JDJ PROPERTIES

TIFFANY'S EXPANSION PROPOSED DEVELOPMENT

Stormwater Management Plan

Issue Date: 25 October 2022
Revision No.: 0
Project No.: 17134
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Date:	25 October 2022
Document Title:	TIFFANY’S EXPANSION – STORMWATER MANAGEMENT PLAN
Author:	J. SPOONER
Revision Number:	0
Checked by:	T. YORK
Approved by:	G. VISSER Pr Eng
Signature:	
For:	SiVEST SA (Pty) Ltd

DESCRIPTION

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APPENDICES

Tiffany's Expansion - Stormwater Management Plan

1. INTRODUCTION

SiVEST SA (Pty) Ltd have been appointed by JDJ Properties, the developer, to prepare the Stormwater Management Plan for the proposed Tiffany's Expansion development, as a part of the basic assessment phase of the project.

The proposed new addition to Tiffany's Shopping Centre is situated at Salt Rock PTN 173 (of 92) of lot 71. The development will be an expansion of the existing Tiffany's Shopping Centre and will be retail and commercial land use.

The proposed site works include civil infrastructure and building work relating to the construction of the retail centre expansion and surrounding parking lot. The civils infrastructure will include bulk earthworks, civils services and a new internal road and parking lot. The building works will include the construction of the retail centre, internal road, and surrounding parking lot.

The site is currently undeveloped natural bush and grassland. The proposed development of the site will impose a change to the catchment characteristics and increase stormwater surface runoff. The post-development runoff will be higher than the pre-development runoff, and thus attenuation is required to account for this change in runoff.

This report is submitted as part of the basic assessment process and should be read in conjunction with the Architectural and Engineering submission drawings.

2. LOCALITY AND DESCRIPTION OF THE SITE

The Tiffany's Expansion site is situated on lot 71 of Salt Rock PTN 173 (of 92), adjacent to the existing Tiffany's Shopping Centre, approximately 2.4km from Salt Rock Central, and falls within the Kwadukuza Municipal area. The approximate coordinates of the site are 29°28'49'' S, 31°13'45'' E.

The site currently comprises of natural bush, shrubs, and grassland. The site has a ridge along the South-Western edge of the site, adjacent to the existing Tiffany's Shopping Centre, and slopes down to a natural watercourse along the North-Eastern edge of the site. The site is generally quite steep, with slopes as high as 30-40% in places.

The site will form part of the existing Tiffany's Shopping Centre. Access to the site will remain the existing Tiffany's Shopping Centre entrance on Salt Rock Road. The site is boarded by Claremont Farm to the North and East, the N2 highway to the West, and Tiffany's Centre to the South.

The Google Earth extract shown in Figure 1 shows the location of the proposed Tiffany's Expansion site.

Figure 1: Location of Site (outlined in red).

3. STORMWATER MANAGEMENT PHILOSOPHY

3.1 General

The annual precipitation in the region is generally high, with a mean annual precipitation (MAP) of 1037 mm. This rainfall falls predominantly during the summer months. There are generally high temperatures and humidity during the summer months, contrasting with cool, moderate, and dry winters.

This area falls within the Berea Red soil formation. Under conditions of concentrated and uncontrolled surface runoff, exposed soil is highly susceptible to rapid erosion. On-site stormwater management is therefore very important, especially during construction.

The developable area is limited to 60% of the total site area due to the river flood level and 15 m environmental buffer zone, as specified by the Environmental Assessment. The developable area will all be hardened surfaces comprising of a new retail centre and parking lot. This new hardened surface will increase the peak stormwater runoff and this increase in runoff will need to be attenuated before discharging into the existing river system.

Surface runoff from the new retail centre's roof and parking area will be captured by an internal piped stormwater conveyance network. This network will discharge into an attenuation dam or tank, that will release the water in a controlled manner, through outlet structures that lead into the existing river system to the North of the site. In general, stormwater runoff must be managed in a manner whereby it is not concentrated to an extent that would result in any damage to the receiving environment during storm events.

3.2 Objectives

The objectives of the Stormwater Management Plan are to adhere to the following:

- To prevent downstream flooding due to the change in catchment characteristics.
- To protect property from damage by stormwater and floods.
- To maintain watercourses in their natural state, conserving wetlands, fauna, and flora as far as possible.
- To prevent soil erosion and consequential downstream damage.
- To prevent pollution of the water resources.
- To provide for the safe and efficient removal of stormwater runoff from the site.
- Reduce post-development stormwater flows by the effective use of relevant attenuation devices where applicable.
- Prevent concentration of stormwater at points that are susceptible to erosion.
- Manage and contain potential soil erosion problem areas during the construction phase.
- Maintain adequate ground cover, particular to those areas disturbed during construction.
- Ensure that natural and artificial slopes do not become saturated and unstable.
- Ensure that the receiving soils can accommodate the increased flow.
- Ensure all stormwater control works are constructed safely and aesthetically.

The adjacent stormwater course and on-site stormwater infrastructure must be maintained in a state free of rubbish, debris, and any deleterious material likely to pose a threat to the lower reaches of the watercourses.

4. STORMWATER CONVEYANCE SYSTEM

4.1 General

The purpose of this SMP is to set the governing stormwater management philosophy for the future development of the site. It is to be noted that this SMP is to be updated at detailed design phase to incorporate the updated stormwater design philosophy and attenuation details for the development.

The stormwater system shall consist of a combination of internal drainage collection points from the roof (in accordance with the Wet Services Engineers design), and the stormwater drainage of the surrounding parking lot. The minor stormwater network servicing the designated rainwater downpipes will connect into the new piped stormwater conveyance system in the parking area and roads circulating the building. The stormwater runoff will then be conveyed into an attenuation facility, from where it will be released in a controlled manner, through an outlet structure, into the existing river system.

The calculation of the pre- and post-development hydrology for the site was computed using the Rational Method. The methodology used for these calculations was as per the *SANRAL Drainage Manual* (2013). The design rainfall data used was obtained from the *Design Rainfall for South Africa* software developed by Prof JC Smithers (2002). The detailed hydrology calculations are contained in Appendix B and are summarised in Table 1 and Table 2.

Table 1 - Summary of Pre-Development Hydrology			
Time of Concentration (mins)	17.67		
Area (m^2)	55 196		
Return Period (years)	5	10	50
C Factor	0.20	0.22	0.30
Point Rainfall (mm)	32.36	40.77	63.66
Average Intensity (mm/hour)	109.87	138.45	216.17
Peak Discharge (m^3/s)	**0.333**	**0.458**	**0.990**

Table 2 - Summary of Post-Development Hydrology			
Time of Concentration (mins)	12.42		
Area (m^2)	55 196		
Return Period (years)	5	10	50
C Factor	0.62	0.63	0.67
Point Rainfall (mm)	26.73	33.65	52.56
Average Intensity (mm/hour)	129.18	162.61	254.02
Peak Discharge (m^3/s)	**1.236**	**1.578**	**2.628**

4.2 Piped Stormwater conveyance network

The on-site piped stormwater network is to connect to the existing river network via energy dissipating outlet structures, after being attenuated. The stormwater network will drain both the retail centre, as well as the parking lot and roads surrounding it. The parking area should be adequately shaped to fall to several low points, where runoff will be collected by grid inlets. The rainwater downpipes will discharge into gullies, (for maintenance access) and then into the site's piped stormwater network.

The design of the general stormwater piped conveyance network for the parking lot and new retail centre should be based on a 10-year return period design storm from the direct surface runoff.

4.3 Landscaped erosion control

The lower portion of the site, to the North, will remain undeveloped, as it falls within the flood line and environmental buffer zone. Due to the generally steep slope of the area, natural stormwater control measures should be implemented to prevent concentration of runoff and to lower the risk of potential erosion. Several berms and trenches should be placed in a transverse direction to the bank slope, capturing and controlling the runoff. This is of particular importance during the construction phase, when the site is exposed, and susceptible to erosion.

