LENNOXTON ROAD SUBDIVISION
CIVIL DESIGN REPORT

PROJECT LOCATION

256 LENNOXTON ROAD, VACY

CLIENT NAME

PETER EVANS
C/- PERCEPTION PLANNING

DRB PROJECT No.

200380

DISCLAIMER

Project Number: 200380

Client: Peter Evans

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Report Issues

Revision	Date	Issue Description	Author	Reviewer	Approver
A	07/08/2024	Development Application Submission	BR	MM	BR
-	-	-	-	-	-

CONTENTS

1 INTRODUCTION

This design report has been prepared to support the proposed subdivision of 256 Lennoxton Road, Vacy. The site is located approximately 7.5km north-west of Paterson on Lennoxton Road and is made up of two smaller lots, Lot 8 DP 739338 and Lot 94 DP 788016. The development area proposed over the two lots covers an area of approximately 61 ha. The proposed subdivision is located within the Dungog Shire Council (Council) LGA and is generally zoned R5 – Large Lot Residential but also includes areas of C3 – Environmental Management. Figure 1 and Figure 2 below show the site location and planning areas.

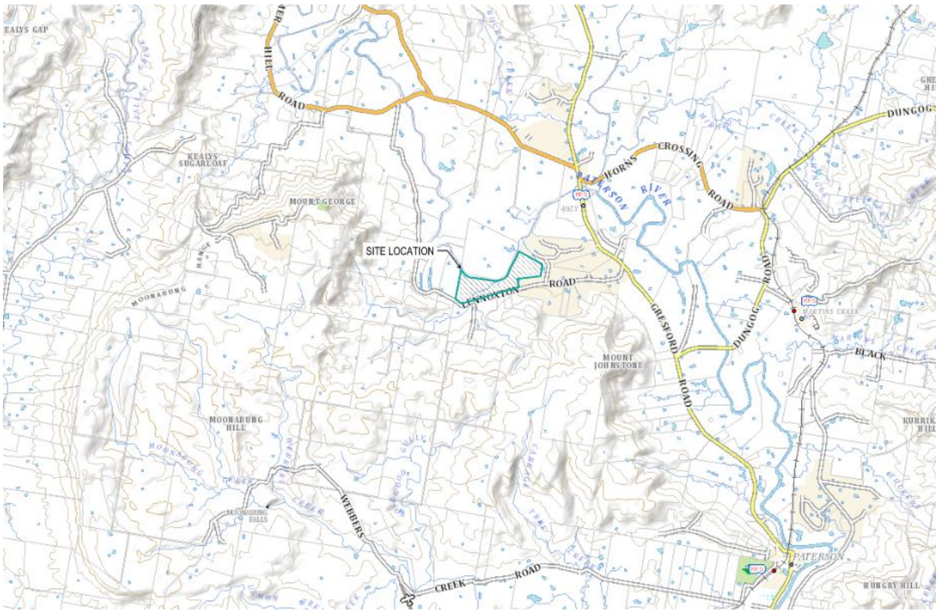

Figure 1 - Locality Plan

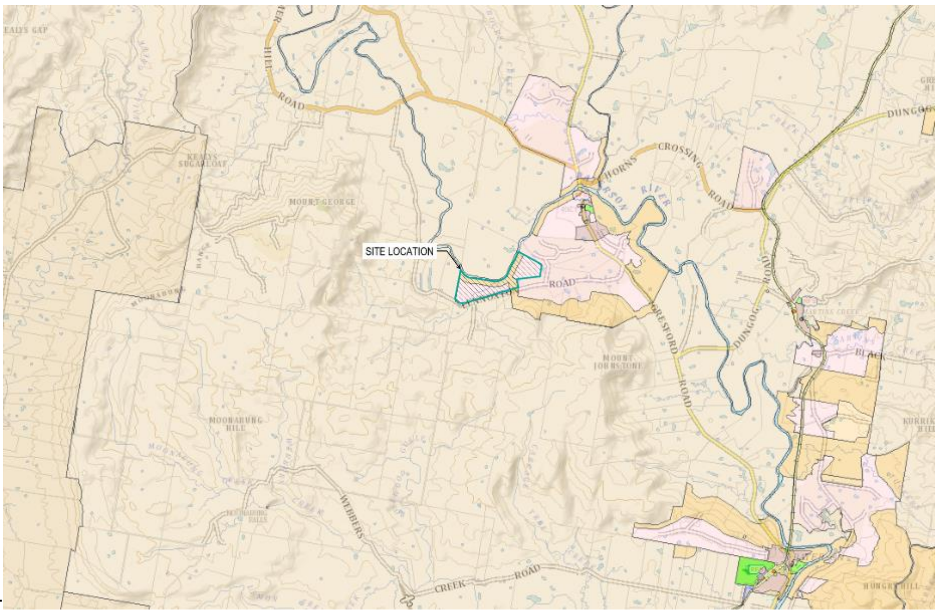

Figure 2 – Planning Map

The existing site is predominantly undeveloped with one existing dwelling on the site, which is intended to remain. A number of watercourses traverse the property and feature sparsely wooded areas along their banks. Based on the SixMaps data exports obtained, there are 15 natural watercourses across the lots ranging from 1st order to 4th order streams. Some of these streams stretch up to 4km upstream of the site. The site generally falls from Lennoxton Road on the southern boundary of the site, towards the Paterson River on the northern boundary of the site. Site grades are relatively consistent with varying slopes generally between 5% and 10%.

1.1 SCOPE AND REFERENCE DOCUMENTS

This report has been prepared to outline the civil design aspects of the proposed subdivision. Typically, the initial approach to meeting detention requirements would entail provision of an end of line basin(s). However, due to the number of small tributaries running through the site, the subdivision would be required to incorporate somewhere in the order of 20 - 30 small basins immediately prior to a watercourse to meet typical requirements for all discharge locations. Based on the number of basins required, the resulting scale of maintenance and recent guidance received from NRAR on other similar developments, this method has been discarded and on lot treatment measures have been adopted instead. Further justification of this decision has been included below in Section 3.

In the preparation of this report, we have made reference to the following documents:

- Australian Rainfall and Runoff 2019,
- Dungog Shire Council DCP,
- AS3500.3, and
- LandCOM Blue Book.

This report should also be read in conjunction with the following documentation:

- DRB Design Drawings: 200380- CIV001 to 352
- DRAINS Model: 2024 08 06 – Lennoxton Road Subdivision DRAINS Model - 200380
- MUSICX Model: 2024 08 06 – Lennoxton Road Subdivision MUSIC Model - 200380

1.2 PROPOSED DEVELOPMENT

The proposed subdivision will comprise the creation of 25 new large residential lots within the R5 residential zone and associated new road reserves which will be dedicated to Council at the completion of works. A total of approximately 1.65km of new sealed road will be constructed along with three new cul de sacs, an internal T-intersection and two BAR/BAL intersection treatments on Lennoxton Road. The proposed development is shown on the civil design documentation ref. 200380-CIV001 to 352 and an excerpt of the typical road sections is shown below.

