

**PLANNING and ENVIRONMENT ACT
BAROONDARA PLANNING SCHEME**

**CONSENT UNDER CLAUSE 52.20
VPP2101334
ENDORSED PLAN
Sheet 1 of 46**

**Signed: _____ for
MINISTER FOR ENERGY, ENVIRONMENT
AND CLIMATE CHANGE
Date: 5 Nov 2021**

MORDUE ENGINEERING
STRUCTURAL ENGINEERING CONSULTANTS

1-12 Bills Street, Hawthorn

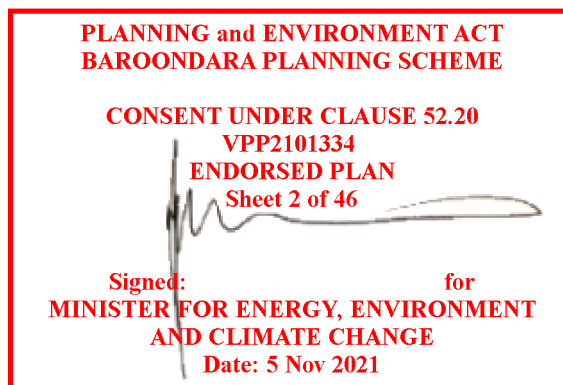
Report: WSUD Report

Job Number: J190070

Date: 27.08.2021

Revision: 4

Status: For Council Review



Document history

Revision	Description	By	Date
1	Preliminary	AN	26/03/2021
2	Preliminary	AN	26/04/2021
3	For Council Review	AN	11/06/2021
4	For Council Review	AN	27/08/2021

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Date: 5 Nov 2021

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1 Executive Summary

Water from the entire site area is to be captured and directed into a treatment system to achieve storm water discharge quality that exceeds recommendations of the 'Urban Stormwater: Best practice Environmental Management Guidelines' (1999) published by the CSIRO. The proposed system is as follows:

1. Three retention tanks will collect stormwater from roof areas. This water will be reused for irrigation of landscape and toilet flushing.
2. Three detention tanks of volumes 26 kL, 26 kL and 42 kL will collect stormwater from terrace areas and landscaping.
3. Two rain gardens – one for buildings A, B and C and another for buildings E, F and G to control of storm water discharge quality before it flows into the LPOD.
4. Storm water falling on a portion of Bills Street will flow directly to the LPOD.

The proposed detention/retention system satisfies the stormwater detention requirements of the planning permit and provides adequate stormwater retention to meet the demands of the landscaping.

2 Introduction

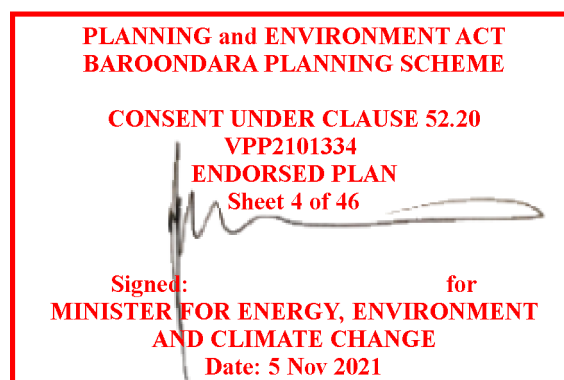
The site is located at 1-12 Bills Street, Hawthorn.

The site comprises of existing buildings that will be demolished and combined into one development. The development will consist of 6 buildings – A, B, C, E, F and G.

The total site area is 10,080 m².

The site has a gentle fall from approximately RL21.0 in the north-east corner to RL11.3 in the south-west corner.

Mordue Engineering has been engaged to prepare a Storm Water Management Plan (SWMP) and design and document the in-ground storm water system.



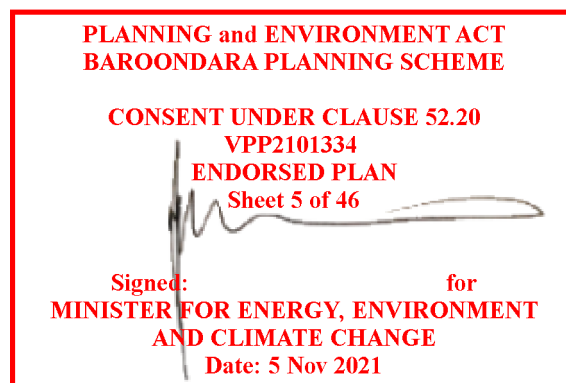
2.1 Site location

Site address: 1-12 Bills Street, Hawthorn

Site coordinates: 37°50'17.45"S 145°2'27.26"E



Figure 1 - Aerial view of existing site conditions



2.2 Floor plans



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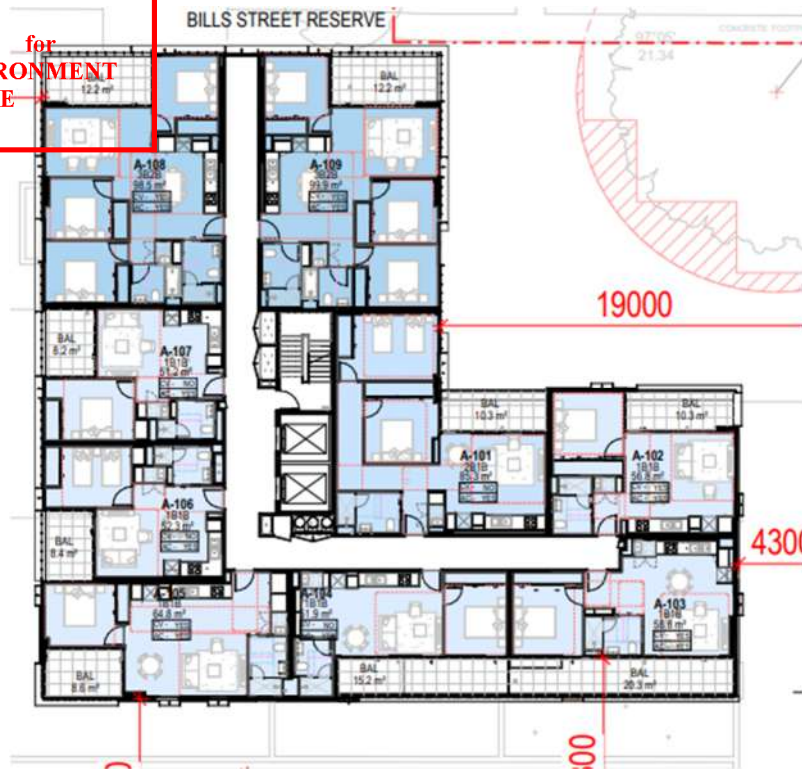


Figure 4 – Building A – Level 1 plan



Figure 5 – Building A – Level 2 plan

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Figure 6 – Building A – Level 3 plan

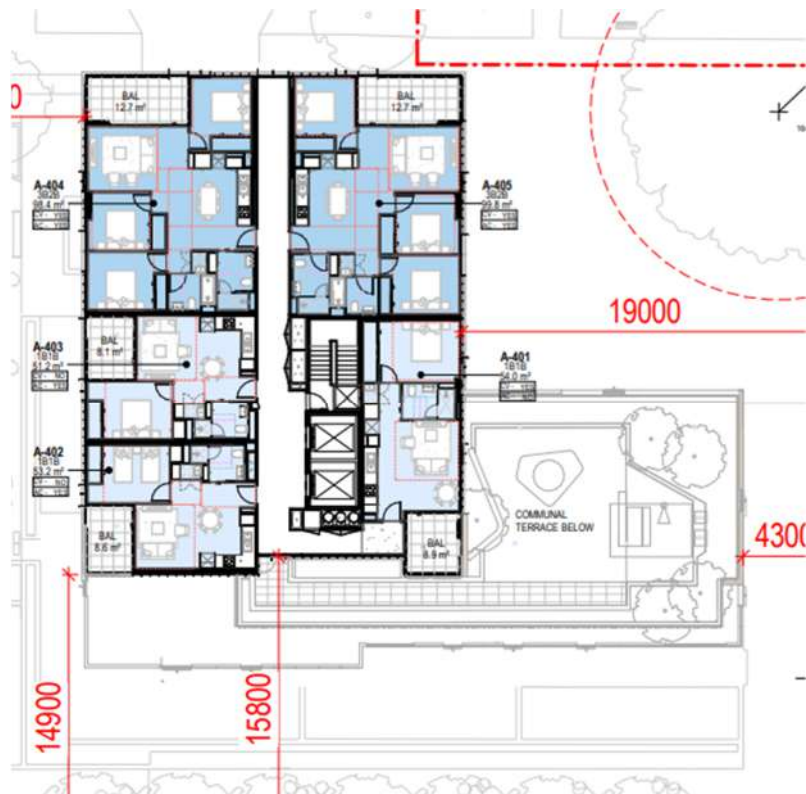


Figure 7 – Building A – Level 4 plan

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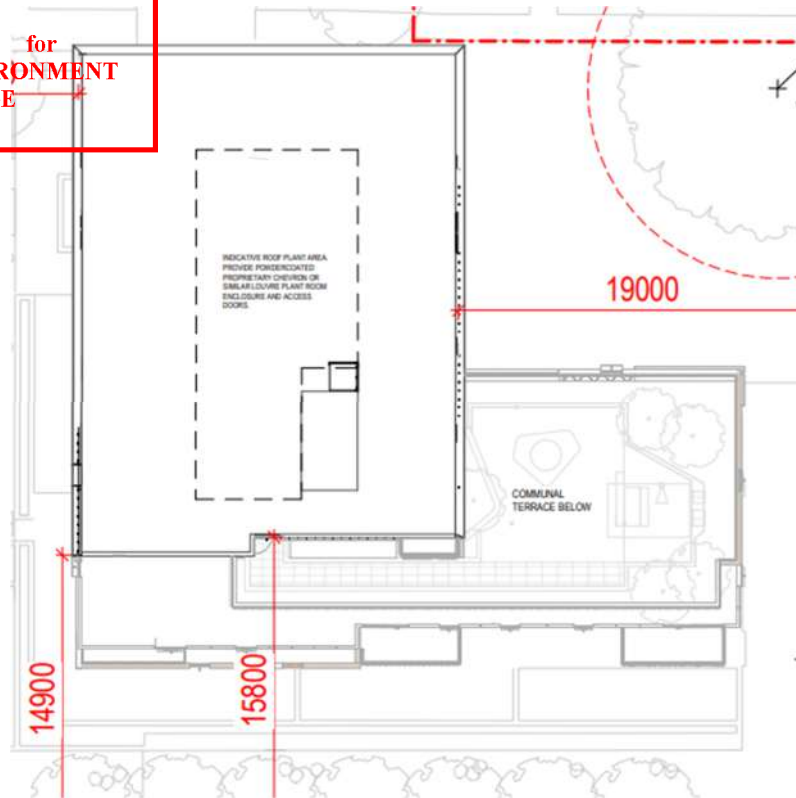


