ARUN PROJECTS (PTY) LTD

Firwoods Development
Stormwater Management Plan

Contract 3394-00-00

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Table of Contents

List of Annexures

1. Scope and Purpose of Report

Bigen Africa Services (Pty) Ltd was appointed by Arun Projects (Pty) Ltd as the civil and electrical consulting engineers for the proposed Firwoods development on Erf 8892, Paarl.

The purpose of this report is to provide clear and specific detailed information showing how the stormwater control and management will function once the Firwoods development is fully constructed. The report further describes the various infrastructure items that are to be constructed and the stormwater management objectives and measures that the land-owner will undertake to ensure sustainable management of the constructed stormwater infrastructure.

The following reports should be read in conjunction with this report:

- The Landscaping Plan which ties in with the Stormwater Management
- The Floodline Report prepared by Graeme McGill consulting, dated November 2018
- The Technical memorandum (Design Criteria and associated considerations for the infilling of the 1:100 floodline) prepared by SAS Consulting, dated December 2018
- The Firwoods Bulk Services Report, dated April 2020

The design guidelines utilised are:

- Drainage Manual published by the South African National Road Agency SOC Limited, 6th Edition
- Guidelines for Human Settlement and Design (Red Book) prepared by the CSIR
- Georgia Stormwater Management Manual, Technical Handbook-Volume 2: 2016 Edition.

2. Site Description

2.1. Locality

The proposed land is situated adjacent to the N1 national road in Paarl (south of the N1 and west of the Berg River). The development falls within the Drakenstein Municipal jurisdiction. Access to the site can be obtained from New Eskdale Street, off the R45 (Main Street). Refer to Figure 1 below which indicates the Firwoods Development.

