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Telford Consulting Pty Ltd

# Site Based Stormwater Management Plan

Proposed North Maclean Enterprise Precinct
4499-4651 Mount Lindesay Highway, North Maclean, 4280

Prepared For
**Economic Development Queensland/Logan City Council**

Client
**Wearco Pty Ltd**

Project No.
**TEL202159**

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| Wearco Pty Ltd | Nil |

**Disclaimer**

The advice and information contained within this report relies on the quality of the records and other data provided by the Client and obtained from Logan City Council and EDQ along with the time and budgetary constraints imposed.

# EXECUTIVE SUMMARY

This report assesses the site based stormwater quantity and quality requirements, the overland flow and the lawful point of discharge for the Proposed North Maclean Enterprise Precinct at 4499-4651 Mt Lindesay Highway, North Maclean in accordance with Economic Development Queensland Development and Logan City Council's Planning Scheme.

On-site detention and water quality treatment will be provided by one (1) detention basin with bio-retention basin incorporated at the base, for the road reserve areas.

The proposed industrial allotments will have lot-based on-site stormwater detention and water quality treatment measures to be provided by the future land owner.

All external catchment runoff will be intercepted within the property boundary and then safely conveyed towards the Lawful Points of Discharge.

A DRAINS ILSAX model was used to simulate the stormwater runoff through the site for 63% AEP, 39% AEP, 18% AEP, 10% AEP, 5% AEP, 2% AEP and 1% AEP storm events to demonstrate the 'no worsening' of the pre-development state, at the lawful points of discharge.

A MUSIC model was developed to simulate pollutant loads discharging within stormwater runoff from the site and demonstrate the compliance with the water quality objectives in accordance with current State Planning Policy.

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# 1 INTRODUCTION

Telford Consulting Pty Ltd have been commissioned to undertake a Site Based Stormwater Management Plan for the Proposed North Maclean Enterprise Precinct at 4499-4651 MT Lindesay Highway, North Maclean.

The aim of this report is to thus:

1. Identify the proposed development details;
2. Describe the existing site topography and features;
3. Identify the Lawful point of discharge;
4. Stormwater quantity management;
5. Stormwater quality management;
6. Assess erosion and sediment control;
7. *Ensure the proposed development achieves the principle of "no worsening", as per the Queensland Urban Drainage Manual and the provisions of the Economic Development Queensland Development Scheme.*

The limitations of this report are:

1. No analysis or calculations as to the capacity of the existing services have been undertaken;
2. No geotechnical investigations have been undertaken;
3. Existing services location and size have been derived from Council and Statutory Authorities' search records which have been made available;
4. The concept plans provided are preliminary only and not for construction purpose. These plans are subject to change during detailed design.
5. No field sampling or testing has been undertaken;

This report has been prepared generally in accordance with Economic Development Queensland PDA (Priority Development Area) guidelines, Logan City Council Planning Scheme and other reference documents mentioned in **Section 6** of this report.

# 2 STORMWATER QUANTITY MANAGEMENT PLAN

## 2.1 Site Details Summary

Table 2.1 provides a summary of development details for the subject site.

**Table 2.1 – Site Details / Development Summary**

| Development Details | Comments |
|---|---|
| Applicant's Name | Wearco Pty Ltd |
| Street Address | 4499-4651 MT Lindesay Highway |
| Suburb | North Maclean |
| State / Postcode | QLD / 4280 |
| Statutory Authority | Economic Development Queensland (EDQ) |
| Zoning | Industry and Business Zone |
| Development Type | Reconfiguring of a Lot (ROL – Proposed Subdivision) |
| Number of Proposed Lots | 4 |
| Current Site Area | 117.9 ha |
| Real Property Description | Lot 39 SP 258739 |

### 2.1.1 *Location / Existing Development Details*

The subject is located at 4499-4651 MT Lindesay Highway, North Maclean and has a total site area of approximately 117.9 hectares. The subject site is bound by Mount Lindesay Highway to the east, Crowson Lane to the north, existing rural residential areas to the west and Priority Development Area to the south.

The lot is zoned as Industry and Business Zone in the Greater Flagstone Priority Development Area.

The majority of the site consists of open grassed areas with scattered trees. The subject site currently contains one dwelling, two (2) sheds and one paved/gravel hardstand area.

The site is accessed from Mt Lindesay Highway to the east and from Crowson Lane to the north.

There is an overhead power line easement (EMT D on RP 125435) bisecting the site in the east-west direction.

See **Figure 2.1** below for a locality map of the site. Refer to **Appendix A** for site contour information.

