MANDALAY

ERF 3733, MANDALAY

STORMWATER MANAGEMENT PLAN

VERSION 00

13 FEBRUARY 2026

Developer	Civil Engineers	Stormwater Management Consultant
asrin property developers	edifice CONSULTING ENGINEERS	uds africa
Unit 66, Millenium Business Park 19 Edison Way Century City Cape Town	42 Havenga Street Bo-Oakdale Bellville 7530	11 Elektron Road Techno Park Stellenbosch 7600

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Annexures

STORMWATER MANAGEMENT PLAN FOR THE EXISTING GREENFIELD SITE AT ERF 3733, MANDALAY

1. Background

UDS Africa was appointed to compile a stormwater management plan for the greenfield site at The Erf 3733, Mandalay. For the purposes of this report Erf 3733, Mandalay will be referred to as the site.

The scope of our appointment includes the compilation of a stormwater management plan for the planned residential development. Our mandate includes compliance with the latest City of Cape Town by-laws in order to meet the requirements regarding the quality and quantity treatment volumes of the stormwater run-off generated by this site.

2. Locality

The site covers an area of 57 500m² (5.75ha) and is undeveloped. The site will be developed as a residential development with apartment buildings.

The site is situated at approximately 31m above sea level. The central position of the development is at Lat: 34° 1'12.99"S and Long: 18°37'27.97"E.

Figure 1: Locality map

3. The development

The proposed development will be categorized as a greenfield development and was allocated for this residential development with apartment blocks. From the topographical survey that has been conducted, the site has a natural flat slope of <1% from the west towards the east. The site is currently covered with sand and a small amount of vegetation, mainly grass.

The site does not form part of the regional stormwater management system. The site was not included in the regional stormwater management plan, therefore on-site stormwater management needs to be done for this development. This stormwater management plan is applicable to the development on Erf 3733.

Currently a stormwater box culvert traverses the site, entering at the northern boundary as a 900 x 750mm (blue) box culvert flowing towards the southeastern side, existing as a 1200 x 900mm box culvert (blue). See the figure below indicating the existing pipeline route, represented by the blue line. The green line represents the future reroute route.

Figure 2: Existing stormwater pipe and reroute route

A stormwater attenuation pond and bio-swale system will be ideal for this development. The stormwater will be treated by a combination of a pond and swale system.

4. Mean annual precipitation

The City of Cape Town's Design Rainfall Depth Grid (that accounts for the additional 15% climate change) data has been used for all stormwater runoff, attenuation, and treatment calculations.
For further hydrological calculations a MAP of 534mm is used. For this report The City of Cape Town's Design Rainfall Depth Grid data has been used in conjunction with the Rational method.

STATION FID	**LAT**	**LONG**	**MAP (mm)**
8344 – 8349	34.016 (Decimal) 34°1' (D M S)	18.616 (Decimal) 18°37' (D M S)	534

RETURN PERIOD	EVENT DURATION AND RAINFALL					
	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS
5	5.175	6.900	8.165	9.545	11.385	12.880
15	9.315	12.420	14.720	17.135	20.585	23.345
30	12.420	16.560	19.665	22.885	27.370	31.050
60	16.560	22.195	26.335	30.590	36.570	41.515
120	22.080	29.670	35.075	40.825	48.875	55.430
360	31.050	41.630	49.450	57.500	68.770	77.970
720	38.525	51.750	61.295	71.300	85.330	96.715
1440	47.840	64.170	76.015	88.435	105.800	120.060

Rainfall intensities for the 0.5 year RI; 24 h storm event and 1 year RI; 24 h storm event was calculated using the following formula:

$$i = \frac{(3.4 + 0.023\ MAP)\ R^{0.3}}{(0.2 + td)^{0.75}}$$

Where i = rainfall intensity; R = Recurrence Interval; td = storm duration in hours

5. Hydrology

5.1 Calculation method

The catchment area is small, therefore the Rational Method is deemed to be a suitable method to calculate the flood peaks.

		RETURN PERIOD IN YEARS						
INFLOW VOLUME = (C)(i)(A)(D)/1000		**1:1@24H** Extended detention	**1:2**	**1:5**	**1:10** Protect downstream system	**1:20**	**1:50** Protect Floodplain Developments	**1:100**
		PRE DEVELOPMENT						
PEAK FLOW	m³/s		0.037	0.055	0.071	0.093	0.137	0.187
	l/s		37.447	55.029	71.266	92.517	136.949	187.233
INFLOW VOLUME	m³		115.110	169.158	219.069	284.395	420.980	
		POST DEVELOPMENT						
PEAK FLOW	m³/s		0.356	0.474	0.562	0.654	0.786	0.892
	l/s		355.801	474.401	562.254	654.498	786.276	891.699
INFLOW VOLUME	m³		318.845	425.127	503.854	586.517	704.608	
		DIFFERENCE BETWEEN PRE- AND POST DEVELOPMENT LEVEL						
VOLUME	m³	3.94	203.735	255.968	284.784	302.123	283.628	

Refer to Annexure C for the pre- and post-development run-off calculations.

