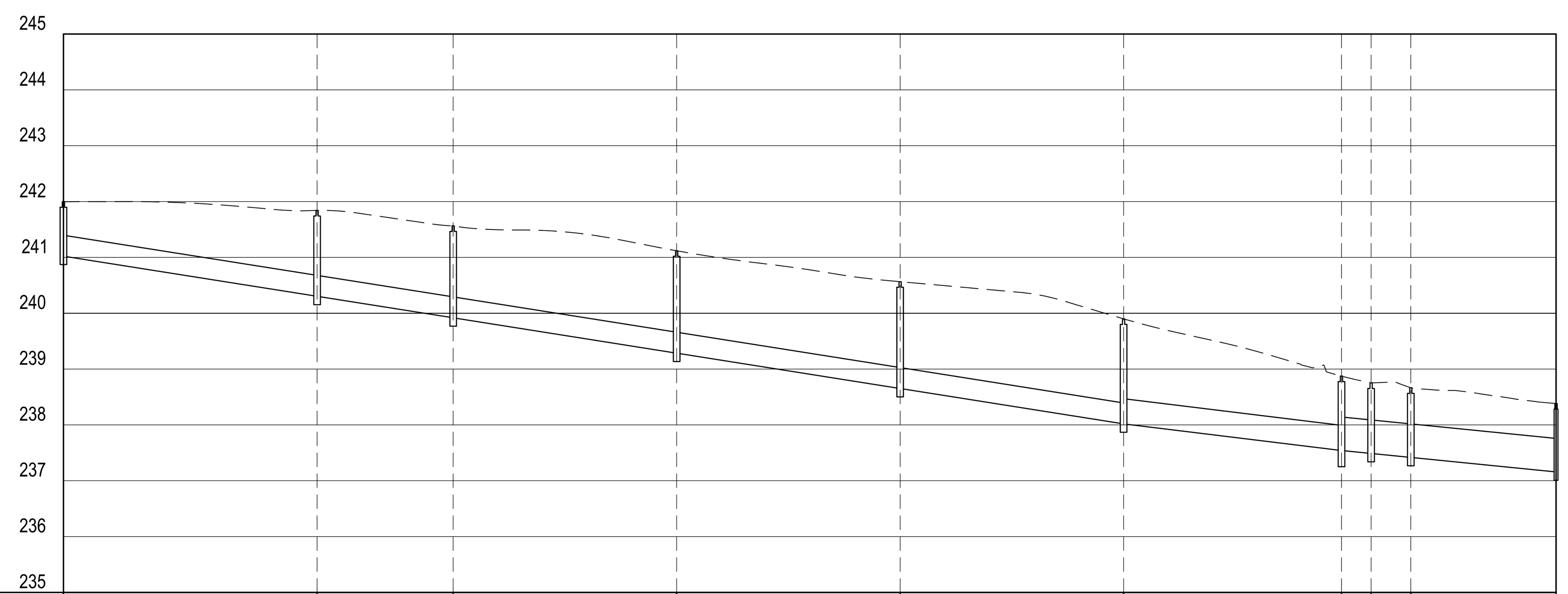
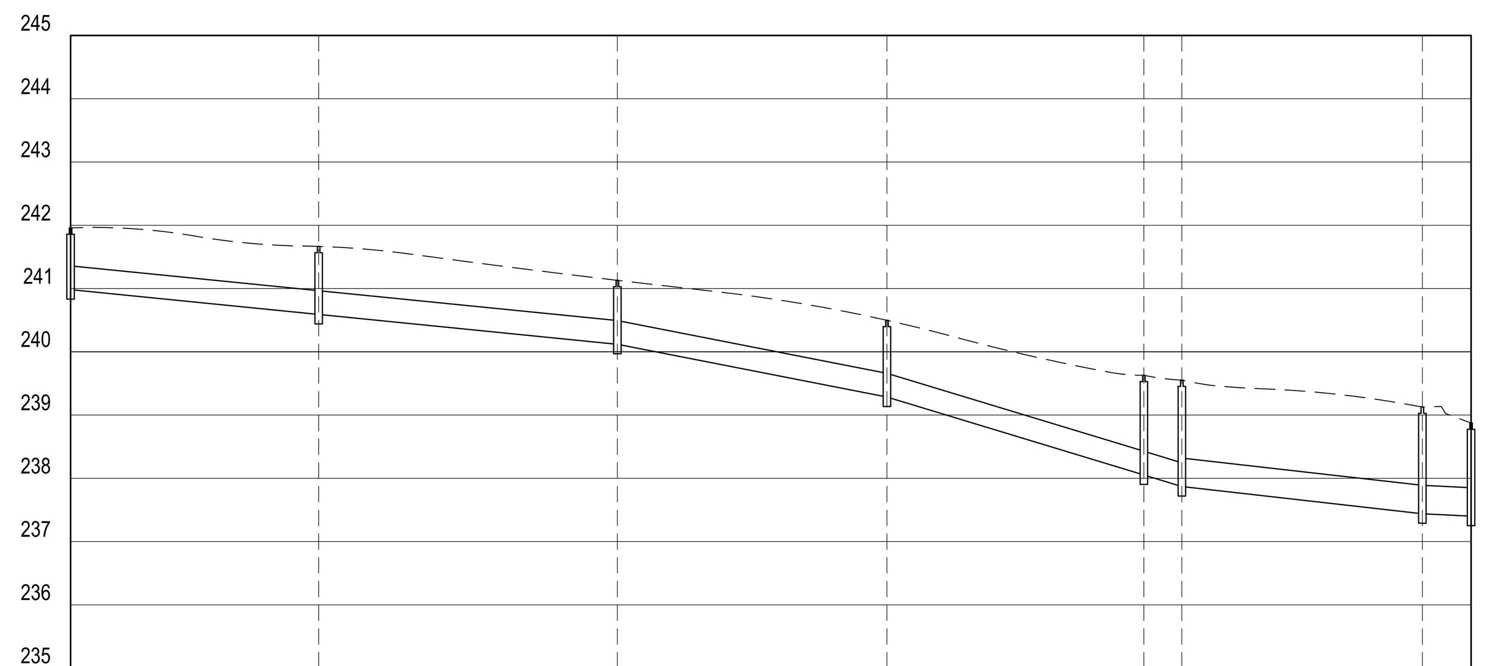


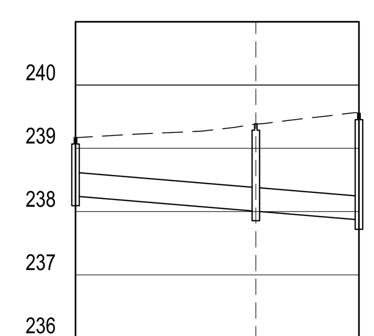
	CP01	CP02	CP03	CP04	CP05	CP06	CP07	CP08	SM01	CHANNEL
FINAL COVER LEVEL	241.997	241.841	241.565	241.119	240.565	239.899	238.875	238.752	238.664	238.383
EXISTING GROUND LEVEL	241.997	241.841	241.565	241.119	240.565	239.899	238.875	238.752	238.664	238.383
INVERT LEVEL OF PIPE	241.022	240.303	239.918	239.285	238.652	238.019	237.542	237.489	237.418	237.158
DEPTH TO INVERT (m)	0.975	1.537	1.647	1.834	1.913	1.881	1.473	1.263	1.247	1.225
PIPE DESCRIPTION		Ø375mm CLASS 100D	Ø375mm CLASS 100D	Ø375mm CLASS 100D	Ø375mm CLASS 100D	Ø375mm CLASS 100D	Ø450mm CLASS 100D	Ø600 [illegible] 100D	[illegible] 100D	[illegible]00mm CLASS 100D
CONSTRUCTION GRADIENT (%)		1.583%	1.583%	1.583%	1.583%	1.583%	1.223%	1.000%	1.000%	1.000%
PEG DISTANCE – BETWEEN POINTS (m)		45.400	24.356	40.000	40.000	40.000	39.001	5.300	7.100	26.000
PEG DISTANCE – ACCUMULATED (m)	0.000	45.400	69.756	109.756	149.756	189.756	228.757	234.057	241.157	267.157
STRUCTURE NO.	CP01	CP02	CP03	CP04	CP05	CP06	CP07	CP08	SM01	CHANNEL

STORMWATER LONGSECTION - CP01 TO CHANNEL



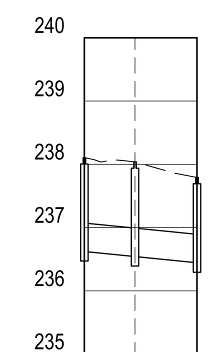
	CP09	CP10	CP11	CP12	CP13	CP14	CP15	CP07
FINAL COVER LEVEL	241.958	241.666	241.130	240.497	239.629	239.553	239.127	238.875
EXISTING GROUND LEVEL	241.958	241.666	241.130	240.497	239.629	239.553	239.127	238.875
INVERT LEVEL OF PIPE	240.983	240.591	240.119	239.285	238.054	237.870	237.440	237.401
DEPTH TO INVERT (m)	0.975	1.075	1.011	1.212	1.575	1.683	1.687	1.473
PIPE DESCRIPTION		Ø375mm CLASS 100D	Ø375mm CLASS 100D	Ø375mm CLASS 100D	Ø375mm CLASS 100D	Ø375mm CLASS 100D	Ø450mm CLASS 100D	Ø450mm CLASS 100D
CONSTRUCTION GRADIENT (%)		1.000%	1.000%	1.957%	3.033%	3.059%	1.132%	0.500%
PEG DISTANCE – BETWEEN POINTS (m)		39.200	47.200	42.600	40.600	6.000	38.000	7.700
PEG DISTANCE – ACCUMULATED (m)	0.000	39.200	86.400	129.000	169.600	175.600	213.600	221.300
STRUCTURE NO.	CP09	CP10	CP11	CP12	CP13	CP14	CP15	CP07

STORMWATER LONGSECTION - CP09 TO CP07



	CP16	CP17	CP14
FINAL COVER LEVEL	239.168	239.386	239.553
EXISTING GROUND LEVEL	239.168	239.386	239.553
INVERT LEVEL OF PIPE	238.243	238.006	237.870
DEPTH TO INVERT (m)	0.925	1.380	1.683
PIPE DESCRIPTION		Ø375mm CLASS 100D	Ø375mm CLASS 100D
CONSTRUCTION GRADIENT (%)		0.833%	0.833%
PEG DISTANCE – BETWEEN POINTS (m)		28.500	16.300
PEG DISTANCE – ACCUMULATED (m)	0.000	28.500	44.800
STRUCTURE NO.	CP16	CP17	CP14

STORMWATER LONGSECTION - CP16 TO CP14



	KI01	CP18	CP21
FINAL COVER LEVEL	238.105	238.038	237.792
EXISTING GROUND LEVEL	238.105	238.038	237.792
INVERT LEVEL OF PIPE	236.622	236.542	236.444
DEPTH TO INVERT (m)	1.483	1.496	1.348
PIPE DESCRIPTION		Ø450m[illegible] 100D	[illegible] CLASS 100D
CONSTRUCTION GRADIENT (%)		1.000%	1.000%
PEG DISTANCE – BETWEEN POINTS (m)		8.000	9.800
PEG DISTANCE – ACCUMULATED (m)	0.000	8.000	17.800
STRUCTURE NO.	KI01	CP18	CP21

STORMWATER LONGSECTION - KI01 TO CP21

PROJECT NUMBER: PC22024

PROJECT NAME: URBAN COUNTRY ESTATE

CLIENT: URBAN FRONT (Pty) Ltd.

