SECTION 96A OF THE PLANNING AND ENVIRONMENT ACT 1987

Appendix I Stormwater Management Strategy

PREPARED FOR 108 & 110 PARR STREET PTY LTD

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Parr Street

Stormwater Management Plan

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1 Introduction

Noyce Environmental Pty Ltd was engaged to provide a review of stormwater requirements for a proposed development of a property at 108 & 110 Parr Street, Leongatha.

This Stormwater Management Plan (SMP) outlines the proposed management of stormwater on site and suggested upgrades to drainage infrastructure to enable development to occur without increasing flooding to the adjacent properties.

A collaborative and holistic approach to stormwater management has been made where adjacent development runoff and treatment are combined to provide least cost community infrastructure assets.

One and two dimensional modelling has been undertaken to characterise the catchment flows of the existing and developed scenarios for flood events up to and including the 100 year AEP event to Australian Rainfall and Runoff (ARR) Standards. A comparison between the current and developed conditions is presented for consideration of the high-level strategy for the sensitive development of the subject site to ensure that works do not adversely impact neighbouring properties in times of peak flood flow compared to the existing condition.

Water quality modelling shows the proposed water sensitive urban design response for residential development and proposed measures to be implemented that minimise the ongoing maintenance costs to Council while encouraging maximum integrated water reuse on site to achieve best practice environmental management outcomes.

2 Subject Site Description

The subject development site is described as 108 & 110 Parr Street, Leongatha Vic 3953.

Two titles make up the subject site: LP98406 and PS448885 shown below.

The total subject site area is approximately 22.5ha.

Municipality: South Gippsland Shire Council

Centre co-ordinates: -38.488680 Lat, 145.965759 Long

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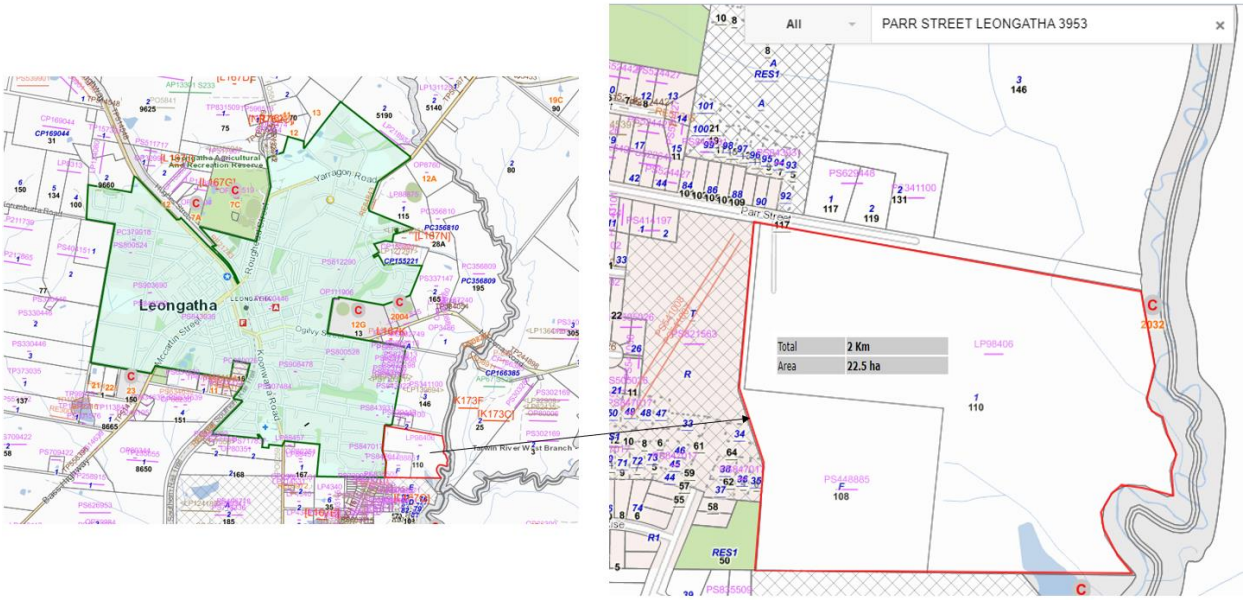

Figure 1: Site Location

Lidar survey of the site was obtained and a 2d surface produced for the site.

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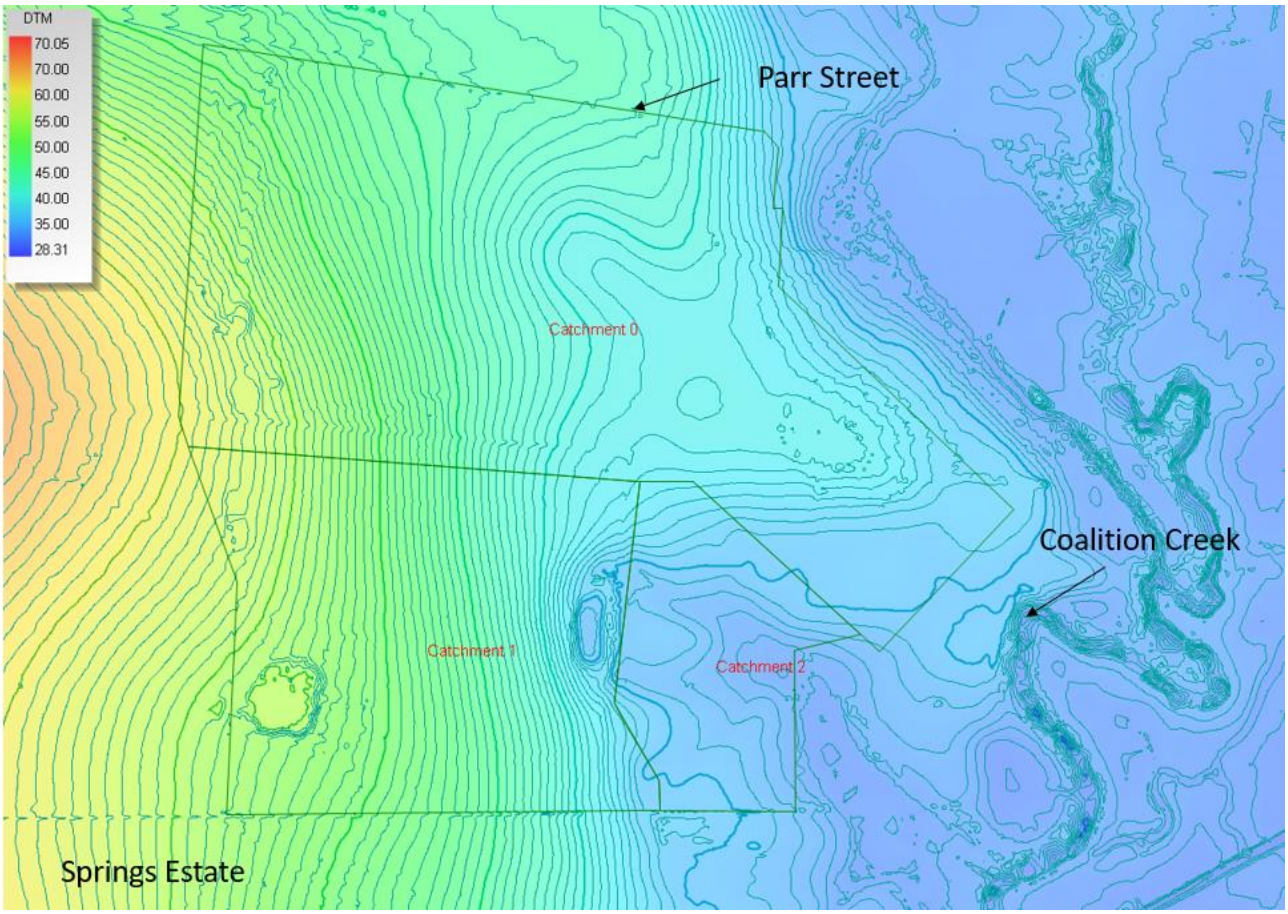

Figure 2: Lidar Survey

From the survey, the site generally falls from west to south east from RL 60m AHD to RL 33m AHD at the south eastern boundary.

The site is bounded by Parr Street to the north, Coalition Creek to the east, residential development to the west and southern boundaries.

An aerial of the site:

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Figure 3: Aerial

Key features of the site:

The eastern site of the site interfaces with the Coalition Creek and is subject to flooding with advice from the West Gippsland Catchment Management Authority (WGCMA) stating:

- The applicable 1% Annual Exceedance Probability (AEP) flood level for this property (commonly known as the 1 in 100-year flood) under current climatic conditions ranges from 33.4 to 33.6 metres AHD. The eastern portion of the property is subject to flooding from Coalition Creek.

- There are two designated waterways shown in the south eastern corner which feed into an existing lake adjacent to Coalition Creek which runs along the eastern boundary of the property.

The average LSIO contour of 33.5m AHD was adopted for the development plan.

Further discussion in relation to the two designated waterways is provided in this report which argues that the waterways are no longer required to be maintained and should be removed.