5.5 Flood lines

The site is not within the 1:100 year flood line level.

5.6 Geotechnical investigation

The material on site consists mainly of “made ground” and “calcrete”. Groundwater at this site was encountered at a depth of 1.7m – 2.2m in these test pits during the investigation. Refer to Annexure D for the geotechnical report.

6. Best management practice

In order to reduce impacts of urban stormwater systems on receiving waters, all stormwater management systems shall be planned and designed in accordance with best practice criteria and guidelines laid down by council, to support water sensitive urban design principles and the following specific sustainable urban drainage system objectives:

The main Sustainable Urban Drainage System objectives are to:
- Improve the quality of the runoff;
- Control the quantity and rate of runoff, and
- Encourage natural groundwater recharge.

The City of Cape Town Management of Stormwater Impact Policy of 2009 states that stormwater management is required for sites larger than 4 000m² in order to:

- Improve the quality of stormwater runoff for the ½ year RI, 24-hour design storm. This requires the 80% reduction of Suspended Solids and 45% reduction of Total Phosphorus.
- Control the quantity and the rate of stormwater runoff by way of:
  - 24-hour extended detention of the 1-year RI, 24-hour storm event,
  - Reduction of the peak flow for up to the 10-year RI storm to pre-development levels,
  - Reduction of the peak flow for up to the 50-year RI storm to existing development levels,
  - Encourage groundwater recharge where possible.

The BMP (Best Management Practice) proposed is to improve the quality and control of the quantity of the stormwater runoff. As such, the BMP (Best Management Practice) proposed will improve the quality and control of the quantity of the stormwater run-off.

6.1 Protect the Stability of Downstream Channels

In order to protect the stability of the downstream channels, 24 hour extended detention of the 1 year RI; 24 h storm event is required. However, according to the Georgia Stormwater Management Manual channel protection is only required for post-development discharges more than 0.0566m³/s. In this case the post-development discharge is 0.014m³/s which is less than the specified minimum of 0.0566m³/s and therefore channel protection is not required.

6.2 Protect Downstream Properties

The downstream properties must be protected against frequent nuisance floods by reducing the post-developed peak flows with recurrence interval up to 10 years to the undeveloped levels. See the summary table in section 5 (Hydrology).

6.3 Protect Floodplain developments

Floodplain developments are to be protected by limiting the post-development run-offs to that of the existing development run-offs for storms with a recurrence interval of up to 50 years. See the summary table in section 5 (Hydrology).

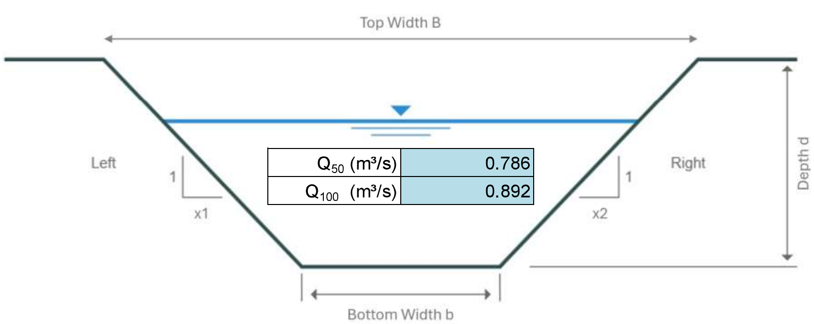
6.4 Water Quality

The run-off from the 0.5 year RI; 24 h storm event must be subjected to treatment to ensure the required reduction in suspended solids and total phosphorus levels. The peak flow for the 0.5 RI; 24 h storm event is 0.005m³/s.
The water quality volume to be treated is calculated by the following formula:
WQV = P x C x A x 10 (Red Book 2019)

P = RAINFALL DEPTH (mm) (TYPICALLY 25mm)	25.4
C = RUN-OFF COEFFICIENT	0.595
A = SITE AREA (ha)	5.750
WQV = WATER QUALITY VOLUME (m³)	869.422

The total treatment volume required for this site is 1349.956m³ (Water quality 869.422m³ + Floodplain Developments 480.534m³).

An overland escape route must be provided for floods greater than the 1:50 years storm event (1:100 year). A shallow lined channel is proposed, designed to safely discharge the peak runoff. This channel must be designed to safely discharge the peak runoff into Stinkwood Road. This overland channel must be formed kerb of the development to allow the overland flow to discharge through the main entrance road of the development.
This overland escape route for this development will be indicated by the civil engineer on the stormwater drawing. The stormwater from the surrounding properties does not contribute to this site.



