CIVIL CONCEPTS
Consulting Civil and Structural Engineers

PTN 13 BOSCHKOP 543-JR ORGANIC WASTE COMPOSTING AND PELLETING FACILITY

STORMWATER MANAGEMENT AND CIVIL DESIGN REPORT

REPORT NO: C2868/SMR/001
REVISION 3
APRIL 2021

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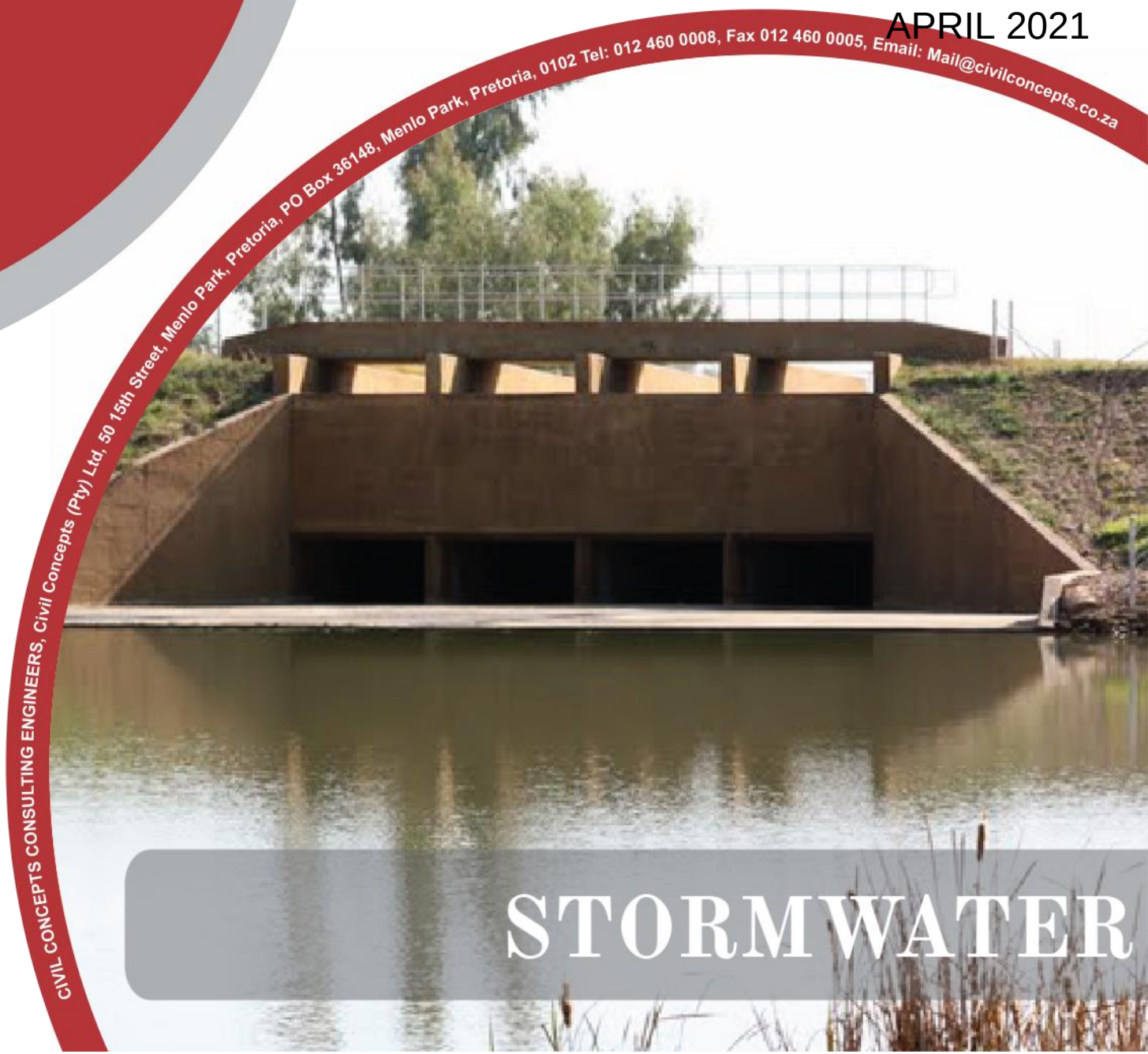

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. WATER USE LICENCE – CIVIL DESIGN SUMMARY

The following information are provided in order to assist in assessing this report from a Civil Design perspective with specific reference to requirements as set out from a Water Use Licence perspective. Note that detailed information can be found under the applicable sections of the report.

Area Concerned:	Portion 13 of the Farm Boschkop 543-JR
Quaternary Catchment:	A23B
Water Use applicable:	21 (b) Storing of water
Status of Application:	New application
Type of Facility:	Stormwater retention dams with earth embankments
Storage Capacity:	1764m^3 & 4096 m^3
Maximum Height of wall:	1.5m
Spillway and Outlet:	Not applicable due to retention of all water
Instrumentation:	Not applicable
Sealing/Waterproofing of structure:	All embankments and retention dam floors to be compacted to 93% Maximum Dry Density, topsoiled and hydroseeded

2. INTRODUCTION

2.1 General Information

Civil Concepts (Pty) Ltd were appointed as the Civil Engineers for the proposed development of an Organic Waste Composting and Pelletizing/Pelleting Facility Stormwater Management Situated on Portion 13 of the Farm Boschkop 543-JR. As part of the development process, a Stormwater Management Plan and Design Report is required for the area of the proposed development and surrounds. This report will address the details of the proposed Stormwater Management Plan and Design Report for Portion 13 of the Farm Boschkop 543-JR.

The proposed development is bounded by:

- Portion 2, Portion 3 and Portion 4 of the Farm Boschkop 543-JR to the north;
- An existing gravel road (proposed Class 3 District Distributor), intersecting with the R25 to the west;
- An existing gravel road (proposed Class 3 District distributer), Portion 18 and Portion R/1 of the Farm Boschkop 543-JR to the south;
- Portion 14 of the Farm Boschkop 543-JR and an existing gravel road (proposed Class 4 Residential Collector) to the east.

Refer to **Annexure A** for the Locality Plan.

2.2 Property Owner / Developer Information

Astral Operations Ltd
Reg. No: 1947/027453/06

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Lynnwood Ridge
Pretoria
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Physical Address:
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Responsible Person: Mr. Basson Viljoen.

2.3 Consulting Engineers

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Postal Address:
PO Box 36148
Menlo Park
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Physical Address:
50, 15th Street
Menlo Park
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0081

Tel: (012) 460 0008
Mail: hannes@civilconcepts.co.za
Responsible Person: Mr. Hannes Welman (PrEng, Reg. No: 20180172).

2.4 Development Information

Portion 13 of the Farm Boschkop 543-JR has the current zoning as summarised in Table 1.1 below.

Portion	Land Use	Area (ha)
13	Undetermined	22.5

Table 2-1: Development Information

Below in Figure 1-1 is an extract from the City of Tshwane e-GIS system, confirming the existing zoning.

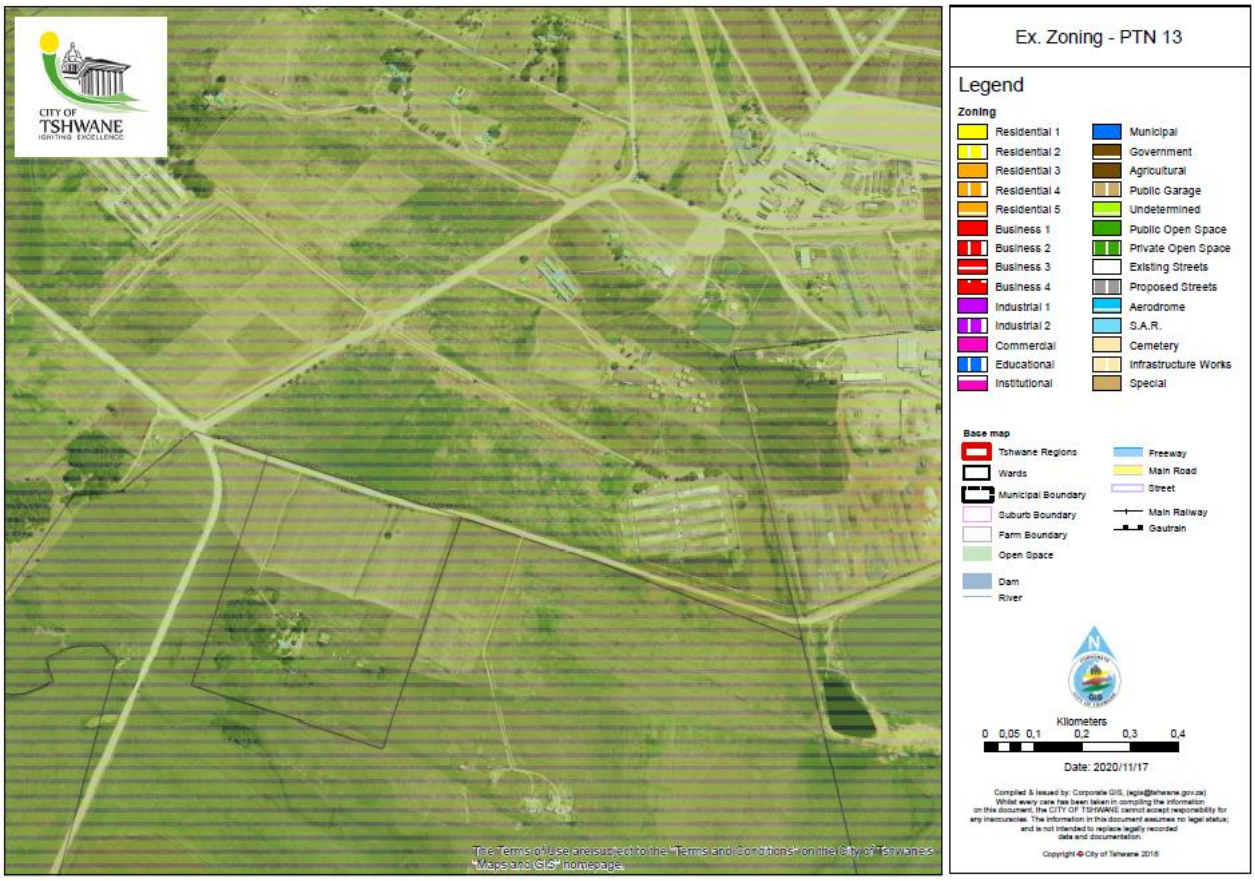


Figure 2-1: City of Tshwane GIS Extract

The e-GIS system illustrates that the entire area of the proposed development is currently zoned as "Undetermined". "Undetermined" zoning incorporates agricultural uses. Based on preliminary desk studies and site visits, the current pre-development land-use supports the majority of the development area to be zoned as "Agricultural." There are also a redundant chicken house that make up a portion of the development site, the current land-use is supportive of "agricultural" activities.

It is the intention of the owner that area be developed to accommodate the storage of compost and related manufacturing. The expected post-development land-uses are tabulated below in Table 1-2.

Catchment	Land Use	Area (ha)
D1.1	Composting	1.6378
D2	Pelletizing / Pelleting / Storage	2.9611
D3	Composting	4.9346
Total		**9.5335**

Table 2-2: Post-Development Land Uses

3. STUDY AREA

3.1 General Site Information

The total area of the development is 9.5335 ha.

The site is located on a part of Portion 13 of the Farm Boschkop 543-JR. It is a largely rural and undeveloped area with no existing formal (up to standard) civil services.

It is concluded from the large scale geological map that the site is underlain with shale with outcroppings of hard-rock at regular intervals. The site is covered with moderate grass cover and the ground was assumed to be varying from permeable to semi-permeable. This is based on expected clayey or residual shale conditions in the upper soil profile. The vegetation on site is split between light bush and farmlands.

The area of the proposed development is represented as Catchments D1.1, D2 and D3 as seen below in Figure 2-1. Catchment D1.1 and D3 currently consist of undeveloped farmlands and Catchment D2 is currently being used as a poultry farm.

As part of the stormwater master planning for development, the greater area contributing stormwater runoff was also analysed. The total study area is thus 63 ha, with Catchments D4, D4.1, D5 and D6 being included in addition to the development area.

It is the intention of the developer to convert the development area into an Organic Waste Composting and Pelletizing/Pelleting Facility. The proposed development strategy of the developer is to make use of the area demarcated as D2 for the industrial manufacturing of compost pellets. The operation is predicted to be relatively small, and therefore the area demarcated as D3 and a D1.1 will be used to store stockpiles of compost.