There is another designated waterway in the north-eastern corner of the site which is to be maintained and enhanced, in conjunction with advice from the WGCMA and Council. Please see the Waterway Management Plan in Appendix 1 at the end of this report for details.

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3 External Catchment

Topographical mapping shows that there is minimal external catchment entering the site from the west as Carr Avenue effectively splits flows from the west towards Parr Street and further south along Carr Avenue.

Norview Drive overland flow discharges across the neighbouring paddock towards Parr Street and Louise Court flows follow a south easterly flow direction across paddocks and towards Coalition Creek to the south east.

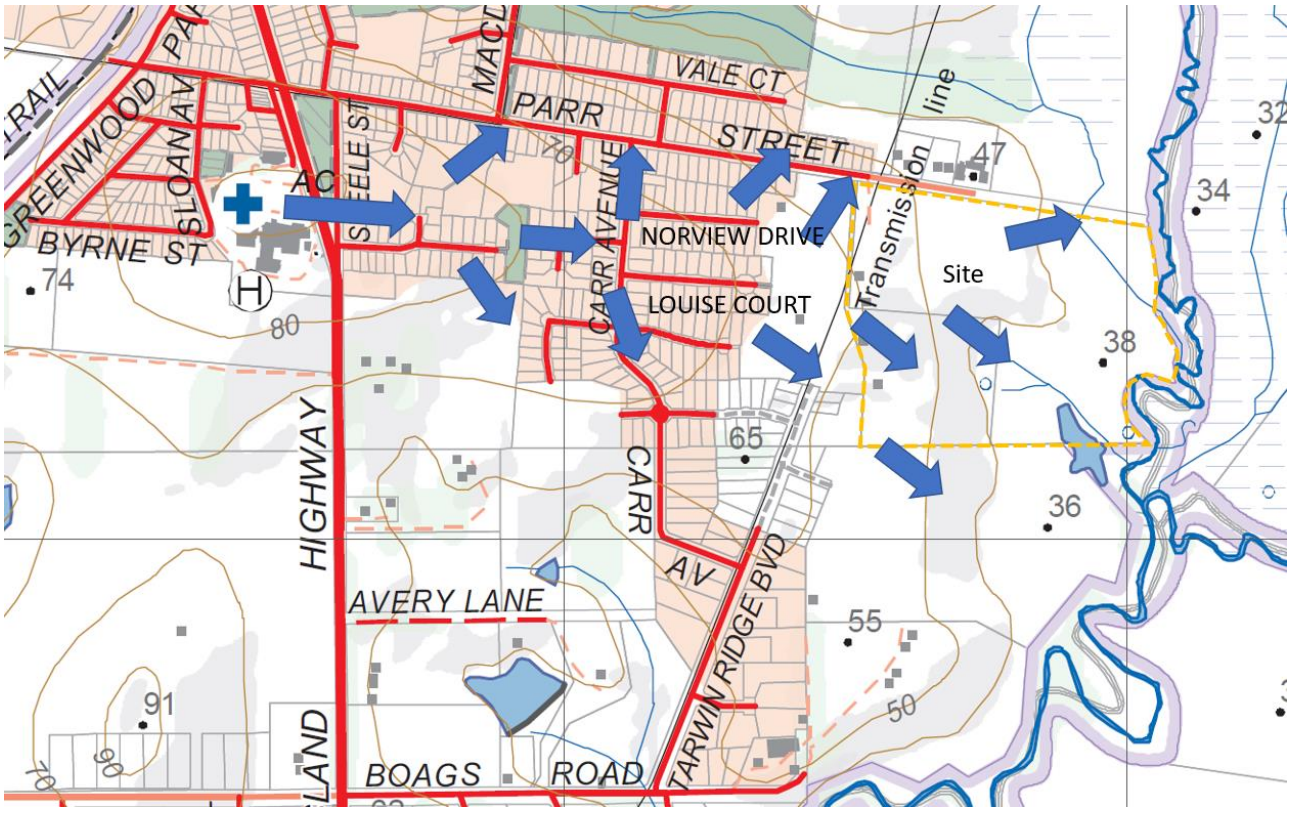

Figure 4: External Site Drainage

Overland flows from external catchments are draining away from the development in the northern catchment and the south western catchment flows will be accommodated in the proposed developed road network during detailed design phases.

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4 Existing Flows

Aerial survey data (lidar) was obtained for the subject site and a 2d rain-on-grid was developed using Tuflow and a 100 year AEP 1hr duration event with the site modelled as a grassed field (mannings n – 0.03).

Runoff velocity vectors confirm the flow assumptions for external catchments which have little interaction with the subject site as the majority of flow exits along Parr Street.

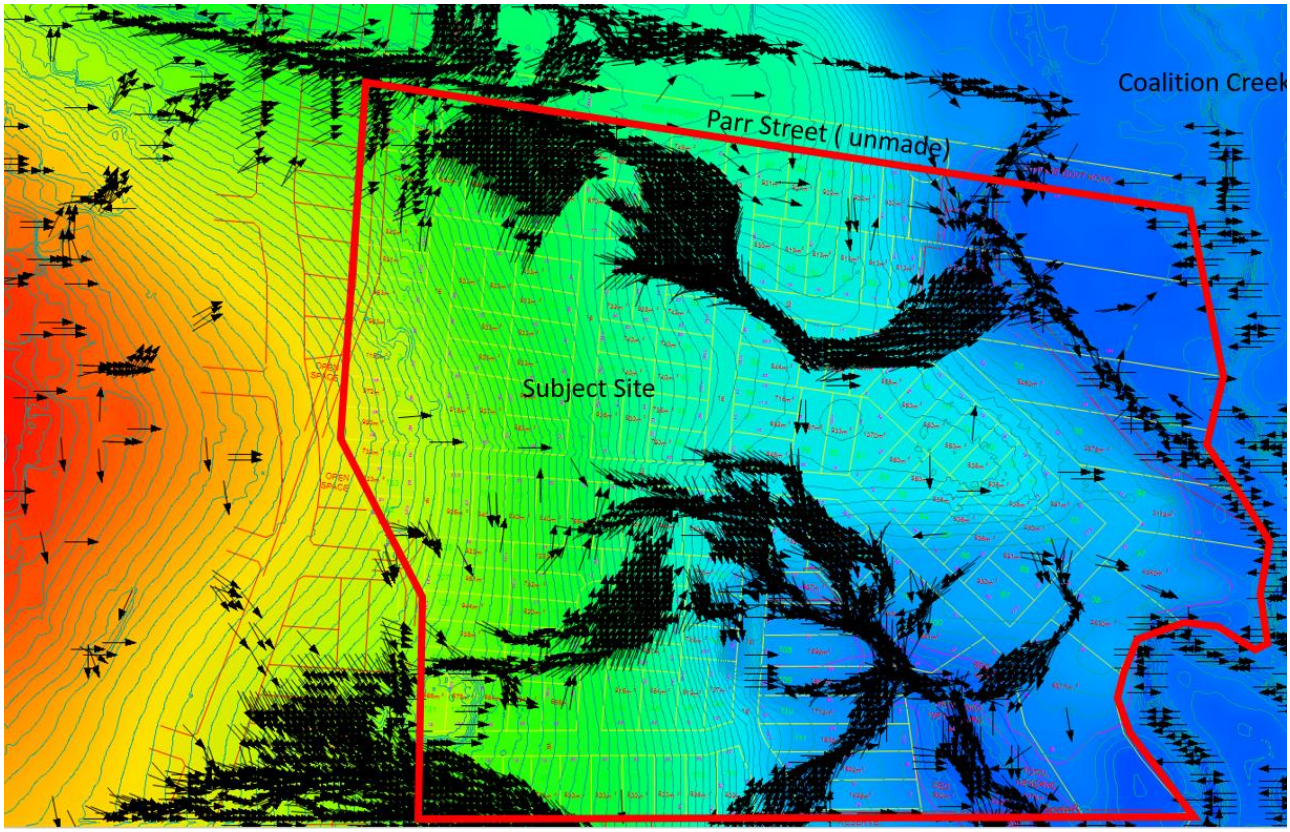

Figure 5: Rain on Grid Analysis

From the Rain on Grid approach, the existing subject site was divided into three main catchment areas:

Northern – 10.0ha

Western - 5.25ha

Central - 1.91ha

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Total 17.16ha

The catchment plan shown in Figure 6 includes large lots which will drain directly to Coalition Creek due to topography along the eastern boundary. These low density lots will be shown on the development plan layout, but excluded from drainage calculations.

Included in the combined treatment system is a portion of the Springs Estate to the south west.

A total of 6.14ha residential, 9.64ha low density residential and 3.83ha of roads will be accommodated into a combined wetland treatment train. Modelling for this existing urban catchment is included in this report. Springs Estate is not an external catchment, it is an adjacent catchment being treated in a combined wetland.

