# PROPOSED MOTOR DEALERSHIP ON PORTIONS 59 AND 168 OF THE FARM BULTFONTEIN 533-JQ

## CITY OF JOHANNESBURG


## STORMWATER MANAGEMENT REPORT

March 2019

| Submission Details | | |
|---|---|---|
| Johannesburg Roads Agency Limited (JRA) | | |
| Joburg a world class African city / JRA | | |

**PREPARED BY:**

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# Quality Control

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*Certification*

*It is herewith certified that this Stormwater Management Report has been prepared according to requirements of the City of Johannesburg Stormwater Guidelines*

Signatory:  Date : 26 March 2019 ECSA no: 20170023

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Quality checklist

| Items | Initial |
|---|---|
| Project take on form | ✓ |
| Report & Figures reviewed | ✓ |
| Authorisation for distribution | ✓ |

# Contents

# Appendix A

- Drawing C339-SWMP-LO-01 – Conceptual Stormwater Management Plan

# 1 Introduction

## 1.1 BACKGROUND

*CHRISEN CONSULTING (PTY) LTD* Civil Engineers have been appointed by *4 WHEEL DRIVE PROPERTY HOLDINGS (PTY) LTD* to compile a Stormwater Management report to address the proposed Motor Dealership development on Portions 59 and 168 (Lanseria Extension 77 and 74) of the Farm Bultfontein 533-JQ. The site is located 2,5 km south from Lanseria Airport, at the north-eastern quadrant of the intersection of Pelindaba Road (R512) and 6th Road (R552) and falls within the City of Johannesburg area of jurisdiction.

The total site area of Portion 59 and 168 (Lanseria Extension 77 and 73) of the Farm Bulfontein 533-JQ is 23.93 ha. The site has recently been rezoned from "Agricultural Holdings" to "Industrial." This report investigates the expected stormwater run-off that will be generated from the proposed development and provides recommendations on how to manage such stormwater run-off. The site locality plan is illustrated on **Figure 1**.


**Figure 1: Locality plan**

## 1.2 APPROVAL OF SUBMISSION

This report will be submitted to the following road authorities for their comments and approval:

- Johannesburg Roads Agency (JRA): Roads and Stormwater Department

# 2 Purpose of the Report

This study forms part of the Environmental Authorisation submission for the proposed Motor Dealership on Portions 59 and 168 (Lanseria Extension 77 and 74) of the Farm Bulfontein 533-JQ, City of Johannesburg.

This report will address the proposed stormwater management which will include stormwater drainage and attenuation infrastructure. The purpose of this report is to evaluate the impact of the proposed Motor Dealership development on the site with respect to stormwater and the control / mitigation of the anticipated impact

# 3 Extent of Development

Portion 59 and 168 (Lanseria 77 and 74) of the Farm Bulfontein 533-JQ has a site area of 23.93 ha and is to comprise of the following:

- Toyota Building
- Used Vehicle Showroom
- Hino Building
- Taxi Dealership
- Car Prep Centre
- Car Rental
- 4X4 Mega world
- External Store
- Wash Bay
- Refuse Area
- Guard House and office
- Parking area
- Landscaping / gardens

# 4 Stormwater Management

## 4.1 THEORETICAL REFERENCE / GUIDELINES

The guidelines with respect to stormwater used in developing this Stormwater Management Plan is: *'JRA Roads & Stormwater Manual Volume 1 Code of Procedure', 'Drainage Manual 6th Edition as published by SANRAL' supplemented by the 'Department of Water Affairs and Forestry, 2006, Best Practice Guideline G1 StormWater Management'.*

## 4.2 PHILOSOPHY

The general level of stormwater management required is that of controlling all runoff emanating from a site in excess of that which would have occurred if the site was in its natural or original virgin state. The onus is placed on the developer to manage the excess stormwater resulting from any hardening of the site area. This management can take the form of soakpits or attenuation facilities such as tanks, ponds or areas designed to retain water provided the soil and geological profiles allow.
Where possible the emphasis should be placed on improving the potential for groundwater infiltration. Many municipal guidelines / policy based on the National Building Regulations presupposes at least a Rational method of determination of stormwater flows.

The **Rational Method** is a commonly used method of estimating the peak runoff value of stormwater run-off generated from urban and rural areas in spite of its limitations in application and accuracy. The attenuation volume is calculated from contrasting pre-development and post-development hydrographs developed using the Rational Method.

In general, modeling the run-off for the Pre and Post development scenarios for at least the **1:5 year, 1:20 and 1:50 year Recurrence Interval Storms** are required for assessment. Refer to **Figure 2.**