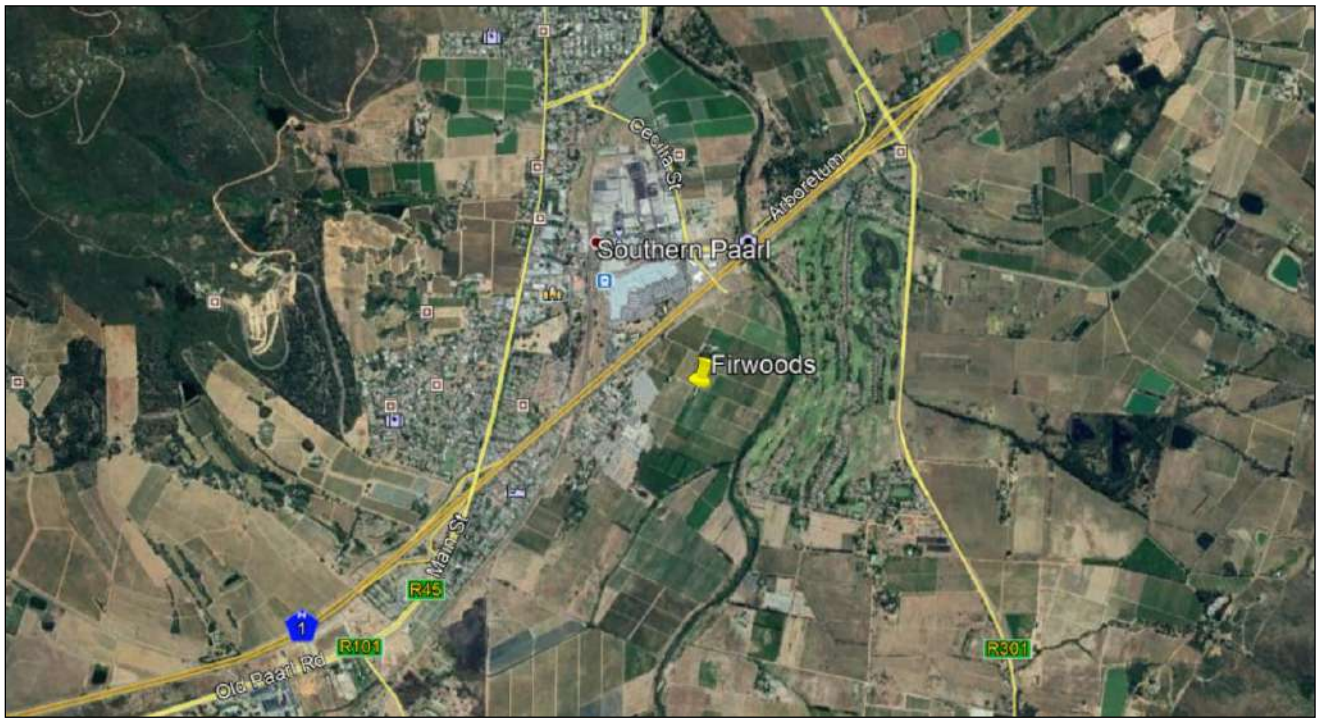

Figure 1 - Site Locality

The central co-ordinates for the site are:

- Latitude: 33°46'15.63"S
- Longitude: 18°58'15.18"E

2.2. Property Description

Table 1: Property Description

Property Description	Property Ownership
Erf 8892	Arun Projects (Pty) Ltd
Proposed Development	
79 Townhouses (3 storeys), 126 Apartments (150 m^2 building footprint), 47 Single-residential stands (200 m^2 building footprint), 14 Gentleman Estates (250 – 300 m^2 building footprint) and 8400 m^2 storage site and Clubhouse.	
Bulk upgrades potentially required	
Bulk water, sewer, stormwater, electrical and road upgrades required	

The Figure below indicates the proposed development layout.

Figure 2 – Development Layout

2.3. Topography

The topography of the proposed land parcels varies across the site. The site slopes generally in a North-South direction towards the Berg River situated on the southern boundary of the proposed development. A tributary of the Berg River is situated on the upstream edge of the site. A large portion of the site falls within the 1:100 floodline.

The site is actively cultivated with orchards, vineyards and pasture.

A levee is located along the eastern edge of the property (adjacent to the Berg River and off varying dimensions).

2.4. Geotechnical Aspects

A geotechnical investigation will be required to confirm the geology and site conditions prior to the detail design stage.

3. Hydrological Data

This report makes reference to South African Weather Service rainfall data captured at the Paarl AGR rainfall station (SAWS 0021825_W). Rainfall record data spans 39 years.

The 24 hour design rainfall depths for the 1:5, 1:50 and 1:100 year RI storm events are tabulated below:

Table 1: 24 Hour rainfall depths

Rainfall station	Recurrence Interval (years) / Rainfall (mm)		
	5 years	50 years	100 years
Paarl GR rainfall station (SAWS 0021825_W)	75	111	122

The 24 hour rainfall depth for each recurrence interval is tabulated in Table 1 above was applied to the South Africa SCS 24 hour Type 1 distribution curve to obtain the rainfall intensity distribution which was used to model the various storm events.

4. Floodlines and infill summary (from Graeme McGill Floodline Report and SAS Technical memorandum)

The following information is summarised from the Graeme McGill Floodline Report (attached in Annexure D of this report) and the SAS Technical Memorandum (attached in Annexure E of this report).

Summary from the Graeme McGill Floodline Report:

"A number of conflicting floodline drawings led to the decision to undertake a new comprehensive study using reliable current survey data.

Flood peaks were calculated, for the Berg River and the Van Wyk's River (which is a tributary for the Berg River), using recommended standard methods. These yielded the following peak flows shown in Table 2:

Table 2: 24 Hour rainfall depths

River	**1:50 Year Peak Flow (m^3/s)**	**1:100 Year Peak Flow (m^3/s)**
Berg River	1114	1293
Van Wyk's River	57.5	70.5

Flood water surface profiles were computed over a 2,6 km reach of the Berg River, extending from 0,8 km upstream of the property to 0,36 km downstream of the Arboretum Road bridge. For the Van Wyk's River, flood water surface profiles were computed over a 1,25 km reach extending 1,05 km upstream of the property to the confluence with the Berg River. It was found the some 67.4% of the site falls below the 1:100 year floodline."

Cross-sections through the river are presented as Figures 8-17 in the attached Floodline Report (Addendum B) and illustrate the extent and depth of flooding.