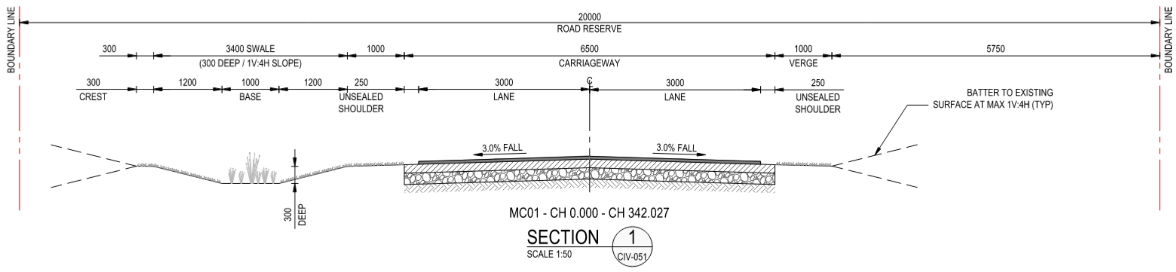

Figure 3 - Typical Road Cross-Section

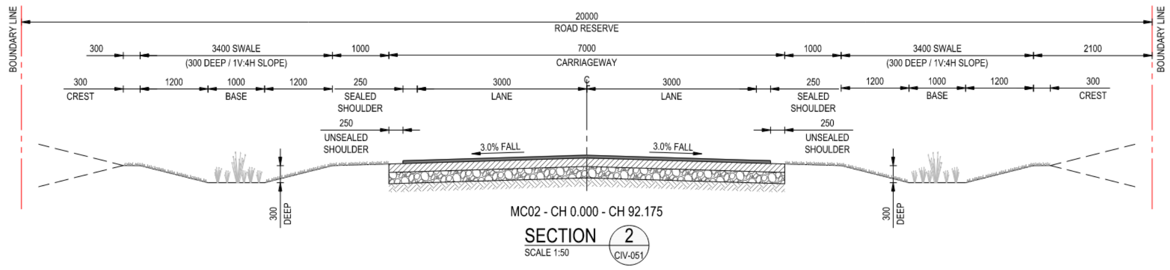

Figure 4 - Typical Road Cross-Section

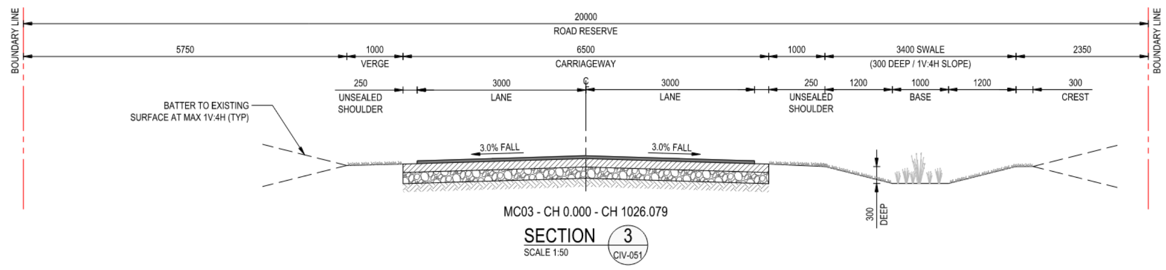

Figure 5 - Typical Road Cross-Section

1.3 CATCHMENT BREAK-UP

The catchment area of the lots has been broken up into three zones depending on the existing legal discharge points for the lots. The site features two small catchments at the eastern and western ends of the site that discharge into existing natural watercourses. The catchment zones used on this site are shown in the figure below.

For clarity, the portion of the lot on the southern side of Lennoxton road which is zoned C3 – Environmental Management has been excluded from any water quality or water quantity calculations. As there is not intended to be any proposed development of this area, the exclusion of this area will not affect the Neutral or Beneficial Effect or Pre vs Post Runoff Quantity calculations outlined below.

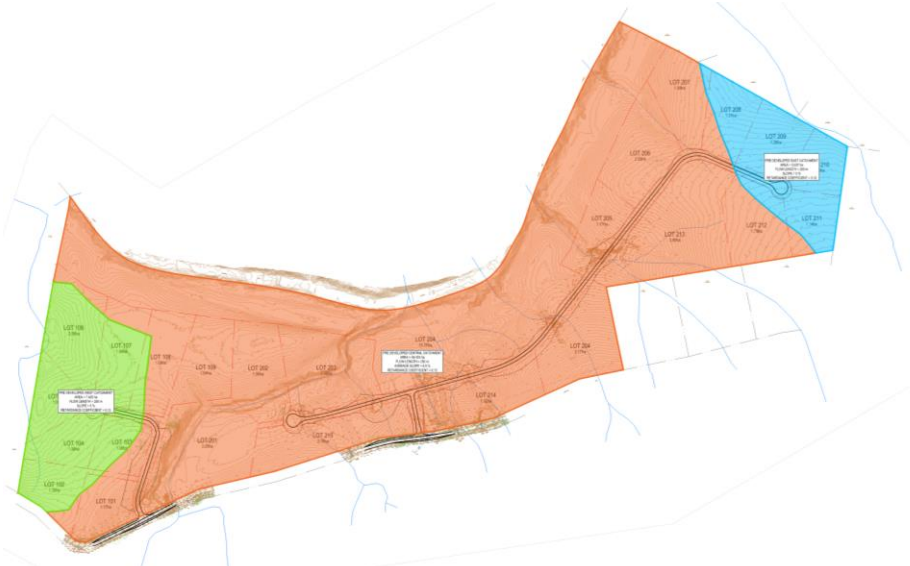

Figure 6 - Catchment Breakup (Pre-Development)

Figure 7 - Catchment Breakup (Post-Development)

2 STORMWATER QUALITY MANAGEMENT

Stormwater quality treatment analysis was undertaken using the MUSICX software package to show that the proposed development could adequately achieve Council's typical requirements. Note, the MUSICX file has been provided with this submission for review by Council.

2.1 MUSICX MODEL AND ASSUMPTIONS

The MUSICX model was prepared assuming that all new dwellings will be required to provide at least a 40kL rainwater tank for internal and external use. Re-use rates of 0.775kL/day for internal usage and 0.150kL/day for external usage (0.925kL/day per lot) have been adopted into the modelling. Based on similar developments in the LGA, an assumed roof area of 500m^2 per lot along with 150m^2 of new driveway hardstand was adopted for this model. All remaining area of the proposed residential lots was considered to be pervious and the MUSICX modelling undertaken has considered the roof, driveway and landscaped areas of the lots as separate source nodes. Source node parameters for the residential lots was assumed to be in line with rural residential pollutant loads, with varying impervious fractions based on the number of lots and variable rainfall thresholds depending on the type of catchment being assessed.