Figure 8 – Building A – Roof plan

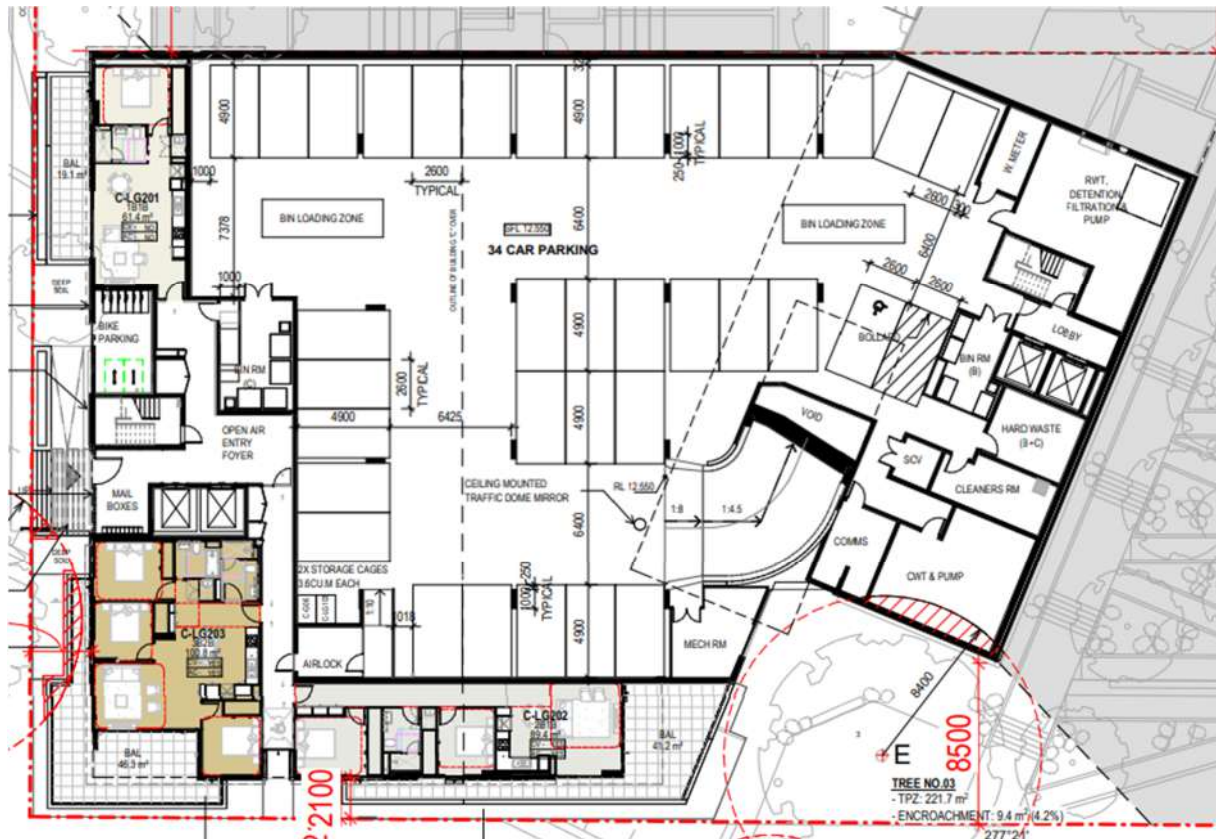


Figure 9 – Buildings B, C – Lower Ground 2 plan

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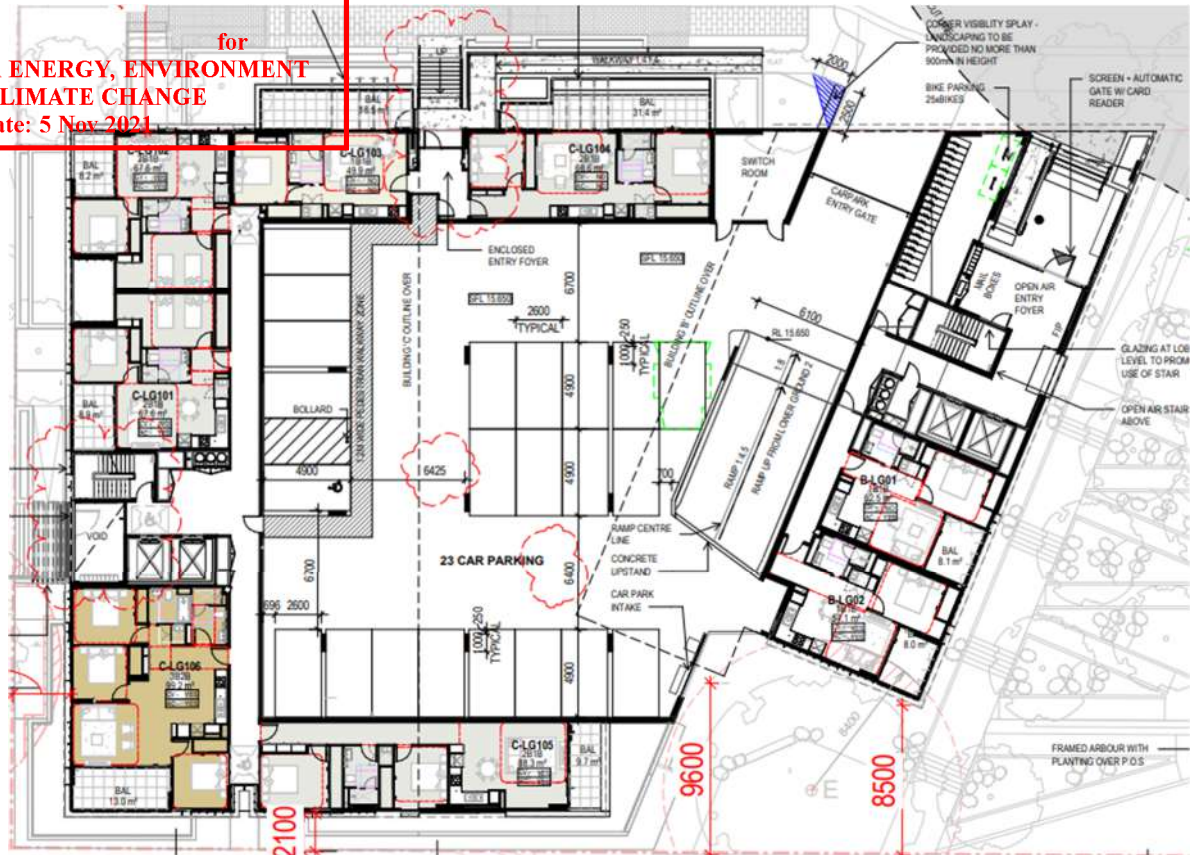


Figure 10 – Buildings B, C – Lower Ground 1 plan



Figure 11 – Building B, C – Ground floor plan

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Figure 12 – Building B, C – Level 1 plan



Figure 13 – Building B, C – Level 2 plan

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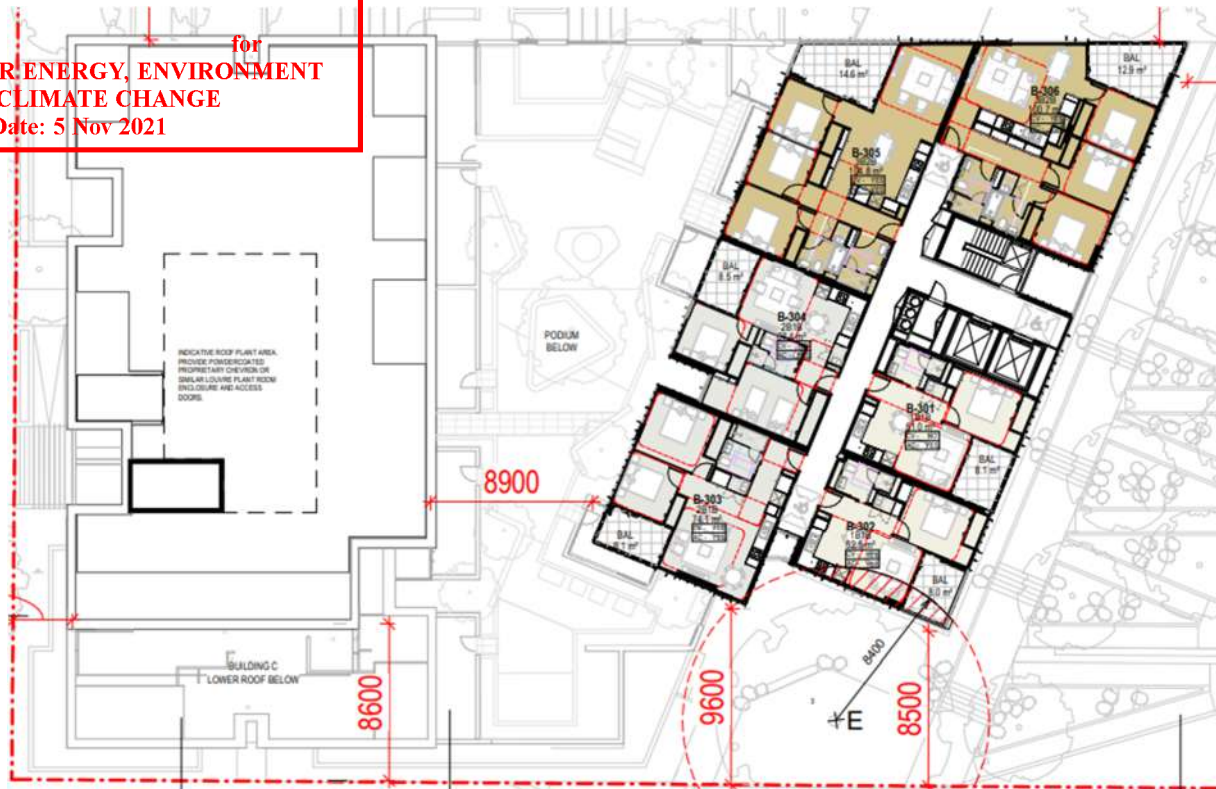


