

PREPARED FOR: IMPACT FOR CHRIST MINISTRIES

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Local Authority:
Johannesburg Roads Agency (JRA)

Storm Water Management Report

PROPOSED DEVELOPMENT : NIETGEDACHT EXT 4– Situated on Portion 39 of the Farm Nietgedacht 535_JQ

RELEVANT INFORMATION

Version Control:

- (0) = Original Report

30 November 2025

Town Planning Application No.:

Total Area of Investigation Site: = 14.587 Ha

Effective Area of Development: = 4.000 Ha

Compiled by: Gawie Le Roux – Pr Tech (Eng) 200070105

Approved by: Gawie Le Roux – Pr Tech (Eng) 200070105



signature

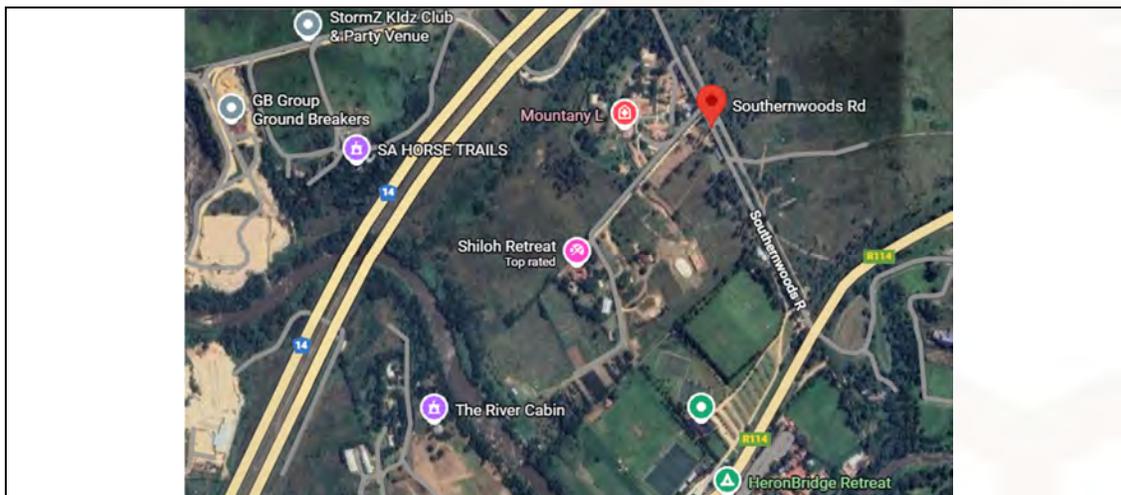


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1. INTRODUCTION

Triple 3 Engineering has been appointed by **Impact for Christ Ministries** as consulting engineers to prepare the Storm Water Management Plan (SWMP) envisaged for the proposed Nietgedacht Extension 4 development, situated on Portion 39 of the Farm Nietgedacht 535-JQ. (See Annexure A – Locality Plan).

The main objective of the storm water management plan is to ensure that the difference in flow between the pre-development and post-development storm water run-off, for both the 1:5 and 1:25 year return period storms are absorbed in the attenuation pond, while the 1:100-year return period event safely traverse the pond.

Other objectives include proposals for multiple land uses of attenuation areas, suggested maintenance plans and safety precautions, evaluation of the existing (receiving) storm water system, meeting environmental objectives and optimization of the storm water management system.

Lastly, a further objective is to deliver to the client a stormwater management plan and design that incorporates Best Management Practices (BMPs) that meets environmental stormwater quality standards as well.

Please note that during the detail design process; positional and structural changes might be made to the pond to better suit the site, however the attenuation hydraulics as discussed in this report will always remain intact.

2. SITE DESCRIPTION

2.1. LOCALITY

The proposed development is situated north of the Heron Bridge Sports Complex, east of the Jukskei River and west of Southernwoods Road in Nietgedacht. The site is 14.587 hectares in size, however the effective hardened development area is approximately 4 hectares in size. This reduced area had been used in determining the attenuation requirement as the balance of the site will remain as farmland and landscaped areas.

The site co-ordinates are 25°56'59.4" S and 27°57'36.8" E.

Also refer to Annexure "A" (Locality Plan), Annexure "B" (Aerial Photo) and Annexure "C" (Survey & Site Development Plan).

The climatic N-value (Weinert, 1980) of the region is assumed to be less than 5, which implies that chemical weathering is presently dominant. The mean annual precipitation (MAP) for the area equals 750mm.

The site falls within the area controlled by the city of Johannesburg.

2.2. SITE CHARACTERISTICS

2.2.1. Topography

The land slopes in a south westerly direction at a gradient of about 7.55% from the highest point 1353m MSL on the north-eastern side to the lowest 1304.5m MSL on the north-western side. Refer to the Land Use Diagram in Annexure "C".

The site is affected by a 1 in 100 year floodline as indicated on the layout however, no other specific drainage channels occur within the site boundaries and pre-development run off will be in the form of un-concentrated sheet flow.

The stormwater emanating on the site, due to the development, will be re-directed towards the new attenuation pond that will be located on the north-western boundary of the property as shown in Annexure "D" (Proposed Roads & Stormwater Layout). The attenuation pond outflow will discharge into a stilling basin along the same boundary, prior to it's unconcentrated release into the flood plane area.

2.2.2. Geology and Soils

A Geotechnical investigation of the site was conducted in July 2011 by Mshandukani Trading and Projects, only the cover page is attached as Annexure "D", however the full report is available on request.

The following key points, extracted from the abovementioned Geotechnical report, are considered pertinent to the current Stormwater Management report:

- **SITE GEOLOGY**

- **Regional Geology: -**

The area is manifested by relatively complex geology both lithologically and structurally. Lithologically, on a regional scale, the area is underlain by sedimentary and metamorphic rocks of the West Rand and Central Rand Groups, Witwatersrand Supergroup. This formation dates to the Randian Age. Overlaying these are rocks are Ventersdorp and Transvaal Supergroup of the Randian to Vaalian Age.

- **Local Geology: -**

Bedrock

Locally, the site is underlain by read medium grained quartzite of the Government Formation, west Rand Group, Witwatersrand Supergroup. This formation dates to the Randian Period.

Residual Soils

Residual soils are composed of very moist, whitish brown, orange speckled, very dense, intact, silty sand Gravel with ferricrete nodules, residual whitish brown Quartzitic Sandstone. These soils are the weathering product of the underlying whitish brown, moderately weathered, medium jointing, medium to hard rock Quartzite.

Transported Soils

Overlaying the residual soils is the moist, light brown, dense, intact, sandy Gravel, Colluvial, tree roots which are in turn overlain by moist, light brown, dense, intact, silty fine Sand, Colluvial, roots.

- **HYDROLOGY**

The topographical setting of the site in conjunction with anthropological activities encourages stagnation of water, following precipitation, giving rise to highly saturated ground especially at Test pit 01 which is closer to the river.

Perched water table resulting from the contact between various geologic zones occurs during rainy seasons in some of the areas.

This investigation was carried out in a rainy season. By the time of investigation, excavations were moist to wet, with some saturated due to high water table.

- **OBSERVATIONS**

- **Activity, Expansiveness of Swelling Soils**

Damage to structures erected on potentially active soils occurs where the expansiveness has not been determined and necessary remedial measures not employed. The potential expansiveness of a soil depends upon its clay content, the type of clay mineral present, its chemical composition and mechanical character. A material is potentially expansive if it exhibits the following properties:

- Clay content of more than 12%.
- Plasticity index of more than 12%.
- Liquid limit of more than 30%.
- Linear shrinkage of more than 8%.

The method of van der Merwe (1964) was used to determine the potential heave of soil samples. In addition to van der Merwe's method, the plasticity index and linear shrinkage of soil samples were used to indicate the soils potential expansiveness.

Where development is anticipated on areas with potential expansiveness, the following modified construction methods proposed by Williams *et al.* (1985) may need to be employed:

- Pre-wetting of expansive soil horizons
- Removal of the active layer
- Construction of moisture barriers and paving around the structures
- Stiffened raft foundations, sandwich raft foundations (two overlying raft foundations with a mattress of gravel or sand between the rafts)
- Split construction.

From the visual observations coupled with lab testing, the *potential expansiveness of the soils on the site is Low*. This is due soil texture and low percentage of clay content which result in low plasticity index and liquid limit. The possibility of structural distress resulting from cyclic drying shrinkage in dry seasons and swell after wetting is therefore minimum.

- **Settlement and Collapse Potential**

Collapsible soils are soils that can withstand relatively large, imposed stresses with small settlements at low in situ moisture content but will decrease in volume causing relatively larger settlements when wetting occurs under a load. This volume change is associated with a change in the structure of the soil and can occur in any open textured clayey silty sandy soils with a high void ratio. Colluvial soils situated on straight slopes, plains and residual soils on well-drained hillslopes derived from weathered granite generally exhibit a collapsible fabric.

Site soils are not *prone to collapse potential* due to their thickness, presence of coarse material and absence of some notable voids. The site soils are consolidated to unconsolidated and immature.

Soil settlement is due to consolidation of soils resulting from imposed loads. These loads mobilise the soil particles into tight form by particle orientation rearrangement and closing of voids.

The compact nature and the limited thickness in the residual soils (Appendix III) manifest into low to medium settlement ratio.

The foundation designs should, however, be such that it takes settlement, especially differential settlement into account. This is due to variations in the site soils resulting from geology,

geohydrology, reworked material by farming and construction activities, waste disposal pits, closed pit latrines, presence of pedogenic material etc. The site falls under **R, S1 (up to 20 mm movement) soil classification**.

2.2.3. Vegetation

In terms of vegetation the site is mainly open grass-covered veld, with areas of agricultural activity and some scattered trees and shrubs. There are also some buildings with associated informal infrastructure on the land.

On completion of the development, it is anticipated that approximately 30% of the area within the development will be hardened. Refer to Annexure "B" (Aerial Photo), and Annexure "C" (Site Development Plan).

3. MODELLING

3.1. MODEL SELECTION

At Triple 3, we utilise both Civil Designer and Civil 3D software package for stormwater design. As the detailed stormwater design will only follow at detailed design stage (upon approval of this report), we are not sure yet which one of the two packages will be used on this project. Hence we therefor will discuss one of them in this report and should the other package be used, we will issue a revision to this report. It is anticipated that the storm version 6.3 module of the Civil Designer software developed by Knowledgebase will be used in the analysis and design of the storm water network for this development.

Pre-development design flows are based on the Rational method. Post-development Design flows were calculated according to the illudas Time Area method, whereafter the rational method has been employed as a check to establish whether or not an acceptable run off coefficient was achieved.

The CBA model developed by Chris Brooker and Associates was utilised for attenuation pond component of the analysis. This model entails the following principals:

Reservoir discharge was calculated by employing the Stephenson series of formulae for both the unsubmerged and submerged scenarios of the **1:5-year (piped) pre & post-development** outflow at the base of the attenuation basin. The same method was used to model the **1:25-year (piped) pre & post-development** outflow. The general weir equation was utilised to determine the 1:100-year outflow at the crest of the spillway & the weir overflow structures.

3.1.1. Illudas Time Area method

The illudas time-area method is used for the estimation of runoff from a uniformly distributed design storm. The results correspond satisfactorily with observed runoff events for the method to be an accurate and useful design tool (Watson 1981).

The catchment area under consideration is divided into sub-catchment areas of a similar or homogenous nature which drain into an inlet.

Illudas assumes that overland flow is the sole source of storm runoff. Losses due to infiltration and surface irregularities are subtracted from the rainfall to determine the excess precipitation.

The runoff hydrograph is calculated from the excess rainfall hyetograph and the time-area curve of the sub-catchment area.

The runoff is routed over the sub-catchment with no further losses and then combined with the runoff from other sub-catchments as described in the section on routing.

The illudas method distinguishes between paved (impervious), supplementary (impervious areas which drain onto pervious areas) and grassed (pervious) areas in each sub-catchment.

Hydrographs are calculated for the paved area and the grassed area. The total grassed area is increased by the supplementary area. The paved and grassed area hydrographs are added to form the sub-catchment hydrographs.

