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Conceptual Stormwater Management Report

Client: Victor Di Ruggiero
Project Address: No. 117-119
Main Street, Westbrook

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1. Introduction

This report has been prepared to investigate the post-development impacts associated with localised stormwater runoff from the proposed development site located at No. 117-119 Main Street, Westbrook.

The proposed development will involve reconfiguring of the land to create twenty (20) total allotments. The proposed general layout of the site development is documented on the following:

- (i) Survey Plan – Plan Ref No K4090 which was prepared by Ken Wilson Surveyors
- (ii) Reid Consulting Engineers Pty Ltd Drawing No. 13472 Sheets D01 to D06

This report quantifies the peak stormwater runoff associated with the pre-and post-development site. A Stormwater Management solution is proposed which complies with Council's Planning Policy requirements, the Queensland Urban Drainage Manual, and with normally accepted engineering principles.

1.1. Basis of Report

This stormwater management report has been prepared upon the basis of:

- (i) Modelling and calculations completed in accordance with normally accepted engineering principles and practices
- (ii) Compliance with the intent of normally accepted principles, codes and policies including the Toowoomba Regional Council Planning Scheme Policy.
- (iii) Compliance with the general intent of *The Queensland Urban Drainage Manual* (QUDM 2016).
- (iv) Compliance with the general intent of *The Australian Rainfall and Runoff Guidelines 2016* publication.
- (v) Stormwater network design modelling prepared using 12d Model, utilising the Rational Method of Hydrology.
- (vi) Queensland State Planning Policy 2018 (SPP2018).
- (vii) Detailed topographical survey and site evaluations.

2. Site Parameters and Hydrology (Stormwater Quantity Management)

2.1. Site Location and Description

The development site is located at No. 117-119 Main Street, Westbrook. The subject site is currently vacant.

The stormwater runoff generated on the subject site generally discharges across the southern property boundary of the development site through the process of relatively uniform overland stormwater sheet flow.



Figure 2-1 Site Locality

2.2. Design Event and Modelling Approach

Section 7.1 *Urban Drainage* of the QUDM highlights the concept of the major and minor drainage system with the design to avoid the likelihood of damage/nuisance as well as providing protection of life and property. It is then considered that the 0.5EY, 5%AEP and 1%AEP design events are the most appropriate design storms to be investigated for the residential development.

The hydrological analysis adopted within this study utilises the *Rational Method of Hydrology* as defined in the QUDM. This method is considered as the most appropriate approach because of the relative simplicity and small nature of the stormwater catchment areas involved. Stormwater runoff will be collected and discharged freely through a proposed drainage easement.

The design rainfall data adopted for stormwater modelling was obtained from the Bureau of Meteorology's website, selecting Westbrook as the source. (Refer Appendix 2 for peak rainfall intensities associated with the adopted time of concentration.)

The proposed stormwater management solution documented within the design drawings provides a solution to discharge the stormwater from the post-development site generally in accordance with pre-development conditions. On this basis, the Rational Method of Stormwater Management has been adopted as a method recognised within the QUDM for this application.

2.3. Lawful Point of Discharge - Test

Section 3.9.1 *Lawful point of discharge test* of the QUDM highlights criteria to be achieved when assessing that the proposed discharge location for a development is a "lawful point of discharge". The lawful point of discharge adopted for this development is the location nominated as Point C on drawing D01 and D02. Point C is located within the existing Gore Highway road reserve, immediately upstream of existing culverts which drains stormwater under the Gore Highway.

Section 3 of this report details the expected additional quantity of peak stormwater runoff. This peak stormwater runoff is within acceptable limits and does not result in an actionable nuisance when the erosion and scour protection measures (as detailed within the conceptual drawings noted within appendix 1) are implemented.

2.4. External Catchment

The development site has one external catchment area which is depicted in Appendix 1. Stormwater generated from the external catchment areas is currently accepted into the development site in the form of overland sheet flow.

Stormwater runoff from external catchments will continue to be accepted into the site during post-development conditions and will be largely captured in the proposed drainage reticulation network.