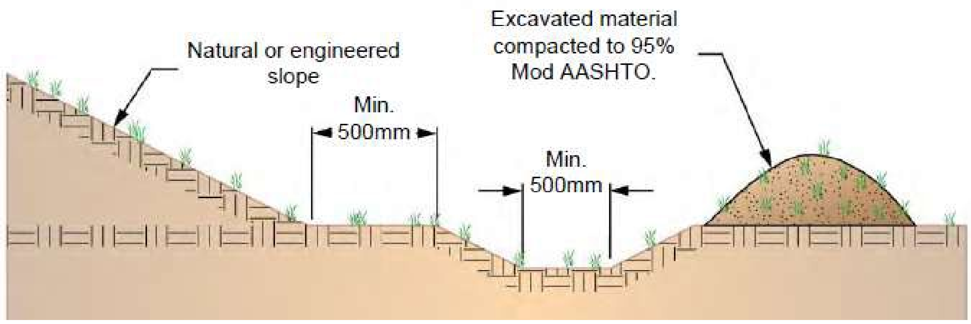


Figure 2: Indicative diagram of stormwater trenches and berms

4.4 Attenuation

The proposed development of the site will impose a change to the catchment characteristics and increase the stormwater surface runoff of the site. This is due to the decrease in rainfall infiltration caused by the development. This increases flood damage risks downstream unless adequate measures are taken to attenuate the flood peaks.

The post-development runoff will be higher than the pre-development runoff, and thus attenuation is required to account for this change in runoff, as per the *Planning and Design Guide* issued by the Department of Human Settlement (2019). The outflow from the site needs to be limited to the allowable pre-development peak discharge rate for both the 10-year and 50-year return periods.

This attenuation needs to be achieved using appropriate attenuation structure(s) and outlet controls. Such structures may include an attenuation pond, underground tank, and/or making use of temporary storage in the parking lot.

The approximate required attenuation volume for the site has been determined by calculating the difference between the pre- and post-development runoff hydrograph for a 50-year return period. A symmetrical triangular hydrograph with a duration of 2Tc (Time of Concentration) was assumed for both the pre- and post-development hydrographs.
The attenuation volume requirements are shown in Table 3, below.

Table 3 - Attenuation Volume Requirements			
Return Period (years)	5	10	50
Volume [Pre-development] (m^3/s)	353.5	486.0	1049.7
Volume [Post-development] (m^3/s)	920.5	1175.7	1957.7
Attenuation Requirement (m^3/s)	**567.0**	**689.6**	**908.0**

During detailed design and upon submission of drawings for plan approval, this SMP is to be updated to detail the exact manner of attenuation and is to clearly show how the post-development peak flow will be reduced to the allowable pre-development outflow for the 10 and 50-year recurrence intervals.

4.5 Outlet Control Structures

Once the stormwater runoff has been attenuated, the water will need to be released back into the existing river in a controlled manner. This will be achieved using outlet structures and stilling basins. Some typical outlet structures that may be used are shown in Figure 3 and Figure 4.

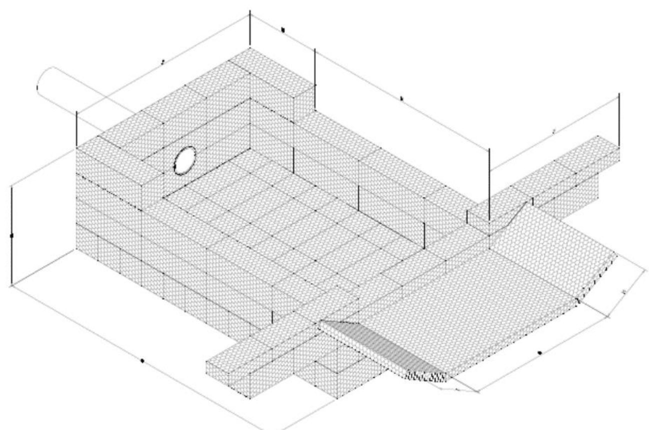


Figure 3: 3D sketch of typical outlet structure and stilling basin

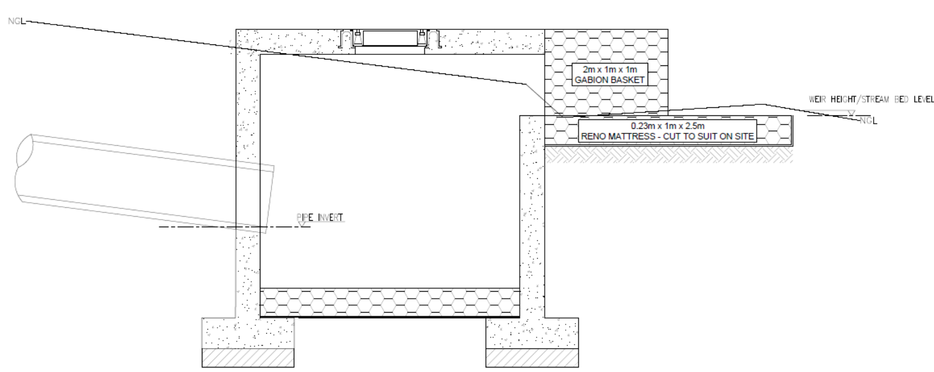


Figure 4: Cross-section of typical outlet structure

4.6 Flood line and Buffer Zone

The floodline for the site was delineated by the Environmental team during the Environmental Assessment of the site. They also delineated a 15m Watercourse Buffer in which no development can take place. It must be ensured that all stormwater infrastructure is constructed outside of this 15m buffer zone and that stormwater controls are implemented that insure that this area is protected.

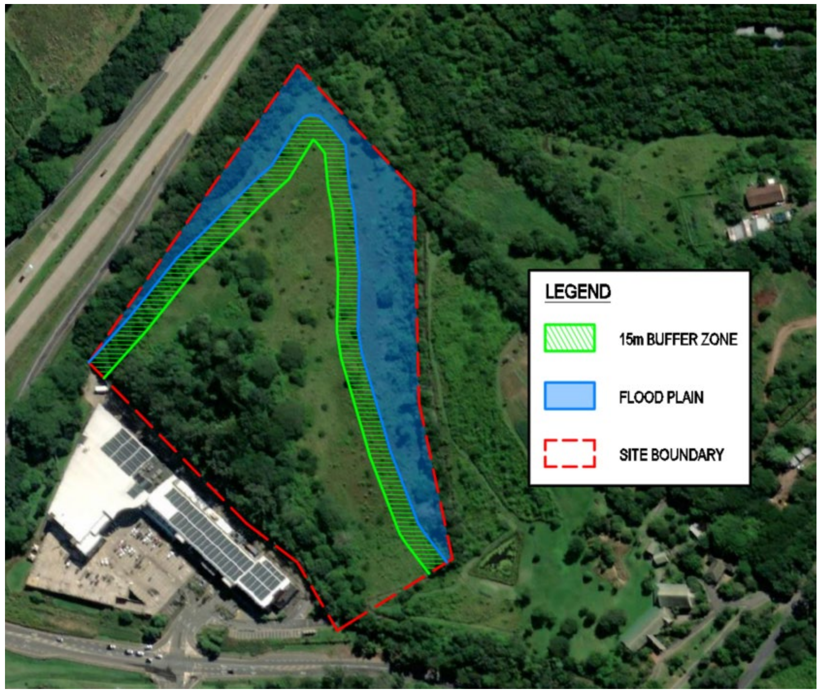


Figure 5: Flood line and Environmental Buffer Zone

4.7 Subsoil Drainage

A Geotechnical Investigation would need to be conducted to verify whether there is any significant shallow depth groundwater seepage. However, perched water tables may occur during wet seasons. To mitigate risk to the development and prolong the life span of the infrastructure, all retaining structures must incorporate suitable subsoil drainage which ties into the stormwater conveyance network.