The computation of the sub-catchment hydrograph may be illustrated in the following series of figures:

3.1.2. Design Storms (Chicago & Triangular)

The “Storm” module of civil designer can model a number of different storm types. Generally the design storm is based on IDF data. However, it is also possible to model the Chicago storm from regionalised IDF curves proposed by Op ten Noort and Stephenson (1982) or from recorded IDF curve data.

Watson (1981) proposed the use of the following IDF coefficients in Southern Africa.

Region	b	c	ratio	il	iR
Inland	14.4	0.883	0.40	22.5	241
Coastal	12.6	0.737	0.40	11.8	84

The value of the coefficient a is calculated according to the formula below. This value is accurate provided the mean Annual Precipitation does not exceed 1000mm.

$$a = iR \wedge (e \wedge (0.06 * \sqrt{MAP}) * T \wedge 0.3)$$

Where :

MAP	=	Mean Annual Precipitation
T	=	Recurrence interval
iR	=	Regional Constant

As IDF curve data is not readily available to us, we opted to generate a regionalised IDF curve as determined by Op ten Noort and Stephenson (1982). This curve is generated from the following equation :

Region : Inland

$$I = (7.5 + 0.034 * MAP) * R \wedge 0.3 / (0.24 + td) \wedge 0.89$$

Where

MAP	=	Mean Annual Precipitation
R	=	Return period in years
td	=	Storm duration

Please note that whilst the Chicago storm was used for designing the network elements, the Triangular storm was utilised to ultimately determine the attenuation basin volume, as it yields larger required storage volumes.

3.1.3. Infiltration

Infiltration is the absorption of water by the soil. Water enters the soil through pores as well as clearly defined cracks in the surface.

The infiltration rate is usually high at the start of a storm (the initial infiltration capacity) and decreases with the passage of time to a fairly constant value (the final infiltration capacity).

The rate at which the infiltration rate decreases (also known as the rate of decay) is a function of the volume of the water that has been absorbed.

The infiltration rate is calculated using an implicit form of Horton's equation as proposed by Watson (1981). The infiltration rate is also dependent on the characteristics of the soil as well as the cover conditions, ie. Density and type of vegetation. Soils are classified according to the U.S soil conservation service (1972) into four main groups as presented in the following table.

In addition to the four main groups listed three intermediate soil groups are supported as recommended by Schmidt and Schulze (1987).

These intermediate soil groups are used for soil which have characteristics that place them between the main groups.

For instance, the classification A/B would represent a soil with characteristics that fall between those of group A and group B.

Type	Infiltration rate	Soil description
A	High	Permeability is rapid. Overall drainage is excessive to well-drained. Typically coarse textured soils, ie. Sands and gravels.
B	Moderate	Permeability is slightly restricted. Effective soil depth and drainage. Moderately fine to moderately coarse textured soils.
C	Slow	Rate of infiltration deteriorates rapidly. Permeability is restricted. Soil depth tends to be shallow. Moderately fine to fine textured soils with layers that impede infiltration.
D	Very slow	Severely restricted permeability. Very shallow soils. High shrinks-swell potential. Typically clay soils with permanently high water tables.

The moisture content of the soil before a storm also affects the infiltration rate. This is called the Antecedent Moisture Conditions and is determined according to rainfall criteria specified below.

AMC No	Description	Total rainfall during 5 days preceding storm
1	Completely dry	0
2	Rather dry	0 to 12,5mm
3	Rather wet	12,5 to 25mm
4	Saturated	25+mm

3.1.4. Flow resistance in pipelines

Various formulae for head losses in pipes are recognised in theory. We decided to use Manning's equation as it is one of the methods preferred by hydraulic engineers and furthermore it is easy to implement.

3.2. ATTENUATION POND ANALYSIS

As mentioned before, the main objective of the storm water management plan is to ensure that the difference in flow between the pre-development and post-development storm water run-off, for both the 1:5 and 1:25 year return period storms are absorbed in the attenuation pond, while the 1:100 year return period safely transverse the pond. The CBA model developed by Chris Brooker and Associates was utilised for attenuation pond component of the analysis (Refer to Annexures H1 to H6).

The mean annual precipitation (MAP) for the proposed development is 750mm with a rain distribution type II resulting in the rainfall depths for the different return periods as follow:

5 year Return Period	:	81.3 mm
25 year Return Period	:	119.2 mm
50 year Return Period	:	134.4 mm
100 year Return Period	:	144.9 mm

3.2.1. Pre-development Modelling Parameters

Area	:	14.587 Ha
Effective Hardened development Area	:	4.0 Ha
Slope	:	7.03 %
Length of Longest Watercourse (to Attenuation Pond only)	:	455 m
Rational C Value (1:5 pre-dev)	:	0.28
Rational C Value (1:25 pre-dev)	:	0.35
Rational C Value (1:100 pre-dev)	:	0.70

3.2.2. Post Development Modelling Parameters

Area	:	14.587 Ha
Effective Hardened development Area	:	4.0 Ha
Anticipated average Slope across the longest water course for the Hardened development Area (to the attenuation pond only)	:	5.04 %

Length of Longest Watercourse	:	635 m
Rational C Value (1:5 pre-dev)	:	0.80
Rational C Value (1:25 pre-dev)	:	0.85
Rational C Value (1:100 pre-dev)	:	0.90

3.2.3. Model Results

See the attached summary sheets of the CBA model results (Annexure H1 to H6).

Description	Pre Development Inflow	Post Development Inflow	Attenuation requirement	Actual attenuation provided	Critical storm duration
	m ³ /s	m ³ /s	m ³	m ³	Min.
1: 5 Year	0.175	0.484	742	1356	40
1:25 Year	0.488	1.127	959	1437	25
1:100 Year	2.248	2.817	N/A	1575	15

As indicated above, the designed attenuation system therefore satisfies the JRA stormwater management objective. If one considers the JRA's general rule of thumb of 350 cubic meters attenuation storage required per hectare, the requirement is 1400 m³, and we satisfy that requirement as well.

Note that the 1:100 year post development scenario had also been modeled utilizing the CBA model to make sure that the emergency overflow had sufficiently been sized, (Refer to Annexure H).

4. MANAGEMENT SCHEME

4.1. DESCRIPTION OF PROPOSED SCHEME

4.1.1. Storm water Drainage

- *External Stormwater System*

The bulk of the stormwater emanating from the hardened area of the site (approximately 4 Ha), will discharge into an attenuation pond which will be constructed on the north-western boundary on Erf 4. From the attenuation pond, stormwater will discharge through a ±120 m long, 450mm diameter pipe system on the northern boundary of Erf 4, where it will discharge into a stilling basin to ensure an unconcentrated release of the stormwater discharge into the natural watercourse (Jukskei River), as indicated on Annexure "D".

The attenuation pond will have the capacity to attenuate the difference between the pre-development and post-development flows for both the 1:5-year and the 1:25-year stormwater scenarios. Refer to Annexure "E" for details of this attenuation pond.

Please note that prior to construction, detailed construction drawings pertaining to the roads and stormwater systems will be submitted for approval as well.

It is our understanding that the discharge pipe downstream of the development will be deemed as an external system as it discharges into the Jukskei River. On completion the City of Johannesburg Municipality will take over the external storm water system. However, safety & security measures as well as maintenance of the attenuation pond are to be provided by the Property Owners as the pond together with the piped system upstream of it, will remain private.

- *Internal Stormwater System*

Stormwater drainage will be managed on surface, where after an underground piped drainage system will be installed for the 1:25-year return period storm so as to ensure that the full 25-year storm event, across the hardened areas, ends up in the attenuation pond via the piped system. Allowance has been made for the 1:100-year storm to traverse the site in defined channels (which includes the internal parking and road system) without causing any damage to buildings.

Both the piped (for minor storm) and overland (for major storm) systems will discharge into the attenuation pond located on the north-western boundary of Erf 4 as indicated on Annexure "D".

Currently it is anticipated that an attenuation pond structure with a sandwich wall perimeter will be used. Refer to Annexure "E" for details of the attenuation pond. However as mentioned earlier in this report, during the detail design process; positional and structural changes might be made to the pond to better suit the site, but the attenuation hydraulics as discussed in this report will always remain intact. Should the pond design change, the stormwater management report will be revised and submitted to the JRA together with the detailed external roads and stormwater construction drawings as well.

On completion, the owners of the development will take over and maintain the internal stormwater system and associated attenuation pond.

Refer to Annexures D to G for details of the internal stormwater system, Attenuation pond details and CBA calculation summary sheets.

4.1.2. Subsoil Drainage

The subsurface drainage is designed to effectively lower the permanent and seasonal water table of the development to protect the road's subgrade layers and building's foundations against ground water. The subsurface drainage will tie into the stormwater system. Subsurface drainage will only be installed if required after evaluating specific site conditions.

4.2. EFFECTIVENESS OF THE SCHEME

As indicated in the table under item 3.2.3 earlier in this report, the stormwater system exceeds the JRA's stormwater attenuation management objective.

4.3. CAPACITY OF RECEIVING SYSTEM

The difference in flow due to the development will be absorbed in the attenuation pond as discussed earlier in this report. We therefore deem the receiving system's capacity to be adequate.

4.4. MULTIPLE LAND USE WITHIN DETENTION BASINS

The attenuation pond areas will be developed as artificial wetlands or landscaped park areas.

4.5. **MAINTENANCE ISSUES**

The attenuation ponds and storm water channels are to be cleaned and de-sludged (removing mud and silt) at the beginning of the rainy season, at least once a month during the rainy season and at the end of the raining season. No elements that occupy a large volume (whether organic or inorganic) are to be placed within the attenuation pond enclosure; however, trees and grass are permitted.

4.6. **SAFETY AND HAZARDS**

- Appropriate signage to be erected on site by the developer.
- Pond area must be fenced in.
- Pipe inlet (at the tower spillway) to be protected by a grid to prevent a vortex from forming.
- Tower spillway to be fitted with access steps / step irons on the inside.
- The pond is not deemed as a dam with a safety risk as its wall is lower than 5m.

5. ENVIRONMENTAL OBJECTIVES

The design of the storm water system is based on the implementation of measures pertaining to water quality and storm water management to ensure that acceptable environmental values and water quality objectives are met. These measures are referred to as Best Management Principals or BMP's. We strive to achieve these objectives by:

- maintaining as accurately as possible natural water infiltration and flows
- using water sensitive urban design principals
- using best practice urban storm water quality and quantity management

Furthermore these measures specifically address temporary and permanent erosion prevention, sediment control and control of other development activities that can cause pollution.

The site was assessed from a combined hydrological, hydraulic, vegetation, soils and geological view point whereby relevant site constraints which will influence the erosion and sediment control plan was identified. BMP's can be grouped into two broad categories namely Erosion Prevention and Sediment Control. Both these categories have appropriate uses, but erosion prevention BMP's are more effective as it prevents soil particles from leaving the site. Once soils are dislodged, they are very difficult to recover.

5.1. **RECOMMENDED BMP'S FOR CONSTRUCTION & OPERATIONAL PHASES**

- Site Entry BMP's
- Perimeter Sediment control BMP's
- Storm water Control BMP's
- Erosion Prevention BMP's
- Development Control BMP's

5.1.1. **Site Entry BMP's**

Construction phase

- Access to and from the work site must be controlled so as to prevent migration of sediments off the work site.

5.1.2. Perimeter Sediment Control BMP's

Construction phase

- Temporary sediment control fences should be installed prior to commencement with construction to provide a physical barrier to sediment movement and reducing run off velocities.
- Filtration bags (e.g. sandbags) may be used as an alternative.
- Storm drain inlets are to be temporarily protected by means of filtration berms or a sandbag barrier.

Operational phase

- Vegetated buffers must be placed along the sides of the side drains as a permanent measure against sediment entering the storm water side drains.
- The entire site will be covered by buildings, paving, grass, and other vegetation as part of the permanent solution to sediment control.

5.1.3. Stormwater Control BMP's

Construction phase

- Temporary Interceptor Dikes and swales must be used during rainstorms
- Alternatively Storm water barriers in the form of sand bag check dams could be used.