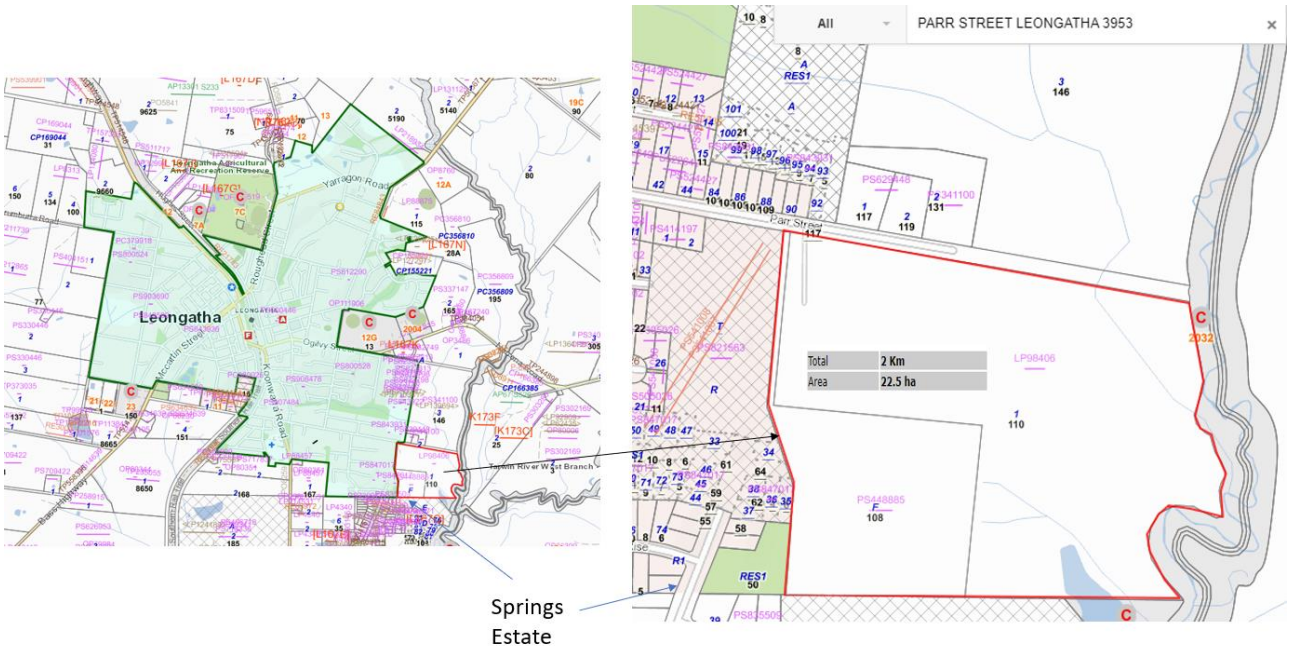

Figure 6: Catchment Plan

Laurenson's method was used to calculate flows for the existing and developed catchments using ARR data hub parameters and IFD values.

This method uses the familiar non-linear routing equation used in other programs such as RORB:

$$S = B\,Q^{n+1}$$

Where: n = -0.2 to provide:

$S = BQ^{0.8}$

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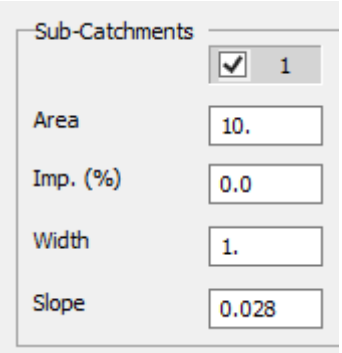
The above equation becomes the same as RORB where the exponent m = 0.8 is used in all Victorian flood studies.

The parameter B is estimated within the XPStorm program.

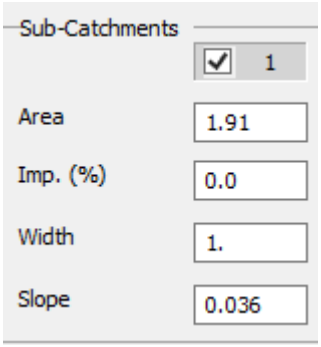
Australian Rainfall and Runoff (ARR) data hub parameters were obtained for the site and a range of storm hyetographs were downloaded from the BoM and included IFD values for the subject site's location.

Additional parameters for the existing catchment include the average slope.

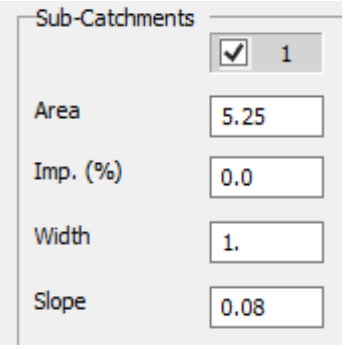
Northern Catchment



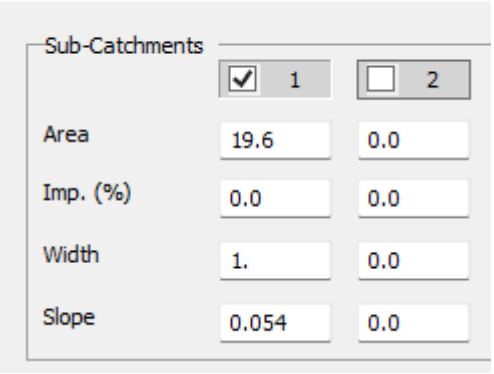
Central



Western



Runoff Node : Springs undeveloped 19.6ha



Slope is expressed in m/m, for example the Northern catchment slope is 2.8% average and expressed as 0.028m/m in the model. The Western catchment is much steeper at 8%.

All fraction impervious area values were set to 0% to represent the existing conditions.

XPStorm was used to calculate the pre-development runoff for the site for the 45min, 1hr, 1.5hr 2hr, 3hr and 4.5hr duration, 5 year and 100-year AEP events.

Initial losses used in the model use an initial 20mm/hr and 0mm/hr continuing loss over the 4hr simulation to provide a more conservative design storm profile. If the larger loss

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values were used, the minor event runoff would be taken up in the loss profile and no resultant flow would be produced.

BoM data for the subject site suggest that initial losses are 27mm and continuing losses 7mm/hr.

The storm ensemble was run for each catchment to determine the peak flows leaving the site.

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4.1 Existing 5yr Minor and Major 100 years results

Parr Street results run for all storms:

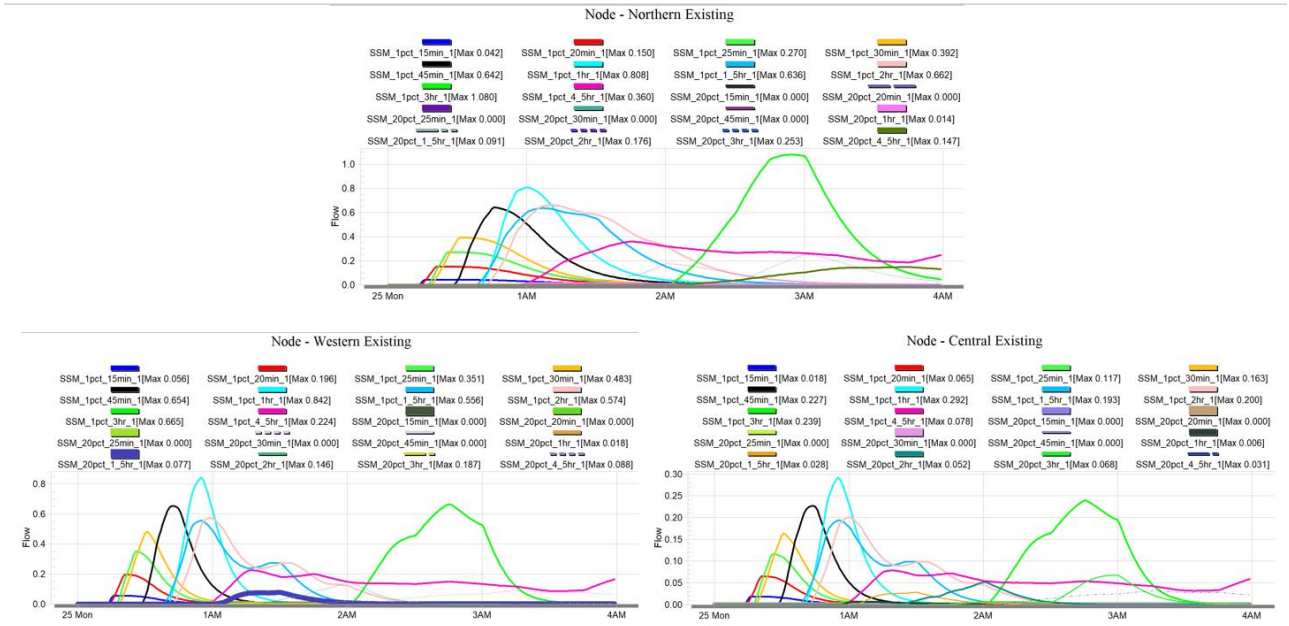

Figure 7: Parr Street Subject Site Existing Flows

Springs Estate flows:

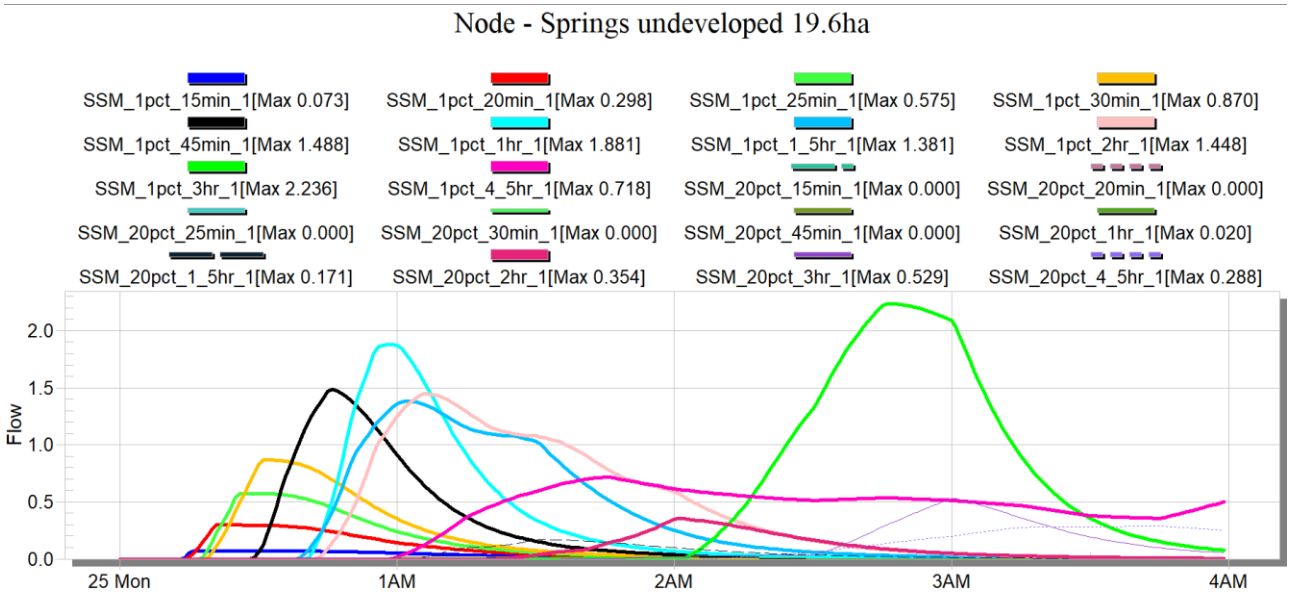

Figure 8: Springs Estate Site Existing Flows

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Existing peak 5 year flows are dominated by the 3hr storm duration and for the 100 year events, the 25minute duration is the dominate duration for the steeper catchments and the northern catchment's critical storm is the longer duration 3hr event.

Summary of existing flows:

Catchment	Peak 5yr flow (m3/s)	Peak 100yr flow (m3/s)
Northern	0.253	1.138
Central	0.068	0.292
Western	0.187	0.842
Total Parr Street flow	**0.508**	**2.214**
Springs Estate	**0.529**	**2.240**
Total combined flow to Coalition Creek	**1.037**	**4.450**

As a check only, a Rational Method calculation was performed for the rural catchment as a lumped for the Parr Street catchment.

Area	17.16	ha
Tc (adams)	0.389	Hrs
	23.3	Mins
C10	0.35	

ARI	Intensity (mm/hr)	Q (m3/s)
1	23.6	0.236
2	30.8	0.386
5	40.2	0.603
10	46.3	0.773
20	54.6	1.003
50	66.4	1.330
100	76.0	1.649

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Predicted peak 5-year flows based on a Rational Method check were similar for the 5yr AEP, but were less for the 100 year AEP.

Note that the Rational Method does not take into account slope, initial losses and longer duration peak flow patterns as described in ARR.

For this study, the adopted pre-development flows will be the XPStorm values as they take into account a wider range of parameters unique to the site.

Adopted pre-development rates from the above table will need to be maintained for the developed scenario with retardation provided in the developed scenario.

5 LSIO Advice

The West Gippsland Catchment Management Authority (WGCMA) advises that the site is subject to inundation with an average level of 33.5m AHD.

The development plan shows the LSIO level and all proposed residential houses will be located outside the LSIO contour with at least 600mm freeboard to habitable floor levels.

Minimum floor levels for all properties will be 34.1m AHD to accommodate the WGCMA's advice.

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6 Proposed Development

The proposed Parr Street development is a residential development where lot densities will result in a modelled ultimate fraction impervious of 60%. Outer lots along the eastern boundary will retain a rural residential style with large lots that retain area within the designated LSIO overlay.

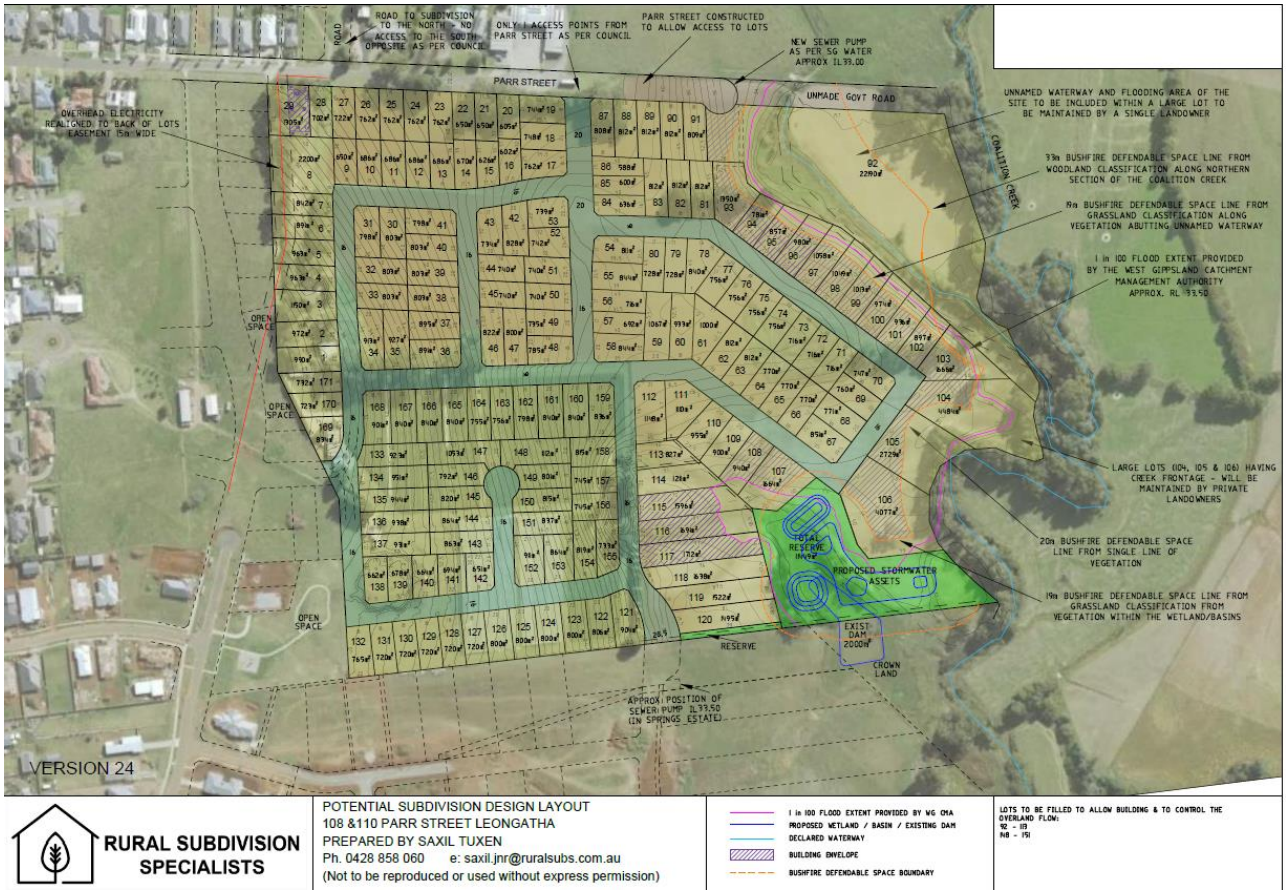

Figure 9: Development Layout

As shown in the development plan, a total of 171 lots are proposed with lot sizes ranging from 602m2 to 22,190m2.

Coalition Creek bounds the development to the east and provides the natural discharge point for the development after treatment and detention of flows to pre-development levels.

It is proposed that all flows will be directed to a dedicated drainage reserve in the south eastern corner of the site which is also the lowest point and a natural flow path for stormwater.

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Key Stormwater Strategy Points:

The key stormwater strategies to be employed on the development:

Conveyance

- A 5 year piped drainage system will convey all residential and street flows to a central wetland/retarding basin in the south east corner of the site.
- The road network will split flows into the wetland/RB and enter via two sedimentation ponds initially before entering the wetland/RB system.
- Flow from the Western catchment will be directed to a drainage reserve south of Lot 120 to allow piped and overland flows to enter the wetland/RB system.
- The drainage reserve south of Lot 120 will join the proposed Municipal Reserve to the south in the Springs Estate.
- All treatment of stormwater will be located below the applicable 1 in 100 year AEP line or 33.5m AHD to avoid loss of floodplain storage.
- Retarded flows will be released from the wetland/RB into Coalition Creek as pre-developed flows.
- The existing dam will be reshaped to accommodate new drainage infrastructure as it is not constructed to current standards and holds no environmental value.

