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**STORMWATER MANAGEMENT PLAN FOR THE PROPOSED
DEVELOPMENT ON ERF 7379, PACALTS DORP.**

17 October 2023



Directors: Henk Roux Pr Eng

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Stephen Brand Pr Eng

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2. Introduction

Our Stormwater Management Plan is aimed at outlining the design philosophy that will be applied when designing the minor and major stormwater services for the proposed development. It is also aimed at providing relevant data on existing municipal infrastructure, and the ability of this infrastructure to accommodate the proposed development.

3. Proposed & Existing Development

The Proposed development will consist of a filling station combined with a Drive through and a line shop of which the total GLE calculates to 863m².

The resultant area comprises of a yard area, electrical room, Refuse room, toilets, roads, and parking's.

The Site Development Plan (SDP) is presented in Annexure 1.

4. Site Location & Characteristics

Location

The site is described as Erf 7379, Pacaltsdorp. It is 4 663 m² in extent. The current zoning is Single Residential Zone I. The site is located at 34° 0'52.31"S; 22°27'4.90"E (50668.452 Y; 3765412.558 X). Pacaltsdorp Central is located to the east of the site.

The site is bordered on the northern side by Church Street. It is bordered on the east by Erf 2558. Mission Road forms the southern boundary. The site is bordered on the west by the Beach Road.

The location of the site is presented in Annexure 2.

Topography

The topography of the site is defined by the existing stormwater furrow creating a valley terrain. Generally, the northwestern portion falls from northwest to southeast; the southeastern portion falls from southeast to northwest. Generally, the site falls from northeast to southwest with the main stormwater furrow.

A comprehensive topographical survey of the site was completed and is attached as Annexure 3.

There are currently no structures on the site.

The site is covered with medium to sparse grass.

Soil and Geotechnical Conditions

A comprehensive geotechnical investigation must be done for input from structural and civil engineer.

5. Stormwater

Municipal Stormwater System

On the northern perimeter of the site, a piped system is situated within Church Street, directing its flow from west to east.

Conversely, on the southern boundary of the site, a separate piped system can be found within Mission Road, facilitating a west-to-east directional flow.

The site is intersected by a stormwater furrow, which descends from the northern boundary to the western boundary. This watercourse enters the site from the northern direction via a stormwater pipe beneath Church Street and subsequently departs from the site to the west through another box culvert positioned beneath Beach Road. Further to the west, the watercourse discharges into Erf 7387.

Runoff and Flow

The Province of the Western Cape: Provincial Gazette Extraordinary 8795 has been applied.

This requires that 1in 10 year Post-development flows be limited to 1 in 10 year Pre-development levels, and that water quality be improved. Flows have been calculated using the Rational Method of flood calculation.

The minor system will be designed to cater for the 1:5 year return storm, and overland flow routes will be provided. Roads and parking areas will be shaped to the main drainage routes and will be finished in material that will prevent scouring and erosion.

Existing Water Courses and Bodies

There are no natural water courses on the property.

Existing stormwater infrastructure on the property

To the north of the site along Church Street, stormwater from erf 785, as per the municipal GIS diagram, is channelled underneath Church Street and released onto the proposed development through a headwall structure.

Additionally, at the same location where Church Street creates a low point, stormwater is gathered by a catchpit and then directed, via the same headwall, onto the proposed development.

Starting from the headwall entry point, a designated stormwater furrow is contoured to guide the water flow towards the western boundary of the site.

Upon reaching the western boundary, another stormwater headwall collects the stormwater. Subsequently, in accordance with the municipal GIS, the water flows beneath Beach Road and is discharged onto erf 7387.

Notably, the elevation at the northern culvert is 200.90, whereas at the western culvert, is 199.45. The overall length of the stormwater furrow spans 58 meters. Consequently, the calculated average gradient of this watercourse equates to 1:40.

The Existing water furrow is to be rerouted outside the erf boundaries of erf 7379 with cost being deductible from development contributions.



Stormwater furrow standing upstream looking towards western boundary



Discharge point on erf 7387

Proposed new stormwater infrastructure on the property.

New stormwater infrastructure will be required to service the proposed development.

Materials

Stormwater pipes will generally be Class 100D pre-cast concrete pipes with spigot and socket joints, laid on a Class B bed. Minimum pipe diameters on main lines will be 375 millimetres. Pipe diameters of catchpit links to be 300 millimetres. The minimum cover on stormwater pipes will generally be 0,8 metres under sidewalks and 1,0 metre at road crossings. Pipes will be bedded and backfilled with clean sand compacted to 95% Mod AASHTO density. Brick built catchpits with double cast iron grid inlets will be constructed to collect surface water. Pre-cast concrete ring manholes with precast concrete top slabs with ductile iron covers and frames will be constructed. Sub-surface drainage will be installed in appropriate areas to act as cut-off drains. Perforated pipes with bedding and blanket layers and appropriate geofabric filter surround will be used.