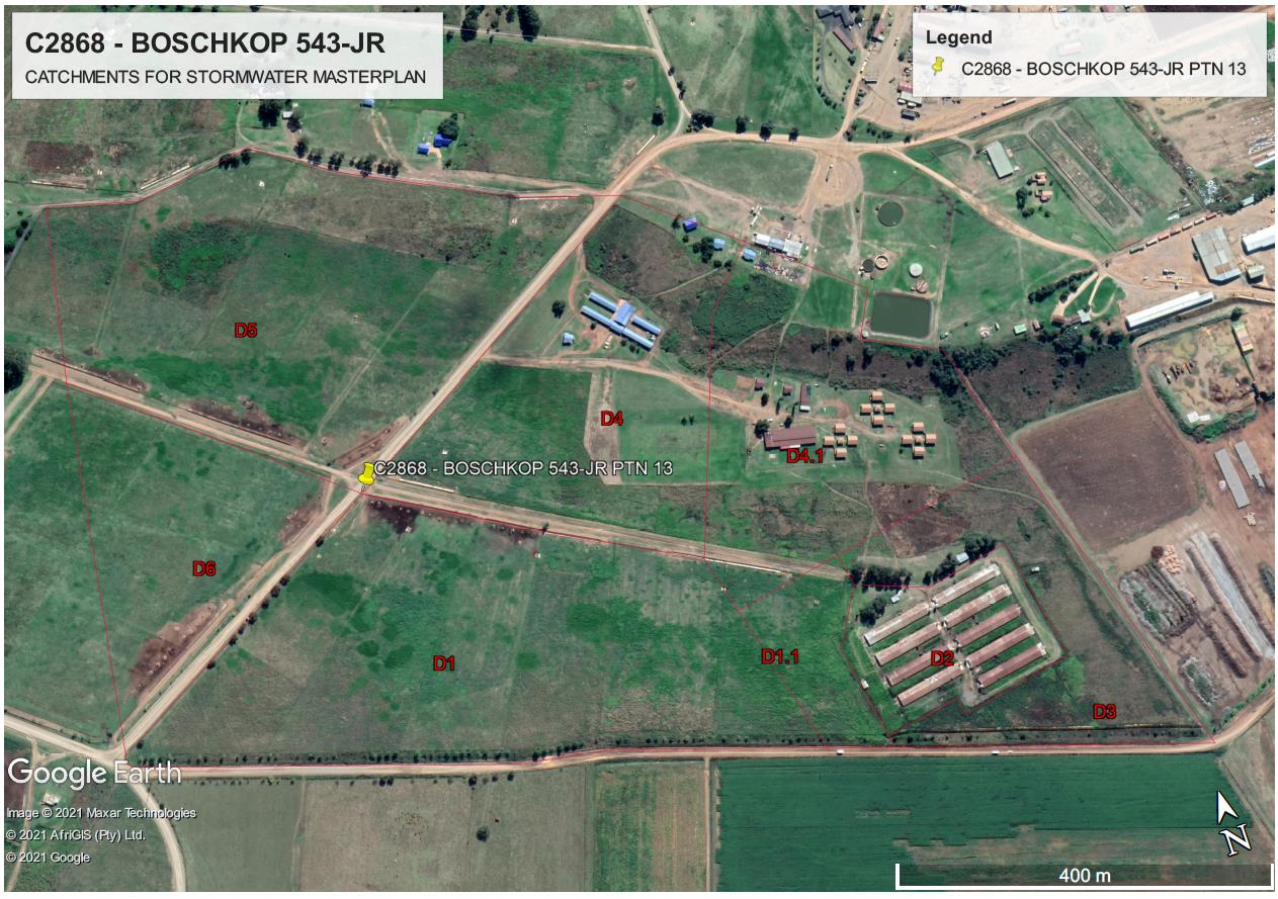


Figure 3-1: Proposed Catchment Areas

3.2 Existing Road Network

As aforementioned, the development site is situated in a rural area with few existing civil services. Accordingly, the site is largely surrounded by informal gravel/dirt roads. The development currently gains access via the existing gravel road running adjacent to the site on the northern boundary. Below are the existing and proposed roads in the immediate vicinity of the site:

- An existing gravel road to the north (Class 5 Access Road);
- An existing gravel road (Class 3 District Distributor), intersecting with the R25 to the west;
- An existing gravel road (proposed Class 3 District distributer);
- An existing gravel road (proposed Class 4 Residential Collector) to the east.

Refer to **Annexure B** for the City of Tshwane Road Masterplan.

3.3 Existing Stormwater Network

There are 2 x 600 mm diam. stormwater pipes located roughly in the middle of Catchment D1, adjacent to the gravel road on the southern boundary. These pipes accommodate the runoff generated within the western portion of Catchment D1 and portions of the surrounding upstream areas. There is another existing 600 mm diam. stormwater pipe located roughly 50 m to the east of the site. This pipe accommodates the runoff generated within the adjacent property to the east. Similarly, the pipe crosses the gravel road on the southern boundary, and then discharges via an undefined open channel southwards towards an existing earth dam with grasses banks. The Dam is the closest waterbody to the site but falls outside the scope of this investigation as it is not negatively affected by the proposed compost operations.

There is an existing berm and channel on the southern boundary of the site, the use of which is currently unknown. The berm and channel does not discharge towards the existing pipe culvert crossing below the road but stop short and abruptly near the eastern boundary of the property. In rain events the berm and channel will in effect cut of stormwater from the property draining southward towards the road until such time as run-off overtops the berm and channel. There is an existing earth channel on the northern side of the aforementioned road routing the runoff away from the road surface, towards the pipe culvert crossings.

There is no additional stormwater infrastructure in the vicinity of the proposed development. Stormwater runoff is generally accommodated via overland flow and natural channels towards existing watercourses. The closest waterbody is an existing dam located approximately 120 m south-east of the proposed development. The dam discharges into a perennial stream that flows towards the north-east direction, eventually discharging into the Bronkhorstspruit Dam.

Refer to **Annexure C** for the City of Tshwane Existing Stormwater Network.

4. GENERAL DRAINAGE

The total area analyzed in the stormwater master planning is 63 ha. The general fall of the site towards the south-east at an average slope of 3%. The site is currently undeveloped and is not affected by any floodlines.

The total area contributing stormwater runoff was determined by analysing the higher-lying areas around the development. The existing natural ground contours were examined to identify key ridges and valleys that define the existing drainage basins in the area. It was determined that a ridge along the northern boundaries of D4 and D5 delineates the drainage basins such that: the area south of the ridge will contribute to the stormwater runoff in the development. The Catchment D6 to the east also generates runoff that flows towards the development site, which was also determined from the natural ground contours.

Runoff generated from the composting areas (D1.1 and D3) will be considered ‘dirty water’ and the runoff generated within the redundant chicken housing area (D2) will at present be considered ‘clean water’. The developer has requested that all ‘dirty water’ runoff be self-isolated in each catchment by means of a retention pond. A system of channels and berms were therefore designed to isolate each catchment and retain the 1:50 year runoff. ‘Clean water’ run-off will discharge via an outlet structure designed to dissipate the concentrated flow into sheet flow.

The site lies between the rainfall stations, Welbekend (0513836W) and Blesbokfontein (0514537W). The Mean Annual Precipitation (MAP) was determined by interpolating between the stations, and was found to be is 710 mm. The number of days thunder is heard in this region is 60. The aforementioned is required to determine the stormwater runoff generated within the site using the Rational Method.

5. SITE VERIFICATION

A site visit was conducted to identify stormwater routes and existing watercourses. The natural drainage routes have been taken into account during development of the stormwater master plan.

6. DESIGN STANDARDS

The design principles as set out below were incorporated to determine the element sizes:

- All major systems were designed to accommodate the 1:50 year runoff;
- The major systems are a combination of berms, channels and retention ponds;
- The existing gravel roads were assumed to have no capacity;
- The pre-development and post-development design flow is determined via the Rational Method;
- All runoff must be delineated between ‘clean water’ and ‘dirty water’;
- All catchments generating ‘dirty water’ are to remain self-isolated and retain the entire 1:50 year runoff.

7. SMP DESIGN APPROACH

This SMP consists of major stormwater drainage networks. The design was based on the following steps:

- Selection of appropriate design standards;
- Determination of the major catchments for the area;
- Capturing of topographical data for each catchment (slope, size, imperviousness, overland flow length);
- Determination of an anticipated stormwater drainage network and physical properties (length and slope);
- Elements required to augment existing under-capacity networks;
- Determination of the required types and sizes of the drainage network elements through hydrological modelling using the Rational Method.

8. RUNOFF CALCULATION

The pre-development and post-development runoff values for each catchment was calculated using the Rational Method. The parameters used in the calculations are provided in Table 7-1 below.

Parameter	Value
Contributing Area	63 Ha
Mean Annual Precipitation (MAP)	710 mm
Rainfall Hydrograph	Triangular
Type of Flow	Overland Flow
Storm Duration	240 min
Time of Concentration (T_c)	Varies by Catchment
Return Periods (Year)	1:2, 1:20 and 1:50
Run-off Coefficients (C)	Varies by Catchment
Rainfall Intensity (I)	$(7.5 + 0.034 \times MAP)R^{0.3} / (0.24 + T_C)^{0.89}$
Number of Days Thunder was Heard Annually	60

Table 8-1: Runoff Parameters Used in Hydrological Calculations

The run-off for the 1:2, 1:20 and 1:50 year frequency was calculated. A design flow and applicable element sizes were then determined based on a 2 year flow for minor systems (excluded from this report, but used to inform the major system) and 50 year flow for major systems. Design flows affecting any watercourses were designed at a 1:5 year flow for minor systems and 1:50 year flow for major systems.

Refer to **Annexure D** for the Stormwater Runoff Calculations.

9. PROPOSED STORMWATER SYSTEM

9.1 Design Parameters

From the results of the simulations for the 2 year, 20 year and 50 year recurrence periods, each element has been designed taking into consideration the following:

- Topographical elements, i.e. slope, type, length, etc.
- The element's category for minor or major systems;
- Any existing element with capacity that can reduce the flow in the new elements.

The final detail design, should it be requested, will be concluded with:

- Accurate slope calculation;
- Final contributing areas;
- Cost saving principles;
- Available construction space;
- Other services.

9.2 Construction of Stormwater Infrastructure

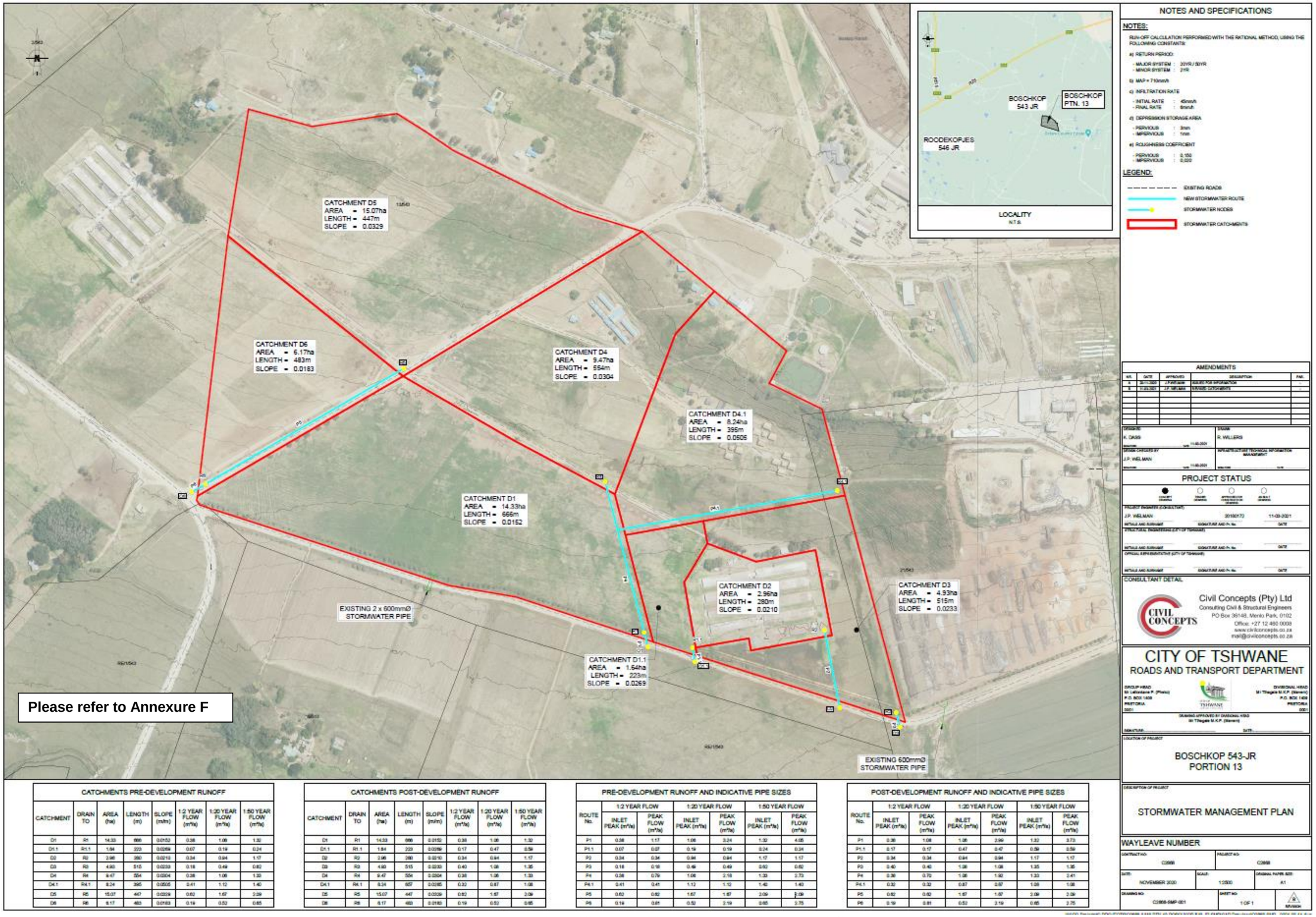
All stormwater infrastructure will be in the form of earth channels, berm, retention ponds and outlet structures. Note that it is proposed that the channels, berms and retentions ponds be such that a cut-to-fill balance is achieved as far as possible. The infrastructure required to service each catchment will be discussed in further detail in the following chapter of the report.