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REFERENCE DRAWINGS

REV	DATE	DESCRIPTION

REVISIONS

DESIGNER: T de JAGER	DRAFTER: J WEST
REVIEWER: L FOURIE	DATE: 10 JULY 2023

DRAWING NAME: STORMWATER LONGSECTIONS SHEET 1 OF 2

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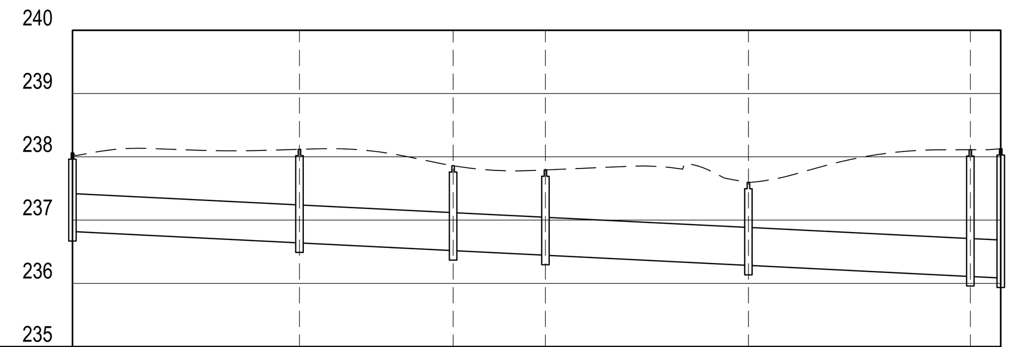
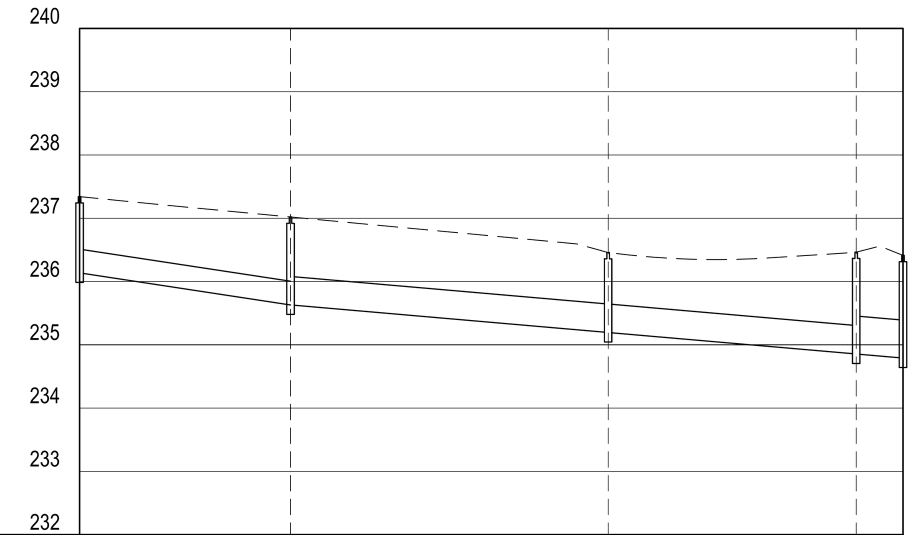
SIGNATURE: | DATE: 10/07/2023



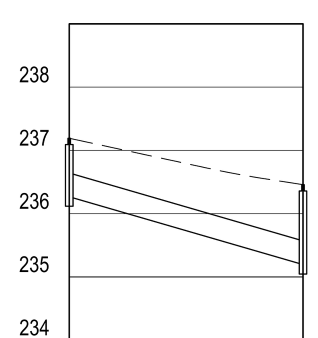
FINAL COVER LEVEL	238.061	238.118	237.859	237.792	237.595	238.112	238.127
EXISTING GROUND LEVEL	238.061	238.118	237.859	237.792	237.595	238.112	238.127
INVERT LEVEL OF PIPE	236.818	236.639	236.517	236.444	236.284	236.108	236.084
DEPTH TO INVERT (m)	1.243	1.479	1.342	1.348	1.312	2.004	2.043
PIPE DESCRIPTION		Ø600mm CLASS 100D	Ø600mm CLASS 100D	Ø600mm CLASS 100D	Ø600mm CLASS 100D	Ø600mm CLASS 100D	Ø600mm CLASS 100D
CONSTRUCTION GRADIENT (%)		0.500%	0.500%	0.500%	0.500%	0.500%	0.500%
PEG DISTANCE – BETWEEN POINTS (m)		35.900	24.300	14.600	32.100	35.100	4.800
PEG DISTANCE – ACCUMULATED (m)	0.000	35.900	60.200	74.800	106.900	142.000	146.800
STRUCTURE NO.	CP19	CP20	CP29	CP21	CP22	CP23	HW01

STORMWATER LONGSECTION - CP19 TO HW01



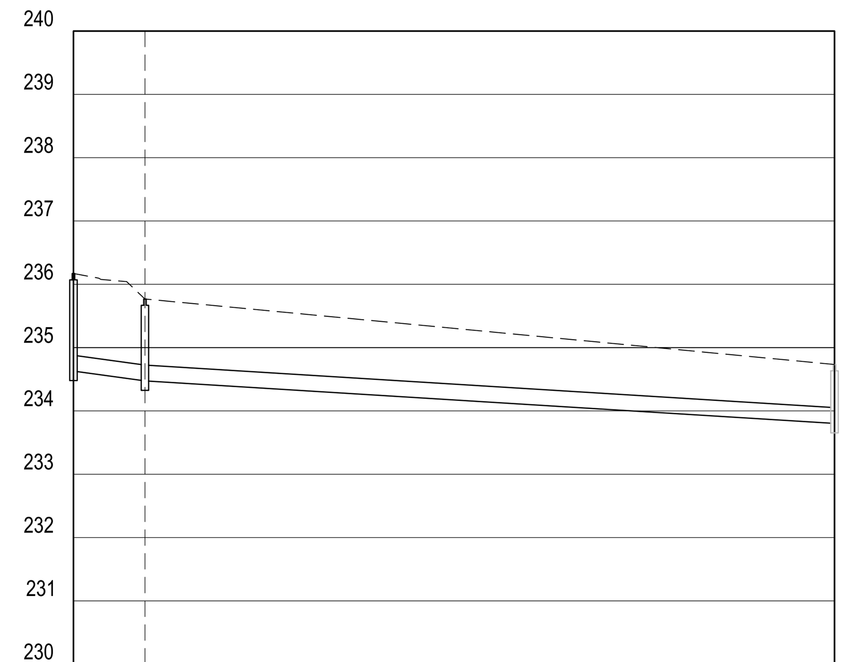
FINAL COVER LEVEL	237.342	237.020	236.459	236.465	236.414
EXISTING GROUND LEVEL	237.342	237.020	236.459	236.465	236.414
INVERT LEVEL OF PIPE	236.136	235.630	235.195	234.855	234.791
DEPTH TO INVERT (m)	1.206	1.390	1.264	1.610	1.623
PIPE DESCRIPTION		Ø375mm CLASS 100D	Ø450mm CLASS 100D	Ø450mm CLASS 100D	Ø600mm CLASS 100D
CONSTRUCTION GRADIENT (%)		1.518%	0.866%	0.866%	0.866%
PEG DISTANCE – BETWEEN POINTS (m)		33.359	50.231	39.229	7.407
PEG DISTANCE – ACCUMULATED (m)	0.000	33.359	83.590	122.820	130.226
STRUCTURE NO.	CP24	CP25	CP26	CP27	HW02

STORMWATER LONGSECTION - CP24 TO HW02



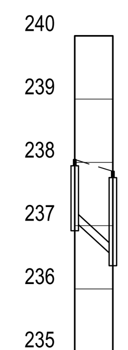
FINAL COVER LEVEL	237.192	236.459
EXISTING GROUND LEVEL	237.192	236.459
INVERT LEVEL OF PIPE	236.267	235.195
DEPTH TO INVERT (m)	0.925	1.264
PIPE DESCRIPTION		Ø375mm CLASS 100D
CONSTRUCTION GRADIENT (%)		2.907%
PEG DISTANCE – BETWEEN POINTS (m)		36.891
PEG DISTANCE – ACCUMULATED (m)	0.000	36.891
STRUCTURE NO.	CP28	CP26

STORMWATER LONGSECTION - CP28 TO CP26



FINAL COVER LEVEL	236.170	235.768	234.733
EXISTING GROUND LEVEL	236.170	235.768	231.341
INVERT LEVEL OF PIPE	234.629	234.475	233.803
DEPTH TO INVERT (m)	1.541	1.293	0.931
PIPE DESCRIPTION		Ø250mm uPVC CLASS 51	Ø250mm uPVC CLASS 51
CONSTRUCTION GRADIENT (%)		1.368%	0.617%
PEG DISTANCE – BETWEEN POINTS (m)		11.300	109.000
PEG DISTANCE – ACCUMULATED (m)	0.000	11.300	120.300
STRUCTURE NO.	PD02	SM02	Existing KI

STORMWATER LONGSECTION - PD02 TO EXISTING KI



FINAL COVER LEVEL	238.046	237.859
EXISTING GROUND LEVEL	238.046	237.859
INVERT LEVEL OF PIPE	237.069	236.517
DEPTH TO INVERT (m)	0.977	1.342
PIPE DESCRIPTION		Ø160mm uPVC CLASS 34
CONSTRUCTION GRADIENT (%)		9.204%
PEG DISTANCE – BETWEEN POINTS (m)		6.000
PEG DISTANCE – ACCUMULATED (m)	0.000	6.000
STRUCTURE NO.	Fountain	CP29

STORMWATER LONGSECTION - FOUNTAIN TO CP29

PROJECT NUMBER: PC22024

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REFERENCE DRAWINGS

REV	DATE	DESCRIPTION

REVISIONS

DESIGNER: T de JAGER	DRAFTER: J WEST
REVIEWER: L FOURIE	DATE: 10 JULY 2023

DRAWING NAME: STORMWATER LONGSECTIONS SHEET 2 OF 2

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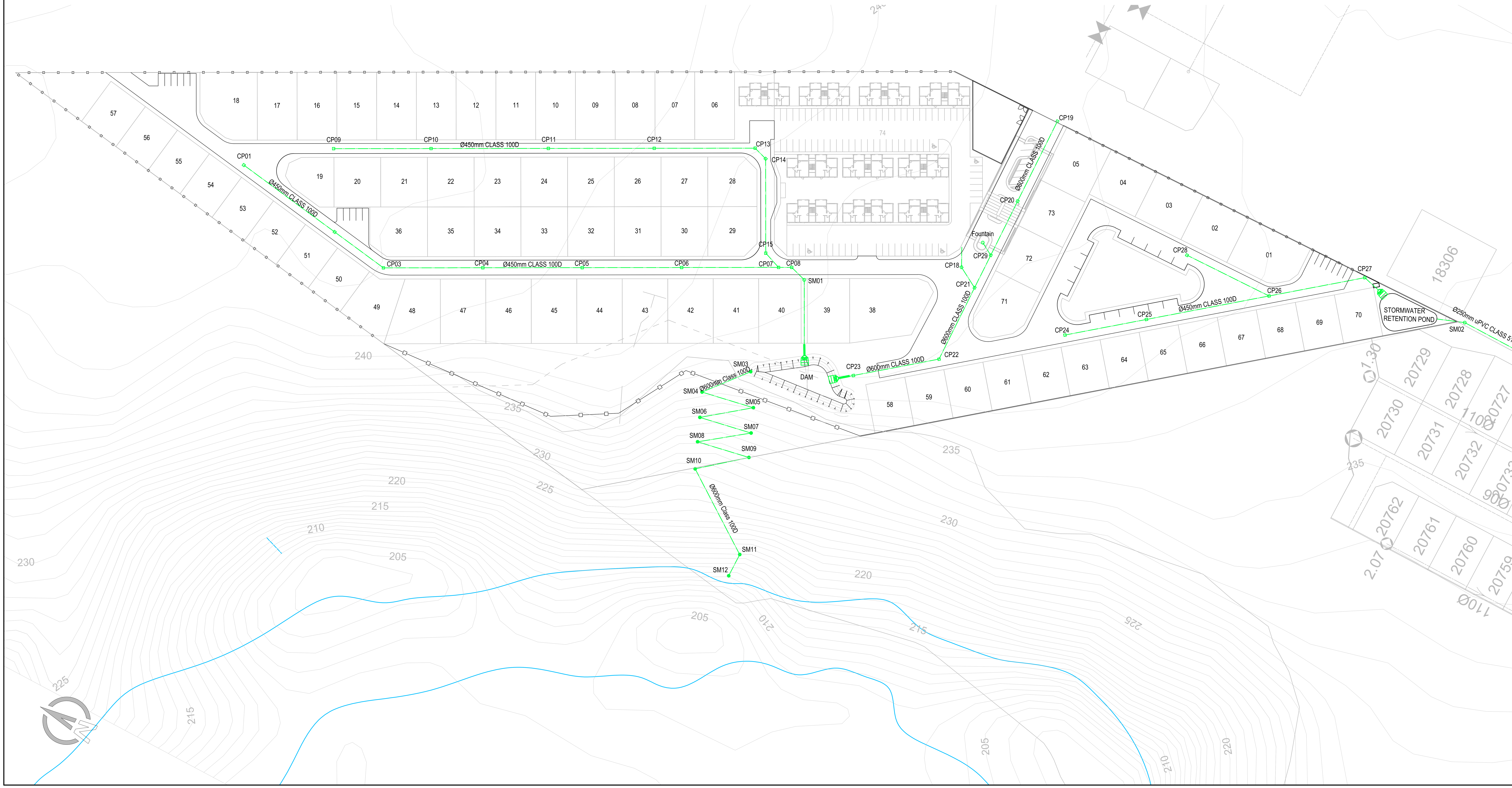
APPROVED BY ENGINEER: SIGNATURE: | DATE: 10/07/2023