Figure 14 – Building B, C – Level 3 plan

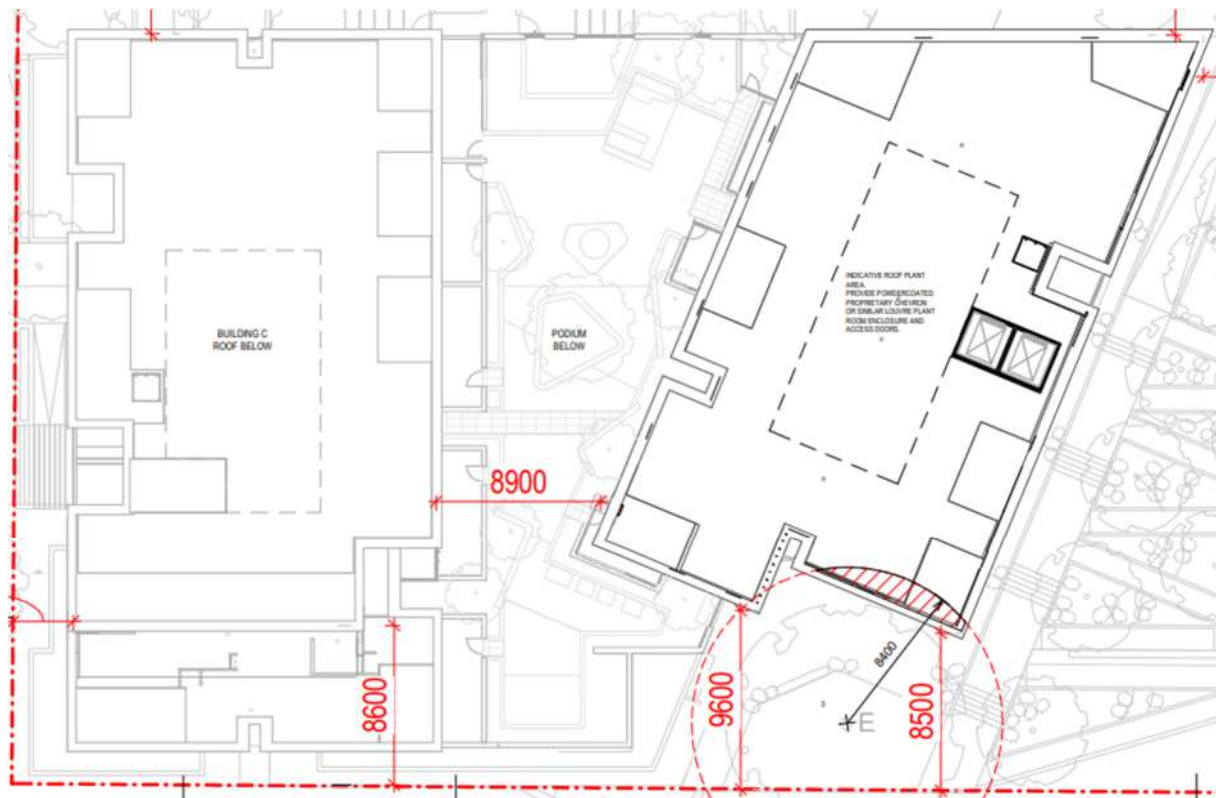


Figure 15 – Building B, C – Roof plan

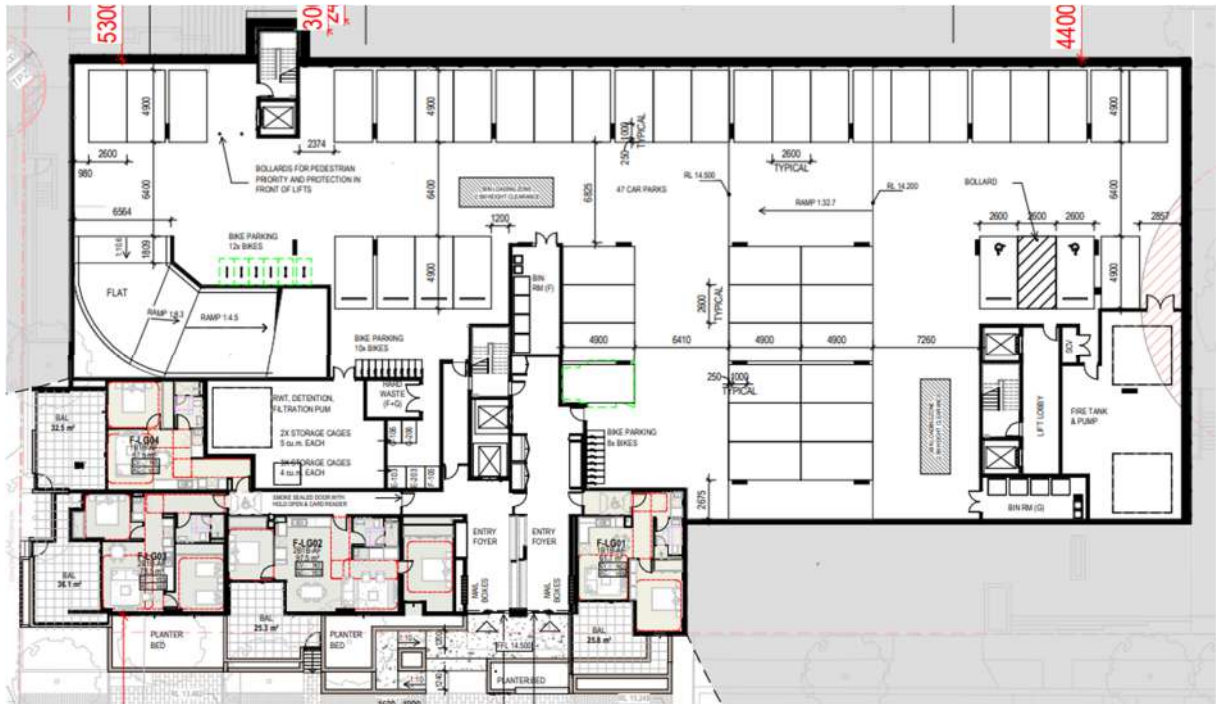


Figure 16 – Building E, F, G – Lower Ground plan

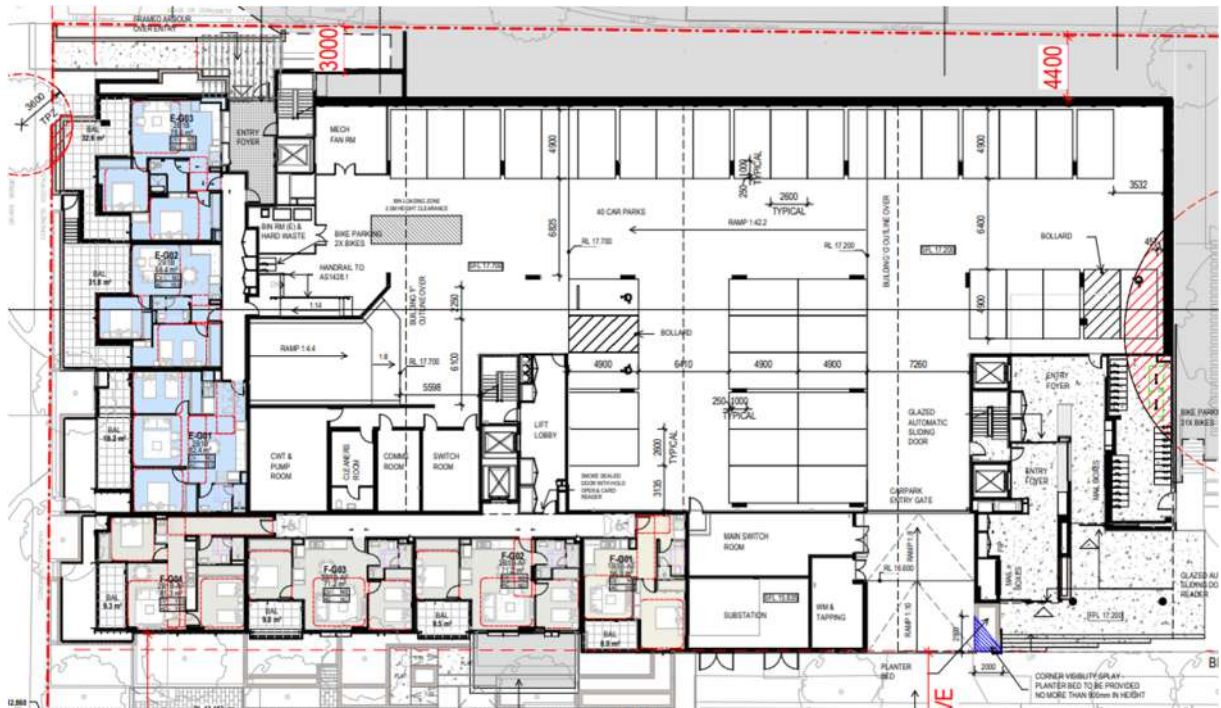


Figure 17 – Building E, F, G – Ground floor plan

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Figure 18 – Building E, F, G – Level 1 plan

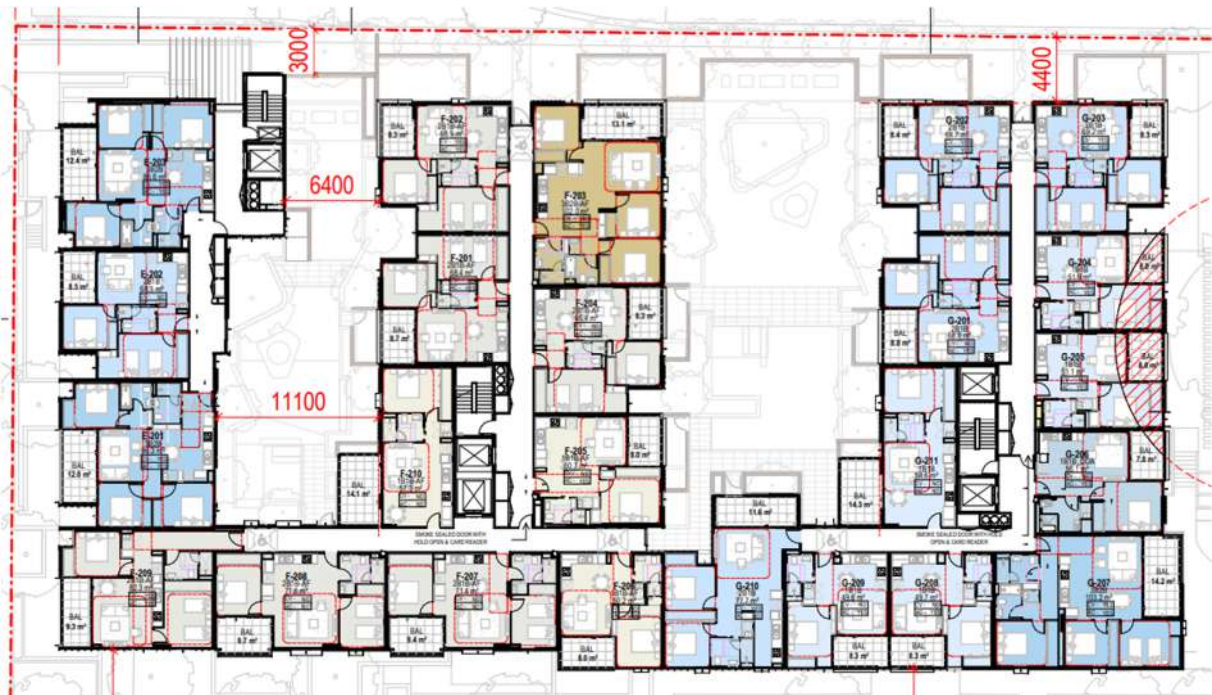


Figure 19 – Building E, F, G – Level 2 plan

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Figure 20 – Building E, F, G – Level 3 plan



Figure 21 – Building E, F, G – Level 4 plan

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Figure 22 – Building E, F, G – Level 5 plan



Figure 23 – Building E, F, G – Level 6 plan

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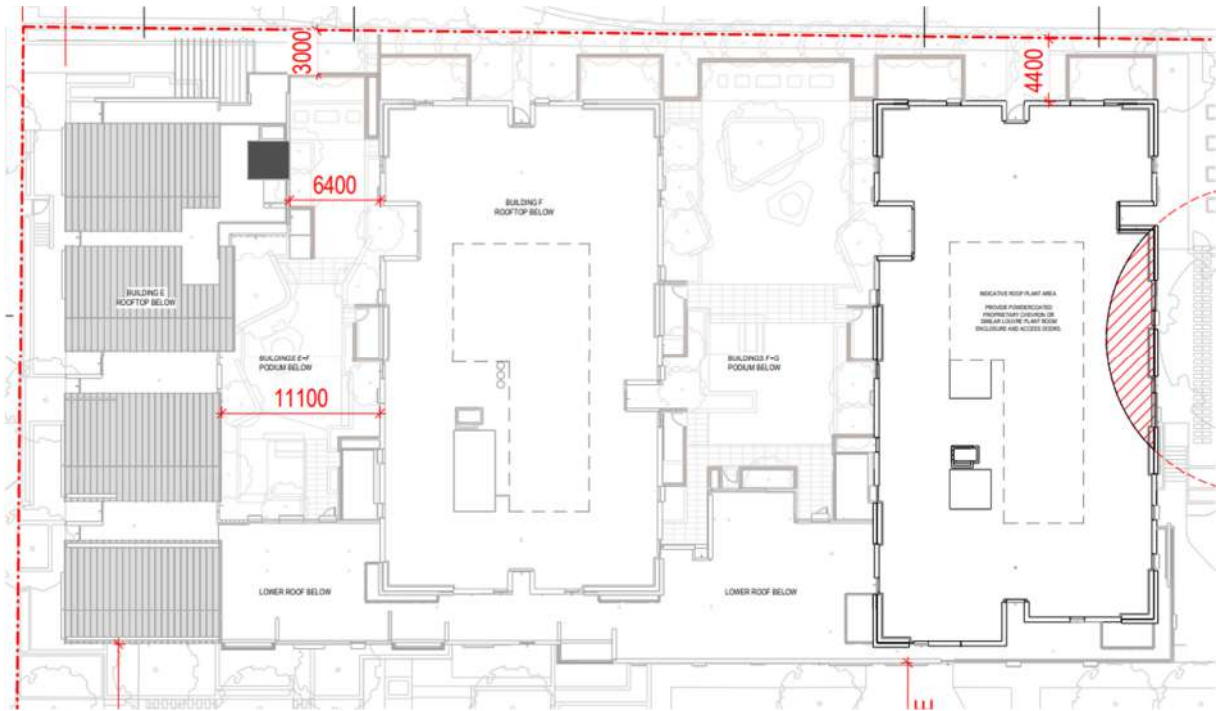