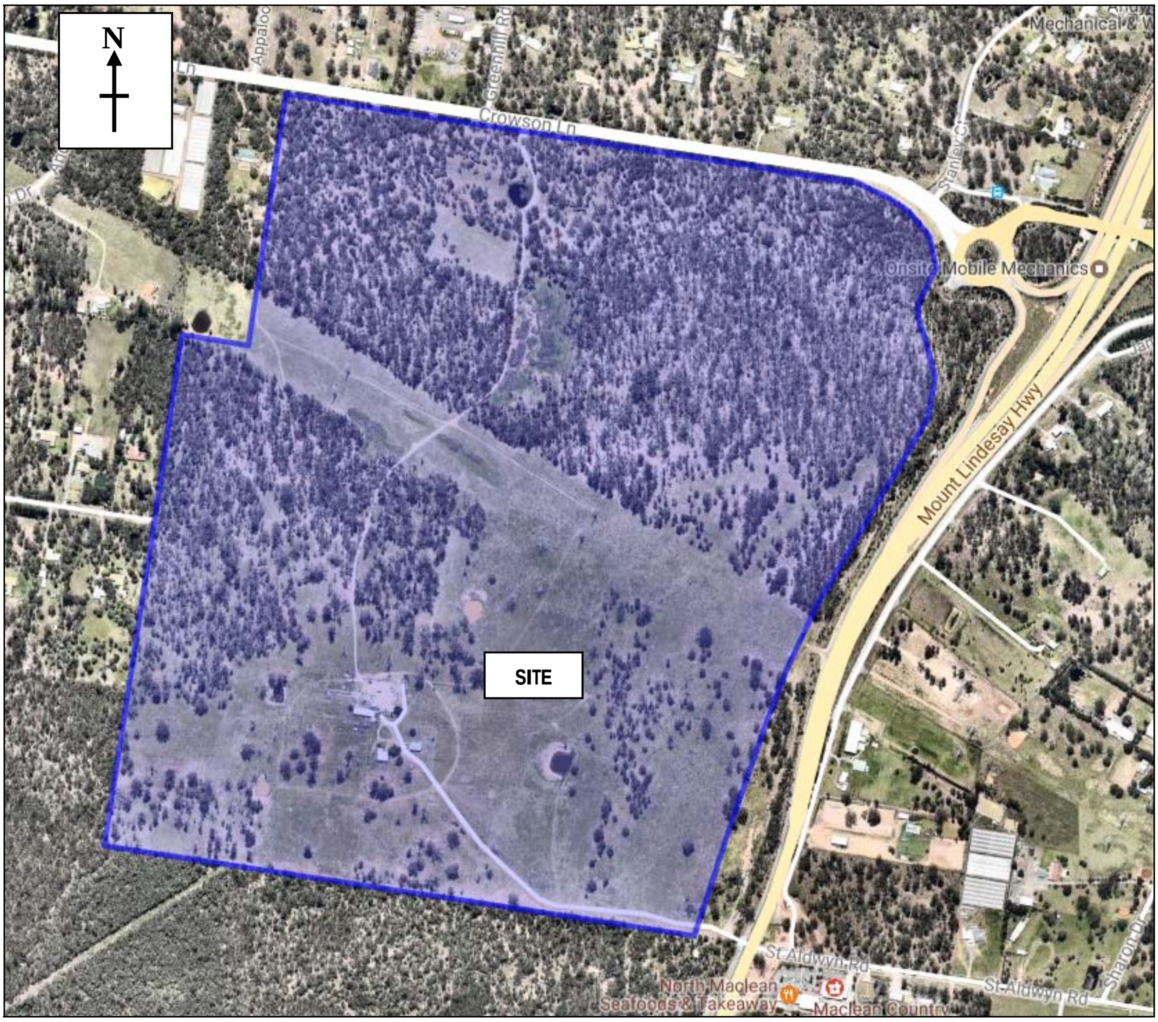


**Figure 2.1 - Locality Map, Source: Nearmap**

### 2.1.2 *Existing Topography and Drainage Patterns*

The topography and drainage patterns of the subject site are generally as follows :

1. Overland flow paths exist through the site to convey runoff from the external catchment to the north, west and south.
2. There is a ridge that runs in the north-south direction to the west of the site. The highest point on the ridge is approximately at RL 43m at the north-west corner of the site. The site falls towards the south-west from the ridge at an approximate grade of 1.5 % and towards the east at an approximate average grade of 1.7 %. The lowest point of the site on the southern boundary is at RL 27m and the lowest point of the site on the eastern boundary is approximately at RL 22m.

See **Figure 2.2** below for topography, drainage pattern and existing overland flow path. Also, refer to **Appendix A** for the detailed Site Contour Plan.

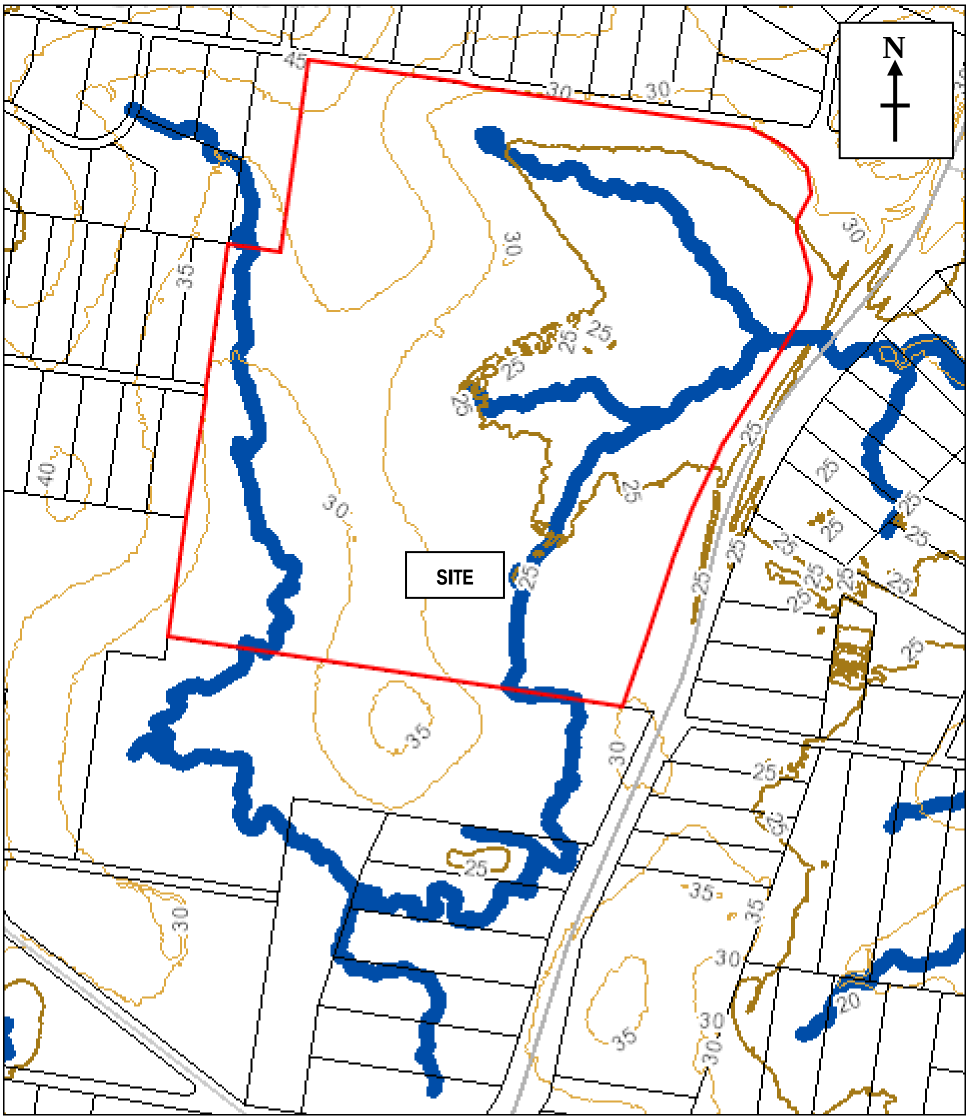


**Figure 2.2 – Overland Flow Paths Map, Source: Logan City Council**

### 2.1.3 *Flooding*

Although the current Logan City Council Flood Map, attached in Appendix A, indicates flooding on the site, detailed investigations indicate that the subject site is not affected by flood.