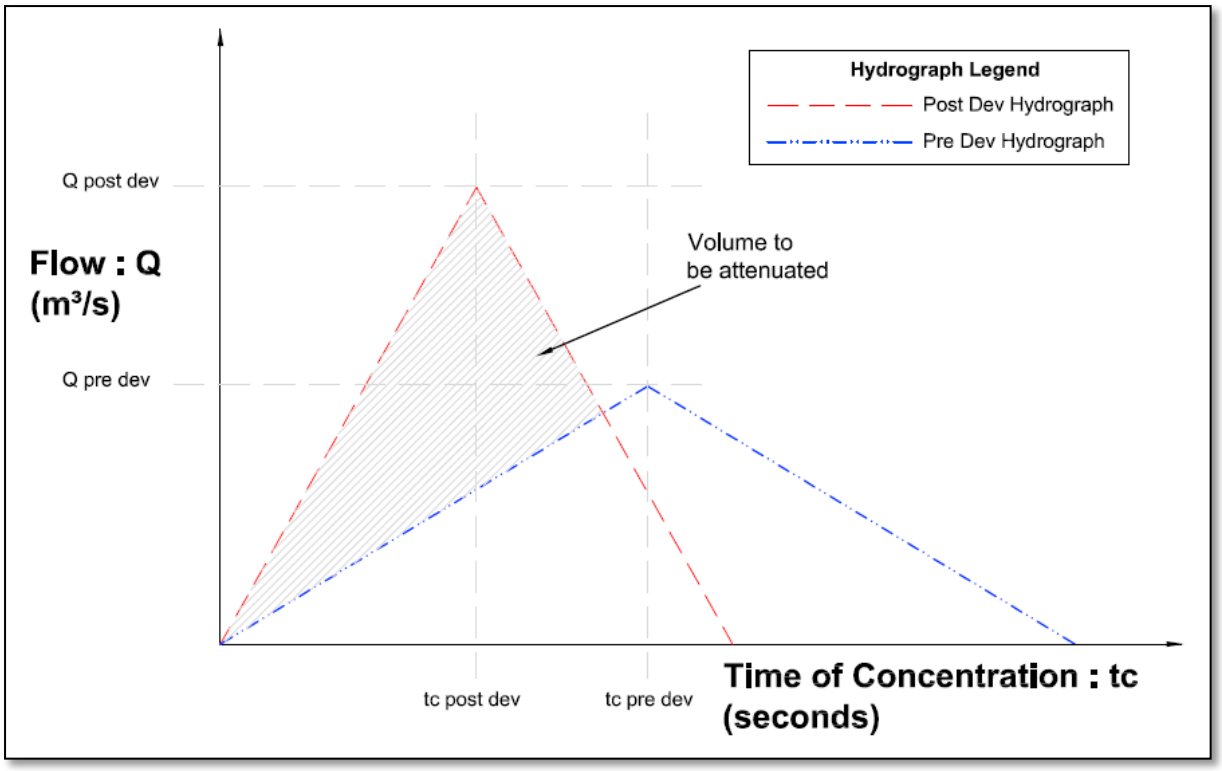



**Figure 2: Typical contrast of hydrographs**

## 4.3 METHODOLOGY

*Estimating the peak stormwater runoffs and attenuation volumes required:*

*The Rational Method:*

*The following is a synopsis on the method only. Refer to the Guidelines / Text for a detailed explanation on the method.*

The formula used in the Rational Method is:

***Q = ft x C x I x A/360 cumecs***

*Where*

*Q = the maximum/peak rate of run-off in cumecs ($m^3/s$)*

*ft = an adjustment factor for the recurrence interval storm considered (pre dev),*

*{post dev ft = 1}*

*C= run-off coefficient*

*I = the rainfall intensity (mm/hr)*

*A = area of catchment in hectares (1 ha = 10 000 $m^2$)*

Critical in this method is determining the time of concentration (tc) which influences determination of the rainfall intensity. The time of concentration can be regarded as the time it takes for the rainfall resulting in run-off from the furthest significant part of a natural catchment to reach the point being considered. Hence determining a flow path/length is required. The general practice is to use a minimum time of concentration of 15 minutes for all undeveloped / rural / residential type sites if the calculated time of concentration is less than 15 and where a site is predominantly hardened i.e. fully developed commercial / industrial sites then a minimum of 10 minutes is used if the calculated time of concentration is less. Rainfall Intensity is calculated using the time of concentration (tc) and either (1) the Design Rainfall Estimation in South Africa software for point rainfall or (2) the Depth-Duration-Frequency Diagram.

## 4.4 SITE APPRAISAL: PRE-DEVELOPMENT

This section describes the site in its existing condition i.e. Pre-Development state. The catchment is predominantly covered with a mix of light grass and sandy patches. The site is sloped with an average gradient of approximately 2-4 % in an east-west direction. There is no existing stormwater infrastructure adjacent to the site. **Table 1** illustrates the pre-development extent.

**Table 1: Pre-development extent (catchment area)**

| Pre-development extent | Area ($m^2$) |
|---|---|
| Sandy area / clean soil | 36015 $m^2$ |
| Grass Area | 175560 $m^2$ |
| Existing Building Roof Area | 2365 $m^2$ |

## 4.5 SITE APPRAISAL: POST-DEVELOPMENT

This section describes the proposed development to the site i.e. Post-Development state. The total site area is 23.932 ha. The proposed motor dealership development will comprise of the following: Car Prep Centre, Hino Truck Dealership, Toyota Car Dealership, Used Vehicle Show Room, Taxi Dealership, Car Rental, 4X4 Mega World, Wash Bay Facilities, External Store, Guard House, Refuse Area and Parking Bays. **Table 2** illustrates the post-development extent.

**Table 2: Proposed development extent (catchment area)**

| Post-development extent | Area ($m^2$) |
|---|---|
| Building Roof Area | 22870 $m^2$ |
| Grass Area | 50978 $m^2$ |
| Hard Area (Internal driveway and parking areas) | 140092 $m^2$ |

## 4.6 STORMWATER CALCULATIONS

### 4.6.1 Idealised Drainage

In the Pre-Development state, the site naturally drains in an east-west direction in a sheet flow manner. The site is sloped with an average gradient of approximately 2-4 %.

In the Post-Development state, the catchments are determined from the designed / asbuilt falls and stormwater drainage infrastructure constructed.

The post development slopes of the building platforms will be 0-0,5% and the parking areas will be 1,0%.