10. MAJOR CATCHMENTS AND DRAINAGE PROPOSALS

The catchments within the major network were delineated to represent separate portions of the development area with different land-uses, and the greater area contributing to the overall drainage.

As aforementioned, 'dirty water' generated within the compost storage areas, demarcated as Catchments D1.1 and D3, needs to be isolated and retained in retention ponds. The runoff generated within the Catchment D2 and the areas surrounding the development (Catchments D4, D4.1, D5 and D6) is considered 'clean water'. Areas generating 'clean water' are delineated from areas generating 'dirty water' via means of cutoff berms and channels, which are illustrated in the detail design drawings attached as **Annexure G**. Runoff generated in surrounding areas will be accommodated via overland flow, travelling in the direction of the existing ground contours. The exception to the aforementioned is Catchment D2, with the runoff generated within it being accommodated via a pipe network or an isolated earth channel, discharging via an outlet structure south of the proposed development.

The 'clean water' discharged from the catchments will eventually flow into an existing earth channel along the northern edge of the gravel road south of the proposed development. The runoff is then able to pass under the gravel road via the existing stormwater pipe and travel towards the existing Dam via an existing open earth channel.



CATCHMENTS PRE-DEVELOPMENT RUNOFF

CATCHMENT	DRAIN TO	AREA (ha)	LENGTH (m)	SLOPE (m/m)	1:2 YEAR FLOW (m³/s)	1:20 YEAR FLOW (m³/s)	1:50 YEAR FLOW (m³/s)
D1	R1	14.33	666	0.0152	0.38	1.08	1.32
D1.1	R1.1	1.64	223	0.0269	0.07	0.19	0.24
D2	R2	2.96	280	0.0210	0.34	0.94	1.17
D3	R3	4.93	515	0.0233	0.18	0.49	0.62
D4	R4	9.47	554	0.0304	0.38	1.06	1.33
D4.1	R4.1	8.24	395	0.0505	0.41	1.12	1.40
D5	R5	15.07	447	0.0329	0.62	1.67	2.09
D6	R6	6.17	483	0.0183	0.19	0.52	0.65

CATCHMENTS POST-DEVELOPMENT RUNOFF

CATCHMENT	DRAIN TO	AREA (ha)	LENGTH (m)	SLOPE (m/m)	1:2 YEAR FLOW (m³/s)	1:20 YEAR FLOW (m³/s)	1:50 YEAR FLOW (m³/s)
D1	R1	14.33	666	0.0152	0.38	1.08	1.32
D1.1	R1.1	1.64	223	0.0269	0.17	0.47	0.59
D2	R2	2.96	280	0.0210	0.34	0.94	1.17
D3	R3	4.93	515	0.0233	0.40	1.08	1.35
D4	R4	9.47	554	0.0304	0.38	1.06	1.33
D4.1	R4.1	8.24	557	0.0285	0.32	0.87	1.08
D5	R5	15.07	447	0.0329	0.62	1.67	2.09
D6	R6	6.17	483	0.0183	0.19	0.52	0.65

PRE-DEVELOPMENT RUNOFF AND INDICATIVE PIPE SIZES

ROUTE No.	1:2 YEAR FLOW		1:20 YEAR FLOW		1:50 YEAR FLOW	
	INLET PEAK (m³/s)	PEAK FLOW (m³/s)	INLET PEAK (m³/s)	PEAK FLOW (m³/s)	INLET PEAK (m³/s)	PEAK FLOW (m³/s)
P1	0.38	1.17	1.06	3.24	1.32	4.05
P1.1	0.07	0.07	0.19	0.19	0.24	0.24
P2	0.34	0.34	0.94	0.94	1.17	1.17
P3	0.18	0.18	0.49	0.49	0.62	0.62
P4	0.38	0.79	1.06	2.18	1.33	2.73
P4.1	0.41	0.41	1.12	1.12	1.40	1.40
P5	0.62	0.62	1.67	1.67	2.09	2.09
P6	0.19	0.81	0.52	2.19	0.65	2.75

POST-DEVELOPMENT RUNOFF AND INDICATIVE PIPE SIZES

ROUTE No.	1:2 YEAR FLOW		1:20 YEAR FLOW		1:50 YEAR FLOW	
	INLET PEAK (m³/s)	PEAK FLOW (m³/s)	INLET PEAK (m³/s)	PEAK FLOW (m³/s)	INLET PEAK (m³/s)	PEAK FLOW (m³/s)
P1	0.38	1.08	1.06	2.99	1.32	3.73
P1.1	0.17	0.17	0.47	0.47	0.59	0.59
P2	0.34	0.34	0.94	0.94	1.17	1.17
P3	0.40	0.40	1.08	1.08	1.35	1.35
P4	0.38	0.70	1.06	1.92	1.33	2.41
P4.1	0.32	0.32	0.87	0.87	1.08	1.08
P5	0.62	0.62	1.67	1.67	2.09	2.09
P6	0.19	0.81	0.52	2.19	0.65	2.75

Figure 10-1: Extract from Stormwater Management Plan

11. Catchment and Stormwater Runoff Details

11.1 Catchment D1.1

The Catchment D1.1 has the properties as tabulated below in Table 10-1:

Catchment	Proposed Land-Use	Area (ha)
D1.1	Storage of Compost	1.6378

Table 11-1: Catchment D1.1 Information

The runoff generated within Catchment D1.1 at various recurrence intervals is seen below.

Pre-Development Runoff:

- 1:2 Year: Q_2 = CIA = 0.069 m³/s
- 1:20 Year: Q_{20} = CIA = 0.189 m³/s
- 1:50 Year: Q_{50} = CIA = 0.236 m³/s

Post-Development Runoff:

- 1:2 Year: Q_2 = 0.172 m³/s
- 1:20 Year: Q_{20} = 0.470 m³/s
- 1:50 Year: Q_{50} = 0.586 m³/s

The following stormwater infrastructure is required to service this Catchment:

Stormwater Infrastructure	Location	Length / Size / No.
Berm and Channel	North, south and western boundaries of D1.1	371 m
Retention Pond	South-eastern corner of D1.1	1 764 m³
Outlet Structure	Just outside the south-eastern corner of D1.1	1

Table 11-2: Proposed Stormwater Infrastructure for Catchment D1.1

Refer to **Annexure D** for the Stormwater Runoff Calculations and **Annexure E** for the Retention Pond Calculations.

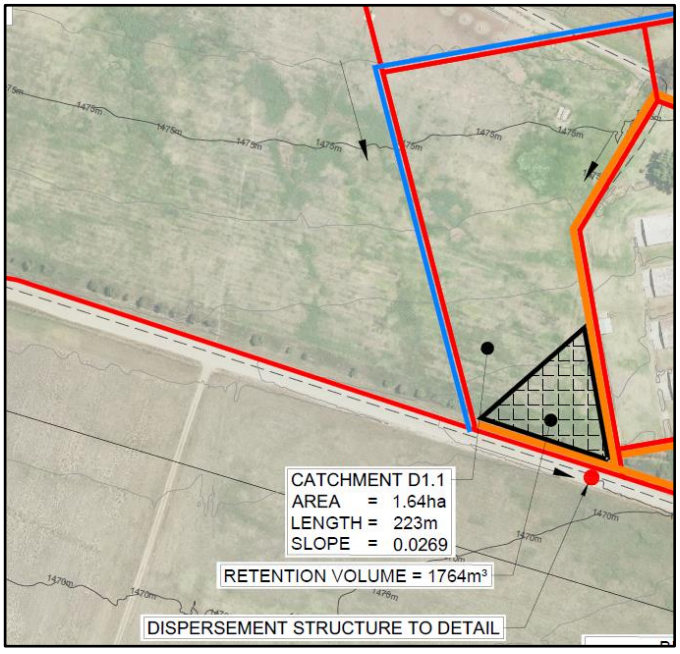


Figure 11-1: Proposed Stormwater Infrastructure for Catchment D1.1

Refer to **Annexure F** for the Stormwater Masterplan and **Annexure G** for the Stormwater Design.

11.2 Catchment D2

The Catchment D2 has the properties as tabulated below in Table 10-3:

Catchment	Proposed Land-Use	Area (ha)
D2	Pelletizing / Pelleting	2.9611

Table 11-3: Catchment D2 Information

The runoff generated within Catchment D2 at various recurrence intervals is seen below.

Pre-Development Runoff:

- 1:2 Year: Q_2 = CIA = 0.344 m^3/s
- 1:20 Year: Q_{20} = CIA = 0.938 m^3/s
- 1:50 Year: Q_{50} = CIA = 1.172 m^3/s

Post-Development Runoff:

- 1:2 Year: Q_2 = 0.344 m^3/s
- 1:20 Year: Q_{20} = 0.938 m^3/s
- 1:50 Year: Q_{50} = 1.172 m^3/s

The following stormwater infrastructure is required to service this Catchment:

Stormwater Infrastructure	Location	Length / Size / No.
Berm and Channel	North, south, east and western boundaries of D2	724 m
Pipe Network or Channel	South-eastern corner of D2 travelling south	125 m
Outlet Structure	Just outside D3, perpendicular to the inlet at D2	1

Table 11-4: Proposed Stormwater Infrastructure for Catchment D2

Refer to **Annexure D** for the Stormwater Runoff Calculations.

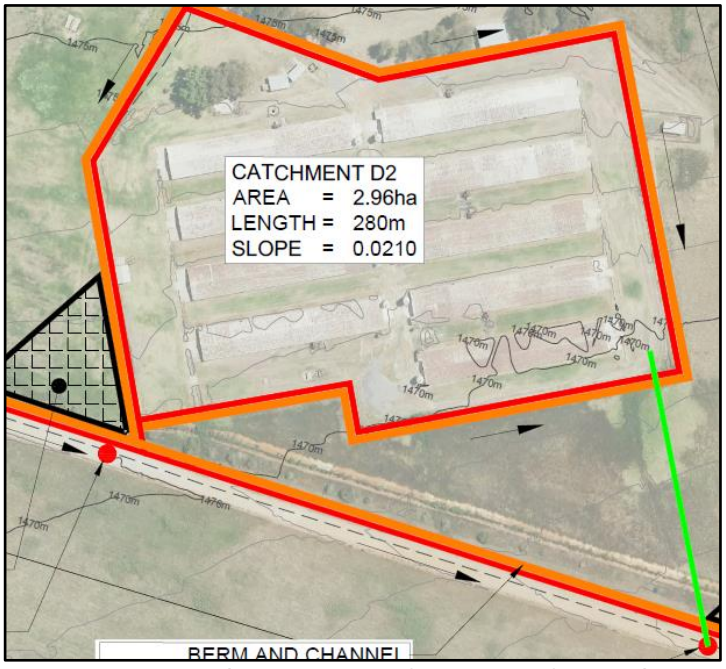


Figure 10-2: Proposed Stormwater Infrastructure for Catchment D2

Refer to **Annexure F** for the Stormwater Masterplan and **Annexure G** for the Stormwater Design.

11.3 Catchment D3

The Catchment D3 has the properties as tabulated below in Table 10-5:

Catchment	Proposed Land-Use	Area (ha)
D3	Storage of Compost	4.9346

Table 11-5: Catchment D3 Information

The runoff generated within Catchment D3 at various recurrence intervals is seen below.

Pre-Development Runoff:

- 1:2 Year: Q_2 = CIA = 0.183 m^3/s
- 1:20 Year: Q_{20} = CIA = 0.493 m^3/s
- 1:50 Year: Q_{50} = CIA = 0.617 m^3/s

Post-Development Runoff:

- 1:2 Year: Q_2 = 0.399 m^3/s
- 1:20 Year: Q_{20} = 1.077 m^3/s
- 1:50 Year: Q_{50} = 1.347 m^3/s

The following stormwater infrastructure is required to service this Catchment:

Stormwater Infrastructure	Location	Length / Size
Berm and Channel	North, east and southern boundaries of Catchment D3	940 m
Retention Pond	South-eastern corner of D3	4 096 m^3
Outlet Structure	Just outside the south-eastern corner of D1.1	1

Table 11-6: Proposed Stormwater Infrastructure for Catchment D3

As an alternative, Catchments D1.1 and D3 may be combined, and a single retention pond with increased capacity can be implemented. As aforementioned, 'clean water' from Catchment D2 will have to be kept separate from the 'dirty water' generated in Catchments D1.1 and D3.

