PROPOSED TOWNSHIP SITUATED ON PORTION 488 OF THE FARM TOWNLANDS OF LYDENBURG 31JT
ENGINEERING SERVICES REPORT

February 2021

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1 INTRODUCTION AND BACKGROUND

1.1 Introduction

This report provides an overview of the engineering services (i.e. roads and civil engineering services) to be constructed for the proposed development on Portion 488 of Portion 453 of the farm Lydenburg 32– JR, in Lydneburg/Mashishing town.

The report is aimed only at providing scoping level detail for inclusion in each of:

- The environment scoping report, and
- The planning approval application process being prepared by town planners

1.2 Study area

The development falls inside the jurisdiction of the Thaba Chewu Local Municipality. The site is situated on Portion 488 of Portion 453 of the farm Lydenburg 32– JR, south of Lydenburg Town. The site is 17 hectares in size. The co-ordinates of the site are 25° 6'32" South and 30°26'21" East.

Figure 1: Locality Plan

1.3 Other Contextual Information

The report is to be read in the context of the following information.

- Town Planner Layout - Elmon Consulting
- Geotechnical Investigations: Portion 453 Townlands of Lydenburg 31JR – MWEM PTY Limited
- Floodlines assessments for the unnamed stream adjacent to the proposed Pentagon Business and Development (PBRD) – Gomelelo Environmental & Management Consulting

2 SITE DESCRIPTION

Based on the available information, the following site characteristics are summarised:

2.1 Topography and Drainage

The site is located between 1455 masl and 1380 masl. The site slopes down in a southern direction towards Dorpsrivier stream. Existing natural drainage is in the form of sheetflow or overland flow.

2.2 Geology

The geotechnical investigation indicate that the site is typically underlain by sandy clay classified as ML (Silt), MH (Silt of high plasticity and elastic silt) and SM (Silty sand).

2.3 Hydrology

No development is allowed below the 1:100 year flood line. The flood line study (done by others) confirmed the position of the 1:100 year flood line. The delineated 1:100 year floodlines indicates that the project boundary for the proposed development lies outside the delineated floodlines. Thus the proposed development poses no risk on the adjacent water resource in terms of flooding while the development the development itself will also not be exposed to the risk of flooding during high rainfall events.

2.4 Land Use

The land use table for the proposed township is indicated on table and figure below:

Land Use-Zoning	Erven	Area (Ha)
Dwelling Houses	251	7.36
Dwelling Units/Flats	1	1.22
Shopping Center, Commercial Uses and other Business Uses	2	0.90
School	1	0.33
Parks, Sports Field and other recreational or related uses	2	2.98
Clinic	1	0.76
Filing Station	1	0.35
Streets & Roads	N/A	4.80

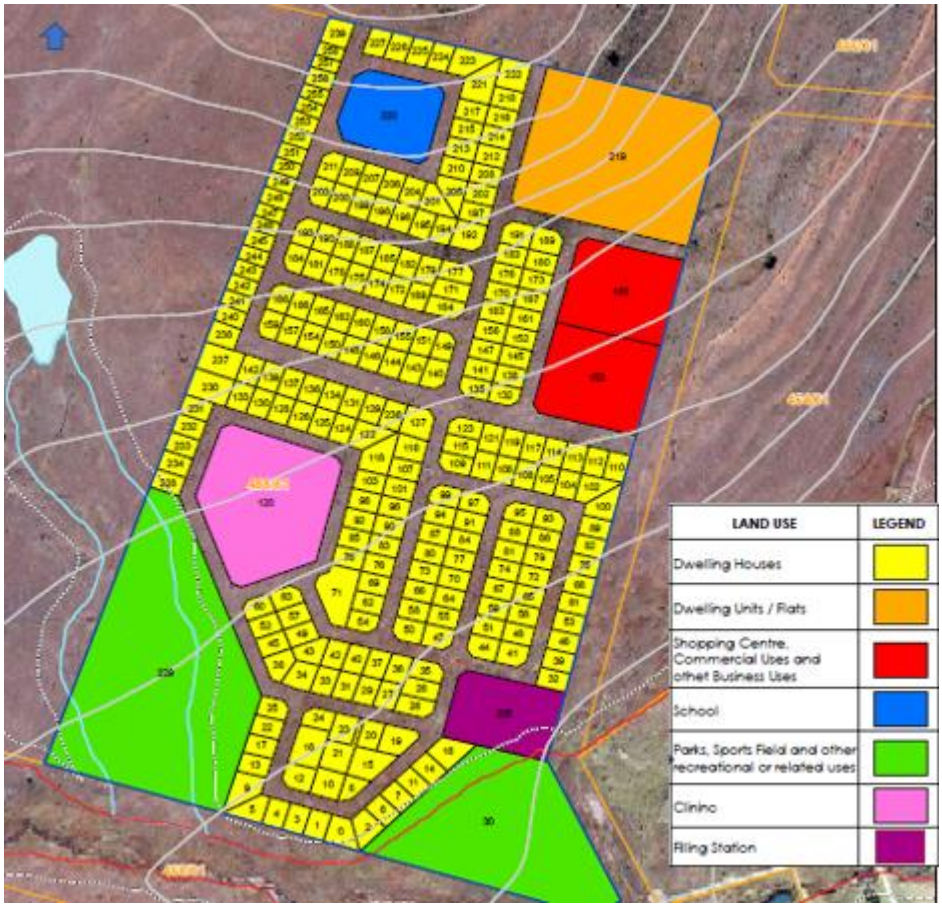


Figure 2: Proposed Site Plan

2.5 Engineering Services Required

Annexure B provided an overview of the site and a general layout of the services proposed for the overall development.