Width b	3.000	m
Depth d	0.200	m
x1	4	m
x2	4	m
Width B	4.600	m

Slope So	1	100	1	%

The post development site will consist of two catchment areas. Catchment area A will be the greater portion of the site, with an area of 46 850m² (81.5%). Catchment area B will be the smaller eastern portion of the site, with an area of 10 650m² (18.5%).

See the figure below indicating the post development catchment areas.

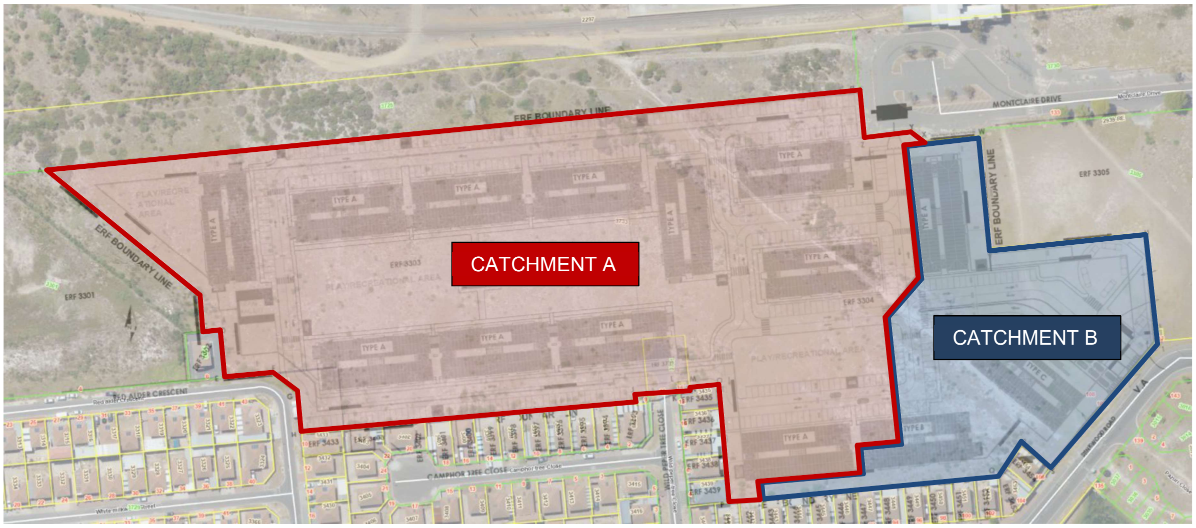


Figure 3: Site post development catchment areas

Catchment areas detail:

Catchment	Area (m²)	Area Percentage (%)	Stormwater management syster
Catchment A	46 850	81.5	Attenuation Pond
Catchment B	10 650	18.5	Bio-swale

6.4.1 Attenuation Pond

The attenuation pond will collect the stormwater of catchments area A from the roads and overland flow. The attenuation pond will be the main attenuation facility. The following parameters must be used to size the attenuation pond.

	OUTSIDE DIMENSION S OF POND				
	LENGTH (m)	WIDTH (m)	DEPTH (m)	AREA (m²)	VOLUME (m3)
ATTENUATION POND (SIDES 1:3)	63.0	17.000	1.5	1071	1096.875
				TOTAL	**1096.875**

The pond needs to have an outer edge footprint area of 1071m², with the embankments sloped towards the inside at 1:3.

The following table summarizes the flows and water depths for the stormwater pond based on the above-mentioned dimensions:

	TREATMENT		ATTENUATION						
ATTENUATION POND									
RECURRENCY INTERVAL	0.5 YEAR 24H EVENT	1 YEAR 24H EVENT	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS	QUALITY
PEAK RUN-OFFS (m^3/s)	0.012	0.014	0.356	0.474	0.562	0.654	0.786	0.892	
Tc (min)	14.936	14.936	14.936	14.936	14.936	14.936	14.936	14.936	
VOLUME (m^3)	10.446	12.246	318.845	425.127	503.854	586.517	704.608	799.081	1099.920
H (m)	0.014	0.017	0.436	0.581	0.689	0.802	0.964		1.504
BOTTOM LEVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000		0.000
WATER DEPTH OF ATTENUATION POND (m)	0.014	0.017	0.436	0.581	0.689	0.802	0.964		1.504
WATER DEPTH OF ATTENUATION POND (mm)	14	17	436	581	689	802	964		1504