Figure 24 – Building E, F, G – Roof plan

2.3 Catchment areas

Building	Roof (m ²)	Terrace (m ²)	Landscape (m ²)	Total area (m ²)
A	540	202	288	1030
B	587	24	510	1122
C	589	150		739
E	360	55	-	415
F	625	274	-	899
G	678	199	-	877
North Precinct E-F	-	25	300	325
North Precinct F-G	-	60	399	459
Concrete pavement				453
Soft landscape				3692
Bills St. – Road area				316

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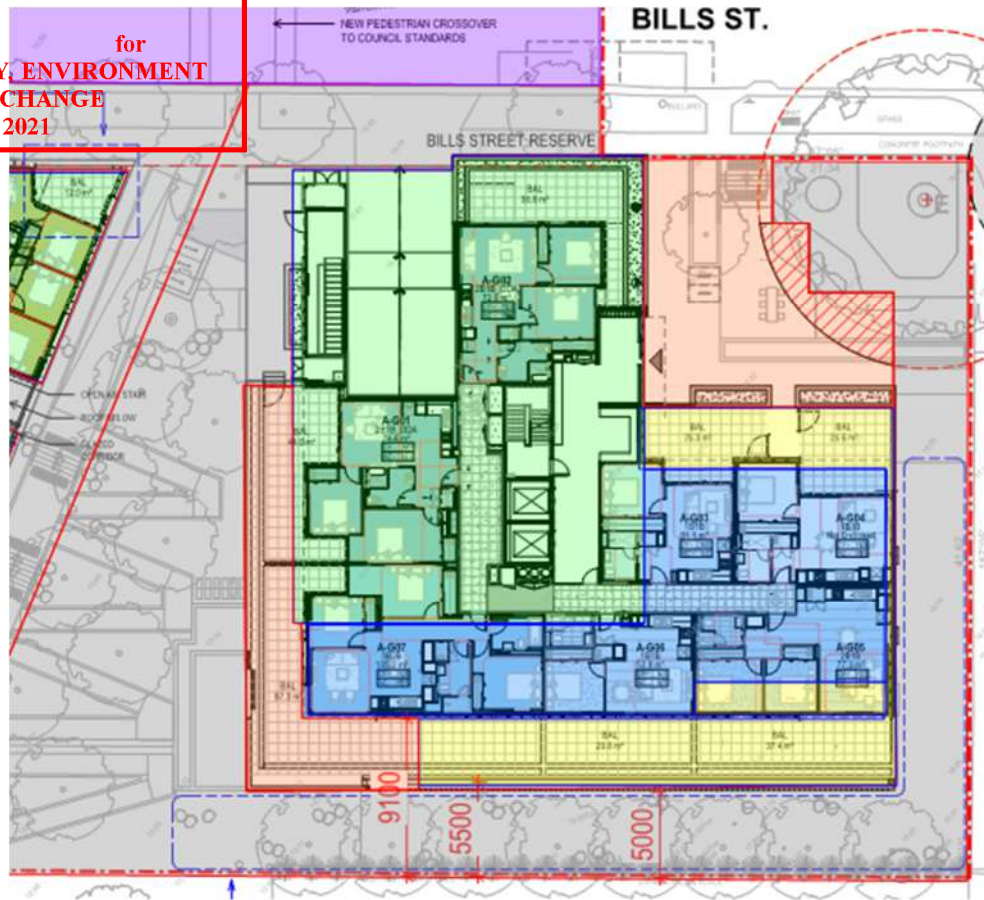


Figure 25 - Catchment plan – Building A

(Legend: GREEN – roof, YELLOW – Terrace, BLUE – podium landscape, ORANGE – concrete paving, GREY – soft landscape, PURPLE – road area)

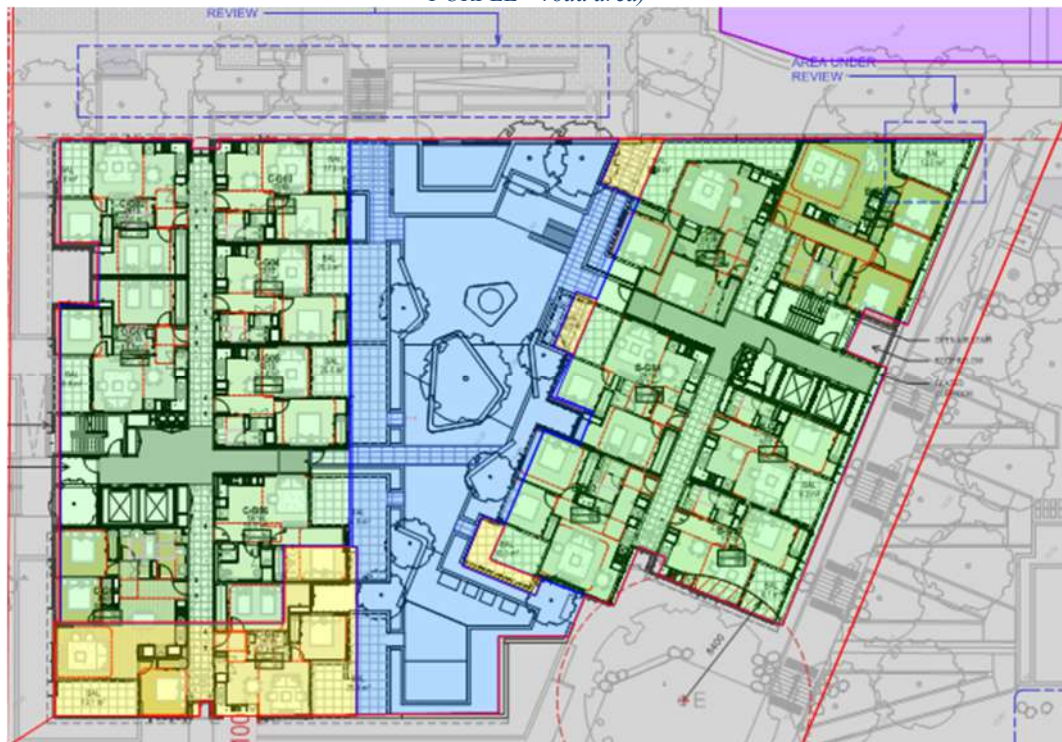


Figure 26 - Catchment plan – Buildings B & C

(Legend: GREEN – roof, YELLOW – Terrace, BLUE – podium landscape, ORANGE – concrete paving, GREY – soft landscape, PURPLE – road area)

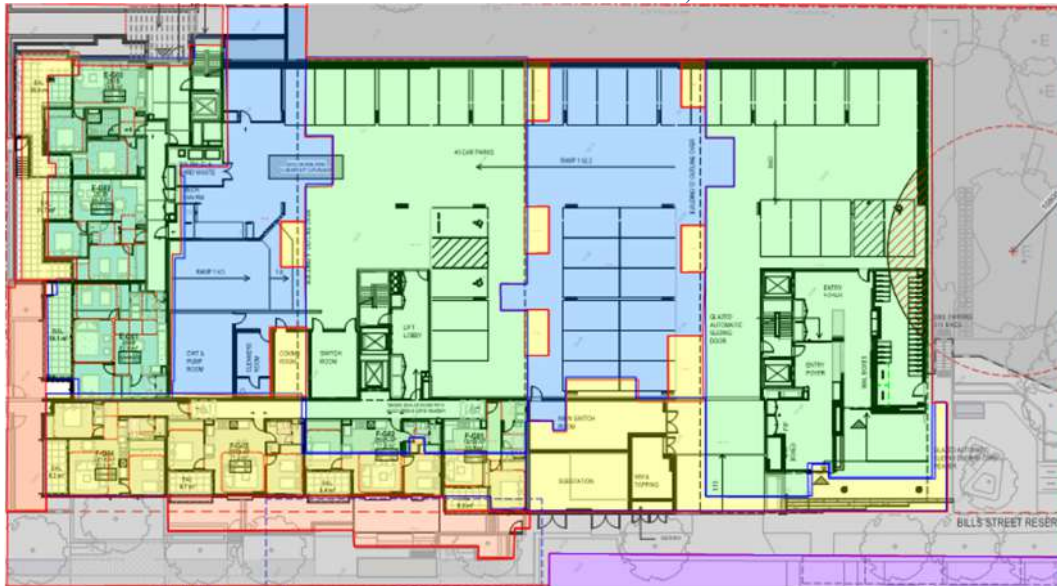


Figure 27 -

Catchment plan – Buildings E, F & G

(Legend: GREEN – roof, YELLOW – Terrace, BLUE – podium landscape, ORANGE – concrete paving, GREY – soft landscape, PURPLE – road area)

2.4 Conditions of Legal point of discharge (LPOD)

LPOD conditions have been advised by the civil department of the City of Boroondara and are listed below.

- Storm water drainage runoff shall be collected in a complete and effective system of drains and connected to the Approved Point of Storm water discharge.
- Onsite detention (orifice) control pit is required to be designed to meet the council specified PSD and the detention volume in accordance with Council's standard drawing SD999 rev. J.
- No structure is to be built over and no cut or fill over:
 - A drainage easement on Title
 - An existing council storm water drain that is located outside any easement on Title.
- No ground water or anything other than storm water is to be discharged into an open drainage system.

See Appendix A for the complete LPD.

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3 Proposed Storm Water Management System

Water from the entire site area is to be captured and directed into two separate stormwater management systems where it is to be treated as follows:

- Water falling on the roof areas is to be conveyed via gravity to retention tanks. This water is then to be reused for irrigation of landscape and toilet flushing.
- Water falling on terraces and podium landscape areas is to be conveyed via gravity to detention tanks.
- Water falling on the soft landscape around the buildings is to be directed towards rain gardens via gravity.
- Flow from retention and detention tanks is to be gravity fed to rain gardens from where it will flow to the LPOD, also via gravity.
- Water falling on a portion of Bills Street will flow directly to the LPOD.