Operational phase

- Furthermore the cut off side drains west of the development will also act as silt traps, which will form part of the permanent perimeter Sediment Control BMP's of the development. This Drain should be maintained and regularly de-sludged (removing mud and silt) by the body corporate.

5.1.4. Erosion Prevention BMP's

Construction & Operational phase

- Due to the eroding characteristics of the in-situ soils, the entire site will be covered by buildings, paving, grass, and other vegetation as part of the erosion prevention plan.
- All low flow channels inside the attenuation ponds will be covered with Armorflex DN-140 so as to prevent any erosion to take place in these high erosion risk areas.

5.1.5. Development Control BMP's

Construction phase

- Use soil erosion controls to prevent pollutants from washing off
- Enclose or cover material storage areas to prevent contact with stormwater run off
- Use good housekeeping practices
- Use safer, environmentally friendly or alternative products
- Train employees appropriately on stormwater and environmental objectives to meet water quality objectives as stipulated above under section 5.
- Employ spill prevention BMP's
- Supply bins for solid waste management
- Fuelling only to take place in dedicated, protected area
- Plant maintenance to be handled off site as far as possible

5.2. IMPLEMENTATION STAGE

- Construction may commence once all approvals pertaining to the proposed residential development has been received.
- Contractor must review the storm water management plan together with the related erosion and sediment control plan prior to construction
- Strict attention should be given to construction site management.
- Quality monitoring during construction is essential.

6. CONCLUSION

The developer of the above property requires the support from the Mogale City Municipality to rezone the property for establishment of the proposed development.

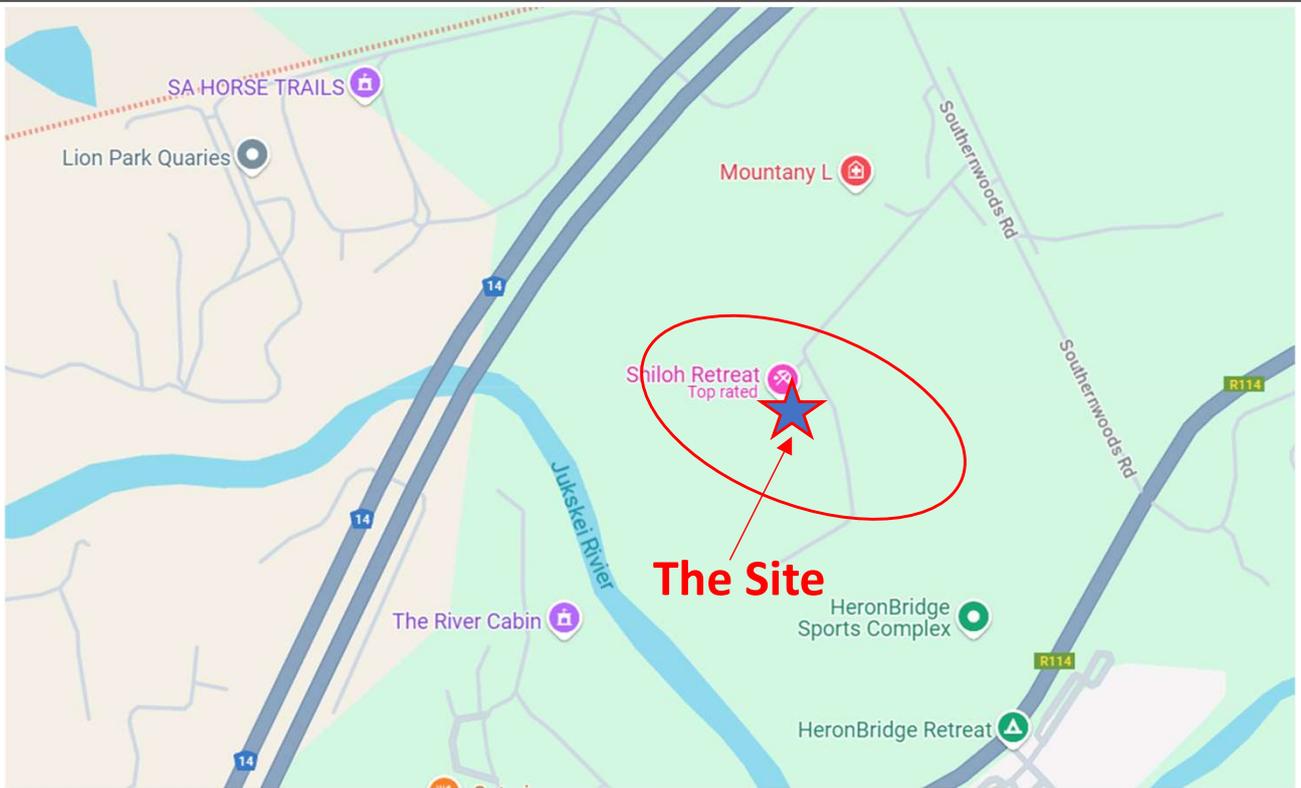
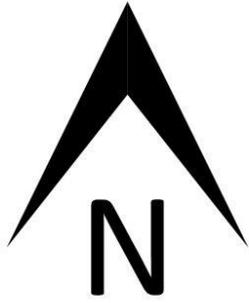
A Storm Water Management Report was therefore prepared by Triple 3 Engineering, to demonstrate to the relevant technical departments that the City's stormwater management objectives will be achieved.

It will be appreciated if this Stormwater Management Report is approved at your earliest convenience.

7. LIST OF ANNEXURES

Annexure A	- Site Locality Plan
Annexure B	- Aerial Photo
Annexure C	- Site Development Plan & Site Survey
Annexure D	- Proposed Stormwater Layout, Longitudinal Sections & Setting Out
Annexure E	- Attenuation Pond Detail
Annexure F(1-3)	- Stormwater Details
Annexure H 1	- Attenuation Pond – CBA Analysis 1:5 Year Pre-development
Annexure H 2	- Attenuation Pond – CBA Analysis 1:5 Year Post-development
Annexure H 3	- Attenuation Pond – CBA Analysis 1:25 Year Pre-development
Annexure H 4	- Attenuation Pond – CBA Analysis 1:25 Year Post-development
Annexure H 5	- Attenuation Pond – CBA Analysis 1:100 Year Pre-development
Annexure H 6	- Attenuation Pond – CBA Analysis 1:100 Year Post-development

Annexure A
- Site Locality Plan

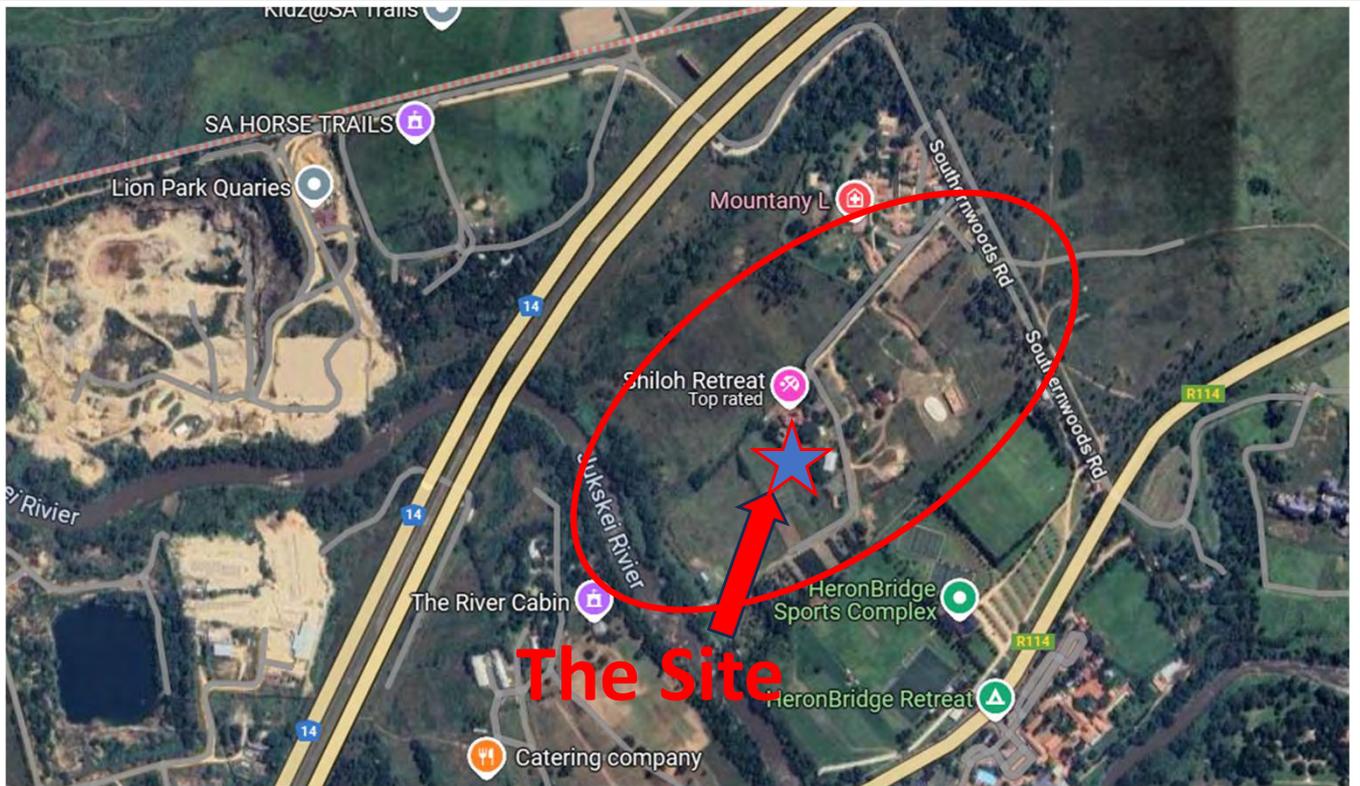
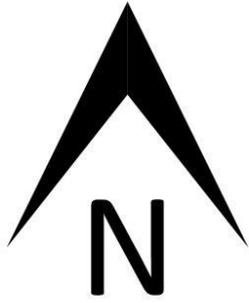


TRIPLE 3 GROUP

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NIETGEDACHT X4

LOCALITY PLAN

Annexure B
- Aerial Photo

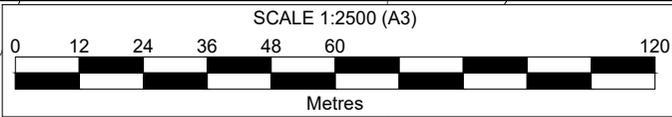


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NIETGEDACHT X4

Aerial Photo

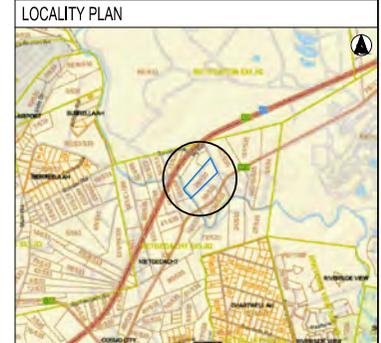
Annexure C

- Site Development Plan & Site Survey



FLOOD LINE CERTIFICATION
 It is hereby certified that the proposed township as shown is AFFECTED / NOT AFFECTED by a 1:100 year flood line, as per the provisions of Section 144 of the National Water Act, 1998 (Act 36 of 1998).
 (Pr Eng) (Reg No)

LAYOUT PLAN
**PROPOSED TOWNSHIP
 NIETGEDACHT
 EXTENSION 4**
 SITUATED ON
 PORTION 39 OF THE FARM
NIETGEDACHT 535-JQ
 Province : Gauteng



ZONING SCHEDULE

LAND USE TABLE			
PROPOSED ZONING	ERF No.	No. OF ERVEN	% OF AREA
Educational	1	1	22,20
Commercial 1	2	1	3,52
Special	3	1	26,78
Agricultural	4	1	37,65
Private Open Space (Social)	5	1	8,51
Roads, Railway & Air: Public Road			1,34
TOTAL		5	100