It was determined that the levee next to the Berg River has a significant effect of raising the flood water levels. It was shown that flood levels can be lowered by cutting the levee and placing and compacting the material of the edge of the floodplain to the north of the existing homestead (Phase 1).

It was proposed to extend the earthworks with Phase 2 whereby additional material will be excavated from the floodplain and the material so generated will be placed and compacted at the edge of the floodplain to the south of the existing homestead.

A levee of soil and river stone exists along the western bank of the Berg River, for almost the entire length of the. The levee varies in height up to approximately 3m. It is vegetated with the western side having low shrubs and

grass and the eastern (river) side being covered with trees and shrubs. The age and origin of the levee are unknown but it is clearly man made. The presence of the levee is a significant cause of raised water flood levels as it is an obstruction in itself and reduces the flow area significantly due to the water behind the levee being an ineffective flow area."

Technical Memorandum from SAS (refer to attached memorandum which includes the full memo, and photos and figures):

"Scientific Aquatic Services (SAS) was appointed to provide design input into the proposed Firwoords Estate development, located to the South of the N1 highway, to the west of the existing Boschenmeer Golf Estate and to the west of the Berg River in southern Paarl, Western Cape. As part of this assessment, and as a result of the Berg River identified to the east of the subject property, it has been deemed necessary to infill the upper portion of the 1 in 100 year floodline associated with the Berg River in order to provide a sufficient buildable area to ensure the proposed development is economically feasible and optimised. On pre-consultation with the Department of Water and Sanitation, it was requested that a freshwater specialist provide input into the design criteria for the subsequent infilling and to ensure that all freshwater ecological perspectives are taken into consideration.

A meeting was held with the Environmental Assessment Practitioner (Guillaume Nel Environmental Consultants) as well as the Civil and Stormwater Engineers (Graeme McGill Consulting) on Monday the 10th of December 2018 to ensure all aspects were considered as part of the pre-feasibility investigation and freshwater ecological components included. The details presented below provide input into the final proposed layout plan.

The client wishes to infill approximately 70,000m2 of the 1:100 year floodline of the Berg River. To account for this, a floodline investigation was undertaken and the stormwater engineers proposed the following mitigation:

1. *An existing earth berm was identified associated with the Berg River for the portion of the subject property. Removal of this berm will allow for better drainage of the area in a flood event and reduce the general constriction and hence flood width of the system.*
2. *An excavated depression or preferential flow path with a series of depressions with a total volume of 50,000m3 will be required below the 1:100 year floodline in order to accommodate the water that would have inundated by proposed infill site during a flood event.*

The following design criteria are recommended from a freshwater ecological perspective to ensure that the proposed floodline alteration is as ecologically friendly as possible and that goods and service provision are enhanced as much as possible:

1. *On removal of the earthed berm associated with the Berg River, the embankment should be rehabilitated and a slope with a ratio of 5:1 implemented. A site specific rehabilitation and maintenance plan should*

be developed for the riparian zone for the Berg River and should include a landscaping and plant species plan.

2. *It is not recommended that one large depression with a capacity of 50,000m3 be created as a mitigation for the floodline infill, but rather a network of earthed swales and ponds should be developed in which wetland vegetation is established. The total volume of these swales and ponds should be designed to meet the engineering requirements.*
3. *The hydrological drivers for these ponds should be from precipitation and stormwater run-off only. No water should be pumped from alternate sources such as groundwater to augment the system for aesthetic purposes. As such, the Stormwater management Plan for the proposed site should take into consideration the designs specified in this memorandum.*
4. *All swales should be designed to meander in a manner mimicking natural drainage features.*
5. *All swales and ponds should be constructed through excavation of the in-situ material and sloped to a ratio not steeper than 4:1 although a 5:1 ratio is considered to be more appropriate and cobbles excavated during construction can then be used to line the swales. Cobble lining will assist with energy dissipation and prevent sedimentation and erosion as well as improve the aesthetic appeal of the swale.*
6. *Swales should be vegetated with indigenous wetland species suitable for seasonal saturation (Figure 2). Wooden boardwalks could be developed over the swales for pedestrian walkways should the developer so desire.*
7. *All ponds between swales must be designed in such a way that they do not exceed a depth of one metre (although 700mm is preferred). Creating varying depths within a pond is considered ideal so as to allow varying degrees of light penetration to the bottom for photosynthesis, which will create a diverse micro-habitat and promote the proliferation of a diversity of wetland vegetation.*
8. *The ponds should be designed to have a relatively thick rock bottom within the deepest areas in order to prevent excessive sedimentation build-up which may result in proliferation of undesirable Typha capensis throughout the system.*
9. *As far as possible, in situ material must be used in the construction of the swales and ponds and material from external sources, which could introduce contaminants, should be avoided in the construction process. Consideration should also be given to using materials which will assist in increasing the surface roughness (such as stone cobbles) in order to improve habitat provision.*
10. *A conservation buffer of at least 5 metres (although 10 metres is preferred) should be developed around the swale and pond network and should be vegetated with indigenous vegetation forming a continuum from terrestrial species to species associated with seasonally saturated soils. This buffer will provide an ecological corridor for faunal species and assist with polishing storm water from the surrounding area.*
11. *An outlet structure should be developed from the network of ponds to the Berg River. This should be developed by means of an open swale and culverts should be avoided as far as possible. Gabion mattresses and wingwalls can be utilised in portions of the system, as deemed necessary.*