Refer to **Annexure D** for the Stormwater Runoff Calculations and **Annexure E** for the Retention Pond Calculations.

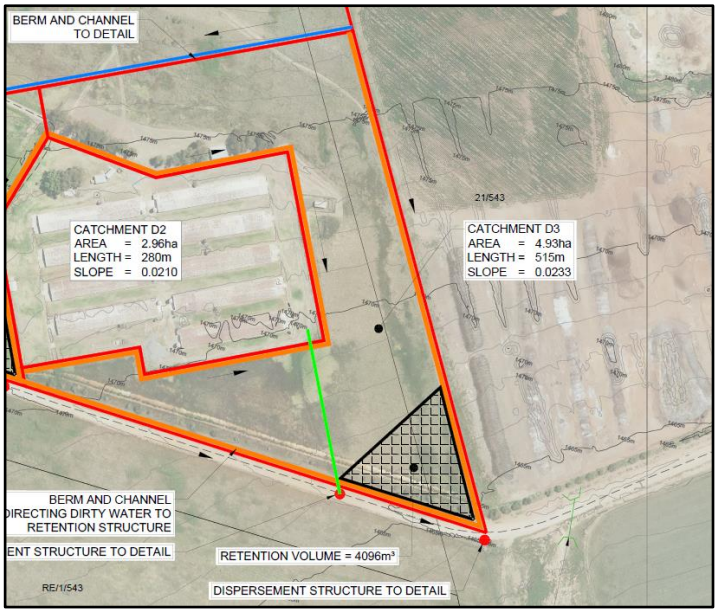


Figure 11-3: Proposed Stormwater Infrastructure for Catchment D3

Refer to **Annexure F** for the Stormwater Masterplan and **Annexure G** for the Stormwater Design.

12. SERVITUDES

Where infrastructure will be constructed outside of private property or road reserves, servitudes will be registered in favour of the applicable service and authority.

13. FLOODLINES

There are no floodlines that are affecting the development.

14. CONCLUSIONS AND RECOMMENDATIONS

The SMP determined the proposed sizing for all elements of the study area. Proposed upgrades and sizing are only indicative, upgrades and new stormwater elements should be implemented as development progresses in the catchments.

The information provided is sufficient to enable the developer to service the proposed development without affecting the surrounding area negatively. We trust the report addresses the requirements necessary.

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Civil Concepts (Pty) Ltd
April 2021

Checked By:

Hannes Welman
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April 2021

LIST OF ANNEXURES

ANNEXURE A:
LOCALITY PLAN

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PTN. 13 BOSCHKOP 543-JR
LOCALITY PLAN

N.T.S

ANNEXURE B:
ROAD MASTERPLAN

Road Masterplan

Legend

Road Master Plan

- U1 Class 1_Primary metropolitan distributor
- U2 Class 2_Metropolitan distributor
- U3/A Class 3/A_ District distributor
- U3 Class 3_ District distributor
- U4 Class 4(a)_Collector (non-residential)
- U4 Class 4(b)_Collector (Residential)
- Class 5(a)_Local street (Non-residential)
- Class5(b)_Local street (Residential)
- De-Classification_U1
- De-Classification_U2
- De-Classification_U3
- De-Classification_U4(a)
- De-Classification_U4(b)
- De-Classification_U5(a)
- Proposed Class 3/A_ District distributor
- Proposed_U1 Class 1_Primary metropolitan distrubutor
- Proposed_U2 Class 2_ Metropolitan distrubutor
- Proposed_U3 Class 3_District distrubutor
- Proposed_U4 Class 4(a)_Collector (Non-residential
- Proposed_U4 Class 4(b)_Collector (Residential)
- Proposed_Class 5(a)_Local street (Non-residential)
- Proposed_Class 5(b)_Local street (Residential)

Base map

- Tshwane Regions
- Wards
- Municipal Boundary
- Suburb Boundary
- Farm Boundary
- Open Space
- Dam
- River
- Freeway
- Main Road
- Street
- Main Railway
- Gautrain

Kilometers

0 0,1 0,2 0,4 0,6 0,8

Date: 2020/11/17

Compiled & Issued by: Corporate GIS, (egis@tshwane.gov.za)

ANNEXURE C:
EXISTING STORMWATER NETWORK

CITY OF TSHWANE
IGNITING EXCELLENCE

CoT Stormwater Network

Legend

Points of Interest

- Shopping Centre
- Social Service
- Hotel & Lodges
- Police Station
- Emergency Services
- Clinic
- Hospital
- Primary School
- Secondary School
- Tertiary Education
- Post Office
- Library
- Animal Welfare
- Places of Interest
- Court
- Tourism Information
- Municipal
- Government Department
- Foreign Representation
- Societies, Institutes
- Theatre
- Cinema
- Casino
- Museum
- Art Gallery
- Park
- Nature Conservation
- Resort
- Caravan Park
- Swimming Pool
- Ice Rink
- Cemetery
- Place of Worship
- Refuse Site
- Sport
- Stadium
- Toll Gate
- E-Toll
- Airport

Base map

- Tshwane Regions
- Wards
- Municipal Boundary
- Suburb Boundary
- Farm Boundary
- Open Space
- Dam
- River
- Freeway
- Main Road
- Street
- Main Railway
- Gautrain

Storm Water

- Outlets
- Junction Box
- Manhole
- Grid Inlet
- Kerb Inlet
- Veld Inlet
- Pipes
- Culvert
- Channel

Kilometers

0 0,05 0,1 0,2 0,3 0,4

Date: 2020/11/20

Compiled & Issued by: Corporate GIS, (egis@tshwane.gov.za)

ANNEXURE D:
STORMWATER RUNOFF CALCULATIONS

CATCHMENTS PRE-DEVELOPMENT RUNOFF							
CATCHMENT	DRAIN TO	AREA (ha)	LENGTH (m)	SLOPE (m/m)	1:2 YR FLOW (m^3/s)	1:20 YR FLOW (m^3/s)	1:50 YR FLOW (m^3/s)
D1	R1	14.33	666	0.0152	0.38	1.06	1.32
D1.1	R1.1	1.64	223	0.0269	0.07	0.19	0.24
D2	R2	2.96	280	0.0210	0.34	0.94	1.17
D3	R3	4.93	515	0.0233	0.18	0.49	0.62
D4	R4	9.47	554	0.0304	0.38	1.06	1.33
D4.1	R4.1	8.24	395	0.0505	0.41	1.12	1.40
D5	R5	15.07	447	0.0329	0.62	1.67	2.09
D6	R6	6.17	483	0.0183	0.19	0.52	0.65

CATCHMENTS POST-DEVELOPMENT RUNOFF							
CATCHMENT	DRAIN TO	AREA (ha)	LENGTH (m)	SLOPE (m/m)	1:2 YR FLOW (m^3/s)	1:20 YR FLOW (m^3/s)	1:50 YR FLOW (m^3/s)
D1	R1	14.33	666	0.0152	0.38	1.06	1.32
D1.1	R1.1	1.64	223	0.0269	0.17	0.47	0.59
D2	R2	2.96	280	0.0210	0.34	0.94	1.17
D3	R3	4.93	515	0.0233	0.40	1.08	1.35
D4	R4	9.47	554	0.0304	0.38	1.06	1.33
D4.1	R4.1	8.24	657	0.0285	0.32	0.87	1.08
D5	R5	15.07	447	0.0329	0.62	1.67	2.09
D6	R6	6.17	483	0.0183	0.19	0.52	0.65

PRE-DEVELOPMENT PEAK FLOWS						
ROUTE NO.	1:2 YEAR FLOW		1:20 YEAR FLOW		1:50 YEAR FLOW	
	INLET PEAK (m^3/s)	PEAK FLOW (m^3/s)	INLET PEAK (m^3/s)	PEAK FLOW (m^3/s)	INLET PEAK (m^3/s)	PEAK FLOW (m^3/s)
P1	0.38	1.17	1.06	3.24	1.32	4.05
P1.1	0.07	0.07	0.19	0.19	0.24	0.24
P2	0.34	0.34	0.94	0.94	1.17	1.17
P3	0.18	0.18	0.49	0.49	0.62	0.62
P4	0.38	0.79	1.06	2.18	1.33	2.73
P4.1	0.41	0.41	1.12	1.12	1.40	1.40
P5	0.62	0.62	1.67	1.67	2.09	2.09
P6	0.19	0.81	0.52	2.19	0.65	2.75

POST-DEVELOPMENT PEAK FLOWS						
ROUTE NO.	1:2 YEAR FLOW		1:20 YEAR FLOW		1:50 YEAR FLOW	
	INLET PEAK (m^3/s)	PEAK FLOW (m^3/s)	INLET PEAK (m^3/s)	PEAK FLOW (m^3/s)	INLET PEAK (m^3/s)	PEAK FLOW (m^3/s)
P1	0.38	1.08	1.06	2.99	1.32	3.73
P1.1	0.17	0.17	0.47	0.47	0.59	0.59
P2	0.34	0.34	0.94	0.94	1.17	1.17
P3	0.40	0.40	1.08	1.08	1.35	1.35
P4	0.38	0.70	1.06	1.92	1.33	2.41
P4,1	0.32	0.32	0.87	0.87	1.08	1.08
P5	0.62	0.62	1.67	1.67	2.09	2.09
P6	0.19	0.81	0.52	2.19	0.65	2.75

Description of Catchment:	CATCHMENT D1
Project:	C2868
Calculated By:	K DASS
Date:	8-Mar-21
	Pre - Development

Physical Characteristics

Mean annual rainfall (P)	**P =**	710	**mm**
Size of Catchment	**A =**	143342	**m²**
Longest water course	**L =**	666	**m**
Height Difference	=	10.15	**m**
Average slope of water cours	**S =**	0.0152	**m/m**

Area Distribution Factors

$\alpha + \beta + \gamma = 1$		
Rural	**Urban**	**Lakes**
α =	**β =**	**γ =**
1.00	0.00	0.00

Table 3: Suggested values of r

Paved area	**0.02**
Clean soil	**0.1**
Sparse grass	**0.3**
Moderate grass	**0.4**
Thick bush	**0.8**
Use r =	0.4

Overland flow	=	0.865 **Hours**	**Use Tc =**	0.865	**Hours**
Watercourse	=	0.243 **Hours**			

Rural C1									**Urban C2**		
Surface Slope	**%**	**C_s**	**Permeability**	**%**	**C_p**	**Vegetation**	**%**	**C_v**	**Use**	**%**	**C_2**
Vlei's and pans	100%	0.03	**Very Permeable**			**Thick bush and plantation**			**Lawns and parks**		
Flat areas			**Permeable**	50%	0.08	**Light bush and farm-lands**	50%	0.11	**Industrial areas**		
Hilly			**Semi-Permeable**	50%	0.16	**Grass-lands**	50%	0.21	**City/Residential**		
Steep areas			**Impermeable**			**No vegetation**			**Streets**		
TOTAL	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**0.00**	

Table 1: Rural runoff-coefficients

Component	**Classification**	**MAR (mm)**		
		600	**600-900**	**900**
Surface slope C_s	**Vleis and pans (<3%)**	**0.01**	**0.03**	**0.05**
	Flat areas (3-10%)	**0.06**	**0.08**	**0.11**
	Hilly (10-30%)	**0.12**	**0.16**	**0.20**
	Steep areas (>30%)	**0.22**	**0.26**	**0.30**
Surface slope C_p	**Very permeable**	**0.03**	**0.04**	**0.05**
	Permeable	**0.06**	**0.08**	**0.10**
	Semi permeable	**0.12**	**0.16**	**0.20**
	Impermeable	**0.21**	**0.26**	**0.30**
Surface slope C_v	**Thick bush and plantation**	**0.03**	**0.04**	**0.05**
	Light bush and farm-lands	**0.07**	**0.11**	**0.15**
	Grass-lands	**0.17**	**0.21**	**0.25**
	No vegetation	**0.26**	**0.28**	**0.30**

Table 2: Urban runoff-coefficients

Use	**Coefficient**
Lawns & Parks	
Sandy, flat (<2%)	**0.05-0.10**
Sandy, steep (>7%)	**0.15-0.20**
Heavy soil, steep (>7%)	**0.13-0.17**
Heavy soil, flat (<2%)	**0.25-0.35**
Residential areas	
Houses	**0.30-0.50**
Flats	**0.50-0.70**
Industry	
Light Industry	**0.50-0.80**
Heavy Industry	**0.60-0.90**
Business	
City centre	**0.70-0.95**
Surburban	**0.50-0.70**
Streets	**0.70-0.95**

Summer rainfall region

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Point rainfall (mm)	27	46	60	74	93	107
Point intensity (mm/h)	31	53	69	86	107	124

Run-off factor

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Rural C1	0.31	0.31	0.31	0.31	0.31	0.31
Urban C2	0.00	0.00	0.00	0.00	0.00	0.00
Lakes C3	1.00	1.00	1.00	1.00	1.00	1.00
Combined C = C1 + C2 + C3	0.31	0.31	0.31	0.31	0.31	0.31