Orifice sizing for attenuation pond to release pre-development flow

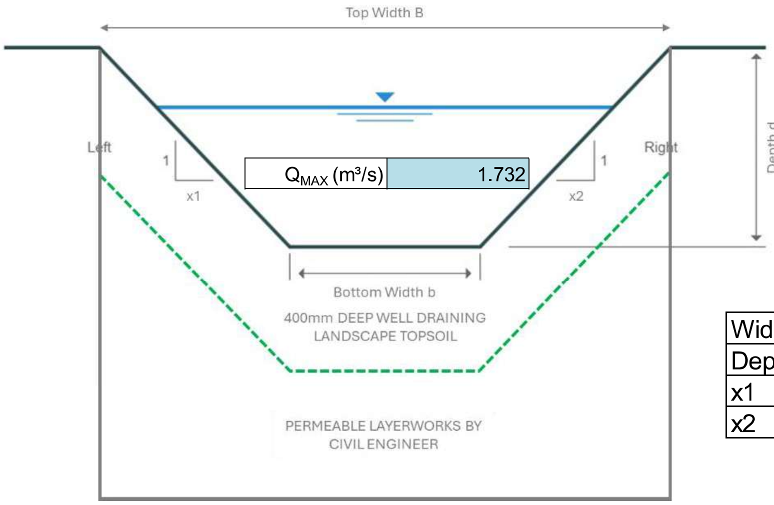
		PRE (l/s)	PRE (m^3)	POST (l/s)	POST (m^3)		PRE WATER DEPTH (FACILITY IN THIS CATCHMENT AREA)	POST WATER DEPTH (FACILITY IN THIS CATCHMENT AREA)	ORIFICE BOTTOM ELEVATION (m)	ORIFICE TOP ELEVATION (m)	ORIFICE TOP ELEVATION (m)	WIDTH OF ORIFICE (m) (0.2 wide x0.4m high)	OUTFLOW (THROUGH OUTLET ORIFICE) (m^3/s)
RETURN PERIOD IN YEARS	1:2	30.511	51.660	289.901	180.501		0.111	0.355	0.111	0.411	0.331	0.15	0.032
	1:5	44.837	76.196	386.534	252.680		0.163	0.474			0.290	0.15	0.045
	1:10	58.066	100.856	458.114	310.018		0.211	0.561			0.385	0.15	0.058
	1:20	75.381	134.633	533.274	373.769		0.274	0.654			0.550	0.15	0.076
	1:50	111.584	210.750	640.644	471.144		0.406	0.785			1.020	0.15	0.112
	1:100	152.554											

6.4.2 Bio-swale

The attenuation pond will collect the stormwater of catchments area B from the roads and overland flow. The following parameters must be used to size the bio-swale.

60m long swale

Q_{50} (m^3/s)	0.146
Q_{100} (m^3/s)	0.165

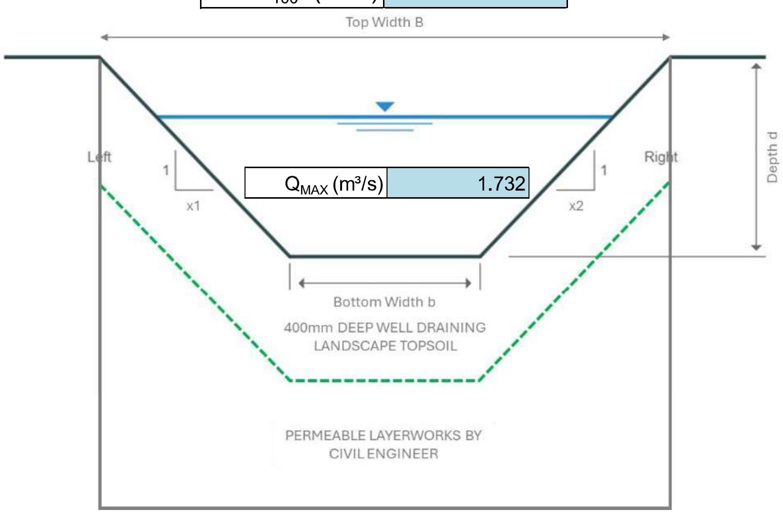


Width b	2.000	m
Depth d	0.400	m
x1	3	m
x2	3	m

Slope So	1	200	0.5	%

35m long swale

Q_{50} (m^3/s)	0.146
Q_{100} (m^3/s)	0.165



Width b	5.000	m
Depth d	0.400	m
x1	3	m
x2	3	m
Width B	7.400	m

Slope So	1	200	0.5	%

	LENGTH (m)	WIDTH (m)	DEPTH (m)	PLAN AREA (m^2)	VOLUME (m3)	VOLUME - LAYERWORKS (m^3)
BELOW GROUND (PERMEABLE LAYER)	120.0	2.0	0.700	240	168.000	50.400
TRAPZOIDAL ABOVE GROUND (SIDES 1:3)	120.0	2.0	0.400		96.000	96.000
BELOW GROUND (PERMEABLE LAYER)	35.0	5.0	0.700	175	122.500	36.750
TRAPZOIDAL ABOVE GROUND (SIDES 1:3)	35.0	5.0	0.400		70.000	70.000
					TOTAL	**253.150**

The bio-swales will need to have a plan view area of at least 415m², with a trapezoidal shaped channel which must be at least 0.4m deep, sides 1:3. The permeable layerworks below ground must be at least 0.7m deep.

