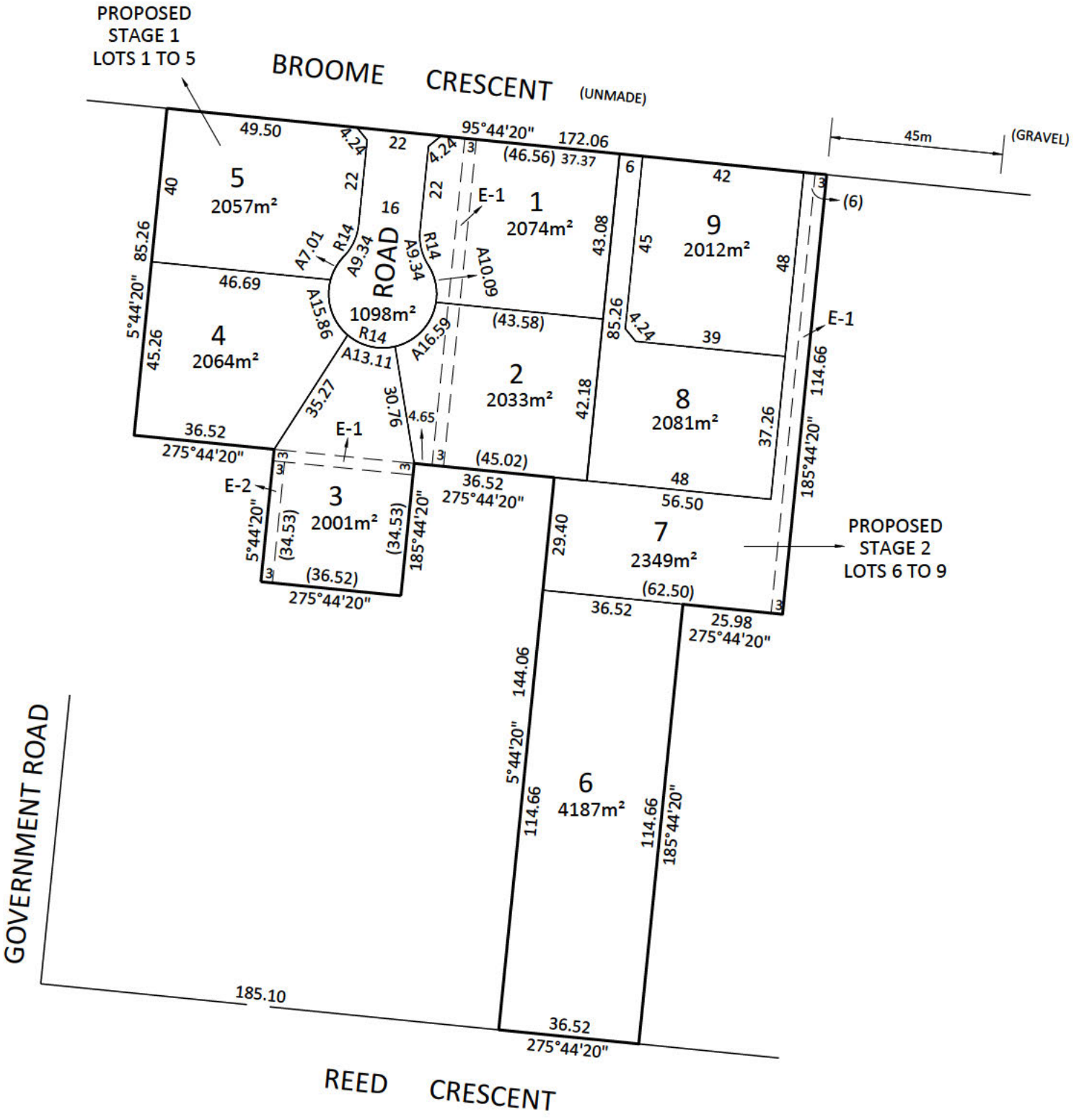
MGA2020

10/2/2022



NOTE:

ALL DIMENSIONS ARE APPROXIMATE AND SUBJECT TO FINAL SURVEY.
E-1 & E-2 DENOTES DRAINAGE EASEMENT IN FAVOUR OF BASS COAST SHIRE COUNCIL
PART OF LAND SUBJECT TO COVENANT Y000002X

10 0 10 50

SCALE: 1:1000
SHEET SIZE: A3
REFERENCE: 2102696
VERSION: 1

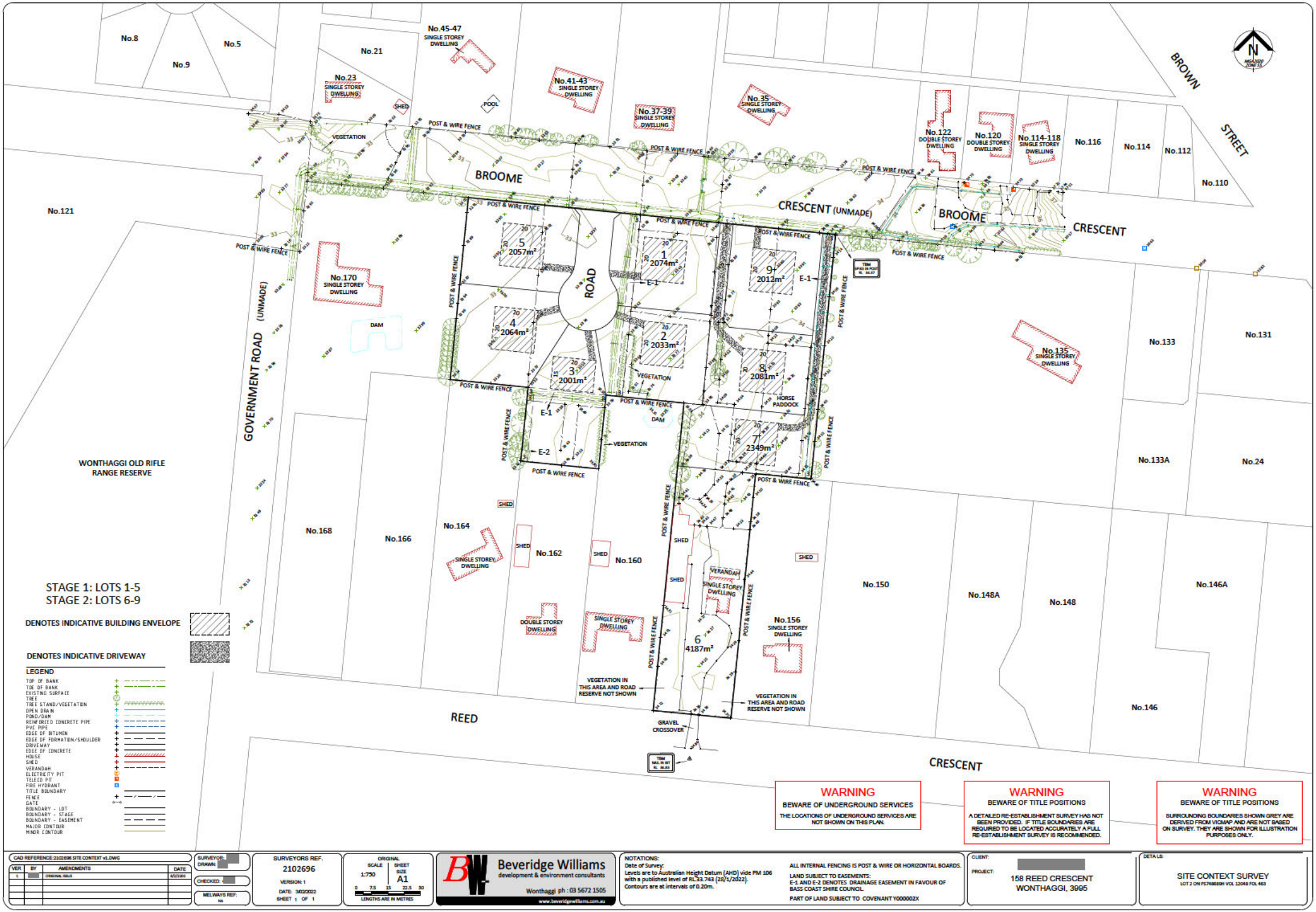
Proposed Plan of Subdivision

Lot 2 on PS748689H - Volume 12048 Folio 463

158 Reed Crescent, Wonthaggi 3995

Beveridge Williams
development & environment consultants
Wonthaggi ph : 03 5672 1505
www.beveridgewilliams.com.au

Site Context Plan



STAGE 1: LOTS 1-5
STAGE 2: LOTS 6-9

DENOTES INDICATIVE BUILDING ENVELOPE

DENOTES INDICATIVE DRIVEWAY

LEGEND

TOP OF BANK
TOE OF BANK
EXISTING SURFACE
TREE
TREE STAND/VEGETATION
OPEN DRAIN
POND/DAM
REINFORCED CONCRETE PIPE
PVC PIPE
EDGE OF BITUMEN
EDGE OF FORMATION/SHOULDER
DRIVEWAY
EDGE OF CONCRETE
HOUSE
SHED
VERANDAH
ELECTRICITY PIT
TELECD PIT
FIRE HYDRANT
TITLE BOUNDARY
FENCE
GATE
BOUNDARY - LOT
BOUNDARY - STAGE
BOUNDARY - EASEMENT
MAJOR CONTOUR
MINOR CONTOUR

WARNING
BEWARE OF UNDERGROUND SERVICES
THE LOCATIONS OF UNDERGROUND SERVICES ARE NOT SHOWN ON THIS PLAN.

WARNING
BEWARE OF TITLE POSITIONS
A DETAILED RE-ESTABLISHMENT SURVEY HAS NOT BEEN PROVIDED. IF TITLE BOUNDARIES ARE REQUIRED TO BE LOCATED ACCURATELY A FULL RE-ESTABLISHMENT SURVEY IS RECOMMENDED.

WARNING
BEWARE OF TITLE POSITIONS
SURROUNDING BOUNDARIES SHOWN GREY ARE DERIVED FROM VICMAP AND ARE NOT BASED ON SURVEY. THEY ARE SHOWN FOR ILLUSTRATION PURPOSES ONLY.

CAD REFERENCE: 2102696 SITE CONTEXT v1.DWG

VER	BY	AMENDMENTS	DATE
1		ORIGINAL ISSUE	6/2/2022

SURVEYOR:
DRAWN:
CHECKED:
MELWAYS REF: NA

SURVEYORS REF. 2102696
VERSION: 1
DATE: 3/02/2022
SHEET 1 OF 1

ORIGINAL
SCALE 1:750
SHEET SIZE A1
0 7.5 15 22.5 30
LENGTHS ARE IN METRES

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NOTATIONS:
Date of Survey:
Levels are to Australian Height Datum (AHD) vide PM 106 with a published level of RL33.743 (28/1/2022).
Contours are at intervals of 0.20m.

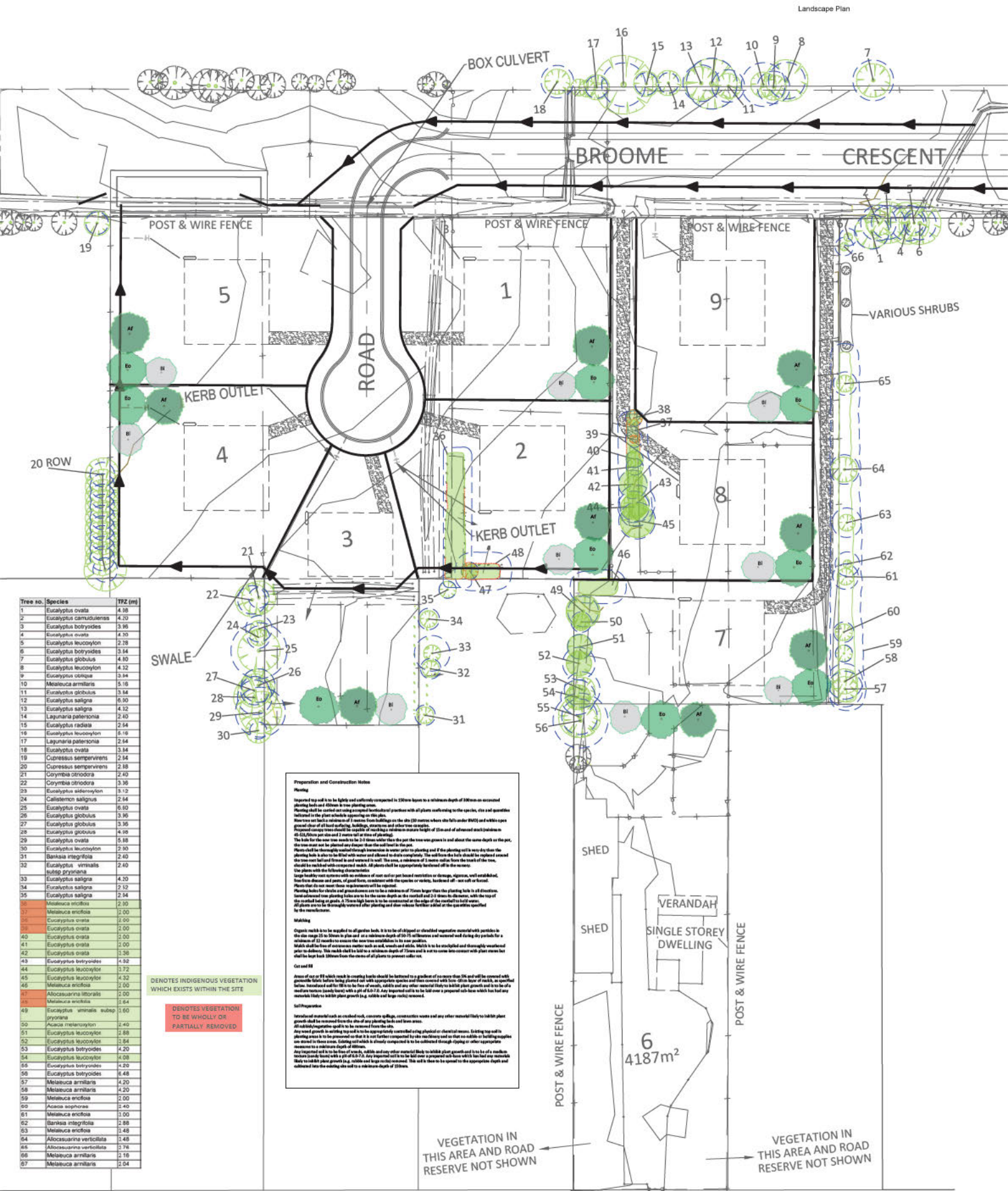
ALL INTERNAL FENCING IS POST & WIRE OR HORIZONTAL BOARDS.

LAND SUBJECT TO EASEMENTS:
E-1 AND E-2 DENOTES DRAINAGE EASEMENT IN FAVOUR OF BASS COAST SHIRE COUNCIL.

PART OF LAND SUBJECT TO COVENANT Y000002X

CLIENT:
PROJECT: 158 REED CRESCENT WONTHAGGI, 3995

DETAILS: SITE CONTEXT SURVEY
LOT 2 ON PS740869H VOL 12048 FOL 463



Tree no.	Species	TPZ (m)
1	Eucalyptus ovata	4.38
2	Eucalyptus camuldulensis	4.20
3	Eucalyptus botryoides	3.96
4	Eucalyptus ovata	4.30
5	Eucalyptus leucoxylon	2.28
6	Eucalyptus botryoides	3.54
7	Eucalyptus globulus	4.80
8	Eucalyptus leucoxylon	4.32
9	Eucalyptus obliqua	3.84
10	Melaleuca armillaris	5.16
11	Eucalyptus globulus	3.84
12	Eucalyptus saligna	6.90
13	Eucalyptus saligna	4.32
14	Lagunaria patersonia	2.40
15	Eucalyptus radiata	2.64
16	Eucalyptus leucoxylon	5.16
17	Lagunaria patersonia	2.64
18	Eucalyptus ovata	3.34
19	Cupressus sempervirens	2.64
20	Cupressus sempervirens	2.18
21	Corymbia citriodora	2.40
22	Corymbia citriodora	3.36
23	Eucalyptus sideroxylon	3.12
24	Callistemon salignus	2.64
25	Eucalyptus ovata	6.60
26	Eucalyptus globulus	3.96
27	Eucalyptus globulus	3.36
28	Eucalyptus globulus	4.98
29	Eucalyptus ovata	5.88
30	Eucalyptus leucoxylon	2.90
31	Banksia integrifolia	2.40
32	Eucalyptus viminalis subsp pryoriana	2.40
33	Eucalyptus saligna	4.20
34	Eucalyptus saligna	2.12
35	Eucalyptus saligna	2.34
36	Melaleuca ericifolia	2.90
37	Melaleuca ericifolia	2.00
38	Eucalyptus ovata	2.00
39	Eucalyptus ovata	2.00
40	Eucalyptus ovata	2.00
41	Eucalyptus ovata	2.00
42	Eucalyptus ovata	3.36
43	Eucalyptus botryoides	4.92
44	Eucalyptus leucoxylon	3.72
45	Eucalyptus leucoxylon	4.32
46	Melaleuca ericifolia	2.00
47	Allocasuarina littoralis	2.00
48	Melaleuca ericifolia	2.64
49	Eucalyptus viminalis subsp pryoriana	3.60
50	Acacia melanoxylon	2.40
51	Eucalyptus leucoxylon	2.88
52	Eucalyptus leucoxylon	2.64
53	Eucalyptus botryoides	4.20
54	Eucalyptus leucoxylon	4.08
55	Eucalyptus botryoides	4.20
56	Eucalyptus botryoides	6.48
57	Melaleuca armillaris	4.20
58	Melaleuca armillaris	4.20
59	Melaleuca ericifolia	2.00
60	Acacia sophorae	2.40
61	Melaleuca ericifolia	3.00
62	Banksia integrifolia	2.88
63	Melaleuca ericifolia	3.48
64	Allocasuarina verticillata	3.48
65	Allocasuarina verticillata	2.76
66	Melaleuca armillaris	2.16
67	Melaleuca armillaris	2.04

DENOTES INDIGENOUS VEGETATION WHICH EXISTS WITHIN THE SITE

DENOTES VEGETATION TO BE WHOLLY OR PARTIALLY REMOVED

Preparation and Construction Notes

Planting

Imported top soil is to be lightly and uniformly compacted in 150mm layers to a minimum depth of 300mm on excavated planting beds and 450mm in tree planting areas.
Planting shall be carried out using accepted horticultural practices with all plants conforming to the species, size and quantities indicated in the plant schedule appearing on this plan.
New trees set back a minimum of 3 metres from buildings on the site (10 metres where site falls under BMO) and within open ground clear of all hard surfacing, buildings, structures and other tree canopies.
Proposed canopy trees should be capable of reaching a minimum mature height of 15m and of advanced stock (minimum 45-52L/50cm pot size and 2 metre tall at time of planting).
The hole for the new tree needs to be 2-3 times wider than the pot the tree was grown in and about the same depth as the pot, the tree must not be planted any deeper than the soil level in the pot.
Plants shall be thoroughly watered through immersion in water prior to planting and if the planting soil is very dry then the planting hole is also to be filled with water and allowed to drain completely. The soil from the hole should be replaced around the tree root ball and firmed in and watered in well. The area, a minimum of 1 metre radius from the trunk of the tree, should be mulched with compacted mulch. All plants shall be appropriately hardened off in the nursery.
Use plants with the following characteristics
Large healthy root systems with no evidence of root coil or pot bound restriction or damage, vigorous, well established, free from disease and pests, of good form, consistent with the species or variety, hardened off - not soft or forced.
Plants that do not meet these requirements will be rejected.
Planting holes for shrubs and groundcovers are to be a minimum of 75mm larger than the planting hole in all directions.
Semi-advanced tree planting holes are to be the same depth as the rootball and 2-3 times its diameter, with the top of the rootball being at grade. A 75mm high berm is to be constructed at the edge of the rootball to hold water.
All plants are to be thoroughly watered after planting and slow release fertiliser added at the quantities specified by the manufacturer.

Mulching

Organic mulch is to be supplied to all garden beds. It is to be of chipped or shredded vegetative material with particles in the size range 15 to 50mm in plan and at a minimum depth of 50-75 millimetres and watered well during dry periods for a minimum of 12 months to ensure the new trees establishes in its new position.
Mulch shall be free of excessive matter such as soil, weeds and sticks. Mulch is to be stockpiled and thoroughly weathered prior to delivery. This mulch shall be laid to a minimum depth of 75mm and is not to come into contact with plant stems but shall be kept back 100mm from the stems of all plants to prevent collar rot.

Cut and fill

Areas of cut or fill which result in creating banks should be battered to a gradient of no more than 5% and will be covered with geotextile fabric before being planted out with appropriate species and then covered with 5cm -10cm layer of mulch, as specified below. Introduced soil for fill is to be free of weeds, rubble and any other material likely to inhibit plant growth and is to be of a medium texture (sandy loam) with a pH of 6.0-7.0. Any imported soil is to be laid over a prepared sub-base which has had any materials likely to inhibit plant growth (e.g. rubble and large rocks) removed.