Any seepage that does occur should be dealt with symptomatically as and when encountered. It should be collected and fed into the piped stormwater conveyance network for efficient removal.

4.8 Operation & Maintenance

The stormwater management system is to be designed to operate automatically without human intervention. Routine maintenance comprising cleaning of blocked pipes and inlets and repair of any localised erosion damage will, however, be required.

The infrastructural services will be handed over to JDJ Properties who will ultimately be responsible for operation and maintenance thereof. They are to be made aware of any design and operational requirements via the issue of "as-built" or "for record" drawings and operational manuals if applicable.

Due to the erodible nature of the soils on-site, some erosion and downstream silt accumulation can be expected until construction is complete, and a full cover of permanent vegetation has been established. The Contractor must assess suitable locations to incorporate protective works to trap sediment.

The Contractors are to take cognisance of all aspects of any Environmental requirements whilst performing construction activities.

4.9 Construction

4.9.1 General

The management of stormwater runoff during the construction phase must be controlled and the contractor is obligated with a duty of care to make use of sand bagging, trenches, berms, silt fences & vegetation screens to reduce runoff velocities and prevent erosion and the movement of soil - refer to Appendix C for control measures for Stormwater runoff during construction.

All construction activities within the development must comply with the Environmental Management Plan (EMP) as applicable.

4.9.2 Stormwater Controls During Construction

The control measures set out herein are not to be considered all-encompassing as the contractor will also have to adapt his control measures to the varying onsite conditions. All stormwater must be controlled and the following points act as guideline requirements that the Contractor is to take note of during the construction phase:

- The soils encountered on site are highly erodible and thus adequate controls to reduce stormwater runoff velocities and potential erosion damage are to be implemented and kept in place throughout the construction phase and the contractor must ensure that all control measures are continually maintained in good effective working order.
- The contractor is to install all downslope sandbagging and other controls (i.e. silt fencing, strip sodding, earth deflection berms, etc) required before earthworks are commenced.
- All areas that incur damage during rainstorms are to be rehabilitated as soon as the area in question has dried out sufficiently to allow work to take place (within 24 hours). All remedial fill is to be adequately benched into the existing soil mass and compacted to 95% Mod AASHTO.
- All stormwater temporarily channelled off the site must be directed in such a manner as not to cause damage to common/neighbouring grounds and must have controls in place to trap any sediment from getting into the major stormwater system. Where applicable, this can be achieved by forcing runoff through a succession of silt catches e.g. Silt fences.
- The permanent stormwater control reticulation should be installed as early as possible in the construction phase. All precautions must be taken to ensure sediment/runoff does not end up in common ground, neighbouring properties, streams, or wetlands.
- It is essential that all completed embankments and large open areas are top soiled and planted with vegetation as soon as practical on completion. In this instance, the banks are to be

shaped as required and then handed over to the landscape contractor to carry out the planting. It is recommended that full coverage of sods staked to the relevant embankments is implemented.

- The contractor is to take note of vulnerable points after all precipitation events and must reinforce the stormwater control measures in these areas if necessary.
- Stormwater must not be allowed to pond near building foundations.
- At the end of each working day, the access route onto the site must be protected by sandbagging, to prevent the flow of stormwater and silt onto or off the site.
- All contractors shall ensure that no materials, fluids, or substances are allowed to enter the stormwater system that could have a detrimental effect on the flora, fauna and aquatic life in the watercourses and neighbouring sites.
- The temporary stormwater control measures must evolve as conditions on-site evolve.

5. CONCLUSION

The Development Team, including the Contractor, shall be responsible for ensuring that the requirements of this Stormwater Management Plan are met. Similarly, the conditions as set out in the development's EMP are to be adhered to and this document should be read in conjunction with the EMP.

JDJ Properties or the relevant Property Owner shall be responsible for the ongoing performance of all stormwater control measures implemented on-site and the impact such works may have on downstream or neighbouring properties.

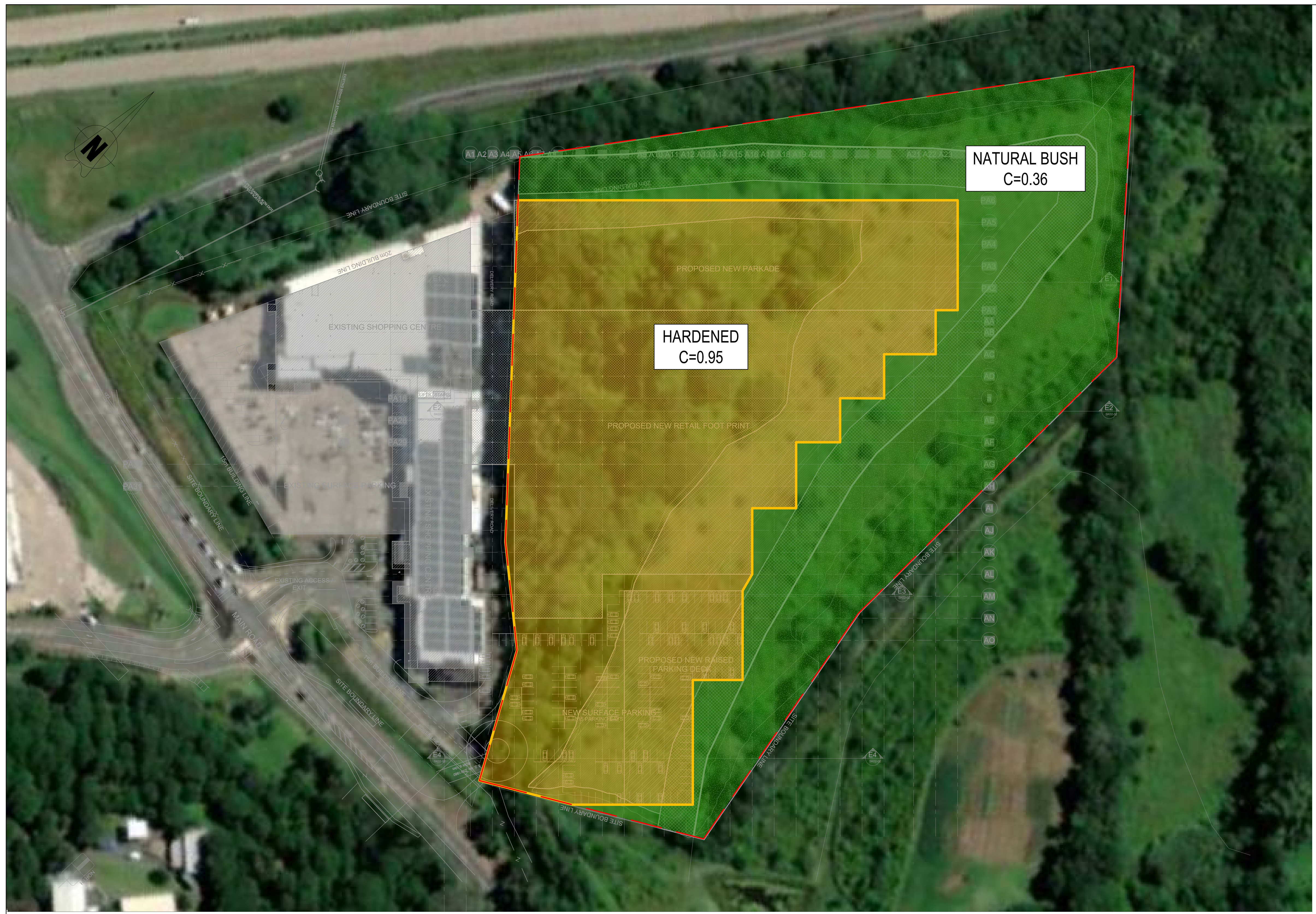
This document should be considered a "live" document and is subject to change as and when required.