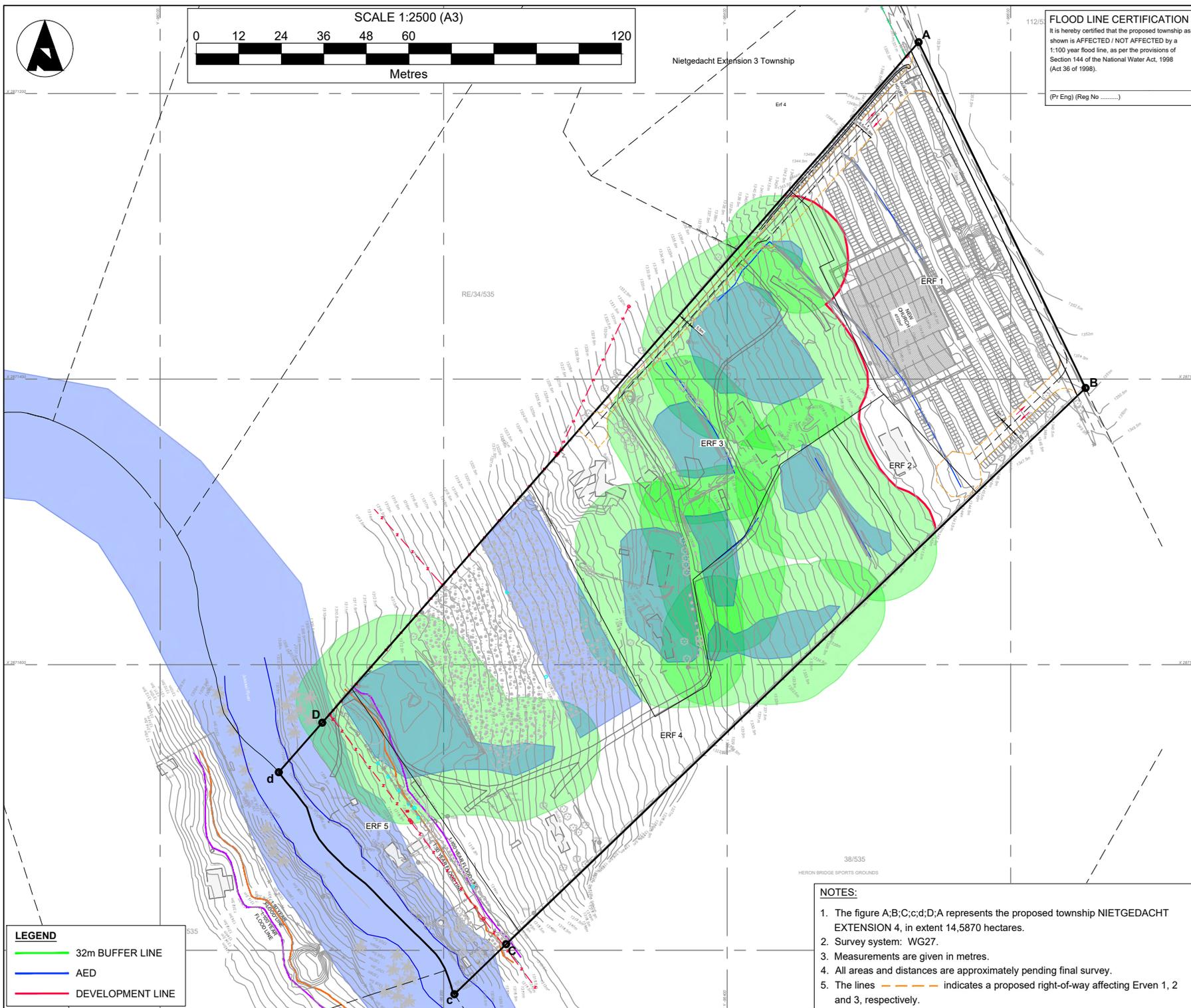
LOCAL AUTHORITY
CITY OF JOHANNESBURG

CONTOURS
 Contour Interval: 0,5m
 Datum (AHSL): Sea Level
 Surveyed by: Geometric Surveys
 Date of Survey: June 2025

CLIENT
Impact for Christ Ministries

SERVITUDE NOTES

LAYOUT PLAN No. : -
 DRAWING No. : **S2506_4-8**
 Date : **October 2025**
 Copyright : **Synchronicity DP**



LEGEND

- 32m BUFFER LINE
- AED
- DEVELOPMENT LINE

- NOTES:**
- The figure A;B;C;d;A represents the proposed township NIETGEDACHT EXTENSION 4, in extent 14,5870 hectares.
 - Survey system: WG27.
 - Measurements are given in metres.
 - All areas and distances are approximately pending final survey.
 - The lines - - - indicates a proposed right-of-way affecting Erven 1, 2 and 3, respectively.

- Proposed Stormwater Layout, Longitudinal Sections & Setting Out



- GENERAL NOTES**
1. THE CONTRACTOR IS TO CONFIRM ALL DIMENSIONS ON SITE AND TO REPORT ANY DISCREPANCIES TO THE ENGINEER IMMEDIATELY.
 2. ALL WORK IS TO BE EXECUTED IN ACCORDANCE WITH THE PROVISIONS OF SANS 1200 AS WELL AS ANY ADDITIONAL REQUIREMENTS STIPULATED.
 3. NOTE THAT NO OTHER BURIED SERVICES ARE INDICATED ON THIS DRG.
 4. DIMENSIONS ARE NOT TO BE SCALED FROM THIS DRAWING.
 5. THIS DRAWING IS NOT TO BE USED FOR CONSTRUCTION UNLESS SPECIFICALLY DIRECTED OR INDICATED.
 6. THE CONTRACTOR IS REQUIRED TO MINIMISE DUST AND NOISE NUISANCE TO ALL SURROUNDING PROPERTIES.
 7. A MINIMUM NOTICE PERIOD OF 24 HOURS IS REQUIRED FOR ANY INSPECTION.
 8. CONTRACTOR IS TO PROVIDE A DETAILED SCHEDULE OF INFORMATION REQUIRED INDICATING ALL SUCH DATES.
 9. THE PROPOSED WORK MUST BE SUPERVISED BY A REPRESENTATIVE OF TRIPLE 3 ENGINEERING (PTY) LTD.
 10. THE CONTRACTOR MUST HAVE THE FOLLOWING ITEMS IN PLACE PRIOR TO CONSTRUCTION IN THE ROAD RESERVE:
 - a. A WAYLEAVE/CONSTRUCTION PERMIT FROM SERVICES DEPARTMENTS ARE ON SITE PRIOR TO CONSTRUCTION IN THE ROAD RESERVE.
 - b. ANY CONNECTION TO THE EXISTING SERVICES TO BE CLARIFIED WITH THE RESPECTIVE SERVICE DEPARTMENTS.
 - c. ALL REGULATIONS IN TERMS OF THE OHS ACT TO BE ADHERED TO DURING CONSTRUCTION.
 - d. THE CONTRACTOR MUST BE IN POSSESSION OF ADEQUATE PUBLIC LIABILITY INSURANCE.

LEGEND:

REVISIONS

NO.	DRAWN	DATE	REVISION
A	RA	2025-11-19	FOR REPORT STAGE

REFERENCE DRAWINGS

BENCH MARKS

BM	Y	X	Z

PERSONS RESPONSIBLE

DESIGNED	NAME	SIGNATURE	DATE
	RICARDO ALHO Draughtsman		2025-11-19
	RICARDO ALHO Draughtsman		2025-11-19
	DAVIDE LE ROUX PR Tech (Eng)		2025-11-19
	DAVIDE LE ROUX PR Tech (Eng)		2025-11-19

APPROVED FOR TRIPLE 3 ENGINEERING
 REGISTERED PERSON: DAVIDE LE ROUX
 PR TECH (REG) 029019195
 DATE: 2025-11-19

IN ASSOCIATION WITH

LOCAL AUTHORITY

CLIENT

CONSULTANTS

TRIPLE 3 GROUP
 TRIPLE 3 ENGINEERING
 Tel: +27 (0) 10 745 1333
 Email: info@triple3.co.za
 Web: www.triple3.co.za

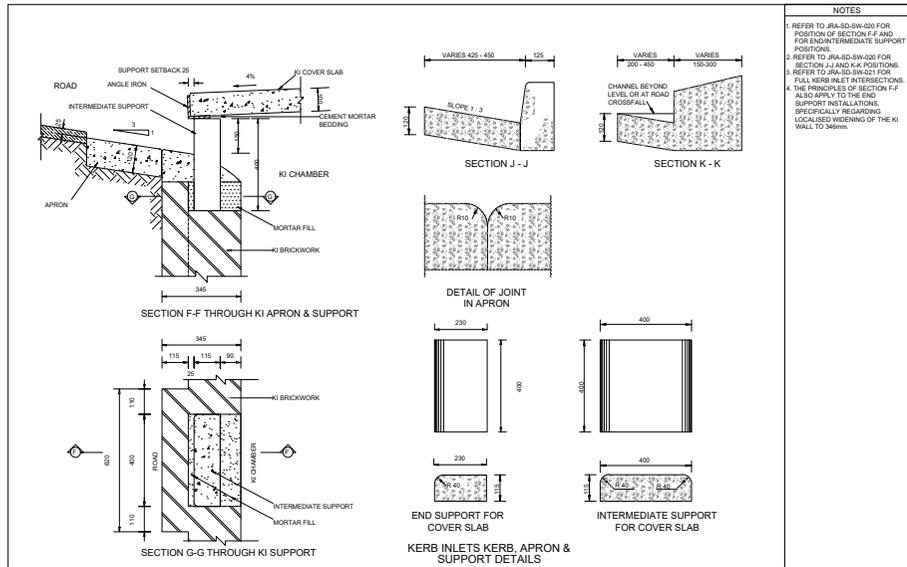
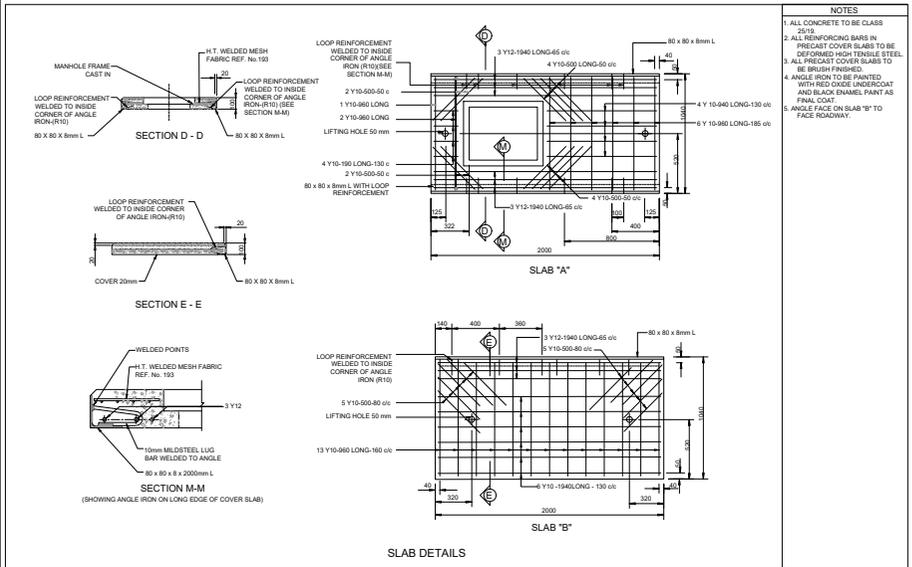
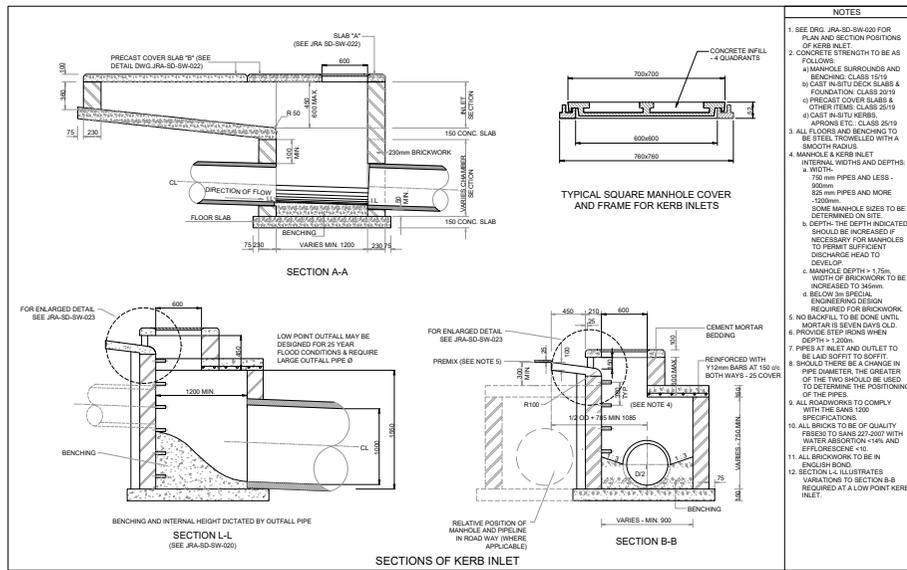
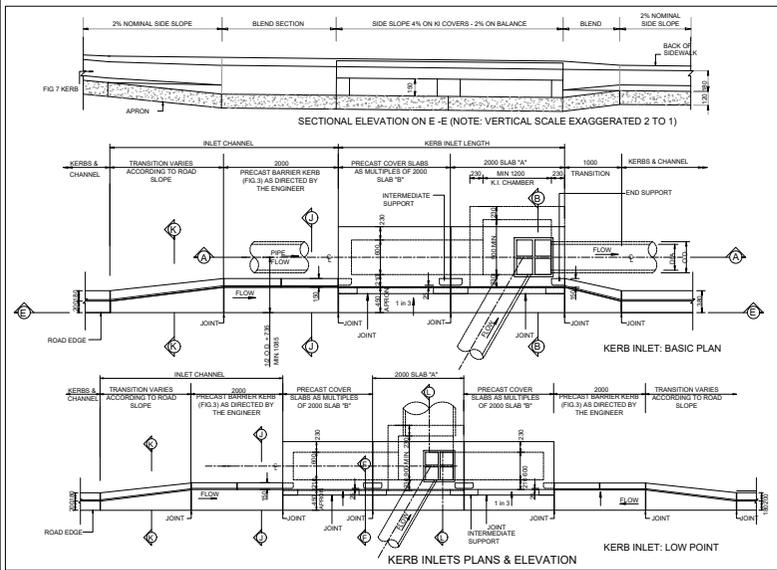
PROJECT DESCRIPTION