Logan City Council development engineers indicated that the subject flood mapping has been produced from a very high level model used to denote the planning trigger map and is not detailed enough to provide actual flood levels for the site.

It is also noted that a flood map for the site under Beaudesert Shire Council Planning Scheme (attached in **Appendix A**) showed the site had little impact due to flooding.

Telford Consulting (formerly Australian Consulting Engineers) has undertaken an assessment for the site using HEC-RAS to analyse flooding for the site. The existing culvert under Mount Lindesay Highway has been analysed in HEC-RAS including approximately 600m upstream and downstream from the culvert.

A total upstream catchment of approximately 120 ha including the site currently flows east towards Mount Lindesay Highway and discharges through 4x2100mmx1800mm RCBC culverts under Mount Lindsay Highway and ultimately discharges into Logan River which is located approximately 1.1 km to the east from the site.

The HEC-RAS analysis demonstrates that the existing culverts under the Mount Lindsay Highway has the capacity to cater for 100-year ARI flow from the upstream catchment without overtopping the highway.

The Logan River is located approximately 1.1 km further downstream of the culvert and the invert of the culvert is approximately 20m higher in elevation from the Logan River, which makes it very unlikely to be affected by back water effect from main stream flooding of Logan River.

See **Figure 2.3** below demonstrating the existing culverts have capacity to convey 100 year ARI flow without overtopping the highway and the Logan River backwater will not impact the capacity and hydraulics of the existing culverts.

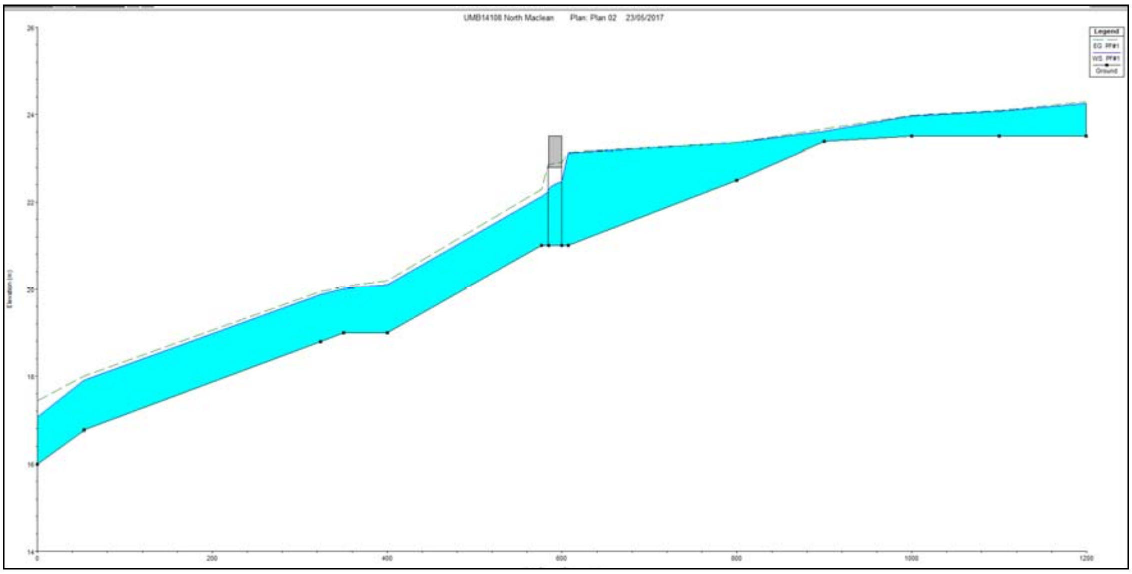


**Figure 2.3 – The longitudinal section through the culverts**

The HEC-RAS model demonstrates that the 100 year ARI flow from the site and the external catchment will freely discharge through the existing 4x2100mmx1800mm RCBC culverts downstream towards Logan River, without overtopping Mount Lindesay Highway.

Therefore, considering the above and the results from the flood analysis undertaken for the site, it can be concluded the site is free from flooding from any main stream, Logan River backwater and overland flow.

Refer to **Appendix G** for the HEC-RAS model layout, results and cross-sections.

Furthermore, in the post-developed state, the stormwater runoff from the developed site will be collected through the pit and pipe drainage system and directed in to the proposed detention basin (located upstream of the culvert) which will attenuate the post-development flows at a rate not more than pre-development state, which will cause no adverse impact on the capacity of the existing culverts.

### 2.1.4 *Proposed Subdivision Plan*

It is proposed to construct a 4 lot industrial subdivision with allotments ranging in size between 14.90 ha to 46.62 ha.

Refer to **Appendix A** for the proposed development layout plan.

## 2.2 Methodology Used

### 2.2.1 *Assumptions*

The 'no-worsening' of runoff to the pre-development state for the proposed development has been achieved based on the assumption that

- The proposed detention basin in Lot 1 is designed to cater for stormwater detention and water quality treatment for the road reserve areas only.
- The proposed industrial allotments will have their own independent on-site stormwater detention and water quality treatment measures (including Lot 1) in the post-development phase. It will be the responsibility of the end users to provide onsite stormwater detention and water quality treatment for their own lots.
- It has been assumed that the road reserve areas will have 75% of impervious areas, in accordance with Table 3.5 of MUSIC Modelling Guidelines by Water by Design.

The pre-development and post-development runoff from the road reserve area have been assessed in DRAINS by utilizing ILSAX calculations for all (63% AEP, 39% AEP, 18% AEP, 10% AEP, 5% AEP, 2% AEP and 1% AEP) storm events.

### 2.2.2 *Lawful Point of Discharge*

The site currently has two (2) discharge points to the south and east for the proposed development. See **Figure 2.4** below for the location of the lawful points of discharge for the proposed site.

Majority of the site discharges to the east and ultimately discharges through the existing culverts under MT Lindesay Highway. This will be referred as Lawful point of discharge 1 (LPOD 1) in the remainder of this report.