Layout

The minor stormwater system will be designed as a system of underground pipes, with associated manholes and catchpits and open channels to accommodate the runoff of a 1 in 5-year storm event.

Flows will be piped and accommodated in open channels to discharge into the existing bodies where it will be attenuated.

The emergency system recognises failure or malfunction of the minor system by providing continuous overland flow routes in order to disperse the stormwater into the attenuation facilities.

6. Applicable Conditions

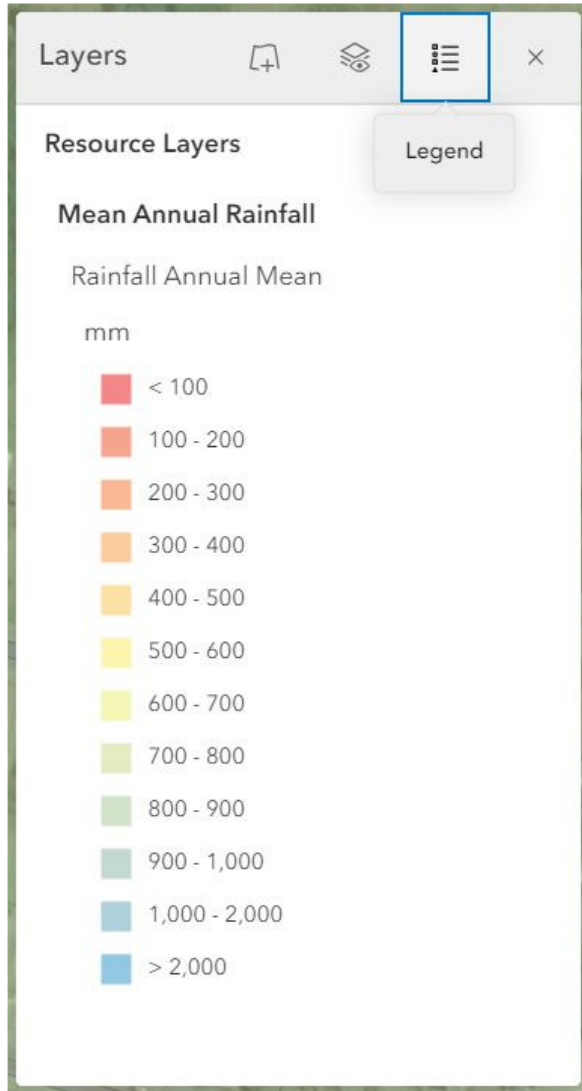
6.1 Rainfall

Rainfall information was obtained from Cap Farm Mapper 3

The mean annual rainfall can be seen on image extracted below.



From the legend below a mean annual rainfall of 800mm was used for calculation purposes



7. Pre-development flows

The site was treated as completely undeveloped for this calculation.

| Ground Cover | Kerby Retardance Coefficient, r (Chin, 2000) |
|---|--|
| Conifer timberland, dense grass | 0.80 |
| Deciduous timberland | 0.60 |
| Average grass | 0.40 |
| Poor grass, bare sod | 0.30 |
| Smooth bare packed soil, free of stones | 0.10 |
| Smooth pavements | 0.02 |

We have applied the n-factor used for Kerby as 0.3.

The Kerby formula was used to calculate the pre-development peak time of concentration. This was used to obtain the depth for the various events. The Rational Method was then used to calculate the runoff flows.

Our calculations are presented in Annexure 7.

The pre-development flows are as follows:

| | | |
|---------------------------|--|-----------|
| RECURRENCE INTERVAL (YRS) | 10 | 50 |
| PEAK (l/s) | 62 | 129.4 |
| | Notes: 1. The catchment area is 4663m 2. The runoff factor is: Mean Annual Precipitation= 800mm | |

8. Proposed on-site stormwater configuration and restriction of flows

The Bransby Williams formula was used to calculate the post-development peak time of concentration. This was used to obtain the depth for the various events. The Rational Method was then used to calculate the runoff flows.

The comparison between pre-development and post-development flows are as follows:

Combined

| | | |
|-----------------------------|-----------|-----------|
| RECURRENCE INTERVAL (YRS) | 10 | 50 |
| PEAK PRE-DEVELOPMENT (l/s) | 62 | 129.4 |
| PEAK POST-DEVELOPMENT (l/s) | 117.2 | 192.1 |

| | | |
|----------------|-----------------------|-------------------------|
| Storm Event | Storage Required (m3) | Allowable outflow (l/s) |
| 10 year | 14.6 | 62 |
| 50 year | 12.1 | 129.4 |

9. Improving quality of runoff

Before entering the attenuation ponds, water will pass through a leaf and litter trap. This will remove leaves and litter and the larger suspended particles.

In order to remove the Suspended Solids and Phosphates, stormwater will be spread over a wider area, at a flatter gradient, thus slowing down the flow in order to allow the suspended particles to settle out.

The receiving heads of the detention area will have silt traps installed.