Peak flow -Catchments

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Peak flow Q = CIA/3600 (l/s)	383	654	852	1062	1321	1531

Notes:

Description of Catchment:	CATCHMENT D1.1
Project:	C2868
Calculated By:	K DASS
Date:	8-Mar-21
	Post - Development

Physical Characteristics

Mean annual rainfall (P)	**P =**	710	**mm**
Size of Catchment	**A =**	16378	**m²**
Longest water course	**L =**	223	**m**
Height Difference	= 6.00 **m**		
Average slope of water cours	**S =**	0.0269	**m/m**

Area Distribution Factors

α + β + γ = 1		
Rural	**Urban**	**Lakes**
α =	**β =**	**γ =**
0.30	0.70	0.00

Table 3: Suggested values of r

Paved area	**0.02**
Clean soil	**0.1**
Sparse grass	**0.3**
Moderate grass	**0.4**
Thick bush	**0.8**
Use r =	0.4

Overland flow	= 0.454 **Hours**	**Use Tc =**	0.454	**Hours**
Watercourse	= 0.084 **Hours**			

Rural C1									**Urban C2**		
Surface Slope	**%**	**C_s**	**Permeability**	**%**	**C_p**	**Vegetation**	**%**	**C_v**	**Use**	**%**	**C_2**
Vlei's and pans	100%	0.03	**Very Permeable**			**Thick bush and plantation**			**Lawns and parks**		
Flat areas			**Permeable**			**Light bush and farm-lands**			**Industrial areas**	100%	0.90
Hilly			**Semi-Permeable**	100%	0.16	**Grass-lands**			**City/Residential**		
Steep areas			**Impermeable**			**No vegetation**	100%	0.28	**Streets**		
TOTAL	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**1.00**	

Table 1: Rural runoff-coefficients

Component	**Classification**	**MAR (mm)**		
		600	**600-900**	**900**
Surface slope C_s	**Vleis and pans (<3%)**	**0.01**	**0.03**	**0.05**
	Flat areas (3-10%)	**0.06**	**0.08**	**0.11**
	Hilly (10-30%)	**0.12**	**0.16**	**0.20**
	Steep areas (>30%)	**0.22**	**0.26**	**0.30**
Surface slope C_p	**Very permeable**	**0.03**	**0.04**	**0.05**
	Permeable	**0.06**	**0.08**	**0.10**
	Semi permeable	**0.12**	**0.16**	**0.20**
	Impermeable	**0.21**	**0.26**	**0.30**
Surface slope C_v	**Thick bush and plantation**	**0.03**	**0.04**	**0.05**
	Light bush and farm-lands	**0.07**	**0.11**	**0.15**
	Grass-lands	**0.17**	**0.21**	**0.25**
	No vegetation	**0.26**	**0.28**	**0.30**

Table 2: Urban runoff-coefficients

Use	**Coefficient**
Lawns & Parks	
Sandy, flat (<2%)	**0.05-0.10**
Sandy, steep (>7%)	**0.15-0.20**
Heavy soil, steep (>7%)	**0.13-0.17**
Heavy soil, flat (<2%)	**0.25-0.35**
Residential areas	
Houses	**0.30-0.50**
Flats	**0.50-0.70**
Industry	
Light Industry	**0.50-0.80**
Heavy Industry	**0.60-0.90**
Business	
City centre	**0.70-0.95**
Surburban	**0.50-0.70**
Streets	**0.70-0.95**

Summer rainfall region

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Point rainfall (mm)	22	38	49	61	76	88
Point intensity (mm/h)	49	83	108	134	167	193

Run-off factor

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Rural C1	0.47	0.47	0.47	0.47	0.47	0.47
Urban C2	0.90	0.90	0.90	0.90	0.90	0.90
Lakes C3	1.00	1.00	1.00	1.00	1.00	1.00
Combined C = C1 + C2 + C3	0.77	0.77	0.77	0.77	0.77	0.77

Peak flow -Catchments

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Peak flow Q = CIA/3600 (l/s)	172	291	379	470	586	677

Notes:

Description of Catchment:	CATCHMENT D2
Project:	C2868
Calculated By:	K DASS
Date:	8-Mar-21
	Pre - Development

Physical Characteristics

Mean annual rainfall (P)	**P =**	710	**mm**
Size of Catchment	**A =**	29611	**m²**
Longest water course	**L =**	280	**m**
Height Difference	=	5.89	**m**
Average slope of water cours	**S =**	0.0210	**m/m**

Area Distribution Factors

$\alpha + \beta + \gamma = 1$		
Rural	**Urban**	**Lakes**
α =	**β =**	**γ =**
0.00	1.00	0.00

Table 3: Suggested values of r

Paved area	**0.02**
Clean soil	**0.1**
Sparse grass	**0.3**
Moderate grass	**0.4**
Thick bush	**0.8**
Use r =	0.4

Overland flow	=	0.535 **Hours**	**Use Tc =**	0.535	**Hours**
Watercourse	=	0.110 **Hours**			

Rural C1									**Urban C2**		
Surface Slope	**%**	**C_s**	**Permeability**	**%**	**C_p**	**Vegetation**	**%**	**C_v**	**Use**	**%**	**C_2**
Vlei's and pans	100%	0.03	**Very Permeable**			**Thick bush and plantation**			**Lawns and parks**		
Flat areas			**Permeable**	50%	0.08	**Light bush and farm-lands**	50%	0.11	**Industrial areas**		
Hilly			**Semi-Permeable**	50%	0.16	**Grass-lands**	50%	0.21	**City/Residential**		
Steep areas			**Impermeable**			**No vegetation**			**Streets**	100%	0.95
TOTAL	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**1.00**	

Table 1: Rural runoff-coefficients

Component	**Classification**	**MAR (mm)**		
		600	**600-900**	**900**
Surface slope C_s	**Vleis and pans (<3%)**	**0.01**	**0.03**	**0.05**
	Flat areas (3-10%)	**0.06**	**0.08**	**0.11**
	Hilly (10-30%)	**0.12**	**0.16**	**0.20**
	Steep areas (>30%)	**0.22**	**0.26**	**0.30**
Surface slope C_p	**Very permeable**	**0.03**	**0.04**	**0.05**
	Permeable	**0.06**	**0.08**	**0.10**
	Semi permeable	**0.12**	**0.16**	**0.20**
	Impermeable	**0.21**	**0.26**	**0.30**
Surface slope C_v	**Thick bush and plantation**	**0.03**	**0.04**	**0.05**
	Light bush and farm-lands	**0.07**	**0.11**	**0.15**
	Grass-lands	**0.17**	**0.21**	**0.25**
	No vegetation	**0.26**	**0.28**	**0.30**

Table 2: Urban runoff-coefficients

Use	**Coefficient**
Lawns & Parks	
Sandy, flat (<2%)	**0.05-0.10**
Sandy, steep (>7%)	**0.15-0.20**
Heavy soil, steep (>7%)	**0.13-0.17**
Heavy soil, flat (<2%)	**0.25-0.35**
Residential areas	
Houses	**0.30-0.50**
Flats	**0.50-0.70**
Industry	
Light Industry	**0.50-0.80**
Heavy Industry	**0.60-0.90**
Business	
City centre	**0.70-0.95**
Surburban	**0.50-0.70**
Streets	**0.70-0.95**

Summer rainfall region

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Point rainfall (mm)	24	40	52	64	80	93
Point intensity (mm/h)	44	74	97	120	150	173

Run-off factor

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Rural C1	0.31	0.31	0.31	0.31	0.31	0.31
Urban C2	0.95	0.95	0.95	0.95	0.95	0.95
Lakes C3	1.00	1.00	1.00	1.00	1.00	1.00
Combined C = C1 + C2 + C3	0.95	0.95	0.95	0.95	0.95	0.95

Peak flow -Catchments

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Peak flow Q = CIA/3600 (l/s)	344	578	758	938	1172	1352

Notes:

Description of Catchment:	CATCHMENT D3
Project:	C2868
Calculated By:	K DASS
Date:	8-Mar-21
	Pre - Development

Physical Characteristics

Mean annual rainfall (P)	**P =**	710	**mm**
Size of Catchment	**A =**	49346	**m²**
Longest water course	**L =**	515	**m**
Height Difference	=	12.01	**m**
Average slope of water cours	**S =**	0.0233	**m/m**

Area Distribution Factors

$\alpha + \beta + \gamma = 1$		
Rural	**Urban**	**Lakes**
α =	**β =**	**γ =**
1.00	0.00	0.00

Table 3: Suggested values of r

Paved area	**0.02**
Clean soil	**0.1**
Sparse grass	**0.3**
Moderate grass	**0.4**
Thick bush	**0.8**
Use r =	0.4

Overland flow	=	0.695 **Hours**	**Use Tc =**	0.695	**Hours**
Watercourse	=	0.169 **Hours**			

Rural C1									**Urban C2**		
Surface Slope	**%**	**C_s**	**Permeability**	**%**	**C_p**	**Vegetation**	**%**	**C_v**	**Use**	**%**	**C_2**
Vlei's and pans			**Very Permeable**			**Thick bush and plantation**			**Lawns and parks**		
Flat areas	100%	0.08	**Permeable**	50%	0.08	**Light bush and farm-lands**	50%	0.11	**Industrial areas**		
Hilly			**Semi-Permeable**	50%	0.16	**Grass-lands**	50%	0.21	**City/Residential**		
Steep areas			**Impermeable**			**No vegetation**			**Streets**		
TOTAL	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**0.00**	

Table 1: Rural runoff-coefficients

Component	**Classification**	**MAR (mm)**		
		600	**600-900**	**900**
Surface slope C_s	**Vleis and pans (<3%)**	**0.01**	**0.03**	**0.05**
	Flat areas (3-10%)	**0.06**	**0.08**	**0.11**
	Hilly (10-30%)	**0.12**	**0.16**	**0.20**
	Steep areas (>30%)	**0.22**	**0.26**	**0.30**
Surface slope C_p	**Very permeable**	**0.03**	**0.04**	**0.05**
	Permeable	**0.06**	**0.08**	**0.10**
	Semi permeable	**0.12**	**0.16**	**0.20**
	Impermeable	**0.21**	**0.26**	**0.30**
Surface slope C_v	**Thick bush and plantation**	**0.03**	**0.04**	**0.05**
	Light bush and farm-lands	**0.07**	**0.11**	**0.15**
	Grass-lands	**0.17**	**0.21**	**0.25**
	No vegetation	**0.26**	**0.28**	**0.30**

Table 2: Urban runoff-coefficients

Use	**Coefficient**
Lawns & Parks	
Sandy, flat (<2%)	**0.05-0.10**
Sandy, steep (>7%)	**0.15-0.20**
Heavy soil, steep (>7%)	**0.13-0.17**
Heavy soil, flat (<2%)	**0.25-0.35**
Residential areas	
Houses	**0.30-0.50**
Flats	**0.50-0.70**
Industry	
Light Industry	**0.50-0.80**
Heavy Industry	**0.60-0.90**
Business	
City centre	**0.70-0.95**
Surburban	**0.50-0.70**
Streets	**0.70-0.95**

Summer rainfall region

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Point rainfall (mm)	26	43	56	70	87	100
Point intensity (mm/h)	37	62	81	100	125	145

Run-off factor

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Rural C1	0.36	0.36	0.36	0.36	0.36	0.36
Urban C2	0.00	0.00	0.00	0.00	0.00	0.00
Lakes C3	1.00	1.00	1.00	1.00	1.00	1.00
Combined C = C1 + C2 + C3	0.36	0.36	0.36	0.36	0.36	0.36

Peak flow -Catchments

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Peak flow Q = CIA/3600 (l/s)	183	306	400	493	617	716

Notes:

Description of Catchment:	CATCHMENT D4
Project:	C2868
Calculated By:	K DASS
Date:	8-Mar-21
	Pre - Development

Physical Characteristics

Mean annual rainfall (P)	**P =**	710	**mm**
Size of Catchment	**A =**	94735	**m²**
Longest water course	**L =**	554	**m**
Height Difference	=	16.82	**m**
Average slope of water cours	**S =**	0.0304	**m/m**

Area Distribution Factors

$\alpha + \beta + \gamma = 1$		
Rural	**Urban**	**Lakes**
α =	**β =**	**γ =**
0.90	0.10	0.00

Table 3: Suggested values of r

Paved area	**0.02**
Clean soil	**0.1**
Sparse grass	**0.3**
Moderate grass	**0.4**
Thick bush	**0.8**
Use r =	0.4

Overland flow	=	0.676 **Hours**	**Use Tc =**	0.676	**Hours**
Watercourse	=	0.162 **Hours**			

Rural C1									**Urban C2**		
Surface Slope	**%**	**C_s**	**Permeability**	**%**	**C_p**	**Vegetation**	**%**	**C_v**	**Use**	**%**	**C_2**
Vlei's and pans			**Very Permeable**			**Thick bush and plantation**			**Lawns and parks**		
Flat areas	100%	0.08	**Permeable**	50%	0.08	**Light bush and farm-lands**	50%	0.11	**Industrial areas**	100%	0.70
Hilly			**Semi-Permeable**	50%	0.16	**Grass-lands**	50%	0.21	**City/Residential**		
Steep areas			**Impermeable**			**No vegetation**			**Streets**		
TOTAL	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**1.00**	

