha capensis</i> and <i>Phragmites sp.</i> , with a large percentage of alien vegetation infestation.
(HGM E) Hillslope Seep	A wetland area located on (gently to steeply) sloping land, which is dominated by the colluvium (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.	The hillslope seep is in the top of the catchment with some development nearby.

Figures 9 indicates the positions of the 25 HMG units which were used to classify the wetland groups, whereas Figures 10 indicates the three wetland areas present on the Olanga River banks.

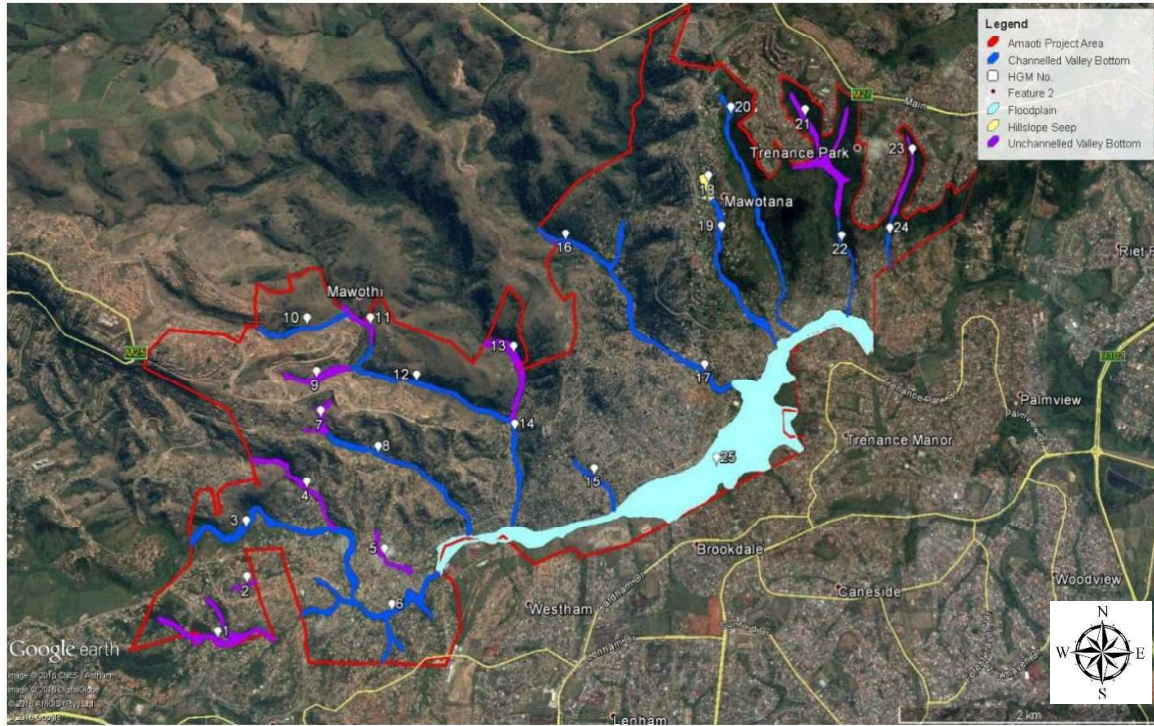


FIGURE 9: 25 HGM UNIT POSITIONS (WETLAND ASSESSMENT REPORT BY THE BIODIVERSITY COMPANY)



FIGURE 10: THREE WETLAND AREAS (WETLAND ASSESSMENT REPORT BY THE BIODIVERSITY COMPANY)

6.1.5 Buffer Zones

As a measure to “*preserve the integrity of the Durban Metropolitan Open Space System (D’MOSS) and to minimise the impact of the development on the environment*” The Biodiversity Company determined that a buffer zone of between 30 and 34m will be required during the construction and operation phases of the project. *(The Biodiversity Company, 2017 (Updated 2019))*

6.1.6 Current Conditions

An environmental study was conducted by The Biodiversity Company in 2017 and the report was recently updated in 2019. Very little vegetation remains in the area and is highly disturbed due to residents, and invasive plant species. On the steeper slopes were no development activities occur, forested and some grassland areas were present. For additional details on the wetland conditions refer to **Table 2** under section 6.1.4.