### 4.6.2 Rainfall Intensity

Using the Depth-Duration-Frequency Diagram to determine design rainfall, applying the Rational Method for calculation of peak stormwater runoffs and subsequently determining the drainage volume for the catchment yield the following for the 1:20 year and 1:50 year Recurrence Interval Storms.

| **RAIN STATION: Depth-Duration-Frequency** | | | |
|---|---|---|---|
| **Latitude, Longitude** | 25°57'S, 27°55'E | | |
| **Region** | Inland | | |
| **MAP** | 654 mm | | |
| **Elevation** | 1385 msl | | |
| **Duration(minutes)** | **Rainfall (mm) per Return Period** | | |
| | 5 Year | 20 Year | 50 Year |
| 5 | 15.2 | 21.2 | 25.6 |
| 10 | 22.3 | 31.2 | 37.7 |
| 15 | 27.9 | 39.1 | 47.2 |
| 30 | 35.2 | 49.3 | 59.5 |

### 4.6.3 Peak Runoff and Hydrographs

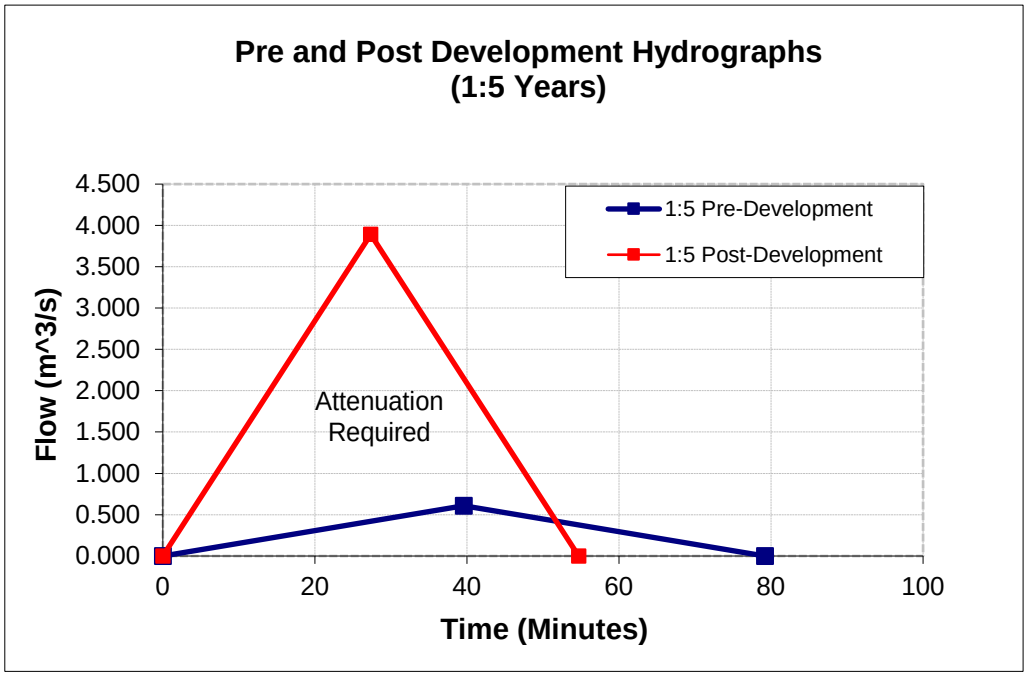
Applying the Rational Method for calculation of peak stormwater runoffs and subsequently determining attenuation volumes for the catchments yield the following:

| RATIONAL METHOD: SUMMARY OF FACTORS AND VARIABLES | | |
|---|---|---|
| **Description** | **Pre-Dev** | **Post-Dev** |
| Catchment area 'A' ($m^2$) | 213940 | |
| Flow path length 'L' (m) | 495 | 495 |
| Average slope 's' (%) | 2.0% | 1.0% |
| Factor 'r' | 0.35 | 0.11 |
| Time of concentration 'Tc' (minutes) | 39.59 | 27.35 |
| Run-off coefficient 'C'(Pre max=0.28, Post min=0.8) | 0.32 calculated hence use 0.28 | 0.75 calculated hence use 0.8 |
| Rainfall intensity 'i' (mm/hr) 1:5 year return period | 60.42 | 74.4 |
| Rainfall intensity 'i' (mm/hr) 1:20 year return period | 84.60 | 104.21 |
| Rainfall intensity 'i' (mm/hr) 1:50 year return period | 102.09 | 125.77 |
| Storm reduction factor '$f_t$' | 0.55 {1:5 year}<br>0.67 {1:20 year}<br>0.83 {1:50 year} | use 1 to get maximum flood peak |

1:5 Year Return Period

| 1:5 YEAR - SUMMARY OF PEAK RUNOFFS | | | |
|---|---|---|---|
| **Pre-Dev** | | **Post-Dev** | |
| **Time (min)** | **Q ($m^3/s$)** | **Time (min)** | **Q ($m^3/s$)** |
| 0.000 | 0.000 | 0.000 | 0.000 |
| 39.593 | 0.608 | 27.347 | 3.891 |
| 79.185 | 0.000 | 54.693 | 0.000 |

The following hydrograph contrasts the pre and post development runoffs.