Table 1: Rural runoff-coefficients

Component	**Classification**	**MAR (mm)**		
		600	**600-900**	**900**
Surface slope C_s	**Vleis and pans (<3%)**	**0.01**	**0.03**	**0.05**
	Flat areas (3-10%)	**0.06**	**0.08**	**0.11**
	Hilly (10-30%)	**0.12**	**0.16**	**0.20**
	Steep areas (>30%)	**0.22**	**0.26**	**0.30**
Surface slope C_p	**Very permeable**	**0.03**	**0.04**	**0.05**
	Permeable	**0.06**	**0.08**	**0.10**
	Semi permeable	**0.12**	**0.16**	**0.20**
	Impermeable	**0.21**	**0.26**	**0.30**
Surface slope C_v	**Thick bush and plantation**	**0.03**	**0.04**	**0.05**
	Light bush and farm-lands	**0.07**	**0.11**	**0.15**
	Grass-lands	**0.17**	**0.21**	**0.25**
	No vegetation	**0.26**	**0.28**	**0.30**

Table 2: Urban runoff-coefficients

Use	**Coefficient**
Lawns & Parks	
Sandy, flat (<2%)	**0.05-0.10**
Sandy, steep (>7%)	**0.15-0.20**
Heavy soil, steep (>7%)	**0.13-0.17**
Heavy soil, flat (<2%)	**0.25-0.35**
Residential areas	
Houses	**0.30-0.50**
Flats	**0.50-0.70**
Industry	
Light Industry	**0.50-0.80**
Heavy Industry	**0.60-0.90**
Business	
City centre	**0.70-0.95**
Surburban	**0.50-0.70**
Streets	**0.70-0.95**

Summer rainfall region

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Point rainfall (mm)	25	43	56	69	86	100
Point intensity (mm/h)	37	63	83	102	128	147

Run-off factor

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Rural C1	0.36	0.36	0.36	0.36	0.36	0.36
Urban C2	0.70	0.70	0.70	0.70	0.70	0.70
Lakes C3	1.00	1.00	1.00	1.00	1.00	1.00
Combined C = C1 + C2 + C3	0.39	0.39	0.39	0.39	0.39	0.39

Peak flow -Catchments

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Peak flow Q = CIA/3600 (l/s)	384	653	861	1058	1327	1524

Notes:

Description of Catchment:	CATCHMENT D4.1
Project:	C2868
Calculated By:	K DASS
Date:	8-Mar-21
	Post - Development

Physical Characteristics

Mean annual rainfall (P)	**P =**	710	**mm**
Size of Catchment	**A =**	82388	**m²**
Longest water course	**L =**	657	**m**
Height Difference	= 18.72	**m**	
Average slope of water cours	**S =**	0.0285	**m/m**

Area Distribution Factors

α + β + γ = 1		
Rural	**Urban**	**Lakes**
α =	**β =**	**γ =**
0.90	0.10	0.00

Overland flow	= 0.743 **Hours**	**Use Tc =**	0.743	**Hours**
Watercourse	= 0.189 **Hours**			

Table 3: Suggested values of r

Paved area	**0.02**
Clean soil	**0.1**
Sparse grass	**0.3**
Moderate grass	**0.4**
Thick bush	**0.8**
Use r =	0.4

Rural C1									**Urban C2**		
Surface Slope	**%**	**C_s**	**Permeability**	**%**	**C_p**	**Vegetation**	**%**	**C_v**	**Use**	**%**	**C_2**
Vlei's and pans			**Very Permeable**			**Thick bush and plantation**			**Lawns and parks**		
Flat areas	100%	0.08	**Permeable**	50%	0.08	**Light bush and farm-lands**	50%	0.11	**Industrial areas**	100%	0.70
Hilly			**Semi-Permeable**	50%	0.16	**Grass-lands**	50%	0.21	**City/Residential**		
Steep areas			**Impermeable**			**No vegetation**			**Streets**		
TOTAL	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**1.00**	

Table 1: Rural runoff-coefficients

Component	**Classification**	**MAR (mm)**		
		600	**600-900**	**900**
Surface slope C_s	**Vleis and pans (<3%)**	**0.01**	**0.03**	**0.05**
	Flat areas (3-10%)	**0.06**	**0.08**	**0.11**
	Hilly (10-30%)	**0.12**	**0.16**	**0.20**
	Steep areas (>30%)	**0.22**	**0.26**	**0.30**
Surface slope C_p	**Very permeable**	**0.03**	**0.04**	**0.05**
	Permeable	**0.06**	**0.08**	**0.10**
	Semi permeable	**0.12**	**0.16**	**0.20**
	Impermeable	**0.21**	**0.26**	**0.30**
Surface slope C_v	**Thick bush and plantation**	**0.03**	**0.04**	**0.05**
	Light bush and farm-lands	**0.07**	**0.11**	**0.15**
	Grass-lands	**0.17**	**0.21**	**0.25**
	No vegetation	**0.26**	**0.28**	**0.30**

Table 2: Urban runoff-coefficients

Use	**Coefficient**
Lawns & Parks	
Sandy, flat (<2%)	**0.05-0.10**
Sandy, steep (>7%)	**0.15-0.20**
Heavy soil, steep (>7%)	**0.13-0.17**
Heavy soil, flat (<2%)	**0.25-0.35**
Residential areas	
Houses	**0.30-0.50**
Flats	**0.50-0.70**
Industry	
Light Industry	**0.50-0.80**
Heavy Industry	**0.60-0.90**
Business	
City centre	**0.70-0.95**
Surburban	**0.50-0.70**
Streets	**0.70-0.95**

Summer rainfall region

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Point rainfall (mm)	26	44	57	71	89	102
Point intensity (mm/h)	35	59	77	96	120	138

Run-off factor

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Rural C1	0.36	0.36	0.36	0.36	0.36	0.36
Urban C2	0.70	0.70	0.70	0.70	0.70	0.70
Lakes C3	1.00	1.00	1.00	1.00	1.00	1.00
Combined C = C1 + C2 + C3	0.39	0.39	0.39	0.39	0.39	0.39

Peak flow -Catchments

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Peak flow Q = CIA/3600 (l/s)	316	532	694	866	1082	1244

Notes:

Description of Catchment:	CATCHMENT D5
Project:	C2868
Calculated By:	K DASS
Date:	8-Mar-21
	Pre - Development

Physical Characteristics

Mean annual rainfall (P)	**P =**	710	**mm**
Size of Catchment	**A =**	150661	**m²**
Longest water course	**L =**	447	**m**
Height Difference =	14.72	**m**	
Average slope of water cours	**S =**	0.0329	**m/m**

Area Distribution Factors

$\alpha + \beta + \gamma = 1$		
Rural	**Urban**	**Lakes**
α =	**β =**	**γ =**
1.00	0.00	0.00

Table 3: Suggested values of r

Paved area	**0.02**
Clean soil	**0.1**
Sparse grass	**0.3**
Moderate grass	**0.4**
Thick bush	**0.8**
Use r =	0.4

Overland flow	=	0.600 **Hours**	**Use Tc =**	0.600	**Hours**
Watercourse	=	0.133 **Hours**			

Rural C1									**Urban C2**		
Surface Slope	**%**	**C_s**	**Permeability**	**%**	**C_p**	**Vegetation**	**%**	**C_v**	**Use**	**%**	**C_2**
Vlei's and pans			**Very Permeable**			**Thick bush and plantation**			**Lawns and parks**		
Flat areas	100%	0.08	**Permeable**	50%	0.08	**Light bush and farm-lands**	50%	0.11	**Industrial areas**	100%	0.70
Hilly			**Semi-Permeable**	50%	0.16	**Grass-lands**	50%	0.21	**City/Residential**		
Steep areas			**Impermeable**			**No vegetation**			**Streets**		
TOTAL	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**1.00**	

Table 1: Rural runoff-coefficients

Component	**Classification**	**MAR (mm)**		
		600	**600-900**	**900**
Surface slope C_s	**Vleis and pans (<3%)**	**0.01**	**0.03**	**0.05**
	Flat areas (3-10%)	**0.06**	**0.08**	**0.11**
	Hilly (10-30%)	**0.12**	**0.16**	**0.20**
	Steep areas (>30%)	**0.22**	**0.26**	**0.30**
Surface slope C_p	**Very permeable**	**0.03**	**0.04**	**0.05**
	Permeable	**0.06**	**0.08**	**0.10**
	Semi permeable	**0.12**	**0.16**	**0.20**
	Impermeable	**0.21**	**0.26**	**0.30**
Surface slope C_v	**Thick bush and plantation**	**0.03**	**0.04**	**0.05**
	Light bush and farm-lands	**0.07**	**0.11**	**0.15**
	Grass-lands	**0.17**	**0.21**	**0.25**
	No vegetation	**0.26**	**0.28**	**0.30**

Table 2: Urban runoff-coefficients

Use	**Coefficient**
Lawns & Parks	
Sandy, flat (<2%)	**0.05-0.10**
Sandy, steep (>7%)	**0.15-0.20**
Heavy soil, steep (>7%)	**0.13-0.17**
Heavy soil, flat (<2%)	**0.25-0.35**
Residential areas	
Houses	**0.30-0.50**
Flats	**0.50-0.70**
Industry	
Light Industry	**0.50-0.80**
Heavy Industry	**0.60-0.90**
Business	
City centre	**0.70-0.95**
Surburban	**0.50-0.70**
Streets	**0.70-0.95**

Summer rainfall region

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Point rainfall (mm)	24	41	54	67	83	96
Point intensity (mm/h)	41	69	90	111	139	160

Run-off factor

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Rural C1	0.36	0.36	0.36	0.36	0.36	0.36
Urban C2	0.70	0.70	0.70	0.70	0.70	0.70
Lakes C3	1.00	1.00	1.00	1.00	1.00	1.00
Combined C = C1 + C2 + C3	0.36	0.36	0.36	0.36	0.36	0.36

Peak flow -Catchments

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Peak flow Q = CIA/3600 (l/s)	618	1040	1356	1672	2094	2411

Notes:

Description of Catchment:	CATCHMENT D6
Project:	C2868
Calculated By:	K DASS
Date:	8-Mar-21
	Pre - Development

Physical Characteristics

Mean annual rainfall (P)	**P =**	710	**mm**
Size of Catchment	**A =**	61740	**m²**
Longest water course	**L =**	483	**m**
Height Difference	=	8.84	**m**
Average slope of water cours	**S =**	0.0183	**m/m**

Area Distribution Factors

$\alpha + \beta + \gamma = 1$		
Rural	**Urban**	**Lakes**
α =	**β =**	**γ =**
1.00	0.00	0.00

Overland flow	=	0.713 **Hours**	**Use Tc =**	0.713	**Hours**
Watercourse	=	0.177 **Hours**			

Table 3: Suggested values of r

Paved area	**0.02**
Clean soil	**0.1**
Sparse grass	**0.3**
Moderate grass	**0.4**
Thick bush	**0.8**
Use r =	0.4

Rural C1									**Urban C2**		
Surface Slope	**%**	**C_s**	**Permeability**	**%**	**C_p**	**Vegetation**	**%**	**C_v**	**Use**	**%**	**C_2**
Vlei's and pans	100%	0.03	**Very Permeable**			**Thick bush and plantation**			**Lawns and parks**		
Flat areas			**Permeable**	50%	0.08	**Light bush and farm-lands**	50%	0.11	**Industrial areas**		
Hilly			**Semi-Permeable**	50%	0.16	**Grass-lands**	50%	0.21	**City/Residential**		
Steep areas			**Impermeable**			**No vegetation**			**Streets**		
TOTAL	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**1.00**		**TOTAL**	**0.00**	

Table 1: Rural runoff-coefficients

Component	**Classification**	**MAR (mm)**		
		600	**600-900**	**900**
Surface slope C_s	**Vleis and pans (<3%)**	**0.01**	**0.03**	**0.05**
	Flat areas (3-10%)	**0.06**	**0.08**	**0.11**
	Hilly (10-30%)	**0.12**	**0.16**	**0.20**
	Steep areas (>30%)	**0.22**	**0.26**	**0.30**
Surface slope C_p	**Very permeable**	**0.03**	**0.04**	**0.05**
	Permeable	**0.06**	**0.08**	**0.10**
	Semi permeable	**0.12**	**0.16**	**0.20**
	Impermeable	**0.21**	**0.26**	**0.30**
Surface slope C_v	**Thick bush and plantation**	**0.03**	**0.04**	**0.05**
	Light bush and farm-lands	**0.07**	**0.11**	**0.15**
	Grass-lands	**0.17**	**0.21**	**0.25**
	No vegetation	**0.26**	**0.28**	**0.30**