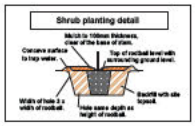
Soil Preparation

Introduced material such as crushed rock, concrete spillage, construction waste and any other material likely to inhibit plant growth shall be removed from the site of any planting beds and lawn areas.
All rubbish/vegetative spoil is to be removed from the site.
Any weed growth in existing top soil is to be appropriately controlled using physical or chemical means. Existing top soil in planting areas is to be preserved so that it is not further compacted by site machinery and so that no rubble or building supplies are stored in these areas. Existing soil which is already compacted is to be cultivated through ripping or other appropriate measures to a minimum depth of 400mm.
Any imported soil is to be free of weeds, rubble and any other material likely to inhibit plant growth and is to be of a medium texture (sandy loam) with a pH of 6.0-7.0. Any imported soil is to be laid over a prepared sub-base which has had any materials likely to inhibit plant growth (e.g. rubble and large rocks) removed. This soil is then to be spread to the appropriate depth and cultivated into the existing site soil to a minimum depth of 150mm.

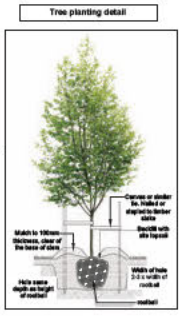
Legend

- DENOTES VEGETATION TO BE REMOVED (37-39)
- DENOTES VEGETATION SURVEYED (WITHIN 3m OF BOUNDARY)
- DENOTES INDIGENOUS VEGETATION WHICH EXISTS WITHIN THE SITE
- DENOTES INDICATIVE BUILDING ENVELOPE
- DENOTES INDICATIVE DRIVEWAY TO COUNCIL SPECIFICATIONS
- DENOTES SWALE DRAINS, TANKS AND STORMWATER

Shrub planting detail



Tree planting detail



Plant List

Code	Plant Name	Common Name	H x W (m)	Q.
Af	Angophora floribunda	Rough Barked Apple	15x9	9
Bi	Banksia integrifolia	Coast Banksia	15x7	9
Eo	Eucalyptus ovata	Swamp Gum	15x9	9

Must be advanced stock at a minimum 45-52L/50cm pot size and 2 metre tall at time of planting.

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Client

Site Address
158 Reed Crescent, Wonthaggi, VIC

Title
Landscape Plan

Base plan version:
BW - 2102696 SITE CONTEXT v1
BW - 2102696 Drainage Strategy v3

N

Date 24/11/2023
Drawn SM
Scale 1:400 at A1
Drawing TP01

Stormwater Management Strategy

158 Reed Crescent, Wonthaggi

Client

[redacted]

Issued
5/05/2025



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Beveridge Williams

Client:	[redacted]
Issued:	5/05/2025
Version:	F
Prepared by:	[redacted]
Checked by:	[redacted]
Project Manager:	[redacted]
Project Number:	2102696

Surveying
Asset Recording
Civil Engineering
Infrastructure Engineering
Traffic & Transport Engineering
Environmental Consulting
Water Resource Engineering
Strata Certification (NSW)
Town Planning
Urban Design
Landscape Architecture
Project Management

Revision Table

Rev	Description	Date	Authorised
A	ISSUED FOR INFORMATION	23/09/2024	[redacted]
B	UPDATED SWMS	13/11/2024	[redacted]
C	UPDATED SWMS	28/11/2024	[redacted]
D	UPDATED SWMS	19/12/2024	[redacted]
E	UPDATED SWMS	25/02/2025	[redacted]
F	UPDATED SWMS	05/05/2025	[redacted]

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APPENDIX B:PRE AND POST DEVELOPMENT CATCHMENT PLANS
APPENDIX C:BUREAU OF METEOROLOGY DATA
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APPENDIX E:PC CONVEY RESULTS

Glossary of terms

Alphabetical list of terms and abbreviations used in report

AHD	Australian Height Datum A common national surface level datum approximately corresponding to mean sea level.
AEP	Annual Exceedance Probability. Probability of a flood event occurring in any year
Authorities	Organisations responsible for supply and management of sewer, water, gas, electricity and telecommunications, roads and transport
BPEMG	Best Practice Environmental Management Guidelines
BWCo	Beveridge Williams & Co Pty Ltd
CMA	West Gippsland Catchment Management Authority
Client	
Council	Bass Coast Shire Council
DSS	Drainage Services Scheme
IDM	Infrastructure Design Manual
LSIO	Land Subject to Inundation Overlay
MPA	Metropolitan Planning Authority
MWDS	Melbourne Water Drainage Scheme
NTWL	Normal Top Water Level
Q_5	Storm water flow generated from 20% AEP storm event.
Q_{100}	Storm water flow generated from 1% AEP storm event.
Q_{gap}	Flow difference between Q_5 and Q_{100} storm event.
PSP	Precinct Structure Plan
SBRB	Sedimentation Basin/ Retention Basin
WLRB	Wetland Retention Basin
WSUD	Water Sensitive Urban Design

1 INTRODUCTION

Beveridge Williams has been commissioned by [redacted] to prepare a Stormwater Management Strategy (SWMS) for a proposed residential development at 158 Reed Crescent, Wonthaggi. The total site area is approximately 2.20 hectares and is proposed to be developed into approximately 7 normal density residential lots with a cul-de-sac.

This SWMS is intended to provide sufficient evidence that the stormwater discharges from the proposed development can meet stormwater *Best Practice Environmental Management guidelines (BPEMG)* and that stormwater discharging from the proposed development shall be to the satisfaction of West Gippsland Catchment Management Authority (WGCMA), Bass Coast Shire Council (BCSC) and other stakeholders.

This report will provide detail on stormwater quantity and quality management, including overland flow paths, detention requirements, sub-surface drainage, water quality assets and all associated modelling.

1.1 Site Overview

The existing site is zoned as Low Density Residential (LDRZ) with mostly gassed paddocks, minimal vegetation, a horse paddock, and a residential homestead with adjacent sheds towards the south. The property fronts Reed Crescent to the south and backs onto the Broome Crescent road reserve to the north. The surrounding properties are other Low Density Residential lots as shown in Figure 1 below.



Figure 1: Site Plan (Aerial) (Not to scale)

2 EXISTING CONDITIONS

2.1 Topography

The site's high point (RL 34.58) is located at the boundary with 156 Reed Crescent with flow grading in two directions; the north-west to a low point (RL 32.91) with an average grade of 1 in 105 and the south-west to a low point (RL 34.41) with an average grade of 1 in 643 as shown in Figure 2. The associated survey has been provided in Appendix A.

A swale drain can be seen running north through the centre of the site, draining out to Broome Crescent.

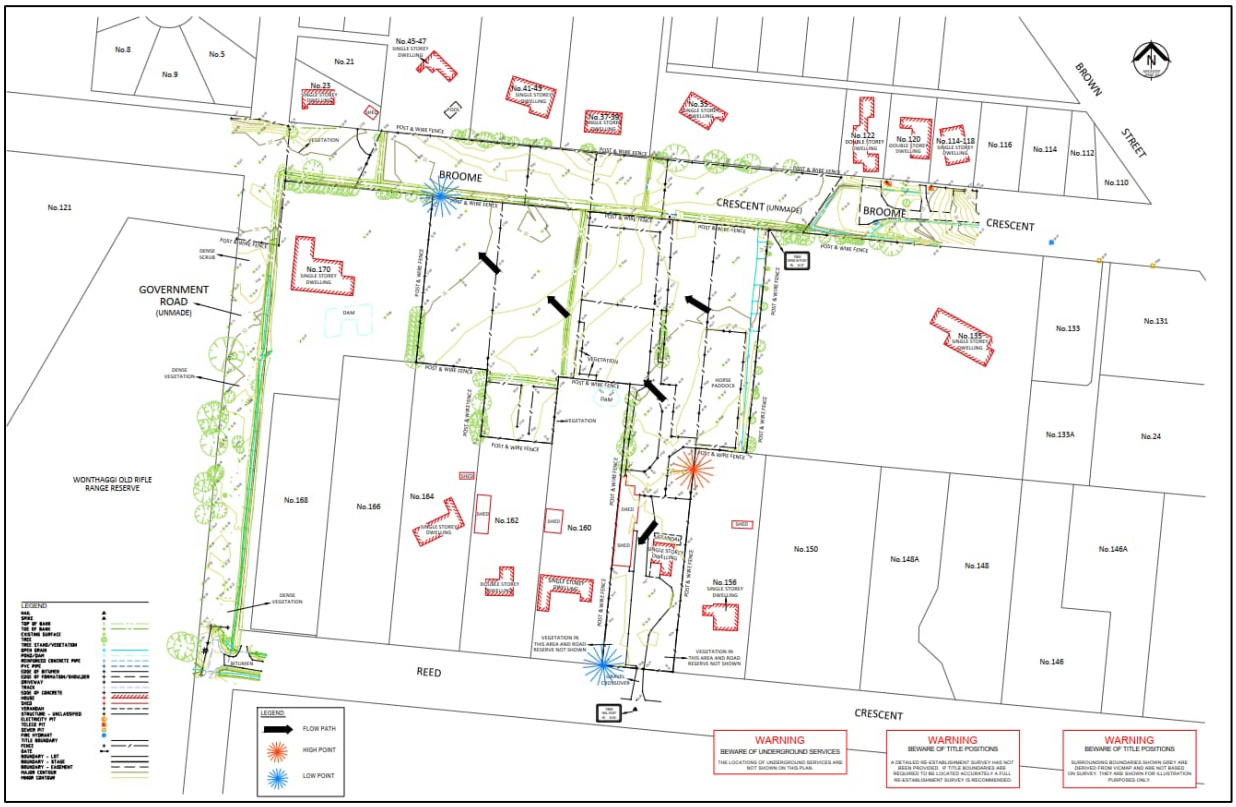


Figure 2: Site Flow Analysis Plan (Not to scale)

3 DESIGN INTENT

3.1 Proposed Development

The proposed development site intends to create 9 normal density residential lots with an average lot size of 2057 m². A small cul-de-sac will provide access to 5 lots off Broome Crescent with the remaining lots fronting the existing road reserve as shown in Figure 3 below.

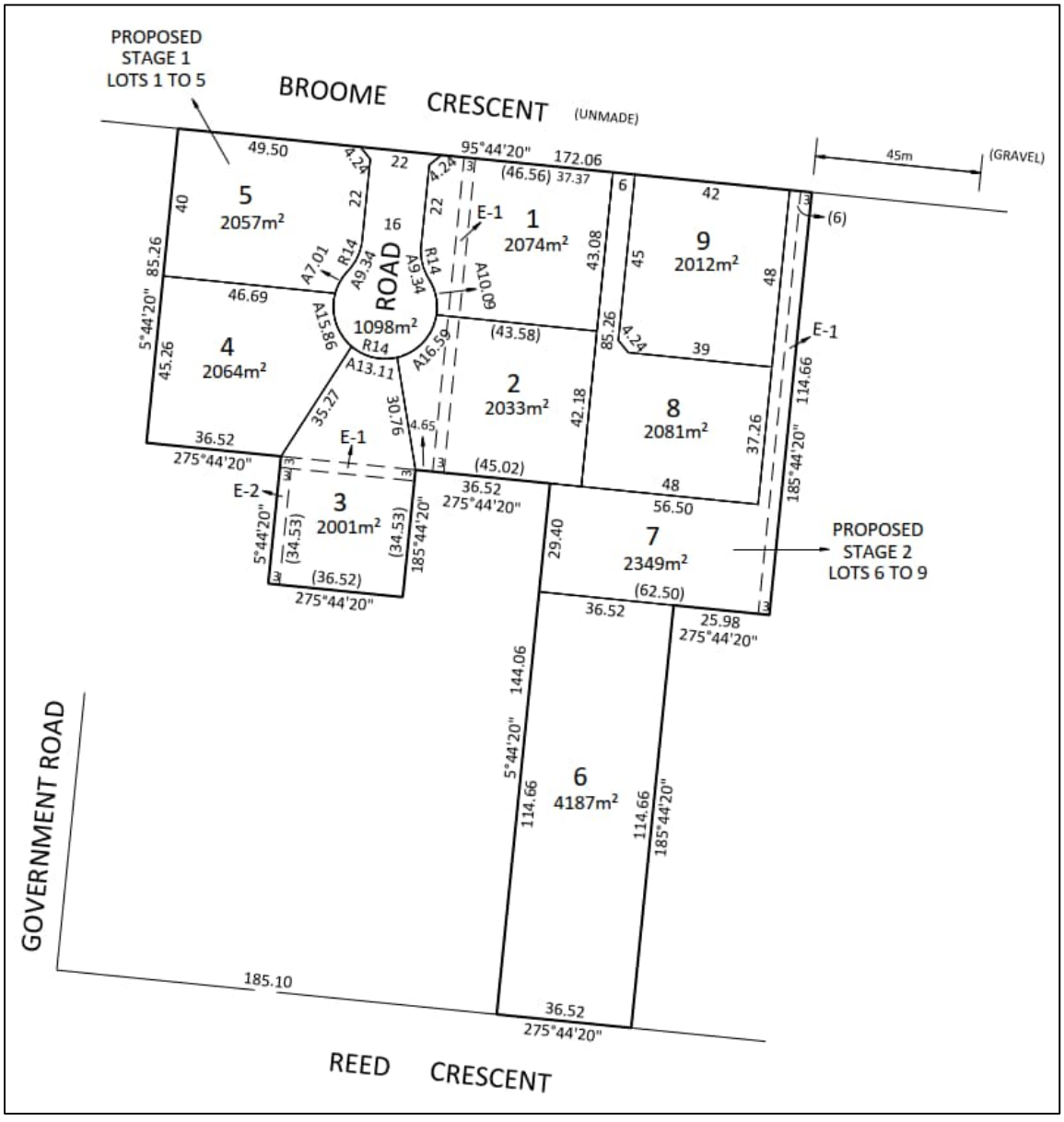


Figure 3: Indicative Development Layout (Not to scale)

3.2 Existing Conditions

The proposed development will not be utilising the existing drainage network for stormwater quantity management.

No existing pit or pipe infrastructure was identified along Broome Crescent and Reeds Crecent. Flows from the current residential property discharges to an existing roadside swale along Broome Crescent, while the remaining areas drain toward an existing swale exists along Government Road west of the site. These flows then flow through a 375mm diameter pipe under Reed Crescent to a 1050mm diameter pipe discharging into the Heathland Bird Hide Reserve.



Figure 4: Indicative Development Layout (Not to scale)

3.3 Tailwater Conditions

The outfall location will be the Heathland Bird Hide reserve, west of Reed Crescent. Stagnate water has been observed in the Heathland Bird Hide reserve (Figure 5) after a week without rainfall, with the level of water was measured 280mm above the 1050mm diameter pipe outfall level. This outfall level was picked up by survey as IL31.61m, therefore a constant tailwater level of RL31.89m will be applied to the DRAINs model.



Figure 5: Site Photos. Heathland Bird Hide Reserve (left). 1050mmØ outfall into Heathland Bird Hide Reserve (right)

4 STORMWATER QUANTITY MANAGEMENT

Hydrological analysis for the proposed development site was undertaken for both the 20% AEP and 1% AEP events using the Rational Method and utilising the kinematic wave equation to determine both pre-development flows and design flows in the ultimate development condition. The Rational Method will determine the permissible site discharge (PSD) for the minor storm event and assist in determining the requisite detention volumes. The stormwater and drainage modelling program DRAINS was used to analyse the flows associated with the proposed design and subsequent detention requirements.

As illustrated in Figure 6 and Appendix B, the proposed development site naturally grades from the south-east to the north-west towards the Broome Crescent road reserve. With the outfall located within Broome Crescent, it is expected 6.65 hectares (catchments A. B and C) of low density residential overland flow to transverse to Broome Crescent towards the outfall location. Existing external flows from catchment E (0.7 ha) also enters the proposed development site.

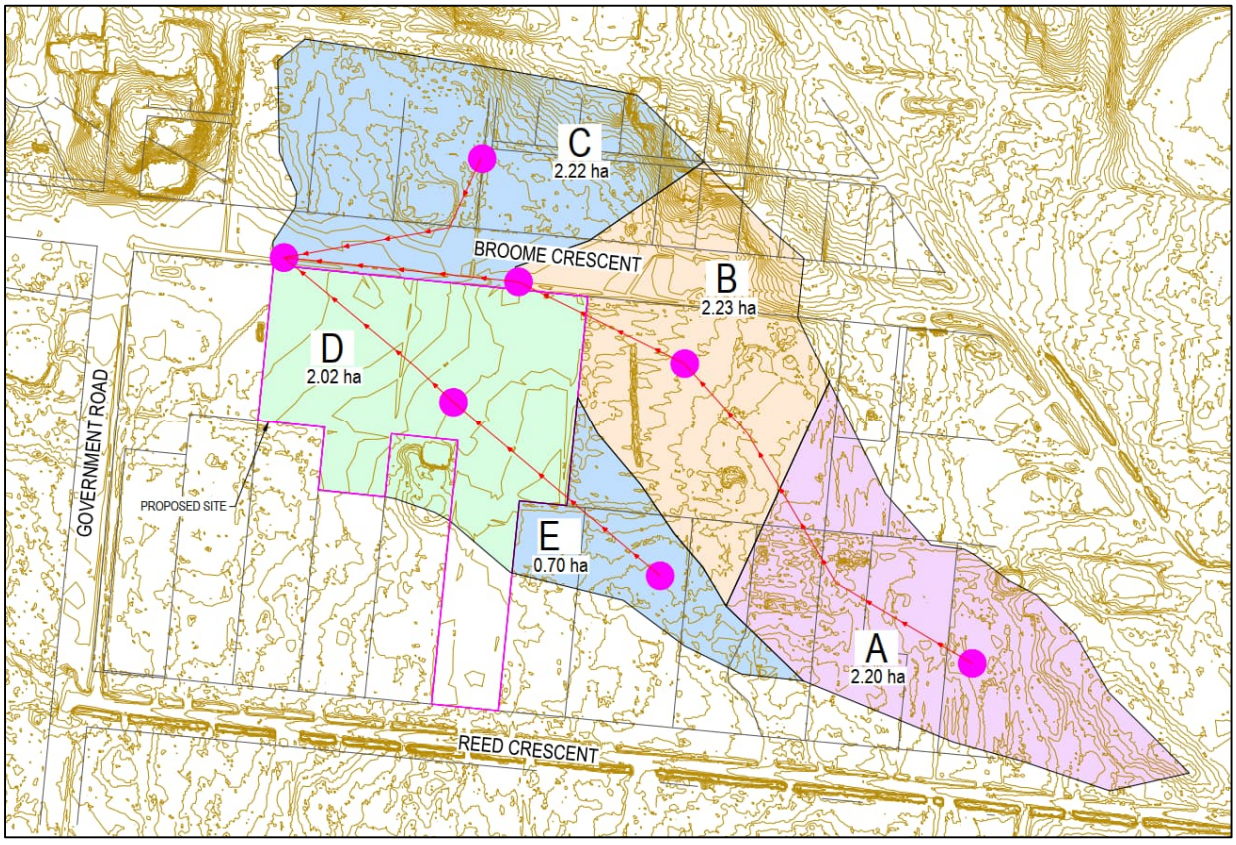


Figure 6: Pre-development catchment plan

Based on the initial grading of the site, a post-development catchment plan was produced as shown in Figure 7, Figure 8 and Appendix B.

The post-development catchment plan will act in a similar fashion to the pre-development catchment plan, with the following changes:

- The driveway for Lot 7 will direct flow entering the site north towards Broome Crescent.
- External catchment C will be directed further west via roadside swales before joining the basin outfall swale. A basin is proposed on the north-western corner of the proposed site within Broome Crescent. Catchment C will bypass this basin, via roadside swales.