See the table below, summarizing the water depths within the bio-swales, based on the above parameters.

	TREATMENT		ATTENUATION						
BIO-SWALE									
RECURRENCY INTERVAL	0.5 YEAR 24H EVENT	1 YEAR 24H EVENT	2 YEARS	5 YEARS	10 YEARS	20 YEARS	50 YEARS	100 YEARS	QUALITY
PEAK RUN-OFFS (m^3/s)	0.002	0.003	0.066	0.088	0.104	0.121	0.146	0.165	
Tc (min)	14.936	14.936	14.936	14.936	14.936	14.936	14.936	14.936	
VOLUME (m^3)	1.935	2.268	59.056	78.741	93.322	108.633	130.506	148.004	250.035
H (m)	0.005	0.005	0.142	0.190	0.225	0.262	0.314	0.357	0.602
BOTTOM LEVEL	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
WATER DEPTH WITH PERMEABLE LAYERWORKS (m)	0.011	0.013	0.332	0.443	0.525	0.611	0.734 (0.7+0.034)		0.890 (0.7+0.190)
WATER DEPTH WITH PERMEABLE LAYERWORKS (mm)	10.878	12.753	332.040	442.720	524.705	610.789	733.767		890.000

Orifice sizing for bio-swales to release pre-development flow

		PRE (l/s)	PRE (m^3)	POST (l/s)	POST (m^3)		PRE WATER DEPTH (FACILITY IN THIS CATCHMENT AREA)	POST WATER DEPTH (FACILITY IN THIS CATCHMENT AREA)	ORIFICE BOTTOM ELEVATION (m)	ORIFICE TOP ELEVATION (m)	ORIFICE TOP ELEVATION (m)	WIDTH OF ORIFICE (m) (0.2 wide x0.4m high)	OUTFLOW (THROUGH OUTLET ORIFICE) (m^3/s)
RETURN PERIOD IN YEARS	1:2	5.651	1.695	53.695	16.108		0.036	0.338	0.036	0.136	0.136	0.1	0.006
	1:5	8.305	2.491	71.593	21.478		0.052	0.451			0.150	0.1	0.008
	1:10	10.755	3.226	84.851	25.455		0.068	0.534			0.190	0.1	0.010
	1:20	13.962	4.189	98.772	29.631		0.088	0.622			0.320	0.1	0.014
	1:50	20.667	6.200	118.658	35.598		0.130	0.747			0.650	0.1	0.021
	1:100	28.256											

7. Stormwater System

Roof runoff (gutters) is to be directed from the downpipes onto paving slabs which will distribute the run-off and prevent erosion. The roof run-off will then infiltrate into the surrounding soil/landscaping to assist in recharging the groundwater.

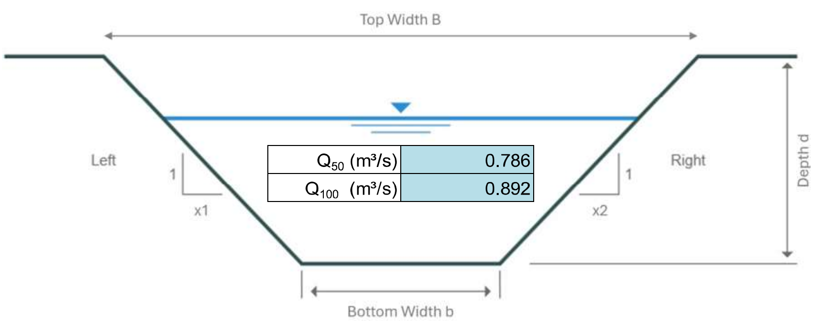
The road will be constructed following vertical alignment. The road surface consists of 80mm concrete interlocking pavers (40MPa). The stormwater will be collected by the grid inlets in the road. The stormwater will be discharged in the attenuation pond with culvert headwalls, which will act as silt and litter traps for the pond.

For the bio-swales, the stormwater will be collected grid inlets in the road with pipes linking to the manholes at the bio-swales. The manholes at the bio-swales will act as silt and litter traps for the bio-swales. Refer to the civil engineering drawings for the details. Overland flow will be able to enter the bio-swale from the top, infiltrating into the bio-swale.

Pipe sizes as per the design of the civil engineer using the information from this SWMP.

Overland escape

An overland escape route must be provided for floods greater than the 1:50 years storm event (1:100 year). A shallow lined channel is proposed, designed to safely discharge the peak runoff. This channel must be designed to safely discharge the peak runoff into Stinkwood Road. This overland channel must be formed kerb of the development to allow the overland flow to discharge through the main entrance road of the development.
This overland escape route for this development will be indicated by the civil engineer on the stormwater drawing. The stormwater from the surrounding properties does not contribute to this site.