Water Quality Treatment

- All lots will be required to install 5kl rainwater tanks for toilet flushing and irrigation use to maximise water reuse at the lot scale.
- Two sediment ponds are required to take initial flush of sediment before overflowing into a wetland/retarding basin within the LSIO area.
- WGCMA were consulted and have indicated that there is no objection with location of the wetland within the base of the LSIO area.
- The wetland will provide water quality treatment.

6.1 Combining Stormwater Assets with Springs Estate

The combination of sediment and treatment with the neighbouring Springs Estate to the south offers a rationalisation of assets and minimises ongoing maintenance costs to Council.

It is proposed that the southern sediment basin services the Springs Estate and the western catchment of the Parr Street estate.

A connected downstream retarding basin/wetland system will replace the existing dam and provide water quality treatment services before discharging retarded and treated water to Coalition Creek.

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6.2 Key Stormwater Element Sizing

The hydraulic model was re-run with changes in fraction impervious representing the developed case.

Hydraulic sizing of the retardation basins are undertaken using XPStorm while sizing of sediment and wetlands are undertaken using MUSIC V6.3.

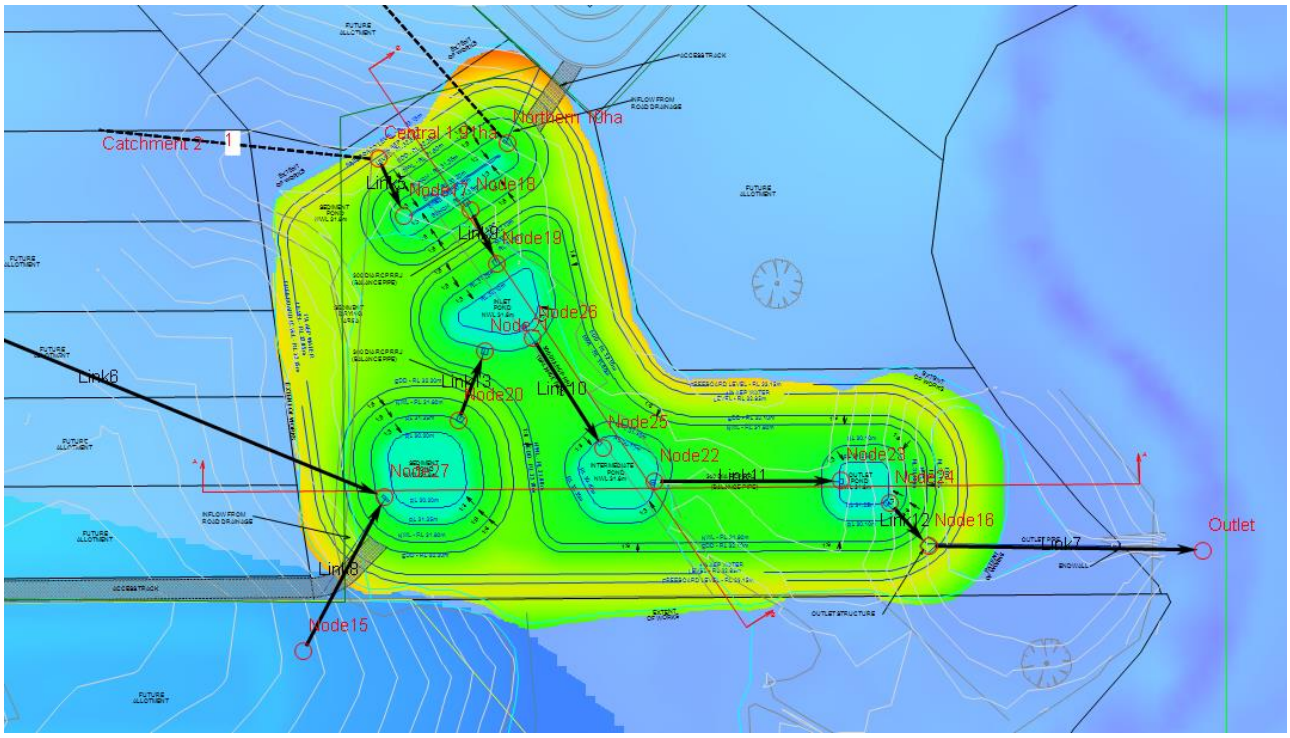

Figure 10: Hydraulic Model

The retarding basin is set with the following parameters:

Top water level 32.9m AHD (ground level at boundary)

Normal top water level: 31.8m AHD

Outlet pipe: 750mm diameter

Floor area: 2,000m2

Top Surface area 3,500m2

Weir: 3m wide set at 32.6m AHD.

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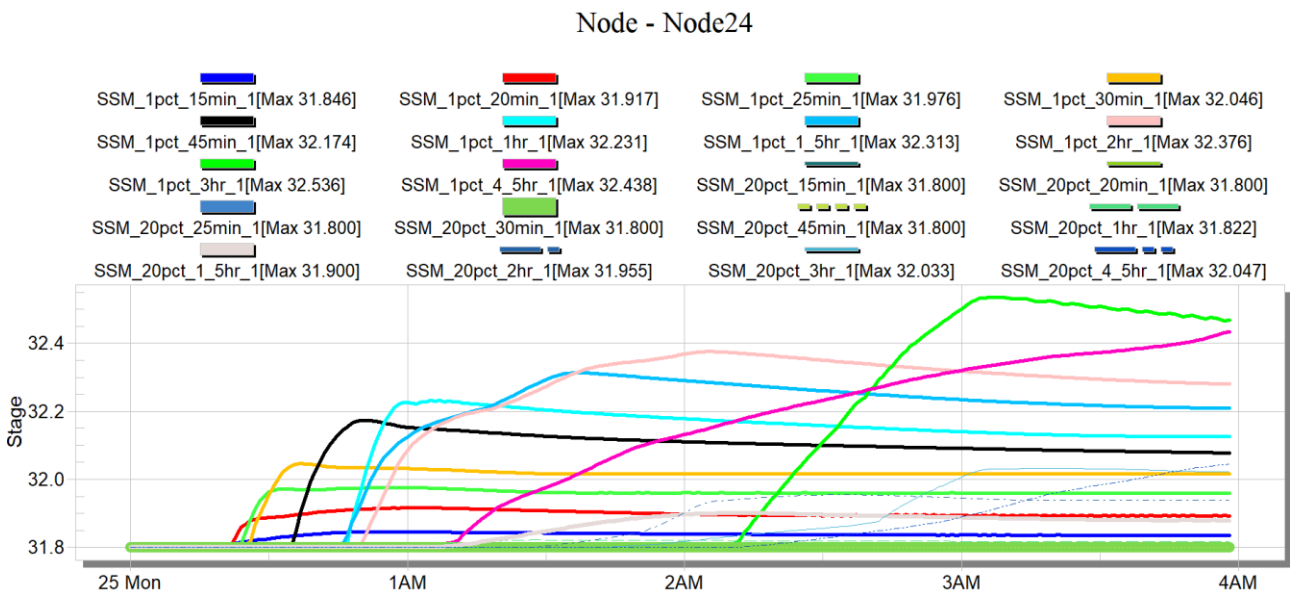

Figure 11: Retarding basin performance

All flows are contained within the basin including the 1 in 100 year AEP event.

Outflow from the 750mm outlet:

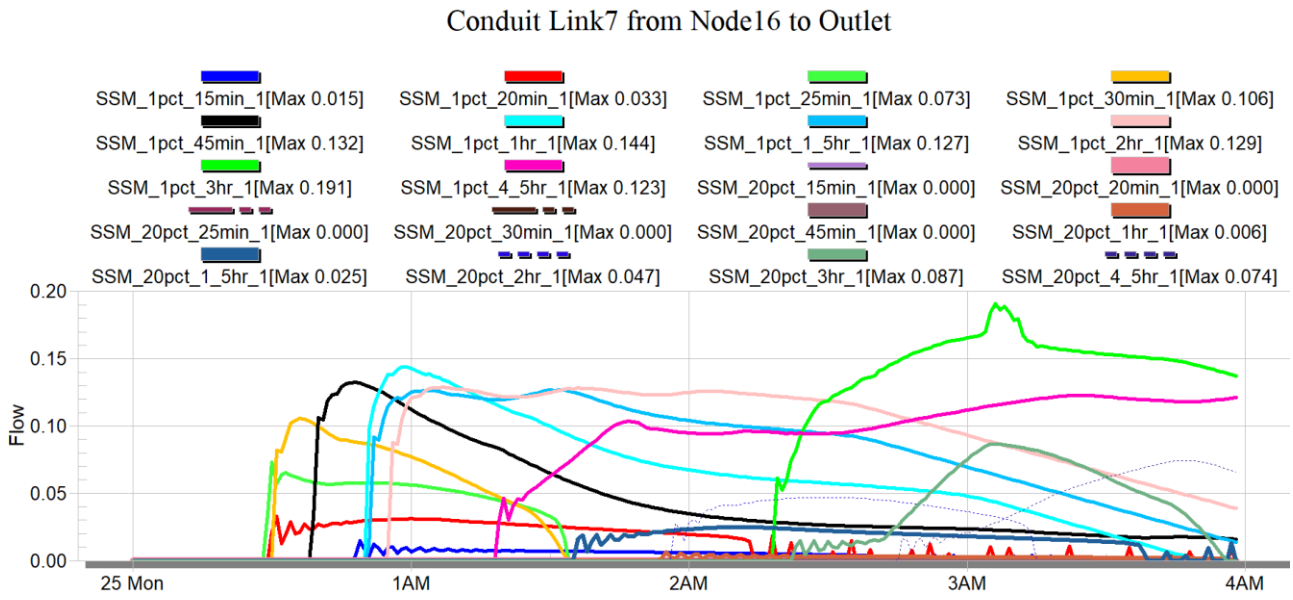

Figure 12: Retarding basin outflow

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In 2d, the basin results for the peak 20% AEP event:

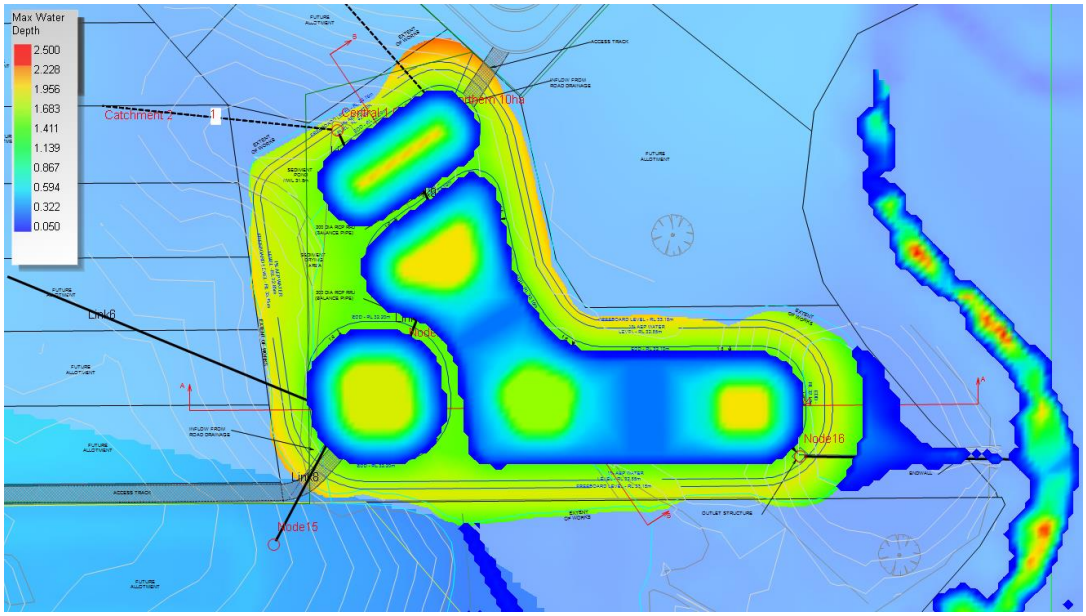

Figure 13: Retarding basin 20% Flows

All flows from the 20% AEP are contained within the sediment basins and connected wetlands. Sediment dry out area to the north east remains dry.

For the 1% event:

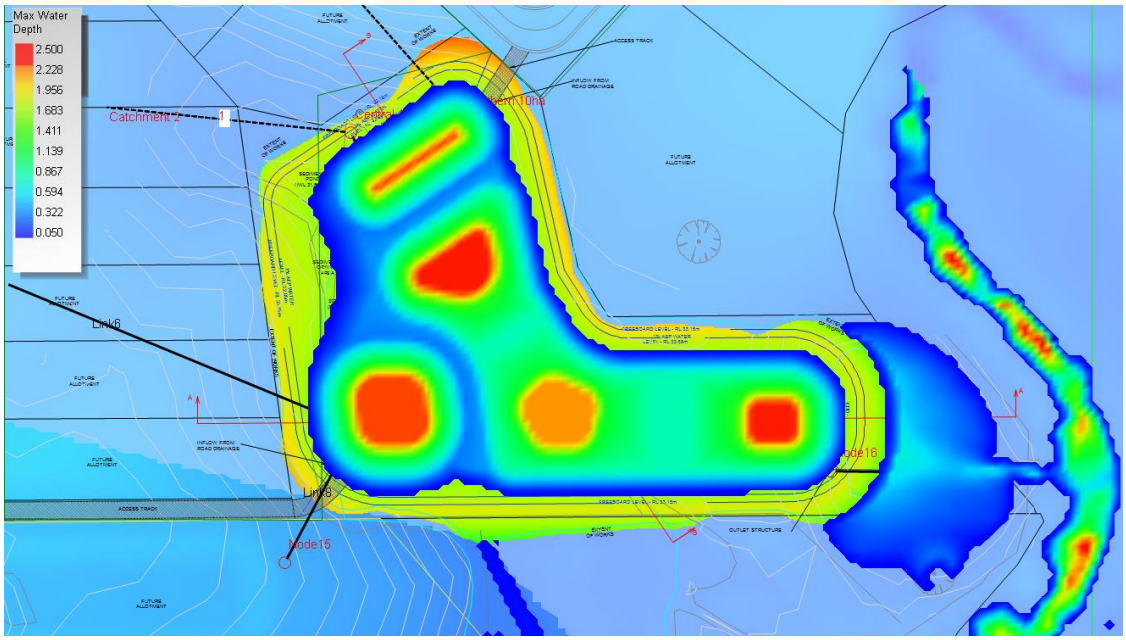

Figure 14: Retarding basin 1% Flows

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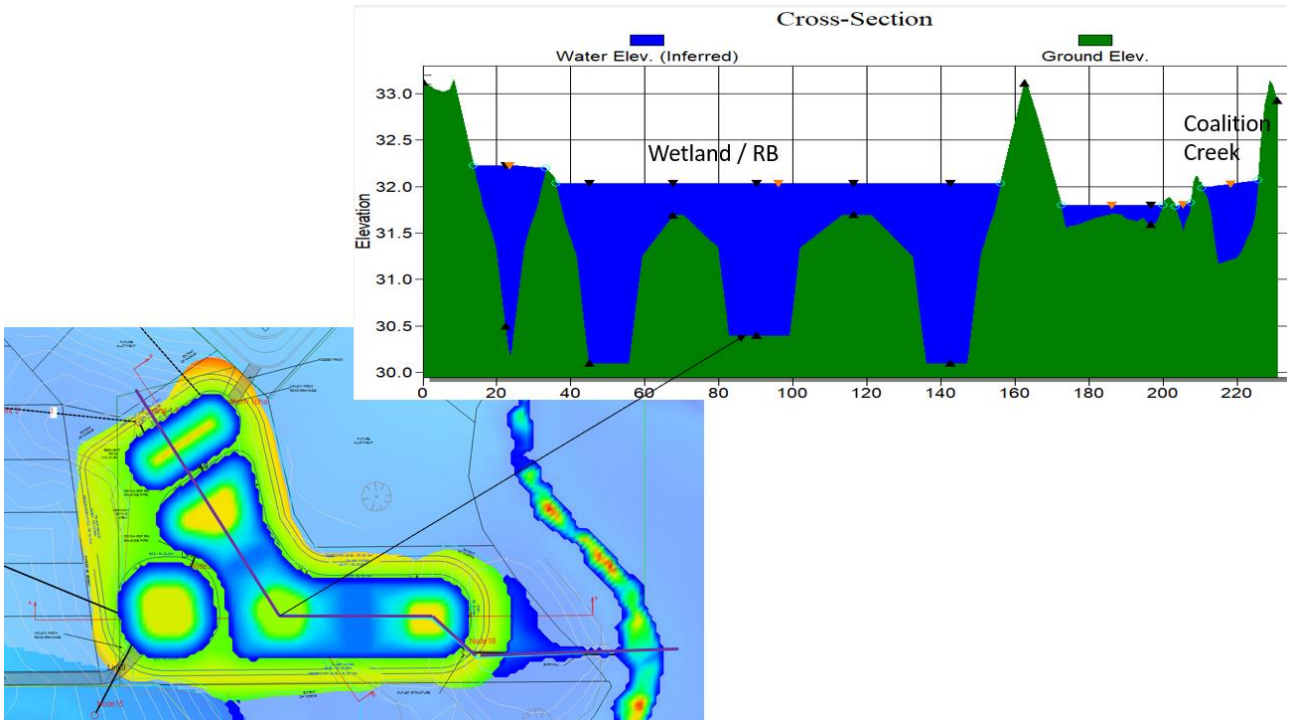
In the 1% event from the local catchment, the entire basin area is full. Sediment dry out area is perched above the top level and free from flooding. Additional airspace is provided by the bunding around the wetland which protects it from external flooding from the Coalition Creek minor flood events.