10. Servitudes

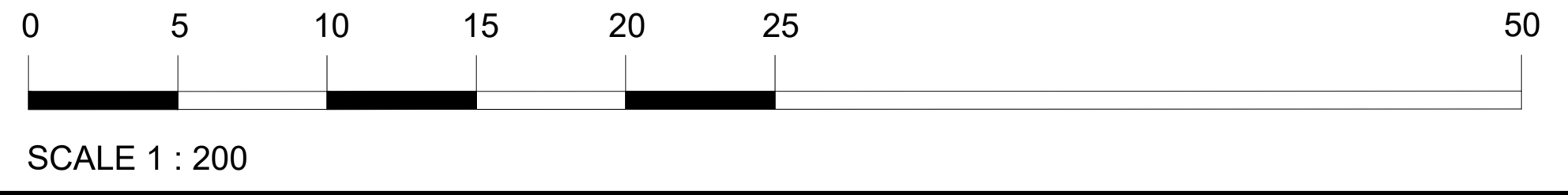
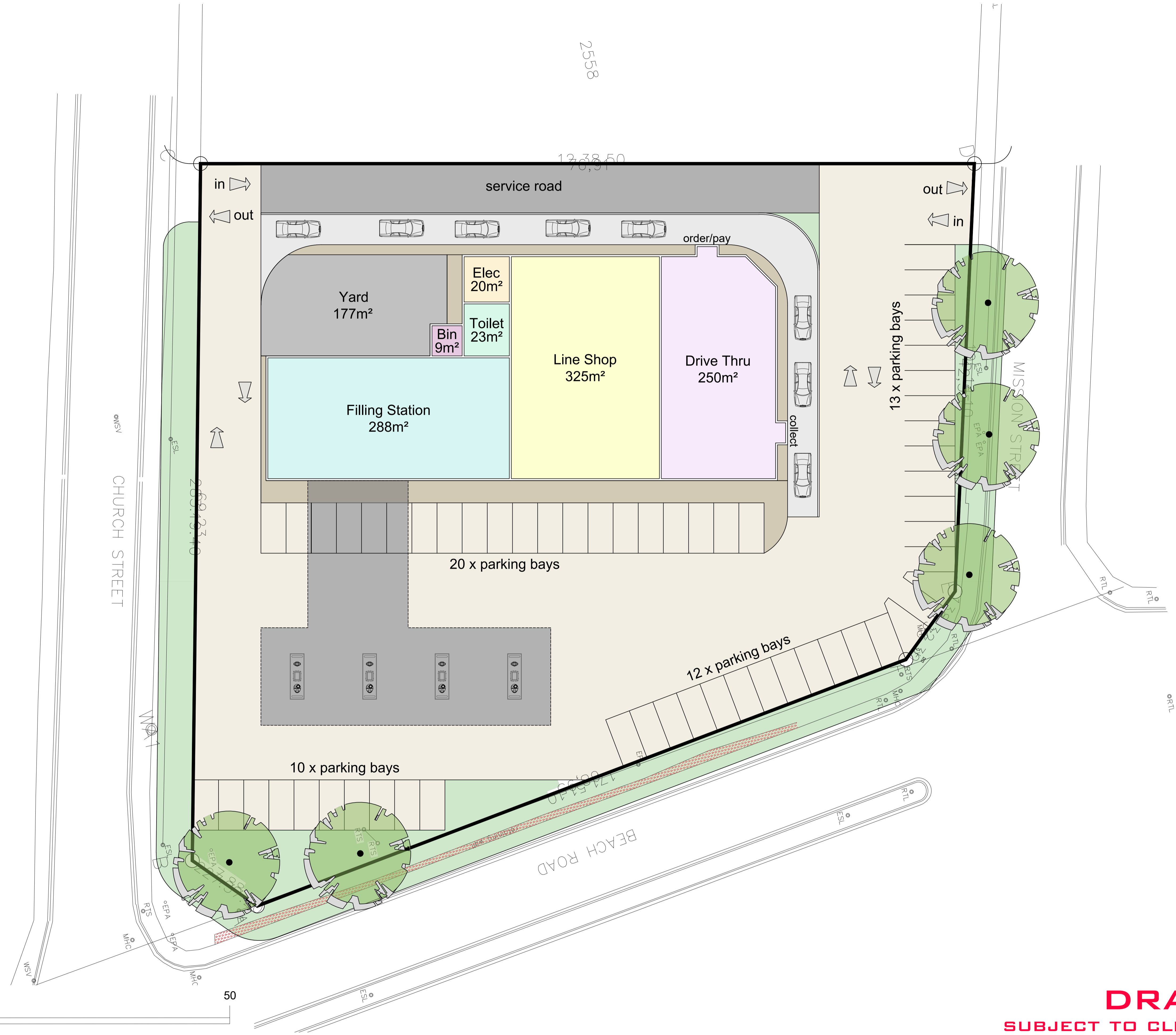
No stormwater servitudes are required over the property.