The services are to be designed to standards similar to those adopted at Lydenburg Town. In general, these are to be typical of most up-market developments and are guided by the standards adopted by the Thaba Chewu Local Municipality.

All roads and services infrastructure will be signed off in accordance with Municipal requirements, and SANS 10400 where applicable, by the design Engineer concerned.

Construction of the roads and services will be done by medium to large, experienced specialist contractors, with construction monitoring by the respective Professional Engineer for each discipline.

3 WATER SUPPLY (POTABLE AND FIRE)

3.1 Existing Infrastructure

The property to be developed is currently vacant land. The site is currently undeveloped, and no water services have been installed on the site. The only existing water related infrastructure is the existing pipeline connecting to the houses on 5th Street about 2km from the proposed development.

3.2 Design Layout

Pipelines will largely run within road reserves. **Appendix B** indicates a preliminary system layout with pipelines following the road network.

3.3 Water Design Criteria

The following standards will be used in the design of the water reticulation:

- Average annual daily demand (AADD)
    - Dwelling Houses : 0.8 kl/unit
    - Dwelling Units/Flats : 0.6 kl/unit
    - Business, Commercial and schools : 50 kl per hectare
    - Clinic :500l/day for 100m^2 of gross floor area
    - Street : N/A
- Peak hour demand
    - Peak hour factor (PHF) : 4.6

- Peak hour demand : PHF x AADD

- System heads
  - Maximum static head (no demand) : 90 m
  - Minimum residual head under conditions of peak hour demand at erf boundary : 24 m

- Fire - fighting
  - Fire risk category : Category C (residential)
  - Total fire flow : 15 ℓ/s
  - Flow at any one hydrant : 15 ℓ/s
  - Minimum pressure at fire : 8 m
  - Minimum pressure rest of system : 5 m
  - Spacing of fire hydrants : 240 m max

- Linear pipeline velocity
  - Maximum under conditions of peak hour : 1.8 m/s
  - Maximum under conditions of firefighting : 2.2 m/s

- uPVC ring main feeding the various residential areas, and providing fire fighting supply (110mm – 160mm diameter)
- Pipe material for pipes and fittings < 50 mm Ø: HDPE PE 100 to SANS ISO 4427 reticulation pipework and house connection
  - Minimum pipe class : PN 12 (or higher-pressure class if required)
  - Supply lengths : 12 m minimum
  - Joints : Butt–welded to SANS 10268

- Boundary roughness (k-value) : 0.1 mm
- Flow formula : D'Arcy Weissbach
- Depth of cover below final ground level
  - On sidewalks : 1.0 m(min) – 1.5 m(max)
  - Across streets : 1.0 m(min) – 1.5 m(max)
- Placement of pipes inside 13 m to 25 m road reserves
  - 2.2 m from erf boundary on high side of road (16 m road reserves)
  - 1.8 m from erf boundary on high side of road (13 m road reserves)
- Placement of isolating valves
  - Opposite splay corner pegs in networks so that not more than 4 valves have to be shut off to isolate any part of the network.
- Placement of hydrants
  - Fire Department to specify type and placement
  - Opposite the communal erf pegs and between 0.3 m and 0.5 m away from them not closer than one erf length to any intersection

3.4 Water Demand Calculations

Land Use-Zoning	Erven	Area (m^2)	Units	% of Township	Measuring unit/day	Unit Water Consumption (kl)	ADD * (kl/day)	Peak hourly factor	Peak Domestic Consumption (l/s)
Shopping Center, Commercial Uses and other Business Uses	2	9 000	2	6%	kl per hectare	50	45	4.6	2.3
School (day School)	1	3 300	1	2%	kl per hectare	50	17	4.6	0.8
Dwelling Houses	251	73 600	251	53%	kl per unit	0.8	**201**	4.6	10.2
Dwelling Units/Flats	1	12 200	60	9%	kl per unit	0.6	**36**	4.6	1.8
Clinic	1	7 600	1	5%	kl per m2(100m2 per Gross Area)	0.005	38	4.6	1.9
Filing Station	1	3 500	1	3%	kl per m2(100m2 per Gross Area)	0.004	14	4.6	0.7
Park**	1	29 800 (20%= 5 960)	1	21%	kl per hectare	50	30	4.6	1.5
Total (Exclude street/road)	**258**	**139000**	258	100%			380		19.2

*AADD: Average annual daily demand

**20% of the total park area of 29 800m^2 will be watered/irrigated. The reminder of the area will consist of non-watered vegetation.

3.5 Fire flow under peak

Flow Condition			Min/Max. Pressure	Absolute Min/Max. Pressure
			(m)	(m)
Peak hour demand-minimum			20 to 24	16 to 20
Static (no demand) -maximum			90	120
Fire flow (@peak hour demand)			See below	
Area where fire occurs	Total fire flow (l/s)	Flow at hydrant (l/s)	Min. pressure at fire (m)	Min. pressure rest of system (m)
Residential 3	15	15	8	5

4 SEWER DRAINAGE

4.1 Existing Infrastructure

The property to be developed is currently vacant land. The site is currently undeveloped, and no existing sewer reticulation have been installed on the site. The only existing outfall sewer runs along 5th Street and 1st Street about 2km from the proposed development.

4.2 Design Layout

Appendix B shows the proposed wastewater reticulation system layout. The system comprises of a full water borne gravity reticulation system network of 110mm to 200mm uPVC pipelines which collects all flows to the existing network system.