Part of the site discharges to the south towards the lowest point along southern boundary. This will be referred as Lawful point of discharge 2 (LPOD 2) in the remainder of this report.

The discharge from the lots and the flow from the external catchment west will be discharged directed towards the proposed open space and will discharge towards LPOD 2. This combined discharge will be converted back to sheet flow within the property boundary. Refer to the Concept Stormwater Drainage Layout Plan in **Appendix B** for further detail.

### 2.2.3 *External Catchment*

The proposed development has external catchments to the south, to the west and to the north.

Refer **Appendix B** for the Concept Catchment Layout Plan.

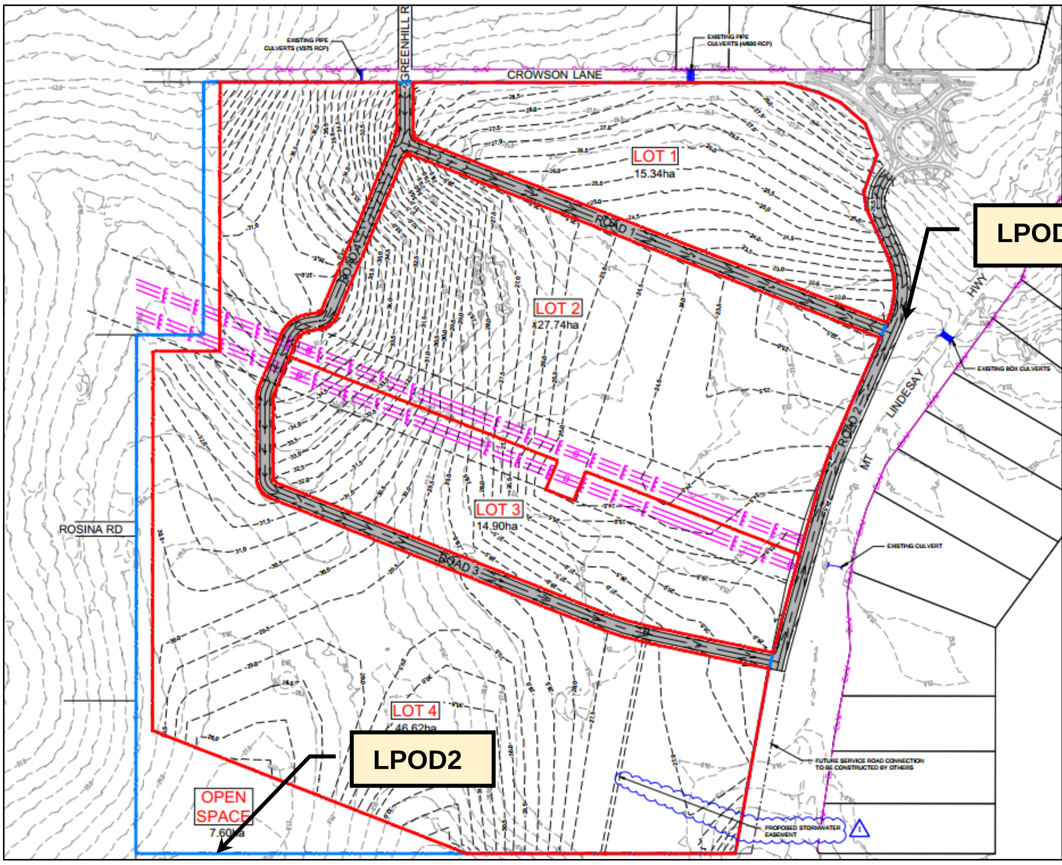


**Figure 2.4 – Location of Discharge Points (Lawful Points of Discharge)**

## 2.3 Hydrologic Model Establishment

DRAINS ILSAX model was used for all storm events to analyse and determine the pre-development stormwater runoff from the road reserve area.

DRAINS is an integrated hydrological and hydraulic model. It is capable of modelling the hydrology through an ILSAX module including detention storages. Model parameters for sub catchment storages have been selected from recommended design values from the following data sources:

1. Time of Concentration – Time of Concentration has been calculated in accordance with QUDM.

2. Catchment roughness values – Based on aerial photography and previous experience with similar hydrologic assessment; and
3. Intensity-Frequency-Duration (IFD) values and rainfall temporal patterns were sourced from the Australian Government, Bureau of Meteorology in conjunction with Council's IFD tables & charts.

### 2.3.1 *Pre-development Scenario*

The following table details the pre-development runoff from the road reserve area (Catchment 1) towards the lawful point of discharge calculated using ILSAX DRAINS model.

**Table 2.2 - Hydrologic Parameters for Catchment 1 – Pre-development**

| Parameters | Value | Source |
|---|---|---|
| Catchment No | 1 | |
| Area (ha) | 7.62 | Catchment Plan |
| Tc (min) | 46 | QUDM |
| $Q_{100}$ – ILSAX ($m^3/s$) | 2.0 | DRAINS |

### 2.3.2 *Post-development Scenario*

The Post-development runoff towards the Outlet has been calculated in DRAINS. Standard inlet times for the upstream section of catchments and pipe flow times are added to calculate the post-development times of concentration for the catchments.

**Table 2.3 - Hydrologic Parameters for Catchment 1 – Post-development**

| Parameters | Value | Source |
|---|---|---|
| Catchment No | 1 | |
| Area (ha) | 7.62 | Catchment Plan |
| Tc (min) | 19 | QUDM |
| $Q_{100}$ – ILSAX ($m^3/s$) | 3.36 | DRAINS |

Refer to **Appendix C** for details of calculation of time of concentration.

## 2.4 Hydraulic Analysis

### 2.4.1 *Detention Requirements for the Road Reserve Area*

To mitigate the increased post-development runoff from the development towards LPOD1, it has been proposed to install one (1) detention basin at the discharge point.

DRAINS ILSAX model was used to analyse the detention requirements for a range of storm events. The following table details the preliminary detention storage requirements for the proposed basins. Refer to **Appendix C** for details of basin properties screenshot from DRAINS.

**Table 2.4 – Preliminary Detention Basin Properties**

| Catchment | Basin | Detention Volume ($m^3$) | Source |
|---|---|---|---|
| Catchment 1 | Basin 1 | 4400 | DRAINS ILSAX Model |

A preliminary footprint has been estimated for the detention basin incorporating the allowance for batters. Refer to Preliminary Stormwater Drainage Layout Plan in **Appendix B** for the location of proposed Basin 1.