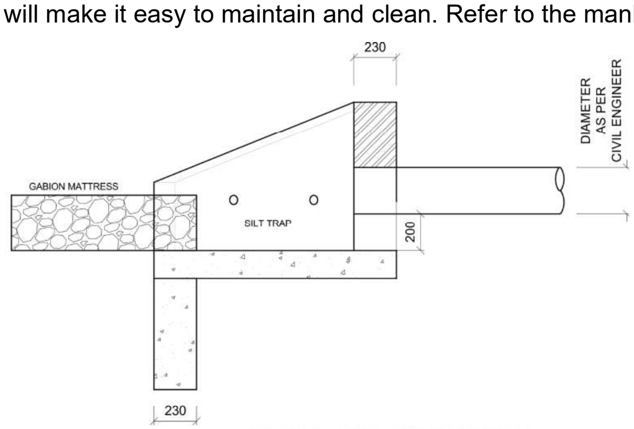


Width b	3.000	m
Depth d	0.200	m
x1	4	m
x2	4	m
Width B	4.600	m

Slope So	1	100	1	%

Silt & litter trap

Culvert headwalls must be placed at the discharge points of the attenuation pond. The culvert headwall will act as a silt trap, using a gabion mattress to retain silt & litter but allow the stormwater to flow through. The culvert concrete floor will make it easy to maintain and clean. Refer to the manhole detail below.



TYPICAL CULVERT HEADWALL WITH SILT TRAP DETAIL

Outlet structures (overflow structures)

An outlet structure is required at each treatment facility. This outlet structures must be able to take the 1:50 year storm event, linked to the outlet manhole. The table below summarizes the parameters of the outlet structure for each facility. These to be implemented in civil engineering design,

	Catchment Area A	**Catchment Area B**
	Pond	Bio-swale
Post 50 year flow (m^3/s)	0.641	0.146
Post 50 year flow (l/s)	640.644	145.632
C = Inlet coefficient	0.800	0.800
F = Blockage factor	0.200	0.500
Length (m)	2.000	0.600
Width (m)	1.000	0.300
Area openings (m^2)	2.000	0.180
H = Head above grid (m)	0.140	0.155
Discharge through grid (m^3/s)	0.530	0.126
Discharge through grid (l/s)	530.351	125.559
Discharge plus orifice	**641.902**	**146.145**

Summary data

The table below is the summary table, indicating the levels of each treatment facilities for the ease of design purposes.

	Catchment Area A	**Catchment Area B**
	Pond	Bio-swale
Outer edge footprint area (m^2)	1071m^2	415m^2
Depth (m)	1.500	1.100 (0.7 permeable + 0.4 channel)
(A) Outlet structure install level (m)	+1.500	+0.890
Emergency overland escape route invert level (m)	+1.640	+1.045
Top level of emergency overland channel (m)	+1.840	+1.245
(B) Top of embankment (m)	+1.840	+1.245
Freeboard (m) = (B) – (A)	0.340	0.355

** 0.000m is the invert level of facility for the purposes of this report (SWMP), for MSL refer to the civil engineering design drawings.*

8. Maintenance

The stormwater system requires some maintenance over time. The owner or body corporate will undertake to maintain the stormwater system to prevent the failure of the system. The stormwater system should always be neat and in a functional condition. This maintenance program follows in the table below and will be handed to the owner and body corporate to be implemented.

<table>
<tr><th>Infrastructure description</th><th>Activity</th><th>Schedule</th></tr>
<tr><td>Grid, kerb inlet grid inlets, and kerb inlet sand trap grid inlets</td><td>• Clean and remove debris and litter
• Remove sand
• Inspect for damages and repair as required</td><td>As required but not less than annually before winter.
After major storm events.
6 month basis (at least once before winter).</td></tr>
<tr><td>Pipe work</td><td>• Clean and remove debris and litter
• Remove sand
• Remove obstruction</td><td>As required but not less than annually before winter.
6 month basis (at least once before winter).</td></tr>
<tr><td>Manholes</td><td>• Clean and remove debris and litter
• Remove sand
• Inspect for damages and repair as required</td><td>As required but not less than annually before winter.</td></tr>
<tr><td>Silt and litter traps</td><td>• Clean and remove debris and litter
• Remove sand
• Inspect for damages and repair as required</td><td>Ongoing but not less than bi-weekly (fortnightly).
After major storm events.</td></tr>
<tr><td>Head wall and gabion structures</td><td>• Clean and remove debris and litter
• Remove sand
Inspect for damages and repair as required</td><td>6 month basis (at least once before winter)</td></tr>
<tr><td>Vegetated channels</td><td>• Clean and remove debris and litter
• Remove sand * sediment from channel
• Inspect for damages and repair as required
• Maintain grass to a height of below 50mm</td><td></td></tr>
<tr><td colspan="3">Once the infiltration system is operational, inspections should occur after every major storm for the initial few months to ensure proper stabilisation and function.</td></tr>
<tr><td colspan="3">Attention should be paid to how long water remains standing after a storm.</td></tr>
<tr><td colspan="3">After the first wet season, infiltration systems should be inspected at least bi-annually (i.e. before and after the wet season). Important items to check and clean or repair if required include: accumulated sediment, leaves and debris in the pre-treatment device, signs of erosion, clogging of inlet and outlet pipes and surface ponding.</td></tr>
<tr><td colspan="3">When ponding occurs, corrective maintenance is required immediately.</td></tr>
</table>