4.3 Sewer Design Criteria

The following standards will be used in the design of the water reticulation:

- Average annual daily demand (AADD)
  - Dwelling Houses : 0.6 kl/unit
  - Dwelling Units/Flats : 0.6 kl/unit
  - Business, Commercial and schools : 30 kl per hectare
  - Clinic :300l/day for 100m^2 of gross floor area
  - Street : N/A
- Peak factor :2.5
- Sewer capacity : Pipes shall be designed to run at 70% full, measured in terms of flow depth
- Provision for stormwater infiltration : The remaining 10%
- Flow formula : Manning with n = 0.013
- Minimum velocities in sewers : 0.75 m/s at full flow with absolute minimum 0.6 m/s
- Fall through manholes : 80 mm (for sewers <315mm dia)
- Minimum pipe size for reticulation pipes : 145mm internal diameter

- Sewer erf connections : 110mm diameter at the lowest point of each erf in the case of Res 1 erven and to a distance of 500 mm inside the erf boundary and not less than 1m from side boundary.
- Minimum gradients

Nominal Ø (mm)	Minimum grade with depth of flow = $^{1}/_{5}$ D and V = 0.6 m/s	Minimum grade with depth of flow = ½ D and V = 0.82 m/s
160	1/80 (for fewer than 24 dwelling units connected)	1/100
200	1/120	1/200
250	1/160	1/240
315	1/200	1/300

- Depth of sewer
  - In mid-blocks : 1.2m depth to invert
  - In street reserves : 1.5m depth to invert
- Sewer system in mid-blocks or street reserves : Mid-block system acceptable if sewers are not installed deeper than 2 m and the main sewer not deeper than 3 m, otherwise a double system may be considered depending on costs.
- Maximum manhole spacing : 110m
- Placement of sewers inside 13 m to 25 m road reserves:
  - 2.85 m from erf boundary on high side of road (16 m road reserves)
  - 2.45 m from erf boundary on high side of road (13 m road reserves)
- Placement of sewers inside mid-blocks : 1.2 m from erf boundary
- 110mm-200mm uPVC full waterborne gravity reticulation network
- Supply lengths :12m minimum
- Sewer manholes : Precast concrete rings with “Pro-Struct 687” sealant at joints

4.4 Sewer Outflow Calculations

Land Use-Zoning	Area (m^2)	Units	% of Township	Measuring unit/day	Sewer Flow (kl)	AADD (kl/day)	Instantaneous Peak Factor	Instantaneous Peak (kl/day)
Shopping Center, Commercial Uses and other Business Uses	9000	2	11%	kl per hectare	28	25	3.4	86
School (day School)	3300	1	8%	kl per hectare	40	13	3.4	45
Dwelling Houses	73600	251	40%	kl per unit	0.64	**161**	3.4	546
Dwelling Units/Flats	12200	1	10%	kl per unit	0.48	**29**	3.4	98
Clinic	7600	1	5%	kl per m2(100m2 per Gross Area)	0.004	30	3.4	103
Filing Station	3500	1	1%	kl per m2(100m2 per Gross Area)	0.0032	11	3.4	38
Park*	29800	1	1%	kl per hectare				
Total Total (Exclude street/road)	139000	258	100%			269		916

*No sewer discharge for the park area. No toilet facilities located at the parking area

5 STORMWATER

5.1 Existing stormwater

The property area to be developed is currently vacant land. The site is currently undeveloped, and no existing stormwater reticulation have been installed on the site. The stormwater runoff is proposed to be discharge to the nearby Dorpsrivier stream.

5.2 Design Layout

Stormwater infrastructure will largely run within road reserves. **Appendix B** indicates a preliminary system layout.

5.3 Storm water infrastructure:

Rainfall:

The rainfall station that are located closed to the site are shown on table below:

Table 1: Rainfall Station Close to the proposed site

Station Name	SAWS Number	Distance (km)	Record (Years)	Latitude (−) (')	Longitude (−) (')	MAP (mm)	Altitude (m)
LYDENBURG (POL)	0554786_W	2.5	89	25 5	30 27	681	1372
LYDENBURG-VIS.	0554816_A	3.6	23	25 6	30 28	670	1423
LEIDENBURG 111	0554752_W	7.2	62	25 2	30 26	703	1356

a) Design philosophy:

The removal of storm water from the entire development will be via a combination of surface channels, road and pipe network. The discharge of storm water will be into the nearby Dorpsrivier stream.

The proposed stormwater control system aims at:

- Reducing runoff peaks as a result of an increase in hardened across the site such that post-development flows into receiving streams are no higher than pre-

development flows.

- Preventing scour and erosion on steep slopes from flow concentrations.

b) Design Flood Calculations

The following table indicate some of the typical guidelines used for run-off calculations:

Table 2: Design flood frequencies for minor systems

Design flood frequencies for minor systems	
Land use	Design flood recurrence interval
Residential	1 - 5 years
Institutional	2-5 years
General commercial	5 years
CBD	5 – 10 years

The Rational Method using 5 year Design flood recurrence interval would used for the determination of stormwater run-off.

5.4 Pre-Development Runoff

The runoff for the pre-developed site was calculated by using the following hydrological and hydraulic parameters:

- Stormwater modelling using the Rational method. However, during the detailed design the EPA-SWMM would be used for the modeling.

- Design storms: Design Rainfall Depth Grid At grid position 25° 6' South and 30°26' East (closest position to proposed site)

The pre-development stormwater modelling results are provided in Table 3 and calculations are shown in Appendix C.

Table 3: Predevelopment stormwater

RETURN PERIOD T (YEARS)	2	5	10	15	20	25	50	100
Q (m^3/s)	0.60	1.02	1.32	1.59	1.76	2.13	2.99	4.24

5.5 Post Development Runoff

The runoff for the post -developed site was calculated by altering the catchment parameters to include for the construction of buildings and surfacing of previously natural ground covered areas.