Table 2: Urban runoff-coefficients

Use	**Coefficient**
Lawns & Parks	
Sandy, flat (<2%)	**0.05-0.10**
Sandy, steep (>7%)	**0.15-0.20**
Heavy soil, steep (>7%)	**0.13-0.17**
Heavy soil, flat (<2%)	**0.25-0.35**
Residential areas	
Houses	**0.30-0.50**
Flats	**0.50-0.70**
Industry	
Light Industry	**0.50-0.80**
Heavy Industry	**0.60-0.90**
Business	
City centre	**0.70-0.95**
Surburban	**0.50-0.70**
Streets	**0.70-0.95**

Summer rainfall region

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Point rainfall (mm)	26	43	57	70	88	101
Point intensity (mm/h)	36	61	80	98	123	142

Run-off factor

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Rural C1	0.31	0.31	0.31	0.31	0.31	0.31
Urban C2	0.00	0.00	0.00	0.00	0.00	0.00
Lakes C3	1.00	1.00	1.00	1.00	1.00	1.00
Combined C = C1 + C2 + C3	0.31	0.31	0.31	0.31	0.31	0.31

Peak flow -Catchments

Return period T (years)	**2**	**5**	**10**	**20**	**50**	**100**
Peak flow Q = CIA/3600 (l/s)	191	324	425	521	654	755

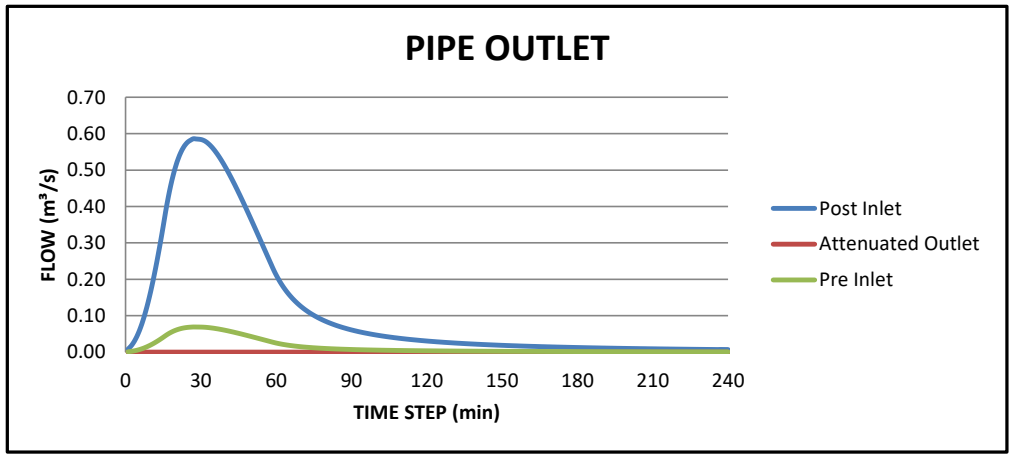
Notes:

ANNEXURE E:
RETENTION POND CALCULATIONS

RETENTION POND CALCULATIONS - D1.1
FOR
PTN 13 OF THE FARM BOSCHKOP 543-JR

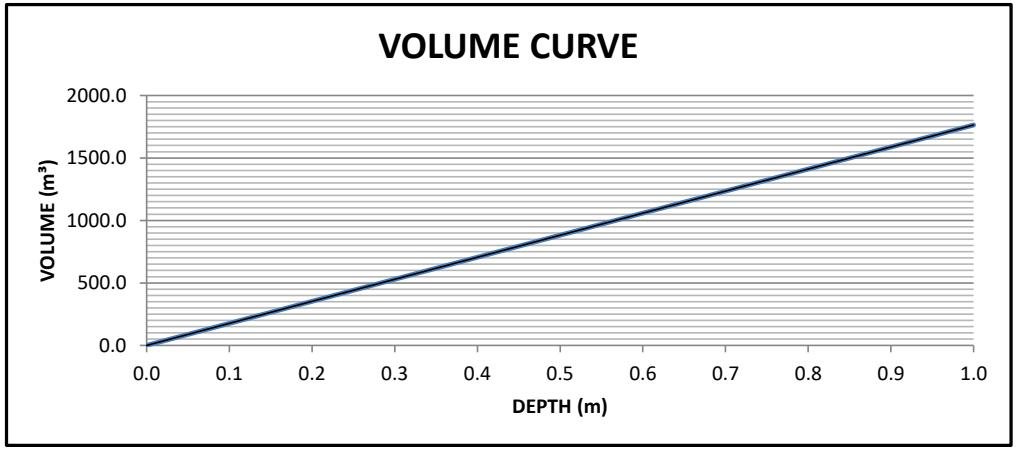
Outlet System	
Pipe Culvert	
Size: D (m)	0.0000001
Height of Wall: H (m)	0.0000001
Slope: So (m/m)	0.0000001
Rectangular opening	
Width: B (m)	0.0000001
Height: D (m)	0.0000001

PIPE OUTLET			
Pre 1:20 Inflow Max (m^3/s):	0.069	**Attenuation Pond**	
Post 1:50 Inflow Max (m^3/s):	0.586	**Vol (m^3):**	1734
Outflow Max (m3/s):	0.000	**Height (m):**	0.983



Attenuation Pond: Volume Curve	
Dim 1: (m)	42
Dim 2: (m)	42
Area: (m^2)	1764

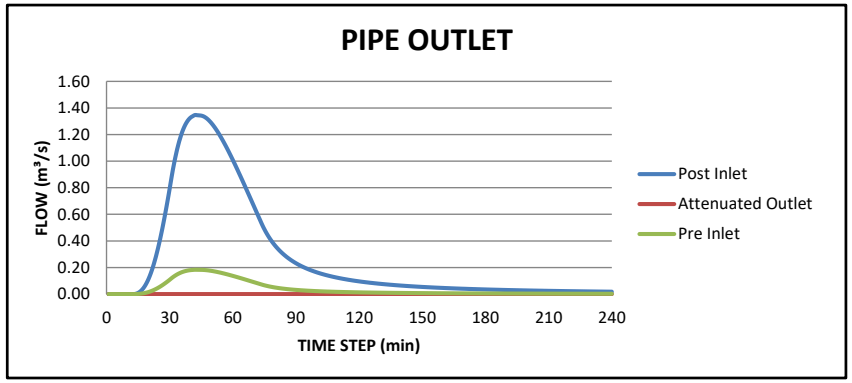
Height	Volume (m^3)
0.0	0.0
0.1	176.4
0.2	352.8
0.3	529.2
0.4	705.6
0.5	882.0
0.6	1058.4
0.7	1234.8
0.8	1411.2
0.9	1587.6
1.0	1764.0



RETENTION POND CALCULATIONS - D2
FOR
PTN 13 OF THE FARM BOSCHKOP 543-JR

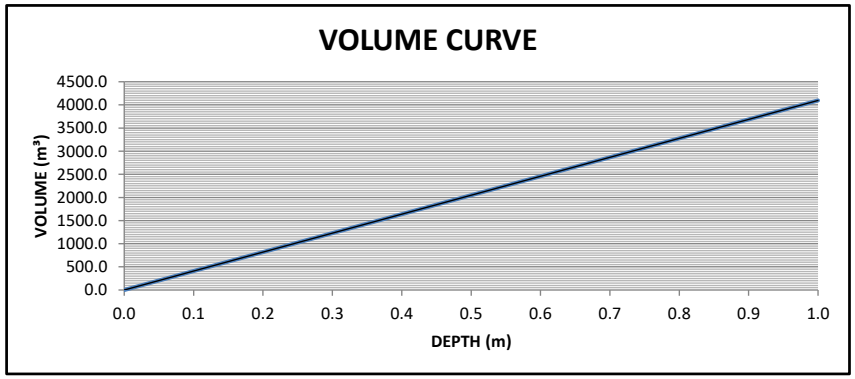
Outlet System	
Pipe Culvert	
Size: D (m)	0.0000001
Height of Wall: H (m)	0.0000001
Slope: So (m/m)	0.0000001
Rectangular opening	
Width: B (m)	0.0000001
Height: D (m)	0.0000001

PIPE OUTLET			
Pre 1:20 Inflow Max (m^3/s):	0.183	**Attenuation Pond**	
Post 1:50 Inflow Max (m^3/s):	1.347	**Vol (m^3):**	3972
Outflow Max (m3/s):	0.000	**Height (m):**	0.970



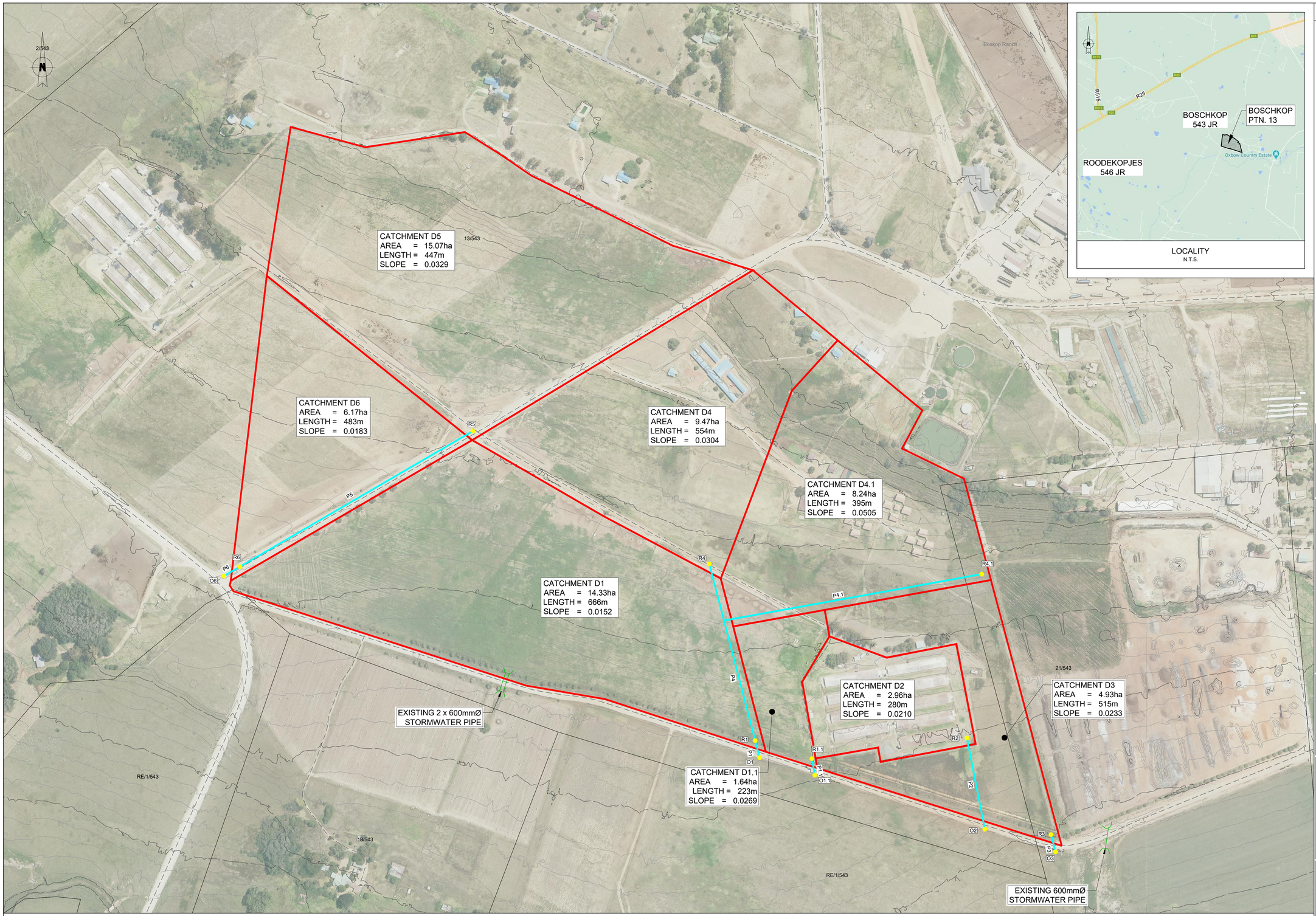
Attenuation Pond: Volume Curve	
Dim 1: (m)	64
Dim 2: (m)	64
Area: (m^2)	4096

Height	Volume (m^3)
0.0	0.0
0.1	409.6
0.2	819.2
0.3	1228.8
0.4	1638.4
0.5	2048.0
0.6	2457.6
0.7	2867.2
0.8	3276.8
0.9	3686.4
1.0	4096.0



ANNEXURE F:

STORMWATER MASTERPLAN



LOCALITY
N.T.S.