It is to be noted that, the proposed detention basins in Lot 1 is designed to cater for the internal road reserve areas only.

The proposed industrial allotments need to have their own independent on-site stormwater detention storage (including Lot 1), which is discussed in Section 2.4.2.

It is to be noted that the calculated detention basin volume and footprint are preliminary only and subject to change during detailed design in Operational Works stage.

Table below summarises the peak discharge from the site in the pre-development and post-development scenario at all Outlets.

**Table 2.5 – Summary of peak discharge**

| Outlet | Scenario | AEP | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 63% | 39% | 18% | 10% | 5% | 2% | 1% |
| LPOD 1 | Pre-development | 0.347 | 0.613 | 0.94 | 1.13 | 1.40 | 1.74 | 2.0 |
| | Post-development | 0.311 | 0.381 | 0.456 | 0.496 | 0.738 | 1.42 | 1.93 |

The table indicates that with the proposed detention basin, the development will successfully attenuate all post-development peak discharges from the road reserve areas to less than pre-development flows, for all investigated return periods, refer **Appendix C.**

A Preliminary Stormwater Drainage Layout Plan has been prepared and attached in **Appendix B** for reference.

### 2.4.2 *Detention Requirements for individual lots*

A separate DRAINS model analysis has been undertaken to calculate the detention requirements for the individual lots in a pro-rata basis.

Due to varying lot sizes ranging from 14.88 hectare to 47.44 hectares, two models have been developed to calculate the required detention storage for smallest lot (14.88 ha) and largest lot (46.41 ha), in order to estimate a representative co-relation between the required detention storage and the corresponding lot size. Refer to **Table 2.6** for the summary of the DRAINS model results.

Refer to **Appendix E** for DRAINS model results.

**Table 2.6 Lot-Based Detention Storage Calculation**

| Lot Type | Area (ha) | Required detention storage ($m^3$) | Required detention storage per ha of lot ($m^3$/ha) | Adopted Average Correlation of Detention Storage per ha of Lot Area ($m^3$/ha) |
|---|---|---|---|---|
| Small | 14.90 | 9000 | 605 | 556 |
| Large | 46.62 | 24000 | 506 | |

Therefore, in accordance with the table above, each industrial lot will need to provide 556 $m^3$ of detention storage per ha of lot area. Refer to **Table 2.7** for the required detention storage for each lot.

It is to be noted that these numbers are preliminary only and subject to change during detailed design.

**Table 2.7 – Individual Lot-based Detention Storage**

| Lot Number | Area (ha) | Preliminary lot-based Detention Storage ($m^3$) [ based on 556 $m^3$/ha] |
|---|---|---|
| 1 | 15.34 | 8529 |
| 2 | 27.74 | 15423 |
| 3 | 14.90 | 8284 |
| 4 | 46.62 | 25920 |

Two preliminary options for lot-based stormwater detention have been detailed in Appendix F, as below -

- Option 1 – Above ground detention basin, and
- Option 2 – Underground detention tank

Refer to Preliminary details for typical detention storage for each lot in **Appendix F.** It is to be noted that the provided concept is preliminary only and subject to change during detailed design.

## 2.5 Catering for External Catchment Runoff

The proposed development has external catchments to the south, to the west and to the north.

The runoff from external catchments to the west will be intercepted at the boundary by swales within the proposed 25m buffer and will be safely conveyed respectively towards LPOD2. The locations of the proposed swales where the dV values will exceed 0.6 $m^2/s$, will be fenced off for public safety.

The runoff from the external catchment to the south will be intercepted and captured by an inlet headwall and will be piped through the site collecting Road 2 runoff towards LPOD1, bypassing any on-site detention.

The runoff from the external catchment to the north will be intercepted by the existing swale along Crowson Lane to the north. There are existing culverts under Crowson Lane that will direct the external flow towards the site. From these locations, the external flow will be conveyed by pipe towards LPOD1.

Refer to Preliminary Stormwater Drainage Layout Plan in **Appendix B** for typical details of the proposed swales and the 25m buffer zone to the west.

Refer to **Appendix D** for the hydraulic calculation of the proposed swales.

It is to be noted that the swale details provided in this report are preliminary only and subject to change during detailed design stage.

# 3 STORMWATER QUALITY MANAGEMENT PLAN

The State Planning Policy July 2014 (SPP) seeks to ensure that development is planned, designed, constructed and operated to manage stormwater and waste water in way that supports the protection of environmental values (Logan Planning Scheme).

The proposed development triggers water quality requirements as the development application involves the reconfiguring of a lot for urban purposes for a land area greater than 2500m2 and will result in six or more lots (SPP 2014).

It has been proposed to install one (1) bio-retention basin to treat stormwater generated from the road reserve area only, to comply with the water quality objectives as outlined in State Planning Policy, July 2014.

## 3.1 Stormwater Quality Management Objectives

### 3.1.1 *Construction Phase*

During the construction phase of this development, the pollutants listed in the Table have been identified as being typically generated for this type of development.

**Table 3.1 – Construction Phase Pollutants**

| Pollutants | Source |
|---|---|
| **Litter** | Paper, construction packaging, food packaging, cement bags, off cuts |
| **Sediment** | Unprotected exposed soils and stockpiles during earthworks and building |
| **Hydrocarbons** | Fuel an oil spill, leaks from construction equipment |
| **Toxic Materials** | Cement slurry, asphalt prime, solvents, cleaning agents, washwater (eg from tile works) |
| **pH Altering Substances** | Acid sulfate soils, cement slurry and washwaters |

The aim of this Stormwater Management Plan is to minimise the generation and export of sediment and other pollutants resulting from construction activities in delivering this project.

Generally, the minimization of the latter can be achieved by the project manager ensuring that the contractual lines of responsibility for all measures are clearly set out to Contractors and sub-Contractors from commencement of works until final stabilisation. Where there is a failure critical to environmental performance by a Contractor, the project manager should ensure there is a system in place to be discovered and promptly remediated.