New road areas were combined into an idealised set of source nodes based on their primary treatment measure. As shown above in the typical road section, the roadways will feature a grass lined swale on the high side of the road, and a batter on the low side. The roadway areas have therefore been split depending on the half road width areas discharging to a grass lined swale along the length of the road alignments or discharging towards the vegetated buffer on the low side of the road alignment.

2.2 PRE-DEVELOPMENT SCENARIO

The target treatment effectiveness for pollutants were taken to be NorBE as the runoff from the proposed subdivision will enter a natural water course. Pre-development mean annual loads for each of the catchments were determined using a rural residential node. The pollutant load calculated from the pre-development scenario catchments are outlined in Table 1 below.

Table 1 - Pre-Development Pollutant Load

Pre-Development (Greenfield) Pollutant runoff			
Catchment Zone	**West**	**Central**	**East**
Total Suspended Solids (kg/yr)	1298	7996	1276
Total Phosphorus (kg/yr)	3.01	19.34	2.95
Total Nitrogen (kg/yr)	27.6	181.2	28.2
Gross Pollutants (kg/yr)	0	0	0

Figure 8 below shows the parameters assumed for the pre-development catchment.

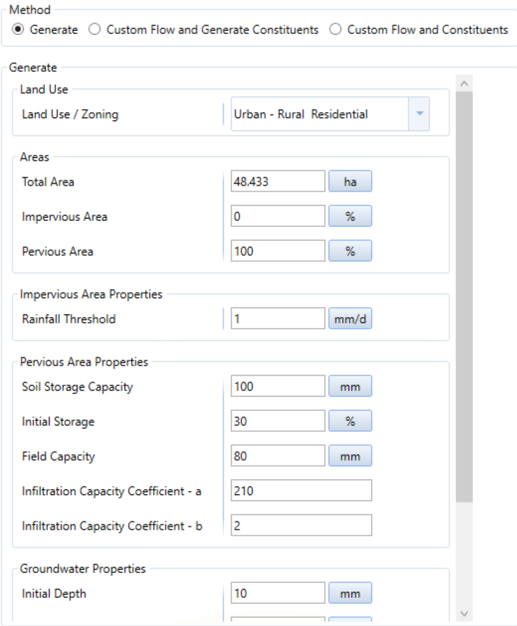

Figure 8 - Pre-Development Catchment Node from MUSICX Model

2.1 POST-DEVELOPMENT MODELLING

As discussed above, the post-development MUSICX model incorporates on lot treatments to achieve the NorBE targets for the site. The following is a breakdown of the different areas and relevant treatment trains used to treat runoff from the proposed works.

2.1.1 RESIDENTIAL LOTS

Roof Areas

Proposed residential lots will be constructed with a minimum of 40kL of reuse volume for internal and external use as outlined above. Overflow from the tanks will discharge to a new raingarden prior to being discharged into the network of natural watercourses or roadside table drains. The below images illustrate the assumed parameters for this treatment train.