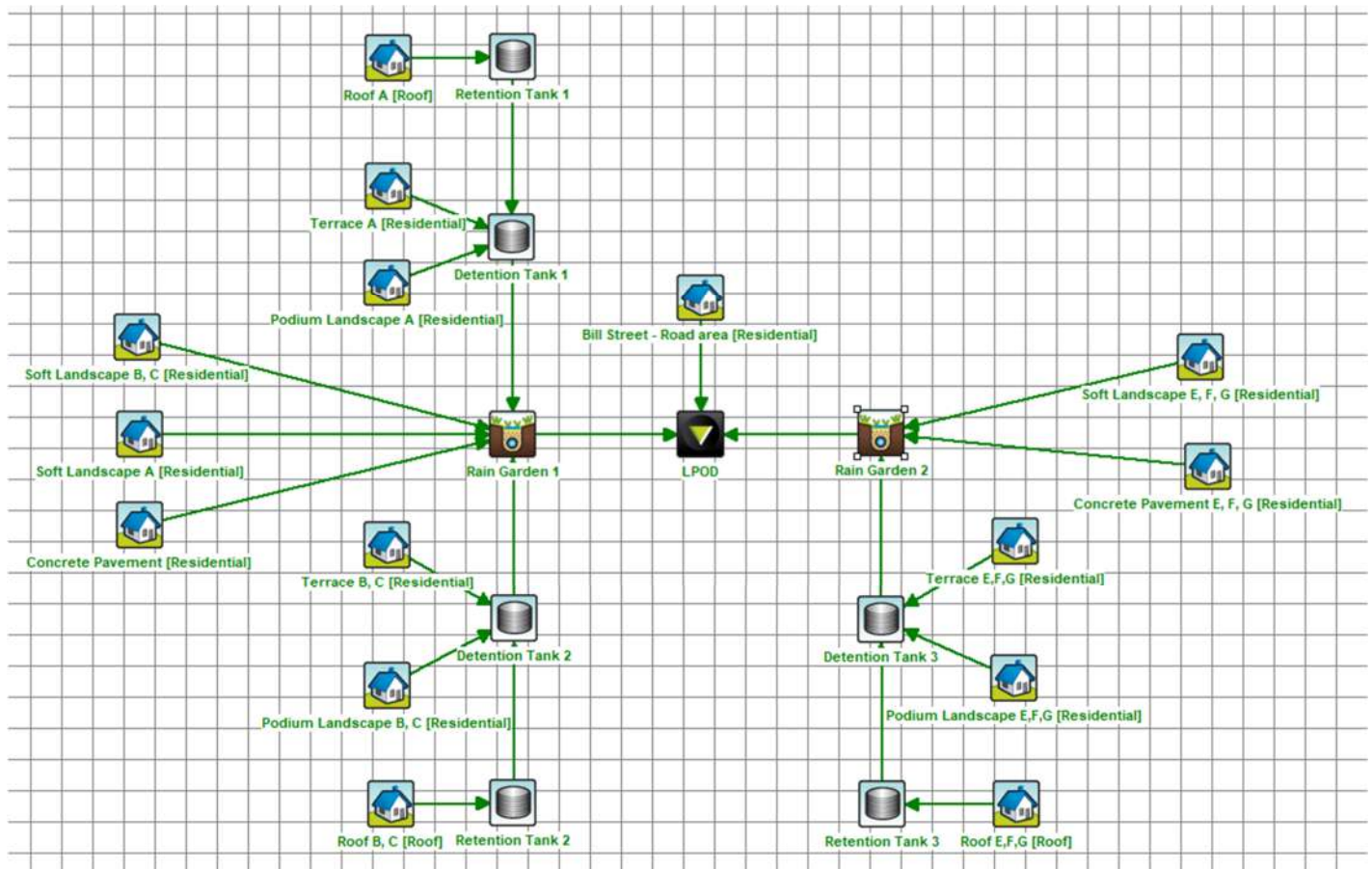


Figure 28 - Schematic plan of the proposed storm water management system

Signed: **3.1 Design parameters**
for
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3.1.1 Reuse requirements

Building	Irrigation (kL/year)	Toilet flushing (kL/year)	Total (kL/year)
A	721	391	1112
B, C	1229	636	1865
E, F, G	4358	1215	5573

(A pattern of monthly loading has been assigned for irrigation reuse – refer to setup of retention tank nodes in MUSIC for further details)

3.1.2 Detention requirements

Size of on-site detention tanks and maximum values of permissible discharge (PSD) have been dictated directly by the civil department of the City of Boroondara. The relevant communication is presented in Appendix B.

Building Group	OSD tank size (m ³)	PSD (L/s)
A, B, C	51.2	43.6
E, F, G	41.5	35.7

3.1.3 Orifice Plate

(TBC)

3.1.4 Treatment requirements

In accordance with CSIRO ‘Urban Stormwater Best Practice Environmental Management Guidelines – 2006’

Total Suspended Solids (SS)	80% reduction
Total Phosphorus (TP)	45% reduction
Total Nitrogen (TN)	45% reduction
Gross Pollutants	70% reduction

3.2 SW treatment

2 rain gardens have been specified in order to achieve quality of the outflow that surpasses the CSIRO best practice guidelines. The first rain garden of area 12.9 m² treats water falling on buildings A, B and C. The second rain garden of area 10.5 m² treats water falling on buildings E, F and G.

Signed: **4 Model for Urban Stormwater Improvement Conceptualisation - MUSIC Analysis**
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4.1 Catchment setup

MUSIC analysis was carried out using the 1959 data from the Flemington Racecourse weather data station in 6 minute format as recommended in the 'MUSIC Guidelines – Recommended input parameters and modelling approaches for MUSIC users' (2010) published by Melbourne Water.

Catchment Name	Building A,B,C
Rainfall Station	86071 MELBOURNE
ET Station	Monthly User Defined
Start Date	1/01/1959 12:00 AM
End Date	31/12/1959 11:54 PM
Modelling Time Step	6 Minutes

X Close

Figure 29 - MUSIC Catchment Properties

4.1.1 Treatment train

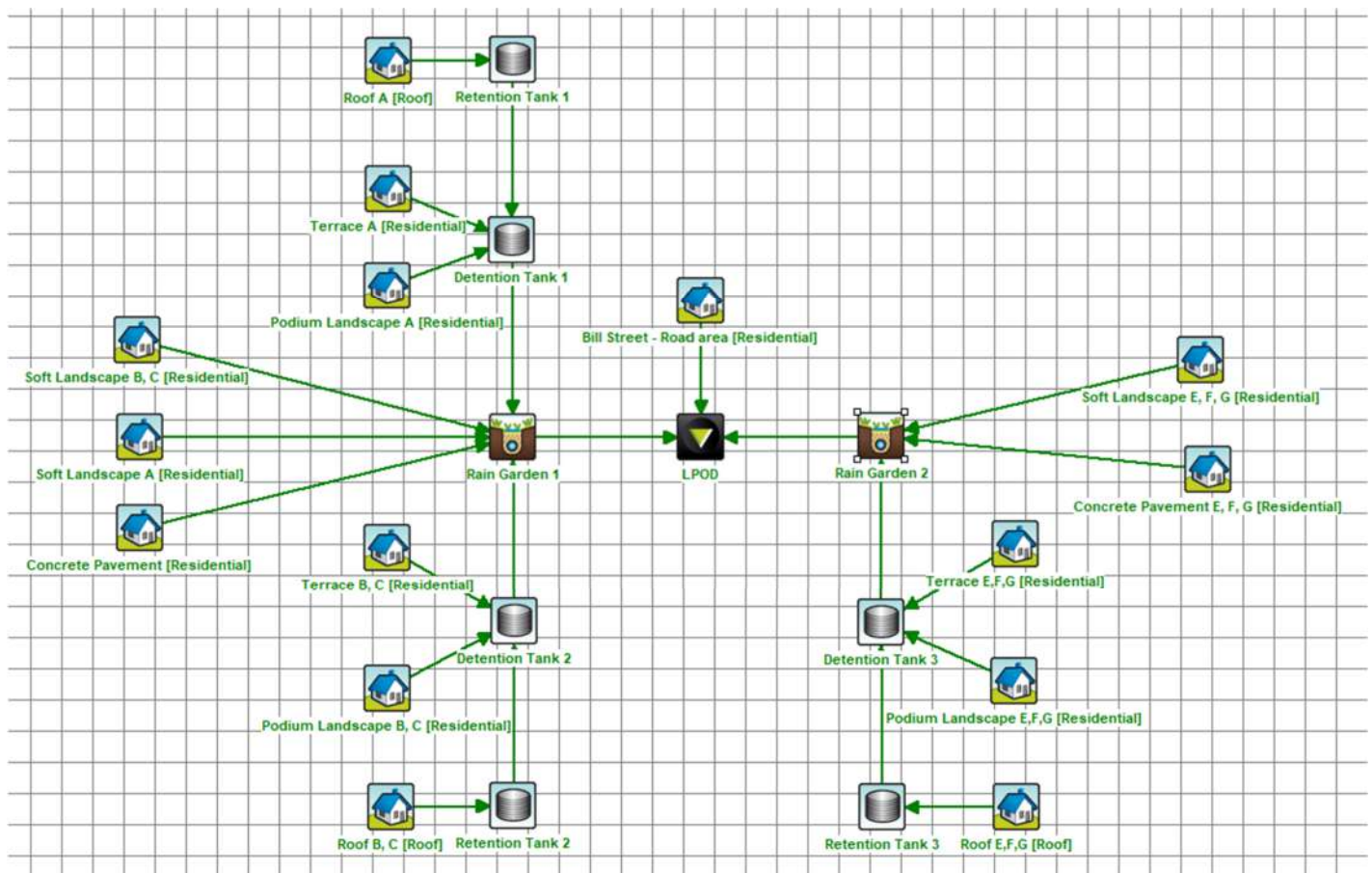


Figure 30 - Schematic treatment train

4.1.2 Catchment zones

Building A

Roof (impervious catchment area of $540 \text{ m}^2 = 0.054 \text{ ha}$)

The screenshot displays the software interface for setting up a roof catchment zone for Building A. The main panel shows the location as 'Roof A' and the total area as 0.054 ha. Below this, there are four sub-panels for different parameters:

- Rainfall-Runoff Parameters:** Includes inputs for Impervious Area Properties (Rainfall Threshold: 1.00), Previous Area Properties (Soil Storage Capacity: 120, Initial Storage: 25, Field Capacity: 80, Infiltration Capacity Coefficient: 200.0, Infiltration Capacity Exponent: 1.00), and Groundwater Properties (Initial Depth: 10, Daily Recharge Rate: 25.00, Daily Baseflow Rate: 5.00, Daily Deep Seepage Rate: 0.00).
- Total Suspended Solids:** Base Flow Concentration Parameters (Mean: 1.100, Std Dev: 0.170) and Storm Flow Concentration Parameters (Mean: 1.300, Std Dev: 0.320). Both sections include a 'Stochastically generated' checkbox and a 'Serial Correlation (R squared)' field.
- Total Phosphorus:** Base Flow Concentration Parameters (Mean: 0.820, Std Dev: 0.190) and Storm Flow Concentration Parameters (Mean: 0.890, Std Dev: 0.250). Both sections include a 'Stochastically generated' checkbox and a 'Serial Correlation (R squared)' field.
- Total Nitrogen:** Base Flow Concentration Parameters (Mean: 0.320, Std Dev: 0.120) and Storm Flow Concentration Parameters (Mean: 0.300, Std Dev: 0.190). Both sections include a 'Stochastically generated' checkbox and a 'Serial Correlation (R squared)' field.

Each parameter section also features a graphical representation of the distribution, showing a bell curve over a range of values. The interface includes navigation buttons like 'Cancel', 'Back', 'Next', and 'Finish'.