### 3.1.2 *Operational Phase*

The key pollutants generated by developments of this kind during the operational phase (post construction) phase are tabulated below. This presented in bold text are identified as the key pollutants to be targeted for treatment and have been selected with consideration of the proposed operational activates and processes to be undertaken on this site.

**Table 3.2 – Operational Phase Pollutants**

| Type | Comment |
|---|---|
| **Litter** | Common |
| **Sediment** | Common |
| **Nutrients (Nitrogen and phosphorus)** | Common |
| **Hydrocarbons** | Common |
| **Heavy metals** | Associated with fine sediment |
| **Surfactants** | Common |
| Organochlorins and organophosphates | Unlikely to be present |
| Thermal pollution | Maybe present |
| pH altering substances | Maybe present |
| Oxygen demanding substances | Maybe present |
| Pathogens/Faecal coliforms | Maybe present |

## 3.2 Stormwater Quality Management Measures

### 3.2.1 *Modelling Guidelines*

*MUSIC Version 6.1* was used to assess pollutant generation and the performance of stormwater treatment measures for the proposed residential development. Selection and testing of stormwater management options was undertaken in accordance with *"MUSIC Modelling Guidelines Version 1.0 - 2010", Water By Design (2010).*

### 3.2.2 *Rainfall Data*

*MUSIC Modelling Guidelines* provide advice on meteorological data for different climatic regions of South East Queensland. Rainfall data for Greenbank (Station ID 40659) was obtained from the Bureau of Meteorology. Six-minute time step rainfall data was obtained for 10 years between the period from 1/1/1980 to 31/12/1989.

**Table 3.3 – Rainfall Runoff Data**

| METEOROLOGICAL and RAINFALL RUNOFF<br>MUSIC Modelling Guidelines Version 1.0 2010 - Water By Design - Table B1 | |
|---|---|
| INPUT | DATA USED IN MODELLING |
| Rainfall station | GREENBANK |
| Time Step | 6 Minute |
| Modelling period | 1/1/1980 to 31/12/1989 |
| Rainfall runoff parameters | Industrial |
| Pollutant export parameters | Industrial |

### 3.2.3 *Model Selection, assumption and removal effectiveness*

In accordance with the *Water By Design MUSIC Modelling Guidelines*, split catchment methods were used for the Source Nodes utilizing modified percentages of impervious area. Also rainfall threshold, soil properties and pollutant concentration input values were sourced from the guidelines. The *MUSIC* modelling inputs for the rainfall source nodes are shown below.

**Table 3.4 – MUSIC Input – Source Parameters**

| RAINFALL RUNOFF PARAMETERS<br>MUSIC Modelling Guidelines Version 1.0 2010 - Water By Design - Table B4 | |
|---|---|
| **PARAMETER** | **SOURCE NODE 1** |
| Land Use | Industrial |
| Rainfall threshold (mm) | 1 |
| Soil storage capacity (mm) | 18 |
| Initial storage (%) | 10 |
| Field capacity (mm) | 80 |
| Infiltration capacity coefficient a | 243 |
| Infiltration capacity coefficient b | 0.6 |
| Initial depth (mm) | 50 |
| Daily percentage rate (%) | 0 |
| Daily basefloe rate (%) | 31 |
| Daily deep seepage rate (%) | 0 |

Base flow and Storm flow parameters for TSS, TP and TN for Roofs, roads and ground level were sourced from *Water by Design MUSIC Modelling Guidelines* (v1 Dated 2010).

### 3.2.4 *MUSIC Model Layout*

The layout of the site and the proposed drainage pattern were considered in the creation of the *MUSIC* model. The figure below presents the layout of source, treatment and receiving nodes used in the modelling.

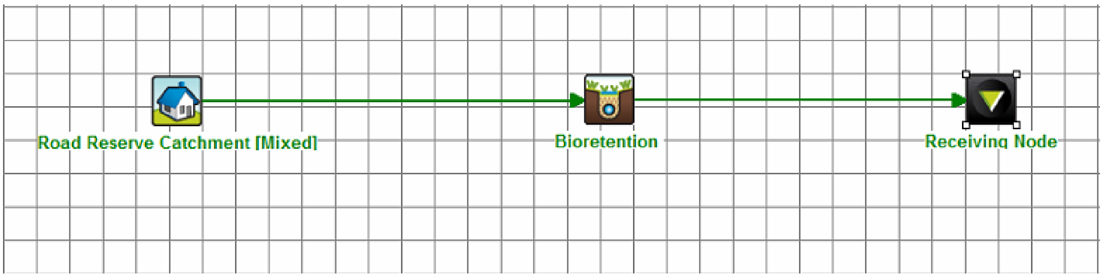


**Figure 3.1 – MUSIC Model Layout**

### 3.2.5 *Bio-retention Basin*

A bio-retention system has been incorporated to act as stormwater treatment device for the site. The bio-retention basin is to be constructed as part of the proposed detention basins in lot 1, refer **Appendix B**. Rainfall runoff generated within the road reserve area will collected via a drainage system and discharged into the proposed basins for treatment. The following parameters were adopted to the bio-filtration basins, and in accordance with *The MUSIC Modelling Guidelines*:

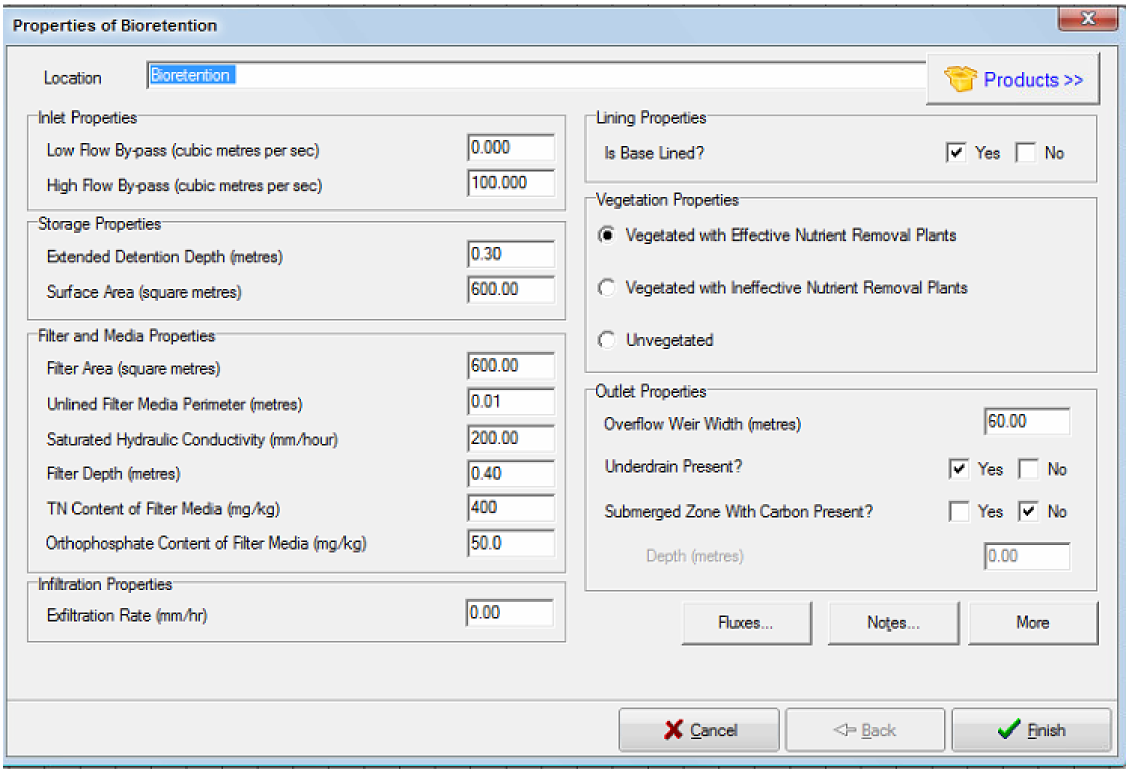


**Figure 3.2 – Bio-retention Basin Filter Parameters**

### 3.2.6 *Modelling Results, Comparisons and Compliance*

The MUSIC modelling results are shown on the figures below. They are in the form of percentage reduction achieved with the proposed stormwater quality treatment basins.

**Table 3.5 - MUSIC Modelling Targets**

| Source Pollutants | Target Reduction |
|---|---|
| Total suspended solid (kg/yr) | 80.00% |
| Total phosphorus (kg/yr) | 60.00% |
| Total nitrogen (kg/yr) | 45.00% |
| Gross pollutants (kg/yr) | 90.00% |

Treatment Train Effectiveness - Receiving Node

| | Sources | Residual Load | % Reduction |
|---|---|---|---|
| Flow (ML/yr) | 43.5 | 42.9 | 1.5 |
| Total Suspended Solids (kg/yr) | 19600 | 3890 | 80.2 |
| Total Phosphorus (kg/yr) | 31.3 | 10.2 | 67.5 |
| Total Nitrogen (kg/yr) | 88.9 | 47.6 | 46.4 |
| Gross Pollutants (kg/yr) | 1100 | 0 | 100 |

**Figure 3.3 - MUSIC Modelling Results – Saturated Hydraulic Conductivity 200mm/hr**

As seen above, it has been demonstrated that the proposed bio-retention basin would be adequate to meet stormwater quality objectives in accordance with the current State Planning policy.

It is to be noted that the bio-retention area nominated above is to treat the runoff from road reserve area only.

The proposed industrial allotments will have lot-based on-site bio-retention areas (including Lot 1) in the operational phase. Refer to Section 3.2.7 for further details.

### 3.2.7 *Bio-retention requirements for individual lots*

A separate MUSIC model analysis has been undertaken to calculate the required bio-retention areas for the individual lots in a pro-rata basis.

Due to varying lot sizes ranging from 14.88 hectare to 47.44 hectares, two models have been developed to calculate the required bio-retention area for smallest lot (14.88 ha) and largest lot (47.44 ha), in order to estimate a representative co-relation between the required bio-retention area and the corresponding lot size. Refer to **Table 3.6** for the summary of the MUSIC model results.

**Table 3.6 Lot-Based Bio-retention Area Calculation**

| Lot Type | Area (ha) | Required Bio-retention Area ($m^2$) | Required Bio-retention Area Percentage of the Total Site Area (%) | Adopted Average Bio-retention Percentage of the Total Site Area (%) |
|---|---|---|---|---|
| Small | 14.90 | 1700 | 1.14 | 1.11 |
| Large | 46.62 | 5100 | 1.09 | |

Therefore, the MUSIC analysis results confirmed that to achieve the required water quality objectives, each lot will need to allocate 1.05% of the total lot area for bio-retention filter area. Refer to **Table 3.7** for the required bio-retention area for individual lots.

Refer to **Appendix E** for MUSIC model results.

It is to be noted that these numbers are preliminary only and subject to change during detailed design.

**Table 3.7 Individual Lot-based Bio-retention Area**

| Lot Number | Area (ha) | Bio-retention Area ($m^2$)<br>[ based on 1.11% of total lot area] |
|---|---|---|
| 1 | 15.34 | 1702 |
| 2 | 27.74 | 3079 |
| 3 | 14.90 | 1653 |
| 4 | 46.62 | 5174 |

Two preliminary options for lot-based water quality treatment have been detailed in Appendix F, as below -

- Option 1 – Above ground bio-retention filter and
- Option 2 –Proprietary underground filter cartridge system

Refer to Preliminary details for typical water quality treatment for each lot in **Appendix F.** It is to be noted that the provided concept is preliminary only and subject to change during detailed design.

Additional documentation on bio-retention system and filter cartridge system are also attached in **Appendix F**.

## 3.3 Operational Phase Stormwater Management Options

At this phase the site needs to be fully stabilised to eliminate any erosion and sediment leaving the site and entering downstream watercourses or properties:-

- All permanent devices need to be installed and fully operational,
- All disturbed surfaces need to be stabilised by hard surfacing/s, turfing, hydro-seeding or mulch,
- All upstream diversion fences/devices removed (if not required for the operational phase),
- All grassed areas to be mowed and clippings removed off site
- All litter, fallen leaves/branches to be removed off site,
- All vegetation and plantings completed including mulching, sprinklers, underground pipework, fencing, edging and all pathways, driveways etc.

No further works will be allowed at this stage without review of the erosion and sediment control measures being implemented.

