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PROPOSED SOCIAL HOUSING DEVELOPMENT
ERF 1359
QUEENSBURGH

STORMWATER MANAGEMENT PLAN REPORT

REVISION 0

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1. Introduction

Jet Singh Civil Engineers (PTY) LTD was requested by the client and architect, to prepare a stormwater management plan (SWMP) for the Proposed Social Housing Development On Erf 1359 Queensburgh

In accordance with the National Building ,Regulations, the Municipality requires a stormwater management plan. Coastal Drainage and Stormwater Management prescribe that the stormwater discharge from a privately owned site be controlled and limited to the pre-development scenario.

2. Overview

Land development can dramatically alter the hydrologic cycle of a site and, ultimately, an entire watershed. Prior to development, native vegetation can either directly intercept precipitation or draw that portion that has infiltrated into the ground and return it to the atmosphere through evapotranspiration. Development can remove this beneficial vegetation and replace it with lawn or impervious cover, reducing the site's evapotranspiration and infiltration rates.

Clearing and grading a site can remove depressions that store rainfall. Construction activities may also compact the soil and diminish its infiltration ability, resulting in increased volumes and rates of stormwater runoff from the site. Impervious areas that are connected to each other through gutters, channels, and storm sewers can transport runoff more quickly than natural areas. This shortening of the transport or travel time quickens the rainfall-runoff response of the drainage area, causing flow in downstream waterways to peak faster and higher than natural conditions. These increases can create new and aggravate existing downstream flooding. Increased peak flows produce greater fluctuations between normal and storm flow rates, which can increase erosion and greatly exceed the required flow in the Municipal stormwater drainage system.

The key objectives of the Stormwater Management Plan for the Development are to define measures to:

- Ensure compatibility of the site with relevant regulations and by-laws from the stormwater perspective;
- Protect all life and property from damage by stormwater floods,
- Prevent erosion of soil by wind and water, and
- Develop a conceptual Surface Water Management Plan for the site during construction and post-development when compared to pre-development.

3. Project Description and Site Location

The site is located at **29°52'25.18 "S, 30°56'17.45 "E** on Huntley Road and the site is presently undeveloped.

The proposed development comprises of 4 multi-storey buildings and hardened area for parking/road way. The proposed development is equivalent to 37% of the total site area.

4. Stormwater Assessment

4.1 Design Standards

The design standard applicable for stormwater modelling prescribes that the stormwater outflow from the site be limited to the pre-development discharge for the 10 and 50 year recurrence interval storms. Attenuation measures must provide for the difference between the Pre-development 1 in 50 year and Post development 1 in 50 year storms or Pre-development 1 in 50 year and 1:10 Post Development. The values that yields higher flow is adopted as indicated in our calculations set out below.

Furthermore, the rate of outflow from the attenuation structure must exceed the Pre-development 1 in 10 year peak runoff rate until the 1 in 50 year storage is reached.

4.2 Hydrology

4.2.1 Catchment area

The proposed development is shown on the site plan. The total site area for calculations, as per Architectural Plans is and the post development characteristics are as follows:

SCHEDULE OF AREAS:			
Description	Area		Percentage %
PRE-DEVELOPMENT			
UNDEVELOPED	m2	18499	100.00%
POST DEVELOPMENT			
PROPOSED BUILDING	m2	3780	20.43%
PAVED AREA	m2	3196	17.28%
UNDEVELOPED	m2	11523	62.29%
		18499	
TOTAL PROPOSED DEVELOPMENT		**18499**	**37.71%**

4.2.2 Runoff coefficients

For the calculation of coefficients of runoff for both the pre and post development. These coefficients hard been calculated based on the soil conditions, topography and finished surface types.

The difference between the pre and post development coefficients of runoff determines the volume to be attenuated.