TOWNSHIP NIETGEDACHT EXTENSION 4
PROPOSED STORMWATER LAYOUT

STATUS	SCALE	SIZE	DRAWING NUMBER	REV
Concept Drawing	1:1 000	A1	397 03 01	A

Annexure E
- Attenuation Pond Detail

Annexure F(1-3)
- Stormwater Details



STATUS: Concept Drawing

SCALE: NTS

SIZE: A1

DRAWING NUMBER: 390 03 10 1

REV: A

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LEGEND:

REVISIONS

NO.	DRAWN	DATE	REVISION
A	RA	2024-11-05	FOR COMMENT

REFERENCE DRAWINGS

BENCH MARKS

BM	Y	X	Z

PERSONS RESPONSIBLE

DESIGNED	DRAWN	APPROVED	CHECKED
GAVIE LE ROUX PRT Tech (Eng)	RICARDO ALHO Design/Draw	GAVIE LE ROUX PRT Tech (Eng)	GAVIE LE ROUX PRT Tech (Eng)

APPROVED FOR TRIPLE 3 ENGINEERING

REGISTERED PERSON: GAVIE LE ROUX
PRT Tech (Eng)
SIGNED: _____
DATE: 2024-11-06

IN ASSOCIATION WITH

LOCAL AUTHORITY

JOHANNESBURG ROADS AGENCY
66 SAUER STREET OUR JEPPE STREET
JOHANNESBURG
2000
PRIVATE BAG 670
BRAAMFONTEIN 2017

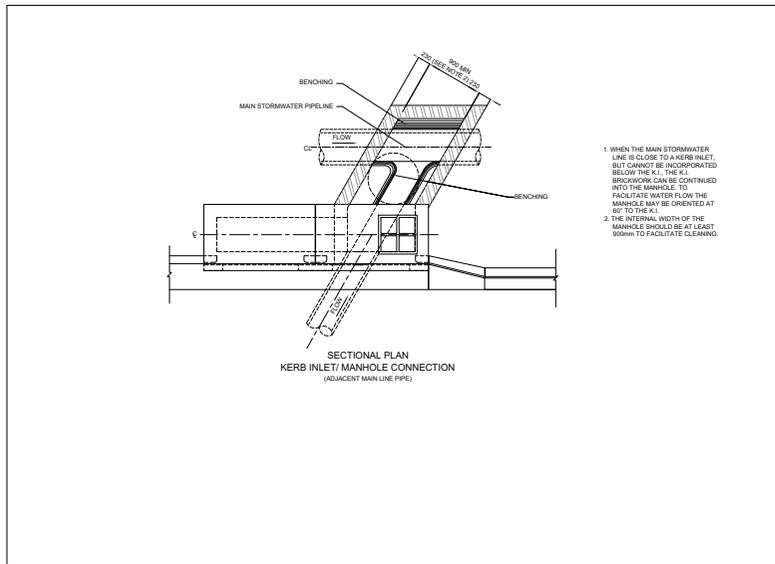
CLIENT

CONSULTANTS

TRIPLE 3 ENGINEERING
1st - 27 (P) 40 745 1333
Email: info@triple3.co.za
Web: www.triple3.co.za

PROJECT DESCRIPTION

CARLSWALD EXT 44 ON ERF 51
TYPICAL STORMWATER DETAILS
SHEET 1

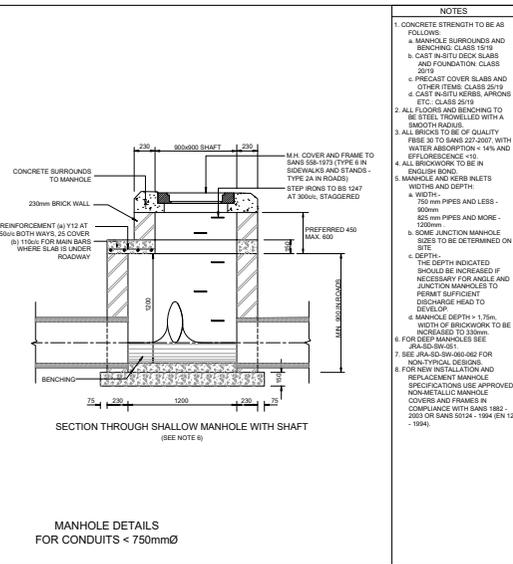
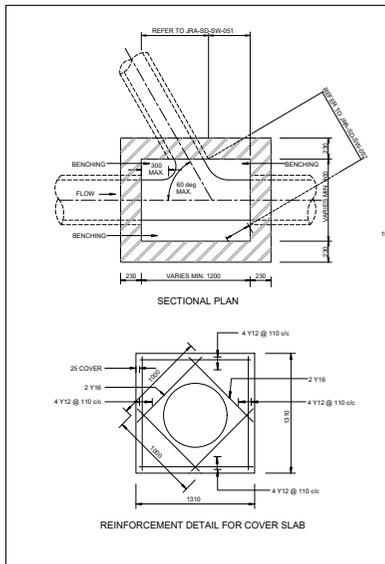


LEGEND

1. WHEN THE MAIN STORMWATER LINE IS CLOSE TO A KERB INLET, BUT CANNOT BE INCORPORATED BELOW THE 1.1m CLEARANCE, REINFORCING CAN BE CONTINUED INTO THE MANHOLE TO FACILITATE WATER FLOW. THE MANHOLE MAY BE ORIENTED AT 90° TO THE 1.1m CLEARANCE.

2. THE INTERNAL WIDTH OF THE MANHOLE SHOULD BE AT LEAST 900mm TO FACILITATE CLEANING.

NOTES



NOTES

- CONCRETE STRENGTH TO BE AS FOLLOWS:
 - MANHOLE BURROUND AND BENCHING CLASS F15/15
 - CAST IN-SITU DECK SLABS AND FOUNDATION CLASS 20/15
 - PRECAST COVER SLABS AND OTHER ITEMS CLASS 25/15
 - CAST KERB ARCHES, ARCHES AND OTHER ITEMS CLASS 25/15
- ALL FLOORS AND BENCHING TO BE STEEL TROWELLED WITH A FINISH TO BE:
 - SMOOTH TO BE:
 - WATER ABSORPTION < 14% AND EFFLORESCENCE < 4%
 - ALL ENGLISH BURNISH TO BE IN ENGLISH BOND.
 - MANHOLE AND KERB INLETS WIDTH AND DEPTH:
 - 100mm
 - 750mm PIPES AND LESS - 150mm
 - 825mm PIPES AND MORE - 150mm
 - SOME JUNCTION MANHOLE SIZES TO BE DETERMINED ON SITE.
 - THE DEPTH INDICATED SHOULD BE INCREASED IF NECESSARY FOR ANGLE AND JUNCTION MANHOLES TO PERMIT SUFFICIENT DISCHARGE HEAD TO DEVELOP.
 - MANHOLE DEPTH > 1.75m, WIDTH OF BRICKWORK TO BE INCREASED TO 250mm (REFER TO JRA-S0-SW-051)
 - SEE JRA-S0-SW-050 FOR NON-TYPICAL DESIGNS.
 - FOR UNUSUAL SIZES AND REPLACEMENT MANHOLE SPECIFICATIONS USE APPROVED NON-METALLIC MANHOLE COVERS AND FRAMES IN COMPLIANCE WITH SANS 1882-1:2003 OR SANS 1024-1:1994 (EN 13494).

GENERAL NOTES

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LEGEND:

REVISIONS

NO.	DRAWN	DATE	REVISION
A	RA	2024-11-05	FOR COMMENT

REFERENCE DRAWINGS

BENCH MARKS

BM	Y	X	Z

PERSONS RESPONSIBLE

DESIGNED	DRAWN	APPROVED	CHECKED
GAIVIE LE ROUX PR Tech (Eng)	RICARDO ALMID Design	GAIVIE LE ROUX PR Tech (Eng)	GAIVIE LE ROUX PR Tech (Eng)

APPROVED FOR TRIPLE'S ENGINEERING

REGISTERED PERSON: GAIVIE LE ROUX
PR Tech (Eng) 2020/10/16

IN ASSOCIATION WITH

LOCAL AUTHORITY

JOHANNESBURG ROADS AGENCY
66 SAUER STREET CAR PARK STREET
JOHANNESBURG
2000
PRIVATE BAG 170
BRAMFONTEIN 2017

CLIENT

CONSULTANTS

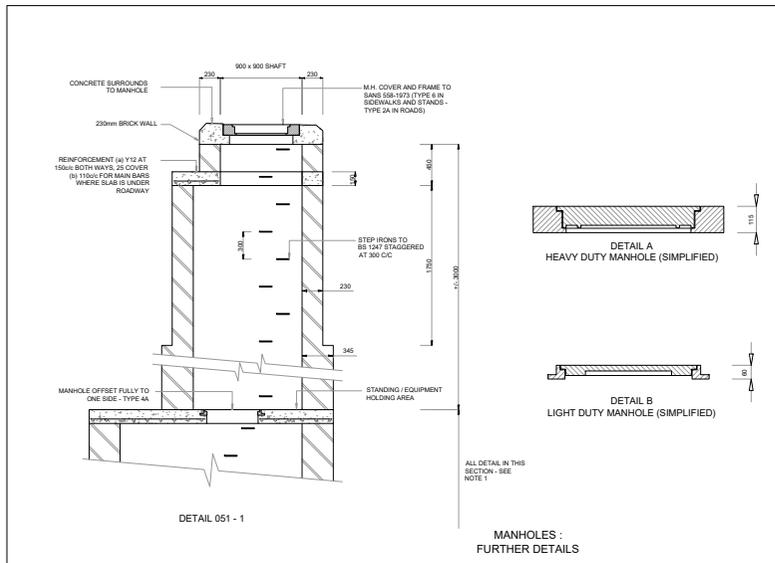
TRIPLE 3 GROUP
16 - 171 10 745 1333
Email: info@triple3.co.za
Web: www.triple3.co.za