The impervious areas consist of proposed building footprints, proposed road and parking areas.

The percentage impervious area per catchment is provided with post development results.

The un-attenuated post development stormwater modelling results are provided in Table 4 and calculations are shown in Appendix C.

Table 4: Post Development Stormwater

RETURN PERIOD T (YEARS)	2	5	10	15	20	25	50	100
Q (m^3/s)	1.07	1.83	2.36	2.84	3.15	3.81	5.36	7.59

5.6 Major System

The road network would be utilized for the drainage of excess runoff not entering the underground system.
The proposed development allows for overland stormwater to be channelled along the internal road network and discharges into the proposed stormwater management facility such as ponds areas.
The road network makes allowance for stormwater runoff in excess of 1:5 year RI.

5.7 Attenuation Pond

The use of the attenuation pond is an effective means of attenuating flood peaks and reduce further downstream erosion. Furthermore, development of new areas attenuate storm water within the developments, before releasing it into a municipality system or surrounding.

There is one proposed attenuation pond to be located at the lowest point of the development.

The size of the attenuation pond would be calculated in terms of the simple triangular hydrograph and the time of concentration would be used to calculate the volume of runoff in terms of this hydrograph. The detention pond would therefore be sized to retain the 1:50 year rainfall event and the outlet of the detention ponds would discharge the 1:5 year rainfall event. The risk of the proposed development flooding due to pond wall breaking would be mitigated by providing a pond spillway with a capacity of 1 in 50 year return period.

Perform routing calculations

The calculated flood peaks /inflow hydrograph were trouted through the pond system to determine the attenuated flood. The flood peaks/ inflow hydrograph were routed through the pond also spillway and control orifice to confirm the capacity of the ponds. If the routed post-development peak discharge exceeds the required peak discharge, then the storage volume and outlet device was re-sized.

Calculation of detention volume

The calculation of the pond sizing are attached in Appendix D.

The attenuation is achieved with an attenuation pond be located at the lowest point of the development. The volume of the attenuation pond is 3318m³ with outlets of; 1 x 600 mm diameter and an overflow broad crest weir of 7m width and 0.5m high freeboard as a back-up safety overflow. The geometry of the proposed attenuation pond is shown in Appendix D and Table below.

Table 5: Proposed attenuation pond geometry

Depth of Pond (m)	2.5
length of pond at base (m)	30
width of pond at base (m)	30
side slope factor (ratio of horizontal to vertical components of side slop	0.4
Maximum area (m^2)	1806

6 ROADS, ACCESS AND PARKING

The road hierarchy and access to the development would be based on the recommendations covered in the Traffic Impact Assessment.

6.1 Access

Access to the site will be via the existing roads 5th street or 1st street, running adjacent to the site. The proposed access road will be off the existing access road to the proposed development as indicated on the attached drawing see Annexure B.

Alternatively, access will be via the main road with access stream crossing or bridge constructed over Dorpsrivier stream.

The detailed traffic assessment report is attached as Appendix E and detail the proposed access roads.

6.2 Internal Network

The geometric design, cross section and structural design of the roads will be based on accepted standards for the class of road proposed.

The road layer works will be finalised during the detail design stage of the project.

7 SERVICES AGREEMENTS

Discussions with Municipality indicated an adequate availability of bulk water and sewer from their system. A dedicated bulk connection will be installed by the Municipality on application by the developer. This can only be done once plans or final development are approved for the development.

A formal services agreement may be required between the Developer and the Municipality prior to final development approval. This would be to cover sewer, water supply arrangements, as well as arrangements for fire-fighting infrastructure provisions.

Report by : M Makhabane (Pr Eng No. 20110268)