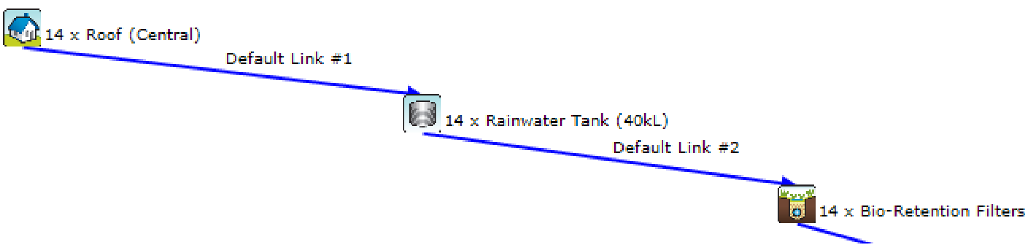

Figure 9 - Residential Lot Roof Area Treatment Train Arrangement

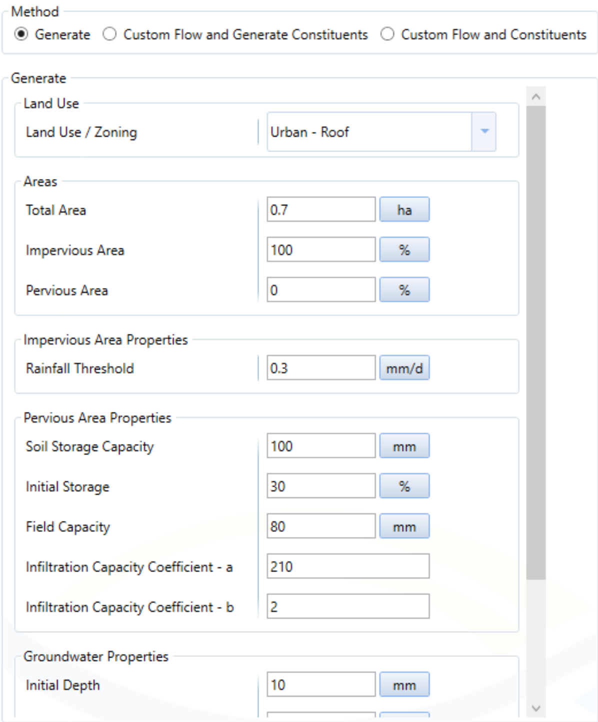

Figure 10 - Residential Lot Roof Area Source Node

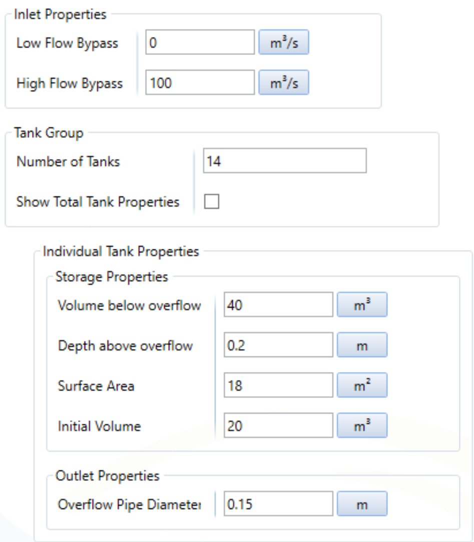

Figure 11 - Residential Lot Rainwater Tank Volume/Arrangement Parameters

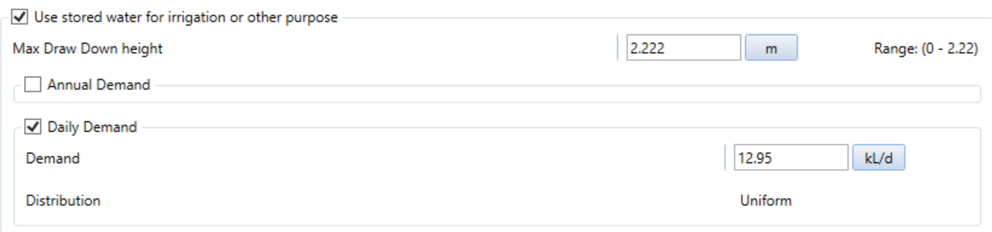

Figure 12 - Residential Lot Rainwater Tank Re-Use Parameters

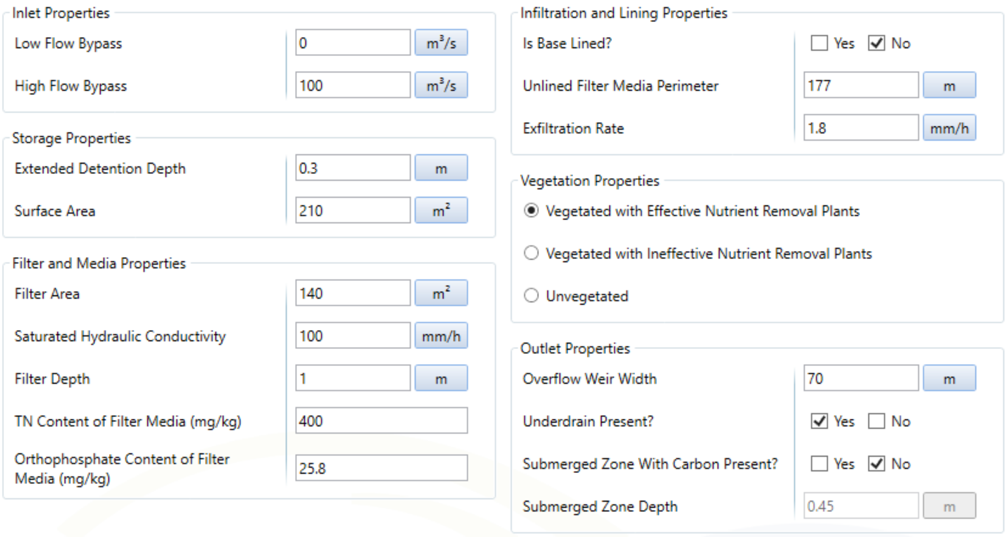

Figure 13 – Bio-Filtration Basin Parameters

The above nodes represent the combination and idealisation of treatment train across of the proposed residential lots in the central catchment. Western and eastern catchments have been modelled based on similar parameters. Rainwater tank volumes, geometry and reuse data has been multiplied by 14 as have the parameters used in the bio-filtration basins. A breakdown of the individual lot roof treatment parameters is outlined below in Table 2.

Table 2 - Individual Rainwater Tank Parameters

Volume below overflow	40kL
Surface Area	18m^2
Initial Volume	20kL
Overflow Pipe Diameter	150mm
Daily Reuse Demand	0.925kL

Driveway Areas

Proposed residential driveways will be constructed with surface runoff from the driveway areas flowing towards an adjacent vegetated buffer area. Once runoff passes through the vegetated buffer area runoff will fall towards the natural watercourses. The below images illustrate the assumed parameters for this treatment train.

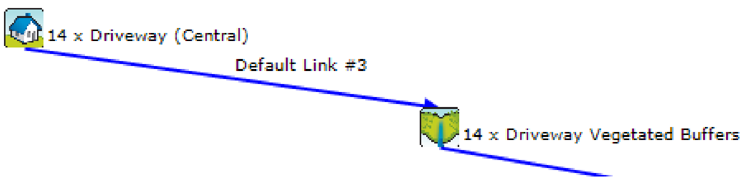

Figure 14 - Residential Lot Driveway Area Treatment Train Arrangement

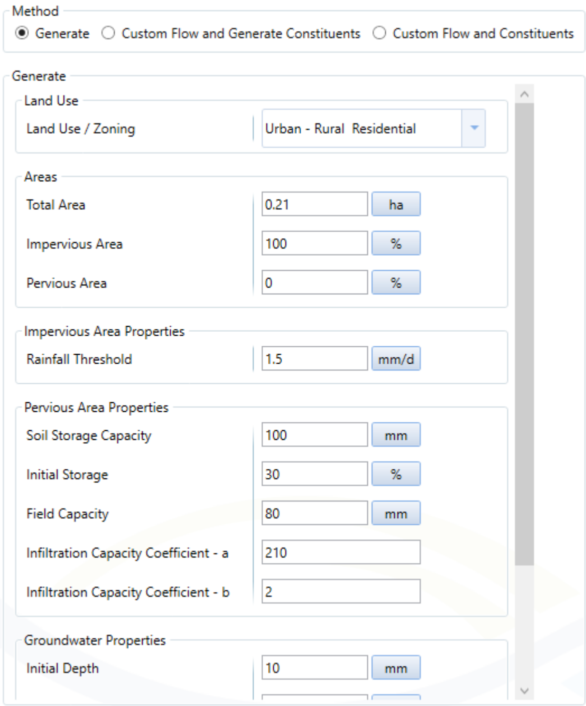

Figure 15 - Residential Driveway Area Source Node

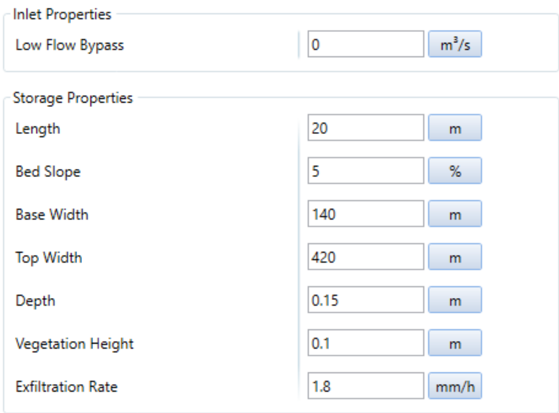

Figure 16 - Vegetated Buffer Geometrical Parameters

Similarly, the above nodes represent the combination and idealisation of the proposed treatment train across 14 of the proposed residential lots. The width of the vegetated buffer has again been multiplied by 14. A breakdown of the individual lot driveway treatment parameters is outlined below in Table 3.

Table 3 – Individual Driveway Vegetated Buffer Parameters

Length	20m
Bed Slope	5.0%
Base Width	10m
Top Width	30m
Depth	0.15m
Vegetation Height	0.10m
Exfiltration Rate	1.8mm/hr

Landscaped Areas

The remaining areas not covered by the 500m²/lot of roof and 150m²/lot of driveway have been modelled as pervious rural residential nodes. The remaining areas for the combined lots have again been grouped together. Runoff from these areas will be conveyed directly to the natural watercourses. The below images illustrate the assumed parameters for this source node only as there is no primary treatment of this runoff.