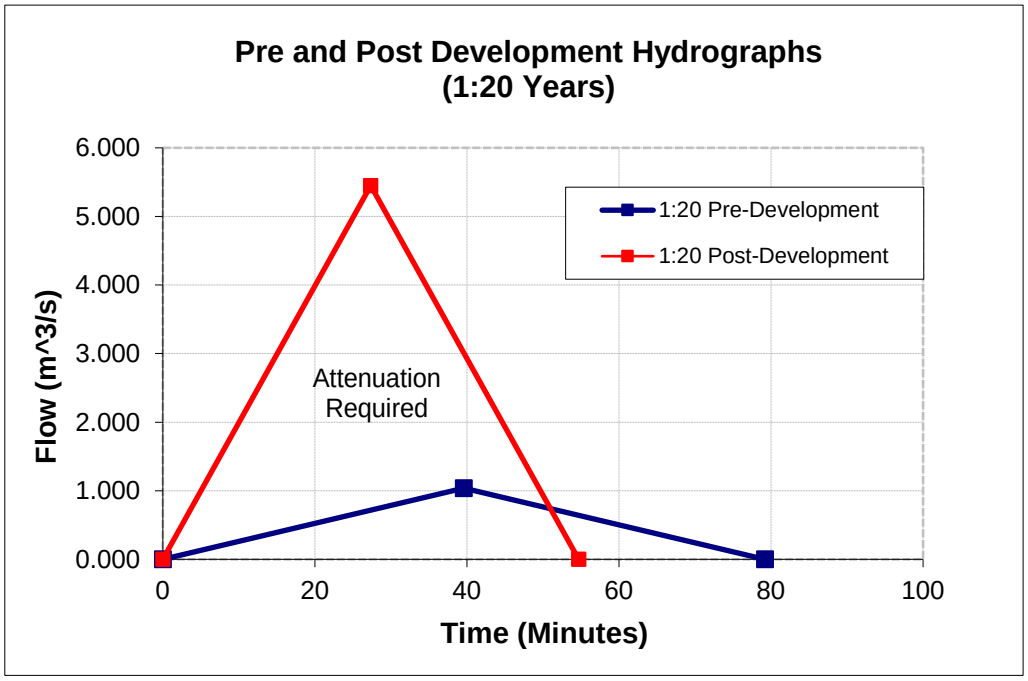



The area by which the post development hydrograph exceeds the pre-development yields the attenuation volume required. From the above graph, in the 1:5 year rain event, **the minimum stormwater attenuation volume required = 4939,0 $m^3$**.

1:20 Year Return Period

| 1:20 YEAR - SUMMARY OF PEAK RUNOFFS | | | |
|---|---|---|---|
| **Pre-Dev** | | **Post-Dev** | |
| **Time (min)** | **Q ($m^3/s$)** | **Time (min)** | **Q ($m^3/s$)** |
| 0.000 | 0.000 | 0.000 | 0.000 |
| 39.593 | 1.037 | 27.347 | 5.450 |
| 79.185 | 0.000 | 54.693 | 0.000 |

The following hydrograph contrasts the pre and post development runoffs.

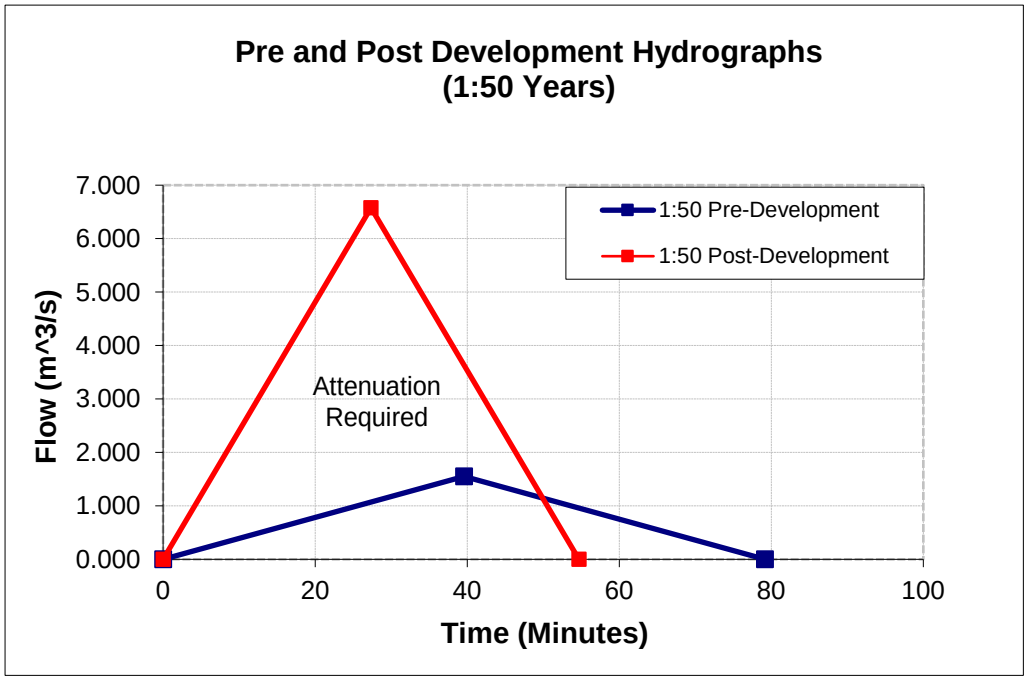



The area by which the post development hydrograph exceeds the pre-development yields the attenuation volume required. From the above graph, in the 1:20 year rain event, **the minimum stormwater attenuation volume required = 6477,0 $m^3$**.

1:50 Year Return Period

| 1:50 YEAR - SUMMARY OF PEAK RUNOFFS | | | |
|---|---|---|---|
| **Pre-Dev** | | **Post-Dev** | |
| **Time (min)** | **Q ($m^3/s$)** | **Time (min)** | **Q ($m^3/s$)** |
| 0.000 | 0.000 | 0.000 | 0.000 |
| 39.593 | 1.551 | 27.347 | 6.577 |
| 79.185 | 0.000 | 54.693 | 0.000 |

The following hydrograph contrasts the pre and post development runoffs.