MLINCO PROJECTS (Pty) Ltd

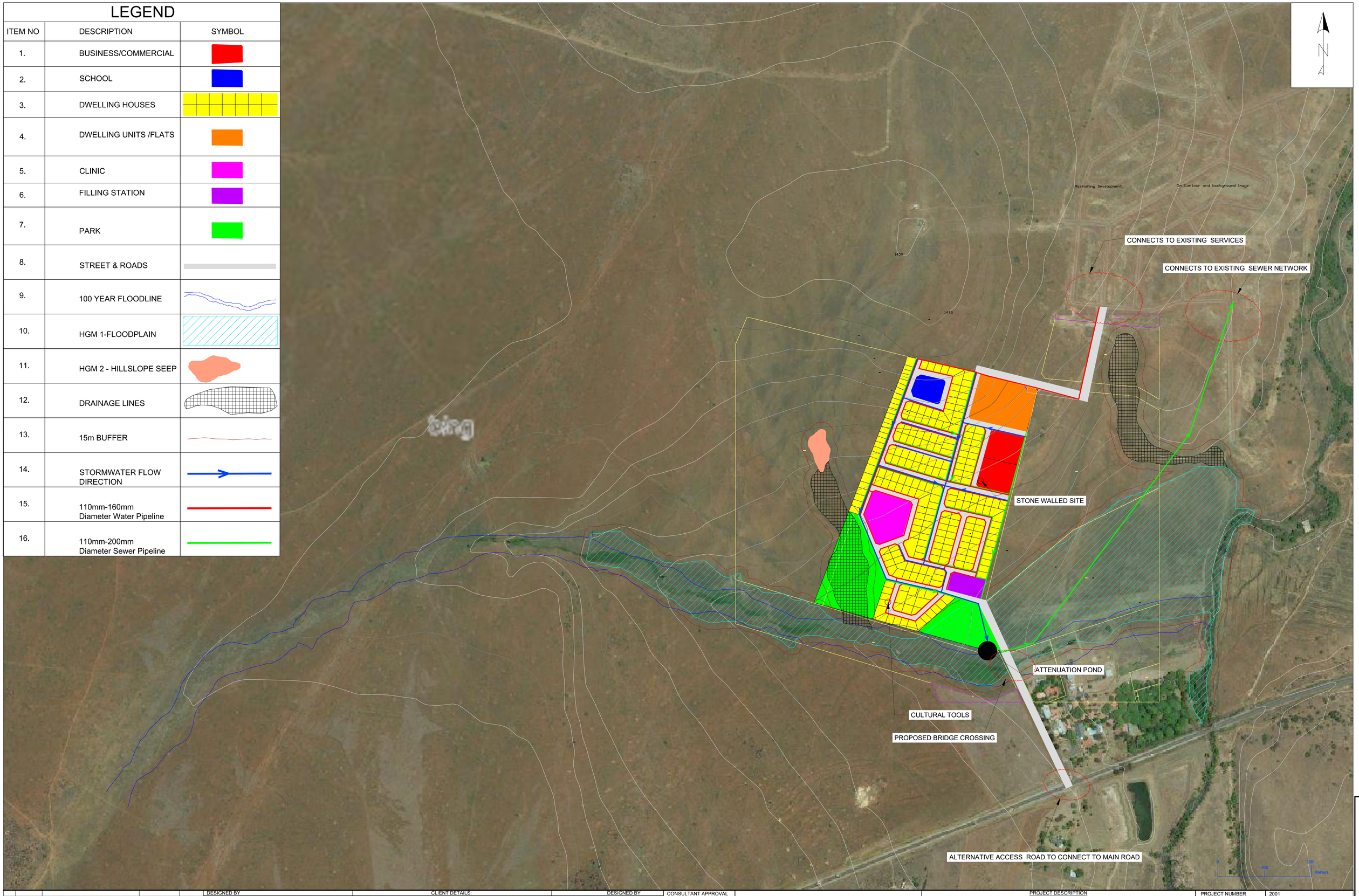
Signed :
Date : 15 February 2021

APPENDIX A: TOWN PLANNER'S LAYOUT

APPENDIX B: SITE AND GENERAL LAYOUT OF PROPOSED SERVICES

LEGEND

ITEM NO	DESCRIPTION	SYMBOL
1.	BUSINESS/COMMERCIAL	
2.	SCHOOL	
3.	DWELLING HOUSES	
4.	DWELLING UNITS /FLATS	
5.	CLINIC	
6.	FILLING STATION	
7.	PARK	
8.	STREET & ROADS	
9.	100 YEAR FLOODLINE	
10.	HGM 1-FLOODPLAIN	
11.	HGM 2 - HILLSLOPE SEEP	
12.	DRAINAGE LINES	
13.	15m BUFFER	
14.	STORMWATER FLOW DIRECTION	
15.	110mm-160mm Diameter Water Pipeline	
16.	110mm-200mm Diameter Sewer Pipeline	



No.	DATE	REVISION	CONSULT. ENG.	DATE
0	23-3-2020			

DESIGNED BY

CLIENT DETAILS:

DESIGNED BY
NAME
Prof. Reg. No.

CHECKED BY
NAME
Prof. Reg. No.

DRAWN BY
NAME

CONSULTANT APPROVAL
Name :
Prof. Reg. No. :
Date :

ORIGINAL DRAWING	ORIGINAL DRAWING A0
SCALE = AS SHOWN	SHEET SIZE: A0
APPROVED: CLIENT OR ASSIGNEE: _____	DATE: _____
CLIENT DRAWING No.:	CLIENT REF No.:

PROJECT DESCRIPTION
PENTAGON BUSINESS & RESIDENTIAL DEVELOPMENT

DRAWING DESCRIPTION
LAYOUT PLAN

PROJECT NUMBER	2001	
DISTRICT		
DRAWING LOCATION DATA		
DRAWING km DISTANCE	FROM	TO
DRAWING TYPE		
TYPE OF DESIGN		
SHEET	001 OF 001	
CONSULTANT DRAWING No.		VER 1

DWG.No.

APPENDIX C: HYDROLOGY/ FLOOD PEAK CALCULATIONS

RATIONAL METHOD-PreDevelopment

(Recommended for areas < 15km^2)

DESCRIPTION OF CATCHMENT Predevelopment — **CALCULATED BY** M Makhabane

INLET 1 — **DATE** 2-Nov-20

PHYSICAL CHARACTERISTICS

SIZE OF CATCHMENT	A	=	0.187	km^2	Ok	AREA REDUCTION FACTOR			1.00
LONGEST WATER COURSE	L	=	0.7	km	L_{OF} = 0.70	L_{WC} = 0.00			
AVERAGE SLOPE	S	=	0.079	m/m					
DOLOMITIC AREA		=	0	%	----20% of "C"				

AREA DISTRIBUTION FACTORS		
RURAL	URBAN	LAKES
$\propto$ = 1.0	B = 0.0	γ = 0.0

RURAL						URBAN	
SURFACE SLOPE	(%)	PERMEABILITY	(%)	VEGETATION	(%)	USE	(%)
VLIE'S & PANS	0	VERY PERMEABLE	0	THICK BUSH & PLANTATION	0	LAWNS & PARKS	0
FLAT AREAS	100	PERMEABLE	0	LIGHT BUSH & FARM LANDS	0	INDUSTRIAL AREAS	0
HILLY	0	SEMI-PERMEABLE	100	GRASS LANDS	100	CITY/RESIDENTIAL	0
STEEP AREAS	0	IMPERMEABLE	0	NO VEGETATION	0	STREETS	0
TOTAL	100	TOTAL	100	TOTAL	100	TOTAL	0