2.5. Pre-Development Assessment

The pre-development stormwater drainage characteristics of this site may be described as follows:

- (i) The subject site is currently vacant.
- (ii) The stormwater drainage generated on the subject site and associated upper catchment area discharges across the south/eastern property boundary through the process of overland stormwater sheet flow.
- (iii) The stormwater runoff from the development site and associated upper catchment area enters an existing culvert under Main Street (depicted as Point A on sheet D01 & D02) and discharges into an existing drainage easement located within No.118 Main Street (Lot 21/22 SP287013). Stormwater runoff then continues, generally in a sheet flow drainage condition, before entering the Gore Highway road reserve.
- (iv) Stormwater runoff generated from the development site and associated upper catchment area which are in excess of the capacity of the existing culvert under Main Street, currently bypasses the culvert and continues east along Main Street.
- (v) Stormwater runoff associated with the development site, upper catchment and external catchment ultimately enters the Gore Highway road reserve before being drainage by the existing culverts under the Gore Highway.

To quantify the magnitude of the pre-development flows leaving the site (across the eastern property boundary), assessment *Line X* (as defined on Drawing No. 13472 Sheet D05) has been utilised.

To quantify the magnitude of the pre-development flows leaving the site and entering the existing culvert under Main Street, assessment Point A (as defined on Drawing No. 13472 Sheet D01) has been utilised.

To quantify the magnitude of the pre-development flows bypassing the existing culvert under Main Street (Flows in excess of culvert capacity), assessment Point B (as defined on Drawing No. 13472 Sheet D01) has been utilised.

To quantify the magnitude of the pre-development flows entering the Gore Highway Road reserve, before being drained by the existing culverts under the Highway, assessment Point C (as defined on Drawing No. 13472 Sheet D01) has been utilised.

2.6. Post-Development Assessment

The proposed development will involve reconfiguring of the land to create twenty (20) residential allotments. This development will include the construction of road pavement, kerb and channelling, road drainage pipework and stormwater drainage channels.

The post-development stormwater runoff characteristics of the site will alter pre-existing drainage conditions in the following manner:

- (i) The magnitude of peak stormwater runoff leaving the site will increase due to the increase in impervious areas.
- (ii) It is proposed that stormwater runoff from the proposed development (including associated upper catchment) will be collected into a network of stormwater gully inlets and the underground drainage system. Stormwater will then be conveyed underground via pipework to the *lawful point of discharge*. (Refer this firm's Drawing No. 13472 Sheets D01-D06 for details of the proposed stormwater management solution).

To quantify the magnitude of the post-development flows entering and leaving the site, the following key location has been investigated:

- (i) To quantify the magnitude of the post-development flows leaving the site, assessment *Line X* (as defined on Drawing No. 13472 Sheet D02) has been utilised.
- (ii) To quantify the magnitude of the post-development flows in excess of the proposed underground drainage network which is proposed to bypass the system and continue east along Main Street (generally in accordance with pre-development conditions), assessment Point B (as defined on Drawing No. 13472 Sheet D02) has been utilised.
- (iii) To quantify the magnitude of the post-development flows entering the Gore Highway Road reserve, before being drained by the existing culverts under the Highway, assessment Point C (as defined on Drawing No. 13472 Sheet D02) has been utilised.

3. Results (Stormwater Quantity Management)

Post-development stormwater flows have been analysed utilising the Rational Method of Hydrology. These flows are summarised and compared to the pre-development conditions as follows:

| Station | Description | Design Event | | | Comments |
|---------|------------------|-----------------|-----------------|-----------------|--|
| | | 0.5 EY (l/s) | 5% AEP (l/s) | 1% AEP (l/s) | |
| Line X | Pre-Development | 103.8 | 205.1 | 310.0 | OK - Reduction |
| | Post-Development | 24.6 | 49.9 | 76.1 | |
| Point A | Pre-Development | 270.5 | 530.3 | 796.9 | Increase in peak stormwater runoff following increase in impervious area - Acceptable following collection with drainage network |
| | Post-Development | 420.0 | 825.8 | 1,243.5 | |
| Point B | Pre-Development | 0.0 | 80.3 | 346.9 | Minor increase - Acceptable |
| | Post-Development | 0.0 | 98.0 | 416.0 | |
| Point C | Pre-Development | 478.7 | 848.8 | 1,039.0 | Minor increase - Acceptable. Refer section 4.0 |
| | Post-Development | 593.7 | 1,062.3 | 1,323.5 | |