Figure 31 – Roof area node setup (Building A)

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Terrace (impervious catchment area of $200 \text{ m}^2 = 0.020 \text{ ha}$)

Figure 32 – Terrace area node setup (Building A)

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Podium Landscape (impervious catchment area of $290 \text{ m}^2 = 0.029 \text{ ha}$)

Areas
Location: Podium Landscape A
Total Area (ha): 0.029
Zoning/Surface Type: Residential
100% Impervious
Pervious 0%

Rainfall-Runoff Parameters
Impervious Area Properties
Rainfall Threshold (mm/day): 1.00
Pervious Area Properties
Soil Storage Capacity (mm): 120
Initial Storage (% of Capacity): 25
Field Capacity (mm): 80
Infiltration Capacity Coefficient - a: 200.0
Infiltration Capacity Exponent - b: 1.00
Groundwater Properties
Initial Depth (mm): 10
Daily Recharge Rate (%): 25.00
Daily Baseflow Rate (%): 5.00
Daily Deep Seepage Rate (%): 0.00

Total Suspended Solids
Base Flow Concentration Parameters
Mean (log mg/L): 1.100
Std Dev (log mg/L): 0.170
Estimation Method: Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): 1.300
Std Dev (log mg/L): 0.320
Estimation Method: Stochastically generated
Serial Correlation (R squared): 0.00

Total Phosphorus
Base Flow Concentration Parameters
Mean (log mg/L): -0.820
Std Dev (log mg/L): 0.190
Estimation Method: Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): -0.890
Std Dev (log mg/L): 0.250
Estimation Method: Stochastically generated
Serial Correlation (R squared): 0.00

Total Nitrogen
Base Flow Concentration Parameters
Mean (log mg/L): 0.320
Std Dev (log mg/L): 0.120
Estimation Method: Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): 0.300
Std Dev (log mg/L): 0.190
Estimation Method: Stochastically generated
Serial Correlation (R squared): 0.00

Figure 33 – Podium Landscape area node setup (Building A)

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Soft Landscape (pervious catchment area of $940 \text{ m}^2 = 0.094 \text{ ha}$)

Area
Location: Soft Landscape A
Total Area (ha): 0.094
Zoning/Surface Type: Residential

Rainfall-Runoff Parameters
Impervious Area Properties
Rainfall Threshold (mm/day): 1.00
Pervious Area Properties
Soil Storage Capacity (mm): 120
Initial Storage (% of Capacity): 25
Field Capacity (mm): 80
Infiltration Capacity Coefficient - a: 200.0
Infiltration Capacity Exponent - b: 1.00
Groundwater Properties
Initial Depth (mm): 10
Daily Recharge Rate (%): 25.00
Daily Baseflow Rate (%): 5.00
Daily Deep Seepage Rate (%): 0.00

Total Suspended Solids
Base Flow Concentration Parameters
Mean (log mg/L): 1.100
Std Dev (log mg/L): 0.170
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): 1.300
Std Dev (log mg/L): 0.320
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00

Total Phosphorus
Base Flow Concentration Parameters
Mean (log mg/L): -0.820
Std Dev (log mg/L): 0.190
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): -0.890
Std Dev (log mg/L): 0.250
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00

Total Nitrogen
Base Flow Concentration Parameters
Mean (log mg/L): 0.320
Std Dev (log mg/L): 0.120
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): 0.300
Std Dev (log mg/L): 0.190
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00

Figure 34 – Soft Landscape area node setup (Building A)

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Concrete Pavement (pervious catchment area of $280 \text{ m}^2 = 0.028 \text{ ha}$)

Location: Concrete Pavement

Areas:
Total Area (ha): 0.028
Zoning/Surface Type: Residential

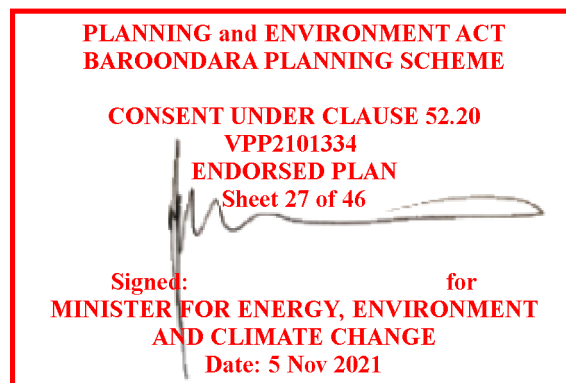
Rainfall-Runoff Parameters:
Impervious Area Properties:
Rainfall Threshold (mm/day): 1.00
Pervious Area Properties:
Soil Storage Capacity (mm): 120
Initial Storage (% of Capacity): 25
Field Capacity (mm): 80
Infiltration Capacity Coefficient - a: 200.0
Infiltration Capacity Exponent - b: 1.00
Groundwater Properties:
Initial Depth (mm): 10
Daily Recharge Rate (%): 25.00
Daily Baseflow Rate (%): 5.00
Daily Deep Seepage Rate (%): 0.00

Total Suspended Solids:
Base Flow Concentration Parameters:
Mean (log mg/L): 1.100
Std Dev (log mg/L): 0.170
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters:
Mean (log mg/L): 1.300
Std Dev (log mg/L): 0.320
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00

Total Phosphorus:
Base Flow Concentration Parameters:
Mean (log mg/L): 0.820
Std Dev (log mg/L): 0.190
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters:
Mean (log mg/L): 0.890
Std Dev (log mg/L): 0.250
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00

Total Nitrogen:
Base Flow Concentration Parameters:
Mean (log mg/L): 0.320
Std Dev (log mg/L): 0.120
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters:
Mean (log mg/L): 0.300
Std Dev (log mg/L): 0.190
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00

Figure 35 – Concrete Pavement area node setup (Building A)



Terrace (impervious catchment area of 170 m² = 0.017 ha)

Location: Terrace B/C

Areas

Total Area (ha)

0.017

Zoning/Surface Type:

Residential

Fluxes...

Notes...

Import Flow

Rainfall-Runoff Parameters

Impervious Area Properties

Rainfall Threshold (mm/day)

1.00

Pervious Area Properties

Soil Storage Capacity (mm)

120

Initial Storage (% of Capacity)

25

Field Capacity (mm)

80

Infiltration Capacity Coefficient - a

200.0

Infiltration Capacity Exponent - b

1.00

Groundwater Properties

Initial Depth (mm)

10

Daily Recharge Rate (%)

25.00

Daily Baseflow Rate (%)

5.00

Daily Deep Seepage Rate (%)

0.00

Total Suspended Solids

Base Flow Concentration Parameters

Mean (log mg/L)

1.100

Std Dev (log mg/L)

0.170

Restore Defaults

Estimation Method

Mean

Stochastically generated

Serial Correlation (R squared)

0.00

Storm Flow Concentration Parameters

Mean (log mg/L)

1.300

Std Dev (log mg/L)

0.320

Restore Defaults

Estimation Method

Mean

Stochastically generated

Serial Correlation (R squared)

0.00

Total Phosphorus

Base Flow Concentration Parameters

Mean (log mg/L)

0.820

Std Dev (log mg/L)

0.190

Restore Defaults

Estimation Method

Mean

Stochastically generated

Serial Correlation (R squared)

0.00

Storm Flow Concentration Parameters

Mean (log mg/L)

0.890

Std Dev (log mg/L)

0.250

Restore Defaults

Estimation Method

Mean

Stochastically generated

Serial Correlation (R squared)

0.00

Total Nitrogen

Base Flow Concentration Parameters

Mean (log mg/L)

0.320

Std Dev (log mg/L)

0.120

Restore Defaults

Estimation Method

Mean

Stochastically generated

Serial Correlation (R squared)

0.00

Storm Flow Concentration Parameters

Mean (log mg/L)

0.300

Std Dev (log mg/L)

0.190

Restore Defaults

Estimation Method

Mean

Stochastically generated

Serial Correlation (R squared)

0.00

Figure 37 – Terrace area node setup (Buildings B & C)

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Podium Landscape (impervious catchment area of $510 \text{ m}^2 = 0.051 \text{ ha}$)

Area
Location: Podium Landscape B, C
Total Area (ha): 0.051
Zoning/Surface Type: Residential
Previous 0 %
Input Flow: ☐
Buttons: [Cancel] [Back] [Next]

Rainfall-Runoff Parameters
Impervious Area Properties
Rainfall Threshold (mm/day): 1.00
Previous Area Properties
Soil Storage Capacity (mm): 120
Initial Storage (% of Capacity): 25
Field Capacity (mm): 80
Infiltration Capacity Coefficient - a: 200.0
Infiltration Capacity Exponent - b: 1.00
Groundwater Properties
Initial Depth (mm): 10
Daily Recharge Rate (%): 25.00
Daily Baseflow Rate (%): 5.00
Daily Deep Seepage Rate (%): 0.00
Buttons: [Cancel] [Back] [Next]

Total Suspended Solids
Base Flow Concentration Parameters
Mean (log mg/L): 1.100
Std Dev (log mg/L): 0.170
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): 1.300
Std Dev (log mg/L): 0.320
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Buttons: [Cancel] [Back] [Next]

Total Phosphorus
Base Flow Concentration Parameters
Mean (log mg/L): 0.820
Std Dev (log mg/L): 0.190
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): 0.890
Std Dev (log mg/L): 0.250
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Buttons: [Cancel] [Back] [Next]

Total Nitrogen
Base Flow Concentration Parameters
Mean (log mg/L): 0.320
Std Dev (log mg/L): 0.120
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): 0.300
Std Dev (log mg/L): 0.190
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Buttons: [Cancel] [Back] [Finish]

Figure 38 – Podium Landscape area node setup (Buildings B & C)

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Soft Landscape (pervious catchment area of $1160 \text{ m}^2 = 0.116 \text{ ha}$)

Areas
Location: Soft Landscape B, C
Total Area (ha): 0.116
Zoning/Surface Type: Residential
Graph: Imperious 50%, Pervious 50%
Buttons: Import Flow, Flows..., Notes...

Rainfall-Runoff Parameters
Imperious Area Properties
Rainfall Threshold (mm/day): 1.00
Pervious Area Properties
Soil Storage Capacity (mm): 120
Initial Storage (% of Capacity): 25
Field Capacity (mm): 80
Infiltration Capacity Coefficient - a: 200.0
Infiltration Capacity Exponent - b: 1.00
Groundwater Properties
Initial Depth (mm): 10
Daily Recharge Rate (%): 25.00
Daily Baseflow Rate (%): 5.00
Daily Deep Seepage Rate (%): 0.00

Total Suspended Solids
Base Flow Concentration Parameters
Mean (log mg/L): 1.100
Std Dev (log mg/L): 0.170
Graph: 8.51, 12.6, 18.6
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): 1.300
Std Dev (log mg/L): 0.320
Graph: 9.55, 20, 41.7
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00

Total Phosphorus
Base Flow Concentration Parameters
Mean (log mg/L): -0.820
Std Dev (log mg/L): 0.190
Graph: 0.0977, 0.151, 0.234
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): -0.890
Std Dev (log mg/L): 0.250
Graph: 0.0724, 0.129, 0.229
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00

Total Nitrogen
Base Flow Concentration Parameters
Mean (log mg/L): 0.320
Std Dev (log mg/L): 0.120
Graph: 1.58, 2.09, 2.75
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): 0.300
Std Dev (log mg/L): 0.190
Graph: 1.29, 2, 3.09
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00

Figure 39 – Soft Landscape area node setup (Buildings B & C)

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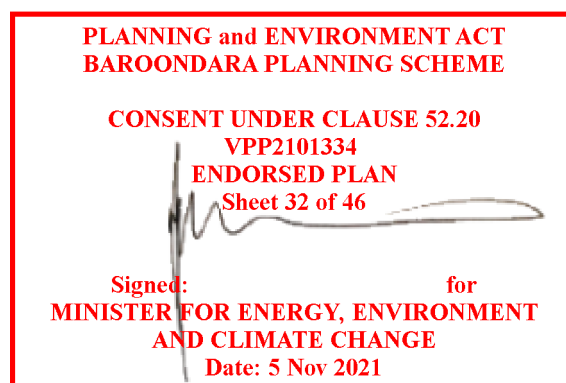
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Building E, F & G

Roof (impervious catchment area of $1670 \text{ m}^2 = 0.167 \text{ ha}$)

The screenshot displays the 'Roof EFG' node setup in a software application. The 'Areas' panel shows a total area of 0.167 ha and a 'Roof' zoning/surface type. The 'Rainfall-Runoff Parameters' panel includes settings for impervious and pervious area properties, groundwater properties, and infiltration capacity. The 'Total Suspended Solids', 'Total Phosphorus', and 'Total Nitrogen' panels each have 'Base Flow Concentration Parameters' and 'Storm Flow Concentration Parameters' sections, with input fields for mean and standard deviation (log mg/L) and a 'Stochastically generated' checkbox. Each concentration panel also features a graph of a probability distribution curve.