At the time this report was compiled, no visual inspection was conducted on the existing natural streams. In connection to the above, received reports and previous experience, maintenance and rehabilitation along the watercourse will be required to mitigate flooding and sediment deposits downstream.

6.1.7 Outstanding

Information required to proceed with the bulk services investigation and report will include the updated wetlands and buffer zones.

6.1.8 Future Procedures

The existing hydrology has a major influence on the new township layout, which influences the best possible locations for residential properties. The recently determined flood lines for this project has been made available for finalisation of the new township layout.

It should be noted that even though phasing will be implemented, the bulk services will be investigated and planned accordingly.

6.2 EXISTING STORMWATER NETWORK

6.2.1 External Stormwater Networks

The existing stormwater data obtained, from the eThekweni GIS website, mainly falls outside the project boundary as seen in **Figure 11**.

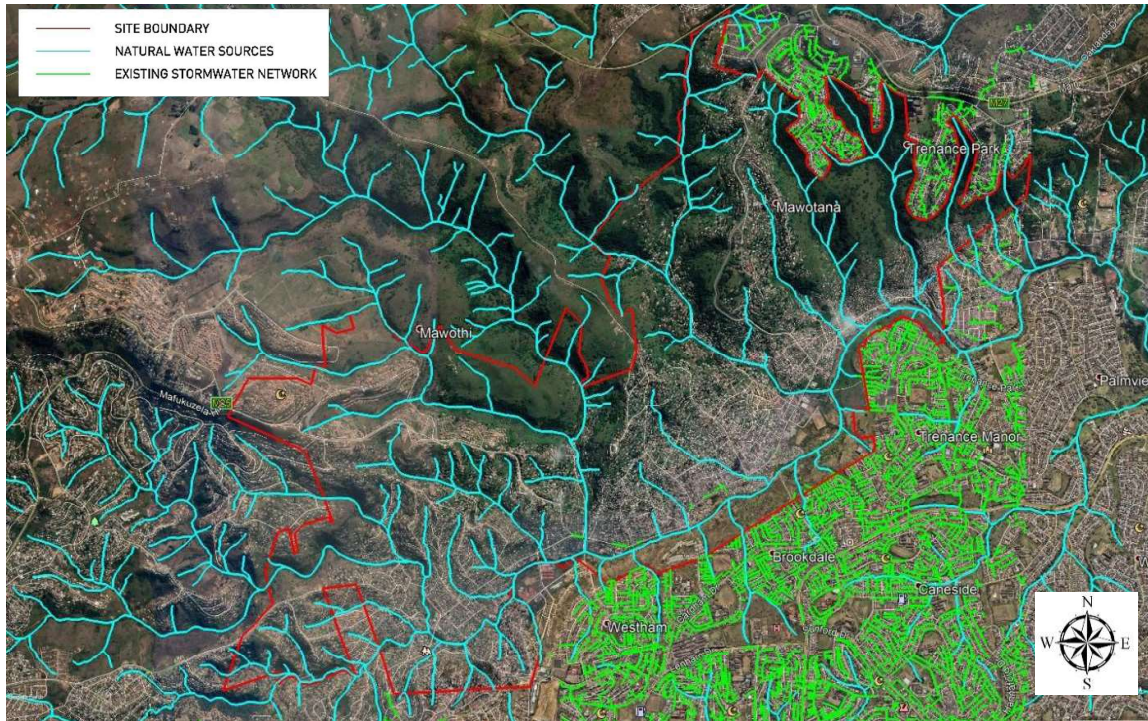


FIGURE 11: EXISTING STORMWATER NETWORK

6.2.2 Internal Stormwater Networks

Figure 12 below indicates some existing stormwater networks along the main road D403 which falls within the development.



FIGURE 12: EXISTING STORMWATER SYSTEM ALONG D403

Managing stormwater runoff into the existing watercourses will be a key priority in mitigating flooding within the development. This will be achieved by designing the internal stormwater reticulation with piped systems, concrete lined channels and, if required, attenuation ponds. Stormwater designs will be according to set standards by eThekweni Municipality.

Table 3 indicates estimated quantities of stormwater data, which are located within the project boundary, received from eThekweni GIS website and the topographical survey.