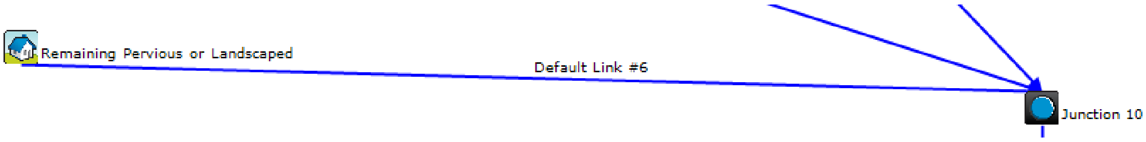

Figure 17 - Residential Lot Landscaped Area Arrangement

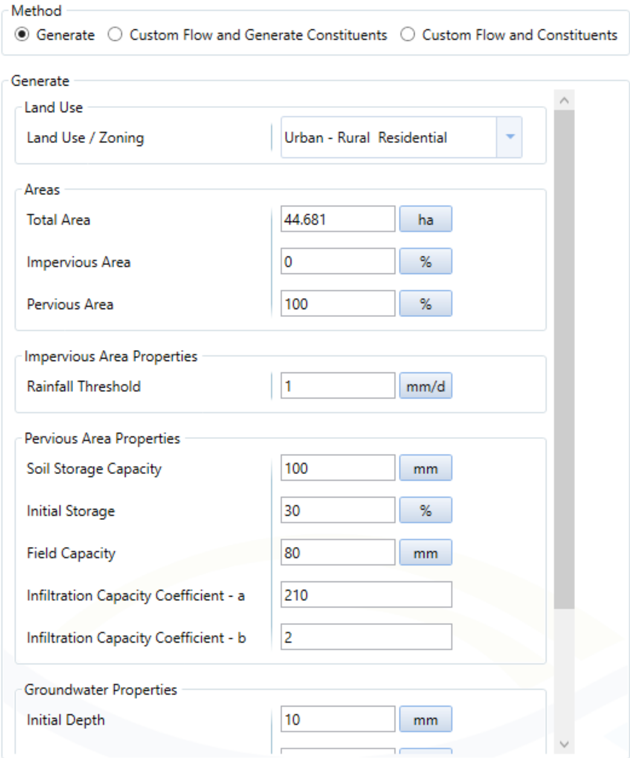

Figure 18 - Residential Landscaped Area Source Node

2.1.1 Road Reserves

Proposed road reserves will be constructed as illustrated in the typical sections, see

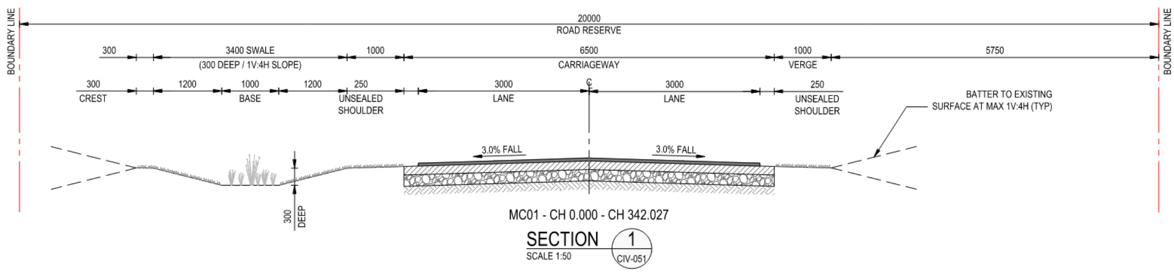

Figure 3, 4 and 5 above. The road reserves are all 20m in width, with 6m of the carriageway made up of a sealed pavement and the remaining 14m made up of grass lined swales on the high side and vegetated verges on the low side. The grass lined swale and vegetated verge areas will provide primary treatment to runoff from the roadway prior to entering the natural watercourses. The total areas of roadway in each catchment has been split into two equal source node catchments with half of the catchment being treated by a grass lined swale, and the other half being treated by a vegetated buffer. The grass lined swale was modelled as the total length of the proposed roadway and the vegetated buffer was modelled with a width equal to the total length of MC01. The road reserve areas have been modelled as using the Urban Sealed Road source node. The below images illustrate the assumed parameters for this treatment train.