NOTES AND SPECIFICATIONS

NOTES:

RUN-OFF CALCULATION PERFORMED WITH THE RATIONAL METHOD, USING THE FOLLOWING CONSTANTS:

a) RETURN PERIOD:

- MAJOR SYSTEM : 20YR / 50YR
- MINOR SYSTEM : 2YR

b) MAP = 710mm/h

c) INFILTRATION RATE

- INITIAL RATE : 45mm/h
- FINAL RATE : 6mm/h

d) DEPRESSION STORAGE AREA

- PERVIOUS : 3mm
- IMPERVIOUS : 1mm

e) ROUGHNESS COEFFICIENT

- PERVIOUS : 0,150
- IMPERVIOUS : 0,020

LEGEND:

EXISTING ROADS
NEW STORMWATER ROUTE
STORMWATER NODES
STORMWATER CATCHMENTS

AMENDMENTS

NR:	DATE	APPROVED	DESCRIPTION	PAR.
A	20-11-2020	J.P. WELMAN	ISSUED FOR INFORMATION	-
B	11-03-2021	J.P. WELMAN	REVISED CATCHMENTS	-

DESIGNED: K. DASS — SIGNATURE — DATE: 11-03-2021
DRAWN: R. WILLERS
DESIGN CHECKED BY: J.P. WELMAN — SIGNATURE — DATE: 11-03-2021
INFRASTRUCTURE TECHNICAL INFORMATION MANAGEMENT — SIGNATURE — DATE

PROJECT STATUS

CONCEPT DRAWING (●) | TENDER DRAWING ( ) | APPROVED FOR CONSTRUCTION DRAWING ( ) | AS BUILT DRAWING ( )

PROJECT ENGINEER (CONSULTANT)

INITIALS AND SURNAME	SIGNATURE AND Pr. No.	DATE
J.P. WELMAN	20180172	11-03-2021

STRUCTURAL ENGINEERING (CITY OF TSHWANE)

INITIALS AND SURNAME	SIGNATURE AND Pr. No.	DATE

OFFICIAL REPRESENTATIVE (CITY OF TSHWANE)

INITIALS AND SURNAME	SIGNATURE AND Pr. No.	DATE

CONSULTANT DETAIL

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CITY OF TSHWANE
ROADS AND TRANSPORT DEPARTMENT

GROUP HEAD
Mr Letlonkane P. (Pheko)
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SIGNATURE: DATE:

LOCATION OF PROJECT
BOSCHKOP 543-JR
PORTION 13

DESCRIPTION OF PROJECT
STORMWATER MANAGEMENT PLAN

WAYLEAVE NUMBER

CONTRACT NO:	PROJECT NO:	
C2868	C2868	
DATE: NOVEMBER 2020	SCALE: 1:2500	ORIGINAL PAPER SIZE: A1
DRAWING NO: C2868-SMP-001	SHEET NO: 1 OF 1	B REVISION

CATCHMENTS PRE-DEVELOPMENT RUNOFF

CATCHMENT	DRAIN TO	AREA (ha)	LENGTH (m)	SLOPE (m/m)	1:2 YEAR FLOW (m³/s)	1:20 YEAR FLOW (m³/s)	1:50 YEAR FLOW (m³/s)
D1	R1	14.33	666	0.0152	0.38	1.06	1.32
D1.1	R1.1	1.64	223	0.0269	0.07	0.19	0.24
D2	R2	2.96	280	0.0210	0.34	0.94	1.17
D3	R3	4.93	515	0.0233	0.18	0.49	0.62
D4	R4	9.47	554	0.0304	0.38	1.06	1.33
D4.1	R4.1	8.24	395	0.0505	0.41	1.12	1.40
D5	R5	15.07	447	0.0329	0.62	1.67	2.09
D6	R6	6.17	483	0.0183	0.19	0.52	0.65

CATCHMENTS POST-DEVELOPMENT RUNOFF

CATCHMENT	DRAIN TO	AREA (ha)	LENGTH (m)	SLOPE (m/m)	1:2 YEAR FLOW (m³/s)	1:20 YEAR FLOW (m³/s)	1:50 YEAR FLOW (m³/s)
D1	R1	14.33	666	0.0152	0.38	1.06	1.32
D1.1	R1.1	1.64	223	0.0269	0.17	0.47	0.59
D2	R2	2.96	280	0.0210	0.34	0.94	1.17
D3	R3	4.93	515	0.0233	0.40	1.08	1.35
D4	R4	9.47	554	0.0304	0.38	1.06	1.33
D4.1	R4.1	8.24	657	0.0285	0.32	0.87	1.08
D5	R5	15.07	447	0.0329	0.62	1.67	2.09
D6	R6	6.17	483	0.0183	0.19	0.52	0.65

PRE-DEVELOPMENT RUNOFF AND INDICATIVE PIPE SIZES

ROUTE No.	1:2 YEAR FLOW		1:20 YEAR FLOW		1:50 YEAR FLOW	
	INLET PEAK (m³/s)	PEAK FLOW (m³/s)	INLET PEAK (m³/s)	PEAK FLOW (m³/s)	INLET PEAK (m³/s)	PEAK FLOW (m³/s)
P1	0.38	1.17	1.06	3.24	1.32	4.05
P1.1	0.07	0.07	0.19	0.19	0.24	0.24
P2	0.34	0.34	0.94	0.94	1.17	1.17
P3	0.18	0.18	0.49	0.49	0.62	0.62
P4	0.38	0.79	1.06	2.18	1.33	2.73
P4.1	0.41	0.41	1.12	1.12	1.40	1.40
P5	0.62	0.62	1.67	1.67	2.09	2.09
P6	0.19	0.81	0.52	2.19	0.65	2.75

POST-DEVELOPMENT RUNOFF AND INDICATIVE PIPE SIZES

ROUTE No.	1:2 YEAR FLOW		1:20 YEAR FLOW		1:50 YEAR FLOW	
	INLET PEAK (m³/s)	PEAK FLOW (m³/s)	INLET PEAK (m³/s)	PEAK FLOW (m³/s)	INLET PEAK (m³/s)	PEAK FLOW (m³/s)
P1	0.38	1.08	1.06	2.99	1.32	3.73
P1.1	0.17	0.17	0.47	0.47	0.59	0.59
P2	0.34	0.34	0.94	0.94	1.17	1.17
P3	0.40	0.40	1.08	1.08	1.35	1.35
P4	0.38	0.70	1.06	1.92	1.33	2.41
P4.1	0.32	0.32	0.87	0.87	1.08	1.08
P5	0.62	0.62	1.67	1.67	2.09	2.09
P6	0.19	0.81	0.52	2.19	0.65	2.75

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ANNEXURE G:
STORMWATER DETAILED DESIGN

CATCHMENT D6
AREA = 6.17ha
LENGTH = 483m
SLOPE = 0.0183

CATCHMENT D4
AREA = 9.47ha
LENGTH = 554m
SLOPE = 0.0304

CATCHMENT D4.1
AREA = 8.24ha
LENGTH = 395m
SLOPE = 0.0505

CATCHMENT D1
AREA = 14.33ha
LENGTH = 666m
SLOPE = 0.0152

BERM AND CHANNEL TO DETAIL

CATCHMENT D2
AREA = 2.96ha
LENGTH = 280m
SLOPE = 0.0210

CATCHMENT D3
AREA = 4.93ha
LENGTH = 515m
SLOPE = 0.0233

EXISTING 2 x 600mmØ STORMWATER PIPE

CATCHMENT D1.1
AREA = 1.64ha
LENGTH = 223m
SLOPE = 0.0269

RETENTION VOLUME = 1764m³

DISPERSEMENT STRUCTURE TO DETAIL

BERM AND CHANNEL DIRECTING DIRTY WATER TO RETENTION STRUCTURE

DISPERSEMENT STRUCTURE TO DETAIL

RETENTION VOLUME = 4096m³

DISPERSEMENT STRUCTURE TO DETAIL

EXISTING 600mmØ STORMWATER PIPE

18/543

RE/1/543

21/543

14/543

LOCALITY
N.T.S.

NOTES AND SPECIFICATIONS

NOTES:

RUN-OFF CALCULATION PERFORMED WITH THE RATIONAL METHOD, USING THE FOLLOWING CONSTANTS:

a) RETURN PERIOD:

- MAJOR SYSTEM : 20YR / 50YR
- MINOR SYSTEM : 2YR

b) MAP = 710mm/h

LEGEND:

- EXISTING ROADS
- STORMWATER CATCHMENTS PHASE 1
- STORMWATER RETENTION STRUCTURE
- BERM AND CHANEL FOR CLEAN WATER
- BERM AND CHANEL FOR DIRTY WATER
- DRAINAGE DIRECTION
- TYPICAL DISPERSEMENT STRUCTURE
- PIPE / ISOLATED EARTH CHANNEL

AMENDMENTS

NR:	DATE	APPROVED	DESCRIPTION	PAR.
A	20-11-2020	J.P. WELMAN	ISSUED FOR INFORMATION	-
B	03-12-2020	J.P. WELMAN	ISSUED FOR INFORMATION	-
C	11-03-2021	J.P. WELMAN	REVISED CATCHMENTS	-

DESIGNED: K. DASS — SIGNATURE — DATE: 11-03-2021
DRAWN: R. WILLERS
DESIGN CHECKED BY: J.P. WELMAN — SIGNATURE — DATE: 11-03-2021
INFRASTRUCTURE TECHNICAL INFORMATION MANAGEMENT — SIGNATURE — DATE

PROJECT STATUS

CONCEPT DRAWING ● | TENDER DRAWING ○ | APPROVED FOR CONSTRUCTION DRAWING ○ | AS BUILT DRAWING ○

PROJECT ENGINEER (CONSULTANT)
J.P. WELMAN — 20180172 — 11-03-2021
INITIALS AND SURNAME — SIGNATURE AND Pr. No. — DATE

STRUCTURAL ENGINEERING (CITY OF TSHWANE)
INITIALS AND SURNAME — SIGNATURE AND Pr. No. — DATE

OFFICIAL REPRESENTATIVE (CITY OF TSHWANE)
INITIALS AND SURNAME — SIGNATURE AND Pr. No. — DATE

CONSULTANT DETAIL

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ROADS AND TRANSPORT DEPARTMENT

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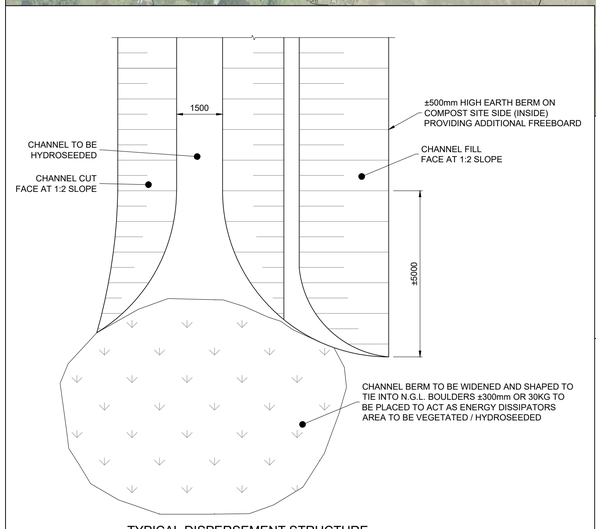
DRAWING APPROVED BY DIVISIONAL HEAD
Mr Tlhagale M.K.P. (Mavern)
SIGNATURE: DATE:

LOCATION OF PROJECT
BOSCHKOP 543-JR
PORTION 13

DESCRIPTION OF PROJECT
PROPOSED NETWORK
DETAIL DESIGN

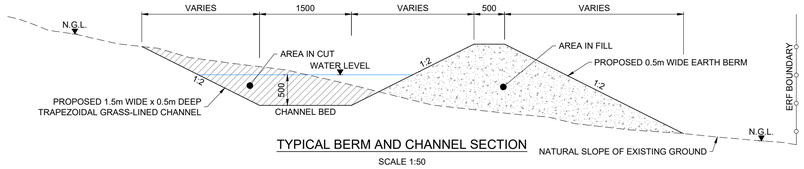
WAYLEAVE NUMBER

CONTRACT NO:	PROJECT NO:
C2868	C2868
DATE: NOVEMBER 2020	SCALE: 1:2000
ORIGINAL PAPER SIZE: A1	
DRAWING NO: C2868-SMP-002	SHEET NO: 1 OF 1
REVISION: C	

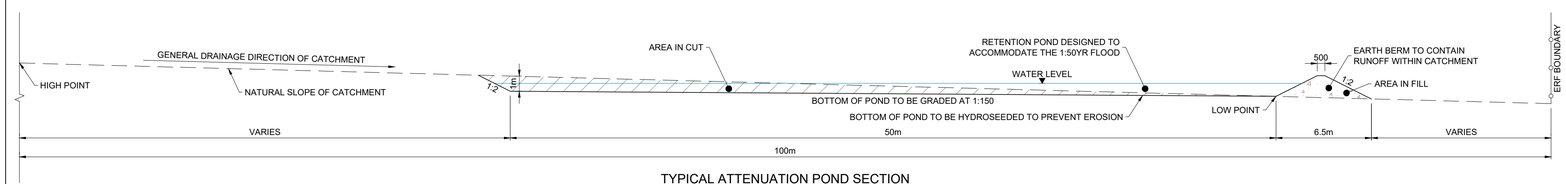


TYPICAL DISPERSEMENT STRUCTURE
SCALE 1:100

NOTE:
CHANNEL DESIGNED TO ACCOMMODATE THE 1:50 YEAR FLOOD



TYPICAL BERM AND CHANNEL SECTION
SCALE 1:50



TYPICAL ATTENUATION POND SECTION
SCALE 1:200

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