4.2.3 Time of Concentration

The time of concentration is calculated using hydrological estimates. Using the **Kerby Formula** for flow lengths less than 200m, the time of concentration, T_c is calculated from the following equation:

$$T_c = 0.604\left(\frac{rL}{\sqrt{S_{av}}}\right)^{0.467}$$

The surface reduction factor (r) is as follows:

Surface Reduction Factor	
Type of Surface	**Factor (r)**
Smooth paving	0.02
Clean soil	0.1
Sparse grass	0.3
Mod grass	0.4
thick bush/grass	0.8

For pre-development scenario, r = 0.8

For the post development scenario, r = 0.02

The minimum allowable time of concentration for design is guided by the following table:

Time of Concentration	
Thick vegetation	15min
Cultivated areas/ Parks	15min
Residential Areas	15min
Fully developed	10min

4.2.4 Rainfall Data

The rainfall data for the site recorded from the nearest rain gauge is as follows:

Rainfall Data						
Return Period	Storm Duration					
	5min	10min	15min	30min	45min	60min
2	9	13.9	18	24.5	29.3	32.2
5	13.4	20.9	27.1	36.7	43.8	49.8
10	16.9	26.3	34.1	46.2	55.2	62.7
20	20.7	32.3	41.8	56.6	67.7	76.8
50	26.4	41.1	53.2	72.2	86.3	97.9
100	31.4	48.8	63.1	85.6	102.3	116.1
200	36.9	57.4	74.3	100.8	120.4	136.6

4.2.5 Storm discharge

The design calculations for pre development and post development scenarios are as follows:

PRE DEVELOPMENT							
Physical Characteristics							
Size of catchment (A)	0.018499 km²	Rainfall Region	Summer Rainfall				
Longest watercourse (L)	0.2 km	Area Distribution Factors					
Average Slope (Sav)	0.19 m/m	Rural (α)	Urban (β)		Lakes (ϒ)		
Dolomite area ($D_{\%}$)	0 %	100.00%	0.00%		0		
Mean Annual rainfall (MAR)	900 mm						
Time of Concentration		Surface coefficient (r)			0.8		
Overland flow	0.38 hr	**Tc = 15mins, Therefore, use 15 mins**					
I_{10} =	136.4 mm/hr	Q_{10} =	0.250	m^3/s			
I_{50} =	212.8 mm/hr	Q_{50} =	0.390	m^3/s			
Run-off Coefficient							
Return period (years), T	**2**	**5**	**10**	**20**	**50**	**100**	**Max**
Run-off Coefficient, ($C_1 = C_s + C_p + C_v$)	0.356	0.356	0.356	0.356	0.356	0.356	
Combined run-off coefficient, C_T ($C_T = \alpha C_{1T} + \beta C_2 + \Upsilon C_3$)	0.356	0.356	0.356	0.356	0.356	0.356	
Rainfall							
1 in 10 Return Period	**5min**	**10min**	**15min**	**30min**	**45min**	**60min**	**Max**
Point Rainfall (mm), P_T	16.9	26.3	34.1	46.2	55.2	62.7	
Intensity (mm/hr), I_T ($I_T = P_T/T_C$)	202.8	157.8	136.4	92.4	73.6	62.7	
Peak Flow (m^3/s), Q_T	0.371	0.289	*0.250*	0.169	0.135	0.115	
1 in 50 Return Period	**5min**	**10min**	**15min**	**30min**	**45min**	**60min**	**Max**
Point Rainfall (mm), P_T	26.4	41.1	53.2	72.2	86.3	97.9	
Intensity (mm/hr), I_T ($I_T = P_T/T_C$)	316.8	246.6	212.8	144.4	115.1	97.9	
Peak Flow (m^3/s), Q_T	0.580	0.451	0.390	0.264	0.211	0.179	
The outflow from the attenuation structure is governed by the pre-development 1:10 return period (15 minute storm duration) which is, Q10 =		*0.250*	*m^3/s*				

The outflow from the attenuation structure is governed by the pre-development 1:10 return period (15 minute storm duration) which is, Q_{10} = 0.250m^3/s