C_h		C_d		C_p		C_1		C_2		C			C_{final}		
0.03	0.0000	0.04	0.000	0.04	0.000	Ch	0.080	0.1	0.000	1.0	of C_1	0.45	**1.00**	**C**	**0.45**
0.08	0.0800	0.08	0.000	0.11	0.000	Cd	0.160	0	0.000	0.0	of C_2	0	0.00	C	0.00
0.16	0.0000	0.16	0.160	0.21	0.210	Cp	0.210	0.6	0.000	0.0	of C_3	0	**20**	**%**	**0.00**
0.26	0.0000	0.26	0.000	0.28	0.000			0.75	0.000						
	0.0800		0.160		0.210		0.450		0.000			0.45			**0.45**

RAINFALL

ROUGHNESS COEFFICIENT	=	r	0.3		
Tc (OVERLAND FLOW)	=	$0.604\ (rL/S^{½})^{0.467}$	0.528 Hrs	T_C = 0.528	Hrs
Tc (WATER COURSE)	=	$(0.87L^2/1000S)^{0.385}$	0 Hrs		
AV. FLOW VELOCITY v	=	L/T_C	0.368 m/s	TYPICAL 0.1 - 4m/s	
MEAN ANNUAL RAINFALL	=		681 mm		
RAINFALL REGION	WINTER:		THROUGHOUT Yr:	SUMMER: yes	

VALUES OF r	
CLEAN SOIL	0.1
PAVED AREA	0.02
SPARSE GRASS	0.3
MODERATE GRASS	0.4
THICK BUSH	0.8

RETURN PERIOD (YEARS)	2	5	10	15	20	25	50	100	MAX
POINT RAINFALL (mm)	27	41.9	49.6763399	56.5	59.2946	64.2	81.449	95.8	
POINT INTENSITY (mm/Hr)	51.2	79.4	94.083977	107	112.3	122	154.26	181	
AREA REDUCTION FACTOR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
AVERAGE INTENSITY (mm/Hr)	51	79	94	107	112	122	154	181	

NOTES:

----Exclude % artificial areas & pans

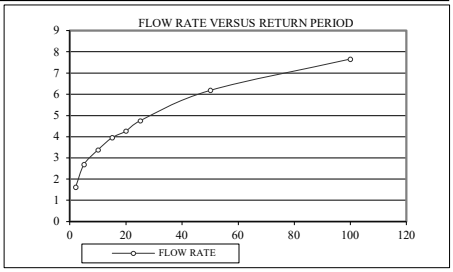
Check & adjust point rainfall @ Fig 2.6

RUN-OFF FACTOR

RETURN PERIOD T (YEARS)	2	5	10	15	20	25	50	100	MAX
RURAL C_1	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	
URBAN C_2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
LAKES C_3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Cfinal	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	

PEAK FLOW

RETURN PERIOD T (YEARS)	2	5	10	15	20	25	50	100	MAX
PEAK FLOW Q=CIA/3.6 (m^3/s)	1.20	1.85	2.20	2.50	2.63	2.84	3.61	4.24	
ADJUSTED PEAK (m^3/s) (Ft x Q)	**0.60**	**1.02**	**1.32**	**1.59**	**1.76**	**2.13**	**2.99**	**4.24**	



RECOMMENDED VALUES OF RUN-OFF FACTOR C

RURAL C_1						URBAN C_2		
COMPONENT	CLASSIFICATION		MEAN AVERAGE RAINFALL (mm) 0 - 600	600 - 900	900 +	USE		FACTOR
SURFACE SLOPE Ch	VLEI'S & PANS	(<03%)	0.01	0.03	0.05	**LAWNS**		
	FLAT AREAS	(03% TO 10%)	0.06	0.08	0.11	SANDY, FLAT	(<2%)	0.05 - 0.10
	HILLY	(10% TO 30%)	0.12	0.16	0.20	SANDY, STEEP	(>7%)	0.15 - 0.20
	STEEP AREAS	(>30%)	0.22	0.26	0.30	HEAVY SOIL, FLAT	(<2%)	0.13 - 0.17
						HEAVY SOIL, STEEP	(>7%)	0.25 - 0.35
PERMEABILITY Cd	VERY PERMEABLE		0.03	0.04	0.05	**RESIDENTIAL AREAS**		
	PERMEABLE		0.06	0.08	0.10	HOUSES		0.30 - 0.50
	SEMI-PERMEABLE		0.12	0.16	0.20	FLATS		0.50 - 0.70
	IMPERMEABLE		0.21	0.26	0.30	**INDUSTRY**		
						LIGHT INDUSTRY		0.50 - 0.80
VEGETATION Cp	THICK BUSH & PLANTATION		0.03	0.04	0.05	HEAVY INDUSTRY		0.60 - 0.90
	LIGHT BUSH & FARM LANDS		0.07	0.11	0.15			
	GRASS LANDS		0.17	0.21	0.25	**BUSINESS**		
	NO VEGETATION		0.26	0.28	0.30	CITY CENTRE		0.70 - 0.95
						SUBURBAN		0.50 - 0.70
RETURN PERIOD (YEARS)	2	5	10	15	20	25	50	100	STREETS		0.70 - 0.95
ADJUSTED FACTOR Ft	0.500	0.550	0.600	0.635	0.670	0.750	0.830	1.000	MAXIMUM FLOOD		1.00