12. *The outlet structure should join the Berg River at an acute angle to prevent creation of turbulent and hence erosive flow in the Berg River and must be at the same elevation level as the Berg River bed.*
13. *Stormwater from the upper portion of the property should be diverted by means of swales, as far as possible. When swales are to go below roads, suitable sized box culverts should be utilised and appropriate engineering designs implemented to prevent erosion and scouring. Litter traps should be installed in appropriate positions within the swale network, if deemed necessary.*
14. *It is considered imperative that alien plant control measures be implemented for the entire property in order to prevent encroachment of alien vegetation. This is of specific importance for the Berg River associated with the eastern boundary of the property.*

Figure 4 below provides a visual representation of the proposed conceptual development layout plan, as discussed with the freshwater ecologist and includes the above-mentioned swales and ponds."

The recommendations as proposed in the Memorandum for the floodline alteration will be implemented during detailed design and construction.

The Stormwater Concept included in Annexure B indicates the series of ponds within the floodplain. Note that the series of ponds within the floodplain will not serve as attenuation ponds for the Firwoods Development stormwater run-off, but the principle is that the volume of the available storage in the ponds below the floodline replaces the same volume of infill below the floodplain. These ponds will drain out after having been filled by the flooding of the Berg River

The stormwater management and attenuation ponds within the Firwoods development is discussed in detail further below in this report.