Table 3-1 - Hydrological Results

4. Lawful Point of Discharge - Validation

Section 2.3 of this report highlights the Gore Highway road reserve as the lawful point of discharge for the development site. Validation of the stormwater management proposal is provided by ensuring that, following construction of the proposed subdivision, no actionable nuisance relating to stormwater runoff occurs. It is proposed that this is achieved by ensuring the following:

- (i) The culverts under the Gore Highway can adequately cater for the increase in peak stormwater runoff.
- (ii) Erosion and scour protection measures are installed as detailed within the conceptual drawings noted within appendix 1.

4.1. Gore Highway Culvert Capacity

To ensure the two DN600 culverts under the Gore Highway have sufficient capacity to cater for the increase in peak stormwater runoff, a hydraulic analysis has been undertaken using the program Culvert Studio.

As detailed within Appendix 2, the post-development 1%AEP peak flow rate from the development site and localised external catchment area can be adequately serviced by the two DN600 culverts. The analysis details the water level elevation at the inlet of the culverts as being contained below the road surface.

The hydraulic analysis details that the two DN600 have capacity for the post development flow of the catchment area defined within sheet D01 & D02, however, the terrain is such that major storm flow of this magnitude will be serviced by a number of culverts east and west of the assessment Point C highlighted within this report. The culvert hydraulic assessment is considered conservative.

5. Stormwater Quality Management

5.1. Treatment Objectives

The development site area exceeds 2,500 square metres and is situated in a region with a population base which exceeds 25,000 persons. Compliance with the State Government Planning Policy for Water Quality Provisions is therefore necessary.

The State Planning Policy details the requirements for removal of solids and nutrients from stormwater leaving the site and specifies that the following treatment targets are met:

| | | |
|-------|-----------------------------------|-----|
| (i) | Removal of Gross Pollutants | 90% |
| (ii) | Removal of Total Suspended Solids | 85% |
| (iii) | Removal of Phosphorous | 60% |
| (iv) | Removal of Nitrogen | 45% |

5.2. Modelling Approach

The stormwater quality management proposal nominated within this report has been formulated using the modelling software MUSIC. The model has adopted a bio-retention system to meet the water quality treatment targets and has been based on the following parameters:

| | |
|---------------------------------|-------------------------|
| Rainfall Station | 41467 |
| Return period | 01/01/1961 - 31/12/1970 |
| Number of allotments | 20 |
| Impervious area per allotment | |
| (i) House | 280 m2 |
| (ii) Shed | 54 m2 |
| (iii) Driveway | 80 m2 |
| Total | 414 m2 |
| Footpath | 290 m2 |
| Pavement (Inc Kerb and Channel) | 1,800 m2 |
| Total | 2,090 m2 |
| Total treatment area | 10,370 m2 |

Reuse

| | | | |
|------|--|-------|--------|
| (i) | 5,000L Rainwater tank per allotment (Capturing only 100sqm per tank) | 2,000 | m2 |
| (ii) | Reuse per tank per day <ul style="list-style-type: none"> TRC water consumption target 175 L/p/d 3.2 EP/ET - 2016 Census Adopt half of TRC water consumption target using rainwater | 5.6 | kL/day |

Treatment train

| | | | |
|-------|--------------------------|--------|----|
| (i) | Total roof area | 4,680 | m2 |
| (ii) | Total roof area to tanks | 2,000 | m2 |
| (iii) | Total driveways area | 1,600 | m2 |
| (iv) | Total pavement and kerb | 2,090 | m2 |
| Total | | 10,370 | m2 |

5.3. Modelling Results

As detailed within appendix 3 it is proposed that a bio-retention basin is adopted as the treatment device to meet the quality targets highlighted above. It is demonstrated that a basin with a surface area of 69 square metres would be sufficient to achieve the following outcomes:

| | | |
|-------|-------------------------------------|-------|
| (i) | Reduction of Gross Pollutants | 100% |
| (ii) | Reduction of Total Suspended Solids | 85.6% |
| (iii) | Reduction of Phosphorous | 77.4% |
| (iv) | Reduction of Nitrogen | 53.9% |

5.4. Voluntary Contribution Proposal

The developer has instructed this firm to request Council to consider a proposal to accept a financial contribution in lieu of constructing the bio-basin.