POST DEVELOPMENT						
Physical Characteristics						
Size of catchment (A)	0.018499	km^2	Rainfall Region	Summer rainfall		
Longest watercourse (L)	0.2	km	Area Distribution Factors			
Average Slope (Sav)	0.19	m/m	Rural (α)	Urban (β)	Lakes (ϒ)	
Dolomite area ($D_{\%}$)	0	%	62.29%	37.71%	0	
Mean Annual rainfall (MAR)	900	mm				
Time of Concentration			Surface coefficient (r)		0.4	
Overland flow	0.04	hr	**Tc < 10mins, Therefore, use 10 mins**			
	I_{10} =	136.4	mm/hr	Q_{10} =	0.275	m^3/s
	I_{50} =	212.8	mm/hr	Q_{50} =	0.430	m^3/s

*Post Development Q_{50} > Pre development Q_{50}, therefore use Pre development flow for storage calculations

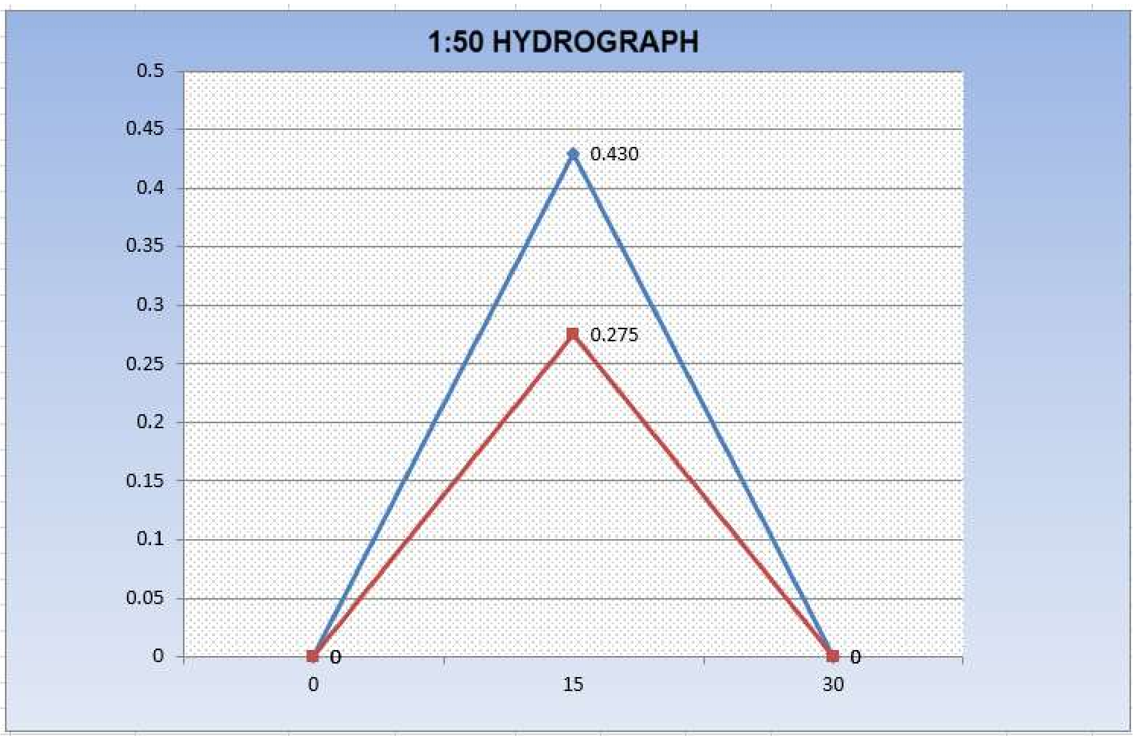
Run-off Coefficient							
Return period (years), T	**2**	**5**	**10**	**20**	**50**	**100**	**200**
Run-off Coefficient, C_1 ($C_1 = C_s + C_p + C_v$)	0.356	0.356	0.356	0.356	0.356	0.356	0.375
Combined run-off coefficient, C_T ($C_T = \alpha C_{1T} + \beta C_2 + \Upsilon C_3$)	0.393	0.393	0.393	0.393	0.393	0.393	0.393