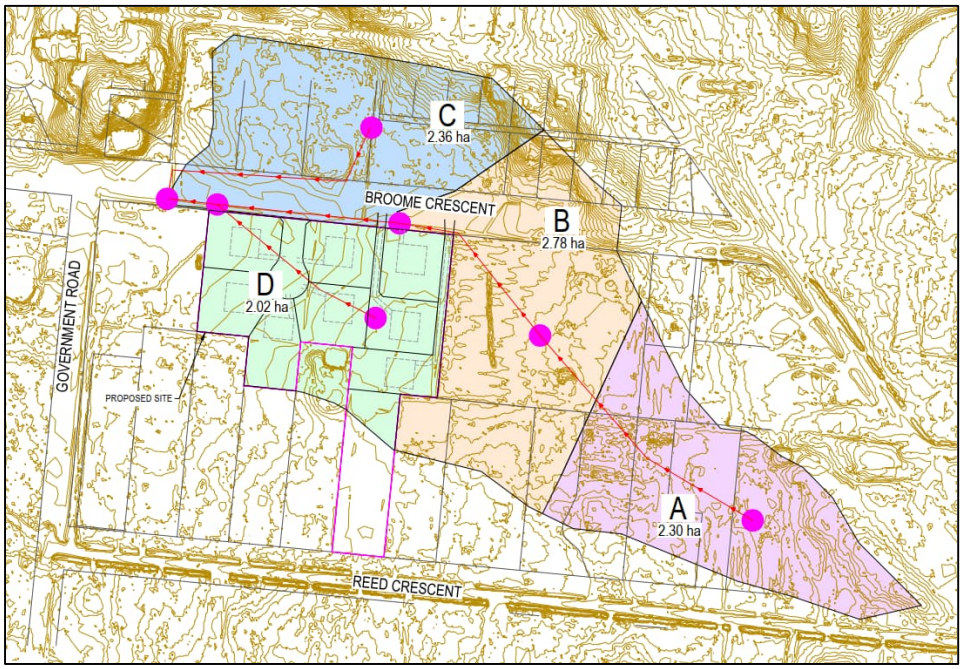


Figure 7: Post-development catchment plan

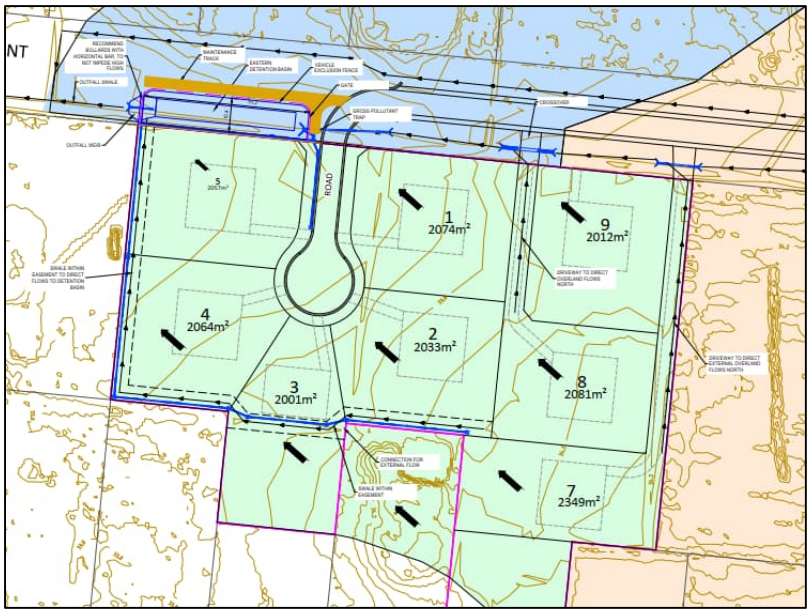


Figure 8: Detailed Post-development catchment plan

4.1 Hydrologic Modelling

Hydrological modelling was undertaken using the rainfall and runoff routing program RORB (version 6.45) to model the 20% and 1% AEP events in both the pre- and post-development conditions. Adopted modelling parameters have been summarised in Table 1 and the Bureau of Meteorology (BOM) data in Appendix C.

Table 1: Rational Parameters and Considerations

DESIGN PARAMETRE	REQUIREMENT/ASSUMPTION	COMMENT
Location	Wonthaggi	
IFD Data	ARR 1987 Design Rainfall	
Tc method	Kinematic Water Equation	0.2 (short grass paddock) was used for the surface roughness coefficient (Horton's roughness coefficient n)
IFD Data	ARR 2016 Design Rainfall	Bureau of Meteorology
Detention	Boyds Detentions	Bureau of Meteorology
Catchments	Existing Catchments mapped from 1m gridded ALS LiDAR and Survey data	Geoscience Australia, Beveridge Williams
Land Use Runoff Coefficient	Pre-development = 0.25 Landscape Area Post Development = 0.45 LDRZ – lot areas >2000m^2 to 4000 m^2 0.75 Residential Road Reserves	Table 10: Runoff Coefficients, Infrastructure design manual, September 2021
Design Events	20% AEP, 1% AEP	Critical Design Event for Basin Design

4.1.1 Rational Results – 20% AEP

Bass Coast Shire Council requires the 1.80 hectare proposed site (excluding external catchments) to have a permissible site discharge (PSD) of the pre-development 20% and 1% AEP flows. Detention is required to reduce the proposed site's post-development flow down to the PSD flow rate.

Results of the Rational Method assessment are shown in below Table 2 and Appendix D.

Table 2: Rational Method Results

DISCHARGE OF PROPOSED SITE		
	20% AEP Storm Event	1% AEP Storm Event
Pre-development flow (PSD)	27.4 L/s	56.7 L/s
Post-development flow	182.3 L/s	368.2 L/s
Detention Volume	111.7 m^3	186.2 m^3
Basin Outfall	300mm @ 1 in 970 Grade (31 L/s capacity)	300mm @ 1 in 450 Grade (60 L/s capacity)
DISCHARGE INTO BROOME CRESCENT (external catchments included)		
20% AEP pre-development flow	20% AEP Storm Event	1% AEP Storm Event
Pre-development flow	109.5 L/s	249.3 L/s
Post-development flow	228.2 L/s	485.9 L/s

4.1.2 DRAINS Analysis

A DRAINS model was set up using current temporal patterns and IFDs (Intensity Frequency Duration) downloaded off the Bureau of Meteorology (BOM) Data Hub for Wonthaggi. Drainage lines and bypass channels were modelled along the southern and western boundaries along with swales along the northern boundary which direct all developed flows to a basin. The basin was modelled with a pipe and weir outfall to a constructed swale along Broome Cresent, Government Road and finally Reed Crescent as shown in Figures 9 and 10.

The initial sizing of the detention basin, within Broome Crescent, basin was a 10.4-metre wide by 48.0-metre long basin with 1 in 3 batter slopes. It had a total depth of 0.80 metres with a 0.20-metre deep spillway, giving it a total storage capacity of 201.7 m^3 below spillway height. The outlet pipe was a 300mm diameter pipe at 1 in 970 grade as shown in Table 2 above.
The basin was then extended to 51.2-metre long to accommodate 1 in 5 slopes for the eastern and western basin batters.

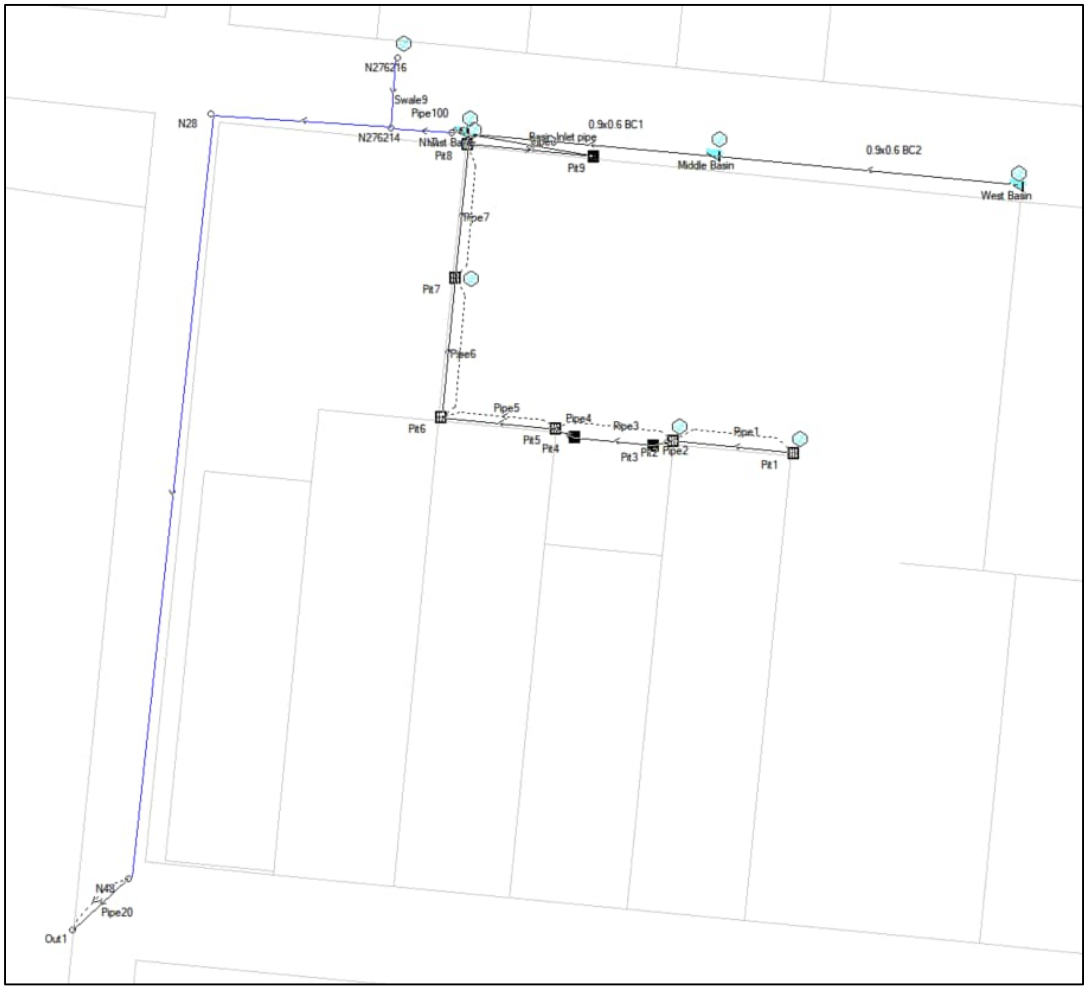


Figure 9: DRAINS layout (not to scale)

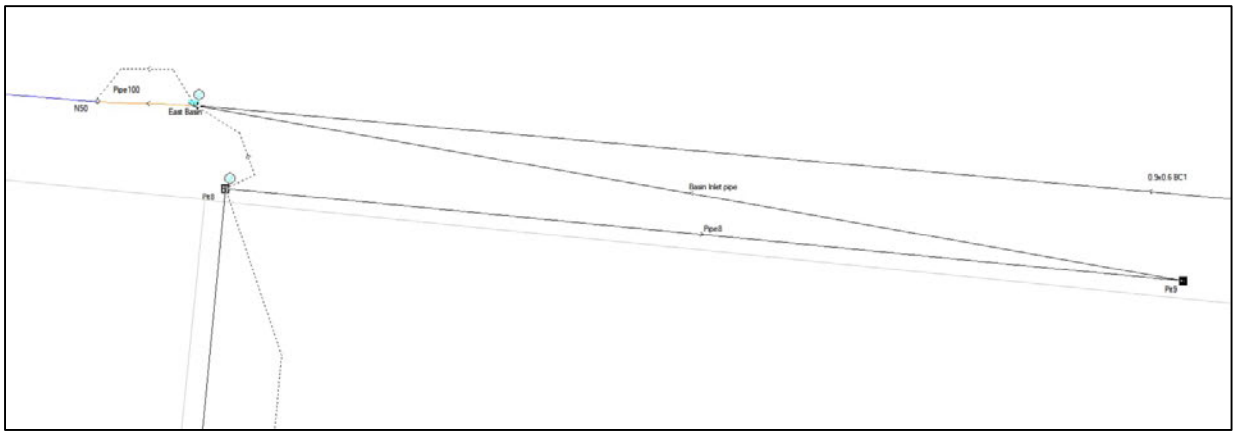


Figure 10: DRAINS Eastern basin layout (not to scale)

The basins parameters modelled in DRAINS are summarised in Table 3.

Table 3: Retarding Basin Values

PARAMETRE	VALUE
Eastern Basin	
RB Depth	0.8 m
RB Base Level	RL 32.23 m AHD
Batters	North/South: 1 in 3 East/West: 1 in 5
Top dimensions	Length = 51.2 m Width = 10.4 m
Outlet Pipe	1 x 300 mm diameter at 1 in 970 grade
Spillway Level	RL 32.83 m AHD
Top of Bank Level	RL 33.03 m AHD

When analysing the flow run off for just 158 Reeds Crescent and excluding external flows; in the 20% AEP event, the water level in the basin rises to an RL of 32.516m AHD. This sits below the spillway level of RL 32.830m AHD as shown in Figure 11.

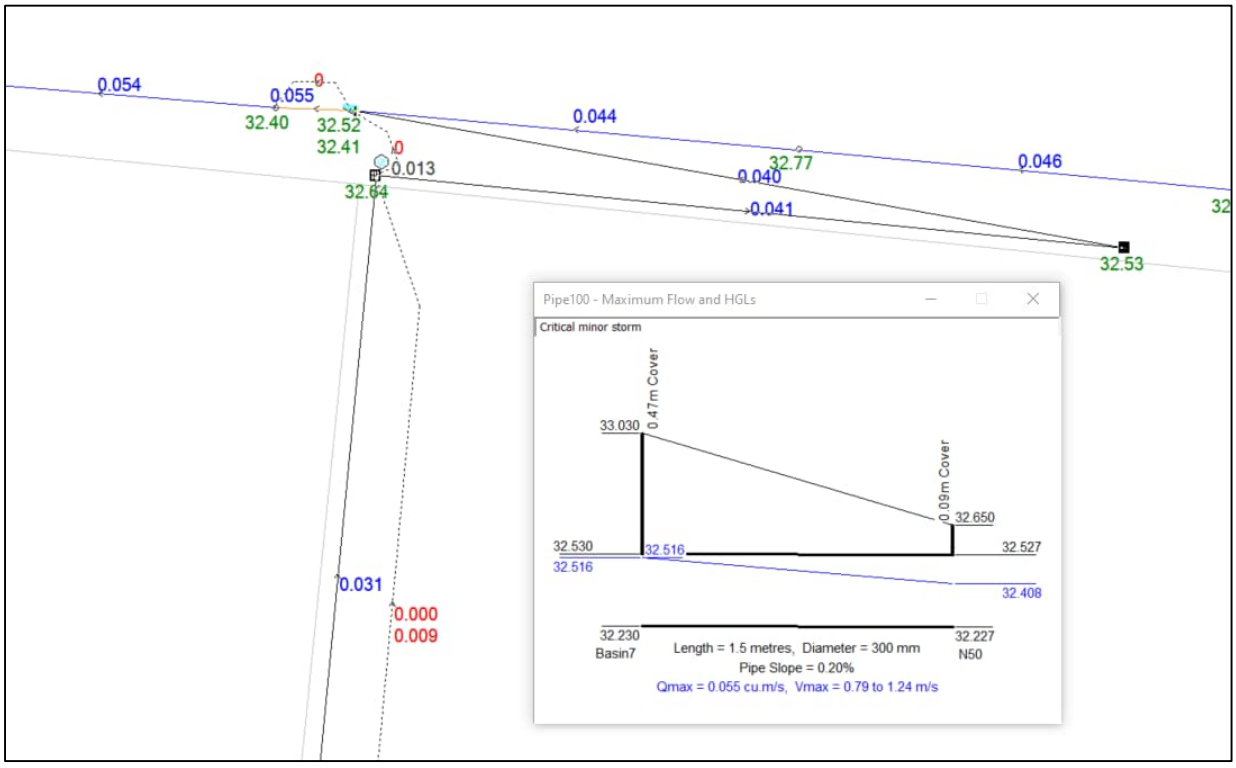


Figure 11: DRAINS model – minor storm basin outfall

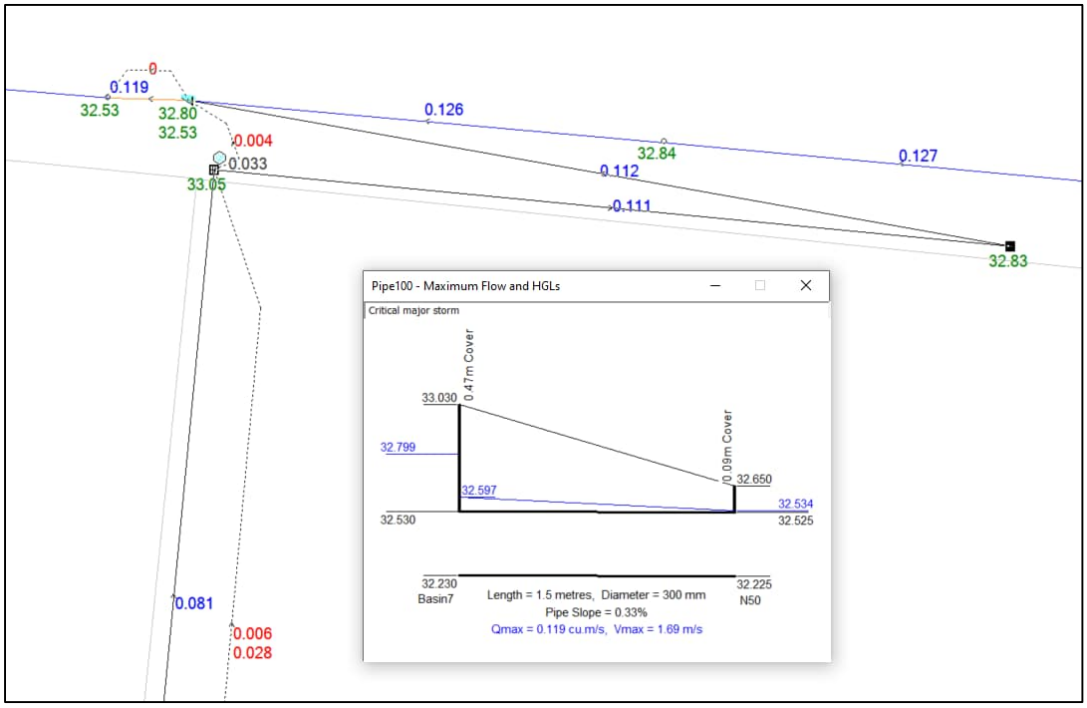


Figure 12: DRAINS model – major storm basin outfall

When analysing the flow run off for just 158 Reeds Crescent and excluding external flows; in the 1% AEP event, the water level in the basin rises 269mm above the 300 mm pipe obvert to an RL of 32.799m AHD. This sits below the spillway level of RL 32.830m AHD as shown in Figure 12. The proposed basin is adequate for the OSD for the permissible site discharge.

Note: the above result is only looking at the internal 1.80 hectare developed site to review the result of the OSD.

4.1.3 DRAINS Results

The DRAINS model was then updated to include the external catchments outlined in the existing catchment plan with results summarised in Table 4.

Table 4: DRAINS Results

	20% AEP EVENT	1% AEP EVENT
Basin inflow	114 L/s	552 L/s
Basin outflow	118 L/S	513 L/s
Basin water level	32.781 m AHD	32.922 m AHD Spillway engaged
Discharge into Government Road	175 L/s	642 L/s
Discharge into Reed Crescent	173 L/s	526 L/s

4.1.4 Freeboard

The 1% AEP level within the basin was estimated to be RL32.92m AHD meaning the adjacent Lot 5 will need to be filled to a minimum of 33.02m AHD to achieve the minimum 300mm freeboard.

The basin will discharge into a swale within Broome Crescent at a rate of 513 L/s. This swale will have 1 in 4 batter slopes, a base width of 0.50 metres and a Manning's roughness coefficient (n) of 0.035 which will allow for long grass.

Figure 13 illustrates a PC Convey assessment of the swale which shows a freeboard depth of 310 millimetres to the top of the swale. The PC Convey results are located in Appendix E.