11. Conclusion

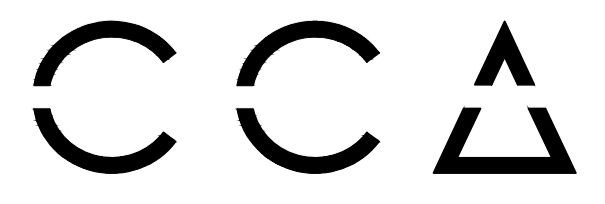
The above serves to confirm that sustainable urban drainage system objectives have been met in the proposed development of the property.

Annexure 1 – Site Development Plan

| KEY | | |
|--|-----------------|---------------------|
|  | Drive Thru | 250m ² |
|  | Line Shops | 325m ² |
|  | Filling Station | 288m ² |
|  | Total GLA | 863m ² |
|  | Anchor Yard | 177m ² |
|  | Electrical | 20m ² |
|  | Bin Area | 9m ² |
|  | Toilets | 23m ² |
|  | Parking | 55 |
|  | Total Site Area | 4 663m ² |



DRAFT
 SUBJECT TO CLIENT FEEDBACK



PACALTSDORP
 SITE DEVELOPMENT PLAN - OPTION 3

Annexure 2 – Locality Plan

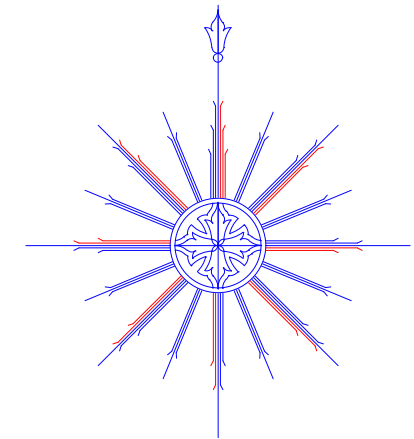


Annexure 3 – Topographical Survey

CONTOUR PLAN ERF 7379 PACALTSDORP

NOTES

- Survey date: January 2020
- Height Datum: MSL based on TSM
- Survey System WGS84 to 23
- Contour Interval: 0.5m
- Dimensions are metric



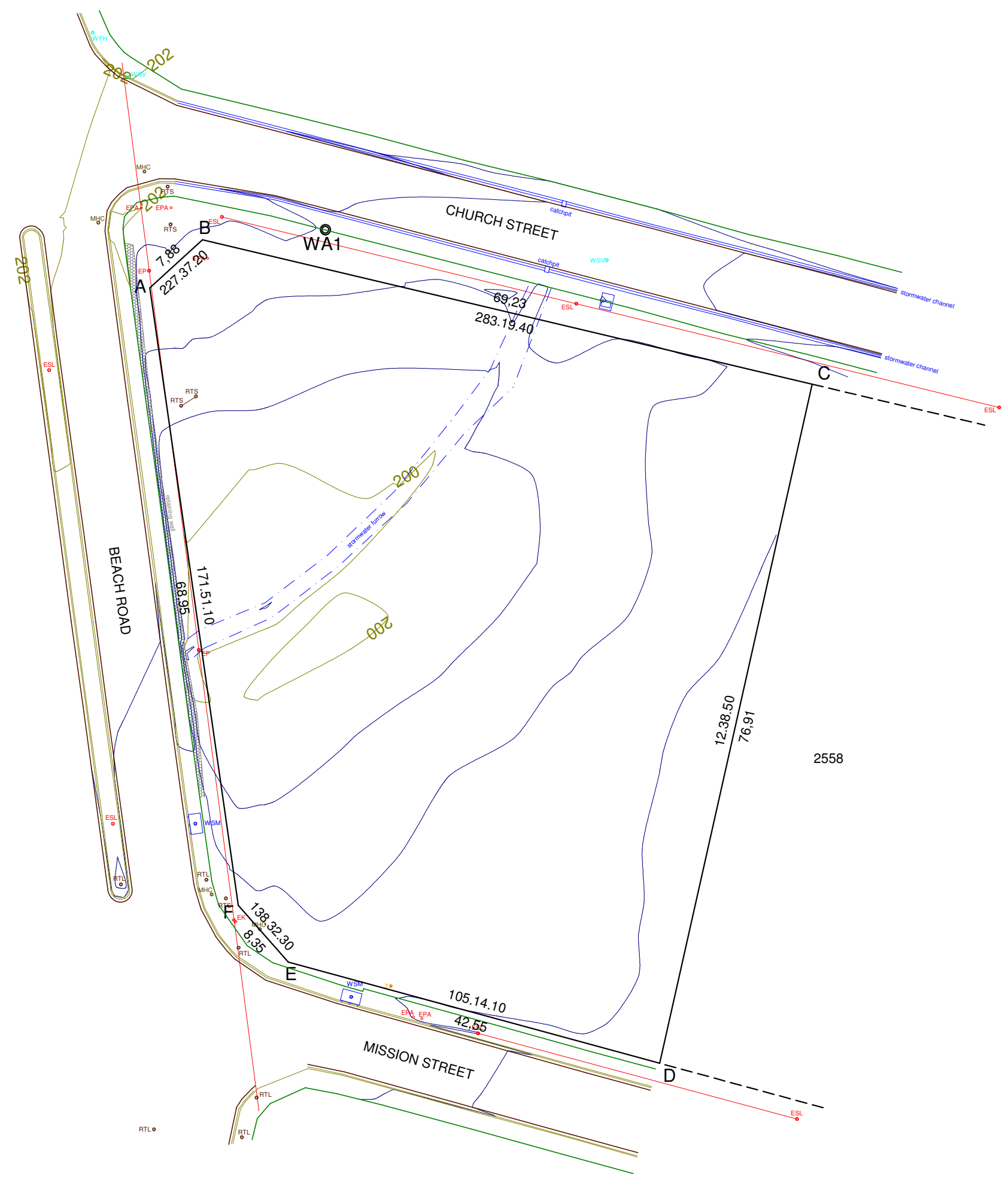
| Legend | |
|--------|---------------------------|
| | Bottom of Kerb |
| | Top of Kerb |
| | Edge of Road |
| | Stormwater channel |
| | Edge of Paved Area |
| | Traffic Sign / Signage |
| | Traffic Light |
| | Stop Valve |
| | Fire Hydrant |
| | Storm Water Manhole |
| | Storm Water Drain/Culvert |
| | Manhole Cover |
| | Electrical Streetlight |
| | Electrical Pole |
| | Electrical Pole Anchor |
| | Electrical Kiosk |
| | Telkom |