WATER PIPE COORDINATES
WGS84 LO23

STRUCTURE NAME	Y COORDINATE	X COORDINATE	PIPE INVERT LEVEL
AV01	53 049.413	3 757 620.643	241.145
EC02	53 005.048	3 757 932.052	236.888
FH01	53 058.617	3 757 745.365	240.161
FH02	53 032.014	3 757 691.198	240.667
FH03	52 979.258	3 757 859.057	238.060
FH04	52 947.087	3 758 003.884	236.094
HB01	53 065.690	3 757 732.137	240.413
HB02	53 039.086	3 757 677.970	240.764
HB03 & VB05	52 953.465	3 757 838.119	238.987
HB04 & VB06	52 955.955	3 757 846.611	238.391
HB09	52 883.946	3 757 941.180	237.151
HB10 & VB09	52 889.389	3 757 947.023	237.148
HB11	52 969.056	3 757 949.268	236.679
HB12 & VB 10	52 967.242	3 757 967.849	236.480
HB13	52 960.553	3 757 971.015	236.526
HB14 & VB11	52 903.675	3 757 969.452	236.873
HB15 & VB12	52 901.452	3 758 048.020	235.560
HB16 & VB13	52 907.526	3 758 052.913	235.552
RSV01	52 960.643	3 757 928.621	237.358

WATER PIPE COORDINATES
WGS84 LO23

STRUCTURE NAME	Y COORDINATE	X COORDINATE	PIPE INVERT LEVEL
RSV02	53 045.518	3 757 677.031	240.806
RSV03	52 956.596	3 757 832.262	239.066
RSV04	52 964.808	3 757 851.339	238.265
RSV05	52 892.888	3 757 947.122	237.127
RSV06	52 971.780	3 757 951.465	236.659
RSV07	52 972.299	3 757 961.522	236.553
RSV08	52 901.593	3 758 043.022	235.647
T01	53 057.392	3 757 675.297	240.884 240.884
T02	52 993.708	3 757 866.775	237.855
T04	52 960.398	3 757 848.984	238.325
T05	52 976.982	3 757 955.663	236.620 236.620
T06	52 982.442	3 757 960.068	236.578
VB01	53 063.281	3 757 715.636	240.692
VB02	52 975.259	3 757 901.283	237.199
VB03	52 958.412	3 757 932.794	237.411
VB04	52 980.670	3 757 787.234	239.963
WM01	52 897.886	3 757 947.263	237.098
Y01	52 949.894	3 757 948.728	236.792



PROJECT NUMBER: PC22024

PROJECT NAME: URBAN COUNTRY ESTATE

CLIENT: URBAN COUNTRY ESTATE (Pty) Ltd.

CIVIL & STRUCTURAL ENGINEER:

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REV	DATE	DESCRIPTION

REVISIONS

DESIGNER: W JEVON	DRAFTER: H OOSTHUIZEN
REVIEWER: L FOURIE	DATE: 3 JUNE 2025

DRAWING NAME: STORMWATER RETICULATION LAYOUT

DRAWING NUMBER: PC22024/CIV/2301

DRAWING ISSUED FOR: INFORMATION

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APPROVED BY ENGINEER:

SIGNATURE: | DATE: 03 June 2025

Project:
Urban Country Estate

Prepared For:
Mr Shaun Gomez (P/A: Henco Scholtz)
STORMWATER MANAGEMENT PLAN

Date	13 November 2024
Drafted	
Wesley Jevon C Eng	
Approved	
Louis Fourie Pr Eng	
Reference	PC22024 Urban Country SWMP 20241112 V00

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1 INTRODUCTION

1.1 Scope of Work

Newground Projects is required to to prepare the Stormwater Management Plan for submission to the George Municipality for the approval of the proposed *Urban Country Estate* development. This report has been prepared to satisfy the requirement of the Municipality that the Developer/Owner provides on-site management for a rainfall event up to and including a 1:50-year event with a controlled release of no more than the 1:5-year rainfall event.

The purpose of this stormwater management plan is to provide the detailed calculations of the attenuation pond size that would be required to contain the 1:50 year rainfall event and release the outflow at no more than the 1:5-year rainfall event. This is believed to be a conservative approach considering the limited options for stormwater release at the site.

This report will be submitted to the municipality for approvals and provides the following:

- Site Description,
- Calculations of the Stormwater Runoff,
- Calculations of the Attenuation Pond Volume,
- SWMP Maintenance plan,
- Drawing of the proposed SWMP.

1.2 Limitations and Assumptions

The following limitations and necessary assumptions were made for the purposes of this design.

- There SWMP was done based on the information available to the engineer at the time of the assessment.
- The bylaw states that the discharge from the site post-development is to match the discharge from site pre-development. Due to the limited access to municipal stormwater infrastructure at the site, it was decided the best solution is to release the runoff into the adjacent river.

2 SITE DESCRIPTION

The site is located at the end of Plantation Road in Heather Park, George. The full extent of the site covers an area of 56 336m^2 which is currently undeveloped. Once developed, the total developed surface area of the site will be in the order of 47 836m^2.

The coordinate of the property is:

- 33° 56' 48"S
- 22° 25' 37"E

The site generally falls in a South Westerly direction at a slope of 3% which becomes steeper towards the Malgasrivier. Water from the site currently drains by means of surface runoff into the Malgasrivier.

The surrounding erven in the area are mainly developed as residential property with a few sites being developed as commercial. The N12 national route passes the site to the north however this is not deemed to increase the surface run-off on the site. This stormwater management plan considers the entire site, and not limited to the developed portion of the site.

Figure 2-1 shows an aerial image of the site and its immediate surroundings.

Figure 2-1: Site Layout

3 STORMWATER RUN-OFF

The stormwater runoff rates were determined using the Rational Method (Alternative 2) as recommended by the Drainage Manual (6th edition). The table below presents a summary of the calculations done to obtain the stormwater flowrates.

Table 3-1: Rational Method Summary

Description	Value
Size of Catchment Area	56 336 m^2
Mean Annual Precipitation	911 mm/year
Weather Service Station	George
Weather Service Number	0028838_W
Run-off coefficient (Pre-development)	0.36
Run-off coefficient (Post-development)	0.75
Time of Concentration	15 minutes
Average Rainfall Intensity (1:5-year)	101.2 mm/hour
Average Rainfall Intensity (1:50-year)	198.2 mm/hour
Peak Flow (1:5-year)	570 l/s
Peak Flow (1:50-year)	2182 l/s

The “Design Rainfall Estimation in Southern Africa (Ver 3)” software was used in combination with TR102 to obtain the required data for the site to accurately determine the expected flow rates. The site comprises of permeable grassy areas sloping towards the Malgasrivier to the west of the site. The site is currently undeveloped but is intended to be developed into a residential estate.

The full design sheet for the above flow rate determination can be seen in Annexure A.

The proposed development will use the roads and stormwater pipelines to manage the runoff. There are two portions of the property will remain uncontrolled flow due however the majority of the site’s surface runoff will be directed into an attenuation pond which will control the release of the runoff at an acceptable manner.

4 ATTENUATION POND

The Abott and Grigg formula is used to determine the required detention pond volume. The equation is as follows:

$$Vst = 60\left(\frac{1+m}{2}\right)q_{pa}.t_{ca}(1-\alpha)^2$$

Where:

- V_{st} = Storage Volume Required (m^3)
- m = Ratio of Hydrograph Recession Time
- q_{pa} = 1:50-year peak discharge post-development (m^3/s)
- t_{ca} = Time of concentration
- $\alpha = q_{pa}/q_{pb}$
- q_{pb} = 1:5-year peak discharge pre-development (m^3/s)

The Abott and Grigg formula calculates the required attenuation pond volume to that will be used to retain the 1:50-year rainfall event. The outlet of the pond will discharge the 1:5-year rainfall event flow rate.

The time of concentration is again taken as 15 minutes as per the BCMM regulations.

Table 4-1 below presents the design parameters and calculations for the determination of the storage volume required.

Table 4-1: Attenuation Pond Calculations

Description	Symbol	Value
Ratio of Hydrograph Recession Time	m	1
1:50-year peak discharge post-development	q_{pa}	2.182 m^3/s
1:5-year peak discharge pre-development	q_{pb}	0.57 m^3/s
q_{pa}/q_{pb}	α	0.245
Time of concentration	t_{ca}	5 minutes
Storage Volume Required	V_{st}	357.2 m^3

The total required volume of the stormwater attenuation pond for this site is therefore 357.2 m^3. We propose that the storage volume be provided by means of an earth dam located centrally. This dam will be constructed with an outlet capable to throttling the outflow to the desired flow rate. The attenuation pond will be able to service the majority of the site, however there will be a portion of the site which will remain uncontrolled due to the difficulty in capturing this runoff. The runoff produced by these areas will be accounted for when determining the flowrate released from the pond.

Drawing PC22024-CIV-2501 provides a layout of the proposed stormwater management as described above. The exact layout and details will be confirmed during the detail design phase of the project due to the complex site conditions and the need for surveys and geotechnical investigations.

5 SWMP MAINTENANCE

The stormwater management plan is designed to be as maintenance free as possible under a range of conditions, however it should be noted that the system will not function as designed should the maintenance and upkeep be neglected.

Under normal operating conditions, the attenuation pond will fill up by means of the stormwater pipelines. The attenuation pond then catches the water and discharges it into the adjacent river system at a controlled rate by means of an outflow pipe sized to restrict the outflow to the 1:5-year flow rate.

The maintenance plan of the stormwater management is as follows:

- Inspection and maintenance of all stormwater pipes and channels on site. This includes the regular inspection of all stormwater outlet pipes and open channels from buildings and carparks that are generating the run-off from the site ensuring they are directed to the attenuation pond and are not blocked.

- Inspection and maintenance of the attenuation pond including regular inspection of ensuring that there is no build-up of debris inside the pond. The outlet from the pond must be regularly inspected ensuring it is clean and not blocked allowing the pond to function as designed.

- Inspection and maintenance of the stormwater catchpits ensuring that there is no build-up of debris inside the catchpits.

- Inspection and maintenance of the outlet pipework downstream of the attenuation pond. This includes the regular inspection of the outlet pipework ensuring that the outlet pipe is not blocked and unrestricted allowing the controlled outflow to drain the attenuation pond into river.

6 SUMMARY

The purpose of this stormwater management plan is to provide the detailed calculations of the attenuation pond size that would be required to contain the 1:50 year rainfall event and release the outflow into adjacent river at no more than the 1:5-year rainfall event.

The site is located at the end of Plantation Road in Heather Park, George. The full extent of the site covers an area of 56 336 Once developed, the total developed surface area of the site will be in the order of 47 836m^2.

- Peak discharge for 1:5-year event: 0.57 m^3/sec
- Peak discharge for 1:50-year event: 2.182 m^3/sec

The total required volume of the stormwater attenuation pond for this site is 357.2 m^3. The attenuation pond will be able to service the majority of the site, however there will be a portion of the site which will remain uncontrolled due to the difficulty in capturing this runoff. The runoff produced by these areas will be accounted for when determining the flowrate released from the pond. The outflow from the pond will be controlled release into the Malgasrivier.

Please refer to Annexure B for the drawing PC22024-CIV-2501 which illustrates the proposed management plan.