TABLE 3: ESTIMATED STORMWATER DATA

ITEM	DESCRIPTION	ESTIMATED VALUE
1	Natural watercourses within project boundary, i.e. streams and gullies. (from topographical survey)	69 km
2	Stormwater system along D403, i.e. pipes, concrete lined channels, etc. (from GIS data)	630 m
3	Stormwater structures corresponding with stormwater system along D403, i.e. manholes, kerb inlets, etc. (from GIS data)	43
4	Additional stormwater structures along D403, i.e. manholes, kerb inlets, etc. (from GIS data)	143

6.2.3 Current Conditions

Recently taken photos indicates that some of the existing stormwater kerb inlets require maintenance and remedial work in the near future, as indicated in Figure 14.



FIGURE 13: EXISTING STORMWATER KERB INLETS

Figure 14 indicates a narrow concrete channel discharging into an inlet structure. From this image it is clear that some of the other existing stormwater structures will also require remedial work.

Figure 15 indicates that the current condition of the concrete lined channels is fair, although some minor remedial work might be necessary.

6.2.4 Outstanding

Additional visual inspections on the existing internal stormwater networks will be required.

6.2.5 Future Procedures

The project will be phased, which will speed up the planning and implementation phases. This will also assist with effectively managing the project and improving the overall quality. Phasing is preliminary addressed within the Sanitation SQR and will be subject to detailed investigations.

The new township layout will have an effect on the existing hydrology with additional discharges into the natural watercourses. According to eThekweni Municipality’s design guidelines for stormwater ponds are rarely necessary due to the topography in Durban, however a thorough design will be done to determine if attenuation ponds might be required. Furthermore, all internal stormwater designs will be in accordance with eThekweni Municipality’s guidelines.



FIGURE 14: EXISTING STORMWATER INLET STRUCTURE

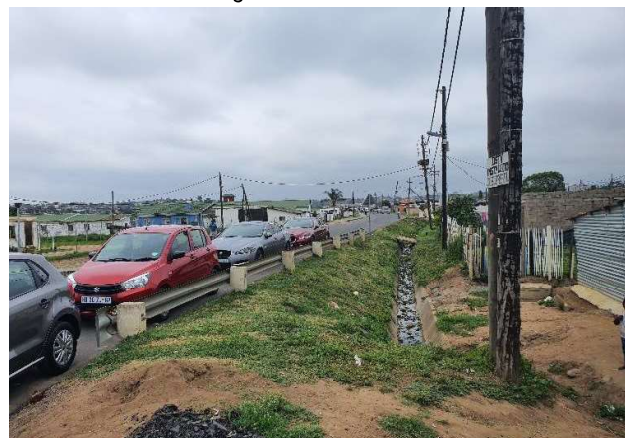


FIGURE 15: EXISTING STORMWATER CONCRETE LINED CHANNEL

7. PROVISIONAL MILESTONES

To ensure that the project progresses on time and within budget, it is of utmost importance that all relevant stakeholders are in continuous liaison and in compliance with timeframes. All communication relating to the project will be through the project manager. Important information will be conveyed formally, written and verbal conversations will be followed up by written communication for confirmation (email or letter).

Table 4 indicates the provisional milestones required for the progression of the project.

TABLE 4: PROVISIONAL MILESTONES

STAGE	MILESTONE	MILESTONE DESCRIPTION	DELIVERABLES	DURATION (MONTHS)	TARGET	STATUS / COMMENTS
Stage 1: Inception	Project Scoping	Establish client requirements, preferences and project brief, including scope of work, programme, risks and opportunities.	Inception Report	1	Feb-20	Complete
Stage 2: Feasibility Studies	Status-Quo Analysis	Investigate existing municipal services and capacities, layout in line existing settlements and the proposed development including risks and recommendations.	Water and Sewer Reports	2	Apr-20	Complete
			Roads and Stormwater Reports			
			Electrical Report	3	May-20	<ul style="list-style-type: none"> Active with the collation of information. Visual inspections required.
	Transport Planning	Establish requirements for both the existing settlements and the proposed development.	Traffic Impact Assessment Report	3	Jul-20*	<ul style="list-style-type: none"> Active with a collation of information. Township Layout required.
			Site Traffic Assessment Report	3	Sep-20*	
	Flood-Line	Establish a flood plain within which development will be prohibited.	Flood-Line Demarcation	2	May-20	Complete
	Bulk Investigation	Establish the status and capacity of the existing bulk services and identify areas of opportunities and develop a strategy for the implementation.	Water and Sewer Reports	2	Jun-20*	<ul style="list-style-type: none"> Active with a collation of information. Existing bulk infrastructure conditions and capacities required. Township Layout required. Visual inspections required.
			Roads and Stormwater Reports			
Electrical Report				Jul-20*		