SiVEST SA (PTY) LTD

Appendix A:

Stormwater Management Layout

17134-5000-Stormwater Management Plan REV A



POST-DEVELOPMENT SITE CHARACTERISTICS

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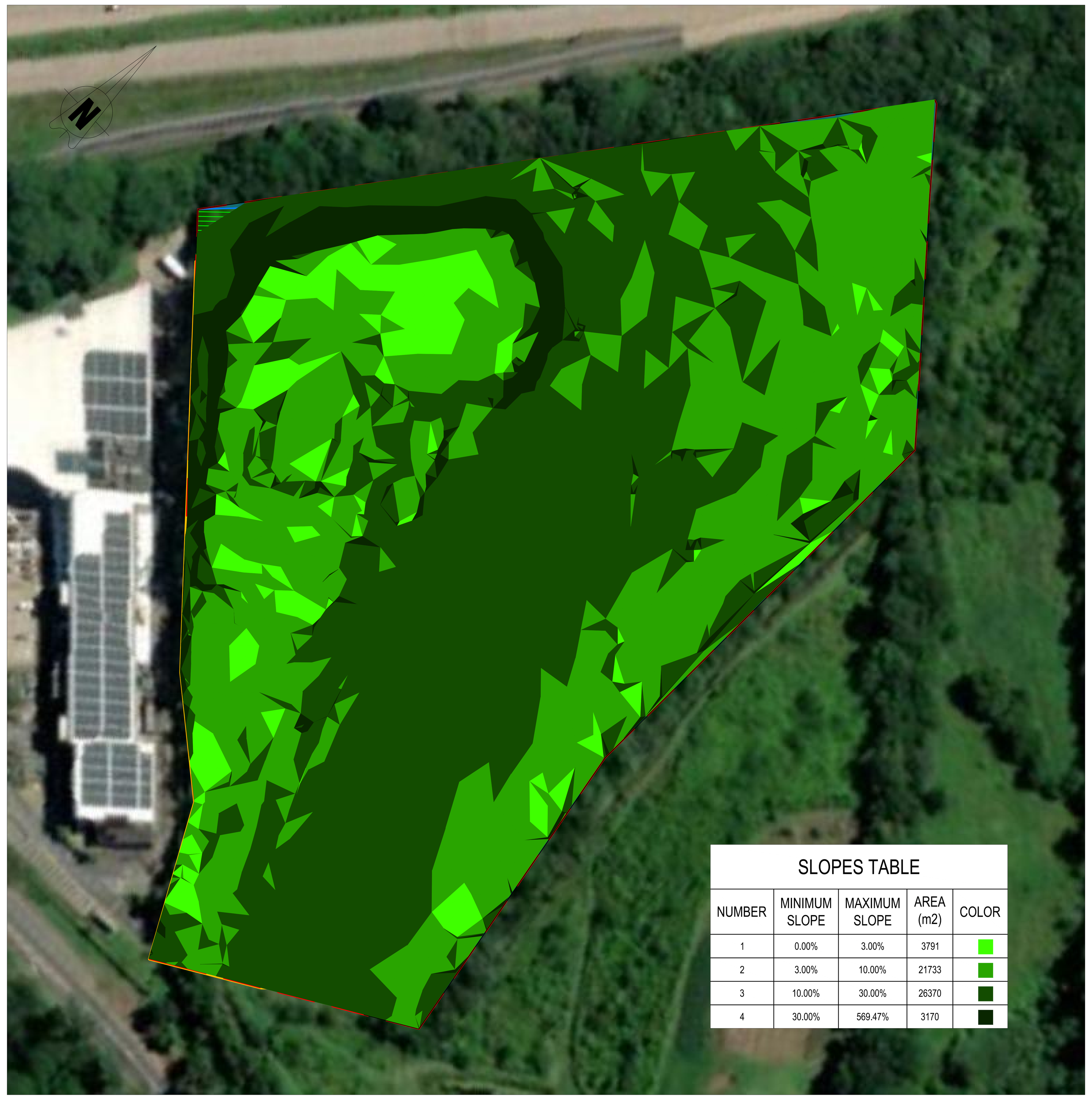
ENVIRONMENTAL FLOOD LINE AND 15m BUFFER ZONE



SLOPES TABLE

NUMBER	MINIMUM SLOPE	MAXIMUM SLOPE	AREA (m2)	COLOR
1	0.00%	3.00%	3791	
2	3.00%	10.00%	21733	
3	10.00%	30.00%	26370	
4	30.00%	569.47%	3170	

PRE-DEVELOPMENT SLOPE ANALYSIS

FOR APPROVAL

GENERAL NOTES

1. THIS DRAWING PROVIDES INFORMATION RELATED TO THE FORM OF THE WORK WHEN COMPLETED TOGETHER WITH GUIDANCE, WHERE FUNDAMENTAL TO THE DESIGN, FOR THE SEQUENCE OF CONSTRUCTION. THIS DRAWING DOES NOT PURPORT TO INCLUDE ANY NECESSARY PRECAUTIONS, ITEMS OR COMPONENTS REQUIRED FOR CONSTRUCTION SAFETY. ALL SUCH PRECAUTIONS MUST BE TAKEN AND ITEMS OR COMPONENTS SUPPLIED BY THE CONTRACTOR.
2. ANY DISCREPANCIES ARE TO BE CONFIRMED WITH THE ENGINEER ON SITE PRIOR TO WORK PROCEEDING.
3. ONLY WRITTEN DIMENSIONS SHALL BE USED.
4. ALL DIMENSIONS ARE IN METERS
5. ALL SERVICES TO BE CONSTRUCTED TO THE SANS 1200 SERIES SPECIFICATIONS AND THE PROJECT SPECIFICATIONS
6. REFER TO ARCHITECTURAL DRAWINGS FOR FIRE FITTINGS AND INTERNAL SERVICES LAYOUT.
7. ALL WORKS TO BE CARRIED OUT IN ACCORDANCE WITH THE RELEVANT SABS 1200 SERIES SPECIFICATIONS

CONSTRUCTION NOTES:

1. SELECTED BACKFILL FOR ALL PIPES MUST BE MIN G7 MATERIAL COMPACTED TO 95% MOD AASHTO, REFER TO SABS 1200 LB FOR MATERIAL GRADING AND PI FOR SELECTED BACKFILL MATERIAL.
2. ALL GRAVITY SEWER PIPES ARE TO BE CLASS 34 (HEAVY DUTY) uPVC.
3. ALL CONCRETE SPIGOT & SOCKET STORMWATER PIPES ARE TO BE CLASS 100D.
4. WELD REPORTS MUST BE GIVEN FOR EACH JOINT ON ALL HDPE PIPES.
5. CONTRACTOR TO CHECK ALL LEVELS AND SETTING OUT PRIOR TO CONSTRUCTION. ANY DISCREPANCIES ARE TO BE RESOLVED WITH THE ENGINEER.
6. ALL PIPES ARE TO BE LAID IN TRENCH CONDITIONS.
7. ALL POLYMER COVERS ARE TO BE GRAY IN COLOUR AND DESIGNATE THE RELATING SERVICES, I.E. STORMWATER, SEWER OR CABLE DUCTING.
8. ALL SERVICES ARE TO BE LAID IN TRENCH CONDITIONS WITH A COVER DEPTH TO A MINIMUM OF THE SPECIFIED SELECTED BACKFILL OR 300mm.
9. CONSTRUCTION VEHICLES TO BE ROUTED ON SITE TO AVOID DAMAGING LOADING ON SHALLOW BURIED PIPES.