It is understood that such a proposal may be favourably considered with the financial contribution paid to Council being used at some later date as part of the cost of the construction for more wide serving treatment infrastructure, possibly located elsewhere within the Toowoomba Regional area, but still nevertheless serving the greater Toowoomba Regional area.

It is understood that Council may favourably consider a contribution of \$440.00 per square metre of bio-basin (otherwise required) plus a \$500.00 application fee.

The area of bio-detention calculated to be required is 69 square metres. This requirement has been assessed using a MUSIC modelling approach.

It is proposed to offer Toowoomba Regional Council the following financial contribution in lieu of providing on-site quality treatment:

| | | |
|------|---|-------------|
| (i) | Application fee (including GST) | \$ 500.0 |
| (ii) | Cost in lieu of basin, \$440.00 per square metre × 69m ² | \$ 30,360.0 |
| | Total | \$ 30,860.0 |

6. Conclusion

We consider that it has been demonstrated that there will be a *non-worsening* of peak stormwater flow conditions draining across neighbouring eastern property boundary during post development conditions as highlighted at the *Line X* investigation point.

The estimated peak increase in stormwater flows leaving the site is not considered to warrant the provision of any on-site stormwater detention following the construction of the proposed drainage network. The bypass flows of peak stormwater in excess of the proposed underground drainage network at Point B, is considered generally in accordance with existing conditions and will not result in an actionable nuisance to downstream property or asset owners

The effects of the additional peak stormwater flows discharging from the site, noted at the *Point A* investigation point is considered to be within reasonable expectations and is considered to comply with the Toowoomba Regional Council Planning Scheme. The estimated peak increase in stormwater flows leaving the site at this location is not considered to warrant the provision of any on-site stormwater detention and will not result in an actionable nuisance to the downstream property owner following construction of the stormwater drainage network.

The effects of the additional peak stormwater flows discharging from the site, noted at the *Point C* investigation point is considered to be within reasonable expectations. The estimated peak increase in stormwater flows leaving the site at this location is not considered to warrant the provision of any on-site stormwater detention and will not result in an actionable nuisance to Gore Highway road reserve.

As detailed within Appendix 2, the post-development 1%AEP peak flow rate from the development site and localised external catchment area can be adequately serviced by the two DN600 culverts. The analysis details the water level elevation at the inlet of the culverts as being contained below the road surface.

This report demonstrates that when the stormwater management system proposed on this firm's Drawing No. 21659 Sheets D01-D05 is implemented, a satisfactory stormwater management solution which complies with Council's Planning Policy requirements, the QUDM and with normally accepted engineering principles will have been achieved.