Figure 40 – Roof area node setup (Buildings E, F & G)

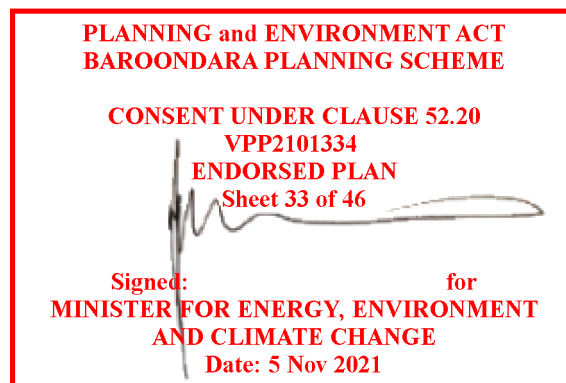


Terrace (impervious catchment area of $530 \text{ m}^2 = 0.053 \text{ ha}$)

The image displays a software interface for setting up a Terrace area node. It consists of several panels:

- Location:** Terrace E.F.G.
- Areas:** Total Area (ha) is 0.053. Zoning/Surface Type is Residential.
- Rainfall-Runoff Parameters:**
 - Impervious Area Properties: Rainfall Threshold (mm/day) is 1.00.
 - PerVIOUS Area Properties: Soil Storage Capacity (mm) is 120, Initial Storage (% of Capacity) is 25, Field Capacity (mm) is 80, Infiltration Capacity Coefficient - a is 200.0, Infiltration Capacity Exponent - b is 1.00.
 - Groundwater Properties: Initial Depth (mm) is 10, Daily Recharge Rate (%) is 25.00, Daily Baseflow Rate (%) is 5.00, Daily Deep Seepage Rate (%) is 0.00.
- Total Suspended Solids:**
 - Base Flow Concentration Parameters: Mean (log mg/L) is 1.100, Std Dev (log mg/L) is 0.170. Estimation Method is Stochastically generated.
 - Storm Flow Concentration Parameters: Mean (log mg/L) is 1.300, Std Dev (log mg/L) is 0.320. Estimation Method is Stochastically generated.
- Total Phosphorus:**
 - Base Flow Concentration Parameters: Mean (log mg/L) is 0.820, Std Dev (log mg/L) is 0.190. Estimation Method is Stochastically generated.
 - Storm Flow Concentration Parameters: Mean (log mg/L) is 0.890, Std Dev (log mg/L) is 0.250. Estimation Method is Stochastically generated.
- Total Nitrogen:**
 - Base Flow Concentration Parameters: Mean (log mg/L) is 0.320, Std Dev (log mg/L) is 0.120. Estimation Method is Stochastically generated.
 - Storm Flow Concentration Parameters: Mean (log mg/L) is 0.300, Std Dev (log mg/L) is 0.190. Estimation Method is Stochastically generated.

Figure 41 – Terrace area node setup (Buildings E, F & G)



Podium Landscape (impervious catchment area of $780 \text{ m}^2 = 0.078 \text{ ha}$)

Location: Podium Landscape E.F.G

Areas

Total Area (ha): 0.078

Zoning/Surface Type: Residential

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%

Impervious 0 %

☐ Import Flow

Fluxes... Notes...

Rainfall-Runoff Parameters

Impervious Area Properties

Rainfall Threshold (mm/day): 1.00

Pervious Area Properties

Soil Storage Capacity (mm): 120

Initial Storage (% of Capacity): 25

Field Capacity (mm): 80

Infiltration Capacity Coefficient - a: 200.0

Infiltration Capacity Exponent - b: 1.00

Groundwater Properties

Initial Depth (mm): 10

Daily Recharge Rate (%): 25.00

Daily Baseflow Rate (%): 5.00

Daily Deep Seepage Rate (%): 0.00

Total Suspended Solids

Base Flow Concentration Parameters

Mean (log mg/L): 1.100

Std Dev (log mg/L): 0.170

Estimation Method

☐ Mean ☒ Stochastically generated

Serial Correlation (R squared): 0.00

Storm Flow Concentration Parameters

Mean (log mg/L): 1.300

Std Dev (log mg/L): 0.320

Estimation Method

☐ Mean ☒ Stochastically generated

Serial Correlation (R squared): 0.00

Total Phosphorus

Base Flow Concentration Parameters

Mean (log mg/L): 0.820

Std Dev (log mg/L): 0.190

Estimation Method

☐ Mean ☒ Stochastically generated

Serial Correlation (R squared): 0.00

Storm Flow Concentration Parameters

Mean (log mg/L): 0.890

Std Dev (log mg/L): 0.250

Estimation Method

☐ Mean ☒ Stochastically generated

Serial Correlation (R squared): 0.00

Total Nitrogen

Base Flow Concentration Parameters

Mean (log mg/L): 0.320

Std Dev (log mg/L): 0.120

Estimation Method

☐ Mean ☒ Stochastically generated

Serial Correlation (R squared): 0.00

Storm Flow Concentration Parameters

Mean (log mg/L): 0.300

Std Dev (log mg/L): 0.190

Estimation Method

☐ Mean ☒ Stochastically generated

Serial Correlation (R squared): 0.00

Figure 42 – Podium Landscape area node setup (Buildings E, F & G)

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Soft Landscape (pervious catchment area of $1270 \text{ m}^2 = 0.127 \text{ ha}$)

Area
Location: Soft Landscape E, F, G
Total Area (ha): 0.127
Zoning/Surface Type: Residential

Rainfall-Runoff Parameters
Impervious Area Properties
Rainfall Threshold (mm/day): 1.00
Pervious Area Properties
Soil Storage Capacity (mm): 120
Initial Storage (% of Capacity): 25
Field Capacity (mm): 80
Infiltration Capacity Coefficient - a: 200.0
Infiltration Capacity Exponent - b: 1.00
Groundwater Properties
Initial Depth (mm): 10
Daily Recharge Rate (%): 25.00
Daily Baseflow Rate (%): 5.00
Daily Deep Seepage Rate (%): 0.00

Total Suspended Solids
Base Flow Concentration Parameters
Mean (log mg/L): 1.100
Std Dev (log mg/L): 0.170
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): 1.300
Std Dev (log mg/L): 0.320
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00

Total Phosphorus
Base Flow Concentration Parameters
Mean (log mg/L): -0.820
Std Dev (log mg/L): 0.190
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): -0.890
Std Dev (log mg/L): 0.250
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00

Total Nitrogen
Base Flow Concentration Parameters
Mean (log mg/L): 0.320
Std Dev (log mg/L): 0.120
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): 0.300
Std Dev (log mg/L): 0.190
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00

Figure 43 – Soft Landscape area node setup (Buildings E, F & G)

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Concrete Pavement (pervious catchment area of $170 \text{ m}^2 = 0.017 \text{ ha}$)

Areas
Location: Concrete Pavement E, F, G
Total Area (ha): 0.017
Zoning/Surface Type: Residential
Impervious 90 %
Pervious 10 %
Input Flow: ☐
Fluxes... Notes...
Cancel < Back Next >

Rainfall-Runoff Parameters
Impervious Area Properties
Rainfall Threshold (mm/day): 1.00
Pervious Area Properties
Soil Storage Capacity (mm): 120
Initial Storage (% of Capacity): 25
Field Capacity (mm): 80
Infiltration Capacity Coefficient - a: 200.0
Infiltration Capacity Exponent - b: 1.00
Groundwater Properties
Initial Depth (mm): 10
Daily Recharge Rate (%): 25.00
Daily Baseflow Rate (%): 5.00
Daily Deep Seepage Rate (%): 0.00
Cancel < Back Next >

Total Suspended Solids
Base Flow Concentration Parameters
Mean (log mg/L): 1.100
Std Dev (log mg/L): 0.170
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): 1.300
Std Dev (log mg/L): 0.320
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Cancel < Back Next >

Total Phosphorus
Base Flow Concentration Parameters
Mean (log mg/L): 0.820
Std Dev (log mg/L): 0.190
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): 0.890
Std Dev (log mg/L): 0.250
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Cancel < Back Next >

Total Nitrogen
Base Flow Concentration Parameters
Mean (log mg/L): 0.320
Std Dev (log mg/L): 0.120
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Storm Flow Concentration Parameters
Mean (log mg/L): 0.300
Std Dev (log mg/L): 0.190
Estimation Method: ☒ Stochastically generated
Serial Correlation (R squared): 0.00
Cancel < Back Next > Finish

Figure 44 – Concrete Pavement area node setup (Buildings E, F & G)

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Bills Street – Road area (pervious catchment area of $320 \text{ m}^2 = 0.032 \text{ ha}$)

Figure 45 – Bill St. Road area node setup

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4.1.3 Tank Parameters

Retention tank 1 (Building A)

Figure 46 - Retention tank parameters

Figure 47 – Re-use parameters

Month	%
Jan	14.8
Feb	11.84
Mar	10.71
Apr	6.75
May	4.24
Jun	3.25
Jul	3.53
Aug	4.95
Sep	7.06
Oct	9.3
Nov	10.36
Dec	13.21

Total: 100

Buttons: OK, Cancel

Figure 48 - Distribution of irrigation demand

Detention tank 1 (Building A)

Figure 49 - Detention tank parameters

Figure 50 – Re-use parameters

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Retention tank 2 (Buildings B & C)

Figure 51 - Retention tank parameters

Figure 52 – Re-use parameters

Month	%
Jan	14.83
Feb	11.86
Mar	10.72
Apr	6.74
May	4.23
Jun	3.24
Jul	3.52
Aug	4.94
Sep	7.05
Oct	9.3
Nov	10.34
Dec	13.23

Total: 100

Buttons: OK, Cancel

Figure 53 - Distribution of irrigation demand

Detention tank 2 (Buildings B & C)

Figure 54 - Detention tank parameters

Figure 55 – Re-use parameters

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Retention tank 3 (Buildings E, F & G)

Figure 56 - Retention tank parameters

Figure 57 – Re-use parameters

Month	%
Jan	14.74
Feb	11.8
Mar	10.68
Apr	6.76
May	4.26
Jun	3.26
Jul	3.55
Aug	4.97
Sep	7.08
Oct	9.32
Nov	10.38
Dec	13.2

Total: 100

Buttons: Ok, Cancel

Figure 58 - Distribution of irrigation demand

Detention tank 3 (Buildings E, F & G)

Figure 59 - Detention tank parameters

Figure 60 – Re-use parameters

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4.1.4 Rain Garden Parameters