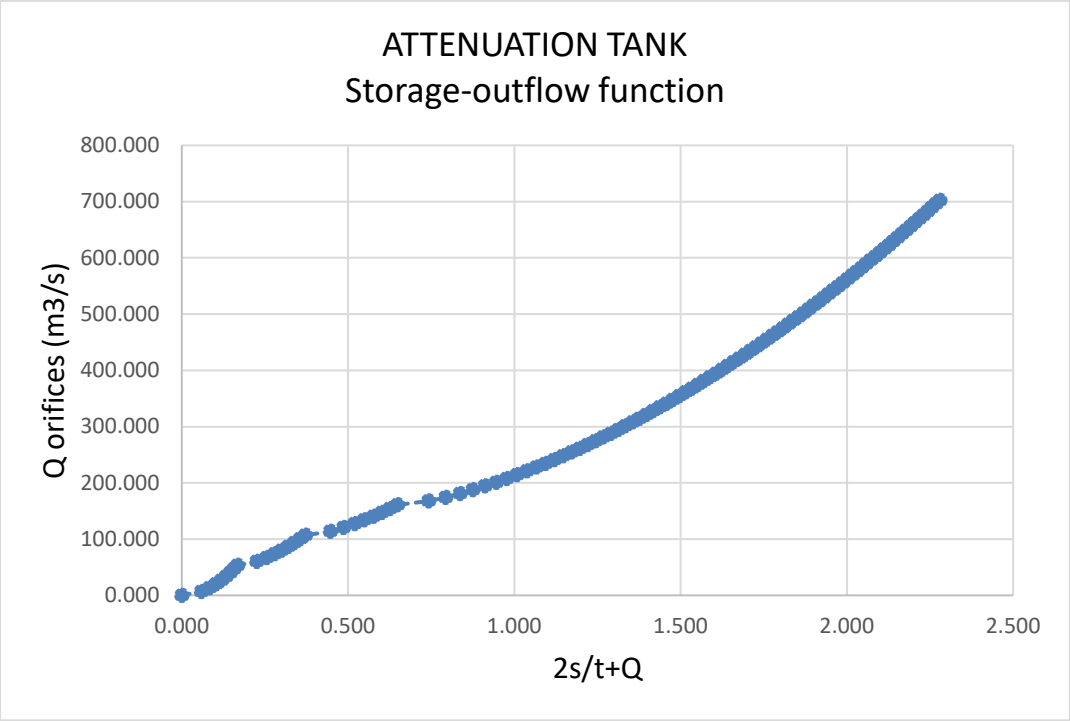

The area by which the post development hydrograph exceeds the pre-development yields the attenuation volume required. From the above graph, in the 1:50 year rain event, **the minimum stormwater attenuation volume required = 7108,0 $m^3$**.

### 4.6.4 Attenuation Design

The attenuation tank has been modelled using the 'Level Pool' flood routing method incorporating a combination of hydraulic control apertures. The flow outfalls into the attenuation tank: internal dimensions of 80 m x 50 m x 1.8 m with the upper 100mm as freeboard as well as allowing pipes to outfall into the tank in this zone. Hence the potential working fluid volume of 6800 $m^3$ is available. The tank floor is graded to fall towards the towards the attenuation control structure orifices and weir to regulate the flow such that the pre-development flow rate is not exceeded viz. 4no. orifices and 1no. Highflow/Overflow weir (refer to Drawing no. **C339-SWMP-LO-01** for details). Access manholes/shafts to enter the tank are provided to enable maintenance. The 1:5 year, 1:20 year and 1:50 year Return Period Storms have been routed/modeled through the attenuation tank and the results for each are depicted in the following graphs:

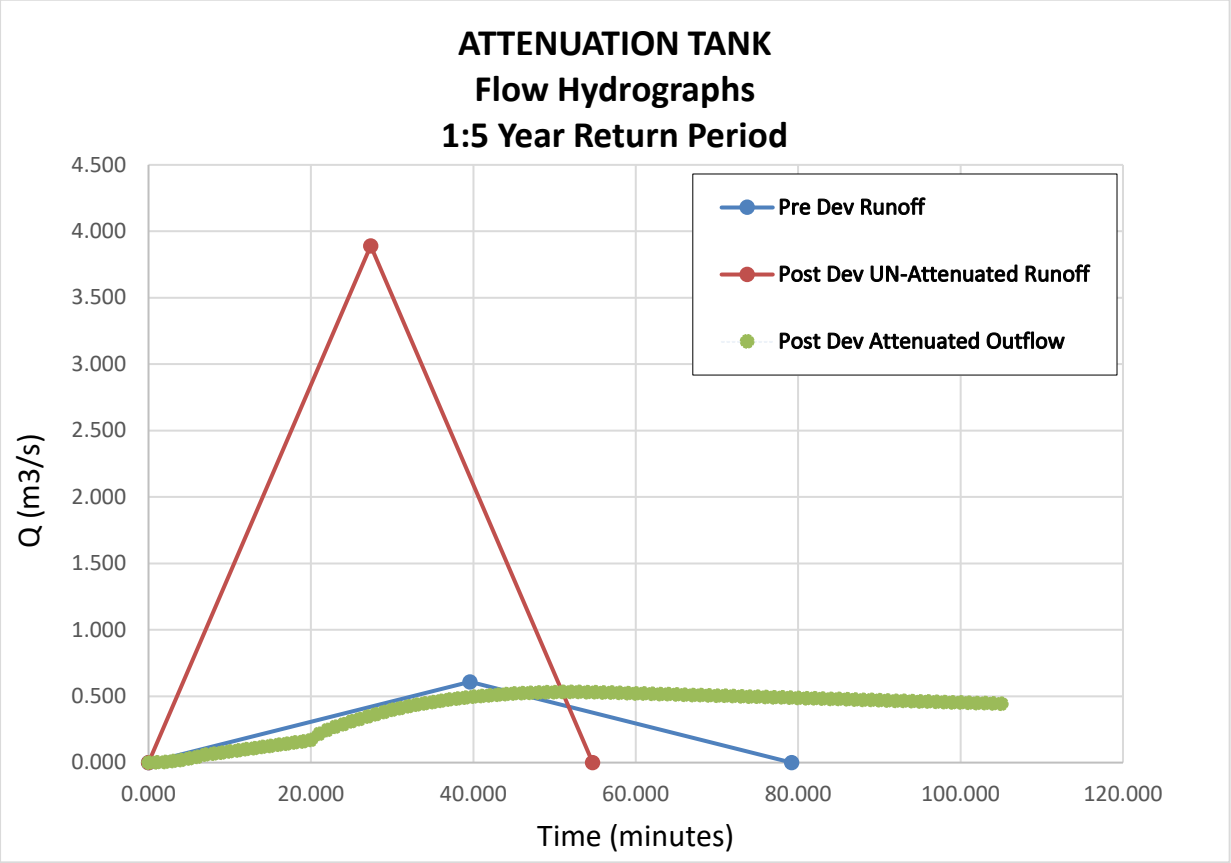
**A) Tank Storage Outflow Function:**

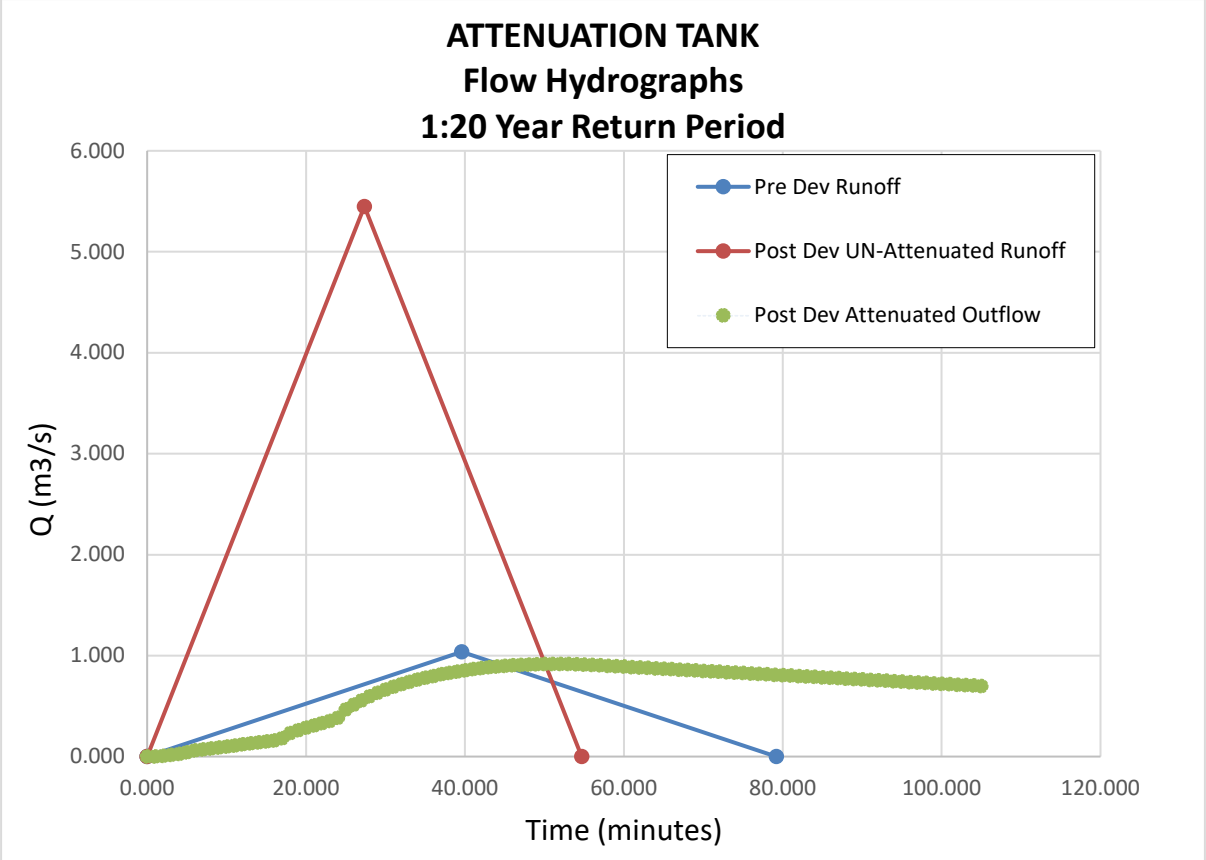
The storage and outflow characteristics of the attenuation tank and orifices is as follows:

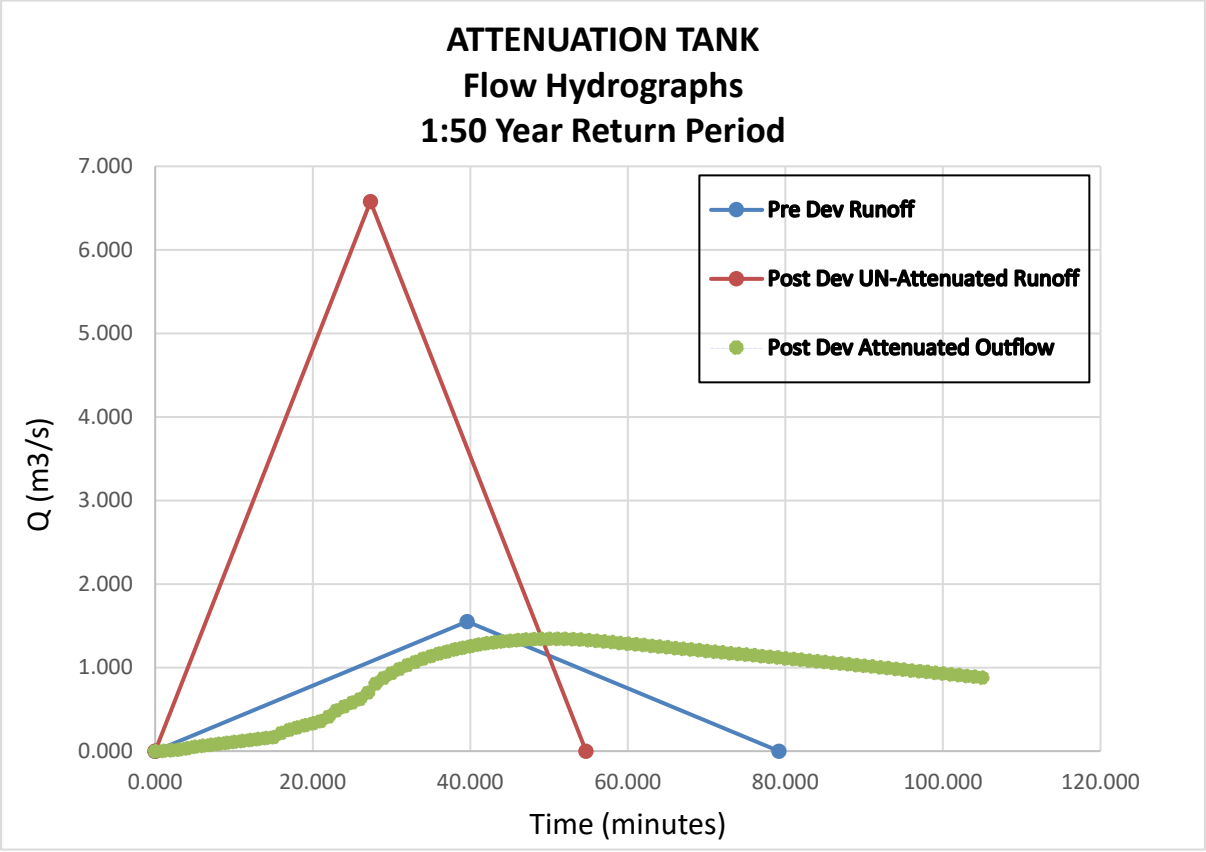


### B) Level Pool Method for Flood Routing:

The attenuation tank hydraulics is modeled using the Level Pool Method for flood routing for the 1:5 year, 1:20 year and 1:50 year return period storms. The following hydrographs reflect the successful attenuation functionality of the proposed tank and orifices. Refer to Drawing no. **C339-SWMP-LO-01** for details (Appendix A).




ATTENUATION TANK
Flow Hydrographs
1:20 Year Return Period
Pre Dev Runoff
Post Dev UN-Attenuated Runoff
Post Dev Attenuated Outflow
Q (m3/s)
6.000
5.000
4.000
3.000
2.000
1.000
0.000
0.000
20.000
40.000
60.000
80.000
100.000
120.000
Time (minutes)


ATTENUATION TANK
Flow Hydrographs
1:50 Year Return Period
Pre Dev Runoff
Post Dev UN-Attenuated Runoff
Post Dev Attenuated Outflow
Q (m3/s)
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
0.000
20.000
40.000
60.000
80.000
100.000
120.000
Time (minutes)

## 4.7 DRAINAGE AND OUTLET

Reference is made to **Drawing C339-SWMP-LO-01** Conceptual Stormwater Management Plan appended.

Bulk drainage is achieved by a network of grid inlets, catchpits and reticulation pipework. The roadways shall be drained by catchpit inlets (Type S2, D3) situated at road edge. The forecourt area shall be drained by grid inlet manholes.

Bulk stormwater pipes shall be Spigot and Socket Concrete Pipes with rolling rubber rings to ensure watertightness. The intercepted flows are reticulated to the Sand Oil Grease Traps (refer to **Section 4.8**). The concrete pipe sizes vary from 375 mm dia. up to 900 mm dia. depending on the flow accumulation.

The flow is reticulated into the Sand Oil Grease Traps to filter the stormwater and is then diverted to the attenuation tank. The flow then leaves the attenuation tank and is reticulated to a new stormwater headwall via a 900 mm dia. pipe and discharged overland in a North Westerly direction on to the road surface. The headwall apron slab has splitter blocks and a “stilling basin” is formed with a combination of reno mattresses and gabion boxes to further dissipate the velocity and energy of the flow. These interventions also provide erosion control.

## 4.8 SAND, OIL & GREASE TRAPS

There are various areas that could experience grease and oil pollution. These pollutants could enter the stormwater drainage system. 4 no. Prefabricated traps viz. 'Calcamite' 12 KL Sand, Grease and Oil Traps (or similar approved) are proposed adjacent to car wash and truck wash areas to filter the drainage stormwater before discharge into the attenuation tank and thereafter into the existing natural drainage/stormwater network. These traps can then be emptied periodically or as required.

# 5 Conclusions and Recommendations

This report has addressed the stormwater management which included stormwater drainage and attenuation design of the proposed development. By limiting the outflow from the site to below the pre-development rate and dissipating the energy of the stormwater at outfalls, control and mitigation of the impact of the proposed development and facilities on stormwater and receiving water bodies / downstream infrastructure has been achieved. Recommendations include:

- Grid inlets and catchpits to drain forecourts and roadway areas.
- The building and canopy will be drained via downpipes which then tie into the reticulation stormwater pipes running adjacent.
- Reticulation pipework to be spigot and socket 100D concrete pipes with sizes varying from 300 mm dia. up to 900 mm diameter. Pipe joints sealed with rolling rubber rings to ensure watertightness.
- 4 no. Prefabricated Sand, Grease and Oil Traps viz. 'Calcamite' 12 KL (or similar approved) are proposed adjacent to car wash and truck wash areas to intercept the drainage stormwater before discharge into the attenuation tank. These traps can then be emptied periodically or as required.
- Reticulated stormwater to outfall into attenuation tank. Attenuation tank of internal dimensions of 80 m x 50 m x 1.8 m with the upper 100mm as freeboard as well as allowing pipes to outfall into the tank in this zone. Hence the potential working fluid volume of 6800,0 $m^3$ is available. The rational method has been applied to determine the 1:5 year, 1:20 year and 1:50 year flow rates and volumes.
- The tank floor is graded to fall towards the towards the attenuation control structure orifices and weir to regulate the flow such that the pre-development flow rate is not exceeded viz. 4no. orifices and 1no. Highflow/Overflow
- The outflow from the attenuation tank is reticulated to a new stormwater headwall via a 900 mm dia. pipe and discharged overland in a North Westerly direction. The headwall apron slab has splitter blocks and a “stilling basin” is formed with a combination of reno mattresses and gabion boxes to further dissipate the velocity and energy of the flow. These interventions also provide erosion control.
- Access manholes/ shafts to enter the tank are provided to enable maintenance.