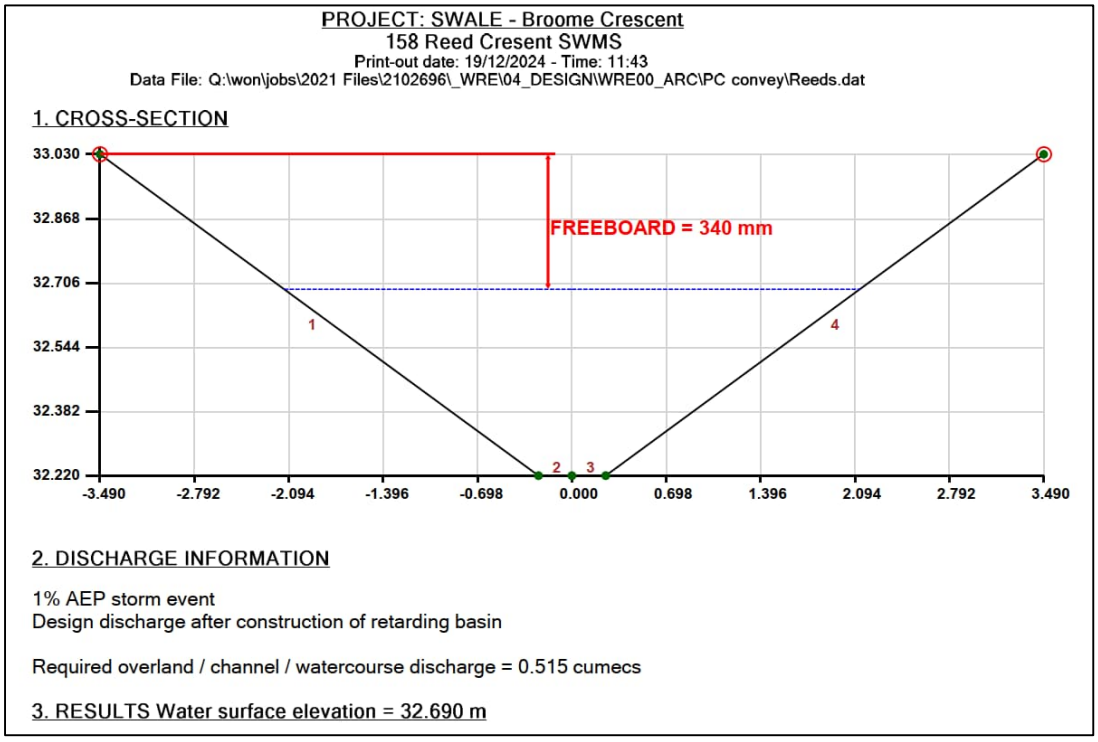


Figure 13: PC Convery - Outfall swale along Broome Crescent

As external flows (catchment C) enter the swale, the flow rate is estimated to increase to 642 L/s as it travels down Government Road. As the swale grades towards Reed Crescent and becomes steeper, the batter slopes steepen to 1 in 3 to minimise the footprint within the small existing road reserve and a Manning's roughness coefficient (n) has been increased to 0.05 to allow for vegetated slopes along this section of the alignment.

A PC Convery assessment to check freeboard levels in the swale are shown in Figure 14. This estimates a freeboard depth of 314 millimetres to the top of the swale.

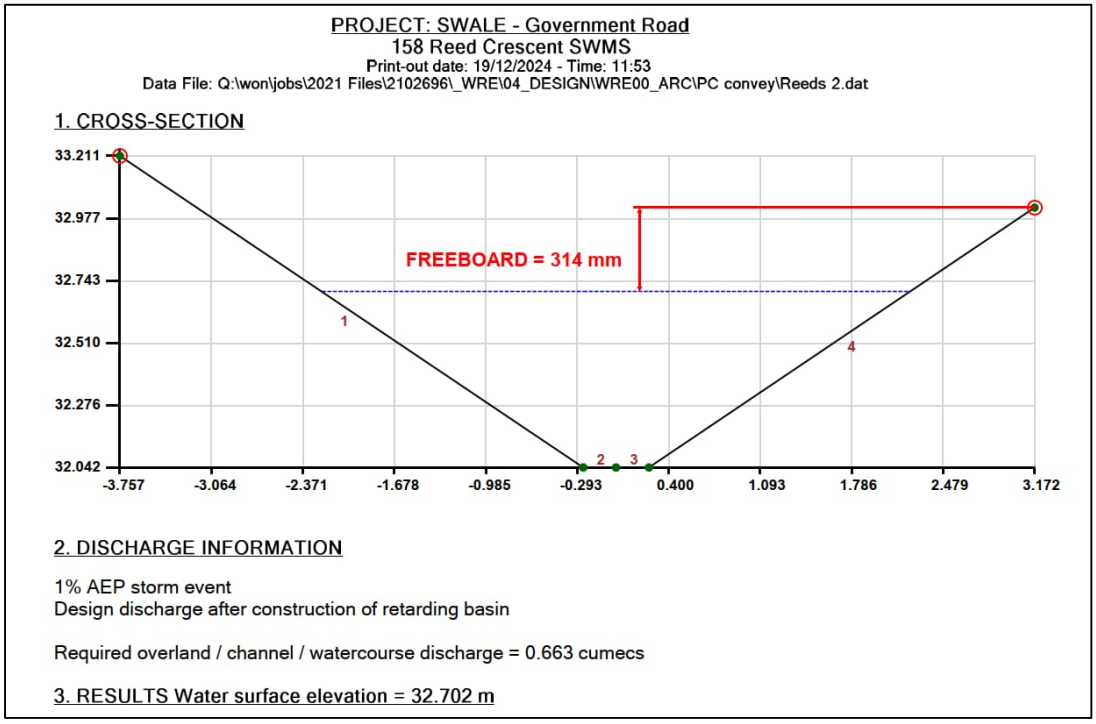


Figure 14: PC Convery - Outfall swale along Broome Crescent

Swales have been proposed along the boundary of the site to direct overland flows north into Broome Crescent. As illustrated in Figure 15, the DRAINS model estimates the maximum 1% AEP flow within the lots to be 55 L/s. To ensure that the neighbouring property has adequate freeboard protection, a 400mm deep swale with a 1 metre base and with 1 in 5 grass slope is required to provide the requisite 300mm freeboard.

A PC Convery assessment to check freeboard levels in the swale are shown in Figure 16. This estimates a freeboard depth of 310 millimetres to the top of the swale. This back of lot swale was estimated to have the largest overland flow as the pipe was modelled as a 300Ø millimetre. The next pipe downstream was modelled with a 375Ø millimetre pipe thus reducing the overland flow.

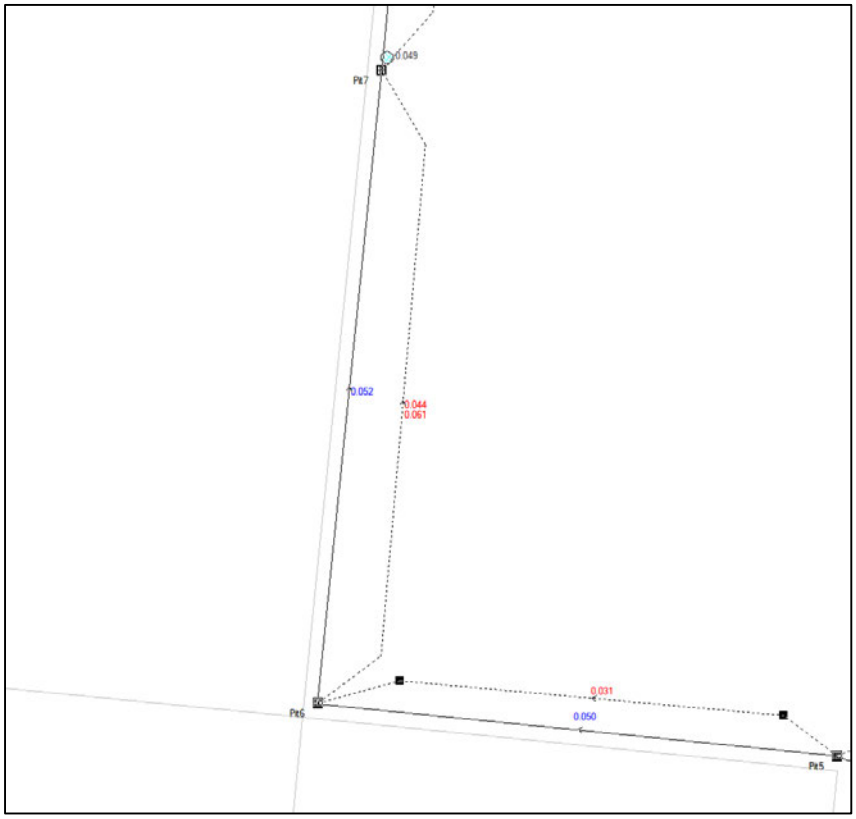


Figure 15: DRAINS model – Swale within lots

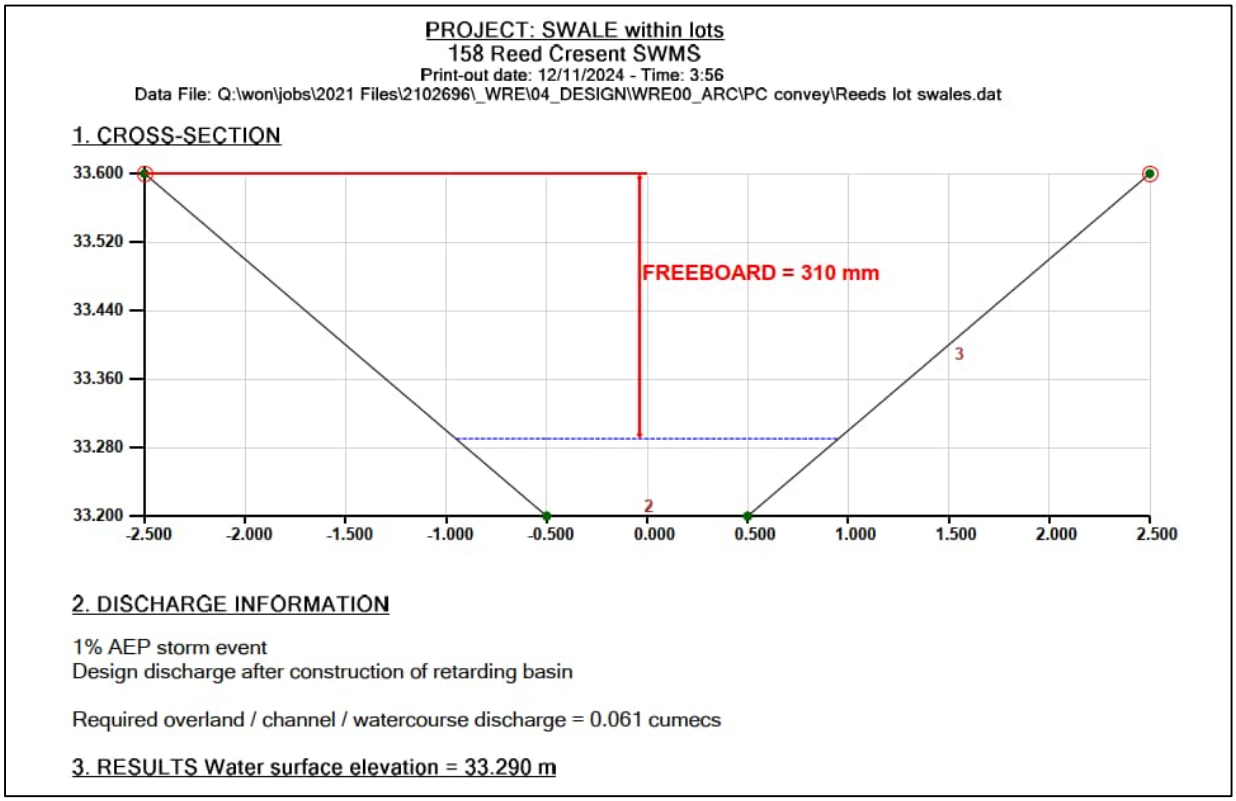


Figure 16: PC Convery – Swale within lots

4.2 Proposed Drainage Assets

4.2.1 On-Site Detention Basin

The on-site detention basin will be located within Broome Crescent north of lot 5, as per Figure 17 and 18. The basin will have a top width and length of 10.4m and 51.2m respectively. The outlet will be a single 300-millimetre diameter pipe with 8 metre wide and 0.20 metre deep weir which will direct flows into the proposed swale in Broome Crescent. A crushed rock 3 metre wide maintenance track will be constructed along the northern and eastern sides of the OSD, servicing the OSD and GTP. The northern and southern basin slope will be vegetated with 1 in 3 grade. The eastern and western basin slope will be 1 in 5 grade.

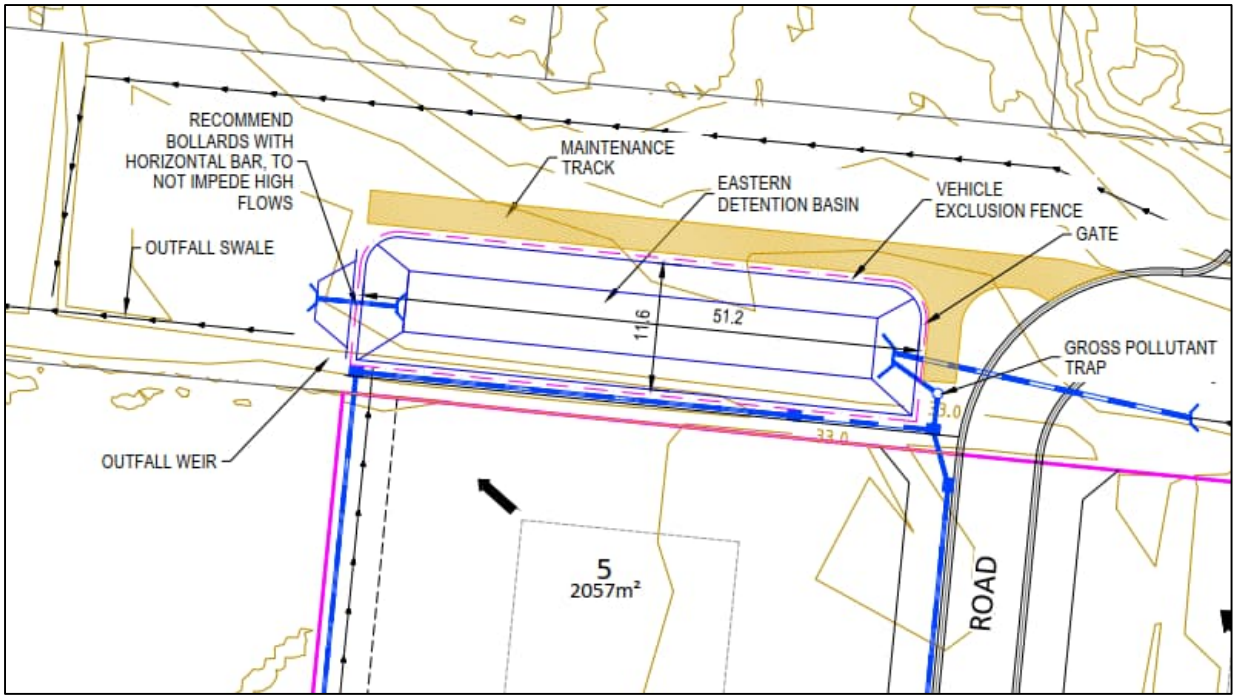


Figure 17: Eastern On-Site Detention Layout Plan

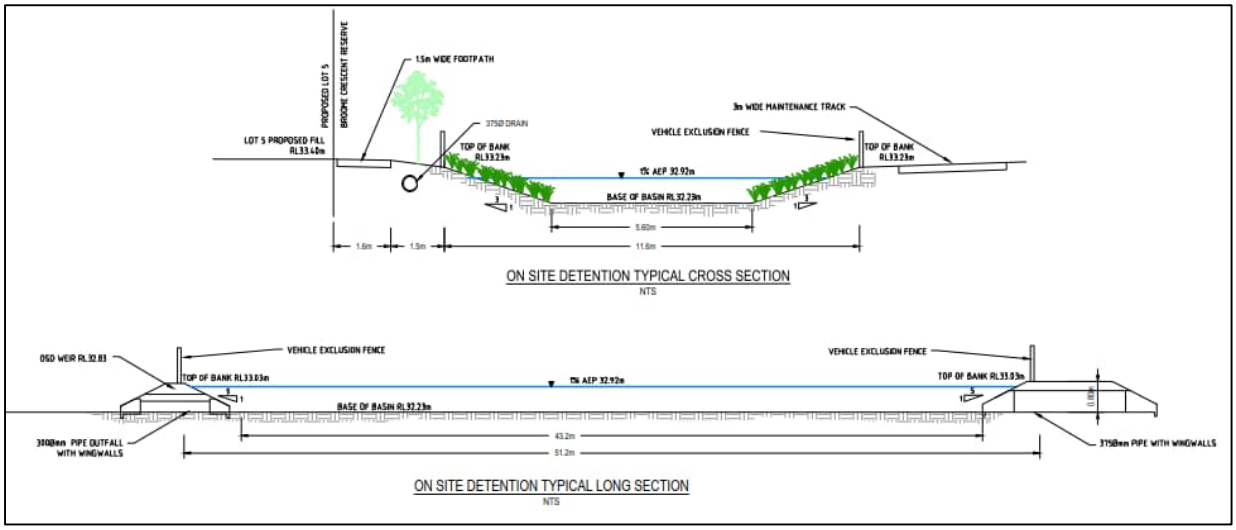


Figure 18: On-Site Detention Typical Cross Section and Long Section

4.2.2 Back of Lot Swale

The back of lot swale will be a 5-metre wide, 0.4-metre deep grassed swale with 1 in 5 batter slopes, as per Figure 19. On average the sub-surface drainage with have about 250-millimetre cover and will be a 300 or 375 millimetre diameter concrete pipe depending on location.

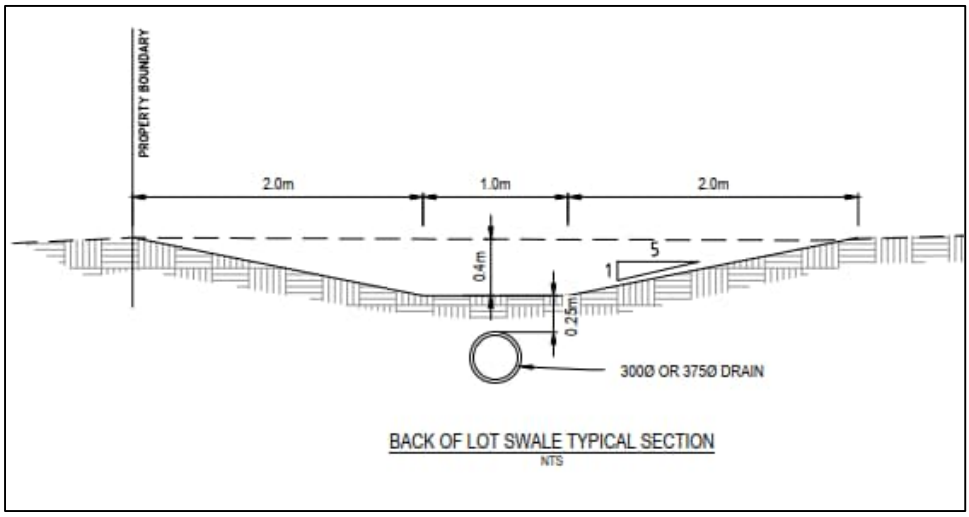


Figure 19: Back of Lot Swale Typical Section

4.2.1 Reed Crescent Outfall

The current outfall into the Heathland Bird Hide reserve consists of two existing concrete pipes under Reed Crescent. The two pipes are 375 and 1050 millimetres in diameter. It is proposed to provide a new 600-milimetre diameter pipe from the Government Road swale to the Heathland Bird Hide reserve, as per Figure 20.

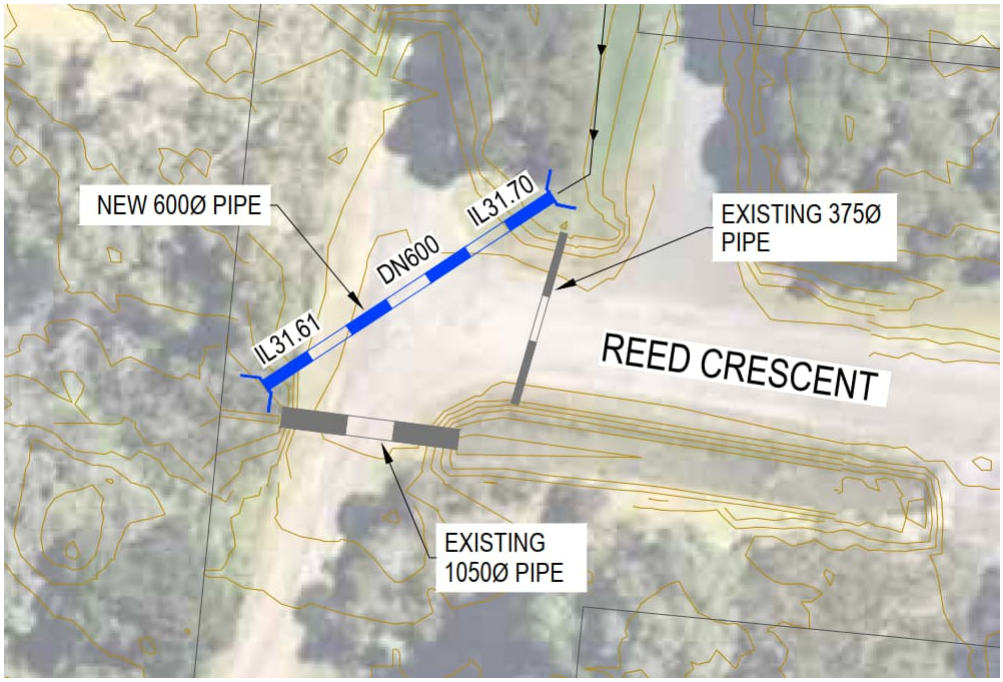


Figure 20: Reed Crescent Outfall Layout

A tailwater was set at RL31.89m in Heathland Bird Hide reserve. From the DRAINS model (Figure 21), this will have minimal impact to the upstream 1% AEP flood level with freeboard being achieved.