7. Appendices

7.1. Appendix 1 – Drawing No. 13472 Sheets D01-D06

7.2. Appendix 2 – Gore Highway Culvert Hydraulic capacity

Culvert Report

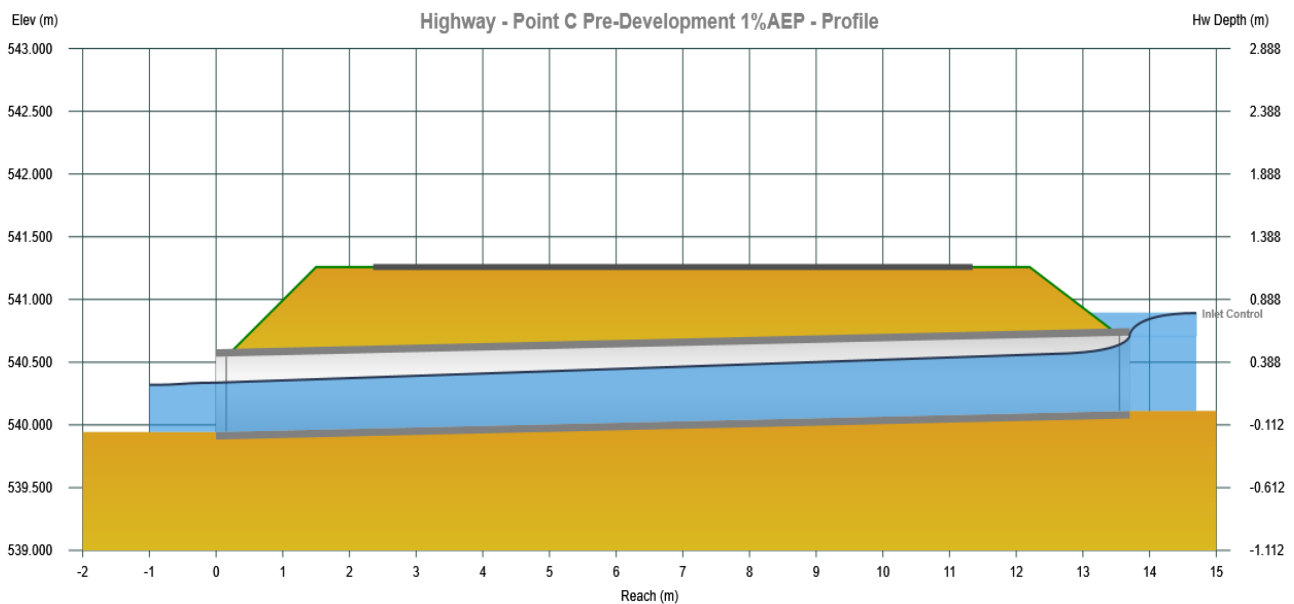
Highway - Point C Pre-Development 1%AEP

Culvert 2

| | | | |
|-------------------|-------------|---------------------|----------------|
| CULVERT | | EMBANKMENT | |
| Shape | = Circular | Top Width | = 10.700 m |
| Inlet Edge | = Beveled | Top Elevation | = 541.259 m |
| Material | = Concrete | Crest Length | = 10.000 m |
| Manning's n | = 0.012 | DISCHARGE | |
| Rise | = 600 mm | Method | = Qmin to Qmax |
| Span | = 600 mm | Q Min | = 0.050 cms |
| Invert Elev. Down | = 539.944 m | Q Max | = 2.000 cms |
| Length | = 13.7 m | Q Increment | = 0.050 cms |
| Slope | = 0.012 m/m | TAILWATER | |
| Invert Elev. Up | = 540.112 m | Tailwater Elevation | = Normal Depth |
| No. Barrels | = 2 | | |
| Plan Skew Angle | = 0 degrees | | |

CALCULATION SAMPLE

| Discharge | | | Velocity | | Depth | | HGL @ Hw/D = 1.299 | | |
|-----------|---------|----------|----------|-------|-------|------|--------------------|---------|---------|
| Total | Culvert | Over Top | Down | Up | Down | Up | Down | Up | Hw |
| (cms) | (cms) | (cms) | (m/s) | (m/s) | (mm) | (mm) | (m) | (m) | (m) |
| 1.050 | 1.050 | 0.000 | 2.677 | 2.185 | 393 | 475 | 540.337 | 540.587 | 540.892 |