+ 3765400 X WG + 50600 Y

+ 3765450 X WG + 50600 Y

| Bench mark and Beacons | | | |
|------------------------|----------|------------|---------|
| Coordinate List | | | |
| | Y-Coord | X-Coord | Z-Coord |
| | WG23 | | |
| WA1 | 50691.61 | 3765367.46 | 201.50 |
| A | 50711.02 | 3765373.87 | |
| B | 50705.20 | 3765368.56 | |
| C | 50637.83 | 3765384.52 | |
| D | 50654.67 | 3765459.56 | |
| E | 50695.72 | 3765448.38 | |
| | 50701.25 | 3765442.12 | |

WA1 ... 12mm iron peg at kerb
A,B,E,F ... 16mm iron peg
C,D ... 12mm iron



| No | Description | Date | By |
|----|-------------|------|----|
| | | | |


REVISIONS

| | |
|----------------|----------|
| Recommended by | Date |
| Approved by | Date |
| Drawn HLR | Designed |
| Checked HLR | Engineer |
| Client App. | Date |

Scale 1:500 (A3)

Client
PACALTSPROPDEV (PTY) LTD

Contract
Proj. No. WAR/PE/2002

 **BAILEY & LE ROUX**
Professional Land Surveyors
88 Meade Street, P O Box 9583
GEORGE, 6530
Tel (044) 8745315
Fax (044) 8745345

PE7379-KP

Drawing No

Rev No **A**

Annexure 4 - Existing Engineering Infrastructure on the Property

Pipes - Existing System Type

- Future
- Raw
- Bulk
- Distribution Main
- Reticulation
- Raw - Private
- Bulk - Private
- Distribution Main - Private
- Reticulation - Private
- Raw - External
- Bulk - External
- Distribution Main - External
- Reticulation - External
- Fire Reticulation
- Closed PIPE
- CV
- Bridge
- Culvert
- Encased
- Meter
- Pipe Sleeve

Nodes

- all other values

Tanks - Tank Types

- all other values
- BULK
- WTP
- GL_TANK
- TANK
- TOWER
- BOREHOLE
- DAM
- RIVER
- WELL
- BPT
- SUMP

Pumps - Pump Types

- all other values
- Closed PUMP
- Open PUMP

Valves - Valve Types

- all other values
- Closed FCV
- Open FCV
- Closed PRV
- Open PRV
- Closed PBV
- Open PBV
- Closed PSV
- Open PSV
- Closed TCV
- Open TCV