PROJECT DESCRIPTION

CARLSWALD EXT 44 ON ERF 51
TYPICAL STORMWATER DETAILS
SHEET 2

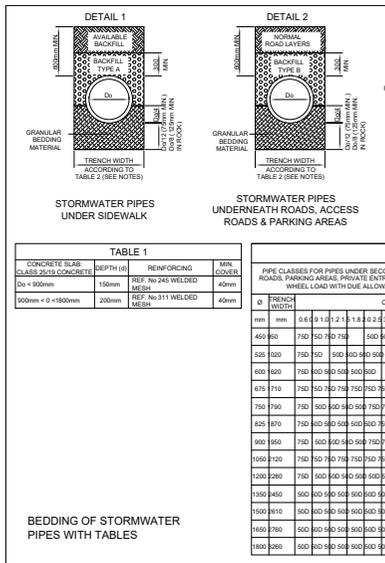
STATUS

Scale	Size	Drawing Number	Rev
NTS	A1	390 03	10 2 A



NOTES

- DETAIL 051 - 1 SHOWS A DEEP MANHOLE BELOW 3m. THE MANHOLE IS SUBJECT TO SITE SPECIFIC / DEPTH ENGINEERING DESIGN. THE DETAIL GIVEN HERE OF THE LOWER SLAB IS FOR ILLUSTRATION PURPOSES ONLY.
- THE SALIENT DESIGN FEATURES OF A DEEP MANHOLE WITH AN INTERMEDIATE LANDING / STAGING SLAB, AS SHOWN, INCLUDE:
 - ADJACENT EXISTENT STAGING AREA.
 - OFFSET MANHOLE TO THE NEXT LEVEL.
 - OFFSET OF THE LOWER STEP IRONS.
- FOR SPECIFIC MANHOLE DETAILS REFER TO SANS 508 - 1973.
- FOR NEW INSTALLATION AND REPLACEMENT MANHOLE SPECIFICATIONS USE APPROVED NON-METALLIC MANHOLE COVERS & FRAMES IN COMPLIANCE WITH SANS 1882-2003 OR SANS 1024-1:1994 (EN 13494).



LEGEND

D = PIPE CLASS
Ø = INTERNAL PIPE DIAMETER

NOTES

- ALL PIPES BELOW SIDEWALKS & OPEN AREAS TO BE CLASS 50+ EXCEPT WHERE COVER < 50 ON 1200mm Ø AND GREATER THE CLASS OF THE PIPES ARE TO BE INCREASED TO 75+.
- FOR STORMWATER PIPES BELOW STREETS & MAIN ROUTES SEE TABLE 2.
- THE CONTRACTOR SHALL AT ALL TIMES ADHERE TO THE SAFETY PRECAUTIONS AS SET OUT IN SANS 10010-2008.
- IF TRENCHES ARE 300mm WIDER THAN THE SPECIFIED WIDTH IN TABLE 2 IT MAY BE NECESSARY TO CHANGE THE PIPE CLASS.
- BEDDING:
 - NORMAL BEDDING ACCORDING TO DETAIL 1.
 - BEDDING ACCORDING TO DETAIL 2.
 - CONCRETE SLAB OVER PIPE ACCORDING TO DETAIL 3.
 - CONCRETE BEDDING ACCORDING TO DETAIL 4.
- BEDDING MATERIAL:
 - SELECTED GRAVEL WITH # 4 & # 8 NETS OR PILES OF STONES LARGER THAN 20mm ORGANIC MATERIAL AND CLAY LUMPS. THE BEDDING MATERIAL AT THE SIDE OF THE PIPE MUST BE COMPACTED TO 90% MOD. ASD/TO IDENTIFY AFTER THE PIPE HAS BEEN Laid.
 - BACKFILL TYPE A.
 - THE MATERIAL USED MUST BE UNIFORM AND MUST BE COMPACTED TO 90% MOD. ASD/TO IDENTIFY IN LAYERS NOT MORE THAN 150mm AND MUST BE FREE OF:
 - ROOTS OF TREES, BUILDING RUBBLE AND ORGANIC.
 - CLAY LUMPS LARGER THAN 20mm.
 - STONES LARGER THAN 20mm.
 - BACKFILL TYPE B.
 - MINIMUM 03 MATERIAL ACCORDING TO THIS CLASSIFICATION COMPACTED TO A MIN. OF 90% MOD. ASD/TO IDENTIFY IN LAYERS NOT MORE THAN 150mm.
 - MINIMUM PIPE SIZE TO BE 400mm DIAMETER.
 - CONNECTIONS FROM ERVEN TO MUNICIPAL SYSTEM TO BE 450mm.

TABLE 1

CONCRETE SLAB CLASS 25/15 CONCRETE	DEPTH (m)	REINFORCING	MIN. COVER
D _u < 900mm	150mm	REF. TO SANS 10113 MESH	40mm
900mm < D _u < 1800mm	200mm	REF. TO SANS 10113 WELDED MESH	40mm

TABLE 2

PIPE CLASSES FOR PIPES UNDER SECONDARY STREETS, LIGHT ACCESS ROADS, PARKING AREAS, PRIVATE ENTRANCES AND SIDEWALKS FOR 400mm WHEEL LOAD WITH DUE ALLOWANCE FOR IMPACT LOADS.	TRENCH WIDTH (mm)	COVER (mm)
400 600	1000	1000
500 600	1000	1000
600 600	1000	1000
750 600	1000	1000
900 600	1000	1000
1000 600	1000	1000
1200 600	1000	1000
1500 600	1000	1000
1800 600	1000	1000

TABLE 3

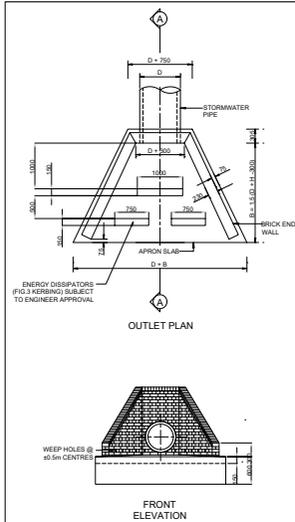
PIPE CLASSES FOR PIPES UNDER ROUTES FOR H ₁₈ WHEEL LOADS OF EIGHT BAN WHEEL LOADS WITH DUE ALLOWANCE FOR IMPACT LOADS.	TRENCH WIDTH (mm)	COVER (mm)
400 600	1000	1000
500 600	1000	1000
600 600	1000	1000
750 600	1000	1000
900 600	1000	1000
1000 600	1000	1000
1200 600	1000	1000
1500 600	1000	1000
1800 600	1000	1000

LEGEND

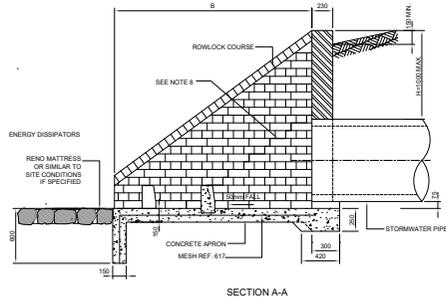
D = PIPE CLASS
Ø = INTERNAL PIPE DIAMETER

NOTES

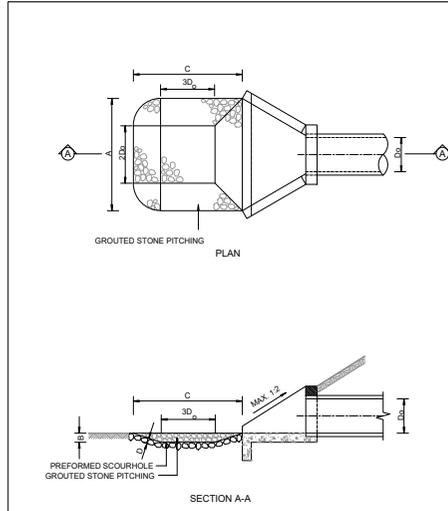
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 - BACKFILL TYPE A.
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DETAIL OF TYPICAL BRICK OUTLET STRUCTURE



- LEGEND**
- 1. PIPE COVER DIAETER
 - 2. HEIGHT OF ROWLOCK ABOVE PIPE
 - 3. LENGTH OF APRON SLAB
- NOTES**
1. THE MATERIAL FOR A DEPTH OF 150mm UNDER THE APRON SLAB MUST BE COMPACTED TO A MINIMUM DENSITY OF 85% OF THE MOD. ASDHTO DENSITY.
 2. ALL CONCRETE TO BE CLASS 20/19.
 3. ENERGY BREAKERS MUST BE PROVIDED WHEN REQUIRED BY THE ENGINEER.
 4. THIS OUTLET STRUCTURE ONLY TO BE USED WHEN PIPE SIZE IS LESS THAN 600mm Ø.
 5. ALL BRICKS TO BE OF QUALITY FREESTO STANS 227-2007 WITH WATER ABSORPTION <math>< 4\%</math> AND EFFLORESCENCE <math>< 1.0</math>.
 6. ALL BRICKWORK TO BE IN ENDS-ON-BOND.
 7. NO PLASTERING OF BRICKWORK WILL BE ALLOWED.
 8. THE LOWER PORTION OF ANY BRICKWORK GREATER THAN 1m IN HEIGHT SHALL BE INCREASED TO 3mm TO A MAX. OVERALL HEIGHT OF 1.75m.
 9. BRICK SAMPLES SHALL BE SUBMITTED FOR TESTING.
 10. IN TERMS OF THE NATIONAL WATER ACT 36 OF 1956, A RATE OF DISCHARGE FROM AN OUTLET STRUCTURE SHALL NOT EXCEED 1m/sec AND SHALL NOT BE GREATER THAN 100mm IN DEPTH. IF DESIGN INDICATIONS ARE THAT THESE FIGURES WILL BE EXCEEDED, ADDITIONAL ENERGY DISSIPATION MEASURES WILL BE REQUIRED.
 11. REFER TO DWGS JRA-SO-SW-081 & 062 FOR FURTHER INFORMATION.



DIMENSIONS			
FOR SHALLOW STILLING BASIN (SEE NOTE)		FOR DEEP STILLING BASIN (SEE NOTE)	
1	2,333 (mm)	Ø50	2,333 (mm)
2	2,333 (mm)	A	2,333 (mm)
3	50 (mm)	B	50 (mm)
4	60 (mm)	C	60 (mm)
5	20 (mm)	D	20 (mm)

THIS TYPE OF EROSION PROTECTION IS NOT TO BE USED IN DOLOMITIC AREAS

- NOTES**
1. REFER TO DRG. JRA-SO-SW-080 OR JRA-SO-SW-081 FOR DETAILS OF THE OUTLET STRUCTURE.
 2. GROUDED STONE PITCHING TO BE DONE ACCORDING TO THE SANS 1200 STANDARDIZED SPECIFICATIONS.
 3. D = HEIGHT OF OUTLET PIPE COLLAR/BOX COLLAR.
 4. REFER TO THE SANRAL DRAINAGE MANUAL 1TH EDITION 2013 AND THE DRAINAGE MANUAL APPLICATION GUIDE 6TH EDITION 2013 FOR THE APPLICABILITY OF THE VARIOUS TYPES OF EROSION PROTECTION.