Annexure A: Rational Design Method

SUMMARY

Discharge Calculations: Rational Method		
Area (m^2) =	A	56336
Hardening Factor Before Development C_b =	0.36	-
Hardening Factor After Development C_a =	0.75	(Specified)
1:5 Year Intensity $I_{1:5}$ (mm/hr) =	101.2	(Specified)
1:50 Year Intensity $I_{1:50}$ (mm/hr) =	198.2	(Specified)
1:5 Year Flood, $Q_{1:5}$ (m^3/sec) =	$C_b\, I_{1:5}\, A$	0.5701
1:50 Year Flood, $Q_{1:50}$ (m^3/sec) =	$C_a\, I_{1:50}\, A$	2.182

Abt & Grigg Formula: $V_{st} = 60\{(1 + m)\div 2\}\, q_{pa} t_c a\, (1 - \alpha)^2$			
Storage Volume Required (m^3) =	V_{st} =		357.18
Ratio of Hydrograph Recession Time =	m =	1	(Specified)
Peak Discharge (1:50) Post-development (m^3/sec) =	q_{pa} =	$Q_{1:50}$	2.182
Post-development Time of Concentration (min) =	t_{ca} =	5	(Calculated)
Peak Discharge (1:5) Pre-development (m^3/sec) =	q_{pb} =	$Q_{1:5}$	0.570
α =	q_{pb}/q_{pa} =		0.261

Design of Controlled Release Facility with Darcy Equation

$$z_A = \frac{u^2}{2g} + z_B + \frac{4fLu^2}{2gd} + k_L \frac{u^2}{2g}$$

Entry loss k_L =	0.5
Exit loss k_L =	1
Friction factor f =	0.08

Calculation Results

Catchment	A (m^2)	Hardening Factor	$Q_{1:50}$ (ℓ/s)	$Q_{Total\ if\ uncontrolled}$	Q_{design} (ℓ/s)
Area 1 (controlled)	24026	1.00	1322.754	1552.857	270.028
	11610	0.36	230.103		
Area 2 (controlled)	6208	1.00	341.785	444.662	115.726
	5191	0.36	102.877		
Area 3 (uncontrolled)	9302	0.36	184.366	184.366	184.366
Total Area	56336	0.70	2326.207	2181.884	570.120

Annexure B: Site Plan

LEGEND:

- STORMWATER PIPE
- M100 SUBSOIL DRAIN
- (CP) STORMWATER CATCH PIT
- (SM) STORMWATER MANHOLE
- (STRE) STORMWATER RODDING EYE
- (KI) STORMWATER KERB INLET
- EXISTING/FUTURE STORMWATER KERB INLET
- (CE) SUBSOIL DRAIN CLEANING EYE
- SUBSOIL PIPE (HB) HORIZONTAL BEND (VB) VERTICAL BEND
- (SWB) STORMWATER PIPE BEND

PROJECT NUMBER: PC22024

PROJECT NAME: URBAN COUNTRY ESTATE

CLIENT: URBAN FRONT (Pty) Ltd.

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URBAN COUNTRY ESTATE:

REMAINDER ERF 6182; ERF 6179; ERF 6156 of LAPSED ERF 19374

Heather Park, near Blanco,
George,
Western Cape

PRELIMINARY STORMWATER MANAGEMENT ENVIRONMENTAL METHOD STATEMENT

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URBAN COUNTRY ESTATE:
REMAINDER ERF 6182; ERF 6179; ERF 6156 of LAPSED ERF 19374
Heather Park, near Blanco,
George, Western Cape

PRELIMINARY STORMWATER MANAGEMENT ENVIRONMENTAL METHOD STATEMENT

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ANNEXURES

1. Introduction.

CHEL Building & Civil Services was appointed by the Developer, Urban Country Estate (Pty) Ltd. to prepare a preliminary stormwater management report environmental method statement in the conceptual phase of the project for the control and release of stormwater from the proposed Development of the Urban Country Estate in Heather Park, near Blanco, George, into the bordering Malgas river.

The preliminary stormwater management report environmental method statement report is required for the EIA and rezoning applications and to make the clear the intentions of the Development in this regard to the relevant authorities for the approval process.

2. Site Description

2.1 Location

Heather Park, near Blanco falls under the jurisdiction of the George Local Municipality and is part of the Garden Route District. The town of George is 429 km East of Cape Town and 324km West of Port Elizabeth/ Gqeberha, via the N2.

The geographical position is approximately 33° 45′ latitude and 22° 50′ longitude.

Access to the site is gained via a Black topped collector road, named Plantation Road that is accessed from the black topped national road N12 CJ Langenhoven Road that routes to Oudtshoorn, Northeast past the planned development site.

The exact location of the Erfs on which the development is planned is shown on the locality plan included in this report as **Annexure A.**

2.2 The Site

Remainder portion of ERF 6182; ERF 6179; ERF 6156 of LAPSED ERF 19374 forms the Development footprint that is 5.63418 Ha with green/park spaces taking up approximately 0.85 Ha. The proposed development is bounded on the south-eastern side by the suburb of Heather Park off from Plantation and Candlewood drive. On the western side of the site the Malgas River separates the development that falls within the Heather Park suburb from the Blanco suburb.

The development will have a grand dual entrance/ exit facility with 24-hour security and automated access control. The green/ parks will contain indigenous botanic gardens with seating/picnic arrangements in tranquil garden settings.

The Site is characterised by a gentle sloping landscape across the site that is surrounded by tree forest on the northern eastern, western, and southwestern sides of the site. The site consists of mostly grass land and small brush, with isolated small trees scattered across the site.

A steep drop-off slope is found along the Southwestern side of the site that slopes towards the Malgas River that is approximately 40m West of the Site boundary line. This slope provides access to a lower elevation area. The slopes will require small to moderate slope stabilization and is planned in the form of terraced platforms with staggered stabilized slopes and retaining structures. The retaining structures will be a combination of Timber logs and columns to gabion baskets and sections of Terraforce walls.

A Bulk Municipal water line crosses the site and will be incorporated as far as possible within the planned Site Development Plan layout. Relocation could be needed but will first be discussed with the Development and Infrastructure Planning department of the George Municipality. The cost thereof to be discussed with George Municipality in the form of an offset against the Development Contribution Levies.

A large eucalyptus tree is located within the perimeter of the property, near the south, eastern side of the development that borders onto the existing Heather Park suburb. There is also an incomplete dwelling found approximately 35m south of the large eucalyptus tree. This incomplete dwelling will be demolished and removed from site. The Tree will also need to be felled by suitably qualified tree fellers under instruction of an Arborist under the approval of the Department Environmental Affairs and Development Planning.

The site falls from the Highest point of 242.0 m above Mean Sea Level to an elevation of 236.0 m on the Southern tip of the site that adjoins onto Homewood Street. The average slope of the site is 1.02%. There does not seem to be elevation problems that could be encountered. Suitable allowances will be made in the design and construction for the slope angles required for the services.

2.3 Geology

A detailed geotechnical investigation was conducted by Outeniqua Geotechnical Services. Testing and sampling were done in accordance with the Generic Specifications GFSH-2 for Geotechnical Site Investigations for Housing Developments as published by the National Department of Housing and the Site Investigation Code of practice as published by the geotechnical Division of SAICE and further to SANS-634, Geotechnical Investigations for Township Development.

The study conducted eight (8) data points randomly spaced and selected over the 5.63418 Ha site. The testing that was conducted consisted of six (6) foundation indicator tests, four (4) MOD AASHTO/ CBR/ Indicator tests as well as in situ cone penetrator (DCP) tests. All testing was conducted at a SANAS-Accredited soils laboratory (Outeniqua Lab) in accordance with SANS 3001 and ASTM methods.

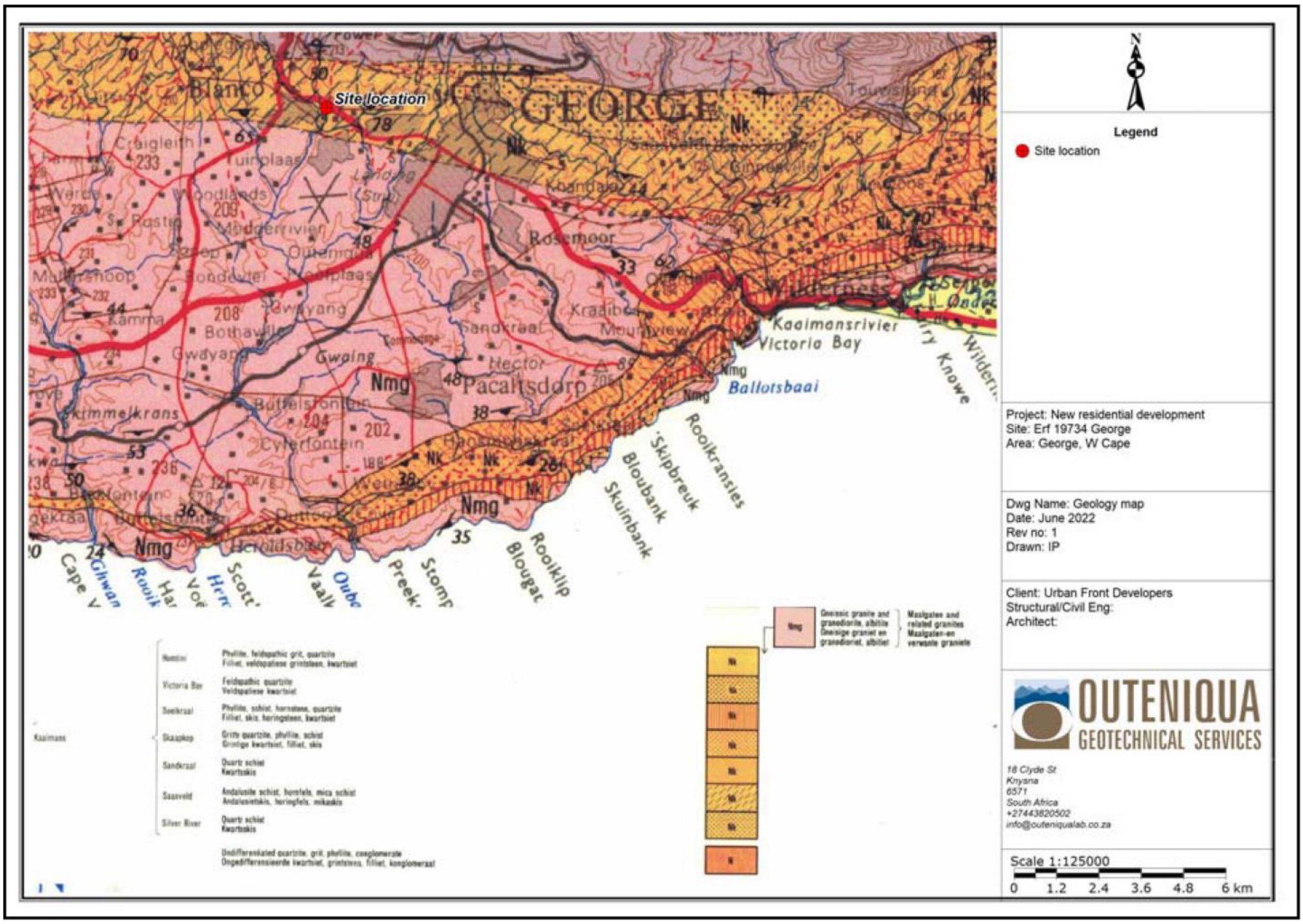

Figure 1: Geological Map of the site.

It is noteworthy to point out that the site is underlain by schist and hornfels of the Saasveld formation of the Kaaimans Group, which had been intruded by granite of the George pluton to the south of the site (Figure 1). The risk of seismic activity in the area is low. The geology of the site was generally considered suitable for urban development purposes with due consideration to local geotechnical constraints.

Test pits revealed variable soil profiles but was generally described as an assembly of fine grained, colluvial soils, including clayey silts and fine sand with sporadic gravel, overlying a sporadic pedogenic horizon (ferricrete nodules in clayey sandy matrix), which was then underlain by clayey sandy gravelly residual soil derived from the complete weathering of the underlying feldspathic sandstone or hornfels.

The underlying rock was only encountered in a few of the pits. The general soil profile was recorded as follows:

- 0-500mm: Moist to very moist, dark brown, soft to firm, intact, clayey silt with abundant roots (topsoil).

- 500-900mm: Moist, light brown, medium dense, intact, silty fine sand, colluvium.

- 900-1100mm: dark red orange, medium dense, pin holed & voided, clay & sandy gravel (ferricrete), pedogenic.

- 1100-2000mm: Moist, mottled light brown & dark red orange, stiff, micro shattered & slicken sided, silty clay with scattered gravel & cobbles, residual (completely weathered feldspathic sandstone – see Figure 2).

- >2000mm: Blotched grey & red orange, highly to completely weathered, highly fractured, soft rock, feldspathic sandstone/hornfels.