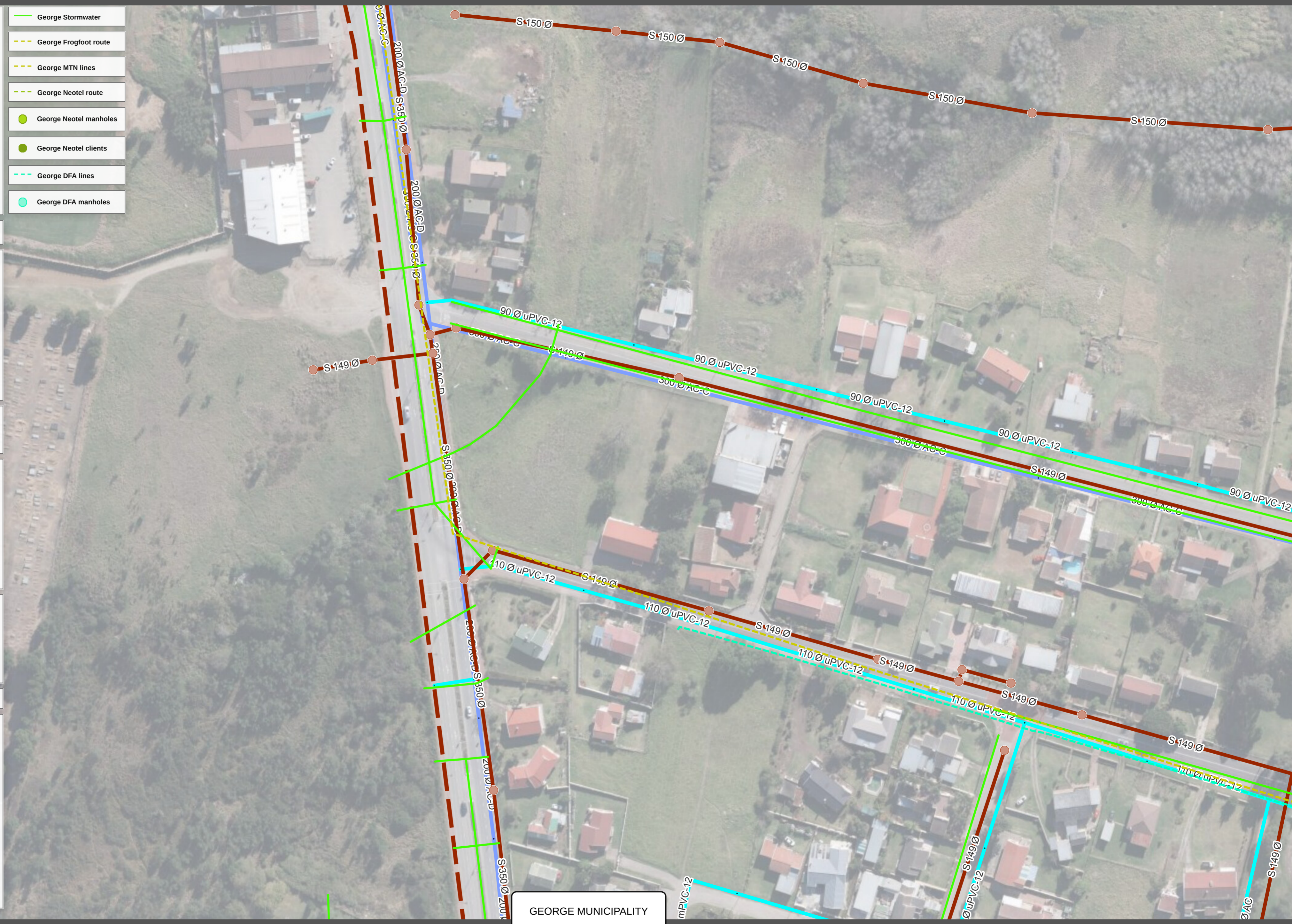
Gravity Pipes! - Generic

- all other values
- Bridge
- Culvert
- Encased
- Siphon
- Sted
- Tunnel

Rising Mains

Structures! - Generic

- all other values
- Conservancy Tank
- Diversion
- Dummy
- End Manhole
- Interceptor Tank
- Manhole
- Pump Structure
- Rodding Eye
- Sub-Catchment
- T-Piece
- Top End
- WWTP
- Septic Tank
- Flow Meter
- Sump



Annexure 5 - Stormwater Management Plan

Annexure 6 – Stormwater runoff calculations

Illudas Runoff Data

| Subcatchment Name | Outlet Node | Runoff Area ha | Paved Area % | Paved Entry Time min | Paved Depr. Storage mm | Supplementary Area % | Grass Entry Time min | Grass Depr. Storage mm | Soil Type |
|-------------------|-------------|----------------|--------------|----------------------|------------------------|----------------------|----------------------|------------------------|-----------|
| A1 | 1 | 0.358 | 0 | 0 | 0 | 0 | 10 | 3 | B/C |
| A2 | 1 | 0.108 | 0 | 0 | 0 | 0 | 7 | 3 | B/C |

Results Summary

File Name: \\192.168.0.250\server\NetBakData\Administrator@FILESRV\Disk D\23 DVP A Projects 2023\A3336-PACALTS DORP GEORGE\Civil\DESIGN\STORM\PRE DEV\PRE DEV.st8

Inflow Calculation Method = Illudas
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Chicago Storm Coastal Region
Mean Annual Precipitation = 800 mm
Return Period = 10 years
Duration = 120 min
Time Step = 1 min
Ratio of Peak/Duration = 0.38
Factor A = 914
Factor B = 12.6
Factor C = 0.737
Total Depth = 50.7 mm
Antecedant Moisture Condition = Rather Wet (3)
Routing Method = Time Shift
Proportional Flow Depth = 100 %
Number of Nodes analyzed = 3

Subnetwork 1
Outfall Node = OUT
Outlet Level = 198.650 m
Design Flow = 0.062 m³/s