Culvert Report

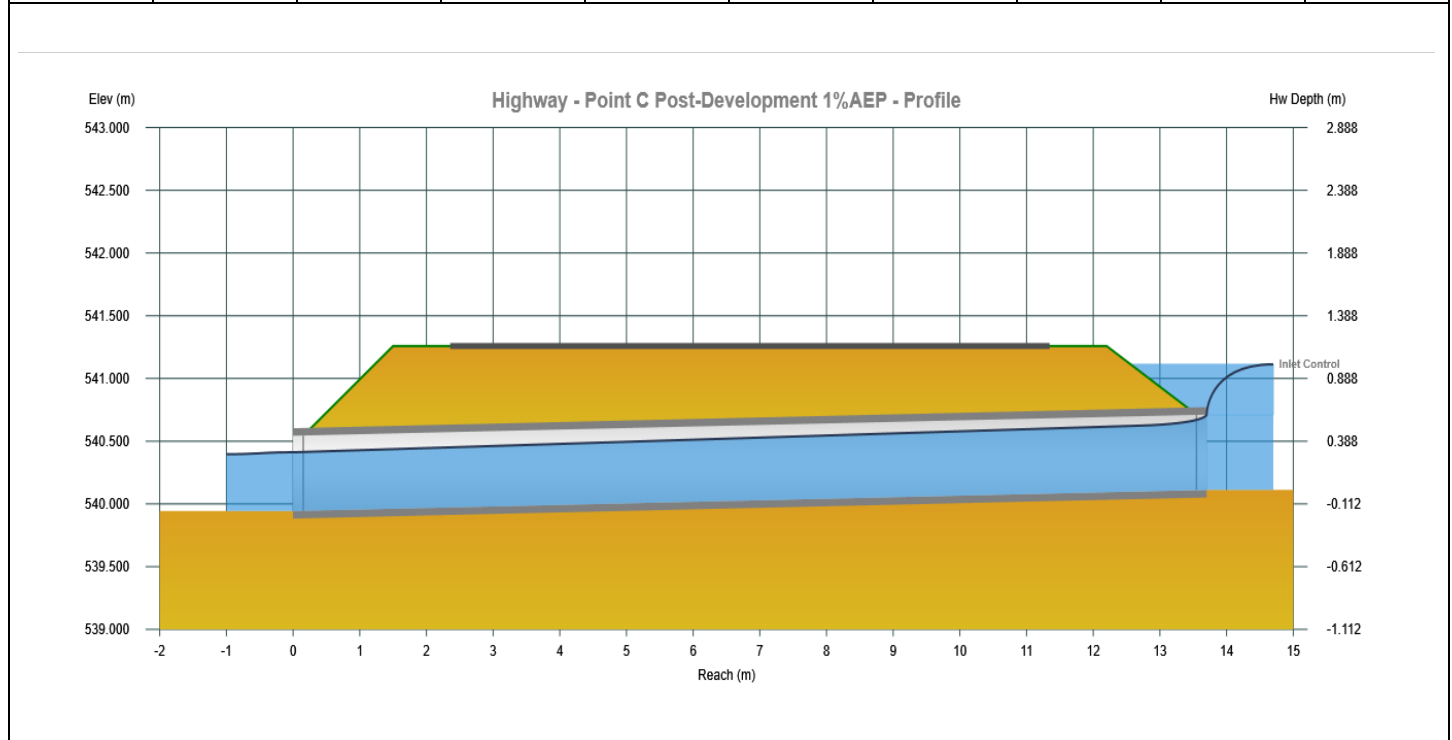
Highway - Point C Post-Development 1%AEP