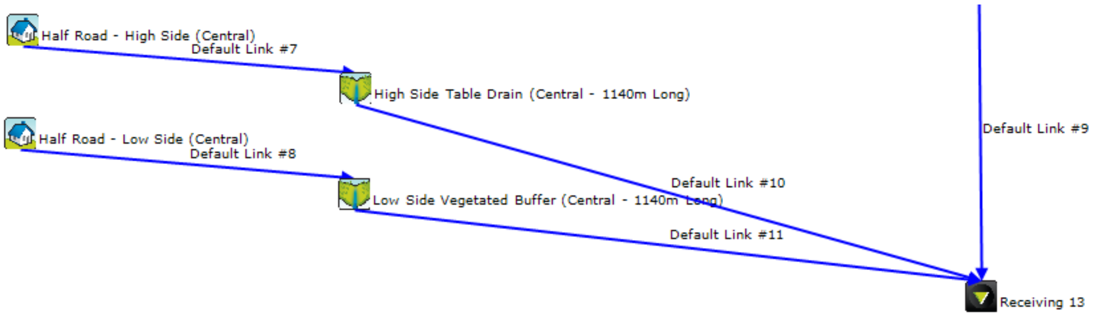

Figure 19 – Road Reserve (MC01) Treatment Train Arrangement

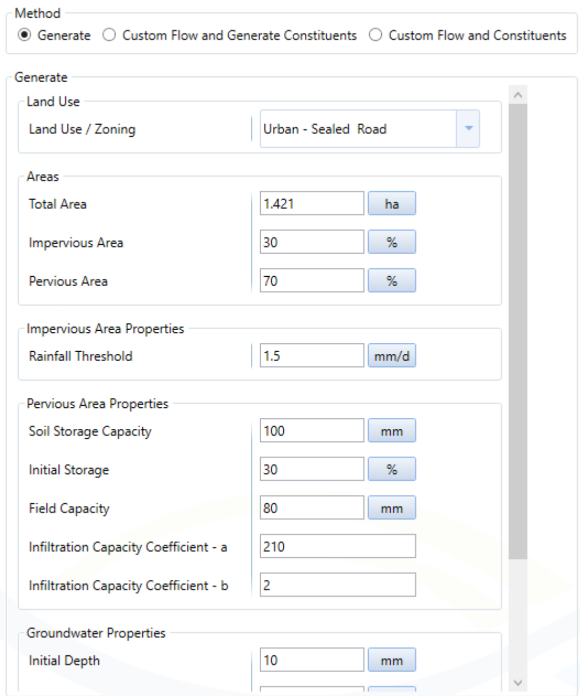

Figure 20 - Road Reserve (MC01) Half Road Width Source Node

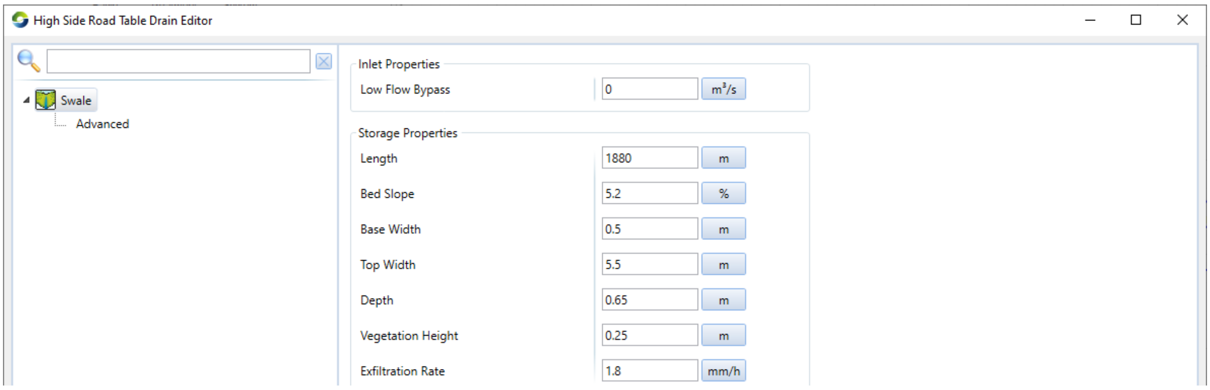

Figure 21 – High Side Swale Geometrical Parameters

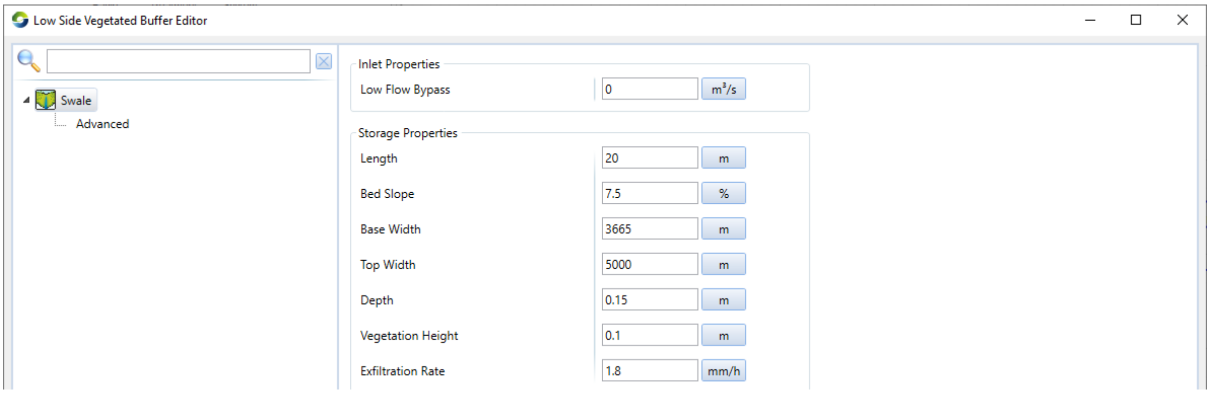

Figure 22 – Low Side Vegetated Buffer Geometrical Parameters

2.1.1 End of Line Subdivision Treatment

Based on recent feedback received from NRAR, no end of line treatment measures have been proposed. On lot treatment measures have been incorporated into the subdivision design to ensure NorBE targets are achieved.

2.2 MUSICX Results

The screenshot below shows the simplified MUSICX model and results. A table showing the comparison between pre-development and post-development pollutant loads is also shown below for clarity. The MUSICX file will be provided with this submission for Council's review.

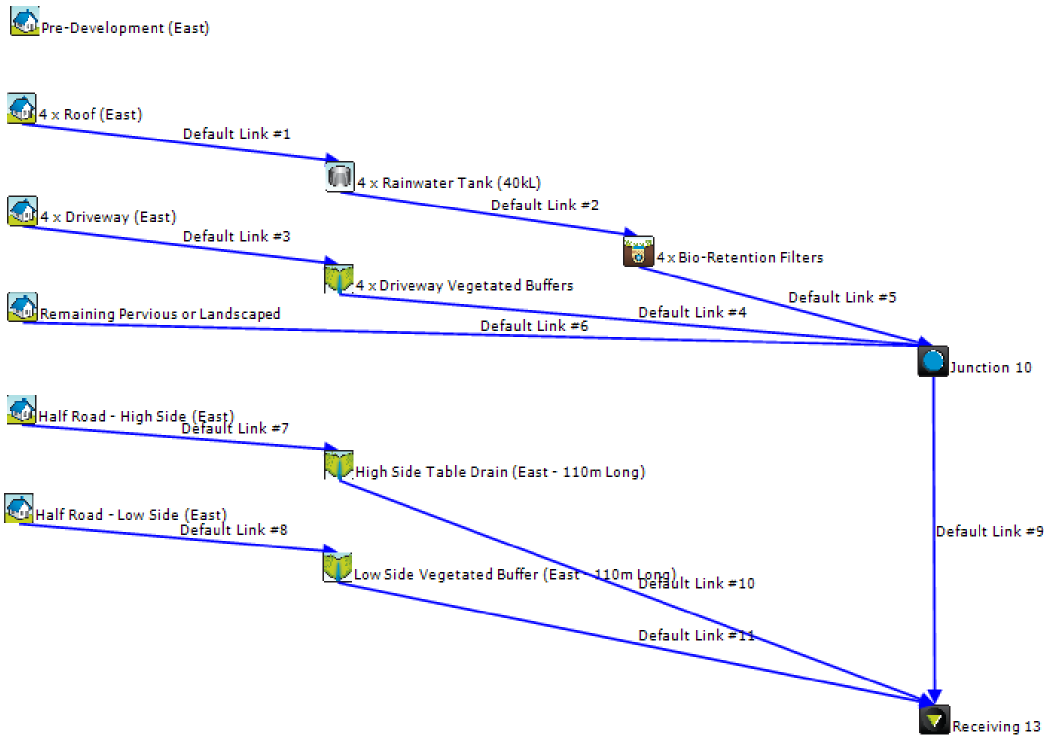

Figure 23 - Overall MUSICX Model Screenshot

Pre-Development vs Post Development Pollutant Loads Western Catchment			
Development Scenario	Pre-Development	Post-Development	Difference
Total Suspended Solids (kg/yr)	1298	1191	-9%
Total Phosphorus (kg/yr)	3.01	2.85	-6%
Total Nitrogen (kg/yr)	27.6	27.6	0%
Gross Pollutants (kg/yr)	0	0	-