Accuracy Check
Volume of inflow = 50.7 m³
Volume at outfall = 50.7 m³
Percentage Error = 0.00 %

Runoff Analysis

| Node Name | Runoff m ³ /s | Surface Inflow m ³ /s | Paved Area Volume m ³ | Grass Area Volume m ³ | Total Volume m ³ |
|-----------|-----------------------------|--|--|--|-----------------------------------|
| 1 | 0.0620 | 0.0620 | 0.000 | 50.715 | 50.7 |

Overflow Analysis

| Link Name | Node Name | Next Node Name | Overflow Node Name | Design Flow m ³ /s | Flow m ³ /s | Capacity m ³ /s | Overflow m ³ /s | Storage m ³ | Inflow Storage m ³ |
|-----------|-----------|----------------|--------------------|----------------------------------|---------------------------|-------------------------------|-------------------------------|---------------------------|----------------------------------|
| L1 | 1 | DAM | | 0.062 | 0.062 | 0.072 | 0.000 | 0.0 | 0.0 |
| LDAM | DAM | OUT | | 0.062 | 0.062 | 0.072 | 0.000 | 0.0 | 0.0 |

Illudas Runoff Data

| Subcatchment Name | Outlet Node | Runoff Area ha | Paved Area % | Paved Entry Time min | Paved Depr. Storage mm | Supplementary Area % | Grass Entry Time min | Grass Depr. Storage mm | Soil Type |
|-------------------|-------------|----------------|--------------|----------------------|------------------------|----------------------|----------------------|------------------------|-----------|
| A1 | 1 | 0.358 | 90 | 2 | 1 | 0 | 0 | 3 | B/C |
| A2 | 1 | 0.108 | 90 | 2 | 1 | 0 | 0 | 3 | B/C |

Results Summary

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| | |
|---|---------------------------|
| Inflow Calculation Method | = Illudas |
| C:\Users\M92p-773\Desktop\alaine pacaltsdorp\NetBakData\Administrator@FILESRV\Disk D\23 DVP A Projects 2023\A3336-PACALTSDORP GEORGE\Civil\DESIGN\STORM\PRE DEV\1IN10.STM | |
| Chicago Storm Coastal Region | |
| Mean Annual Precipitation | = 800 mm |
| Return Period | = 10 years |
| Duration | = 120 min |
| Time Step | = 1 min |
| Ratio of Peak/Duration | = 0.38 |
| Factor A | = 914 |
| Factor B | = 12.6 |
| Factor C | = 0.737 |
| Total Depth | = 50.7 mm |
| Antecedant Moisture Condition | = Rather Wet (3) |
| Routing Method | = Time Shift |
| Proportional Flow Depth | = 100 % |
| Number of Nodes analyzed | = 3 |
| Subnetwork 1 | |
| Outfall Node | = OUT |
| Outlet Level | = 198.576 m |
| Design Flow | = 0.062 m ³ /s |
| Accuracy Check | |
| Volume of inflow | = 165.3 m ³ |
| Volume at outfall | = 165.3 m ³ |
| Percentage Error | = 0.00 % |

Runoff Analysis

| Node Name | Runoff m ³ /s | Surface Inflow m ³ /s | Paved Area Volume m ³ | Grass Area Volume m ³ | Total Volume m ³ |
|-----------|-----------------------------|--|--|--|-----------------------------------|
| 1 | 0.1172 | 0.1172 | 160.249 | 5.072 | 165.3 |

Overflow Analysis

| Link Name | Node Name | Next Node Name | Overflow Node Name | Design Flow m ³ /s | Flow m ³ /s | Capacity m ³ /s | Overflow m ³ /s | Storage m ³ | Inflow Storage m ³ |
|-----------|-----------|----------------|--------------------|----------------------------------|---------------------------|-------------------------------|-------------------------------|---------------------------|----------------------------------|
| L1 | 1 | DAM | | 0.1172 | 0.1172 | 0.1276 | 0.0000 | 0.0 | 0.0 |
| LDAM | DAM | OUT | | 0.1172 | 0.0620 | 0.0620 | 0.0552 | 14.6 | 0.0 |

Illudas Runoff Data

| Subcatchment Name | Outlet Node | Runoff Area ha | Paved Area % | Paved Entry Time min | Paved Depr. Storage mm | Supplementary Area % | Grass Entry Time min | Grass Depr. Storage mm | Soil Type |
|-------------------|-------------|----------------|--------------|----------------------|------------------------|----------------------|----------------------|------------------------|-----------|
| A1 | 1 | 0.358 | 0 | 0 | 1 | 0 | 10 | 3 | B/C |
| A2 | 1 | 0.108 | 0 | 0 | 1 | 0 | 7 | 3 | B/C |