Culvert 2

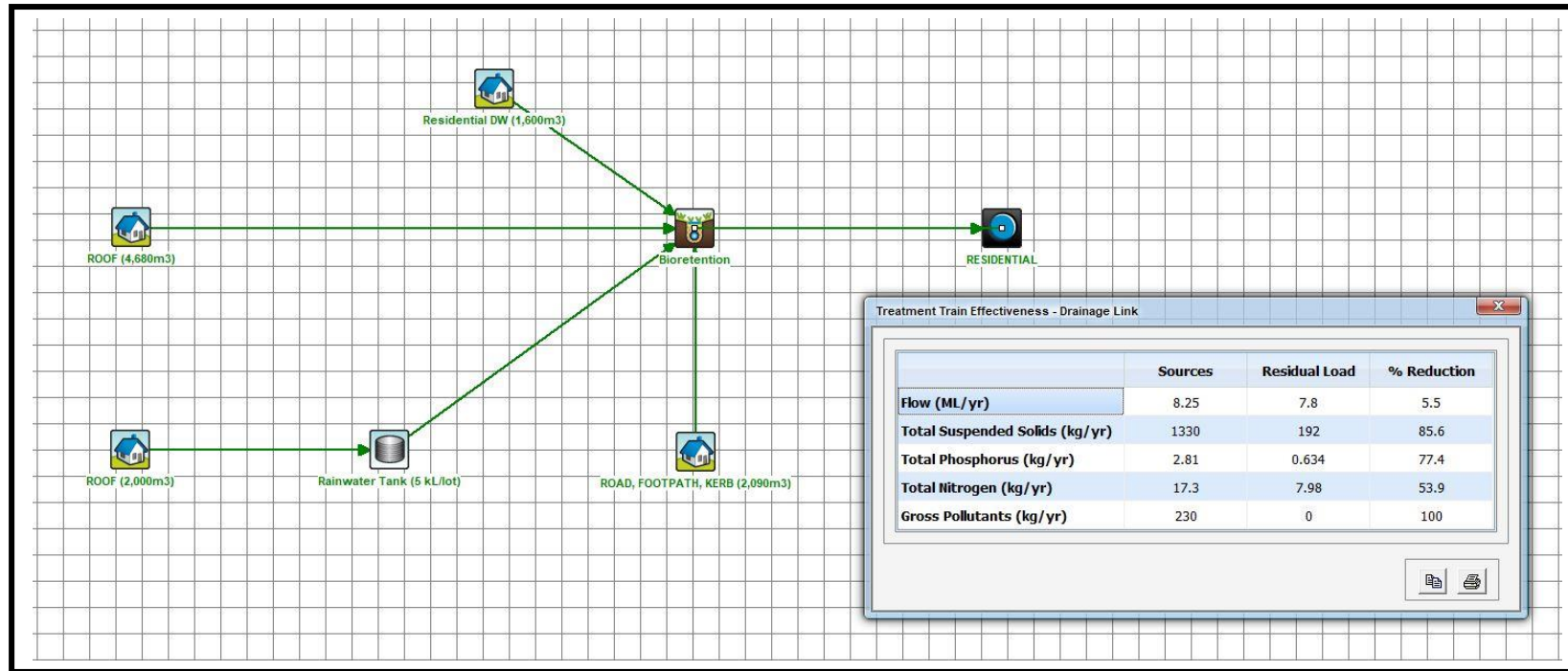
| | | | |
|-------------------|-------------|---------------------|----------------|
| CULVERT | | EMBANKMENT | |
| Shape | = Circular | Top Width | = 10.700 m |
| Inlet Edge | = Beveled | Top Elevation | = 541.259 m |
| Material | = Concrete | Crest Length | = 10.000 m |
| Manning's n | = 0.012 | DISCHARGE | |
| Rise | = 600 mm | Method | = Qmin to Qmax |
| Span | = 600 mm | Q Min | = 0.050 cms |
| Invert Elev. Down | = 539.944 m | Q Max | = 2.000 cms |
| Length | = 13.7 m | Q Increment | = 0.050 cms |
| Slope | = 0.012 m/m | TAILWATER | |
| Invert Elev. Up | = 540.112 m | Tailwater Elevation | = Normal Depth |
| No. Barrels | = 2 | | |
| Plan Skew Angle | = 0 degrees | | |

CALCULATION SAMPLE

| Discharge | | | Velocity | | Depth | | HGL @ Hw/D = 1.668 | | |
|-----------|---------|----------|----------|-------|-------|------|--------------------|---------|---------|
| Total | Culvert | Over Top | Down | Up | Down | Up | Down | Up | Hw |
| (cms) | (cms) | (cms) | (m/s) | (m/s) | (mm) | (mm) | (m) | (m) | (m) |
| 1.350 | 1.350 | 0.000 | 2.853 | 2.557 | 468 | 529 | 540.412 | 540.641 | 541.113 |



7.3. Appendix 3 – MUSIC Modelling results



MUSIC Model Properties

Storage Properties
 Extended Detention Depth : 0.25m

Filter and Media Properties
 Filter Area : 69 sqm
 Saturated Hydraulic Conductivity : 300 mm/hr
 Filter Depth : 0.60m
 TN Content of Filter Media : 300 mg/kg
 Extended Detention Depth : 0.25m