Figure 2: Active residual clay extracted from the test pits.

No Significant ground water tables were encountered in any of the test pits. Slight water seepage was encountered in Test Pit 5. TP 5 happens to be near the 450mm diameter Bulk Municipal water supply line that crosses the site. It is recommended that the area surrounding the pipe be investigated for any possible leakages.

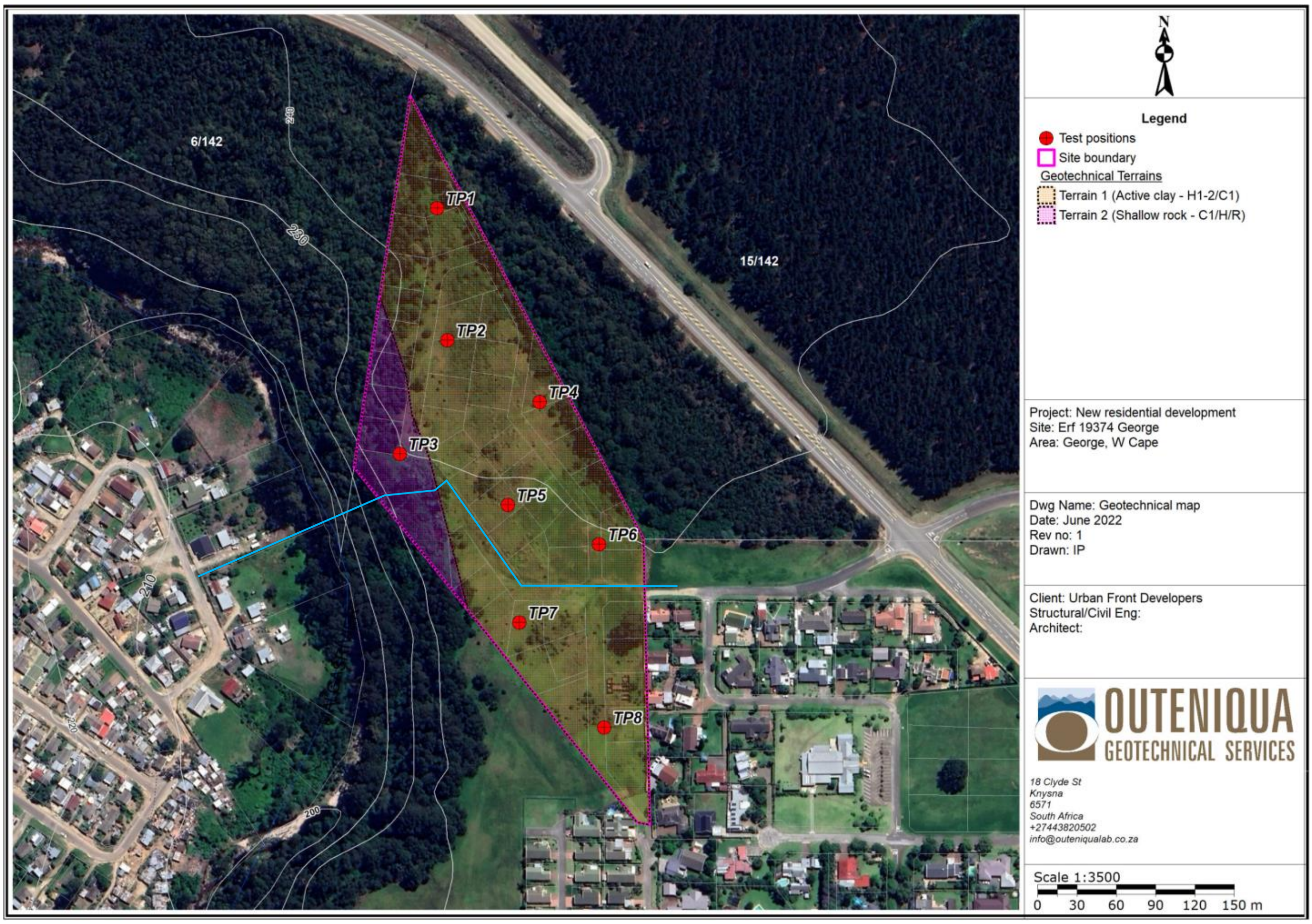

Figure 3: Soil Investigation Test Pit locations. **BLUE** line represents the 450mm dia Municipal water Supply line across the development site.

The DCP tests indicated a generally loose/soft soils in the upper 0.8m, which broadly correlated to the transported horizons, but the tests consistently improved below this depth to medium dense or dense consistency. The tests indicated allowable bearing capacities in the range of 125-150kPa below a nominal founding depth of 0.8m, with less than 10mm anticipated settlement (immediate or collapse-induced). The entire site was classified according to SANS 10400-H as C1.

For access roads and parking areas, it is recommended that allowance is made for importation of selected subgrade material of at least G7 quality to improve the road subgrade, below the conventional road layer works (subbase/base layers).

The site is generally suitable for the proposed development in terms of the geology but there are some geotechnical constraints which may have an effect the engineering. The constraints will be overcome by making allowance for it in the design and construction of the development.

2.4 Climate

George in the Garden Route is the oldest and central city as well as industrial hub of the South African Garden Route. George is approximately 15km inland and lies in close proximity to the majestic Outeniqua Mountains. The mountain tends to affect weather patterns and humidity levels. Suburbs close to the mountain experience more humid conditions than those further away. In general George temperatures are slightly lower than neighbouring towns Knysna or Mossel Bay. The close proximity to the mountain, which tends to bank cloud formations also affects temperature and rainfall. The effect of the mountain and close proximity to the coast tends to alter weather patterns pretty rapidly.

The town has a Mediterranean maritime climate, with moderately hot summers, with mild to chilly winters. George boasts one of the richest rainfall areas in South Africa. Rains usually occur during the winter months, which are brought on by the humid sea-winds from the Indian ocean. As a general rule the Southern Cape & Garden Route's temperate weather falls between two climatic regions of summer and winter rainfall, which results in rain falling mostly at night, which tends to keep the area perennially green.

- Spring usually can be felt toward the end of August into September. October tends to experience a drop in temperature before full summer sets in. General 10-19ºC
- Summer is considered to be between the months of November to March, which are warmer, with December to February seeing mid-summer with daily temperatures ranging between 24-30ºC. February - March usually sees strong berg winds, which on odd days reach a peak where temperatures rise to as much as 38ºC.
- Autumn is commonly persistent pleasant weather and temperatures start cooling from about April, however the pleasant conditions may last until June. General 14-22ºC
- Winter runs through June, July, and August. Temperatures usually fluctuate between 8-17ºC. In general, the barometer seldom drops below 10ºC. Most days are warm with evenings colder.

The site falls within the Temperate/ moderate coastal climate region of South Africa. The George climate is generally classified as mild and generally warm and temperate. There is significant rainfall throughout the year in George. Even the driest month still has a significant amount of rainfall. This location is classified as Cfb by Köppen and Geiger.

The average temperature in George is 16.7 °C. The total rainfall for the area in a year is around 657 mm. The least amount of rainfall occurs in June and July. The average in this month is 43 mm. Most precipitation falls in November, with an average of 75 mm. The number of thunderstorms in the area ranges between 5 to 10 no per annum. The month with the highest number of rainy days is November (10.23 days). The month with the lowest number of rainy days is May (7.0 days).

George

Climate Summary

	January	February	March	April	May	June	July	August	September	October	November	December
Ave Temperature ˚C	20,2	20,4	19,4	17,5	15,7	13,7	13,2	13,5	14,3	16,0	17,2	19,1
Min Temperature ˚C	16,9	17,2	16,1	14,0	12,1	9,8	9,3	9,6	10,6	12,4	13,7	15,8
Max Temperature ˚C	24,0	24,2	23,3	21,5	20,0	18,1	17,6	17,9	18,6	20,0	21,0	22,9
Precipitation/ Rainfall (mm)	55	48	60	60	48	43	43	56	48	67	75	54
Humidity (%)	76	77	76	75	72	69	69	71	72	74	74	75
Rainy Days (d)	6	7	7	6	5	5	6	7	7	7	7	8
Ave Sun Hours (hours)	8,7	8,2	7,8	7,7	7,7	7,4	7,4	7,8	8	8,3	8,9	9,1
Ave Wind Speed (km/hrs)	12,23	11,75	10,94	10,62	11,43	12,55	12,71	12,39	12,39	12,39	12,55	12,39

Table 1: Climate summary for George

The temperatures are highest on average in February, at around 20.4 °C. In July, the average temperature is 13.2 °C. It is the lowest average temperature of the entire year. The month with the highest relative humidity is February (76.74 %). The month with the lowest relative humidity is July (69.05 %).

The month with the most hours of sunshine is December with an average of 9.09 hrs of sunshine. In total there is 281.81 hrs of sunshine throughout December. The month with the fewest daily hours of sunshine in George is January with an average of 9.09 hours of sunshine a day. In total there are 281.81 hours of sunshine in January.

Around 2952.62 hours of sunshine are counted in George throughout the year. On average there are 97.07 hours of sunshine per month. It is therefore favourable for the incorporation of Solar Renewable Energy solutions into the planned development.

There is marked seasonality in wind trajectories. In winter, the wind blows from west to southwest, driven by the northward trajectory of the westerly belt, and in summer it blows easterly to southeast, when atmospheric circulation is dominated by the tropical easterlies. The windier parts of the year are from May through to February with an average wind speed of 11.75km/hr. The windiest month is July with an average Wind Speed of 12.7km/hr.

The Development Infrastructure will be designed for both 1:20 year and 1:50 year floods, with an interval of 1: 5 years occurrence.

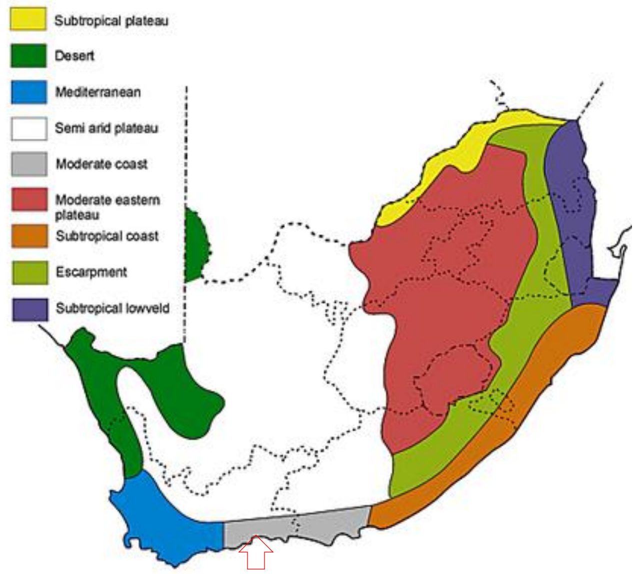

Figure 4: Climate zones of South Africa.

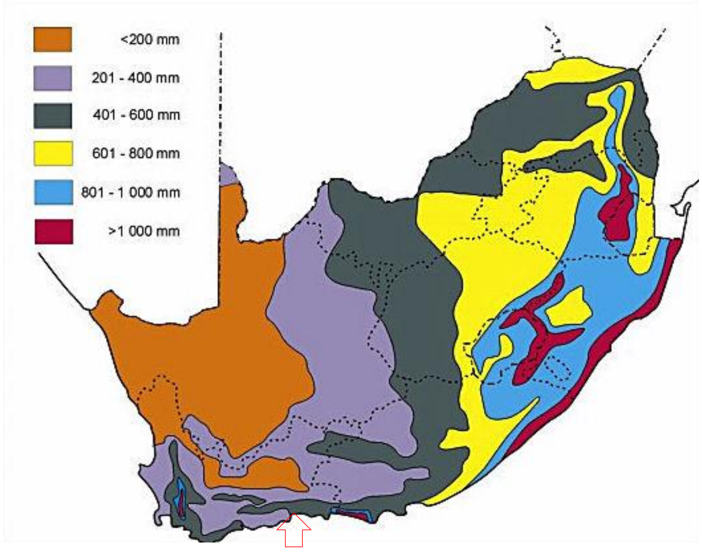

Figure 5: Rainfall zones of South Africa.