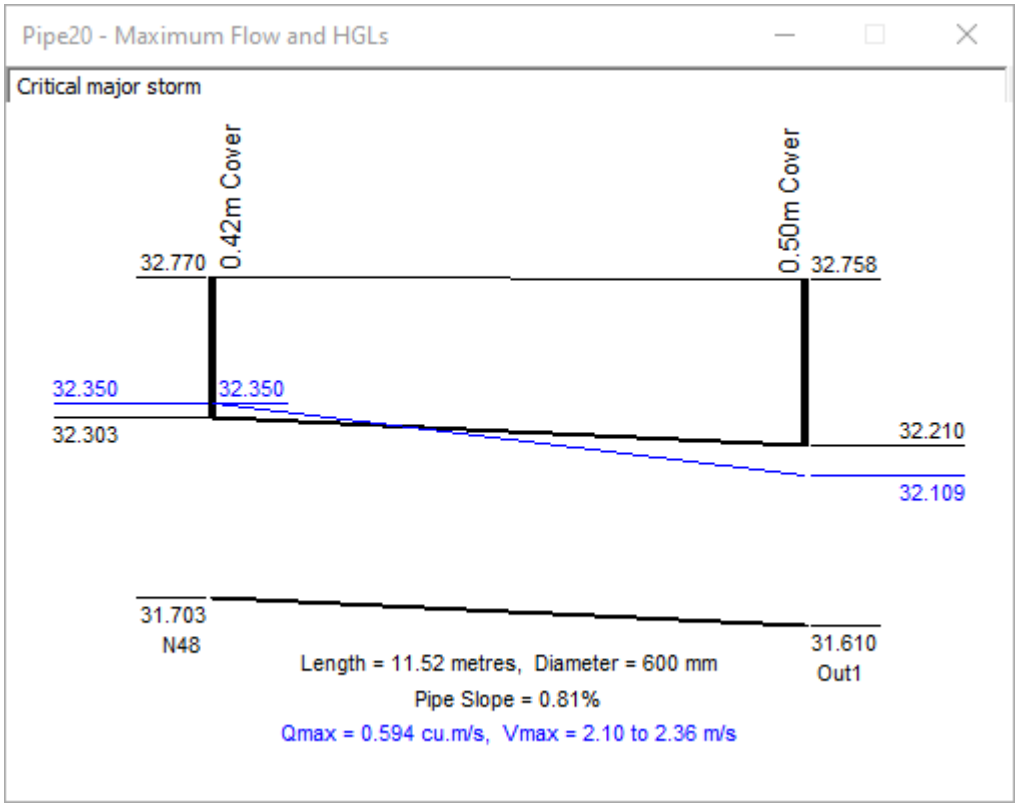


Figure 21: DRAINs Model, 600mmØ Outfall pipe in 1% AEP event

5 STORMWATER QUALITY MANAGEMENT

A stormwater quality treatment train has been assessed utilising the MUSICX software tool (version 1.30.0) in accordance with Melbourne Water's *MUSIC Guidelines* (July 2024). All assets in the treatment train have been selected and configured to meet the best-practice water quality treatment objectives specified in these guidelines by East Gippsland Catchment Management Authority (EGCMA) which requires 'at source' treatment to achieve the following treatment effectivity:

- 80% removal of Total Suspended Solids (TSS),
- 45% removal of Total Phosphorous (TP),
- 45% removal of Total Nitrogen (TN), and
- 70% removal of the Total Gross Pollutant Load (Litter).

The proposed treatment train comprises a rainwater tank (RWT) on each lot, swale drains and a gross pollutant trap (GPT).

5.1 MUSIC Modelling

MUSIC modelling was conducted to assess water quality management for this development with the results summarised in Table 5.

The proposed water quality treatment arrangement is described below and presented Figure 22 within MUSIC. The MLB climate data was sourced from the Wonthaggi region.

- A GPT is proposed prior to the detention basin servicing 5 lots and the cul-de-sac. An Atlan Vortceptor was used in the model with the following reduction parameters:
    - Total suspended solids reduction: 70%
    - Total phosphorous reduction: 30%
    - Total nitrogen reduction: 0%
    - Total gross pollutant load reduction: 99%

  Note: a similar GPT with similar or better reductions should be used.
- RWTs are assumed to have a reuse function
- Roadside swales with vegetated slopes are included in reduction targets.

Table 5: MUSIC Results

PARAMETER	SOURCES (kg/yr)	RESIDUAL (kg/yr)	DIFFERENCE (kg/yr)	REDUCTION (%)	BPEMG TARGET (%)	BPEMG Target Met?
TSS	592.8	108.3	484.5	81.7	80	Yes
TP	2.09	1.00	1.09	51.8	45	Yes
TN	19.46	11.02	8.44	43.4	45	No
GP	203	0	203	100	70	Yes

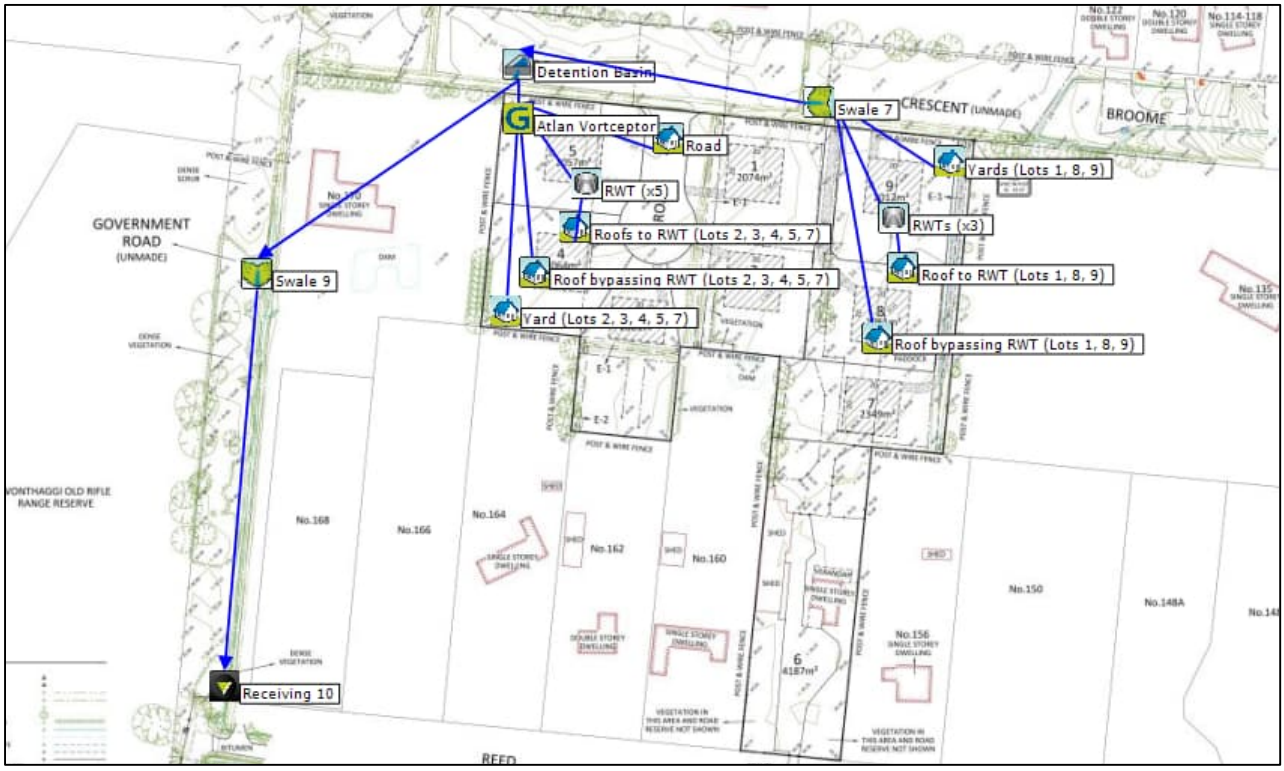


Figure 22*: MUSIC Model Layout - 4EY treatment catchment plan*

6 CONCLUSION

This SWMS is intended to provide sufficient evidence that the stormwater discharging from the proposed development can meet stormwater *Best Practice Environmental Management guidelines (BPEMG)* and that stormwater discharging from the proposed development shall be to the satisfaction of West Gippsland Catchment Management Authority (WGCMA), Bass Coast Shire Council (BCSC) and other stakeholders.

The results of this strategy are summarised below:

- The minor storm (20% AEP) permissible site discharge (PSD) was estimated to be 27.4 L/s which requires a detention basin with a volume of 95.3m^3
- The major storm (1% AEP) permissible site discharge (PSD) was estimated to be 368.2 L/s which requires a detention basin with a volume of 186.2m^3
- Swale drains along Broome Crescent and Government Road will need to be deepened to ensure the neighboring property has freeboard to the 1% AEP level.
- A new 600mm concrete pipe outfall is proposed under Reed Crescent to discharge flows into the Heathland Bird Hide reserve.
- 400mm deep grass swales are required along the western boundary to ensure the neighbouring property has freeboard to the 1% AEP level,
- The only best practice reduction target not met was total nitrogen with 43.4% reduction compared to the required 45%. Additional assets will be required to meet the reduction requirement but given the size of the development and limited space, a 43.4% reduction is considered adequate.

The above strategy can be implemented and all development requirements stipulated by the WGCMA and Council can be achieved.

BEVERIDGE WILLIAMS & CO PTY LTD

Prepared by

[redacted]
Senior Engineer

[redacted]
Project Manager

Reviewed by

[redacted]
Senior Water Resources Engineer
(Team Lead – East Vic)

APPENDIX A: FEATURE & LEVEL SURVEY



LEGEND

NAIL
SPIKE
TOP OF BANK
TOE OF BANK
EXISTING SURFACE
TREE
TREE STAND/VEGETATION
OPEN DRAIN
POND/DAM
REINFORCED CONCRETE PIPE
PVC PIPE
EDGE OF BITUMEN
EDGE OF FORMATION/SHOULDER
DRIVEWAY
TRACK
EDGE OF CONCRETE
HOUSE
SHED
VERANDAH
STRUCTURE - UNCLASSIFIED
ELECTRICITY PIT
TELECO PIT
SEWER PIT
FIRE HYDRANT
TITLE BOUNDARY
FENCE
GATE
BOUNDARY - LOT
BOUNDARY - STAGE
BOUNDARY - EASEMENT
MAJOR CONTOUR
MINOR CONTOUR

STAGE 1: LOTS 1-5
STAGE 2: LOTS 6-9

DENOTES INDICATIVE BUILDING ENVELOPE

DENOTES INDICATIVE DRIVEWAY

WARNING
BEWARE OF UNDERGROUND SERVICES
THE LOCATIONS OF UNDERGROUND SERVICES ARE NOT SHOWN ON THIS PLAN.

WARNING
BEWARE OF TITLE POSITIONS
A DETAILED RE-ESTABLISHMENT SURVEY HAS NOT BEEN PROVIDED. IF TITLE BOUNDARIES ARE REQUIRED TO BE LOCATED ACCURATELY A FULL RE-ESTABLISHMENT SURVEY IS RECOMMENDED.

WARNING
BEWARE OF TITLE POSITIONS
SURROUNDING BOUNDARIES SHOWN GREY ARE DERIVED FROM VICMAP AND ARE NOT BASED ON SURVEY. THEY ARE SHOWN FOR ILLUSTRATION PURPOSES ONLY.

CAD REFERENCE: 2102696 SITE CONTEXT v2.DWG

VER	BY	AMENDMENTS	DATE
1		ORIGINAL ISSUE	8/1/2202
2		ADDITIONAL SURVEY OF GOVERNMENT ROAD	16/7/2024

SURVEYOR:
DRAWN:
CHECKED:
MELWAYS REF: NA

SURVEYORS REF.
2102696
VERSION: 2
DATE: 16/7/2024
SHEET 1 OF 1

ORIGINAL
SCALE 1:750
SHEET SIZE A1
0 7.5 15 22.5 30
LENGTHS ARE IN METRES

Beveridge Williams
development & environment consultants
Wonthaggi ph : 03 5672 1505
www.beveridgewilliams.com.au

Date of Survey: 28/1/2022 & 17/7/2024
Levels are to Australian Height Datum (AHD) vide PM 106 with a published level of RL33.743 (28/1/2022).
Contours are at intervals of 0.20m.
All heights not displayed on this plan are frozen on layers "HT_CODE" or "FROZEN_HEIGHTS".

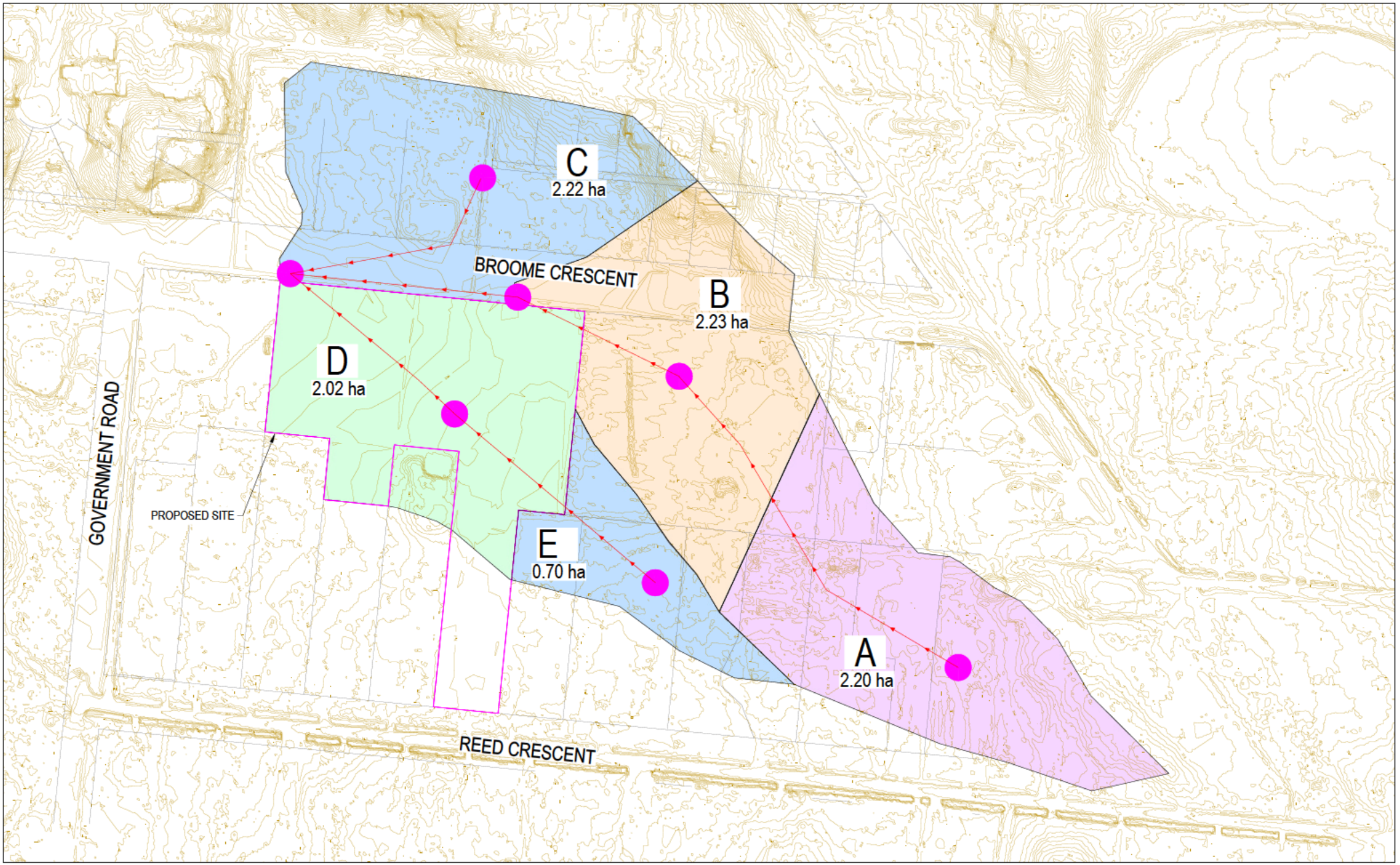
ALL INTERNAL FENCING IS POST & WIRE OR HORIZONTAL BOARDS.

LAND SUBJECT TO EASEMENTS:
E-1 AND E-2 DENOTES DRAINAGE EASEMENT IN FAVOUR OF BASS COAST SHIRE COUNCIL.

PART OF LAND SUBJECT TO COVENANT Y000002X

LOT 2 ON PS749869H VOL 12048 FOL 463

APPENDIX B: PRE AND POST DEVELOPMENT CATCHMENT PLANS



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REV	DESCRIPTION	DATE	DRN	APP
P2	CATCHMENT UPDATED	13.11.24		
P1	ISSUED FOR INFORMATION	12.09.24		

REV	DESCRIPTION	DATE	DRN	APP

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Designed Date 12.09.2024
Drawn Date 12.09.2024
Checked Date 12.09.2024
Approved Reg. No. Date 12.09.2024
PS Number PS1000

Beveridge Williams
Development & Infrastructure Consultants
1 Glenferrie Road
Malvern VIC 3144
ph: 03 9524 8888
www.beveridgewilliams.com.au

Project Details: 158 REED CRESCENT, WONTHAGGI
SWMS
BASS COAST SHIRE COUNCIL

Drawing Title: PRE DEVELOPED FLOW CATCHMENT PLAN

Sheet 01 of 01
Scale 1:500 @ A1
N

Project Ref	Stage No	Drawing No	Rev
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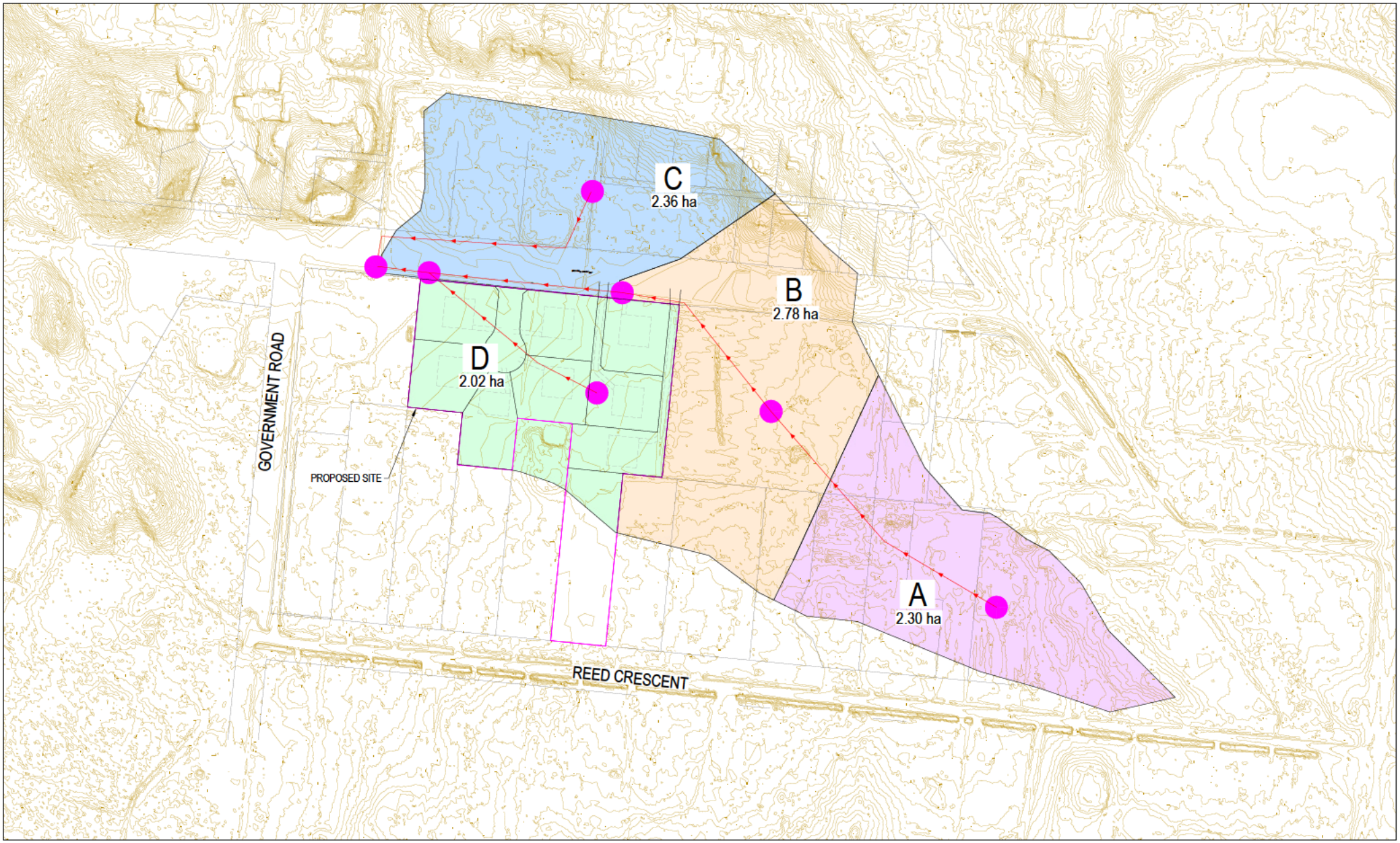