A cross section of the RB/Wetland during the 1% event from the development catchment:



Flow from the developed catchment will enter the new wetland system and be treated before the wider Coalition Creek catchment reaches its peak flow level of 33.5m AHD.

In the extreme event where the Coalition Creek is at maximum flood level, the treatment system will be temporally inundated when flood water reaches RL 33m AHD and overtopping will occur.

The bunds will be rocked and given that the velocities will be low, there is little risk of damage to the proposed bunding, sediment basin or wetlands.

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Summary of flows:

Catchment	Existing Peak 20% flow (m3/s)	Developed 20% Outflow (m3/s)	Peak 1% flow (m3/s)	Developed 1% Outflow (m3/s)
Northern	0.253		1.138	
Central	0.068		0.292	
Western	0.187		0.842	
Total Parr Street flow	**0.508**		**2.214**	
Springs Estate	**0.529**		**2.240**	
Total combined unretired flow to Coalition Creek	**1.037**	**0.087**	**4.450**	**0.191**

The outputs show that the basin flows are heavily retarded to below pre-development levels for the 1% and 20% peak flood flows as a result of the retarding basin configuration.

This will significantly benefit the land and waterway area downstream.

7 Water Quality Model

A continuous rainfall model for the site was prepared using MUSIC for the developed site to show how the site could further mitigate any outfall of stormwater compared to the existing conditions.

As per Melbourne Water MUSIC Guidelines, the reference rainfall file for the site is the Koo Wee Rup 1970 – 1980 10 year, 6 min record.

Total average rainfall and evaporation for the site:

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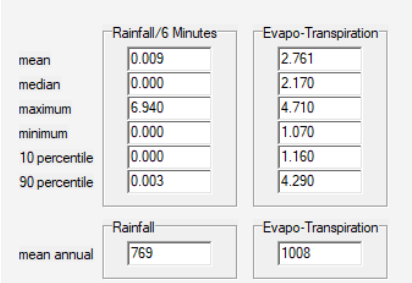

Figure 15: Rainfall and Evaporation Summary

Plotted, the rainfall vs evaporation is:

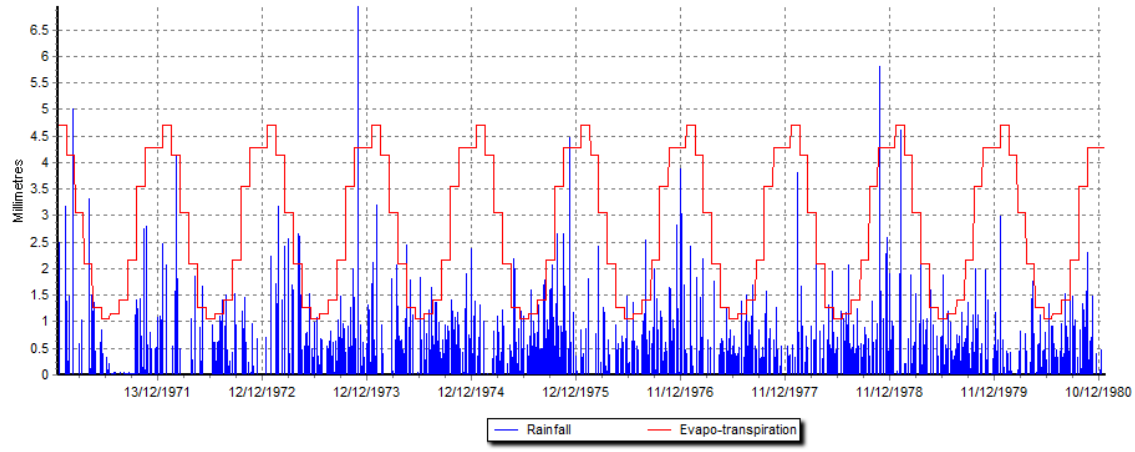

Figure 16: Rainfall and Evaporation Plot

The 10 year record is favoured by Melbourne Water's MUSIC Guidelines to provide a long term assessment of treatment performance.

7.1 Water Quality Objectives

Best Practice environmental outcomes are measured by the following pollutant reductions:

Parameter	Best Practice % removal standard
Total suspended solids	80
Total Phosphorus	45
Total Nitrogen	45

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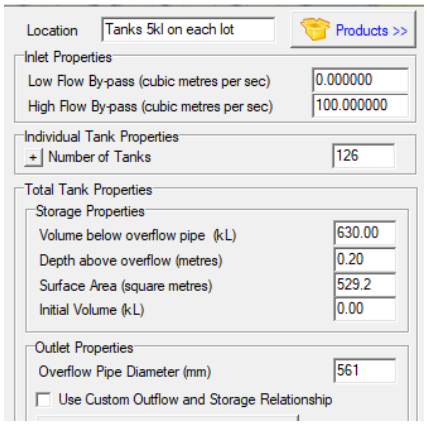
7.2 Water Quality Treatment Train

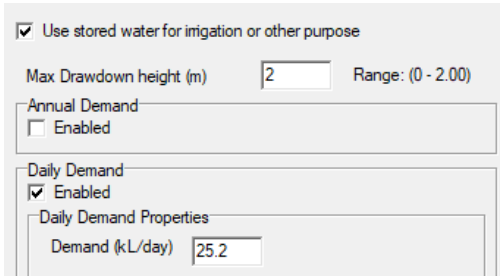
To achieve Best Practice objectives for water quality, a treatment train approach is proposed to be implemented that works in conjunction with the retarding basin.

Lot Scale

Each Lot will have a 5kl water tank connected to the roof area runoff and overflow will then enter the piped drainage system.

The storage within the tank is not counted as part of the site's retardation volume.





Water reuse is based on 200 litres per day water use on average per household.

Sediment Pond

Each sediment pond will be configured to provide effective capture of silt for a 5 year cleanout capacity and protect the wetland system.

A typical section through the sediment pond is shown below.

Figure 17: Typical Sediment Basin Profile

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Wetland/Retarding basin

The wetland/retarding basin is connected to the sediment basins via a pipe and high bypass weir.

The wetland will be planted to Melbourne Water specification with local wetland species detailed in the engineering design phase of the project.

Figure 18: Wetland/Retarding Basin Concept

Thick edge planting will be provided to discourage entry and shallow safety batters provided in accordance with industry Best Practice.

These online wetlands are designed to be completely inundated in the 1% AEP event and quickly recover when the flood water recedes. No harm comes from the peak flood event as velocities are low and the period of inundation at peak levels is relatively short.

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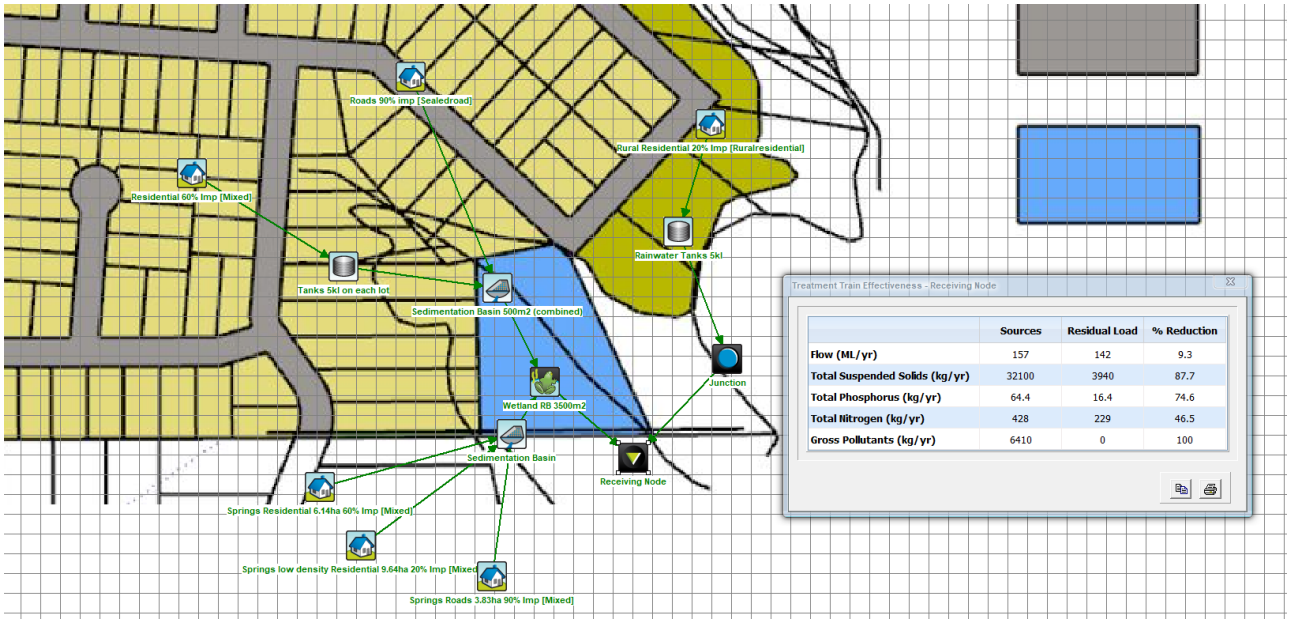
7.3 Water Quality Results

Music results for the proposed combined development:



	Sources	Residual Load	% Reduction
Flow (ML/yr)	157	142	9.3
Total Suspended Solids (kg/yr)	32100	3940	87.7
Total Phosphorus (kg/yr)	64.4	16.4	74.6
Total Nitrogen (kg/yr)	428	229	46.5
Gross Pollutants (kg/yr)	6410	0	100

Comparison of the results with the guidelines shows that the measures proposed will result in a compliant outcome:

Parameter	Best Practice % removal standard	Modelled outcome % removal	Target Achieved
Total suspended solids	80	87.7	YES
Total Phosphorus	45	74.6	YES
Total Nitrogen	45	46.6	YES

All targets for water quality will be met and exceeded.