STAGE	MILESTONE	MILESTONE DESCRIPTION	DELIVERABLES	DURATION (MONTHS)	TARGET	STATUS / COMMENTS
Stage 3: Concept and Viability	Preliminary Design	Collection of all data relevant to the project, investigate options for effective performance and produce concept designs and propose project implementation phasing.	Drawings and Reports: Water and Sewer	4	Oct-20*	<ul style="list-style-type: none"> Active with a collation of information. Draft Township Layout required. Survey required. Geotechnical investigation required.
			Drawings and Reports: Roads and Stormwater			
			Drawings and Report: Electricity			
			Project Phasing Plan			
Stage 4: Design Development	Detail Design	Undertake detailed design of the new facility and associated requirements, plan construction of the project, produce drawings, specifications and tender documentation, adjudicate tenders and recommend contract appointments.	Approved Drawings and Cost Estimate: Water and Sewer	4	Mar-21*	<ul style="list-style-type: none"> Approved Township Layout required. Approval of Preliminary Design and Environmental Authorisation required.
			Approved Drawings and Cost Estimate: Roads and Stormwater			
			Approved Drawings and Cost Estimate: Electricity			
			Project Phasing Plan			
Stage 5: Close-Out	Project completion	Prepare a completion report which will entail the summary of the project findings and recommendations.	Close-Out Report	2	May-20*	All the above

* Will be influenced by inputs from other disciplines and the turnaround time from the relevant authorities.

The visual inspections, which SCIP began in March, was put on hold due to the COVID-19 lockdown period, but will commence as soon as possible after clearance has been given by the government.

8. POTENTIAL RISKS

Table 5 is a live risk register prepared to identify and mitigate potential challenges.

TABLE 5: POTENTIAL RISKS

RISK	IMPACT	CONTINGENCY PLAN	PROBABILITY
Environmental authorization	Reduction of land to be developed. Delays.	Residential 3 and 4 developments. The municipality and the client to facilitate.	Medium
Town planning services	Delays in circulation.	Municipality to prioritize the project.	Medium
Flood plain	Reduced area of development. Location of structures within the flood plain.	Residential 3 and 4 developments.	Medium
Multi-year implementation	Budget, change in priorities Change in the executive.	Sufficient contingency reserves.	High
Red-tape/Bureaucracy	Processes to make decisions. Delays.		High
Executive	The conflict between executives. Executive turnover (leaving the company).		High
Stakeholders	Stakeholder conflicts. Stakeholders ignore communications. Stakeholder turnover.	Social facilitation.	Medium
Resources	Resources turnover. Team dynamics (conflicts, etc.). Unethical conduct.		Medium
Engineering designs	Delays from stakeholders' approval.		Low
Decisions making	Turnaround time. The ambiguity of decisions.		High
Time	Overly optimistic schedule.		Medium
External	Force majeure (e.g. act of nature). Technical change. Political change (local and federal). Community unrest.		High

9. CONCLUSION

The proposed upgrade of informal settlements will be beneficial to the residents of Amaoti and the surrounding areas especially from a flood risk point of view.

The most challenging factors which may cause project delays are the topography and to mitigate relocation of the residents. However, it is anticipated that the upgrades within the township will be prolonged due to the vast density and unstructured settlements.

The approved township layout will be used as a guide for which existing roads and stormwater systems will be utilised or discarded. This includes culverts, small bridges, concrete lined channels and inlet- and outlet structures. The township layout, together with detailed water and sewer investigations will be used to determine the construction phases.

Updated data on the positions and conditions of the existing stormwater systems, attenuation ponds and structures, like manholes, kerb inlets, etc. are required for the concept and design stages of the project.

Visual inspections are recommended for the bulk and internal stormwater networks.