Bio-swale:

<table>
<tr><th>Inspection Task</th><th>Frequency</th><th>Comment</th><th>Maintenance Action</th></tr>
<tr><td colspan="4">Filter media</td></tr>
<tr><td>Check for sediment</td><td>3 monthly, after rain</td><td>Blocking of inlets and filter media reduces treatment capacity.</td><td>Remove sediment from inlets, forebays and other pre-treatment measures, and the surface of biofiltration street trees</td></tr>
<tr><td>Check for holes, erosion, or scour</td><td>3 monthly, after rain</td><td>Holes, erosion and scour can be a sign of excessive inflow velocities due to poor inflow control or inadequate provision for bypass of high flows.</td><td>Infill any holes, repair erosion and scour.
Provide/augment energy dissipation (e.g. rocks and pebbles at inlet)
Reconfigure inlet to bypass high flows
Relocate inlet</td></tr>
</table>

Inspect for the build-up of oily or clayey sediment on the surface of the filter media, excessive moss growth, or evidence of prolonged ponding (i.e. Clogging)	3 monthly, after rain	Reduced surface porosity reduces treatment capacity.	Clear away any mulch on the surface and lightly rake over the surface of the filter media between plants
Check for litter in and around treatment areas	3 monthly, after rain or as desired for aesthetics	Flow paths and infiltration through the filter media may be hindered.	Remove both litter/rubbish and excessive build-ups of plant litter
Damage	6 monthly	Check for damage to the surface from vehicles or pedestrians.	Repair using compatible filter media material.
Horticultural			
Additional checks of system health and function required during establishment	As required – weekly during initial establishment if during dry periods. May reduce to bimonthly later and in wetter periods.	The initial period after construction (up to the first 2 years) requires additional monitoring and maintenance works are required. Ensure a healthy and diverse vegetation cover is developing and that stormwater moves through the system as the design intended.	New seedlings will require regular watering and irrigation, protection from high sediment loads and high flows. If flows do not move through the system as intended, this requires further investigation. Works may be required to remedy the hydraulics.
Assess plants for disease or pest infection	3 monthly, or as desired for aesthetics		• Treat or replace as necessary
Check plants for signs of stunted growth or die off	3 monthly, but more frequently during long dry spells	Poor plant health can be a sign of too much or too little water, or poor flow control.	• Check inlet and overflow levels are correct and reset as required • <u>For too much water:</u> • Replace plants with species more tolerant of wet conditions OR • Replace filter media with that of a higher infiltration capacity • <u>For too little water:</u> • Consider installing a choke on the outlet or retrofitting a submerged zone (i.e. raised outlet) OR • Replant with species more tolerant of dry conditions
Check that original plant densities are maintained	3 monthly, or as desired for aesthetics	Plants are essential for pollutant removal and maintaining drainage capacity. Plants should be close enough that their roots touch each other; 6 – 10 plants/m2 is generally adequate. A high plant density also helps prevent ingress of weeds.	• Carry out infill planting as required – plants should be evenly spaced to help prevent scouring due to a concentration of flow
Check for presence of weeds	3 monthly, or as desired for aesthetics	Weeds can reduce aesthetics and treatment capacity because some plants are more effective at pollutant removal than others.	• Manually remove weeds where possible – where this is not feasible, spot spray weeds with a herbicide appropriate for use near waterways
Pruning and harvesting (if feasible)	Once or twice a year	It may be worth considering occasionally harvesting plants to permanently remove nutrients and heavy metals stored in aboveground tissues, and to promote new plant growth and further	• If practical, cut back and remove above-ground biomass (but do not cut back so severely that plant health and survival is compromised) • Prune plants back as required to enhance aesthetics but remove cuttings from the system.