Rainfall							
1 in 10 Return Period	**5min**	**10min**	**15min**	**30min**	**45min**	**60min**	**Max**
Point Rainfall (mm), P_T	16.9	26.3	34.1	46.2	55.2	62.7	
Intensity (mm/hr), I_T ($I_T = P_T/T_C$)	202.8	157.8	136.4	92.4	73.6	62.7	
Peak Flow (m^3/s), Q_T	0.409	0.319	0.275	0.187	0.149	0.456	
1 in 50 Return Period	**5min**	**10min**	**15min**	**30min**	**45min**	**60min**	**Max**
Point Rainfall (mm), P_T	26.4	41.1	53.2	72.2	86.3	97.9	
Intensity (mm/hr), I_T ($I_T = P_T/T_C$)	316.8	246.6	212.8	144.4	115.1	97.9	
Peak Flow (m^3/s), Q_T	0.639	0.498	0.430	0.287	0.232	0.198	

The design discharge, Q, corresponding to the allowable time of concentration for both the pre development and the post development scenarios is as indicated in the table below and the following graph showing the run-off hydrograph:

Storm Recurrence Interval (yr)	Pre Development, Q (m^3/s)	Post Development, Q (m3/s)
10	0.250	0.275
50	0.390	0.430

4.2.5 Attenuation Volume and pipe outlet size



4.2.6 Attenuation Structure

From the calculations, the total volume required for storage is based on the 1:50 year peak storm discharge, **V =138.7 m^3**. This is the total volume of water to be detained on the site.

The attenuation tank will be constructed according to the following:

The attenuation stormwater volume is not to be less than **138.7 m^3**.

Orifice Sizing – 1: 10 Year pre development run-off

Orifice Sizing-check				
Proposed Orifice Diameter=		250	mm	
Therefore r=		125	mm	
V x Cd(Discharge)=		3.14459536	m/s	
Q= V.A		0.15435996	m^3/s	
Q @ 1 : 10 Pre=		0.24969796		
Hence the flowis :	**Adequately Restricted**			

Therefore,the attenuation structure is to discharge at the ***1:10 year peak storm discharge rate*** as be calculations above. The orifice pipe size from the tank is governed to ***250mm diameter pipe.***

The recommended size of the tank is a **20m long x 5m wide x 1.7 m deep=140 m^3**

This allows the tank to have a :

- ***300mm freeboard*** in the event of minor blockages and siltation in the tank.
- ***Attenuate the volume required.***

5. Conclusion

The discharge from the roof area and hardened will be collected in a piped network and directed to the attenuation tank as indicated on the site plan.

Drawing no : 101-2022-CI-04-001- Option 1 refers to the attenuation tank and slotted pipe system.

Drawing no : 101-2022-CI-04-002- Option 2 refers to the attenuation tank and municipal tie in.

The final design layout must incorporate these requirements as stipulated under 4.2.6 above.

The earthworks operation will be carried out by a suitably qualified contractor. The specifications with respect to the following will be issued on the bulk earthworks drawings and details upon appointment of a contractor.

- Material Utilization plan in terms of the platform cutting and filling.
- Extents of the cutting and filling. Specifications of the platform and required compaction required. The controls and procedures.
- Stormwater Management for the pre and post scenarios.

We will introduce many measures during the construction phase which will mitigate environmental impacts.

These will be in the form of the following construction methods and procedures.

- Earth drains to the top of cut embankments.
- Temporary v-drains
- Silt curtains along the drains and cut and fill embankments – to mitigate erosion and prevent excessive discharge of latent soil elements into the environmental sensitive areas boundary.
- The use of shade clothes strategically positioned along the environmental sensitive areas so that no contamination with respect to dust and litter enter this boundary.

I trust the above meets your requirements. Kindly contact me if you wish to discuss any items outlined within this SWMP

Yours Faithfully

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ANNEXURE A

DRAWING NO : 101-2022-CI-04-001- OPTION 1

ANNEXURE B

DRAWING NO : 101-2022-CI-04-002- OPTION 2