Pre-Development vs Post Development Pollutant Loads Central Catchment			
Development Scenario	Pre-Development	Post-Development	Difference
Total Suspended Solids (kg/yr)	7996	7608	-5%
Total Phosphorus (kg/yr)	19.34	19.00	-2%
Total Nitrogen (kg/yr)	181.2	178.1	-2%
Gross Pollutants (kg/yr)	0	0	-

Pre-Development vs Post Development Pollutant Loads Eastern Catchment			
Development Scenario	Pre-Development	Post-Development	Difference
Total Suspended Solids (kg/yr)	1276	804	-59%
Total Phosphorus (kg/yr)	2.95	1.93	-53%
Total Nitrogen (kg/yr)	28.2	18.2	-55%
Gross Pollutants (kg/yr)	0	0	-

3 STORMWATER QUANTITY MANAGEMENT

A DRAINs model was developed to determine the pre-development and post-development peak flow rates from the proposed subdivision. The DRAINs model used the ARR 2019 Initial loss - Continuing loss (IL/CL) hydrological model and 2016 IFD data which is the current preferred modelling methodology, especially when considering large rural catchments. The Hydrological model parameters were determined using the ARR data hub and are shown below. Note the continuing loss has been factored by 0.4 in line with typical ARR guidance where more accurate data is not available. A copy of the DRAINS model has been provided with this submission for Council assessment.

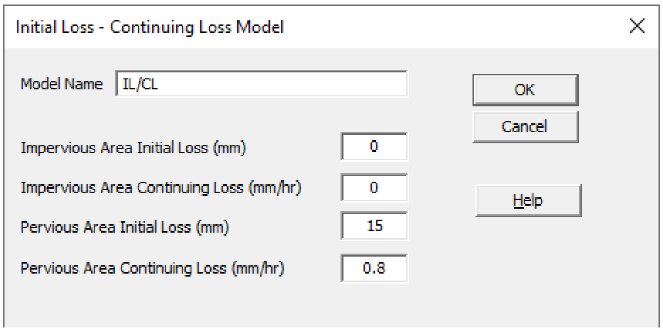

Figure 24 - IL/CL Hydrological Model Parameters

3.1 PRE-DEVELOPMENT PEAK FLOWS

Due to the scale of the predevelopment catchment and the various contributing sub-catchments draining to 3 different discharge points, the catchment was split into 3 sub-catchments for the pre-development scenario and 3 sub-catchments for the post-development scenario. A screenshot of the assumed breakup is shown below in Figure 25, and the pre-development catchment plan is shown on drawing 200380-CIV.351.

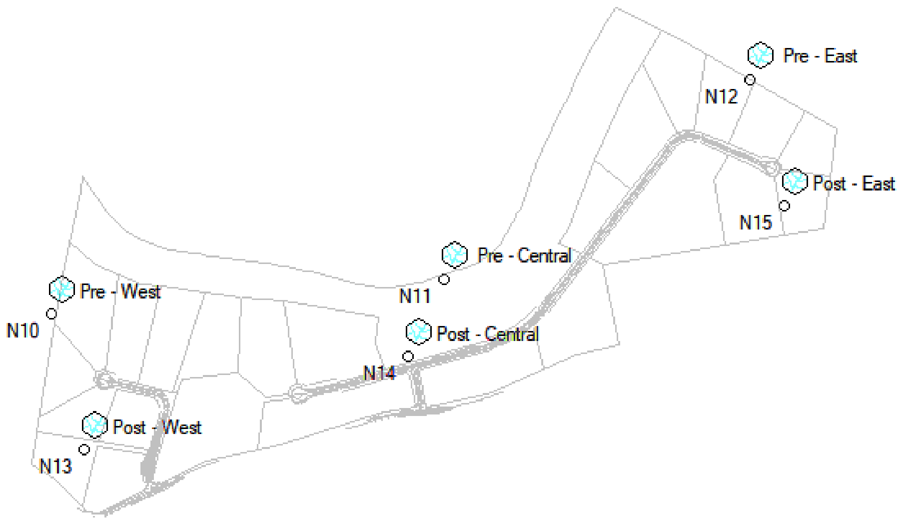

Figure 25 - Pre-Development Catchment Layout

200380-CIV.351 also shows the assumed catchment parameters used in the stormwater runoff modelling. An example of one of the catchments (Pre-Central) is shown below in Figure 26. All pre-development and post-development modelling was undertaken using the Full Unsteady Hydraulic modelling processes.

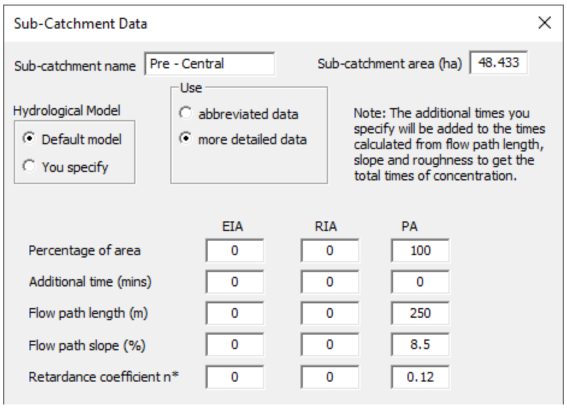

Figure 26 - Pre-Development Catchment Pre-Central parameters

The model was assessed in the 20%, 10%, 5%, 2% and 1% Annual Exceedance Probability (AEP) events and considered the following storm bursts. It's worth noting that initial assessments were undertaken to determine the critical storm duration for the greenfield catchment. It was found that the 45-minute storm duration caused the peak pre-development runoff conditions. As a result, the storm durations assessed during each model run was limited to the below values to reduce modelling time without losing peak flow rate accuracy.

5 minutes	20 minutes	1 hour
10 minutes	45 minutes	3 hours

3.2 Post-Development Peak Flows

The post-developed site conditions have been idealised based on the combined proposed land use in a similar way to those adopted in the MUSICX modelling. Drawing 200380-CIV.352 shows the break-up of the post-development catchments assumed in the design modelling. An example of a post-development catchment (Post-Central) is shown below in Figure 27. Impervious development was assessed using the Remaining Impervious Area (RIA) option as runoff from the developments will not be directly connected to a formalised drainage network.

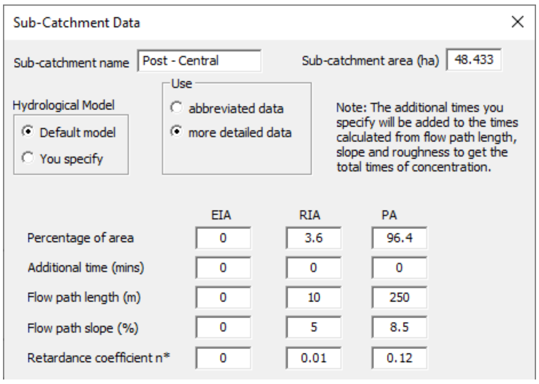

Figure 27 - Post-Development Catchment Post-Central parameters

3.3 DRAINS RESULTS

As was mentioned above, the critical storm duration generating the largest peak flows was generally found to be the 45-minute storm burst. A table showing the comparison between pre-development and post-development peak flow rates is shown below for clarity.