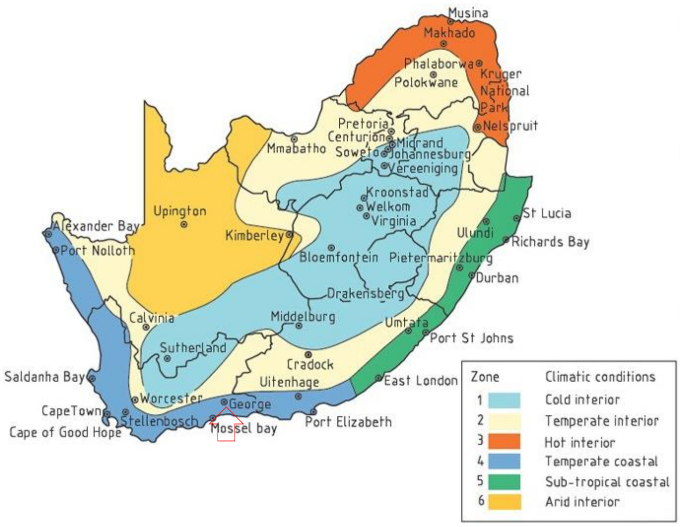

Figure 6: Climate conditions of South Africa.

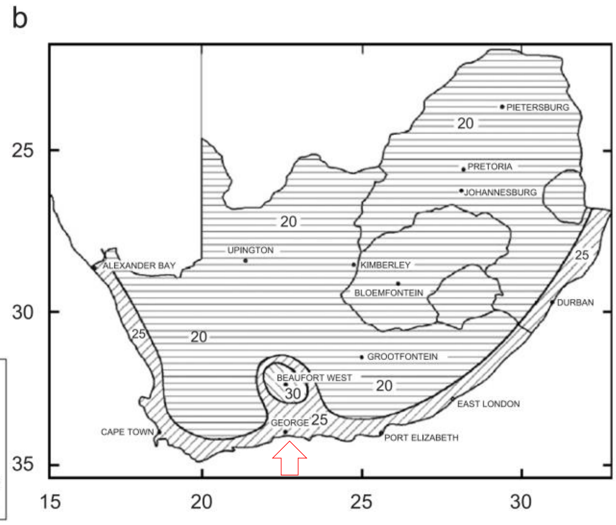

Figure 7: Maximum mean hourly wind speed – 50-year return period.

2.5 Topography

A detailed topography survey was conducted only on the accessible areas on site by a registered land surveyor. Some areas were and still is not accessible to the land surveyor. The Engineer approached GLS consultants that are appointed for the George municipality to obtain their contour surveys of the surrounding areas. Planet GIS survey software was also used to assess the site and surrounding areas to establish what the contours are in the inaccessible areas. A physical site inspection was recently conducted to ascertain the accuracy of the various survey data and to establish which data accurately represents the topography visually verified on site.

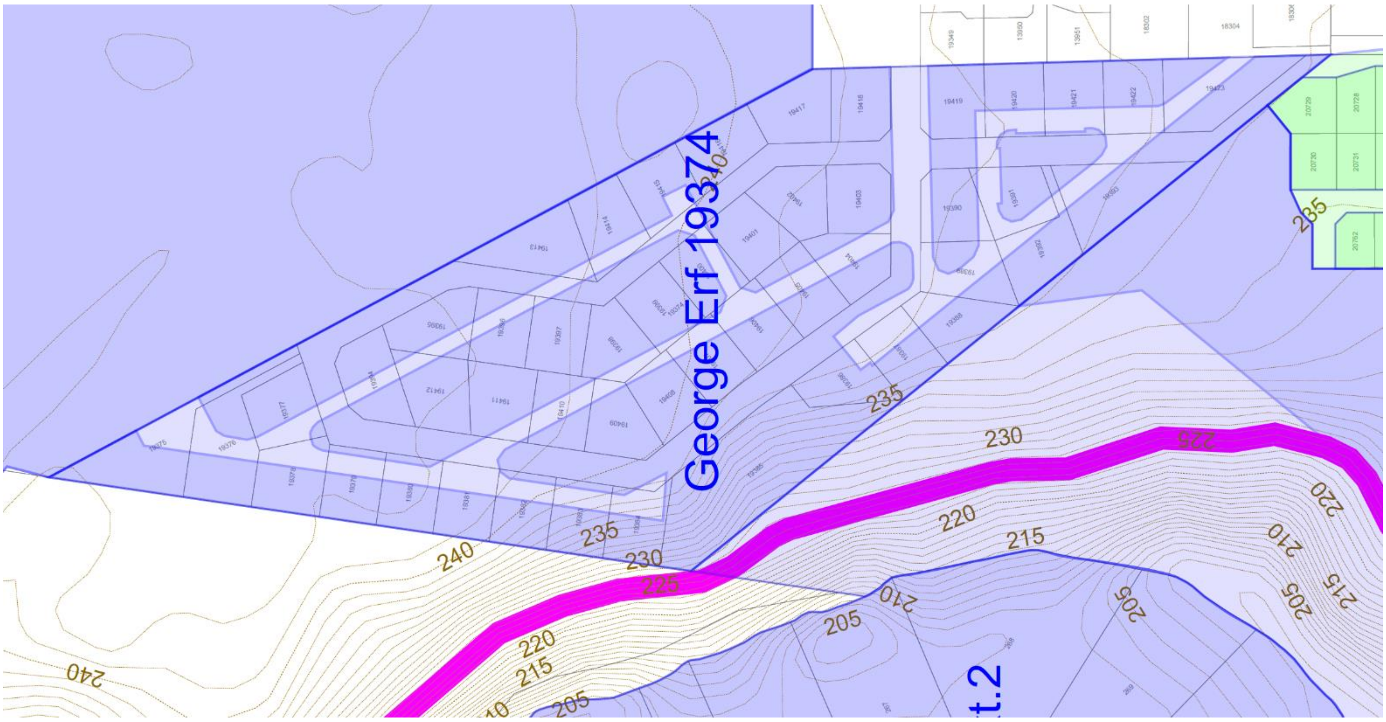

Figure 8: Extract from the GLS consulting contour drawing received with the contours and indicated flood line. Gradual slope is represented as verified on site, Refer to Figure 28 below.

3. Existing services

Stormwater

There is no existing stormwater system within the perimeter of the site, nor along the Plantation Road. Only a shallow earth dish drain is found along the northern side of the Plantation Road that seems to create a pool of water near the Candlewood Street intersection with Plantation Road.

Storm water would need to be attenuated within the boundaries of the development and released at low velocities into the Malgas River. The stormwater release from the attenuation ponds would be done in a controlled manner through a system of energy breaking structures down the steep slope within the identified green public open space, to a lower elevated stormwater attenuation pond system from where it will be released into the Malgas River.

This system would be designed as per Council's requirements and specifications for their approval.

George is a water scarce area and rainwater harvesting and water recycling should be considered as solutions to provide water for irrigation of green areas. Effective re-use of rainwater is less water from that is required from the Municipal supply. At present the Malgas river is not dammed and thus not at risk of starvation of a river source and ultimately a water source for a town or city.

It is proposed that attenuation of stormwater be done in a manner to ensure that the water can be stored and used as irrigation-water throughout the estate, preferential to just being released from site.

4. Proposed Development

The proposed development is a private, gated residential estate consisting of seventy (70) freehold units and forty (40) complex rental units on this property, subject to the necessary approvals for rezoning and subdivision obtained from the George Municipality and further consents from other governmental departments. The development is a Full Title Development. See **Annexure B**

All erven will be provided with services to full acceptable municipal standards and bulk infrastructure supporting the development has been described in the following sections. See **Annexure C**

The planned development will consist of the following residential units and in mix relationship:

Item	Unit Description	Ave ERF Size	Ave FLOOR Size	No of Units	Ownership
1	2 Bedroom – 1 Bathroom Semi-detached Flat Units	-	70 m²	40	Rental Units
2	Single Storey Residential Homes with 2 to 3 Bedrooms and 2 Bathrooms	309 m²	160 m²	19	Freehold Title
3	Single Storey Residential Homes with 2 to 3 Bedrooms and 2 Bathrooms	415 m²	175 m²	32	Freehold Title
4	Double Storey Residential Homes with 3 to 4 Bedrooms and 2.5 Bathrooms	400 m²	160 m²	13	Freehold Title
5	Double Storey Residential Homes with 3 to 4 Bedrooms and 2.5 Bathrooms	452 m²	180 m²	6	Freehold Title
				110	

Table 2: Development unit distribution summary.

The average occupational density will be around 2.8 people per unit, lower than the national average of households. The development would cater for the medium income group and will fall within the development category 3 & 4 for services due to the lower-than-average occupational density per household. The average erf size is 381m².

5. Engineering Services

5.1 General Level of Services

Services will ultimately be provided to full municipal standards as prescribed in the Guidelines for Human Settlement planning and Design compiled by the CSIR Building and Construction Technology.

These shall broadly include surfaced roads with an acceptable stormwater collection and disposal system that fits the theme of the development, waterborne sewerage as well as potable water. Underground electrical and telecommunication connections to each erf/ unit. The Development will implement renewable power solutions for the rental units and will encourage owners of the freehold units to install solar. Investigations are underway for a private electrical microgrid within the Estate to accommodate PV Solar renewable energy within the development with a single bulk SSEG electrical connection to Municipal Electrical grid.

Calculations were done to determine the design demand for the various services and was submitted to the municipality who confirmed availability and approved the connection onto the Municipal network. The sizes of the bulk services were determined as follows:

Land Use		Unit of Measure (No/100m^2/ha....)	No of Units (No/100m^2/ha....)	UWD/ Unit Kl/unit/day	Sewer Ratio % x UWD	AADD Inc UAW kL/day	PDDWF Excl. Infilt. kL/day
Phase 1			**Estimated Start Date: 01st Mar 2025**			**EstimatedOccupation Date: 01st Dec 2025**	
T2	Single Storey Residiential (309m^2 Ave ERF Size)	Unit	10	0,566	70%	5,66	3,96
T4	Double Storey Residiential (454m^2 Ave ERF Size)	Unit	2	0,833	55%	1,67	0,92
Sub Total			**12**			**7,33**	**4,88**
Phase 2			**Estimated Start Date: 01st Aug 2025**			**EstimatedOccupation Date: 01st May 2026**	
T2	Single Storey Residiential (309m^2 Ave ERF Size)	Unit	5	0,566	70%	2,83	1,98
T3	Single Storey Residiential (415m^2 Ave ERF Size)	Unit	18	0,722	60%	13,00	7,80
Sub Total			**23**			**15,83**	**9,78**
Phase 3			**Estimated Start Date: 12th Jan 2026**			**EstimatedOccupation Date: 01st Oct 2026**	
T2	Single Storey Residiential (309m^2 Ave ERF Size)	Unit	4	0,566	70%	2,26	1,58
T3	Single Storey Residiential (415m^2 Ave ERF Size)	Unit	27	0,722	60%	19,49	11,70
T4	Double Storey Residiential (454m^2 Ave ERF Size)	Unit	4	0,833	55%	3,33	1,83
Sub Total			**35**			**25,09**	**15,11**
Phase 4			**Estimated Start Date: 01st Jul 2026**			**EstimatedOccupation Date: 01st Dec 2026**	
T1	2 Bedroom FLats (70m^2 Ave Floor Size)	Unit	40	0,275	90%	11,00	9,90
Sub Total			**40**			**11,00**	**9,90**
TOTAL			**110**			**59,24**	**39,67**

Table 3: Water Demand and Sewer Run-off.

The AADD, peak flow and fire flow calculated for the proposed development is 59.24 kL/d.

- Peak flow using a zone peak hour factor of 3.6‡ = 2.46 L/s
- Fire flow (Cluster housing > 30 units/ha) using a peak hour factor of 2.0 = 20 L/s @ 10 m

(Note: Flow provided at 1 fire hydrant)

The George Municipality Civil Engineering Services Standards requires that provision be made for 15% extraneous flow in the sewer network. The Peak Wet Weather Flow (PWWF) is therefore equal to 39.67 kL/d.

5.2 Road Network and Stormwater.

Access to the development is to be gained from the municipal Plantation Road, which is off from the N12 CJ Langenhoven Road, as recommended by SMEC South Africa in the Traffic Impact Assessment Report.

The estate entrance road will be an 8m wide road leading from Plantation Road that splits into the estate entrance area with an overall width of 13.8m wide that will accommodate two (2) lanes into the Estate and one (1) lane out of the Estate. The entrance lanes and exit lanes will be separated by a security access control building. See **Annexure C**

The internal roads are Class 5 roads and will be set in road servitudes that varies between 7 and 9m wide provided throughout the development. The total road network measures **1380 meters** and its layout have been dictated by the township layout and defined according to the topography so as to achieve a horizontal and vertical alignment that conforms to acceptable standards.