		nutrient and metal uptake.	
Drainage			
Check that inflow areas, weirs and grates over pits are clear of litter and debris and in good and safe condition.	Monthly, and occasionally after rain, but 6 monthly if no construction activity in the catchment	A blocked grate or inlet would cause nuisance flooding and may lead to plant death within the biofilter.	• Replace dislodged or damaged pit covers as required • Remove sediment from pits and entry sites (likely to be an irregular occurrence in mature catchments)
Check that the underdrain is not blocked with sediment or roots	6 monthly, after rain	Filter media and plants can become waterlogged if the underdrain is choked or blocked. Remote camera (CCTV) inspection of pipelines could be useful.	• Clear underdrain as required using a pipe snake or water jet • Water jets should be used with care in perforated pipes
• Clear underdrain as required using a pipe snake or water jet • Water jets should be used with care in perforated pipes	Twice a year (more frequently if accumulation is rapid)	Pre-treatment device may become full of sediment or debris, which stops it serving its function of protecting the biofilter. The biofilter will then be impacted by sediment and rectification will be more costly.	• Remove accumulated sediment and debris before it builds up to excessive levels
Check the water level within the submerged zone (if lined)	Monthly throughout the dry season or as required	Although the submerged zone helps to sustain the biofilter through dry periods and drawdown is expected, if drying persists for long enough it will become drawn down and require replenishment.	Although the submerged zone helps to sustain the biofilter through dry periods and drawdown is expected, if drying persists for long enough it will become drawn down and require replenishment.
Check that the elevated outlet for the submerged zone	Check that the elevated outlet for the submerged zone	Debris may block the outlet or the level of the raised pipe may not match the design, producing a different depth for the submerged zone.	• Check outflow level is correct and reset as required
Other			
Observe biofiltration system after a rainfall event to check drainage	Twice a year, after rain	Ponding on the filter media surface for more than a few hours after rain is a sign of poor drainage	• Check catchment land use and assess whether it has altered from design capacity (e.g. unusually high sediment loads may require installation of a sediment forebay)

<u>Examples of issues requiring maintenance.</u>

Build-up of fine sediments on the surface of the filter media reduces surface porosity and treatment capacity.		Holes, erosion and scour should be repaired and inflow controls provided or augmented.	

Anthropogenic and organic litter build-up is unsightly and can hinder flow paths and infiltration.		Anthropogenic and organic litter build-up is unsightly and can hinder flow paths and infiltration.	
Poor plant growth can be a sign of too much or too little water, or of poor filter function.		Vegetation die off can be a sign of too much or too little water, or of poor filter function.	
Weeds are unsightly and can reduce treatment capacity.		Blocked overflow grates can result in nuisance flooding.	
Overfilling of filters reduces the extended detention storage and treatment capacity.		Overflow levels that are set too low reduces the extended detention storage and treatment capacity.	

<u>During construction:</u>

Infrastructure description	Activity	Schedule
Grid inlets Kerb inlets Grid kerb inlets Silt and litter traps (inlet structures)	• Outlet pipe to be enclosed with brickwork and mortar to prevent silt & sand flushing into the bio-swale. • Install geotextile at the grids to collect the majority of silt, sand, and litter. • Remove sand • Inspect for damages and repair as required	Ongoing but not less than bi-weekly (fortnightly). After major storm events.
Manholes Silt and litter trap manholes	• Outlet pipe to be enclosed with brickwork and mortar to prevent silt & sand flushing into the bio-swale. • Remove sand • Inspect for damages and repair as required	Ongoing but not less than once a month (monthly). After major storm events.
Overland escape route	• Clean and remove debris and litter • Remove sand • Inspect for damages and repair as required	Ongoing but not less than bi-weekly (fortnightly). After major storm events.
The enclosed inlet structures and manholes should be dewatered if necessary, after each storm.		

9. Conclusion

It has been determined that the provision of the attenuation pond and bio-swale combination will satisfy the stormwater quantity and quality requirements of the Urban Stormwater Impact Policy for the proposed development (Mandalay).

1. Our firm, the main civil consultant, and the developer hereby undertakes to comply with the following City of Cape Town requirements:
2. To confirm all aspects of this stormwater management plan in the detail design stage of the project.
3. To revise the stormwater management plan should it vary from what has been approved by the City of Cape Town.
4. To produce civil engineering design drawings once the stormwater management plan approach for the quantity and quality treatment of stormwater has been agreed with City of Cape Town.
5. To compile an operational and maintenance manual for the developer & HOA.
6. To provide a letter from the engineer to undertake that the necessary training will be given to the developer for the operation and maintenance of the system.
7. To provide a set of as-built drawings prior to arranging a final inspection with a representative from the City of Cape Town.
8. To source a letter from the developer confirming their commitment to the continuous maintenance of the system.

Please do not hesitate to contact the undersigned should you require any additional information.
Yours faithfully,

Compiled by
Jacques van Niekerk (Pr Tech Eng)

Attachments:
Form (Regular Inspection & Maintenance)
Annexure A – Form (Regular Inspection & Maintenance)
Annexure B – Site Development Plan
Annexure C – Rational Method Data Sheets
Annexure D – Geotechnical Report of this site

Civil engineering drawings and design will be submitted separately by the main consultant, Edifice Consulting Engineers, based on their civil engineering design.