In addition, a significant reduction in outflow (9.3%) will occur as a result of onsite water reuse and will further lessen the impact of the development of the site.

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8 Designated Waterways & Lake Discussion

Two designated waterways are currently shown on the planning maps in the south eastern corner of the site.

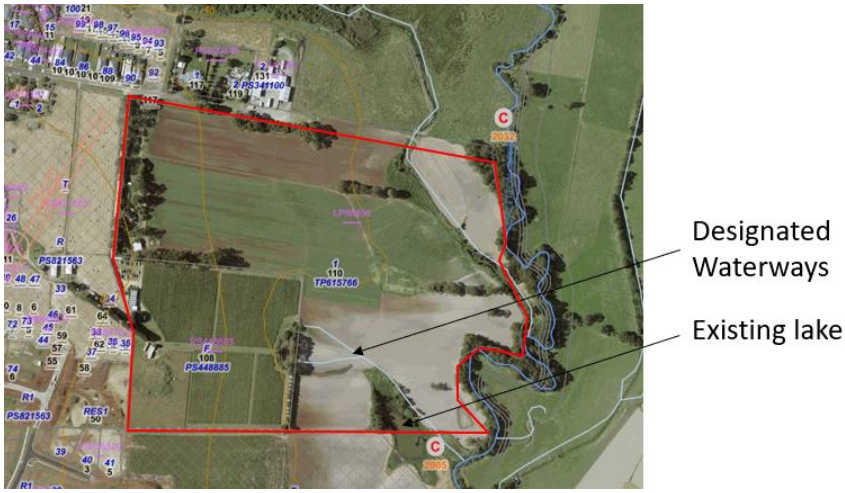

Figure 19: Designated Waterways

Before the site was used extensively for pea cropping, the small depressions currently designated as waterways would be feeding lines to a downstream lake.

In it's current form, the area has been heavily cropped and has no vegetation or habitat value. In the developed case, the natural depressions will remain and serve as drainage lines to the proposed wetland/retarding basin, however the upper existing farm dam will be filled and the surrounding land filled to enable control of overland flow to the proposed wetland/RB.

Figure 20: Existing Waterway Condition

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At the downstream end of the site, a “Lake” exists partially on the subject site and primarily in adjacent Crown land. The dividing fence line can be seen in the picture below.

Figure 21: Existing Lake

The lake is a general depression that is overgrown with grass and weeds. Edge batters are unsafe and stormwater flow from neighbouring properties are directed towards this low point. Overflow from the Lake enters Coalition Creek to the east as general sheet flow.

The new wetland/RB proposed within the subject site is to be located north of the existing lake for expediency, however we would suggest that although the WGCMA has expressed a desire to retain this lake feature, the lake will be made redundant and should be removed once the constructed wetland/RB is formed on the basis that the current lake is not being maintained to current safety standards.

A newly constructed and fully functioning wetland system will provide greater habitat diversity and opportunity to provide environmental services to the adjacent Creek system.

If left in it’s current form, the lake will continue to be a waterway feature that is unsafe and unmaintained to current standards as the Council has expressed concerns with maintenance responsibility.

The practical solution proposed is for the lake to be incorporated into the wetland system servicing both the subject site and the adjacent Springs Estate to provide one larger regional wetland treatment facility and create a safe and well maintained community asset.

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In detailed design, lots within the central catchment will be filled to enable the road network to convey flows to the wetland/RB south of Lot 120.

Removal of the designated waterways within the site development also minimises reserves that would typically be required to hand over to Council for maintenance.

In this case, it is considered impractical to maintain designated waterways where there is no environmental benefit and developed conditions will result in these depressions being filled and therefore made redundant.

9 Waterway Management Plan

The interface between the drainage facilities and the Coalition Creek will be enhanced as a result of this development.

A Waterway Management Plan prepare by Bloom Design shows:

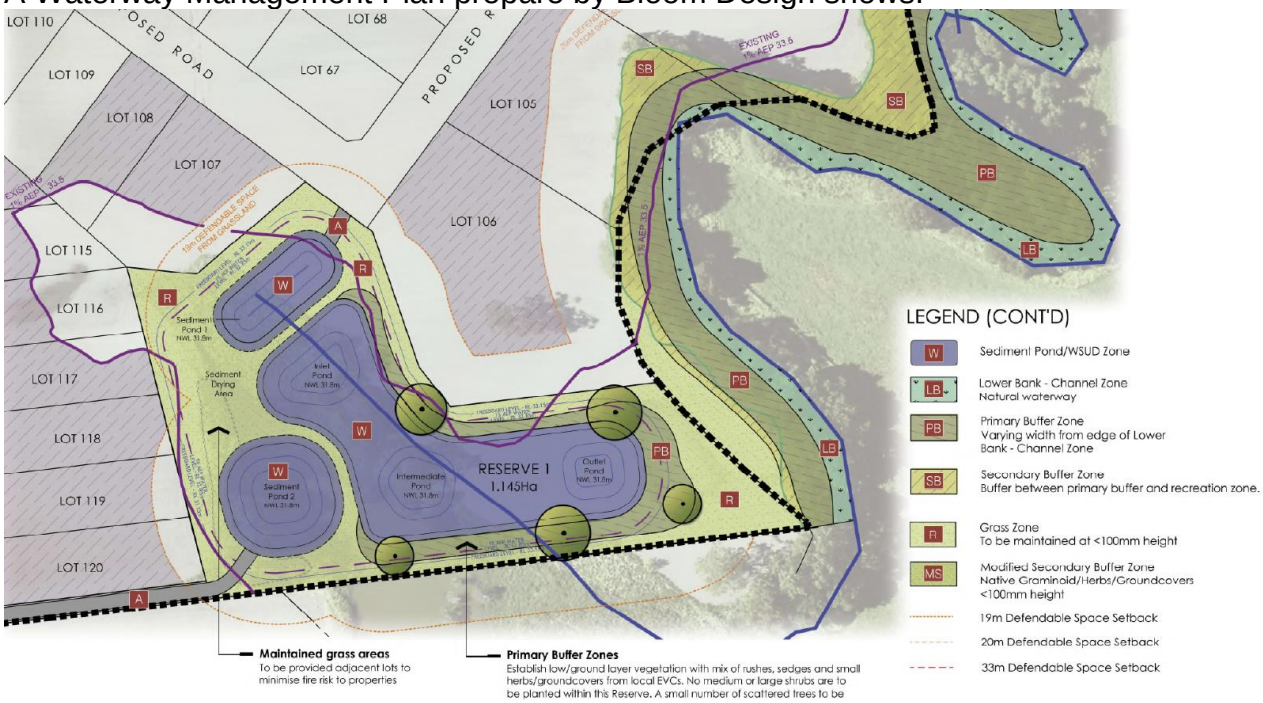

Figure 22: Waterway Management Plan

Outside the proposed wetland, the Primary Buffer Zone (PB) has low plantings that allow visual lines to the wetland edge and interface with the Grass Zone.

Grass zones provide a buffer to the edges of the Coalition Creek and would be mowed areas that define the treatment areas.

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10 Recommendations

Based on hydraulic and water quality analysis of the proposed development, consideration of the current topography and proposed measures to implement water sensitive urban design we recommend:

- All Lots to be required to install 5kl rainwater tanks to maximise on-site water reuse and provide a 9% reduction in flow volume to minimise the development impact on the environment;
- Creation of a sediment basin and wetland/retarding basin in cut for treatment at the low point of the site to meet Best Practice Environmental Management Guidelines. The sediment basin area split across two key entry points into a new wetland downstream;
- A minimum area of 3,500m2 of constructed wetland be provided to treat flows to Best Practice Environmental Management standards as described in this report;
- Provision of a retarding function in cut to retard developed flows to below pre-development levels for all storm events up to and including the 100year AEP event before discharge to Coalition Creek;
- Removal of two small designated waterways within the site on the basis that they are no longer providing environmental services and will be redundant in the developed scenario;
- Removal of the existing “Lake” into a regional wetland/RB that provides function for two Estates and minimises the ongoing maintenance and liability on Council; and
- Implementation of a Waterway Management Plan as proposed by Bloom Design to address the interface between the Coalition Creek and the drainage reserve.

Implementation of the recommended stormwater strategy will demonstrate benchmark environmental performance and integrated stormwater management.

Marc Noyce

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APPENDIX 1 – WATERWAY MANAGEMENT PLAN