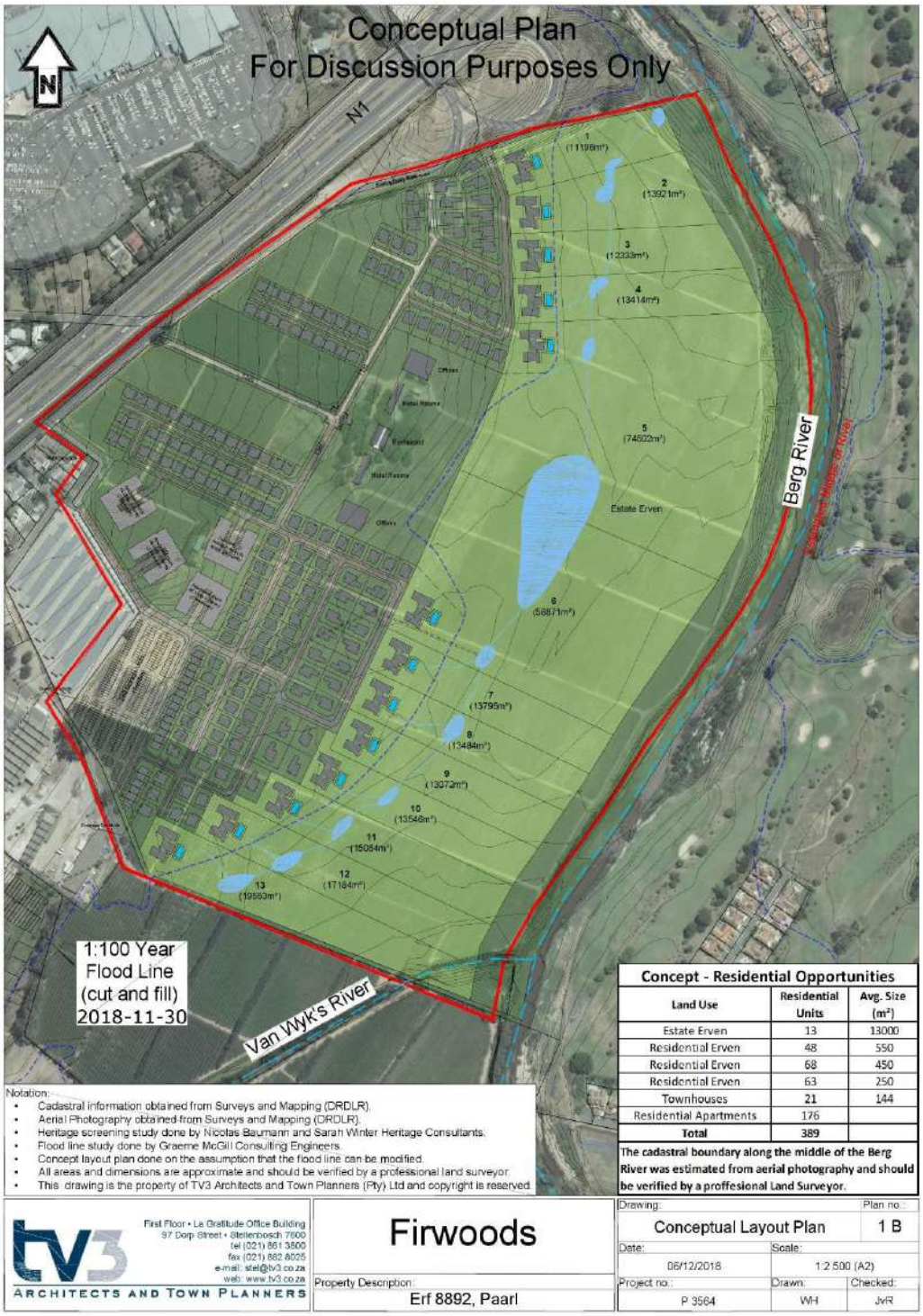

Figure 3 – Visual representation indicating the proposed floodplain infill and series of ponds.

5. Stormwater Management Run-off Quantity

This section describes and provides information on:

i. Quantity Objectives and Criteria
ii. Pre-Development Runoff Flows – Firwoods Development area
iii. Post Development Un-attenuated Runoff Flows – Firwoods Development area
iv. Post Development Partially-attenuated Runoff Flows – Firwoods Development area
v. Post- Development Attenuation Management Strategy – Firwoods Development area
vi. Post- Development Attenuation Management Strategy for Firwoods Development area
vii. Evaluating the 1:100 year RI storm event

This is presented further in the sequence given above in order to firstly understand the Firwoods Development area ultimate stormwater characteristics and management, and then specific stormwater characteristics and management.

i. Quantity Objectives and Criteria

The main purpose of stormwater management planning is to ensure that the influence of urbanisation and development on a site's runoff characteristics does not have an impact downstream of the site.

Reducing permeability and surface roughness through the removal of vegetation and adding buildings and roadways, results in the peak runoff generated on the site being increased. If the higher flow rates are discharged downstream, there could be various negative impacts on the downstream properties and watercourses. This could include: damage to property, overtopping of existing infrastructure and scouring of landscaping and watercourses. Therefore, mitigation measures must be put in place to ensure that the post-development peak runoff exiting the site does not exceed the pre-development peak runoff. Thus the difference between the pre-development runoff and the post-development runoff generated by the proposed development must be attenuated on the development site.

The criteria considered in this report, for achieving the Sustainable Urban Design System (SUDS) objectives for this Greenfields development, is as follows;

- Protect the stability of the downstream channels and infrastructure by 24 hour extended detention of the 1:1 year RI peak flow, 24h storm event.
- Protect downstream properties from fairly frequent nuisance floods by reducing the peak flow to pre-development levels for all events up to the 1:10 year RI peak flow.
- Protect floodplain developments and floodplains from adverse impacts of extreme floods by reducing up to 1:50 year RI peak flow to existing pre- development levels.