Location: Rain Garden 1 Products >>

Inlet Properties	
Low Flow By-pass (cubic metres per sec)	0.000
High Flow By-pass (cubic metres per sec)	100.000
Storage Properties	
Extended Detention Depth (metres)	0.20
Surface Area (square metres)	12.90
Filter and Media Properties	
Filter Area (square metres)	12.90
Unlined Filter Media Perimeter (metres)	0.01
Saturated Hydraulic Conductivity (mm/hour)	360.00
Filter Depth (metres)	0.30
TN Content of Filter Media (mg/kg)	800
Orthophosphate Content of Filter Media (mg/kg)	50.0
Infiltration Properties	
Exfiltration Rate (mm/hr)	0.00
Lining Properties	
Is Base Lined?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Vegetation Properties	
<input checked="" type="radio"/> Vegetated with Effective Nutrient Removal Plants	
<input type="radio"/> Vegetated with Ineffective Nutrient Removal Plants	
<input type="radio"/> Unvegetated	
Outlet Properties	
Overflow Weir Width (metres)	3.00
Underdrain Present?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Submerged Zone With Carbon Present?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Depth (metres)	0.45

Fluxes... Notes... More

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Cancel Back Finish

Figure 61 – Rain garden 1 parameters (for Buildings A, B, C)

Location: Rain Garden 2 Products >>

Inlet Properties	
Low Flow By-pass (cubic metres per sec)	0.000
High Flow By-pass (cubic metres per sec)	100.000
Storage Properties	
Extended Detention Depth (metres)	0.20
Surface Area (square metres)	10.50
Filter and Media Properties	
Filter Area (square metres)	10.50
Unlined Filter Media Perimeter (metres)	0.01
Saturated Hydraulic Conductivity (mm/hour)	360.00
Filter Depth (metres)	0.30
TN Content of Filter Media (mg/kg)	800
Orthophosphate Content of Filter Media (mg/kg)	50.0
Infiltration Properties	
Exfiltration Rate (mm/hr)	0.00
Lining Properties	
Is Base Lined?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Vegetation Properties	
<input checked="" type="radio"/> Vegetated with Effective Nutrient Removal Plants	
<input type="radio"/> Vegetated with Ineffective Nutrient Removal Plants	
<input type="radio"/> Unvegetated	
Outlet Properties	
Overflow Weir Width (metres)	3.00
Underdrain Present?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Submerged Zone With Carbon Present?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Depth (metres)	0.45

Fluxes... Notes... More

Cancel Back Finish

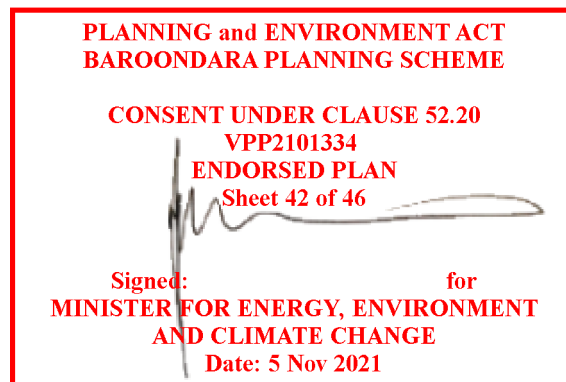
Figure 62 – Rain garden 2 parameters (for Buildings E, F, G)

4.2 Results

	Sources	Residual Load	% Reduction
Flow (ML/yr)	4.5	2.94	34.6
Total Suspended Solids (kg/yr)	541	93.5	82.7
Total Phosphorus (kg/yr)	1.06	0.412	61.2
Total Nitrogen (kg/yr)	9.9	3.47	65
Gross Pollutants (kg/yr)	171	5.92	96.5

Figure 63- Treatment Train Effectiveness output from MUSIC

	CSIRO reduction targets	Achieved reduction
Total Suspended Solids (SS)	80% reduction	82.7%
Total Phosphorous (TP)	45% reduction	61.2%
Total Nitrogen (TN)	45% reduction	65%
Gross Pollutants	70 % reduction	96.5%



5 Treatment system summary

The treatment system is to consist of the following elements.

- Three retention tanks collecting stormwater from roof areas. This water will be reused for irrigation of landscape and toilet flushing.
- Three detention tanks of volumes 26 kL, 26 kL and 42 kL collecting stormwater from terrace areas and landscaping.
- Two rain gardens – one for buildings A, B and C (12.9 m²) and another for buildings E, F and G (10.5 m²) to meet the CSIRO Best Practice Guidelines.

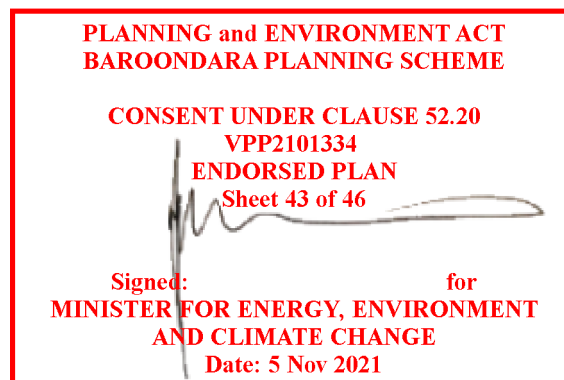
6 Conclusion

The proposed treatment system achieves stormwater discharge quality that exceeds recommendations of the 'Urban Stormwater: Best practice Environmental Management Guidelines' (1999) published by the CSIRO, and is therefore considered to provide best practice control of storm water discharge quality.

The proposed detention/retention system satisfies the stormwater detention requirements of the planning permit and provides adequate stormwater retention to meet the demands of the landscaping.

Sincerely,

Anita Nair
Project Engineer

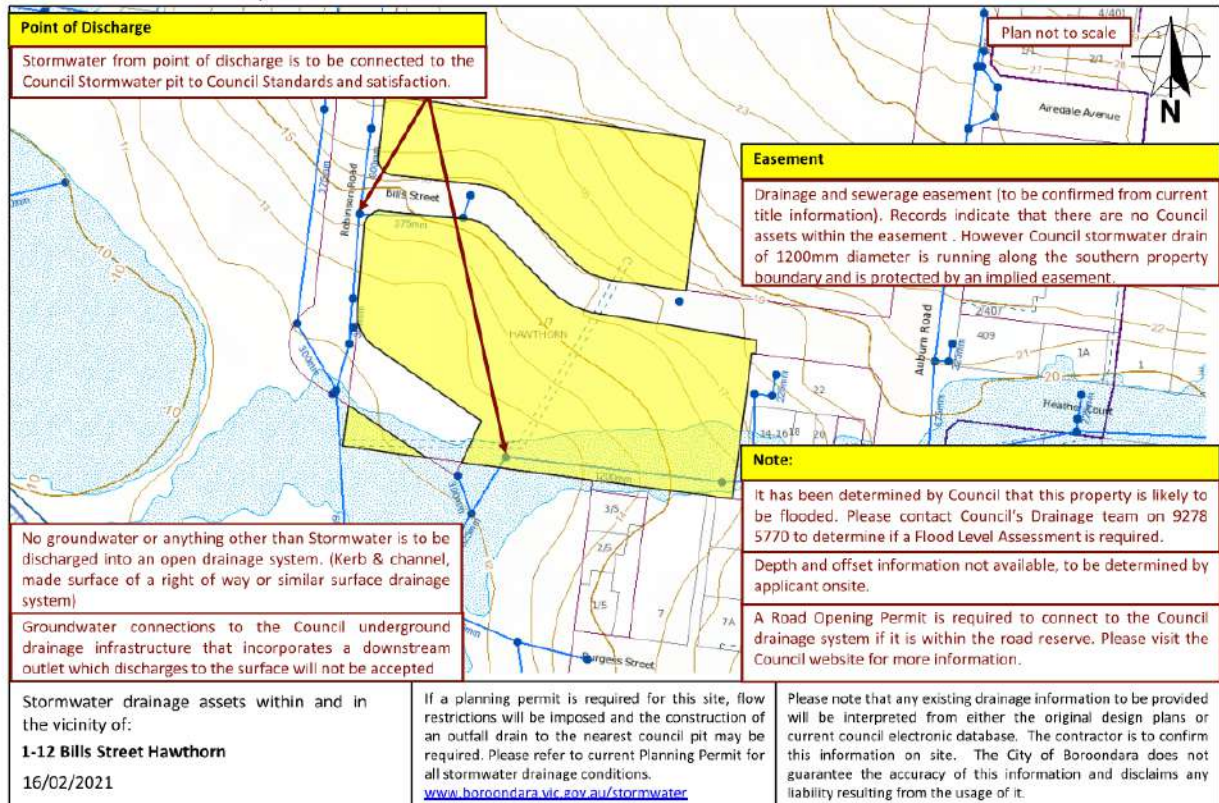


7 Appendix A – Legal Point of Discharge

STORMWATER DRAINAGE - POINT OF DISCHARGE



This information is provided by the City of Boroondara under the Building Regulations (Vic) 2018, Section 133, Sub-regulation 3: Stormwater drainage and section 44.3 of the amenity local law.



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COUNCIL'S STORMWATER DRAINAGE REQUIREMENTS



Council's stormwater drainage requirements for

1-12 Bills Street Hawthorn

16 February, 2021

Stormwater drainage runoff shall be collected in a complete and effective system of drains and connected to the Approved Point of Stormwater Discharge.

Storage volume and PSD will be provided by Council if requested with accurate site coverage details by e-mail to boroondara@boroondara.vic.gov.au.

An Onsite detention (orifice) control pit is required to be designed to meet the Council specified PSD and the detention volume in accordance with Council's standard drawing SD999 rev J.

No structure is to be built over and no cut or fill over:

- i. A drainage easement on Title or;
- ii. An existing Council stormwater drain that is located outside any easement on Title

Notes:

No groundwater or anything other than Stormwater is to be discharged into an open drainage system. (Kerb & channel, made surface of a right of way or similar surface drainage system)

At a minimum, detailed drainage design plans need to contain the following information:

- control pit orifice diameter in millimetre (+0/-2mm)
- orifice invert level in metres and AHD (Australian Height Datum)
- cross-sectional details

Control pit is to be located in an appropriate location and a suitable path is to be designated for stormwater which surcharges from the pit once the design storm has been exceeded.

The proposed development is to provide adequate clearance for overland flow through the property.

For more information, visit:

<http://www.boroondara.vic.gov.au/stormwater>

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**Signed: _____ for
MINISTER FOR ENERGY, ENVIRONMENT
AND CLIMATE CHANGE
Date: 5 Nov 2021**

8 Appendix B – OSD Tank size

Below is the advice from the Council regarding OSD tank sizes.

Based on the revised areas given below we advise that the following are to be incorporated into your drainage designs for Council approval;

Northern part

Total area (m²): 4432

Roof area (m²): 2276

Paved and driveway area (m²): 1078

Landscaped area (m²): 1078

Permissible Site Discharge	35.7	litres per second
OSD Volume Required	41.5	Cubic Metres

Southern part

Total area (m²): 5408

Roof area (m²): 2826

Paved and driveway area (m²): 1291

Landscaped area (m²): 1291

Permissible Site Discharge	43.6	litres per second
OSD Volume Required	51.2	Cubic Metres

For the design of the stormwater Onsite detention system (OSD) system;

- The volume requirement may be achieved by utilising an underground pipe/other approved storage system. Combined RW harvesting/OSD systems are not acceptable. Specifically; above ground rainwater tanks may not be utilised for this purpose.
- A 'sharp edged steel plate orifice' to control the discharge is the preferred method to achieve while not exceeding the permissible site discharge rate under normal conditions.
- All surfaces are to be drained to/and controlled by an orifice control pit (SD999 Revision 'J' as attached) and the site stormwater outlet is to fully 'control' the site.
- A tabulation of pipe & pit volumes demonstrating a final volume as achieving the minimum requirement as per above.
- Make sure to indicate the proposed trees in the drainage plans (as per the endorsed landscape plan).

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