SURVEY SYSTEM: WGS 84 Lo31

LEGEND

15m BUFFER ZONE

FLOOD PLAIN

SITE BOUNDARY

REFERENCE DRAWINGS

Revision Details	By	Date	Suffix
FOR APPROVAL	JS	2022.10.25	A

DURBAN OFFICE
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Fax +2731 5662371
email: info@sivest.co.za

Client
JDJ PROPERTIES

Project Title
TIFFANY'S EXPANSION
SALT ROCK

Drawing Title
STORMWATER MANAGEMENT PLAN LAYOUT

Scale on A0 1:1000
ON ORIGINAL PLAN 0 10 20 30 40 50

PREPARED
BY : J. SPOONER DATE: 2022.10.25

CHECKED
BY : A. MPANZA Pr No: 2019300454
SIGNATURE : DATE: 2022.10.25

APPROVED
BY : G. VISSER Pr No: 960270
SIGNATURE : DATE: 2022.10.25

SiVEST Drawing Number 17134-5000
Revision A

SiVEST SA (PTY) LTD

Appendix B:

Pre- and Post-Development Hydrology Calculations

Calculations

SiVEST

Project:	**TIFFANYS EXPANSION**					**No.**		**17134**	
Design Element:	**TIFFANYS HYDROLOGY SUMMARY**					Page 1 of 1			
Revision	A	B	C	D	E	Designed		Checked	
Initials	JS					Initials	Date	Initials	Date
Date	25.10.2022					JS	25.10.2022	TY	25.10.2022

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Calculations

SiVEST

Project:	TIFFANYS EXPANSION	No.	17134
Design Element:	TIFFANYS PRE-DEVELOPMENT HYDROLOGY		Page 1 of 2

Revision	A	B	C	D	E	Designed		Checked	
Initials	JS					Initials	Date	Initials	Date
Date	25.10.2022					JS	25.10.2022	TY	25.10.2022

RED = Check input **BLUE** = Auto Calculates

Description of catchment:	TIFFANYS PRE-DEVELOPMENT
River detail:	-
Calculated by:	J SPOONER

PHYSICAL CHARACTERISTICS

Size of catchment (A)	**0.0552**	km^2	Rainfall Region	Coastal		
Longest Watercourse (L)	**0.228**	km		**Area distribution factors**		
Dolomite area (D%)	**0**	%		Rural (α)	Urban (β)	Lakes (γ)
Mean annual rainfall (MAR)	**1037**	mm		1	0	0
Catchment type (Effects Ft factor)	**Flat & Permeable**					
r (based on Table 3C.3) =	**0.5**					

RURAL (C1)				**URBAN (C2)**			
Surface Slope	**%**	**Factor**	**C_s**	**Description**	**%**	**Factor**	**C_2**
Vleis and pans (<3%)	**6.9**	0.05	0.003	**Lawns**			
Flat areas (3-10%)	**39.5**	0.11	0.043	Sandy, flat (<2%)	**0**	0.1	0
Hilly (10-30%)	**47.9**	0.2	0.096	Sandy, steep (>7%)	**0**	0.2	0
Steep areas (>30%)	**5.8**	0.3	0.017	Heavy soil, flat (<2%)	**0**	0.17	0
Total	**100**	-	**0.160**	Heavy soil, steep (>7%)	**0**	0.35	0
Permeability	**%**	**Factor**	**C_p**	**Residential areas**			
Very permeable	**80**	0.05	0.04	Houses	**0**	0.5	0
Permeable	**20**	0.1	0.02	Flats	**0**	0.7	0
Semi-permeable	**0**	0.2	0	**Industry**			
Impermeable	**0**	0.3	0	Light industry	**0**	0.8	0
Total	**100**	-	**0.06**	Heavy industry	**0**	0.9	0
Vegetation	**%**	**Factor**	**C_v**	**Business**			
Thick bush and plantation	**30**	0.05	0.015	City centre	**0**	0.95	0
Light bush and farm lands	**50**	0.15	0.075	Suburban	**0**	0.7	0
Grasslands	**20**	0.25	0.05	Streets	**0**	0.95	0
No vegetation	**0**	0.3	0	Maximum flood	**0**	1	0
Total	**100**	-	**0.140**	Total (C_2)	**0**	-	**0**

TIME OF CONCENTRATION (Tc)

Overland flow (Tc1)		Defined watercourse (Tc2)		***Minimum Tc values (eThekwini Guidelines):***		
$T_{c1} = 0.604\left(\frac{rL_1}{\sqrt{S_1}}\right)^{0.467}$		$T_{c2} = \left(\frac{0,87L_2^2}{1000S_2}\right)^{0,385}$		Primary Development:	**Commercial or Industrial**	
				Min Tc =	10	minutes
				Calculated Tc		
L1 (km) =	0.1	L2 (km) =	0.128	Calc Tc = $T_{c1} + T_{c2}$ =	17.670	minutes
S1 (m/m) =	0.104	S2 (m/m) =	0.054	***Final Tc***		
T_{c1} (min) =	**15.160**	T_{c2} (min) =	**2.511**	**Tc =**	**0.295**	**hours**

RUNOFF COEFFICIENT

Return Period (years), T	**2**	**5**	**10**	**20**	**50**	**100**	**Max**
Run-off coefficient, C_1 (C1 =Cs + Cp + Cv)	0.360	0.360	0.360	0.360	0.360	0.360	0.760
Adjusted for dolomitic areas, C_{1D}	0.360	0.360	0.360	0.360	0.360	0.360	0.760
Adjusted factor for initial saturation, Ft	0.50	0.55	0.60	0.67	0.83	1.00	1.00
Adjusted run-off coefficient, C_{1T} (=C1D x Ft)	0.180	0.198	0.216	0.241	0.299	0.360	0.760
Combined run-off coefficient C_T	**0.180**	**0.198**	**0.216**	**0.241**	**0.299**	**0.360**	**0.760**

RAINFALL

Return Period (years), T	**2**	**5**	**10**	**20**	**50**	**100**	**Max**
Point rainfall (mm), P_T **	**21.60**	**32.36**	**40.77**	**49.93**	**63.66**	**75.49**	**88.88**
Point intensity (mm/hour), P_{iT}(=P_T/T_C)	73.34	109.87	138.45	169.53	216.17	256.34	301.78
Area reduction factor (%), ARF_T (7)	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Average intensity (mm/hour), I_T (=PiT x ARF)	73.34	109.87	138.45	169.53	216.17	256.34	301.78
Peak flow (m^3/s),	**0.202**	**0.333**	**0.458**	**0.627**	**0.990**	**1.415**	**3.516**

Calculations

SiVEST

Project:	TIFFANYS EXPANSION					No.	17134	
Design Element:	TIFFANYS PRE-DEVELOPMENT HYDROLOGY						Page 2 of 2	
Revision	A	B	C	D	E	Designed	Checked	
Initials	JS					Initials	Date	Initials	Date
Date	25.10.2022					JS	25.10.2022	TY	25.10.2022

RED = Check input **BLUE** = Auto Calculates

Table 3C.3 - Roughness Coefficient for Overland Flow

Surface Description	r	% Area	r*A
Paved areas	0.02	0%	0
Clean compacted soil, no stones	0.1	0%	0
Sparse grass over fairly rough surface	0.3	20%	0.06
Medium grass cover	0.4	50%	0.2
Thick grass cover	0.8	30%	0.24
		100%	0.5

Average Slope [OVERLAND]:

H_1 (m) =	77.1	
H_2 (m) =	87.5	
L_1 (m) =	100	<= 200m
S_1 (m/m) =	0.104	

Average Slope [WATERCOURSE]:

$H_{0.1}$ (m) =	69.1
$H_{0.85}$ (m) =	74.3
L_2 (m) =	128
S_2 (m/m) =	0.054

Table 3C.5 - Ft adjustment factors

Return period (years)	2	5	10	20	50	100
Adjustment factor (Ft) for steep and impermeable catchments	0.75	0.8	0.85	0.9	0.95	1
Adjustment factor (Ft) for flat and permeable catchments	0.5	0.55	0.6	0.67	0.83	1

Point Rainfall

Duration			Return Period 2	5	10	20	50	100	200
Duration	5	Minutes	9.8	14.8	18.6	22.8	29	34.4	40.5
	10	Minutes	15.5	23.3	29.3	35.9	45.8	54.3	63.9
	15	Minutes	20.3	30.4	38.3	46.9	59.8	70.9	83.5
	30	Minutes	27.6	41.4	52.2	63.9	81.5	96.7	113.7
	45	Minutes	33.1	49.6	62.5	76.6	97.7	115.9	136.3
	1	Hours	37.7	56.5	71.1	87.1	111.1	131.8	155
	1.5	Hours	45.1	67.7	85.2	104.4	133.1	158	185.8
	2	Hours	51.3	76.9	96.9	118.8	151.4	179.6	211.3
	4	Hours	63.1	94.6	119.2	146.1	186.2	220.9	259.9
	6	Hours	71.3	106.8	134.6	164.9	210.2	249.3	293.3
	8	Hours	77.7	116.4	146.6	179.6	229	271.7	319.6
	10	Hours	83	124.4	156.7	192	244.8	290.4	341.7
	12	Hours	87.6	131.4	165.5	202.7	258.5	306.6	360.8
	16	Hours	95.5	143.1	180.3	220.9	281.7	334.1	393.1
	20	Hours	102.1	153	192.7	236.1	301.1	357.1	420.2
	24	Hours	107.8	161.6	203.5	249.3	317.9	377.1	443.7
	1	Days	89.7	134.4	169.4	207.5	264.5	313.8	369.2
	2	Days	113.2	169.6	213.7	261.8	333.8	396	465.9
	3	Days	129.7	194.3	244.8	300	382.4	453.7	533.7
	4	Days	136.6	204.7	257.9	316	402.8	477.9	562.2
	5	Days	142.2	213.1	268.5	329	419.4	497.6	585.4
	6	Days	147	220.3	277.5	340	433.5	514.2	605
	7	Days	151.1	226.5	285.4	349.6	445.7	528.8	622.1

Tc:									
		x1=	15	15	15	15	15	15	15
0.295	hrs	x2=	30	30	30	30	30	30	30
17.670	min	y1=	20.3	30.4	38.3	46.9	59.8	70.9	83.5
		y2=	27.6	41.4	52.2	63.9	81.5	96.7	113.7
		P_T =	21.600	32.358	40.775	49.927	63.663	75.493	88.877

* * Obtain rainfall figures from *Design Rainfall for South Africa software developed by Prof JC Smithers (2002)* - Note that the figures relate to Tc and are point rainfalls which must be converted to an intensity in mm/hr

Calculations

Project:	TIFFANYS EXPANSION	No.	17134
Design Element:	TIFFANYS POST-DEVELOPMENT HYDROLOGY		Page 1 of 2

Revision	A	B	C	D	E	Designed		Checked	
Initials	JS					Initials	Date	Initials	Date
Date	25.10.2022					JS	25.10.2022	TY	25.10.2022

RED = Check input **BLUE** = Auto Calculates

Description of catchment:	TIFFANYS POST-DEVELOPMENT
River detail:	-
Calculated by:	J SPOONER

PHYSICAL CHARACTERISTICS

Size of catchment (A)	0.0552	km^2	Rainfall Region	Coastal	
Longest Watercourse (L)	0.228	km	Area distribution factors		
Dolomite area (D%)	0	%	Rural (α)	Urban (β)	Lakes (γ)
Mean annual rainfall (MAR)	1037	mm	0.45	0.55	0
Catchment type (Effects Ft factor)	Flat & Permeable				
r (based on Table 3C.3) =	0.201				

RURAL (C1)				URBAN (C2)			
Surface Slope	**%**	**Factor**	C_s	**Description**	**%**	**Factor**	C_2
Vleis and pans (<3%)	3.5	0.05	0.002	**Lawns**			
Flat areas (3-10%)	51.2	0.11	0.056	Sandy, flat (<2%)	0	0.1	0
Hilly (10-30%)	39.1	0.2	0.078	Sandy, steep (>7%)	0	0.2	0
Steep areas (>30%)	6.3	0.3	0.019	Heavy soil, flat (<2%)	0	0.17	0
Total	100	-	0.155	Heavy soil, steep (>7%)	0	0.35	0
Permeability	%	Factor	C_p	**Residential areas**			
Very permeable	80	0.05	0.04	Houses	0	0.5	0
Permeable	20	0.1	0.02	Flats	0	0.7	0
Semi-permeable	0	0.2	0	**Industry**			
Impermeable	0	0.3	0	Light industry	0	0.8	0
Total	100	-	0.06	Heavy industry	0	0.9	0
Vegetation	%	Factor	C_v	**Business**			
Thick bush and plantation	20	0.05	0.01	City centre	0	0.95	0
Light bush and farm lands	20	0.15	0.03	Suburban	0	0.7	0
Grasslands	60	0.25	0.15	Streets	100	0.95	0.95
No vegetation	0	0.3	0	Maximum flood	0	1	0
Total	100	-	0.190	Total (C_2)	100	-	0.95

TIME OF CONCENTRATION (Tc)

Overland flow (Tc1)		Defined watercourse (Tc2)		*Minimum Tc values (eThekwini Guidelines):*	
$T_{c1} = 0.604\left(\frac{rL_1}{\sqrt{S_1}}\right)^{0.467}$		$T_{c2} = \left(\frac{0,87L_2^2}{1000S_2}\right)^{0,385}$		Primary Development:	Commercial or Industrial
				Min Tc =	10 minutes
				Calculated Tc	
L1 (km) =	0.1	L2 (km) =	0.128	Calc Tc = T_{c1} + T_{c2} =	12.416 minutes
S1 (m/m) =	0.104	S2 (m/m) =	0.054	*Final Tc*	
T_{c1} (min) =	9.905	T_{c2} (min) =	2.511	Tc =	0.207 hours

RUNOFF COEFFICIENT

Return Period (years), T	**2**	**5**	**10**	**20**	**50**	**100**	**Max**
Run-off coefficient, C_1 (C1 =Cs + Cp + Cv)	0.405	0.405	0.405	0.405	0.405	0.405	0.755
Adjusted for dolomitic areas, C_{1D}	0.405	0.405	0.405	0.405	0.405	0.405	0.755
Adjusted factor for initial saturation, Ft	0.50	0.55	0.60	0.67	0.83	1.00	1.00
Adjusted run-off coefficient, C_{1T} (=C1D x Ft)	0.202	0.223	0.243	0.271	0.336	0.405	0.755
Combined run-off coefficient C_T	0.615	0.624	0.633	0.646	0.675	0.706	0.863

RAINFALL

Return Period (years), T	**2**	**5**	**10**	**20**	**50**	**100**	**Max**
Point rainfall (mm), P_T **	17.82	26.73	33.65	41.22	52.56	62.32	73.37
Point intensity (mm/hour), P_{iT}(=P_T/T_C)	86.11	129.18	162.61	199.17	254.02	301.17	354.56
Area reduction factor (%), ARF_T (7)	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Average intensity (mm/hour), I_T (=PiT x ARF)	86.11	129.18	162.61	199.17	254.02	301.17	354.56
Peak flow (m^3/s),	0.812	1.236	1.578	1.972	2.628	3.258	4.689