- Evaluate the effects of the 1:100 year RI storm event on the stormwater management system, adjacent property, and downstream facilities and property. Manage the impacts through detention controls and / or floodplain management.
- Encourage natural groundwater recharge.

ii. Pre-Development Runoff Flows – Firwoods Development

The stormwater run-off was estimated by using the Rational Method with the Time of Concentration routed via the catchment zones as shown on the pre-development catchment plan. The run-off coefficient for the pre-developed state was estimated to be 0.186 for the catchment by using the 6th edition of the South African National Road Agency SOC Limited's (SANRAL) drainage manual as a guideline. The catchment characteristics for the major catchments in the pre-development state are displayed in **Table 3** below.

Table 3: Pre-development Catchment Characteristics

Pre-development Catchment Characteristics	
Catchment	**Catchment**
Area (m²)	590 590
Pre-development C-value	0.186

The pre-development peak run-offs for the entire development and the individual catchments for the 1 in 50 year storm event is summarised in **Table 4** below.

Table 4: Pre-development Run-off

Pre-development Run-off	
Catchment	**Q (pre-development 50 year)**
	Run-off (m³/s)
Catchment 1	0.199
Catchment 2	0.073
Catchment 3	1.368
Catchment 4	0.170
Catchment 5	0.175
Catchment 6	0.187
Entire Catchment	1.830

iii. Post-Development Un-attenuated Runoff Flows – Firwoods Development

The site consists of six catchment areas as indicated in Stormwater Concept Catchment Plan included as Annexure B.

The post developed run-off volumes were estimated using the Rational Method of calculation and the revised flow routes were used to determine the new Time of Concentration for each catchment contributing as shown on the Post-development un-attenuated catchment plan. The run-off coefficients as shown in Table 5 below were used to determine effective run-off coefficients on a weighted average based on the areas of the catchments that fall within each land use portion.

Table 5: Run-off Coefficients

Land Use	C-value
Mixed use	0.7
Residential High Density	0.7
Residential Medium Density	0.55
Residential Low Density	0.45
Open Space	0.186

The catchment characteristics for the major catchments in the post-development un-attenuated state and the peak run-offs for the 50 year post development storm duration is show in **Table 66** below.

Table 6: Post-development Un-attenuated Catchment Characteristics and Run-off

Catchment	Area	Post Development C-value	Tc	Q (post development 50 year)
	m^2		**Minutes**	**m^3 / s**
Catchment 1	46 004	0.349	10.8	0.374
Catchment 2	11 505	0.435	4.1	0.170
Catchment 3	434 805	0.196	21.8	0.146
Catchment 4	29 741	0.396	6.6	0.363
Catchment 5	29 034	0.615	5.9	0.545
Catchment 6	39 501	0.388	9.3	0.389
Entire Catchment	590 590	0.256	21.1	2.46

The above run-off values are substantially higher than the pre-development run-offs shown in **Table 4** and clearly indicate that attenuation facilities are required. These attenuation facilities are described further on in this report.

iv. Post-Development Attenuation Management Strategy – Firwoods Development

To mitigate the peak runoff successfully, a dry attenuation facility will ultimately be provided as shown in the proposed Stormwater Management Concept Layout drawing attached as ANNEXURE C.

The run-off will be routed via the stormwater pipes (for the minor storms) and via overland flow in the roadway (for major storms) to the swales situated along the link road, which discharges into the Attenuation Dam. The swale will be sized to accommodate the major storm event. Run-off for minor storms will be routed via a pipe reticulation and discharge into the Attenuation Dams. Major storms will be routed into channels.

All open channels will be grass lined (or as otherwise specified in the landscaping plan) to aid in the treatment of the water quality and to prevent erosion. Where the velocity in the channels are high, erosion will be further prevented by the installation of gabion energy dissipaters (only if required). The gabion energy dissipaters will also act as litter and silt traps – refer to the typical attenuation pond detail drawing indicating structures in and out of the pond (Annexure C).

The attenuation dam will have different outlet to control the different storm events.