A 30km per hour design speed is laid down within the development and the road profile will be designed accordingly. The road pavement design will be a flexible pavement design covered by a concrete road surface.

The road surfaces width would be sloped to form a shallow V-drain shape with varying widths between 4m wide for one-way traffic and 6m wide for dual-way traffic with suitable provision for stormwater control in the centre of the road, using heavy duty grid inlets. The stormwater pipes are minimum 375mm diameter in size, laid at a minimum grade of 1:400 to ensure self-cleaning. The road and minor stormwater infrastructure are designed for a 1:5-year recurrence interval with the major system being designed for a 1:50 year recurrence interval.

6. Stormwater Management

6.1 Stormwater Runoff and attenuation

Stormwater will be collected throughout the development along the roadways. The stormwater runoff for this development will flow in a Southern direction. The majority of the runoff will be directed into the main attenuation dam located on the western side in the middle of the site. The volume retained will be the difference between the 1:5-year pre-development flood and the 1:50 year post-development flood.

The release rate out of the attenuation pond will be equal to the 1:5-year flood flow rate. This will be released into a cascading structure which will transport it down the steep slope into the Malgas river. The stormwater will be released onto Reno Mattresses at the bottom of the cascading structure to prevent any soil erosion.

The stormwater on the southern side of the development will be attenuated in a smaller pond located in the green zone in the middle of the southern side of the development (Phase 1). The outflow pipe will be directed to the south with an interim headwall located in George Erf 19001. Because of the topography of the site, it is not possible to direct the stormwater back up towards the main pond.

Due to the lack of municipal infrastructure to the south of the development, the best solution would be to connect to the stormwater infrastructure of George Erf 19001 once it is developed.

The attenuation dams will be fitted with submersible pumps that will be connected to a designed irrigation pipe system throughout the estate.

Figure 9: Typical depiction of an attenuation pond with floating fountain.

Table 4 indicates all the catchment areas that contributed to the stormwater runoff of at the parking area. Area 1 is diverted to the main pond in the middle of the site. Area 2 is diverted to the small pond in Phase 1, while area three is the stormwater that falls below the roads and is therefore not diverted to any pond but rather runs off uncontrolled.

Catchment	A (m^2)	Hardening Factor	$Q_{1:50}$ (ℓ/s)	$Q_{Total\ if\ uncontrolled}$	Q_{design} (ℓ/s)
Area 1 (controlled)	24026	1.00	1322.754	1419.310	222.296
	4872	0.36	96.556		
Area 2 (controlled)	6208	1.00	341.785	444.662	95.270
	5191	0.36	102.877		
Area 3 (uncontrolled)	9302	0.36	184.366	184.366	184.366
Total Area	49598	0.75	2047.984	2048.337	501.932

Table 4: Stormwater Runoff for Catchment Areas.

6.2 Irrigation.

The water level control within the Attenuation Pond will be managed by an electronic float switch unit with a timer switch. The timer switch and float switch will activate a 2.2kw submersible water pump that is installed within the Attenuation Pond. This pump will be connected to an irrigation pipe network throughout the estate, along the roads and within all the green areas.

The irrigation network will be fitted with valves to allow for the manual changeover of water flow to the various desired areas for irrigation. The irrigation system will consist of small pop-up sprinklers throughout the development.

The irrigation system will be set on a timer switch to pump through the day. Levels within the Attenuation Pond will be automatically managed by means of electronic float switches to ensure the protection of the pump.

Figure 10: Pop-up Sprinklers.

Figure 11: Irrigation of Green open areas and along walkways.

The total irrigatable area within the estate is approximately 1.68Ha, this is equivalent to 68m³/day volume of water that can be irrigated.

Figure 12: Submersible water pump.

6.3 Discharge of stormwater to Malgas River.

The outflow from the attenuation pond will be position at a level just below the inlet in order to retain most of the flow inside the chamber and to slow the discharge velocity to acceptable municipal standards. The outflow will be through a pipe that will daylight into a headwall unit that is fitted with energy dissipating structures.

This will discharge the water into a series of holding ponds and descending water stairs to carry the stormwater from a higher elevation to a lower elevation into a final holding pond before it overflows onto a gabion mattress and further into the Malgas river.

The ponds and water staircase structures would take on a similar form as depicted in the Figure 13 and 14 below.

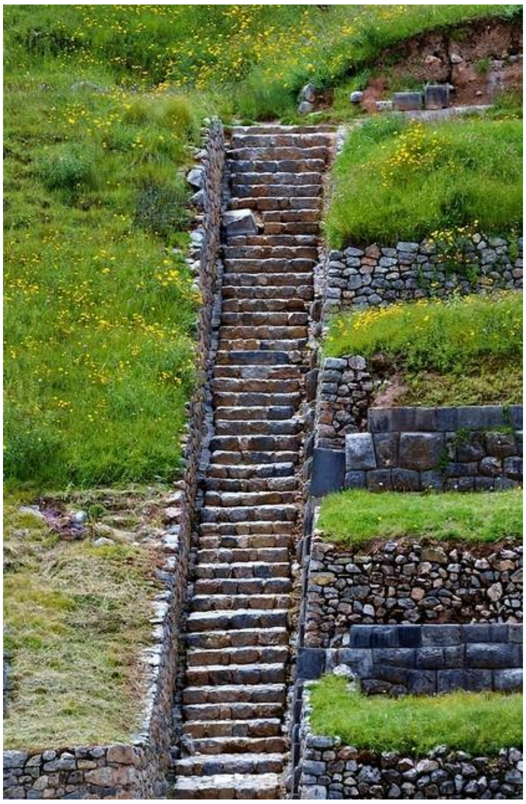

Figure 13 – Water Staircase structure

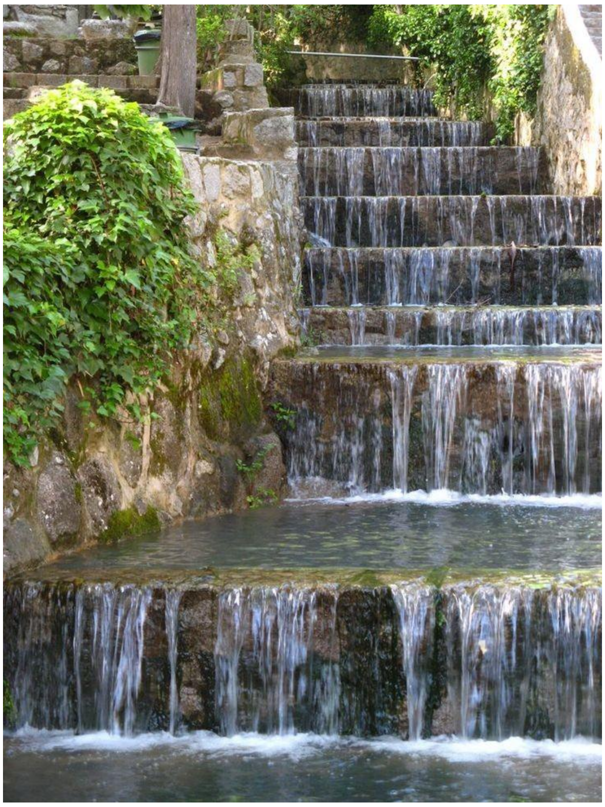

Figure 14 – Water Staircase stilling ponds.

These stormwater stilling ponds and water staircases will be constructed using ready-mix concrete, gabion stones and retaining blocks filled with concrete. The intention is to follow the natural slopes as far as possible and to cut and fill as little as possible. The final discharge from the lowest stilling pond will be over installed rock filled gabion mattresses to dissipate the water flow, an acceptable erosion protection practice.

The embankments will be sloped to a maximum of 40 degrees and will be covered and vegetated using soil saver and retaining logs and indigenous vegetation to establish and stabilize the slopes.

In steeper areas natural timber products will be used to create terraces down the height of the slopes, as depicted in Figure 15. The timber that will be used will be that of non-native, alien trees that will be removed from the development site.

The Natural slopes will be vegetated to provide scenic garden settings for residents among the tall trees canopy on these created terraces, as depicted in Figure 16. All this work will be done within the confines of the Development perimeter.

Figure 15 – Timber log terrace fill for slope control and protection.

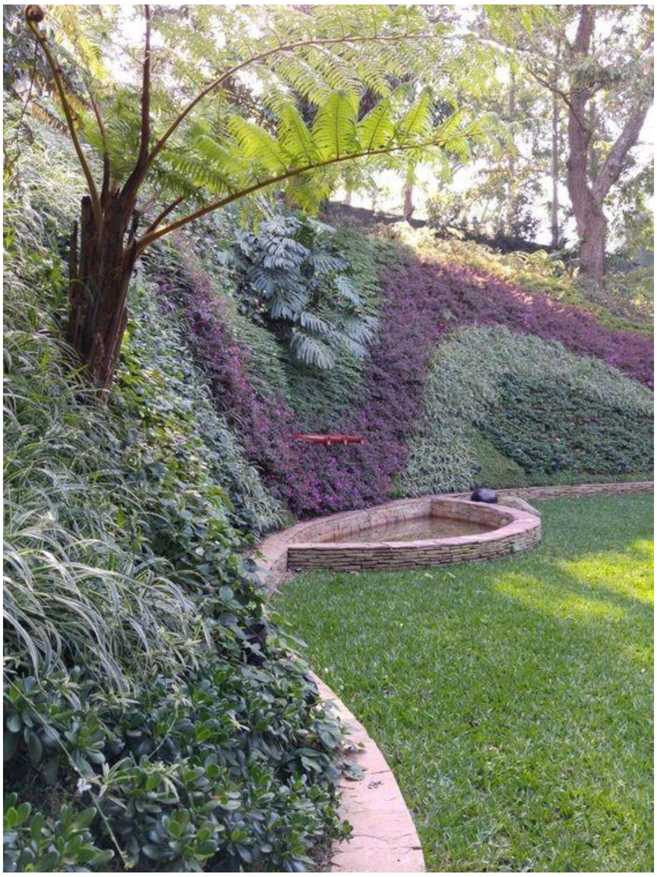

Figure 16 – Natural shaped slopes vegetation to create garden type features.

Stairs will be constructed using gabion stone and mortar to create wandering walk paths down to the natural bird watching area, that the developer wants to create, below the big tree canopy in the green area within the estate perimeter.

Figure 17 – Gabion stone and mortar staircases and footpaths for residents.

Figure 18 – Rock filled Gabion baskets in areas where retaining walls must be created.

Specific areas along the slope would require some form of retaining wall and this will be done in the form of rock filled gabion basket structures.

Artistic renderings of the proposed holding ponds and descending water stairs.


Figure 19 – Outflow Headwall structure into 1st stilling pond, followed by 1st water stair section to the 2nd stilling pond.