Results Summary

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| | |
|--|---------------------------|
| Inflow Calculation Method | = Illudas |
| \\192.168.0.250\server\NetBakData\Administrator@FILESRV\Disk D\23 DVP A Projects 2023\A3336-PACALTSORP GEORGE\Civil\DESIGN\STORM\PRE DEV\1IN50.STM | |
| Chicago Storm Coastal Region | |
| Mean Annual Precipitation | = 800 mm |
| Return Period | = 50 years |
| Duration | = 120 min |
| Time Step | = 1 min |
| Ratio of Peak/Duration | = 0.38 |
| Factor A | = 1482 |
| Factor B | = 12.6 |
| Factor C | = 0.737 |
| Total Depth | = 82.2 mm |
| Antecedant Moisture Condition | = Rather Wet (3) |
| Routing Method | = Time Shift |
| Proportional Flow Depth | = 100 % |
| Number of Nodes analyzed | = 3 |
| Subnetwork 1 | |
| Outfall Node | = OUT |
| Outlet Level | = 198.494 m |
| Design Flow | = 0.129 m ³ /s |
| Accuracy Check | |
| Volume of inflow | = 155.7 m ³ |
| Volume at outfall | = 155.7 m ³ |
| Percentage Error | = 0.00 % |

Runoff Analysis

| Node Name | Runoff m ³ /s | Surface Inflow m ³ /s | Paved Area Volume m ³ | Grass Area Volume m ³ | Total Volume m ³ |
|-----------|-----------------------------|--|--|--|-----------------------------------|
| 1 | 0.1294 | 0.1294 | 0.000 | 155.658 | 155.7 |

Overflow Analysis

| Link Name | Node Name | Next Node Name | Overflow Node Name | Design Flow m ³ /s | Flow m ³ /s | Capacity m ³ /s | Overflow m ³ /s | Storage m ³ | Inflow Storage m ³ |
|-----------|-----------|----------------|--------------------|----------------------------------|---------------------------|-------------------------------|-------------------------------|---------------------------|-------------------------------------|
| L1 | 1 | DAM | | 0.129 | 0.129 | 0.210 | 0.000 | 0.0 | 0.0 |
| LDAM | DAM | OUT | | 0.129 | 0.129 | 0.210 | 0.000 | 0.0 | 0.0 |

Illudas Runoff Data

| Subcatchment Name | Outlet Node | Runoff Area ha | Paved Area % | Paved Entry Time min | Paved Depr. Storage mm | Supplementary Area % | Grass Entry Time min | Grass Depr. Storage mm | Soil Type |
|-------------------|-------------|----------------|--------------|----------------------|------------------------|----------------------|----------------------|------------------------|-----------|
| A1 | 1 | 0.358 | 90 | 2 | 1 | 0 | 0 | 3 | B/C |
| A2 | 1 | 0.108 | 90 | 2 | 1 | 0 | 0 | 3 | B/C |

Results Summary

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| | |
|---|---------------------------|
| Inflow Calculation Method | = Illudas |
| \\192.168.0.250\server\NetBakData\Administrator@FILESRV\Disk D\23 DVP A Projects 2023\A3336-PACALTSDORP GEORGE\Civil\DESIGN\STORM\PRE DEV\1IN50.STM | |
| Chicago Storm Coastal Region | |
| Mean Annual Precipitation | = 800 mm |
| Return Period | = 50 years |
| Duration | = 120 min |
| Time Step | = 1 min |
| Ratio of Peak/Duration | = 0.38 |
| Factor A | = 1482 |
| Factor B | = 12.6 |
| Factor C | = 0.737 |
| Total Depth | = 82.2 mm |
| Antecedant Moisture Condition | = Rather Wet (3) |
| Routing Method | = Time Shift |
| Proportional Flow Depth | = 100 % |
| Number of Nodes analyzed | = 3 |
| Subnetwork 1 | |
| Outfall Node | = OUT |
| Outlet Level | = 198.494 m |
| Design Flow | = 0.129 m ³ /s |
| Accuracy Check | |
| Volume of inflow | = 277.4 m ³ |
| Volume at outfall | = 277.4 m ³ |
| Percentage Error | = 0.00 % |

Runoff Analysis

| Node Name | Runoff m ³ /s | Surface Inflow m ³ /s | Paved Area Volume m ³ | Grass Area Volume m ³ | Total Volume m ³ |
|-----------|-----------------------------|--|--|--|-----------------------------------|
| 1 | 0.1921 | 0.1921 | 261.839 | 15.566 | 277.4 |

Overflow Analysis

| Link Name | Node Name | Next Node Name | Overflow Node Name | Design Flow m ³ /s | Flow m ³ /s | Capacity m ³ /s | Overflow m ³ /s | Storage m ³ | Inflow Storage m ³ |
|-----------|-----------|----------------|--------------------|----------------------------------|---------------------------|-------------------------------|-------------------------------|---------------------------|----------------------------------|
| L1 | 1 | DAM | | 0.1921 | 0.1921 | 0.2103 | 0.0000 | 0.0 | 0.0 |
| LDAM | DAM | OUT | | 0.1921 | 0.1290 | 0.1290 | 0.0631 | 12.1 | 0.0 |