RATIONAL METHOD-Post Development

(Recommended for areas < 15km^2)

DESCRIPTION OF CATCHMENT Predevelopment — **CALCULATED BY** M Makhabane

INLET 1 — **DATE** 2-Nov-20

PHYSICAL CHARACTERISTICS

SIZE OF CATCHMENT	A	=	0.187	km^2	Ok	AREA REDUCTION FACTOR				1.00
LONGEST WATER COURSE	L	=	0.794	km	L_{OF} =	0.79	L_{WC} =	0.00		
AVERAGE SLOPE	S	=	0.05667506	m/m						
DOLOMITIC AREA		=	0	%	----20% of "C"					

AREA DISTRIBUTION FACTORS		
RURAL	URBAN	LAKES
$\propto$ = 0.0	B = 1.0	γ = 0.0

RURAL						URBAN	
SURFACE SLOPE	(%)	PERMEABILITY	(%)	VEGETATION	(%)	USE	(%)
VLIE'S & PANS	0	VERY PERMEABLE	0	THICK BUSH & PLANTATION	0	LAWNS & PARKS	20
FLAT AREAS	100	PERMEABLE	0	LIGHT BUSH & FARM LANDS	0	INDUSTRIAL AREAS	0
HILLY	0	SEMI-PERMEABLE	100	GRASS LANDS	100	CITY/RESIDENTIAL	54
STEEP AREAS	0	IMPERMEABLE	0	NO VEGETATION	0	STREETS	26
TOTAL	100	TOTAL	100	TOTAL	100	TOTAL	100

C_h		C_d		C_p		C_1		C_2		C			C_{final}		
0.03	0.0000	0.04	0.000	0.04	0.000	Ch	0.080	0.1	0.020	0.0	of C_1	0	**1.00**	**C**	**0.54**
0.08	0.0800	0.08	0.000	0.11	0.000	Cd	0.160	0	0.000	1.0	of C_2	0.539	0.00	C	0.00
0.16	0.0000	0.16	0.160	0.21	0.210	Cp	0.210	0.6	0.324	0.0	of C_3	0	**20**	**%**	**0.00**
0.26	0.0000	0.26	0.000	0.28	0.000			0.75	0.195						
	0.0800		0.160		0.210		0.450		0.539			0.54			**0.54**

RAINFALL

ROUGHNESS COEFFICIENT	=	r	0.02			
Tc (OVERLAND FLOW)	=	$0.604\ (rL/S^{½})^{0.467}$	0.171	Hrs	T_C = 0.25	Hrs
Tc (WATER COURSE)	=	$(0.87L^2/1000S)^{0.385}$	0	Hrs		
AV. FLOW VELOCITY v	=	L/T_C	0.882	m/s	TYPICAL 0.1 - 4m/s	
MEAN ANNUAL RAINFALL	=		681	mm		
RAINFALL REGION	WINTER:		THROUGHOUT Yr:		SUMMER: yes	

VALUES OF r	
CLEAN SOIL	0.1
PAVED AREA	0.02
SPARSE GRASS	0.3
MODERATE GRASS	0.4
THICK BUSH	0.8

RETURN PERIOD (YEARS)	2	5	10	15	20	25	50	100	MAX
POINT RAINFALL (mm)	19.1	29.6	35.0875182	39.9	41.9	45.3	57.5293	67.6	
POINT INTENSITY (mm/Hr)	76.3	118	140.350073	160	168	181	230.117	271	
AREA REDUCTION FACTOR	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
AVERAGE INTENSITY (mm/Hr)	76	118	140	160	168	181	230	271	

NOTES:

----Exclude % artificial areas & pans

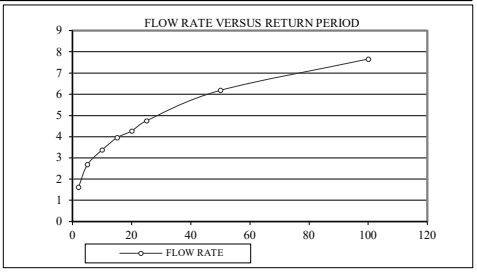
Check & adjust point rainfall @ Fig 2.6

RUN-OFF FACTOR

RETURN PERIOD T (YEARS)	2	5	10	15	20	25	50	100	MAX
RURAL C_1	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	
URBAN C_2	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	
LAKES C_3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Cfinal	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	

PEAK FLOW

RETURN PERIOD T (YEARS)	2	5	10	15	20	25	50	100	MAX
PEAK FLOW Q=CIA/3.6 (m^3/s)	2.14	3.32	3.94	4.48	4.70	5.09	6.45	7.59	
ADJUSTED PEAK (m^3/s) (Ft x Q)	**1.07**	**1.83**	**2.36**	**2.84**	**3.15**	**3.81**	**5.36**	**7.59**	