The outlet structure will choke the stormwater leaving the attenuation pond thereby creating extended detention of the 1:1 year RI, 24h storm event depicted. The stormwater runoff from small rainfall events will slowly infiltrate through the sandy loam in the dam basin before being discharged through subsoil pipes. The typical details are included in Annexure C.

6. Stormwater Management Run-off Quality

i. Quality Objectives and Criteria

The quality of stormwater runoff from the newly developed site will be negatively affected due to increased quantities of solid waste, silt, sand and phosphates and suspended solids present in the stormwater runoff. Proper mitigation measures and management policies will be put in place to improve the runoff quality from the site.

ii. Structural Quality Controls

The structural controls that will be implemented for this development (implemented in series as part of "treatment train" as far as possible to result in the cumulative improvement to the stormwater quality) are:

- Choked Outlet Structures
- Litter and silt traps - for rubbish and grit removal
- Grassed Channels
- Landscaping of channels and attenuation facilities.
- Environment Management Plan

The stormwater management concept is indicated on drawing 3394.00.00.04.U001 included in Annexure B.

a. Choked Outlet Structures

The outlet structure will choke the stormwater leaving the detention pond thereby creating extended detention of the 1:1 year RI, 24h storm event. The stormwater runoff from small rainfall events will slowly infiltrate through the the dam basin before being discharged through a network of subsoil pipes. A detailed drawing of the choked outlet structure is included in Annexure C.

b. Litter and Silt Traps Removal

The litter and silt traps act as pre-treatment before stormwater enters the attenuation ponds by removing coarse to medium sediments and litter. These will be gabion structures, and structures with gratings that will each be purpose designed to be utilised optimally on the positions placed on the site. They will be designed to capture solid waste and silt from surface runoff and piped runoff. The captured debris will be removed manually from the system by the maintenance crew. A detailed drawing of the litter and silt trap is included in Annexure C.

c. Grassed Channels

Grass channels are vegetated open channels that provide “biofiltering” of stormwater runoff as it flows across the grass surface. Erosion within the open channels will be further prevented by the installation of gabion energy dissipaters (where velocity is higher than 1 m/s). The gabion energy dissipaters will also act as litter and silt traps.

d. Improved Water-Quality

The water quality from the attenuation ponds will be enhanced by filtrating stormwater from smaller storm events through the engineered layerworks. The layerworks will consist of a 100mm filtration layer (sandy loam) on a 100mm thick 19mm stone layer wrapped in geotextile. The stones layer must include a 110mm diameter subsoil pipe. This will ensure that finer particulates and contaminants are filtered out of the stormwater. Infiltration will further be promoted by providing low-flow pipes at the outlet of the ponds which will effectively choke the stormwater. Refer to Annexure C for the sandy loam detail at the attenuation ponds.

e. Landscaping

Landscaping the above structural controls with indigenous plants, specified in the SUDS Landscaping and Indigenous Plant Species Guidelines, will make them more effective in pollutant removal and will increase the aesthetic value to the area.

f. Environmental Management Plan

A construction environmental management plan will be implemented and monitored by an environmental consultant to mitigate the risk of construction related pollutants.

7. Landscaping

A separate landscaping plan has been prepared by the Landscape Architect, attached as Annexure D.

8. Operation and Maintenance

Typical maintenance requirements for related stormwater infrastructure and structural controls are listed in **Table 2:** Error! Reference source not found. below.

The Environmental Management Programme (EMP) measures should be followed during the maintenance in order to ensure that the sensitive areas are not adversely impacted upon. In addition to the mitigation measures stipulated in the EMP, the following measures should also be taken into account:

- All maintenance activities must be monitored to ensure that no environmental damage occurs. All damage must be mitigated immediately.
- The area where maintenance is to take place should be cordoned off and the footprint into the surrounding area is prohibited.
- Should vegetation require to be removed in order for maintenance to be conducted, this should be kept to the ultimate minimum; and rehabilitated as soon as practically possible.
- The area where maintenance is to take place should be thoroughly checked in order to ensure that the area is free of faunal species.