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P4	NOTES UPDATED	19.12.24		
P3	NOTES UPDATED	28.11.24		
P2	CATCHMENT UPDATED	13.11.24		
P1	ISSUED FOR INFORMATION	12.09.24		

REV	DESCRIPTION	DATE	DRN	APP
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Date	12.09.2024
Drawn	
Checked	
Date	12.09.2024
Approved	
Reg. No.	
Date	12.09.2024
PS Number	PS1000

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Malvern VIC 3144
ph: 03 9524 8888
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Drawing Title	POST DEVELOPED FLOW CATCHMENT PLAN SHEET 1 OF 3

Sheet 01 of 03
Scale 1:500 @ A1
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Project Ref	Stage No	Drawing No	Rev
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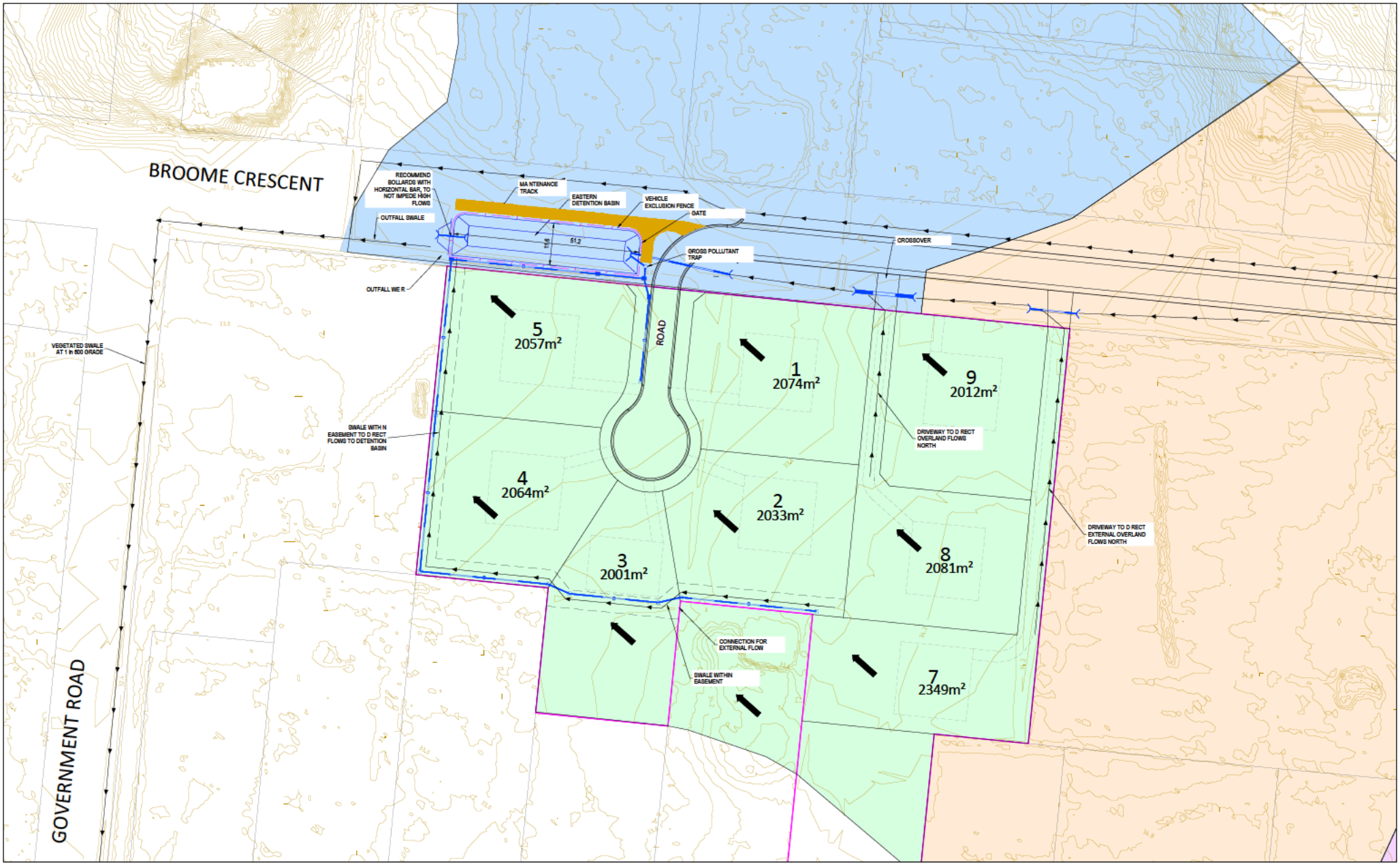

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Date	12.09.2024
Drawn	
Checked	
Date	12.09.2024
Approved	
Reg. No.	
Date	12.09.2024
PS Number	PS1000

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Drawing Title: POST DEVELOPED FLOW
CATCHMENT PLAN
SHEET 2 OF 3

Sheet 02 of 03

Scale: 1:500 @ A1

Project Ref	Stage No	Drawing No	Rev
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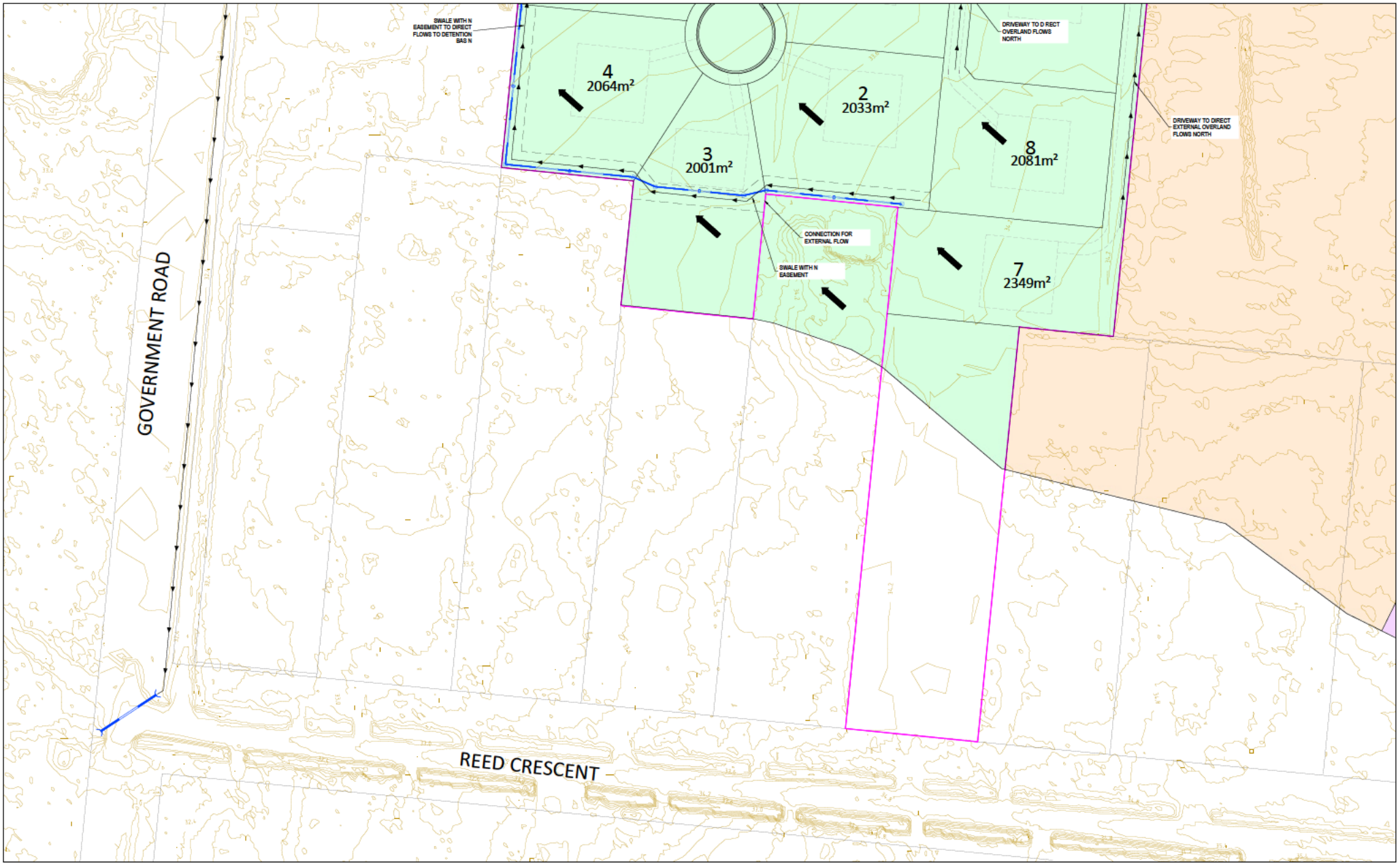

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P1	ISSUED FOR INFORMATION	12.09.24		

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Drawn	
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Date	12.09.2024
Approved	
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Date	12.09.2024
PS Number	PS1000

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Drawing Title: POST DEVELOPED FLOW
CATCHMENT PLAN
SHEET 3 OF 3

Sheet 03 of 03

Scale: 1:500 @ A1

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2102696	00	052	P6

N

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APPENDIX C: BUREAU OF METEOROLOGY DATA

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Time Accessed,23 August 2024 02:18PM
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c,0.372
d,0.315
e,0.000141
f,0.41
g,0.15
h,0.01
i,-0.0027
[LONGARF_META]
Time Accessed,23 August 2024 02:18PM
Version,2016_v1
[END_LONGARF]

Storm Losses
[LOSSES]
ID,16267.0
Storm Initial Losses (mm),21.0
Storm Continuing Losses (mm/h),4.6
[LOSSES_META]
Time Accessed,23 August 2024 02:18PM
Version,2016_v1
[END_LOSSES]

Temporal Patterns
[TP]
code,SSmainland
Label,Southern Slopes (Vic/NSW)
[TP_META]
Time Accessed,23 August 2024 02:18PM
Version,2016_v2
[END_TP]

Areal Temporal Patterns
[ATP]
code,SSmainland
arealabel,Southern Slopes (Vic/NSW)
[ATP_META]
Time Accessed,23 August 2024 02:18PM
Version,2016_v2
[END_ATP]

Median Preburst Depths and Ratios
[PREBURST]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),1.9 (0.116),1.7 (0.076),1.6 (0.059),1.5 (0.046),1.4 (0.036),1.3 (0.030)
90 (1.5),3.7 (0.193),2.9 (0.109),2.3 (0.073),1.7 (0.048),1.9 (0.045),2.0 (0.042)
120 (2.0),1.8 (0.085),2.2 (0.076),2.5 (0.071),2.7 (0.068),1.7 (0.036),0.9 (0.018)
180 (3.0),2.3 (0.090),2.5 (0.075),2.7 (0.068),2.8 (0.062),3.2 (0.060),3.4 (0.058)
360 (6.0),2.1 (0.067),2.2 (0.053),2.3 (0.047),2.3 (0.042),4.9 (0.074),6.7 (0.092)
720 (12.0),0.2 (0.006),1.4 (0.027),2.2 (0.037),3.0 (0.043),4.7 (0.056),6.0 (0.063)
1080 (18.0),0.0 (0.000),0.3 (0.005),0.5 (0.007),0.6 (0.008),1.5 (0.016),2.2 (0.020)
1440 (24.0),0.0 (0.000),0.1 (0.001),0.1 (0.002),0.2 (0.002),1.0 (0.009),1.6 (0.013)
2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.1 (0.000),0.1 (0.001)
2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
[PREBURST_META]
Time Accessed,23 August 2024 02:18PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.
[END_PREBURST]From preburst class

10% Preburst Depths
[PREBURST10]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
90 (1.5),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
120 (2.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
180 (3.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
360 (6.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
720 (12.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000)
1080 (18.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0

(0.000)
1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0
(0.000)
2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0
(0.000)
2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0
(0.000)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0
(0.000)
[PREBURST10_META]
Time Accessed,23 August 2024 02:18PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been
slightly altered. Point values remain unchanged.
[END_PREBURST10]From preburst class

25% Preburst Depths
[PREBURST25]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),0.0 (0.001),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.1 (0.002),0.1 (0.003)
90 (1.5),0.1 (0.004),0.0 (0.002),0.0 (0.001),0.0 (0.000),0.0 (0.000),0.0 (0.000)
120 (2.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0
(0.000)
180 (3.0),0.1 (0.003),0.0 (0.001),0.0 (0.001),0.0 (0.000),0.0 (0.000),0.0
(0.000)
360 (6.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.1 (0.002),0.2
(0.003)
720 (12.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0
(0.000)
1080 (18.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0
(0.000)
1440 (24.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0
(0.000)
2160 (36.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0
(0.000)
2880 (48.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0
(0.000)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0
(0.000)
[PREBURST25_META]
Time Accessed,23 August 2024 02:18PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been
slightly altered. Point values remain unchanged.
[END_PREBURST25]From preburst class

75% Preburst Depths
[PREBURST75]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),7.8 (0.465),9.6 (0.422),10.9 (0.401),12.1 (0.383),12.3 (0.330),12.4
(0.298)
90 (1.5),11.2 (0.576),12.5 (0.473),13.4 (0.427),14.2 (0.392),13.1 (0.309),12.3
(0.260)
120 (2.0),10.5 (0.485),13.1 (0.448),14.8 (0.429),16.4 (0.413),14.1 (0.303),12.3

(0.239)
180 (3.0),10.2 (0.405),13.3 (0.398),15.4 (0.393),17.4 (0.387),16.1 (0.306),15.1 (0.258)
360 (6.0),10.1 (0.315),12.2 (0.290),13.6 (0.278),14.9 (0.267),21.7 (0.331),26.9 (0.365)
720 (12.0),5.6 (0.140),10.2 (0.196),13.3 (0.219),16.2 (0.234),19.6 (0.235),22.1 (0.233)
1080 (18.0),1.7 (0.037),5.0 (0.085),7.3 (0.105),9.4 (0.118),13.9 (0.143),17.3 (0.155)
1440 (24.0),0.6 (0.012),3.3 (0.051),5.1 (0.066),6.8 (0.077),9.5 (0.088),11.6 (0.093)
2160 (36.0),1.2 (0.021),1.2 (0.017),1.3 (0.015),1.3 (0.013),4.0 (0.032),6.1 (0.042)
2880 (48.0),0.0 (0.000),0.1 (0.001),0.1 (0.001),0.1 (0.001),1.2 (0.008),1.9 (0.012)
4320 (72.0),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.0 (0.000),0.4 (0.003),0.7 (0.004)
[PREBURST75_META]
Time Accessed,23 August 2024 02:18PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.
[END_PREBURST75]From preburst class

90% Preburst Depths
[PREBURST90]
min (h)\AEP(%),50,20,10,5,2,1
60 (1.0),18.2 (1.092),24.0 (1.051),27.8 (1.024),31.5 (0.998),32.2 (0.866),32.8 (0.787)
90 (1.5),24.8 (1.276),26.7 (1.011),28.0 (0.894),29.2 (0.806),33.0 (0.777),35.8 (0.758)
120 (2.0),19.4 (0.898),25.5 (0.874),29.5 (0.857),33.4 (0.840),35.9 (0.775),37.9 (0.734)
180 (3.0),25.9 (1.036),28.4 (0.849),30.0 (0.763),31.5 (0.699),34.8 (0.661),37.3 (0.637)
360 (6.0),27.6 (0.863),26.4 (0.630),25.6 (0.525),24.9 (0.447),39.8 (0.606),51.0 (0.692)
720 (12.0),20.2 (0.504),24.8 (0.474),27.7 (0.456),30.6 (0.440),34.6 (0.414),37.6 (0.395)
1080 (18.0),15.7 (0.344),17.9 (0.301),19.4 (0.279),20.8 (0.260),25.7 (0.265),29.5 (0.264)
1440 (24.0),12.1 (0.242),13.8 (0.213),15.0 (0.196),16.1 (0.182),26.0 (0.241),33.5 (0.268)
2160 (36.0),18.4 (0.328),14.6 (0.199),12.1 (0.139),9.8 (0.096),21.9 (0.175),31.0 (0.213)
2880 (48.0),5.1 (0.084),4.5 (0.056),4.1 (0.043),3.7 (0.033),9.2 (0.067),13.4 (0.083)
4320 (72.0),1.2 (0.018),3.0 (0.034),4.2 (0.039),5.3 (0.042),20.1 (0.128),31.2 (0.171)
[PREBURST90_META]
Time Accessed,23 August 2024 02:18PM
Version,2018_v1
Note,Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged.

[END_PREBURST90]From preburst class

Interim Climate Change Factors
[CCF]
,RCP 4.5,RCP6,RCP 8.5
2030,0.648 (3.2%),0.687 (3.4%),0.811 (4.0%)
2040,0.878 (4.4%),0.827 (4.1%),1.084 (5.4%)
2050,1.081 (5.4%),1.013 (5.1%),1.446 (7.3%)
2060,1.251 (6.3%),1.229 (6.2%),1.862 (9.5%)
2070,1.381 (7.0%),1.460 (7.4%),2.298 (11.9%)
2080,1.465 (7.4%),1.691 (8.6%),2.719 (14.2%)
2090,1.496 (7.6%),1.906 (9.7%),3.090 (16.3%)

[CCF_META]
Time Accessed,23 August 2024 02:18PM
Version,2019_v1
Note,ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website.
[END_CCF]

[ENDTXT]

APPENDIX D: RATIONAL METHOD

Time of Concentration

Client:		Date:	19/12/2024
Project:	158 Reed Crescent		
Subject:	PRE DEVELOPED TIME OF CONCENTRATION		
Job No:	2102696	By:	

Location : Wonthaggi

ARI Year : 5

Sub Catchment	Length of Overland Flow m	Retardance Factor F_R	Rainfall Intensity mm/hr	Slope m/m	Time of Overland Flow min	Time Across Lot mins	Channel Flow Length m	Velocity of Channel Flow m/s	Time of Channel Flow min	Pipe Length m	Velocity of Pipe Flow m/s	Time of Pipe Flow min	Time of Concentration T_c min	Remarks
Proposed Site	147.43	0.20	22.22	0.010	60.87				0.00			0.00	60.87	Assume n=0.2 for short grass paddock
									0.00			0.00	0.00	

Catchment Flows

Client:		Date:	19/12/2024
Project:	158 Reed Crescent		
Subject:	PREDEVELOPED CATCHMENT FLOWS		
Job No:	2102696	By:	

Location : Wonthaggi

ARI Year : 5

Storm Duration : 61.00

Coefficients					
a	b	c	d	e	f
3.11127	-0.61036	-0.01418	0.00808	-0.00125	-0.00019

Sub Catchment	Sub catchment controlled or uncontrolled?	Sub Catchment outflow calculation method	Allocated distribution of PSD outflow	OSD storage for PSD outflow	Calculated Tc mins	Total Area ha	Contributing Partial Area ha	Catchment Type	Frequency Factor Fy	Selected f_p	Calculated C 5	Manual Input C 5	Selected C 5	Ae ha	I 5 mm/hr	PSD portion from Sub Catchment	Q 5 L/s
Ex Catch A	Controlled	Rational method		OSD 1	60.870	1.7769	1.777	Rural	0.900		0.09	0.25	0.25	0.444	22.22	N/A	27.42
			0%			1.7769								0.44	22.22	0.00	27.42

C10 Calculated using :

$$C^1_{10} = 0.1 + 0.0133\left(I^{10}_1 - 25\right)$$

$$C_{10} = 0.9 \times f + C^1_{10} \times (1 - f)$$

Equation 14.11 and 14.12 AR&R

Q Calculated using :

$$Q = \frac{A_e \times i}{360}$$

Rational Method

Frequency Factor Determined from;
Table 1.4 of AR&R for Rural flows

Table 1.6 of AR&R for Urban flows

PSD =	27.42
LOT AREA =	17769
LOT PSD =	27.42
UNCONTROLLED FLOW =	0.00
TOTAL OSD PSD =	**27.42**

Time of Concentration

Client:		Date:	19/12/2024
Project:	158 Reed Crescent		
Subject:	POST DEVELOPED TIME OF CONCENTRATION		
Job No:	2102696	By:	