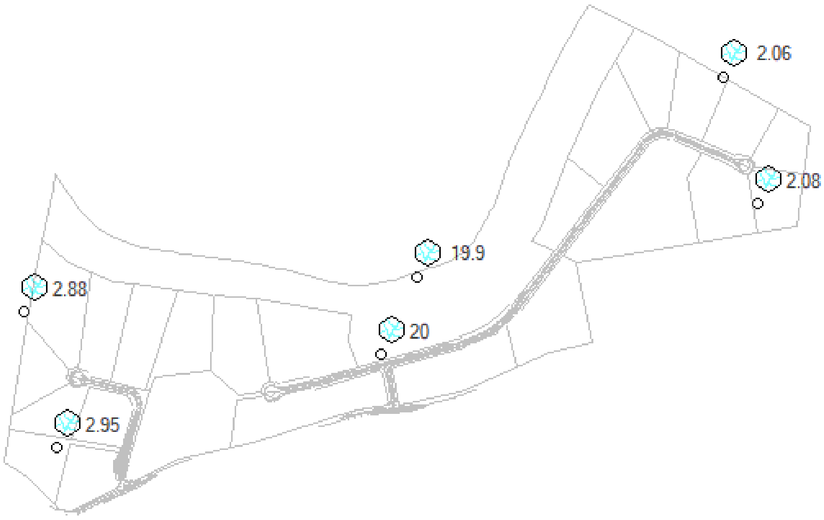

Table 4 - Pre-Development vs. Post-Development Runoff Comparison

Pre-Development vs Post Development Weatern Catchment Peak Flow Rates (m^3/s)			
AEP Storm Event	Pre-Development	Post-Development	Difference
$Q_{20\%}$	1.012	1.026	0.014
$Q_{10\%}$	1.215	1.215	0.000
$Q_{5\%}$	1.552	1.582	0.030
$Q_{2\%}$	2.152	2.185	0.033
$Q_{1\%}$	2.879	2.901	0.022

Pre-Development vs Post Development Weatern Catchment Peak Flow Rates (m^3/s)			
AEP Storm Event	Pre-Development	Post-Development	Difference
$Q_{20\%}$	7.359	7.360	0.001
$Q_{10\%}$	8.808	8.935	0.127
$Q_{5\%}$	11.870	12.000	0.130
$Q_{2\%}$	16.459	16.599	0.140
$Q_{1\%}$	19.940	19.940	0.000

Pre-Development vs Post Development Weatern Catchment Peak Flow Rates (m^3/s)			
AEP Storm Event	Pre-Development	Post-Development	Difference
$Q_{20\%}$	0.751	0.751	0.000
$Q_{10\%}$	0.893	0.918	0.025
$Q_{5\%}$	1.204	1.229	0.025
$Q_{2\%}$	1.669	1.697	0.028
$Q_{1\%}$	2.063	2.063	0.000

Through the hydraulic modelling prepared, it was found that small increases in runoff were expected, commensurate with the scale of development proposed. The increase in impervious area across the three catchments ranges between 3.64% and 6.87%, inclusive of all roof, driveway and new road reserves. Due to the scale of the site, it was found that the increase in RIA impervious area had a minor effect on the calculations as this constituted such a small portion of the overall site. It was noted that alterations to the PA pervious area data had a significant impact on the expected post-development runoff, however due to the nature of the development, it is unlikely that any new development would undertake significant earthworks which would alter the site hydrology. Due to the complexity associated with the construction and maintenance of end of line basins in the road reserve or council drainage reserves, it is proposed that no formal end of line basins be incorporated to manage the minor changes in flows. It is expected with the provision of flood modelling for the site, that these minor changes will be considered negligible and acceptable in the context of the flow rates within the 15 streams across the site.

Notwithstanding, in order to provide some form of mitigation measure across the proposed subdivision, it is proposed that the new residential developments are to provide on lot detention storage to reduce the overall impact of runoff from the development. Th on-lot detention is proposed to be in the form of leaky tank systems. Figure 28 below shows how this arrangement would work on a per lot basis. A range of pre to post runoff results are outlined below showing how each lot may over-detain roof runoff to cater for any increase in runoff due to the driveway areas bypassing the detention volume based on the area of proposed development. This modelling arrangement is included in the DRAINS model provided to Council for review.

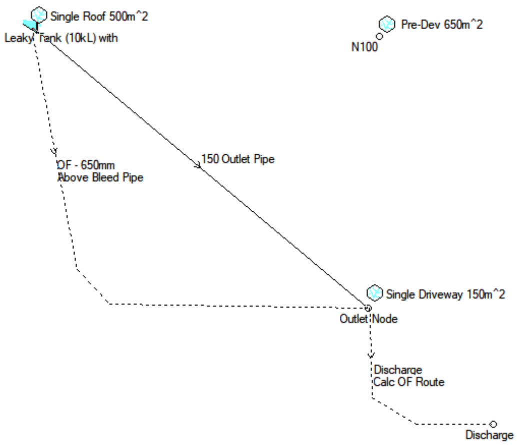

Figure 28 - Individual Lot Detention Model Excerpt

Pre-Development vs Post Development Individual Lot Peak Flow Rates (L/s)			
AEP Storm Event	Pre-Development	Post-Development	Difference
$Q_{20\%}$	18	12	-6
$Q_{10\%}$	22	13	-9
$Q_{5\%}$	26	15	-11
$Q_{2\%}$	33	18	-15
$Q_{1\%}$	44	31	-13

4 CONCLUSION

DRB Consulting Engineers has prepared this Design Management report to outline the stormwater quality and quantity strategy adopted across the proposed subdivision and outline the pre and post development runoff conditions expected using DRAINS and MUSICX modelling. Due to the low density of the proposed development, it is proposed that the subdivision adopt an on-lot approach to both water quality and quantity management. It was found that the provision of on lot water quality management, along with natural roadside treatments for the road reserves, was sufficient to achieve NorBE targets for the proposed subdivision. It was found that the density of the development resulted in a negligible increase in runoff across the subdivision. Further, it is proposed that smaller on-lot treatments be required on individual development lots to help mitigate any changes in the existing runoff regime. It is anticipated that the provision of detailed flood modelling for the site will show that the changes in runoff regime from the site will have a negligible impact on flooding across the site, or downstream of the subdivision.

Should you require any further advice or clarification of any of the above, please do not hesitate to contact us.

Yours faithfully

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