Table 2: Operation and Maintenance Schedule

Infrastructure description	Activity	Proposed Maintenance Schedule
Grid and Kerb Inlet Catchpits	• Clean and remove debris and litter • Remove sand • Inspect for damages and repair as required	As required but not less than annually before winter
Pipe Work and Culverts	• Clean and remove debris and litter • Remove sand • Remove obstructions	As required but not less than annually before winter
Manholes and Headwalls	• Clean and remove debris and litter • Remove sand	As required but not less than annually before winter
	• Inspect for damages and repair as required	As required but not less than annually before winter
Silt and Litter Traps	• Clean and remove debris and litter • Remove sand and silt • Inspect for damages and repair as required	As required but not less than annually before winter
Litter Box and Channel Inlet Structures	• Clean and remove debris and litter • Remove sand and silt	As required but not less than annually before winter

	• Inspect for damages and repair as required	
Dam Outlet Structures	• Clean and remove debris and litter • Remove sand and silt • Inspect for damages and repair as required	As required but not less than annually before winter
Armorflex lined Channels and Overflow Channels (only if Armorflex lined Channels are required)	• Check that channels are well supported and no scour has occurred • Replace grass blocks when required due to cracks • Check and repair mole damage under grass blocks	As required but not less than annually before winter
Attenuation Dam and Grassed Channels	• Remove debris and litter • Mow grass to maintain a height of 50-75mm	After 6 months
	• Remove sediment from the bottom of the channel once it reaches a height of 30mm from channel invert	After 6 months
	• Inspect grassed area and plant new grass species if the original does not establish successfully	After 6 months
	• Inspect embankment for erosion, repair and replant where required	As required but not less than annually before winter
Outflow capacity checks	• Check attenuation pond outlet pipes and overflow channel and clear any potential items that can cause blockages	As required but not less than annually before winter
Subsoil Pipes	• Clean and remove debris and litter • Remove sand • Remove obstructions	As required but not less than annually before winter
Gabion and Reno-mattress Structures	• Clean and remove debris and litter • Remove sand • Remove obstructions	As required but not less than annually before winter
Floodplain	• As per Landscaping Master Plan and Environmental Management Plan	As per Landscaping Master Plan and Environmental Management Plan

ANNEXURE A: Proposed Development Layout

MASTER PLAN


N1
NEW ESKDALE STREET
TOWNHOUSES ▸
GENTLEMAN'S ESTATES ◂
TOWNHOUSES ▸
N1
MANOR HOUSE & HOTEL ◂
APARTMENTS ▸
RESIDENTIAL STANDS ◂
STORAGE ▸
GENTLEMAN'S ESTATES ◂
Berg River
BOSCHENMEER GOLF ESTATE ◂
Van Wyk's River

ANNEXURE B: Stormwater Concept Drawing

LEGEND
SOFT SCAPE
HARD SURFACE
PROPOSED STORMWATER POND
TREATMENT SWALE
CONCEPT

NEW EKSDALE ST

N1

POND 1 FOOTPRINT

POND 5 FOOTPRINT

POND 2 - SHALLOW SWALE WITH 300mm DIA OUTLET

POND 6 FOOTPRINT

PROVISION TO BE MADE FOR STORWATER ESCAPE SERVITUDE OF 5.0m WIDE

PROVISION FOR STORMWATER DAM 3

POND 4 - 0.7m DEEP SWALE, TOP WIDTH = 4.0m WITH 370mmDIA OUTLET

-1.56%
-2.98%
-2.39%

1
2
3
4
5
6

Berg River

Van Wyk's River

VERSION / AMENDMENTS

No.	DATE	DESCRIPTION	AUTH. BY

SURVEY DATUM:

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PROJECT TITLE: FIRWOODS

DRAWING TITLE: **STORMWATER CONCEPT**

ARUN HOLDINGS (PTY) LTD

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100mm ON ORIGINAL DRAWING

ORIGINAL DRAWING SCALE:	1:1500	ORIGINAL DRAWING SHEET SIZE:	A1

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APPROVED ON BEHALF OF CLIENT:
NAME:
DATE:

APPROVED ON BEHALF OF BIGEN:

CLIENT DRAWING No.:	CLIENT REF No.:

DRAWING No.:	VERSION:
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