Location : Wonthaggi

ARI Year : 5

Sub Catchment	Length of Overland Flow m	Retardance Factor F_R	Rainfall Intensity mm/hr	Slope m/m	Time of Overland Flow min	Time Across Lot mins	Channel Flow Length m	Velocity of Channel Flow m/s	Time of Channel Flow min	Pipe Length m	Velocity of Pipe Flow m/s	Time of Pipe Flow min	Time of Concentration Tc min	Remarks
Lots			70.76		0.00	7.00			0.00			0.00	7.00	
Road Reserve			70.76		0.00	7.00			0.00			0.00	7.00	

Catchment Flows

Client:	[redacted]	Date:	19/12/2024
Project:	158 Reed Crescent		
Subject:	POST DEVELOPED CATCHMENT FLOWS		
Job No:	2102696	By:	[redacted]

Location : Wonthaggi

ARI Year : 5

Storm Duration : 7.00

Coefficients					
a	b	c	d	e	f
3.11127	-0.61036	-0.01418	0.00808	-0.00125	-0.00019

Sub Catchment	Sub catchment controlled or uncontrolled?	OSD Storage	Calculated Tc mins	Total Area ha	Contributing Partial Area ha	Catchment Type	Frequency Factor Fy	Selected f_p	Calculated C_5	Manual Input C_5	Selected C_5	Ae ha	I $_5$ mm/hr	Q $_5$ L/s	Remarks
Lots	Controlled	Direct PSD input	7.00	1.6902	1.6902	Urban	0.95		0.10	0.50	0.50	0.845	70.76	166.1	
Road Reserve	Controlled	Direct PSD input	7.00	0.1098	0.1098	Urban	0.95		0.10	0.75	0.75	0.082	70.76	16.2	
				1.800								0.927	70.76	182.3	

C10 Calculated using :

$$C_{10}^1 = 0.1 + 0.0133\left(^{10}I_1 - 25\right)$$

$$C_{10} = 0.9 \times f + C_{10}^1 \times (1 - f)$$

Equation 14.11 and 14.12 AR&R

Q Calculated using :

$$Q = \frac{A_e \times i}{360}$$

Rational Method

Frequency Factor Determined from;
Table 1.4 of AR&R for Rural flows
Table 1.6 of AR&R for Urban flows

Detention Size

Client:		Date:	5/12/2024
Project:	158 Reed Crescent		
Subject:	Boyds Detention, 18% AEP (5 yr ARI)		
Job No:	2102696	By:	

STORAGE VOLUME REQUIRED FOR PAVED AREA

Location : Wonthaggi

ARI Year : 5

Combined 0.000
Overall 111.737

OSD STORAGE SIZING			
OSD System	%	Qallow (l/s)	Vol det (cu.m)
TOTAL SITE	100%	27.42	111.74
OSD1	63.5%	17.41	0.00
OSD2	36.5%	10.01	0.00
OSD3	0.0%	0.00	0.00
OSD4	0.0%	0.00	0.00

	Coefficients							
	a	b	c	d	e	f	g	
U/G SYSTEM	3.11127	####	-0.01418	0.00808	-0.00125	-0.00019	0.00003	
TANK	0.00000	###	0.00000	0.00000	0.00000	0.00000	0.00003	(Check)

TOTAL SITE

Storm Duration	I	Sum CA	Peak Inflow Ip	Inflow Volume V_i	Peak Allowable* Qp	1-Qp/Ip	Smax
min	mm/hr	(ha)	(m^3/s)	(m^3)	(m^3/s)		(m^3)
5	80.96	0.927	0.2086	62.57	0.0274	0.87	54.35
6	75.54	0.927	0.1946	70.06	0.0274	0.86	60.18
7	70.96	0.927	0.1828	76.78	0.0274	0.85	65.26
8	67.03	0.927	0.1727	82.89	0.0274	0.84	69.73
9	63.62	0.927	0.1639	88.51	0.0274	0.83	73.70
10	60.62	0.927	0.1562	93.70	0.0274	0.82	77.24
11	57.95	0.927	0.1493	98.53	0.0274	0.82	80.43
12	55.56	0.927	0.1431	103.05	0.0274	0.81	83.31
13	53.40	0.927	0.1376	107.31	0.0274	0.80	85.92
14	51.45	0.927	0.1325	111.33	0.0274	0.79	88.29
15	49.66	0.927	0.1279	115.14	0.0274	0.79	90.46
16	48.02	0.927	0.1237	118.77	0.0274	0.78	92.45
17	46.52	0.927	0.1198	122.24	0.0274	0.77	94.26
18	45.12	0.927	0.1163	125.55	0.0274	0.76	95.93
19	43.83	0.927	0.1129	128.73	0.0274	0.76	97.47
20	42.63	0.927	0.1098	131.79	0.0274	0.75	98.88
21	41.51	0.927	0.1069	134.73	0.0274	0.74	100.18
22	40.45	0.927	0.1042	137.57	0.0274	0.74	101.37
23	39.47	0.927	0.1017	140.31	0.0274	0.73	102.47
24	38.54	0.927	0.0993	142.97	0.0274	0.72	103.48
25	37.66	0.927	0.0970	145.55	0.0274	0.72	104.41
26	36.84	0.927	0.0949	148.05	0.0274	0.71	105.27
27	36.06	0.927	0.0929	150.48	0.0274	0.70	106.05
28	35.31	0.927	0.0910	152.84	0.0274	0.70	106.77
38	29.56	0.927	0.0761	173.61	0.0274	0.64	111.08
48	25.70	0.927	0.0662	190.72	0.0274	0.59	111.74
58	22.92	0.927	0.0590	205.47	0.0274	0.54	110.04
68	20.79	0.927	0.0536	218.57	0.0274	0.49	106.68
78	19.11	0.927	0.0492	230.42	0.0274	0.44	102.08
88	17.74	0.927	0.0457	241.32	0.0274	0.40	96.52
98	16.60	0.927	0.0428	251.43	0.0274	0.36	90.18
108	15.63	0.927	0.0403	260.90	0.0274	0.32	83.20
118	14.79	0.927	0.0381	269.83	0.0274	0.28	75.67
148	12.85	0.927	0.0331	294.06	0.0274	0.17	50.54
178	11.46	0.927	0.0295	315.41	0.0274	0.07	22.53
208	10.41	0.927	0.0268	334.65	0.0274	-0.02	0.00
238	9.58	0.927	0.0247	352.26	0.0274	-0.11	0.00
738	4.74	0.927	0.0122	540.80	0.0274	-1.25	0.00

* Distribution across controlled OSD storages of the PSD minus all uncontrolled outflows

Required Detention, m^3 111.737

Boyd's Formula

$$Q_P = I_P\left[1 - \frac{S_{max}}{V_I}\right]$$

Inflow volume is determined from simplified

Time of Concentration

Client:		Date:	19/12/2024
Project:	158 Reed Crescent		
Subject:	PRE DEVELOPED TIME OF CONCENTRATION		
Job No:	2102696	By:	

Location : Wonthaggi

ARI Year : 100

Sub Catchment	Length of Overland Flow m	Retardance Factor F_R	Rainfall Intensity mm/hr	Slope m/m	Time of Overland Flow min	Time Across Lot mins	Channel Flow Length m	Velocity of Channel Flow m/s	Time of Channel Flow min	Pipe Length m	Velocity of Pipe Flow m/s	Time of Pipe Flow min	Time of Concentration Tc min	Remarks
Proposed Site	147.43	0.20	45.92	0.010	45.53				0.00			0.00	45.53	Assume n=0.2 for short grass paddock
					0.00				0.00			0.00	0.00	

Catchment Flows

Client:		Date:	19/12/2024
Project:	158 Reed Crescent		
Subject:	PREDEVELOPED CATCHMENT FLOWS		
Job No:	2102696	By:	

Location : Wonthaggi

ARI Year : 100

Storm Duration : 48.00

Coefficients					
a	b	c	d	e	f
3.68172	-0.65034	0.00257	0.00726	-0.00253	0.00005

Sub Catchment	Sub catchment controlled or uncontrolled?	Sub Catchment outflow calculation method	Allocated distribution of PSD outflow	OSD storage for PSD outflow	Calculated Tc mins	Total Area ha	Contributing Partial Area ha	Catchment Type	Frequency Factor Fy	Selected f_p	Calculated C 100	Manual Input C 100	Selected C 100	Ae ha	I 100 mm/hr	PSD portion from Sub Catchment	Q 100 L/s
Ex Catch A	Controlled	Rational method		OSD 1	45.534	1.7769	1.777	Rural	1.300		0.14	0.25	0.25	0.444	45.92	N/A	56.66
			0%			1.7769								0.44	45.92	0.00	56.66

C10 Calculated using :

$$C_{10}^1 = 0.1 + 0.0133\left({}^{10}I_1 - 25\right)$$

$$C_{10} = 0.9 \times f + C_{10}^1 \times (1 - f)$$

Equation 14.11 and 14.12 AR&R

Q Calculated using :

$$Q = \frac{A_e \times i}{360}$$

Rational Method

Frequency Factor Determined from;
Table 1.4 of AR&R for Rural flows

Table 1.6 of AR&R for Urban flows

PSD =	56.66
LOT AREA =	17769
LOT PSD =	56.66
UNCONTROLLED FLOW =	0.00
TOTAL OSD PSD =	56.66

Time of Concentration

Client:		Date:	19/12/2024
Project:	158 Reed Crescent		
Subject:	POST DEVELOPED TIME OF CONCENTRATION		
Job No:	2102696	By:	

Location : Wonthaggi

ARI Year : 100

Sub Catchment	Length of Overland Flow m	Retardance Factor F_R	Rainfall Intensity mm/hr	Slope m/m	Time of Overland Flow min	Time Across Lot mins	Channel Flow Length m	Velocity of Channel Flow m/s	Time of Channel Flow min	Pipe Length m	Velocity of Pipe Flow m/s	Time of Pipe Flow min	Time of Concentration Tc min	Remarks
Lots			142.93		0.00	7.00			0.00			0.00	7.00	
Road Reserve			142.93		0.00	7.00			0.00			0.00	7.00	

Catchment Flows

Client:		Date:	19/12/2024
Project:	158 Reed Crescent		
Subject:	POST DEVELOPED CATCHMENT FLOWS		
Job No:	2102696	By:	

Location : Wonthaggi

ARI Year : 100

Storm Duration : 7.00

Coefficients					
a	b	c	d	e	f
3.68172	-0.65034	0.00257	0.00726	-0.00253	0.00005

Sub Catchment	Sub catchment controlled or uncontrolled?	OSD Storage	Calculated Tc mins	Total Area ha	Contributing Partial Area ha	Catchment Type	Frequency Factor Fy	Selected f_p	Calculated C 100	Manual Input C 100	Selected C 100	Ae ha	I 100 mm/hr	Q 100 L/s	Remarks
Lots	Controlled	Direct PSD input	7.00	1.6902	1.6902	Urban	1.20		0.13	0.50	0.50	0.845	142.93	335.5	
Road Reserve	Controlled	Direct PSD input	7.00	0.1098	0.1098	Urban	1.20		0.13	0.75	0.75	0.082	142.93	32.7	
				1.800								0.927	142.93	368.2	

C10 Calculated using :

$$C_{10} = 0.1 + 0.0133\ln(I_1 - 25)$$

$$C_{10} = 0.9 \times f + C_{10} \times (1 - f)$$

Equation 14.11 and 14.12 AR&R

Q Calculated using :

$$Q = \frac{A_e \times i}{360}$$

Rational Method

Frequency Factor Determined from;
Table 1.4 of AR&R for Rural flows
Table 1.6 of AR&R for Urban flows

Detention Size

Client:		Date:	19/12/2024
Project:	158 Reed Crescent		
Subject:	Boyds Detention, 18% AEP (5 yr ARI)		
Job No:	2102696	By:	

STORAGE VOLUME REQUIRED FOR PAVED AREA

Location : Wonthaggi

ARI Year : 100

Combined 0.000
Overall 186.244

OSD STORAGE SIZING			
OSD System	%	Qallow (l/s)	Vol det (cu.m)
TOTAL SITE	100%	56.66	186.24
OSD1	63.5%	35.98	0.00
OSD2	36.5%	20.68	0.00
OSD3	0.0%	0.00	0.00
OSD4	0.0%	0.00	0.00

	Coefficients							
	a	b	c	d	e	f	g	
U/G SYSTEM	3.68172	####	0.00257	0.00726	-0.00253	0.00005	0.00002	
TANK	0.00000	###	0.00000	0.00000	0.00000	0.00000	0.00002	(Check)

TOTAL SITE

Storm Duration	I	Sum CA	Peak Inflow Ip	Inflow Volume V_i	Peak Allowable* Qp	1-Qp/Ip	Smax
min	mm/hr	(ha)	(m^3/s)	(m^3)	(m^3/s)		(m^3)
5	164.89	0.927	0.4248	127.44	0.0567	0.87	110.44
6	153.31	0.927	0.3950	142.19	0.0567	0.86	121.79
7	143.21	0.927	0.3690	154.96	0.0567	0.85	131.16
8	134.41	0.927	0.3463	166.22	0.0567	0.84	139.02
9	126.72	0.927	0.3265	176.29	0.0567	0.83	145.69
10	119.94	0.927	0.3090	185.40	0.0567	0.82	151.40
11	113.94	0.927	0.2935	193.73	0.0567	0.81	156.34
12	108.59	0.927	0.2797	201.42	0.0567	0.80	160.62
13	103.79	0.927	0.2674	208.55	0.0567	0.79	164.36
14	99.45	0.927	0.2562	215.22	0.0567	0.78	167.63
15	95.52	0.927	0.2461	221.49	0.0567	0.77	170.49
16	91.94	0.927	0.2369	227.40	0.0567	0.76	173.00
17	88.67	0.927	0.2284	233.00	0.0567	0.75	175.21
18	85.66	0.927	0.2207	238.33	0.0567	0.74	177.14
19	82.88	0.927	0.2135	243.42	0.0567	0.73	178.82
20	80.31	0.927	0.2069	248.28	0.0567	0.73	180.29
21	77.93	0.927	0.2008	252.96	0.0567	0.72	181.56
22	75.71	0.927	0.1950	257.45	0.0567	0.71	182.66
23	73.63	0.927	0.1897	261.78	0.0567	0.70	183.59
24	71.69	0.927	0.1847	265.96	0.0567	0.69	184.37
25	69.87	0.927	0.1800	270.01	0.0567	0.69	185.02
26	68.16	0.927	0.1756	273.93	0.0567	0.68	185.54
27	66.55	0.927	0.1714	277.74	0.0567	0.67	185.95
28	65.03	0.927	0.1675	281.44	0.0567	0.66	186.24
38	53.44	0.927	0.1377	313.88	0.0567	0.59	184.69
48	45.92	0.927	0.1183	340.70	0.0567	0.52	177.51
58	40.60	0.927	0.1046	363.99	0.0567	0.46	166.81
68	36.61	0.927	0.0943	384.83	0.0567	0.40	153.65
78	33.49	0.927	0.0863	403.84	0.0567	0.34	138.66
88	30.98	0.927	0.0798	421.42	0.0567	0.29	122.25
98	28.90	0.927	0.0745	437.84	0.0567	0.24	104.67
108	27.15	0.927	0.0700	453.31	0.0567	0.19	86.14
118	25.66	0.927	0.0661	467.95	0.0567	0.14	66.79
148	22.21	0.927	0.0572	508.00	0.0567	0.01	4.84
178	19.76	0.927	0.0509	543.57	0.0567	-0.11	0.00
208	17.91	0.927	0.0461	575.81	0.0567	-0.23	0.00
238	16.46	0.927	0.0424	605.42	0.0567	-0.34	0.00
738	8.09	0.927	0.0208	922.71	0.0567	-1.72	0.00

* Distribution across controlled OSD storages of the PSD minus all uncontrolled outflows

Required Detention, m^3 186.244

Boyd's Formula

$$Q_P = I_P\left[1 - \frac{S_{max}}{V_I}\right]$$

Inflow volume is determined from simplified

Time of Concentration

Client:		Date:	19.12.2024
Project:	158 Reed Crescent		
Subject:	PRE DEVELOPED TIME OF CONCENTRATION		
Job No:	2102696	By:	

Location : Wonthaggi

ARI Year : 5

Sub Catchment	Length of Overland Flow m	Retardance Factor F_R	Rainfall Intensity mm/hr	Slope m/m	Time of Overland Flow min	Time Across Lot mins	Channel Flow Length m	Velocity of Channel Flow m/s	Time of Channel Flow min	Pipe Length m	Velocity of Pipe Flow m/s	Time of Pipe Flow min	Time of Concentration T_c min	Remarks
A	462.00	0.20	28.25	0.010	109.74				0.00			0.00	109.74	n = 0.2. short grass paddock
B	229.00	0.20	28.25	0.010	72.02				0.00			0.00	72.02	Horton Roughness Coefficent for
C	132.00	0.20	28.25	0.010	51.75				0.00			0.00	51.75	kinematic wave equation
D	121.00	0.20	28.25	0.005	60.47				0.00			0.00	60.47	
E	269.00	0.20	28.25	0.01	79.33				0.00			0.00	79.33	

Catchment Flows

Client:		Date:	19.12.2024
Project:	158 Reed Crescent		
Subject:	PREDEVELOPED CATCHMENT FLOWS		
Job No:	2102696	By:	

Location : Wonthaggi

ARI Year : 5

Storm Duration : 41.00

Coefficients						
a	b	c	d	e	f	g
3.11127	-0.61036	-0.01418	0.00808	-0.00125	-0.00019	0.00003

Sub Catchment	Sub catchment controlled or uncontrolled?	Sub Catchment outflow calculation method	Allocated distribution of PSD outflow	OSD storage for PSD outflow	Calculated Tc mins	Total Area ha	Contributing Partial Area ha	Catchment Type	Frequency Factor Fy	Selected f_p	Calculated C 5	Manual Input C 5	Selected C 5	Ae ha	I 5 mm/hr	PSD portion from Sub Catchment	Q 5 L/s
A	Uncontrolled	Rational method			109.735	2.2000	0.822	Rural	0.900		0.09	0.25	0.25	0.205	28.25	N/A	16.13
B	Uncontrolled	Rational method			72.022	2.2300	1.269	Rural	0.900		0.09	0.25	0.25	0.317	28.25	N/A	24.91
C	Uncontrolled	Rational method			51.749	2.2200	1.759	Rural	0.900		0.09	0.25	0.25	0.440	28.25	N/A	34.51
D	Uncontrolled	Rational method			60.470	2.0200	1.370	Rural	0.900		0.09	0.25	0.25	0.342	28.25	N/A	26.87
E	Uncontrolled	Rational method			79.325	0.7000	0.362	Rural	0.900		0.09	0.25	0.25	0.090	28.25	N/A	7.10
			0%			9.3700								0.21	28.25	0.00	109.51

C10 Calculated using :

$$C^1_{10} = 0.1 + 0.0133\left(^{10}I_1 - 25\right)$$

$$C_{10} = 0.9 \times f + C^1_{10} \times (1 - f)$$

Equation 14.11 and 14.12 AR&R

Q Calculated using :

$$Q = \frac{A_e \times i}{360}$$

Rational Method

Frequency Factor Determined from;
Table 1.4 of AR&R for Rural flows

Table 1.6 of AR&R for Urban flows

PSD =	109.51
LOT AREA =	93700
LOT PSD =	109.51
UNCONTROLLED FLOW =	11.05
TOTAL OSD PSD =	98.46

Time of Concentration

Client:		Date:	19.12.2024
Project:	158 Reed Crescent		
Subject:	POST DEVELOPED TIME OF CONCENTRATION		
Job No:	2102696	By:	

Location : Wonthaggi

ARI Year : 5

Sub Catchment	Length of Overland Flow m	Retardance Factor F_R	Rainfall Intensity mm/hr	Slope m/m	Time of Overland Flow min	Time Across Lot mins	Channel Flow Length m	Velocity of Channel Flow m/s	Time of Channel Flow min	Pipe Length m	Velocity of Pipe Flow m/s	Time of Pipe Flow min	Time of Concentration Tc min	Remarks
A	496.00	0.20	63.62	0.010	82.76				0.00			0.00	82.76	0.2 for short grass paddock
B	296.00	0.20	63.62	0.010	60.72				0.00			0.00	60.72	Horton Roughness Coefficent for
C	186.00	0.20	63.62	0.010	45.95				0.00			0.00	45.95	kinematic wave equation
D			63.62		0.00	7.00	171	2.0	1.43			0.00	8.43	

Catchment Flows

Client:		Date:	19.12.2024
Project:	158 Reed Crescent		
Subject:	POST DEVELOPED CATCHMENT FLOWS		
Job No:	2102696	By:	

Location : Wonthaggi

ARI Year : 5

Storm Duration : 9.00

Coefficients						
a	b	c	d	e	f	g
3.11127	-0.61036	-0.01418	0.00808	-0.00125	-0.00019	0.00003