Calculations

SiVEST

Project:	TIFFANYS EXPANSION					No.	17134	
Design Element:	TIFFANYS POST-DEVELOPMENT HYDROLOGY						Page 2 of 2	
Revision	A	B	C	D	E	Designed	Checked	
Initials	JS					Initials	Date	Initials	Date
Date	25.10.2022					JS	25.10.2022	TY	25.10.2022

RED = Check input **BLUE** = Auto Calculates

Table 3C.3 - Roughness Coefficient for Overland Flow

Surface Description	r	% Area	r*A
Paved areas	0.02	55%	0.011
Clean compacted soil, no stones	0.1	0%	0
Sparse grass over fairly rough surface	0.3	30%	0.09
Medium grass cover	0.4	5%	0.02
Thick grass cover	0.8	10%	0.08
		100%	0.201

Average Slope [OVERLAND]:

H_1 (m) =	77.1	
H_2 (m) =	87.5	
L_1 (m) =	100	<= 200m
S_1 (m/m) =	0.104	

Average Slope [WATERCOURSE]:

$H_{0.1}$ (m) =	69.1
$H_{0.85}$ (m) =	74.3
L_2 (m) =	128
S_2 (m/m) =	0.054

Table 3C.5 - Ft adjustment factors

Return period (years)	2	5	10	20	50	100
Adjustment factor (Ft) for steep and impermeable catchments	0.75	0.8	0.85	0.9	0.95	1
Adjustment factor (Ft) for flat and permeable catchments	0.5	0.55	0.6	0.67	0.83	1

Point Rainfall

Duration			Return Period 2	5	10	20	50	100	200
	5	Minutes	9.8	14.8	18.6	22.8	29	34.4	40.5
	10	Minutes	15.5	23.3	29.3	35.9	45.8	54.3	63.9
	15	Minutes	20.3	30.4	38.3	46.9	59.8	70.9	83.5
	30	Minutes	27.6	41.4	52.2	63.9	81.5	96.7	113.7
	45	Minutes	33.1	49.6	62.5	76.6	97.7	115.9	136.3
	1	Hours	37.7	56.5	71.1	87.1	111.1	131.8	155
	1.5	Hours	45.1	67.7	85.2	104.4	133.1	158	185.8
	2	Hours	51.3	76.9	96.9	118.8	151.4	179.6	211.3
	4	Hours	63.1	94.6	119.2	146.1	186.2	220.9	259.9
	6	Hours	71.3	106.8	134.6	164.9	210.2	249.3	293.3
	8	Hours	77.7	116.4	146.6	179.6	229	271.7	319.6
	10	Hours	83	124.4	156.7	192	244.8	290.4	341.7
	12	Hours	87.6	131.4	165.5	202.7	258.5	306.6	360.8
	16	Hours	95.5	143.1	180.3	220.9	281.7	334.1	393.1
	20	Hours	102.1	153	192.7	236.1	301.1	357.1	420.2
	24	Hours	107.8	161.6	203.5	249.3	317.9	377.1	443.7
	1	Days	89.7	134.4	169.4	207.5	264.5	313.8	369.2
	2	Days	113.2	169.6	213.7	261.8	333.8	396	465.9
	3	Days	129.7	194.3	244.8	300	382.4	453.7	533.7
	4	Days	136.6	204.7	257.9	316	402.8	477.9	562.2
	5	Days	142.2	213.1	268.5	329	419.4	497.6	585.4
	6	Days	147	220.3	277.5	340	433.5	514.2	605
	7	Days	151.1	226.5	285.4	349.6	445.7	528.8	622.1

Tc:									
		x1=	10	10	10	10	10	10	10
0.207	hrs	x2=	15	15	15	15	15	15	15
12.416	min	y1=	15.5	23.3	29.3	35.9	45.8	54.3	63.9
		y2=	20.3	30.4	38.3	46.9	59.8	70.9	83.5
		P_T =	17.819	26.731	33.649	41.215	52.565	62.321	73.371

* * Obtain rainfall figures from *Design Rainfall for South Africa software developed by Prof JC Smithers (2002)* - Note that the figures relate to Tc and are point rainfalls which must be converted to an intensity in mm/hr

SiVEST SA (PTY) LTD

Appendix C:

Management of Surface Water During Construction

GUIDELINE DOCUMENT:

MANAGEMENT OF STORMWATER RUN-OFF

DURING CONSTRUCTION

1. GENERAL

1.1 This document sets out guidelines to be followed, as appropriate to specific sites, in order to comply with:

- The Water Act (No 36 of 1998)
- eThekwini Municipality stormwater management policy
- Documented best management practice
- Guidelines for Human Settlement Panning and Design ("Red Book")

1.2 Proper consideration of drainage during construction can frequently prevent costly delays and future failures. Delays can occur not only because of damaged or washed-out facilities, but because of shut-down resulting from environmental considerations.

1.3 Installation of the stormwater management system shall commence immediately on completion of clearing and commencement of earthworks.

2. OBJECTIVES

2.1 Implementation of mitigation measures to minimize negative environmental impacts resulting from uncontrolled run-off from the construction site.

2.2 Retention / detention / attenuation of run-off in order to prevent soil erosion on-site and increased sediment loads on downstream water-courses resulting therefrom.

2.3 Minimize pollutant loads e.g . cement, oil, diesel, paper, plastic, etc.

2.4 Prevent inundation of or damage to adjacent or downstream properties or natural environments.

2.5 Protect downstream water courses against erosion.

2.6 Groundwater recharge.

3. PLANNING

3.1 Efforts to control delays or damages arising from construction drainage must begin in the planning stage and carry through to design and construction. This document has been developed to provide a guide, but it is impractical to prescribe fixed rules to cover all eventualities.

3.2 The recommendations and procedural approaches outlined herein need be adopted as they pertain to the requirements of and conditions on a specific site, in order for the Contractor to formulate an effective plan for management of stormwater runoff during construction activities. Protective measures are the Contractor's responsibility, but cannot generally be reduced to biddable contract items.

3.3 Adequate and constant supervision and monitoring of the stormwater management plan shall be provided by the Contractor.

continued Page 2/ 4. Site Topography...

4 SITE TOPOGRAPHY AND GEOLOGY

4.1 A geotechnical evaluation of the site will inform the degree of management required e.g. greater protective measures will be necessary on steep sites underlain by cohesionless sands.

5 NATURAL ENVIRONMENT ADJOINING OR ON SITE

5.1 The boundary of any natural conservancy areas adjacent to or on the construction site (including non-user servitudes) shall be accurately demarcated and fenced so as to prevent any access from the construction area.

5.2 Temporary fences shall consist of gum-pole support posts (1,5m above ground), with stays as necessary, to which shall be secured three straining wires (top, middle and bottom of posts) for fixing of hessian or shade-cloth, which shall be buried 300mm into ground at the base.

6 POTENTIAL POLLUTANT SOURCES

The following areas and activities require particular attention with regard to the potential negative impacts of uncontrolled stormwater runoff therefrom.

6.1 Construction Camp

- The area allocated should be level and away from watercourses.
- An impervious hardened surface should be constructed on which equipment or hazardous materials (e.g. cement, lime, oil and fuel) can be stored / handled / used. The surface should be graded to the centre. So that any spillage may be collected and satisfactorily disposed of.
- Spillage from taps and possible pollution around ablution facilities shall be controlled.

6.2 Stockpile / Spoil Area

The Contractor shall control the erosion of stockpiles.

- Exposed material in temporary stockpiles should, wherever possible be stored in flat-topped mounds with sides not exceeding 1:2 slope.
- Stockpiling of soil or any other materials shall not be allowed near a watercourse.
- Any surplus or material unsuitable for backfill which is to remain on site for landscaping shall as early as practicable be placed in its permanent position and be topsoiled and vegetated.