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LEGEND:

NO.	DRAWN	DATE	REVISION
A	RA	2024-11-05	FOR COMMENT

REVISIONS

NO.	DRAWN	DATE	REVISION
A	RA	2024-11-05	FOR COMMENT

REFERENCE DRAWINGS

NO.	DRAWN	DATE	REVISION
-----	-------	------	----------

BENCH MARKS

BM	Y	X	Z
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PERSONS RESPONSIBLE

DESIGNED	NAME	SIGNATURE	DATE
DESIGNED	GAVIE LE ROUX PR Tech (Eng)		2024-11-06
DRAWN	RICARDO ALMO Design		2024-11-06
APPROVED	GAVIE LE ROUX PR Tech (Eng)		2024-11-06
CHECKED	GAVIE LE ROUX PR Tech (Eng)		2024-11-06

APPROVED FOR TRIPLE 3 ENGINEERING

REGISTERED PERSON: GAVIE LE ROUX, PR TECH (ENG), 2020/19162

SIGNED: DATE: 2024-11-06

IN ASSOCIATION WITH

LOCAL AUTHORITY

JOHANNESBURG ROADS AGENCY
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JOHANNESBURG
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BRAAMFONTEIN 2017

CLIENT

CONSULTANTS

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TRIPLE 3 ENGINEERING
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PROJECT DESCRIPTION

CARLSWALD EXT 44 ON ERF 51
TYPICAL STORMWATER DETAILS
SHEET 3

STATUS	SCALE	SIZE	DRAWING NUMBER			REV
Concept Drawing	NTS	A1	390	03	10	3

- Attenuation Pond – CBA Analysis 1:5 Year Pre-development

Project **Nietgedacht Ext. 4** 2025/11/20

Engineer **Gawie le Roux**

Summary of Results No data input on this sheet

Developed by Chris Brooker PrEng

Version 1.3

Chris Brooker & Associates

cbrooker@iafrica.com



Region	Input	Computed
MAP	750 mm/year	Storm Td 55.1 min 0.9 hr
RI	5 year	= concentration time plus time to start runoff

Catchment	Input	Computed
Area	4.0 ha	Average Rainfall Intensity Op ten Noord & Stephenson Inland
Conc time Tc	40 min	46.9 mm/h
Rational C	0.28	Peak Rainfall Intensity Triangular Hyetograph 93.9 mm/h At time 21 mins

Storm	Input	Computed
Time to peak	0.4 ratio	Runoff Vol 483 m ³ = C x P x A
Time step	1 min	

Reservoir and Outlet Data

Pipe	U/S	D/S	Tower
No off	1	1 No	Crest Len 6 m C _{d(unsb)} 0.75
Dia	0.690	0.69 m	Crest Lvl 1.8 m C _{d(sub)} 0.62
Invert Lvl	0	0 m	C _h 0.85

Spillway	Input	Computed
Cd	1.60 for Q = Cd x L x h ^{0.67}	Crest Cd 1.40 for Q = Cd x L x h ^{0.67}
Width	5.0	Width 20.0
Invert Lvl	1.95	Invert Lvl 2.10
Free board	0.15	Free board 0.15

Reservoir Data

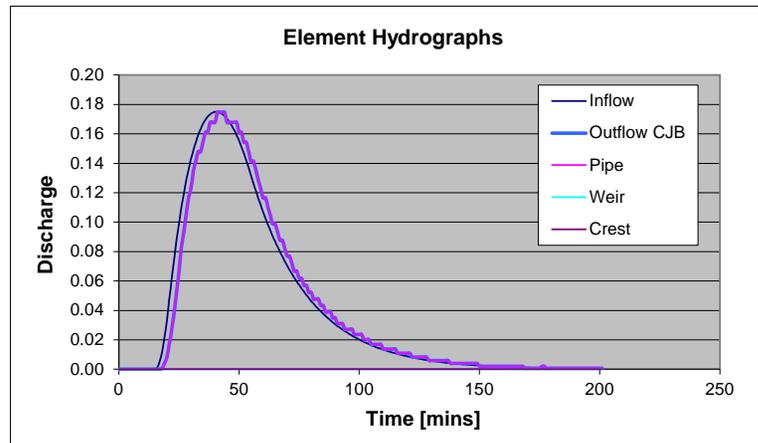
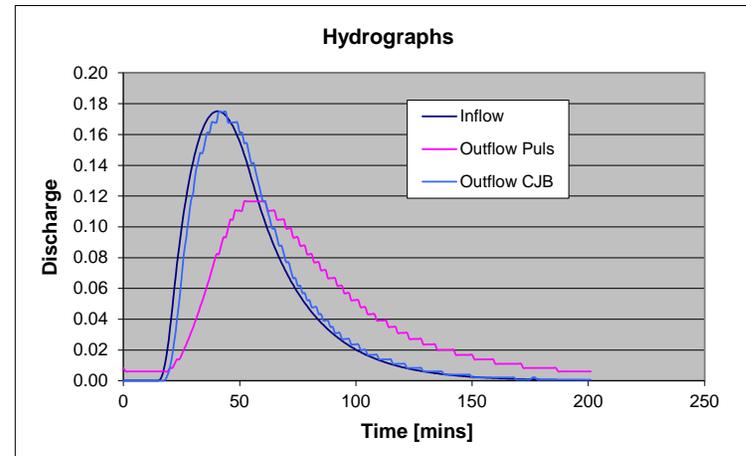
Stage	Depth	Area	Volume
0.00	0.00	1	0
0.30	0.30	800	120
0.60	0.60	800	360
0.90	0.90	800	600
1.20	1.20	800	840
1.50	1.50	800	1080
1.80	1.80	800	1320
2.10	2.10	800	1560

Initial Conditions

Stage	0.00 m
Depth	0.00 m
Vol	0 m ³
Area	0 m ²
Discharge	0.00 m ³ /s

Results Summary

Peaks	Value
Q _{in}	0.175 m ³ /s
Q _{out} CJB	0.175 m ³ /s
Q _{out} Puls	0.116 m ³ /s
Stage	0.401 m
Stored Vol	233 m ³
Q _{pipe}	0.175 m ³ /s
Q _{weir}	0.000 m ³ /s
Q _{crest}	0.000 m ³ /s



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Region	Input	Computed
MAP	750 mm/year	Storm Td 43.3 min 0.7 hr
RI	5 year	= concentration time plus time to start runoff

Catchment	Input	Computed
Area	4.0 ha	Average Rainfall Intensity Op ten Noord & Stephenson Inland
Conc time Tc	40 min	55.4 mm/h
Rational C	0.80	Peak Rainfall Intensity Triangular Hyetograph 110.8 mm/h At time 16 mins

Storm	Input	Computed
Time to peak	0.4 ratio	Runoff Vol 1279 m ³ = C x P x A
Time step	1 min	

Reservoir and Outlet Data

Pipe	U/S	D/S	Tower
No off	1	1 No	Crest Len 6 m C _{d(unsub)} 0.75
Dia	0.200	0.45 m	Crest Lvl 1.8 m C _{d(sub)} 0.62
Invert Lvl	0	0 m	C _h 0.85

Spillway	Input	Computed
Cd	1.60 for Q = Cd x L x h ^{0.67}	Cd 1.40 for Q = Cd x L x h ^{0.67}
Width	5.0	Width 20.0
Invert Lvl	1.95	Invert Lvl 2.10
Free board	0.15	Free board 0.15

Reservoir Data

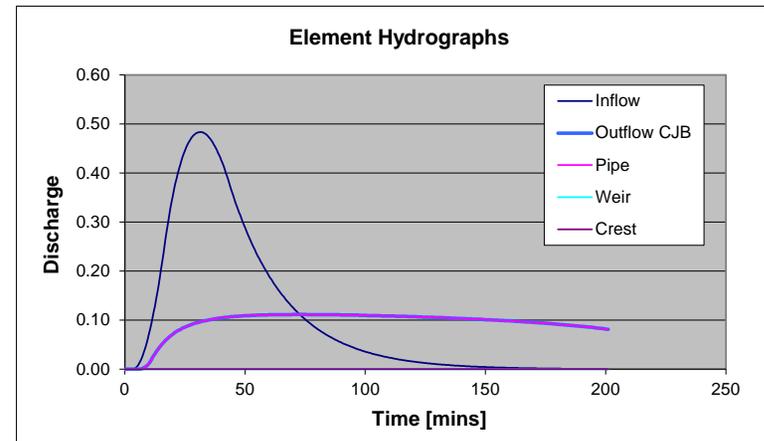
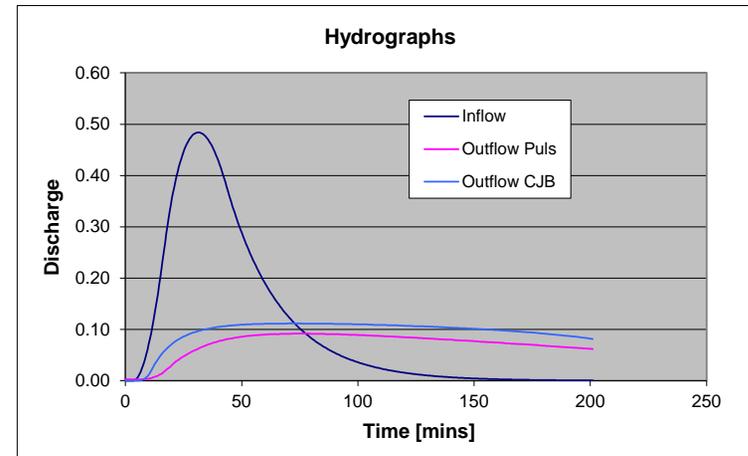
Stage	Depth	Area	Volume
0.00	0.00	1	0
0.30	0.30	800	120
0.60	0.60	800	360
0.90	0.90	800	600
1.20	1.20	800	840
1.50	1.50	800	1080
1.80	1.80	800	1320
2.10	2.10	800	1560

Initial Conditions

Stage	0.00 m
Depth	0.00 m
Vol	0 m ³
Area	0 m ²
Discharge	0.00 m ³ /s

Results Summary

Peaks	Value
Q _{in}	0.484 m ³ /s
Q _{out} CJB	0.112 m ³ /s
Q _{out} Puls	0.092 m ³ /s
Stage	1.849 m
Stored Vol	1356 m ³
Q _{pipe}	0.112 m ³ /s
Q _{weir}	0.000 m ³ /s
Q _{crest}	0.000 m ³ /s



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	Input	Computed	
Region			
MAP	750 mm/year	Storm Td	33.2 min
RI	25 year		0.6 hr
			= concentration time plus time to start runoff

Catchment		<u>Average Rainfall Intensity</u>	
Area	4.0 ha	Op ten Noord & Stephenson	Inland
Conc time Tc	25 min		106.5 mm/h
Rational C	0.35	Peak Rainfall Intensity Triangular Hyetograph	
			213.0 mm/h At time 13 mins

Storm		Runoff Vol	
Time to peak	0.4 ratio	825 m ³	= C x P x A
Time step	1 min		

Reservoir and Outlet Data

Pipe	U/S	D/S	Tower			
No off	1	1 No	Crest Len	6 m	C _{d(unsub)}	0.75
Dia	0.947	0.947 m	Crest Lvl	1.8 m	C _{d(sub)}	0.62
Invert Lvl	0	0 m			C _h	0.85

Spillway		Crest	
Cd	1.60 for Q = Cd x L x h ^{0.67}	Cd	1.40 for Q = Cd x L x h ^{0.67}
Width	5.0	Width	20.0
Invert Lvl	1.95	Invert Lvl	2.10
Free board	0.15	Free board	0.15

Reservoir Data

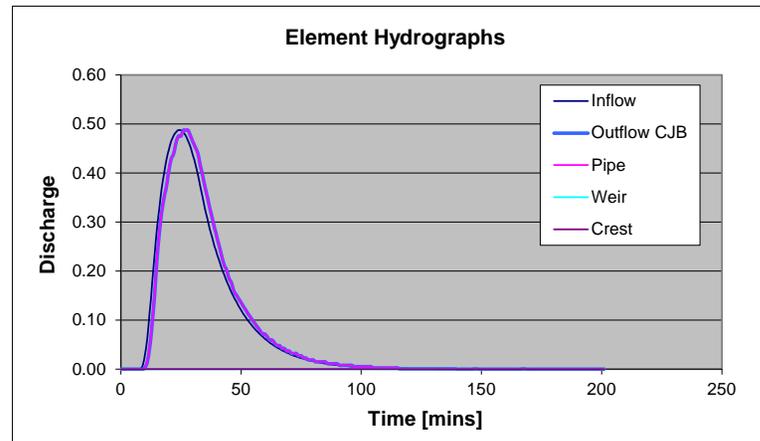
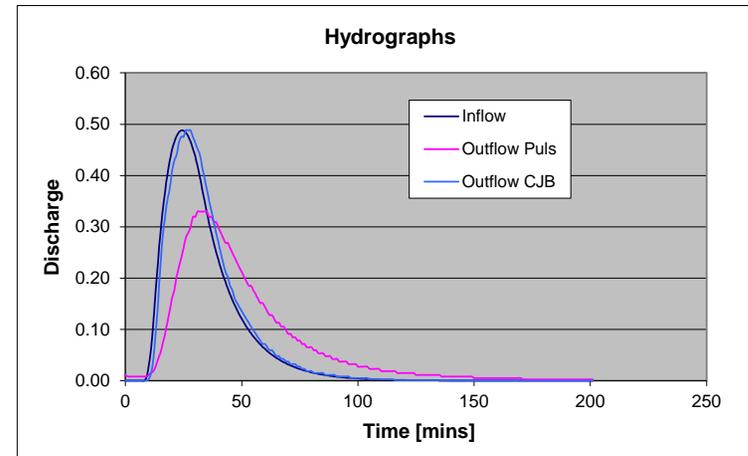
Stage	Depth	Area	Volume
0.00	0.00	1	0
0.30	0.30	800	120
0.60	0.60	800	360
0.90	0.90	800	600
1.20	1.20	800	840
1.50	1.50	800	1080
1.80	1.80	800	1320
2.10	2.10	800	1560