Sub Catchment	Sub catchment controlled or uncontrolled?	OSD Storage	Calculated Tc mins	Total Area ha	Contributing Partial Area ha	Catchment Type	Frequency Factor Fy	Selected f_p	Calculated C 5	Manual Input C 5	Selected C 5	Ae ha	I 5 mm/hr	Q 5 L/s	Remarks
A	Uncontrolled	Direct PSD input	82.76	2.3000	0.2501	Rural	0.90		0.09	0.25	0.25	0.063	63.62	11.1	
B	Controlled	Direct PSD input	60.72	2.7800	0.4121	Rural	0.90		0.09	0.25	0.25	0.103	63.62	18.2	
C	Controlled	Direct PSD input	45.95	2.3600	0.4623	Rural	0.90		0.09	0.25	0.25	0.116	63.62	20.4	
D		Rational method	8.43	2.0200	2.0200	Urban	0.95		0.10	0.50	0.50	1.010	63.62	178.5	
				9.460								1.291	63.62	228.2	

C10 Calculated using :

$$C_{10} = 0.1 + 0.0133\left(I_{10} - 25\right)$$

$$C_{10} = 0.9 \times f + C_{10} \times (1 - f)$$

Equation 14.11 and 14.12 AR&R

Q Calculated using :

$$Q = \frac{A_e \times i}{360}$$

Rational Method

Frequency Factor Determined from;
Table 1.4 of AR&R for Rural flows
Table 1.6 of AR&R for Urban flows

Time of Concentration

Client:	[redacted]	Date:	19.12.2024
Project:	158 Reed Crescent		
Subject:	PRE DEVELOPED TIME OF CONCENTRATION - External flows included		
Job No:	2102696	By:	[redacted]

Location : Wonthaggi

ARI Year : 100

Sub Catchment	Length of Overland Flow m	Retardance Factor F_R	Rainfall Intensity mm/hr	Slope m/m	Time of Overland Flow min	Time Across Lot mins	Channel Flow Length m	Velocity of Channel Flow m/s	Time of Channel Flow min	Pipe Length m	Velocity of Pipe Flow m/s	Time of Pipe Flow min	Time of Concentration Tc min	Remarks
A	462.00	0.20	50.87	0.010	86.73				0.00			0.00	86.73	n = 0.2. short grass paddock
B	229.00	0.20	50.87	0.010	56.92				0.00			0.00	56.92	Horton Roughness Coefficent for
C	132.00	0.20	50.87	0.010	40.90				0.00			0.00	40.90	kinematic wave equation
D	121.00	0.20	50.87	0.005	47.79				0.00			0.00	47.79	
E	269.00	0.20	50.87	0.01	62.70				0.00	0.50		0.00	62.70	

Catchment Flows

Client:		Date:	28.11.2024
Project:	158 Reed Crescent		
Subject:	PREDEVELOPED CATCHMENT FLOWS - External flows included		
Job No:	2102696	By:	

Location : Wonthaggi

ARI Year : 100

Storm Duration : 41.00

Coefficients						
a	b	c	d	e	f	g
3.68172	-0.65034	0.00257	0.00726	-0.00253	0.00005	0.00002

Sub Catchment	Sub catchment controlled or uncontrolled?	Sub Catchment outflow calculation method	Allocated distribution of PSD outflow	OSD storage for PSD outflow	Calculated Tc mins	Total Area ha	Contributing Partial Area ha	Catchment Type	Frequency Factor Fy	Selected f_p	Calculated C 100	Manual Input C 100	Selected C 100	Ae ha	I 100 mm/hr	PSD portion from Sub Catchment	Q 100 L/s
A	Uncontrolled	Rational method			86.732	2.2000	1.040	Rural	1.300		0.14	0.25	0.25	0.260	50.87	N/A	36.74
B	Uncontrolled	Rational method			56.924	2.2300	1.606	Rural	1.300		0.14	0.25	0.25	0.402	50.87	N/A	56.74
C	Uncontrolled	Rational method			40.901	2.2200	2.220	Rural	1.300		0.14	0.25	0.25	0.555	50.87	N/A	78.42
D	Uncontrolled	Rational method			47.794	2.0200	1.733	Rural	1.300	0.50	0.65	0.25	0.25	0.433	50.87	N/A	61.21
E	Uncontrolled	Rational method			62.697	0.7000	0.458	Rural	1.300		0.14	0.25	0.25	0.114	50.87	N/A	16.17
			0%			9.3700								0.26	50.87	0.00	249.29

C10 Calculated using :

$$C_{10}^{1} = 0.1 + 0.0133\left(I_{10}^{1} - 25\right)$$

$$C_{10} = 0.9 \times f + C_{10}^{1} \times (1 - f)$$

Equation 14.11 and 14.12 AR&R

Q Calculated using :

$$Q = \frac{A_e \times i}{360}$$

Rational Method

Frequency Factor Determined from;
Table 1.4 of AR&R for Rural flows

Table 1.6 of AR&R for Urban flows

PSD =	249.29
LOT AREA =	93700
LOT PSD =	249.29
UNCONTROLLED FLOW =	28.99
TOTAL OSD PSD =	220.29

Time of Concentration

Client:		Date:	19.12.2024
Project:	158 Reed Crescent		
Subject:	POST DEVELOPED TIME OF CONCENTRATION - External flows included		
Job No:	2102696	By:	

Location : Wonthaggi

ARI Year : 100

Sub Catchment	Length of Overland Flow m	Retardance Factor F_R	Rainfall Intensity mm/hr	Slope m/m	Time of Overland Flow min	Time Across Lot mins	Channel Flow Length m	Velocity of Channel Flow m/s	Time of Channel Flow min	Pipe Length m	Velocity of Pipe Flow m/s	Time of Pipe Flow min	Time of Concentration Tc min	Remarks
A	496.00	0.20	126.72	0.010	62.82				0.00			0.00	62.82	0.2 for short grass paddock
B	296.00	0.20	126.72	0.010	46.09				0.00			0.00	46.09	Horton Roughness Coefficent for
C	186.00	0.20	126.72	0.010	34.88				0.00			0.00	34.88	kinematic wave equation
D			126.72		0.00	7.00	171	2.0	1.43			0.00	8.43	

Catchment Flows

Client:		Date:	19.12.2024
Project:	158 Reed Crescent		
Subject:	POST DEVELOPED CATCHMENT FLOWS - External flows included		
Job No:	2102696	By:	

Location : Wonthaggi

ARI Year : 100

Storm Duration : 9.00

Coefficients						
a	b	c	d	e	f	g
3.68172	-0.65034	0.00257	0.00726	-0.00253	0.00005	0.00002

Sub Catchment	Sub catchment controlled or uncontrolled?	OSD Storage	Calculated Tc mins	Total Area ha	Contributing Partial Area ha	Catchment Type	Frequency Factor Fy	Selected f_p	Calculated C 100	Manual Input C 100	Selected C 100	Ae ha	I 100 mm/hr	Q 100 L/s	Remarks
A	Uncontrolled	Direct PSD input	62.82	2.3000	0.3295	Rural	1.30		0.14	0.25	0.25	0.082	126.72	29.0	
B	Controlled	Direct PSD input	46.09	2.7800	0.5428	Rural	1.30		0.14	0.25	0.25	0.136	126.72	47.8	
C	Controlled	Direct PSD input	34.88	2.3600	0.6090	Rural	1.30		0.14	0.25	0.25	0.152	126.72	53.6	
D		Rational method	8.43	2.0200	2.0200	Urban	1.20		0.13	0.50	0.50	1.010	126.72	355.5	
				9.460								1.380	126.72	485.9	

C10 Calculated using :

$$C_{10} = 0.1 + 0.0133\left(I_{10}^{1} - 25\right)$$

$$C_{10} = 0.9 \times f + C_{10}^{1} \times (1 - f)$$

Equation 14.11 and 14.12 AR&R

Q Calculated using :

$$Q = \frac{A_e \times i}{360}$$

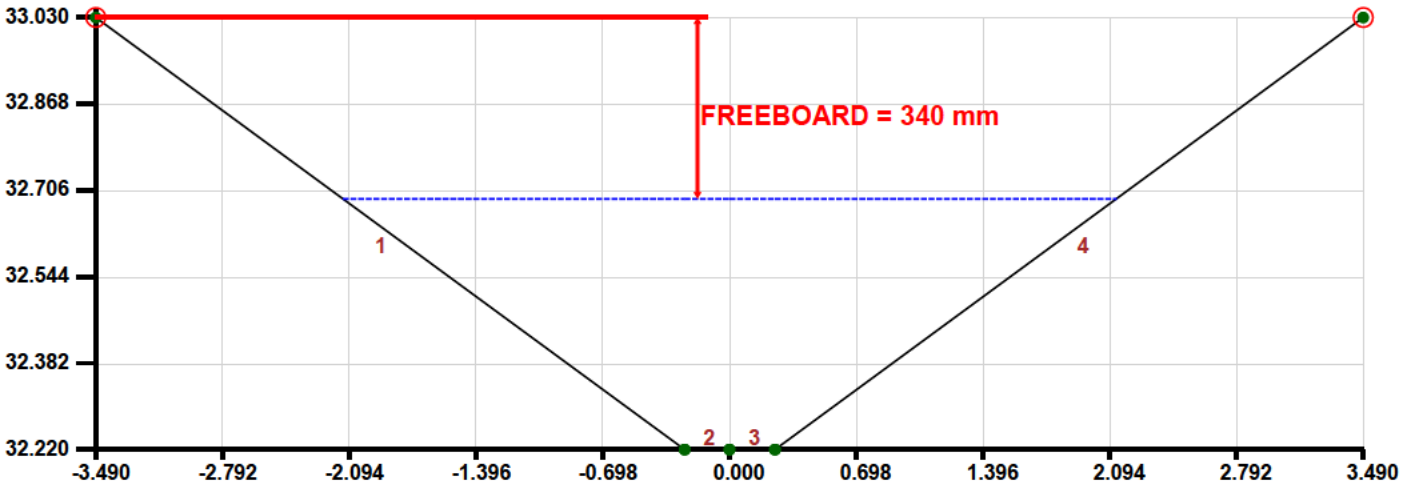
Rational Method

Frequency Factor Determined from;
Table 1.4 of AR&R for Rural flows
Table 1.6 of AR&R for Urban flows

APPENDIX E: PC CONVEY RESULTS

PROJECT: SWALE - Broome Crescent
158 Reed Cresent SWMS
Print-out date: 19/12/2024 - Time: 11:43
Data File: Q:\won\jobs\2021 Files\2102696_WRE\04_DESIGN\WRE00_ARC\PC convey\Reeds.dat

1. CROSS-SECTION



2. DISCHARGE INFORMATION

1% AEP storm event
Design discharge after construction of retarding basin

Required overland / channel / watercourse discharge = 0.515 cumecs

3. RESULTS Water surface elevation = 32.690 m

High Flow Channel grade = 1 in 600, Main Channel / Low Flow Channel grade = 1 in 600.

	LEFT OVERBANK	MAIN CHANNEL	RIGHT OVERBANK	TOTAL CROSS-SECTION
Discharge (cumecs):	0.000	0.526	0.000	0.526
D(Max) = Max. Depth (m):	0.000	0.470	0.000	0.470
D(Ave) = Ave. Depth (m):	0.000	0.263	0.000	0.263
V = Ave. Velocity (m/s):	0.000	0.470	0.000	0.470
D(Max) x V (cumecs/m):	0.000	0.221	0.000	0.221
D(Ave) x V (cumecs/m):	0.000	0.123	0.000	0.123
Froude Number:	0.000	0.293	0.000	0.293
Area (m^2):	0.000	1.119	0.000	1.119
Wetted Perimeter (m):	0.000	4.376	0.000	4.376
Flow Width (m):	0.000	4.260	0.000	4.260
Hydraulic Radius (m):	0.000	0.256	0.000	0.256
Composite Manning's n:	0.000	0.035	0.000	0.035
Split Flow?	-	-	-	No

4. CROSS-SECTION DATA

	LEFT HAND POINT		RIGHT HAND POINT		
SEGMENT NO.	CHAINAGE (m)	R.L. (m)	CHAINAGE (m)	R.L. (m)	MANNING'S N
1	-3.490	33.030	-0.250	32.220	0.035
2	-0.250	32.220	0.000	32.220	0.035
3	0.000	32.220	0.250	32.220	0.035
4	0.250	32.220	3.490	33.030	0.035

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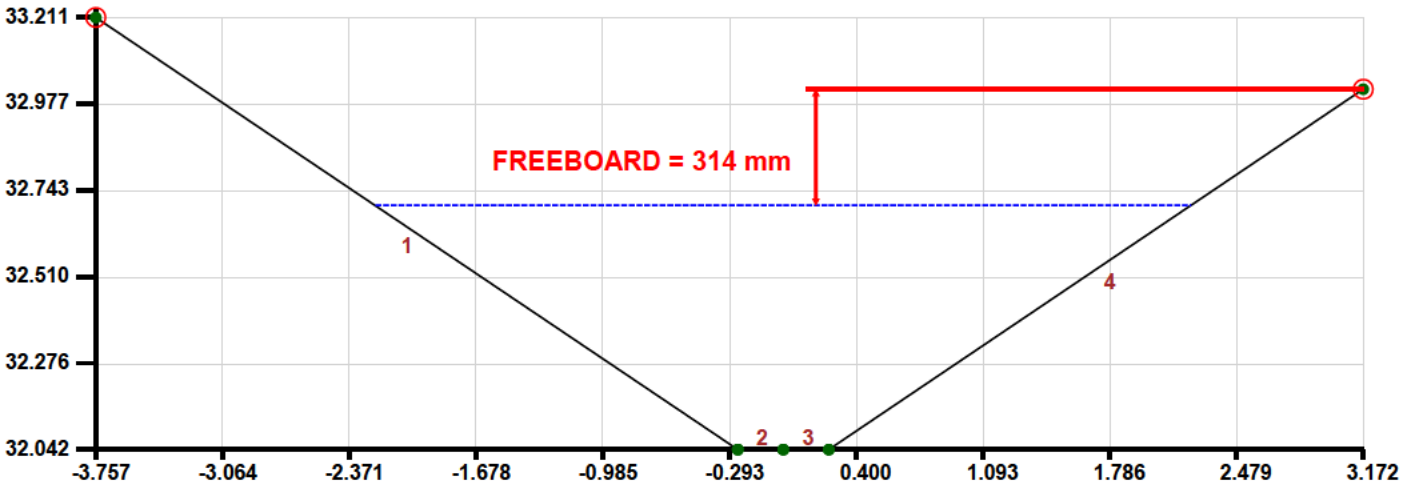
PROJECT: SWALE - Government Road
158 Reed Crescent SWMS
Print-out date: 19/12/2024 - Time: 11:53
Data File: Q:\won\jobs\2021 Files\2102696_WRE\04_DESIGN\WRE00_ARC\PC convey\Reeds 2.dat

1. CROSS-SECTION



2. DISCHARGE INFORMATION

1% AEP storm event
Design discharge after construction of retarding basin

Required overland / channel / watercourse discharge = 0.663 cumecs

3. RESULTS Water surface elevation = 32.702 m

High Flow Channel grade = 1 in 600, Main Channel / Low Flow Channel grade = 1 in 600.

	LEFT OVERBANK	MAIN CHANNEL	RIGHT OVERBANK	TOTAL CROSS-SECTION
Discharge (cumecs):	0.000	0.664	0.000	0.664
D(Max) = Max. Depth (m):	0.000	0.660	0.000	0.660
D(Ave) = Ave. Depth (m):	0.000	0.367	0.000	0.367
V = Ave. Velocity (m/s):	0.000	0.406	0.000	0.406
D(Max) x V (cumecs/m):	0.000	0.268	0.000	0.268
D(Ave) x V (cumecs/m):	0.000	0.149	0.000	0.149
Froude Number:	0.000	0.214	0.000	0.214
Area (m^2):	0.000	1.637	0.000	1.637
Wetted Perimeter (m):	0.000	4.674	0.000	4.674
Flow Width (m):	0.000	4.460	0.000	4.460
Hydraulic Radius (m):	0.000	0.350	0.000	0.350
Composite Manning's n:	0.000	0.050	0.000	0.050
Split Flow?	-	-	-	No

4. CROSS-SECTION DATA

	LEFT HAND POINT		RIGHT HAND POINT		
SEGMENT NO.	CHAINAGE (m)	R.L. (m)	CHAINAGE (m)	R.L. (m)	MANNING'S N
1	-3.757	33.211	-0.250	32.042	0.050
2	-0.250	32.042	0.000	32.042	0.050
3	0.000	32.042	0.250	32.042	0.050
4	0.250	32.042	3.172	33.016	0.050

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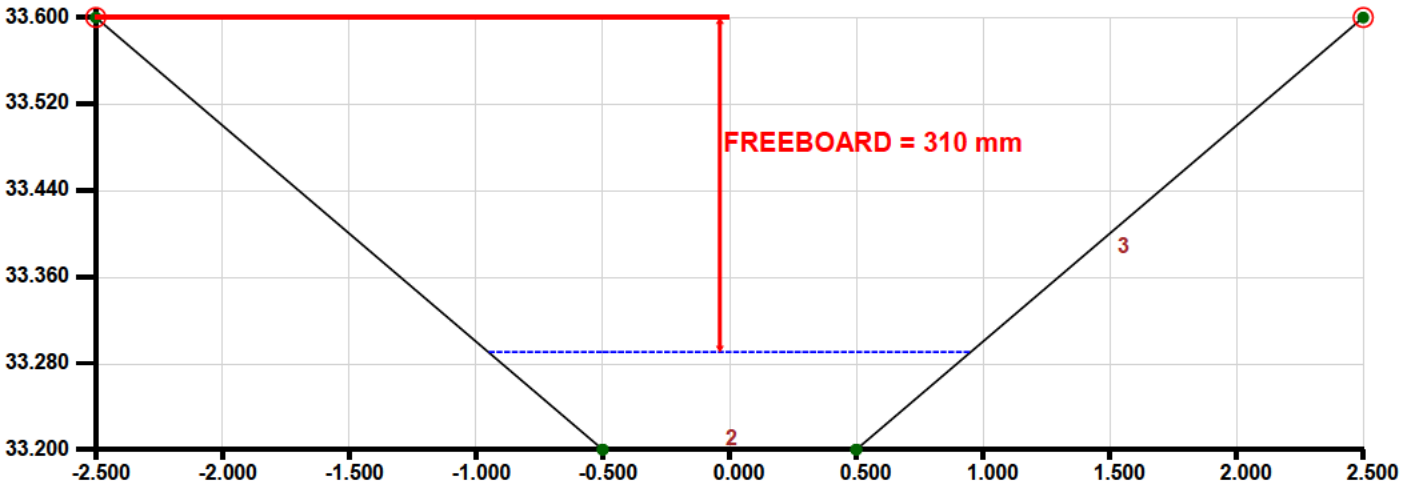
PROJECT: SWALE within lots
158 Reed Cresent SWMS
Print-out date: 12/11/2024 - Time: 3:56
Data File: Q:\won\jobs\2021 Files\2102696_WRE\04_DESIGN\WRE00_ARC\PC convey\Reeds lot swales.dat

1. CROSS-SECTION



2. DISCHARGE INFORMATION

1% AEP storm event
Design discharge after construction of retarding basin

Required overland / channel / watercourse discharge = 0.061 cumecs

3. RESULTS Water surface elevation = 33.290 m

High Flow Channel grade = 1 in 200, Main Channel / Low Flow Channel grade = 1 in 200.

	LEFT OVERBANK	MAIN CHANNEL	RIGHT OVERBANK	TOTAL CROSS-SECTION
Discharge (cumecs):	0.000	0.062	0.000	0.062
D(Max) = Max. Depth (m):	0.000	0.090	0.000	0.090
D(Ave) = Ave. Depth (m):	0.000	0.069	0.000	0.069
V = Ave. Velocity (m/s):	0.000	0.471	0.000	0.471
D(Max) x V (cumecs/m):	0.000	0.042	0.000	0.042
D(Ave) x V (cumecs/m):	0.000	0.032	0.000	0.032
Froude Number:	0.000	0.574	0.000	0.574
Area (m^2):	0.000	0.131	0.000	0.131
Wetted Perimeter (m):	0.000	1.918	0.000	1.918
Flow Width (m):	0.000	1.900	0.000	1.900
Hydraulic Radius (m):	0.000	0.068	0.000	0.068
Composite Manning's n:	0.000	0.025	0.000	0.025
Split Flow?	-	-	-	No

4. CROSS-SECTION DATA

	LEFT HAND POINT		RIGHT HAND POINT		
SEGMENT NO.	CHAINAGE (m)	R.L. (m)	CHAINAGE (m)	R.L. (m)	MANNING'S N
1	-2.500	33.600	-0.500	33.200	0.025
2	-0.500	33.200	0.500	33.200	0.025
3	0.500	33.200	2.500	33.600	0.025

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