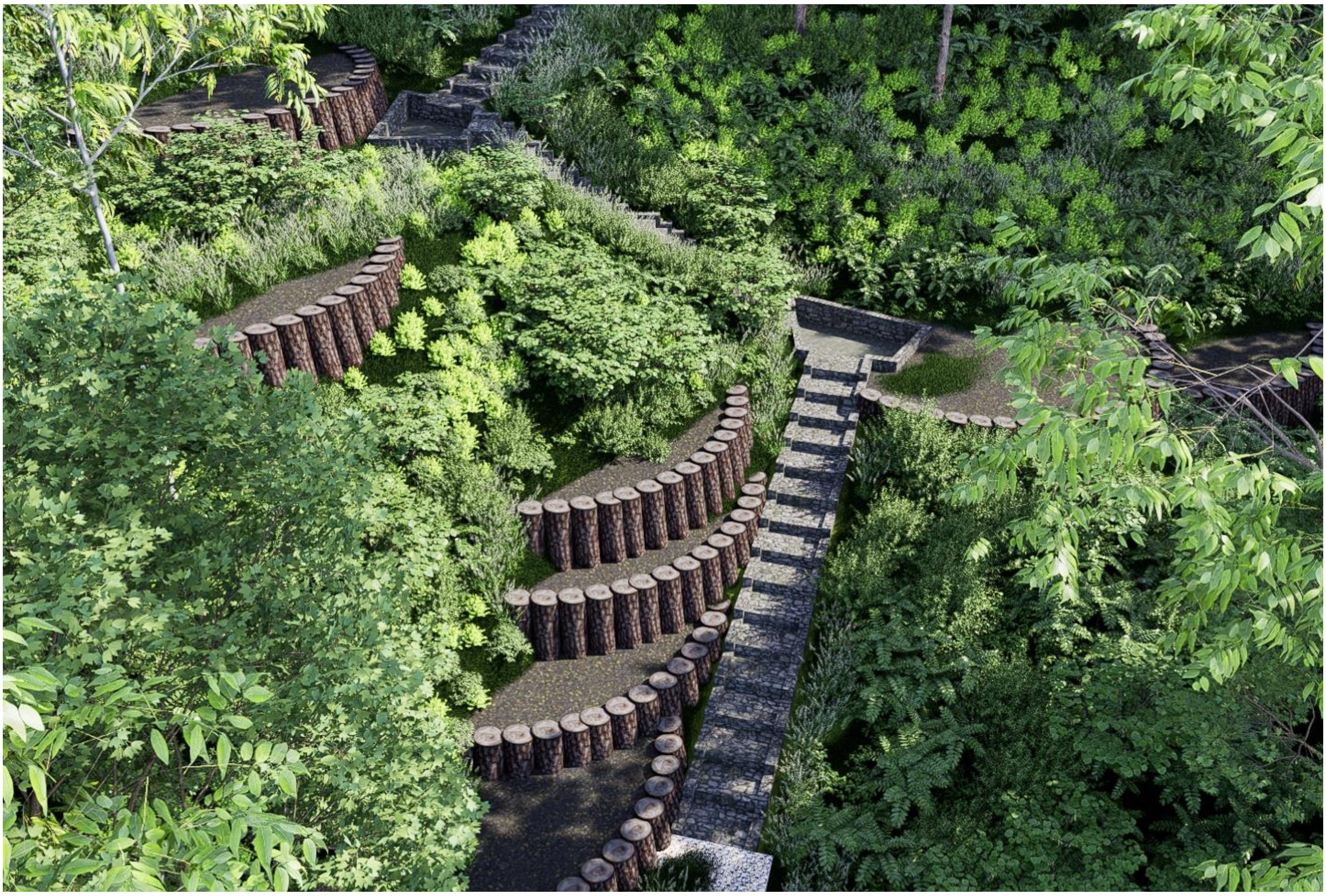

Figure 20 –2nd stilling pond, followed by 2nd water stair section to the 3rd stilling pond and 3rd water stair section.

Figure 21 –Elevated top view of the proposed stilling pond and water stair system.

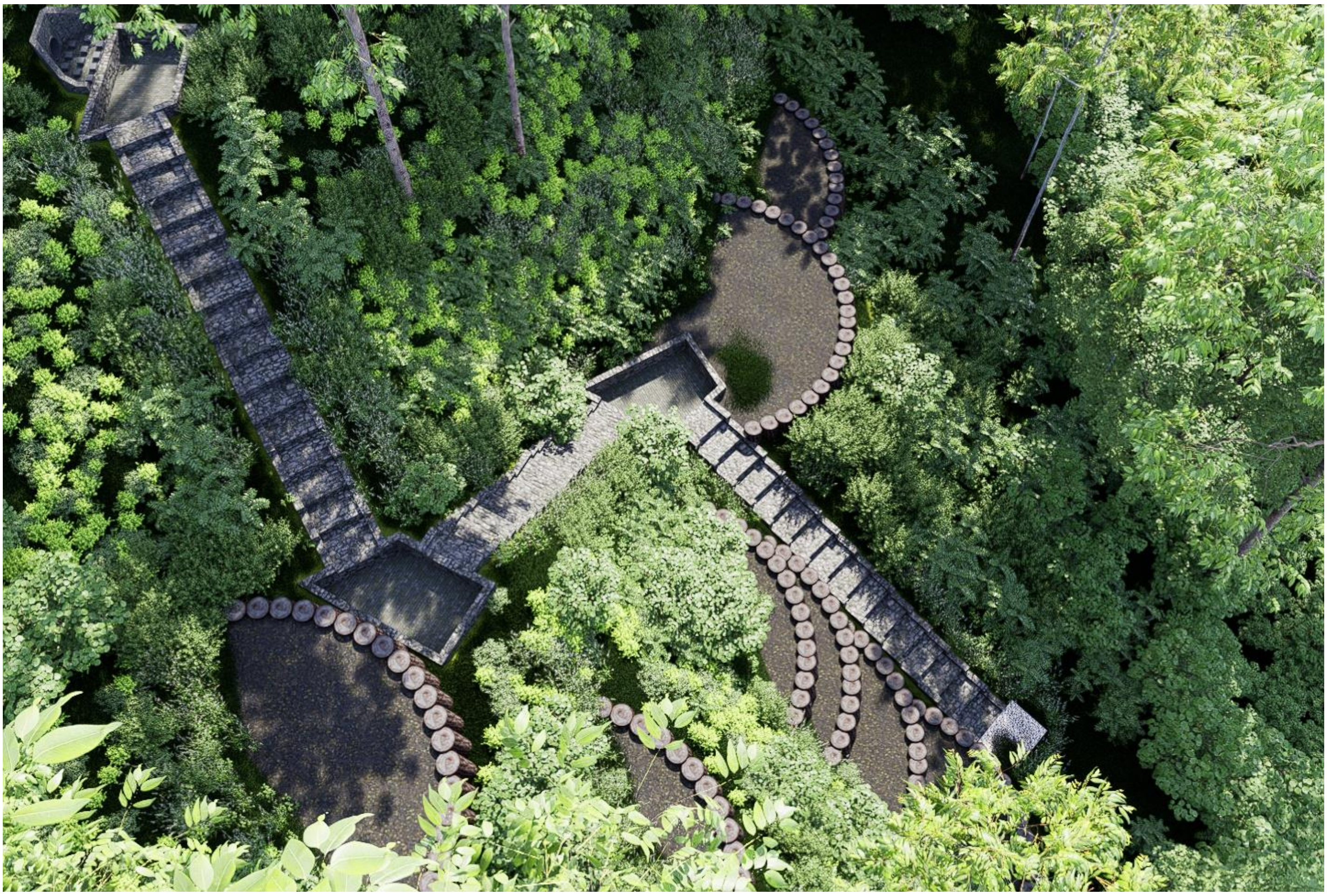

Figure 22 –Elevated top view of the proposed stilling pond and water stair system with discharge over gabion mattress structure at the bottom of the system.

Figure 23 –Side view of the proposed stilling pond and water stair system with discharge following the natural embankment slopes that will be terraced.

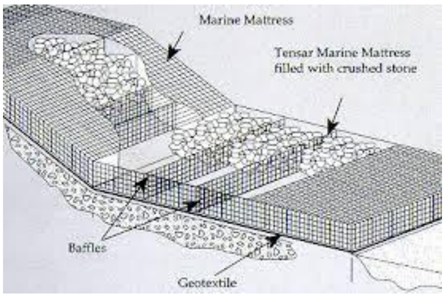

Figure 24 & 25 – Accepted general outflow structure erosion protection systems that are implemented in practice.

Figure 26 – Accepted general outflow structure erosion protection systems that are implemented in practice against slopes.

Figure 27 –View of the proposed stilling outflow pond and reno gabion mattress for the discharge. Flow from the cascading structure is halted in the stilling pond before a slow trickle overflow into the gabion mattress.

Figure 28 – The actual topography near the site location where the cascading structure will be implemented with gradual slopes where the proposed stilling outflow pond and reno gabion mattress will be located.

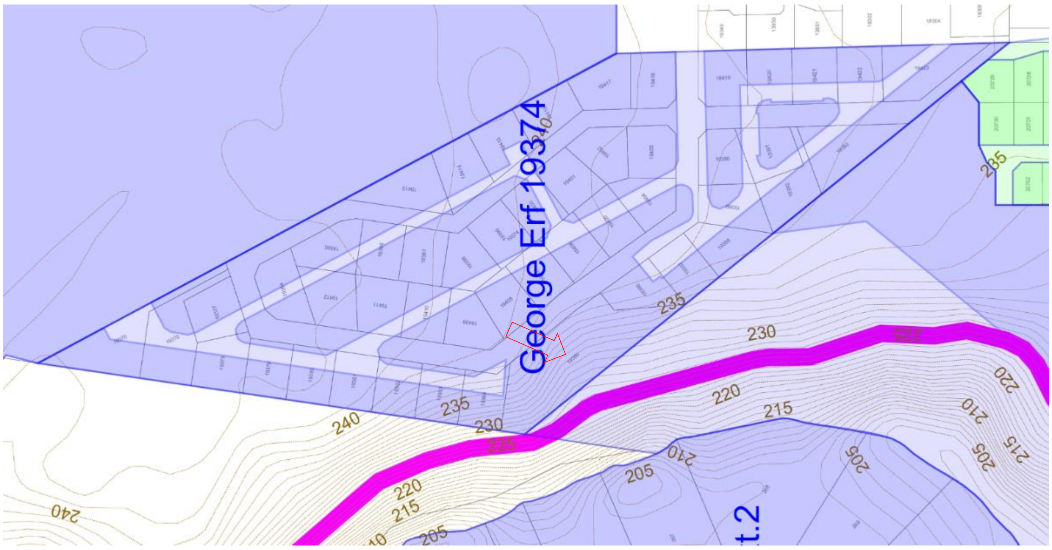

Figure 29 – The position and direction of view of the photo depicted in Figure 28 above.

7. Routine Inspections & Maintenance

7.1 Routine Inspections.

The Developer/ HOA will adopt, implement, and maintain a routine inspection process to inspect the stormwater management systems. These inspections will be executed and reported monthly. The Inspections are to cover all aspects of the stormwater management systems and include:

1. Stormwater/ Grid inlets and chambers.
2. Attenuation ponds,
3. Outflow structures,
4. Cascading structure
5. Stilling Basins
6. Outflow gabion mattress.
7. Surrounding release areas for any signs of erosion.

The inspection to cover the following conditions:

1. Integrity of the structure.
2. Cleanliness.
3. Any Damage.
4. Signs of Erosion.

Records of the inspections are to be kept on file. Any damage must be reported and recorded, and corrective action must be taken timeously to prevent further consequential damage, as part of the ongoing maintenance.

7.2 Routine Maintenance.

The stormwater management system requires frequent scheduled maintenance, in order to upkeep the effectiveness of the system at all times. This should be done weekly or bi-weekly.

The Maintenance will cover the following aspects:

1. Removal of any rubble/litter.
2. Removal of any sediment.
3. Removal of any weeds.
4. Damage repairs.

8. <u>Summary & Conclusion</u>

It is the intent and commitment from the engineer and developer to responsibly implement the best engineering solution to carry the water responsibly and controlled down the embankment. All work will be done within the boundaries of the property and within the green area near the river, with minimal impact.

The contours that were received are mere interpolation at this point in time, as access to the dense bush area is not possible and therefore this area was not surveyed accurately. Accurate assessments can only be done once environmental approval have been obtained to clear the invasive brush in order to obtain an accurate survey of the area.

A visual site inspection walk was conducted as far as practically possible and accessible to observe the dense bush area. It was observed that the proposed outflow structure within the property of the development falls within a relatively gentle slope area. From there the distance to the river centre line is a mere 35m at an estimated slope gradient of 14% to 23%. The total elevation change height from the discharge to the river is estimated to be around 5m to 8m in height. The risk of slope erosion is considered low to medium/low and can be monitored through the proposed routine inspection and maintenance process.

The works will be done using natural products and to a methodology to disturb as little as possible of the natural environment. Large Trees will be maintained as these have been there for many years and would be detrimental if removed even if they are considered invasive species. Smaller invasive brush will be removed, and indigenous forest and garden vegetation will be planted to create a garden feel, bird watching area for residents.

All processes described in this report is subject to further engineering and design calculations. The principles as described within this report will be followed. The exact size and implementation thereof might differ in certain forms to provide suitable capacity to conform to Municipal and national regulatory standards.

Once approval is given to clear the area enough to perform a detailed digital terrain survey the engineering solution can be refined in order to minimize any risk that can be further identified.

This report was drafted by HC Scholtz (N- Dip Civils *with 25-year experience*)
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ANNEXURE A

1: 50 000 Locality Map of the Site

ANNEXURE B

Site Development Plan

ANNEXURE C

Site Development Plan with Preliminary Combined Services Layouts

ANNEXURE D

Stormwater Management Layout Plan