6.3 Trench Excavation

- Trenches shall be backfilled as soon as practicable and trenching shall not proceed unreasonably far ahead of pipe laying, especially on steeper gradients.
- Temporary mounds or sand bags shall be placed along the route of backfilled trenches to prevent wash-out.

6.4 Dust

- Precautions shall be taken to prevent contamination of areas exposed to runoff from any form of easily transported material e.g. cement, lime, brick- and saw - dust.
- Soil to be stored on stockpiles for lengthy periods shall be covered to prevent wind erosion and resultant dust.

continued Page 3/ 6.4 Dust ...

6.5 Mixing of Concrete and Mortar

- Cement mixing should take place on impermeable liners.
- Cleaning of cement mixing and handling equipment shall only be done using proper cleaning trays.

7 PREVENTATIVE MEASURES- MANAGEMENT TOOLS

7.1 General

- Run-off. Control of runoff problems during construction can be costly. Consideration of the following items will aid in maintaining satisfactory drainage during the construction period.

- Natural drainage. Maximum use shall be made of existing ditches and drainage features. Where possible, grading operations should proceed downhill, both for economic grading and to use natural drainage to the greatest extent.

- Temporary drainage. Temporary provisions will be required to facilitate construction drainage. A particular effort should be made to drain pavement subgrade excavations and base-courses to prevent detrimental saturation. Careful consideration needs be given to the drainage of all construction roads, equipment areas, borrow pits, and waste areas, where open excavation can lead to excessive erosion or discharge of turbid water to local streams.

- Final facilities. Installation of final storm-drain facilities and backfilling thereof should be planned and timed to render maximum use during the construction period. Random excavation should be held to a minimum and finished surfaces should, wherever practical, be sodded or seeded immediately.

7.2 Soil Erosion Control Measures

7.2.1 General

- The intent at each stage of site earthworks, as individually considered hereunder, is to prevent accumulation of runoff, reduce flow depths and velocities, promote deposition of silt in stilling basins and dissipate energy at discharge points.
- Wherever possible, permanent features of a stormwater management system should be installed early and be available to assist in control during construction.

7.2.2 Site Clearance

- Vegetation should not be stripped over the entire site at commencement, if the construction programme could accommodate phased clearance.
- If levels are not to be altered over portions of a site, those areas should remain uncleared of in-situ vegetation until closer to the time of final landscaping or provision of alternative vegetal cover.
- Consideration should be given to using cleared vegetation as a temporary brush mattress for erosion control or chipping it for use in mulching or being wrapped in shade-cloth to form "roll" berms.

continued Page 4/ 7.2.3 Topsoil ...

7.2.3 Topsoil Strip

- This exercise should be carried out over limited areas on extensive sites and only commence as work progresses to new areas.
- The period between completion of topsoil removal and commencement of earthworks should be kept to the minimum.

7.2.4 Earthworks

The construction site is most vulnerable to soil erosion during the time that it has been cleared and earthworks commenced, but the stormwater management system has not been provided in its entirety.

1. Cut Faces

- Where significant catchments occur above cut faces temporary or permanent berms or channels (depending on final provisions) should be constructed at the top of these proposed slopes to intercept flows and divert them to managed discharge points.
- Should such cut faces be permanent features they should shortly after excavation be mulched or topsoiled and vegetated with the intended future ground cover.
- Temporary cut faces should be left with a "ripped" finish and protected by mulching or mulch "roll" berms pegged to the slope.
- Hydro-seeding may be an option if the slope is to remain exposed for a lengthy period during construction.

2. Fill Embankments

- As soon as practical after the final height has been reached, any "overfill" should be removed and the embankment shaped to final design slope with a "face" compacted to the specified density.
- Embankments are generally permanent features and should, therefore, as soon as practicable be covered with the finally intended vegetation.
- Where grassing is specified an option may be to strip-turf at 1,0m intervals with hand-planting between the filter and scour prevention barriers provided by the established turf.
- Such slopes are very often covered in builders rubble / waste during construction and this practice should be strictly avoided as surface runoff between such hard material encourages runnells and resultant erosion.
- Toes of extensive fill embankments should be "fenced" with 75 dia. gumpoles, protruding 0,5m above ground at 2,0m centres with hessian, shadecloth or geofabric attached and buried 300mm below ground surface, to act as silt-traps.

3. Cut / Fill Terraces

- Major damage very often results from accumulation of runoff on extensive terraced areas discharging in an uncontrolled manner, particularly down fill embankments.
- Recommended measures to prevent such occurrence include the following:

continued Page 5/ b) Cut material ...

a) No cut or fill slopes of a temporary necessity during construction, should be directed to the crest of fills.

b) Cut material should be moved continuously from a "level" platform to "level" compacted fill layers, such layer always being ±0,5m high CV 2,5m wide at the fill edge of the terrace. A berm which is continually being raised during construction will thus be achieved.

c) On completion of terraces the surfaces should be temporarily shaped to fall toward the cut side for narrow terraces and be dished to central points on more extensive and wider platforms.

d) Stilling basins / sumps should temporarily be constructed ±3,0m x 3,0 x 1,0m deep at the centre, with sloping reno-mattress sides laid on geofabric. 150dia. UPVC piping (with a vertical section of pipe extending 0,5m above the centre of the sump) should drain inflow to the toe of embankments to controlled discharge points, or where possible into a component of the final drainage measure which it has previously been possible to construct.

e) Where a temporary berm has unavoidably to be provided at the top of completed embankments of height greater than 4,0m a temporary continuous berm at the top of the embankment, formed of bales of straw placed on geofabric turned up and secured with wire to the outer-face of the bale, may be considered. Suitable outlet provisions (refer 7.2.4.3.d) should be provided at intervals along the inner (impoundment) face of the berm.

4. Stockpiles

- Protection against water erosion and wind-blown dust needs to be considered:
  - Keep surface of smaller piles of cohesionless material watered during periods of strong wind.
  - Cover surface with a brush mattress derived from cleared vegetation.
  - Form flat topped mounds with sides sloping at 1:2 which should be temporarily protected (refer 7.2.4.1).
  - For stockpiles that are to remain unused for lengthy periods peg hessian covering to banked edges.

5. Reinstatement Of Vegetation

- Areas of site that are to be permanently landscaped and receive vegetal covering, should be reinstated as soon as possible, wherever practical and be protected during the balance of the construction period.

6. Gutters And Downpipes

- These provisions should be completed as soon as possible after completion of roofs (especially pitched) and be linked to the permanent stormwater drainage installation.

continued Page 6/ 8. Controlled ...

7. Attenuation Basins

- Generally such provision should, if possible, be completed ahead of building completion to allow for usage as a stilling basin and silt trap. A temporary outlet pipe at a higher level than the final should be investigated. Removal and satisfactory disposal of silt will have to be undertaken prior to final commissioning.

8. Controlled Discharge

- Accumulated stormwater flows will have to be directed to municipal drains or adjacent natural water-courses at one or more points and at a rate not to exceed that approved in the stormwater management plan for the completed development (generally 1:10 year pre-development runoff).
- During construction silt loads will be unavoidably higher than finally anticipated and all reasonable attempts need be made to reduce such load prior to discharge.
- Routing flows through the final attenuation reservoir will assist, but if that is impractical, impoundment may be necessary in temporary stilling basins, prior to discharge to municipal stormwater drains.
- Where discharge is to a watercourse the final design for such facility should be constructed prior to commencement of earthworks on site and all possible temporary stormwater runoff provisions (collecting flows from terraces or the edge of embankments) linked thereto.
- Final discharge points will have been designed to dissipate water energy before release to natural watercourses. Substantial berms of coarse river-sand around such points could assist in removing silt from during-construction runoff.

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