RECOMMENDED VALUES OF RUN-OFF FACTOR C

RURAL C_1					URBAN C_2		
COMPONENT	CLASSIFICATION	MEAN AVERAGE RAINFALL (mm) 0 - 600	600 - 900	900 +	USE	FACTOR	
SURFACE SLOPE Ch	VLEI'S & PANS (<03%)	0.01	0.03	0.05	**LAWNS**		
	FLAT AREAS (03% TO 10%)	0.06	0.08	0.11	SANDY, FLAT (<2%)	0.05 -	0.10
	HILLY (10% TO 30%)	0.12	0.16	0.20	SANDY, STEEP (>7%)	0.15 -	0.20
	STEEP AREAS (>30%)	0.22	0.26	0.30	HEAVY SOIL, FLAT (<2%)	0.13 -	0.17
					HEAVY SOIL, STEEP (>7%)	0.25 -	0.35
PERMEABILITY Cd	VERY PERMEABLE	0.03	0.04	0.05	**RESIDENTIAL AREAS**		
	PERMEABLE	0.06	0.08	0.10	HOUSES	0.30 -	0.50
	SEMI-PERMEABLE	0.12	0.16	0.20	FLATS	0.50 -	0.70
	IMPERMEABLE	0.21	0.26	0.30	**INDUSTRY**		
					LIGHT INDUSTRY	0.50 -	0.80
VEGETATION Cp	THICK BUSH & PLANTATION	0.03	0.04	0.05	HEAVY INDUSTRY	0.60 -	0.90
	LIGHT BUSH & FARM LANDS	0.07	0.11	0.15			
	GRASS LANDS	0.17	0.21	0.25	**BUSINESS**		
	NO VEGETATION	0.26	0.28	0.30	CITY CENTRE	0.70 -	0.95
					SUBURBAN	0.50 -	0.70

RETURN PERIOD (YEARS)	2	5	10	15	20	25	50	100
ADJUSTED FACTOR Ft	0.500	0.550	0.600	0.635	0.670	0.750	0.830	1.000

STREETS	0.70 -	0.95
MAXIMUM FLOOD	1.00	

APPENDIX D: POND SIZING

POND DETAILS

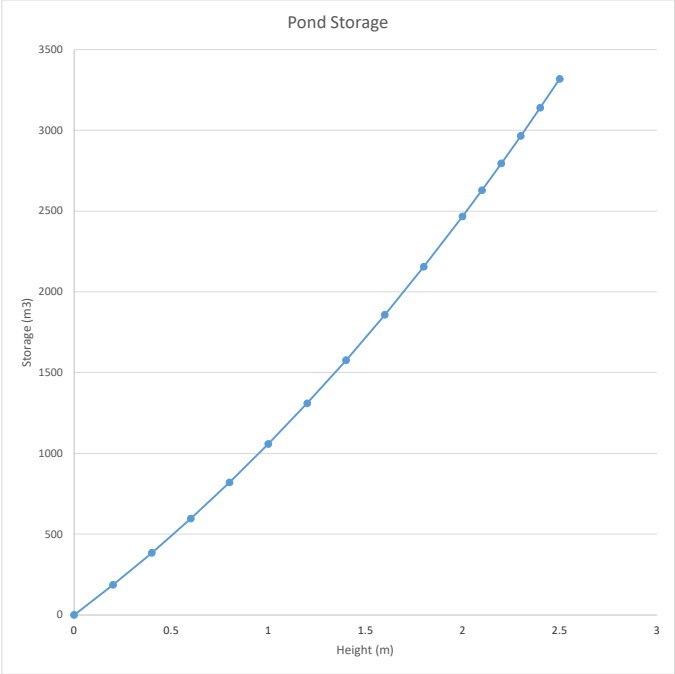
Rectangular Pond	
Depth of Pond (m)	2.5
length of pond at base (m)	30
width of pond at base (m)	30
side slope factor (ratio of horizontal to vertical components of side slop	0.4

Circular Outlet

Outlet Diamater(m)	0.6
Number of.	1
Cd	0.6
Q at Peak	1.1

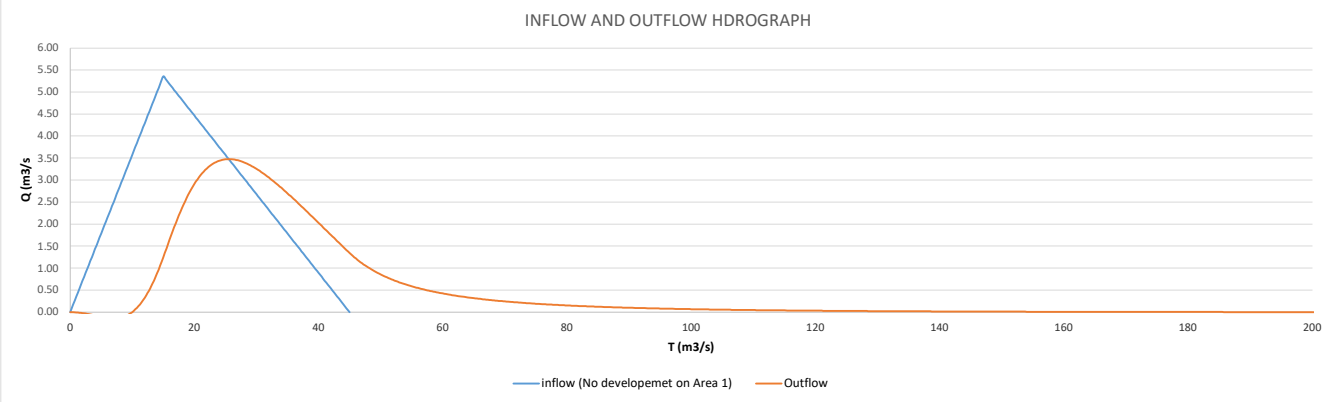
Spillway/Broad Crest Weir

Spilway Length (m)	7
Freeboard (m)	0.5
Spillway Crest Height (m)	2
Cd	1.7
Avail Qmax (m^3/s)	4.21
Pond Volume at Spill Height (m^3)	2467
time step	0.5
Dam break Height (m)	2.5
Dam break Volume (m^3)	3318.0625



Required 1in 50 Yr to avoid overtopping =1.25m3/s

min



APPENDIX E: TRAFFIC STUDY