Based on the above, the post development runoff from the proposed Portions 59 and 168 (Lanseria Extension 77 and 74) of the Farm Bulfontein 533-JQ can be managed on site using an attenuation system and will not negatively affect the downstream properties or the road network. It is therefore recommended the proposed Portions 59 and 168 (Lanseria Extension 77 and 74) of the Farm Bultfontein 533-JQ be supported.

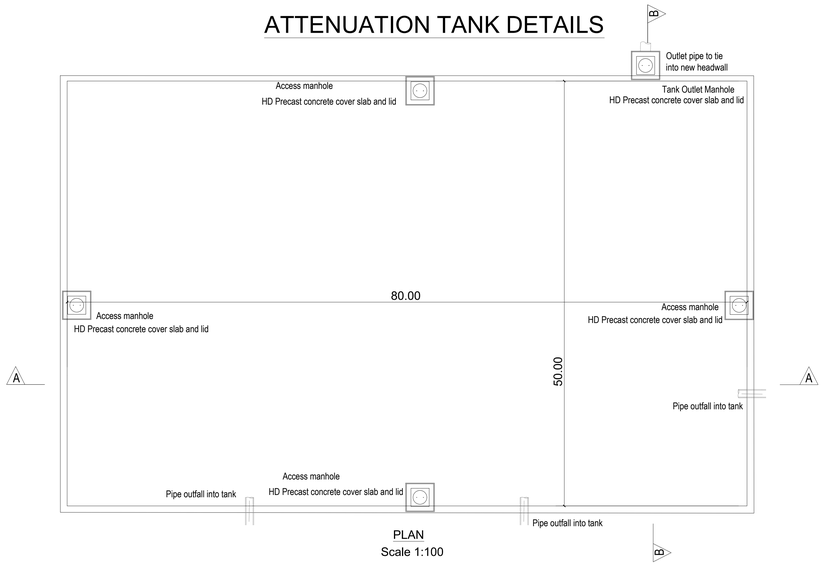
# 6 References

1. Drainage Manual, 6th Edition, The South African National Roads Agency Limited (SANRAL), September 2013.
2. Best Practice Guideline G1 Stormwater Management, Department of Water Affairs and Forestry, August 2006.
3. Code of Procedure, Roads and Stormwater Manual, Volume 1, Johannesburg Road Agency SOC Limited (JRA), June 2015.

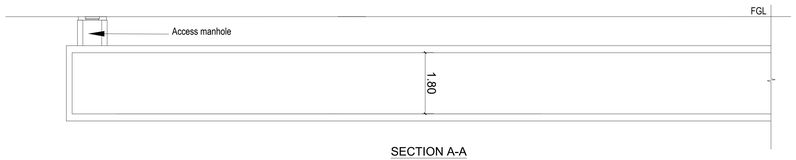
# Appendix A

- Drawing C339-SW-LO-01 – Conceptual Stormwater Management Plan

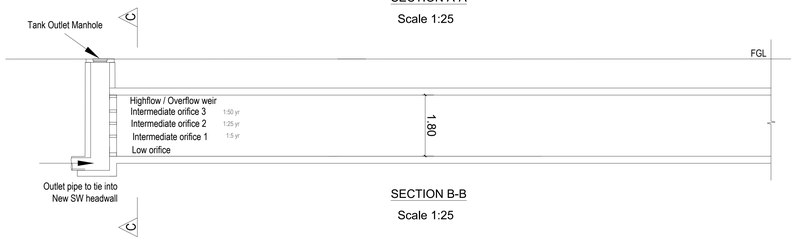
# ATTENUATION TANK DETAILS



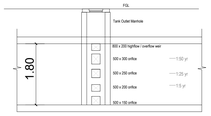

PLAN
Scale 1:100




SECTION A-A
Scale 1:25




SECTION B-B
Scale 1:25




SECTION C-C
Scale 1:25

## LEGEND

| | |
|---|---|
| | 900 Ø Concrete stormwater pipe |
| | 750 Ø Concrete stormwater pipe |
| | 525 Ø Concrete stormwater pipe |
| | 450 Ø Concrete stormwater pipe |
| | 375 Ø Concrete stormwater pipe |
| | 300 Ø Concrete stormwater pipe |
| | Outlet Headwall D=1.12m, W=3.3m |
| CP | Stormwater Catchpit |
| MH | Stormwater Standard Manhole |
| SGi | Stormwater Grid Inlet Manhole |
| | Reno Mattresses |

| REV. | DATE | BY | DESCRIPTION | CHK | APD |
|---|---|---|---|---|---|
| A | 2019/03/25 | L.V.U | FOR INFORMATION | C.E.N | - |

If drawing status = construction, a signed copy of this drawing (either in hardcopy or electronic format) is available at the office of origin and at the office of issue.

DRAWING STATUS: FOR INFORMATION

CLIENT: -

ARCHITECT: -

PROJECT: PROPOSED MOTOR DEALERSHIP ON PORTION 59 AND 168 OF THE FARM BULTFONTEIN 533-JQ

TITLE: CONCEPTUAL STORMWATER LAYOUT PLAN

| SCALE @ A0: | CHECKED: | APPROVED: |
|---|---|---|
| AS SHOWN | C.E NAIR | - |
| DESIGN: C.E NAIR | DRAWN: L.V UBISI / L NAIR | DATE: 2019/03/25 |
| PROJECT No: C339-011118 | DRAWING No: C339-SWMP-LO-01 | REV: A |