Initial Conditions

Stage	0.00 m
Depth	0.00 m
Vol	0 m ³
Area	0 m ²
Discharge	0.00 m ³ /s

Results Summary

Peaks			
Q _{in}	0.488 m ³ /s		
Q _{out} CJB	0.488 m ³ /s	Q _{pipe}	0.488 m ³ /s
Q _{out} Puls	0.330 m ³ /s	Q _{weir}	0.000 m ³ /s
Stage	0.644 m	Q _{crest}	0.000 m ³ /s
Stored Vol	404 m ³		



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Region	Input	Computed
MAP	750 mm/year	Storm Td 26.5 min 0.4 hr
RI	25 year	= concentration time plus time to start runoff

Catchment	Input	Computed
Area	4.0 ha	Average Rainfall Intensity Op ten Noord & Stephenson Inland
Conc time Tc	25 min	121.9 mm/h
Rational C	0.85	Peak Rainfall Intensity Triangular Hyetograph 243.7 mm/h At time 10 mins

Storm	Input	Computed
Time to peak	0.4 ratio	Runoff Vol 1831 m ³ = C x P x A
Time step	1 min	

Reservoir and Outlet Data

Pipe	U/S	D/S	Tower
No off	1	1 No	Crest Len 6 m C _{d(unsub)} 0.75
Dia	0.230	0.45 m	Crest Lvl 1.8 m C _{d(sub)} 0.62
Invert Lvl	0	0 m	C _h 0.85

Spillway	Input	Computed
Cd	1.60 for Q = Cd x L x h ^{0.67}	Cd 1.40 for Q = Cd x L x h ^{0.67}
Width	5.0	Width 20.0
Invert Lvl	1.95	Invert Lvl 2.10
Free board	0.15	Free board 0.15

Reservoir Data

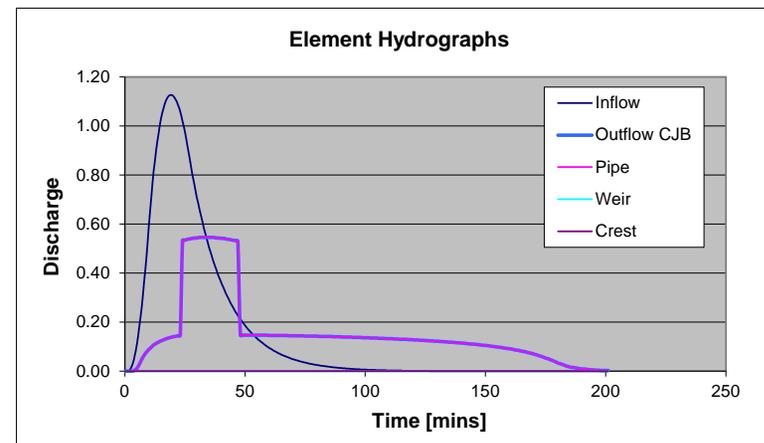
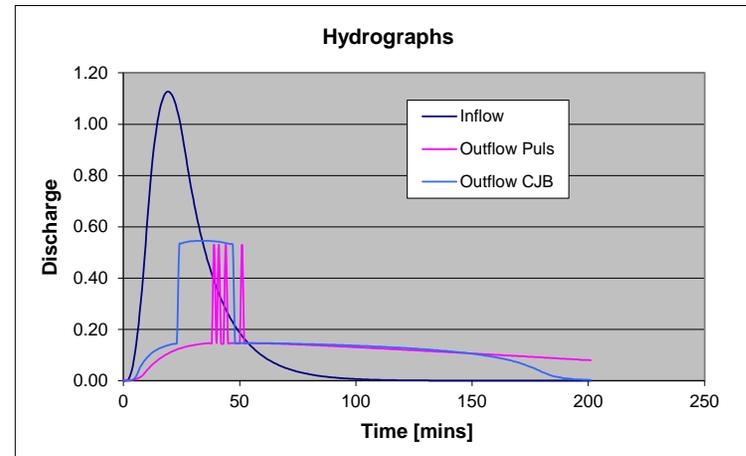
Stage	Depth	Area	Volume
0.00	0.00	1	0
0.30	0.30	800	120
0.60	0.60	800	360
0.90	0.90	800	600
1.20	1.20	800	840
1.50	1.50	800	1080
1.80	1.80	800	1320
2.10	2.10	800	1560

Initial Conditions

Stage	0.00 m
Depth	0.00 m
Vol	0 m ³
Area	0 m ²
Discharge	0.00 m ³ /s

Results Summary

Peaks	Value
Q _{in}	1.127 m ³ /s
Q _{out} CJB	0.546 m ³ /s
Q _{out} Puls	0.531 m ³ /s
Stage	1.949 m
Stored Vol	1437 m ³
Q _{pipe}	0.546 m ³ /s
Q _{weir}	0.000 m ³ /s
Q _{crest}	0.000 m ³ /s



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	Input	Computed	
Region			
MAP	750 mm/year	Storm Td	16.9 min
RI	100 year		0.3 hr
			= concentration time plus time to start runoff

Catchment		<u>Average Rainfall Intensity</u>	
Area	4.7 ha	Op ten Noord & Stephenson	Inland
Conc time Tc	15 min		234.2 mm/h
Rational C	0.70	Peak Rainfall Intensity Triangular Hyetograph	
		468.5 mm/h	At time 6 mins

Storm		Runoff Vol	
Time to peak	0.4 ratio	2175 m ³	= C x P x A
Time step	1 min		

Reservoir and Outlet Data

Pipe	U/S	D/S	Tower				
No off	1	1 No	Crest Len	6 m	C _{d(unsub)}	0.75	
Dia	2.112	2.112 m	Crest Lvl	1.8 m	C _{d(sub)}	0.62	
Invert Lvl	0	0 m			C _h	0.85	

Spillway		Crest	
Cd	1.60 for Q = Cd x L x h ^{0.67}	Cd	1.40 for Q = Cd x L x h ^{0.67}
Width	16.0	Width	20.0
Invert Lvl	1.95	Invert Lvl	2.10
Free board	0.15	Free board	0.15

Reservoir Data

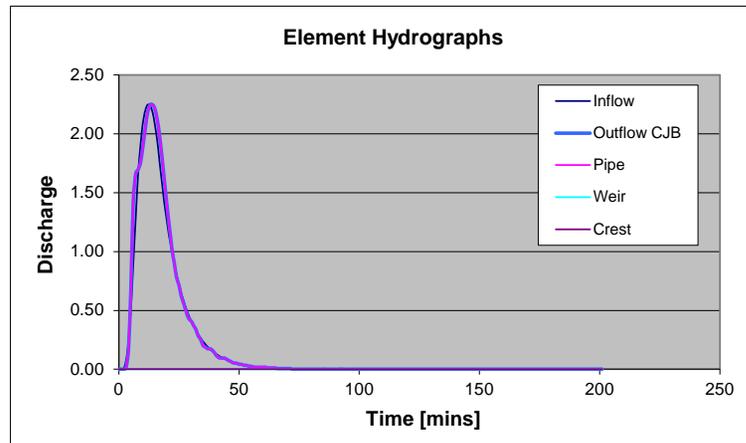
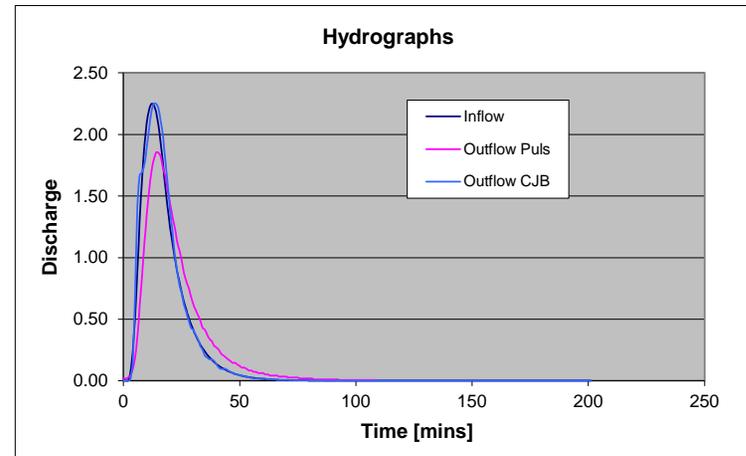
Stage	Depth	Area	Volume
0.00	0.00	1	0
0.30	0.30	800	120
0.60	0.60	800	360
0.90	0.90	800	600
1.20	1.20	800	840
1.50	1.50	800	1080
1.80	1.80	800	1320
2.10	2.10	800	1560

Initial Conditions

Stage	0.00 m
Depth	0.00 m
Vol	0 m ³
Area	0 m ²
Discharge	0.00 m ³ /s

Results Summary

Peaks			
Q _{in}	2.248 m ³ /s		
Q _{out} CJB	2.248 m ³ /s	Q _{pipe}	2.248 m ³ /s
Q _{out} Puls	#N/A m ³ /s	Q _{weir}	0.000 m ³ /s
Stage	1.045 m	Q _{crest}	0.000 m ³ /s
Stored Vol	701 m ³		



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	Input	Computed	
Region			
MAP	750 mm/year	Storm Td	15.6 min
RI	100 year		0.3 hr
			= concentration time plus time to start runoff

Catchment		<u>Average Rainfall Intensity</u>	
Area	4.7 ha	Op ten Noord & Stephenson	Inland
Conc time Tc	15 min		243.5 mm/h
Rational C	0.90	Peak Rainfall Intensity Triangular Hyetograph	
		487.0 mm/h	At time 6 mins

Storm		Runoff Vol	
Time to peak	0.4 ratio	2677 m ³	= C x P x A
Time step	1 min		

Reservoir and Outlet Data

Pipe	U/S	D/S	Tower			
No off	1	1 No	Crest Len	6 m	C _{d(unsub)}	0.75
Dia	0.200	0.45 m	Crest Lvl	1.8 m	C _{d(sub)}	0.62
Invert Lvl	0	0 m			C _h	0.85

Spillway		Crest	
Cd	1.60 for Q = Cd x L x h ^{0.67}	Cd	1.40 for Q = Cd x L x h ^{0.67}
Width	16.0	Width	20.0
Invert Lvl	1.95	Invert Lvl	2.10
Free board	0.15	Free board	0.15

Reservoir Data

Stage	Depth	Area	Volume
0.00	0.00	1	0
0.30	0.30	800	120
0.60	0.60	800	360
0.90	0.90	800	600
1.20	1.20	800	840
1.50	1.50	800	1080
1.80	1.80	800	1320
2.10	2.10	800	1560

Initial Conditions

Stage	0.00 m
Depth	0.00 m
Vol	0 m ³
Area	0 m ²
Discharge	0.00 m ³ /s

Results Summary

Peaks			
Q _{in}	2.817 m ³ /s		
Q _{out} CJB	2.060 m ³ /s	Q _{pipe}	0.572 m ³ /s
Q _{out} Puls	1.904 m ³ /s	Q _{weir}	1.487 m ³ /s
Stage	2.104 m	Q _{crest}	0.000 m ³ /s
Stored Vol	1575 m ³		