# 4 EROSION AND SEDIMENT

## 4.1 Site Establishment

Prior to any earthworks associated with site commencement, on site erosion and siltation control measures are to be put in place in accordance with Council's guidelines and best management practices for erosion and sediment control and as described herein. These measures include:

1. The installation of a perimeter fence covered with shade cloth or solid A class hoarding, to the perimeter of the work site area;
2. The construction of a silt fence on the low side of all site areas that are disturbed;
3. All water leaving each site will be processed through a sediment control basin, where applicable;
4. Swales and hay bales are to be used to assist with sediment control for overland flow paths leading into sedimentation control basins;
5. The erosion and sediment control measures will be inspected at least once a week or after rainfall events to check their integrity.

## 4.2 Construction Phase

The following information is provided to identify controls and procedures, and who is responsible for them, which will be incorporated into the Erosion and Sediment Control Program:

### 4.2.1 *Pre-Construction*

1. A single stabilised entry/exit point is to be established (vehicle shake down device) for each stage of construction. This point should also include a vehicle shakedown device to mitigate the transportation of dust and dirt;
2. Sediment fences are to be placed along the low side of the site to slow flows, reduce scour and capture some sediment runoff;
3. Sediment fences are to be constructed at the base of fill embankments;
4. Divert up-slope water around the work site and appropriately stabilise any drainage channels;
5. Areas for plant and construction material storage are to be designated along with associated diversion drains and spillage holding ponds;
6. Diversion banks are to be created at the upstream boundary of construction activities to ensure upstream runoff is diverted around any areas to be exposed. Catch drains are to be created at the downstream boundary of construction activities;

7. Construction of temporary sediment basins, where required;
8. Site personnel are to be educated in the sediment and erosion control measures to be implemented on site.

### 4.2.2 *During Construction*

1. Progressive re-vegetation of filled areas and fill batters, if applicable;
2. Construction activities are to be confined to the necessary construction areas;
3. The provision of a construction exit to prevent the tracking of debris from tyres of vehicles onto public roads. Only one construction exit will be nominated to limit the movement of construction equipment;
4. The topsoil stockpile location will be nominated to coincide with areas previously disturbed. A sediment fence is to be constructed around the bottom of the stockpile to trap sediment. A diversion drain is to be installed upstream of the stockpile if required;
5. Roof downpipes should be installed as soon as practicable after the roof is laid;
6. Transport loads that are subject to loss through wind or spillage shall be covered or sealed to prevent entry of pollutants to the stormwater system;
7. Regular inspection and maintenance of silt fences, sediment basins and other erosion control measures. Following rainfall events greater than 50mm, inspection of erosion control measures and removal of collected material should be undertaken. Replacement of any damaged equipment should be undertaken immediately;

### 4.2.3 *Post Construction*

1. The Contractor/Developer will be responsible for the maintenance of erosion and sediment control devices from the possession of the site until the site is accepted, or until stabilisation has occurred, to the satisfaction of the superintendent and developer;
2. Key stormwater quality improvement devices requiring maintenance during the operational phase of the project following construction are the bio-retention areas and the gross pollutant traps. Maintenance requirements for these devices consist of regular storm event inspection to ensure;
    a. Sufficient vegetation within bio-retention areas; and
    b. Ensuring no erosion has occurred
3. Regular mowing/harvesting to ensure vegetation is maintained at acceptable levels,
4. Removal of litter within verges, swales and bio-retention areas,

5. Regular trash removal,
6. The Sediment and Erosion Control Management Plans should be provided to all people involved with the site, including sub-contractors, private certifiers, home owners and regulators.

# 5 CONCLUSION

This proposed Site Based Stormwater Management Plan has been prepared for the proposed North Maclean Enterprise Precinct at 4499 - 4651 Mount Lindesay Highway to manage site based stormwater quantity and quality requirements for the design storms up to and including the 1% AEP event.

The proposed site based stormwater management measures are as below:

1. Two (2) Lawful Points of Discharge have been nominated for the proposed subdivision to the east and to the south, in the locations where the natural overland flow from the site and the external catchment discharges.
2. One (1) detention basin will provide non-worsening of post-development discharge from the road reserve areas.
3. One (1) bio-retention basin incorporated at the base of the detention basins will provide stormwater quality treatment for the runoff from the road reserve areas.
4. The proposed industrial allotments will have lot-based on-site stormwater detention and water quality treatment measures in the post-development phase. These treatment devices will be installed by the future lot owner with their size and location being allocated to suit the end use. Maintenance of these devices will be the responsibility of the future lot owners.
5. Runoff from external catchments will be intercepted at the property boundary and then safely conveyed by proposed swales and pipes towards the Lawful Points of Discharge.

The proposed sizes of stormwater quality and quantity measures documented in this report are preliminary only and subject to change during detailed design in Operational Works stage.

The conclusion of this site-based stormwater management plan is that the proposed stormwater quantity and quality management measures for the development, will ensure no worsening effects downstream of the proposed development and conforms to best engineering practices.

# 6 REFERENCES


- Department of State Development, Infrastructure and Planning, July 2014 - State Planning Policy
- Economic Development Queensland, May 2015 – PDA Guideline No. 10
- Logan City Council – Logan Planning Scheme 2015
- Department of Energy and Water Supply - Queensland Urban Drainage Manual, Third Edition 2013 – provisional
- Water by design, Version1.0 – 2010 – MUSIC Modelling Guidelines
- Institution of Engineers – Australian Rainfall and Runoff

# 7 APPENDICES

# Appendix A SITE LAYOUT, CONTOUR, FLOOD PLAN


| Issue | Description | Date | Design | Check |
|---|---|---|---|---|
| H | ISSUE FOR DEVELOPMENT APPLICATION | 07/07/2021 | M.M. | J.B. |
| G | ISSUE FOR DEVELOPMENT APPLICATION | 18/12/2020 | M.M. | J.B. |
| F | ISSUE FOR DEVELOPMENT APPLICATION | 28/11/2019 | M.M. | J.B. |
| E | ISSUE FOR DEVELOPMENT APPLICATION | 01/03/2019 | M.M. | J.B. |
| D | ISSUE FOR DEVELOPMENT APPLICATION | 11/07/2018 | M.M. | J.B. |
| C | ISSUE FOR DEVELOPMENT APPLICATION | 12/06/2018 | M.M. | J.B. |

Client
Wearco Pty Ltd
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Surveyor

Scales
0 20 40 60 80 100 120 m
SCALE 1:2500 @ A1


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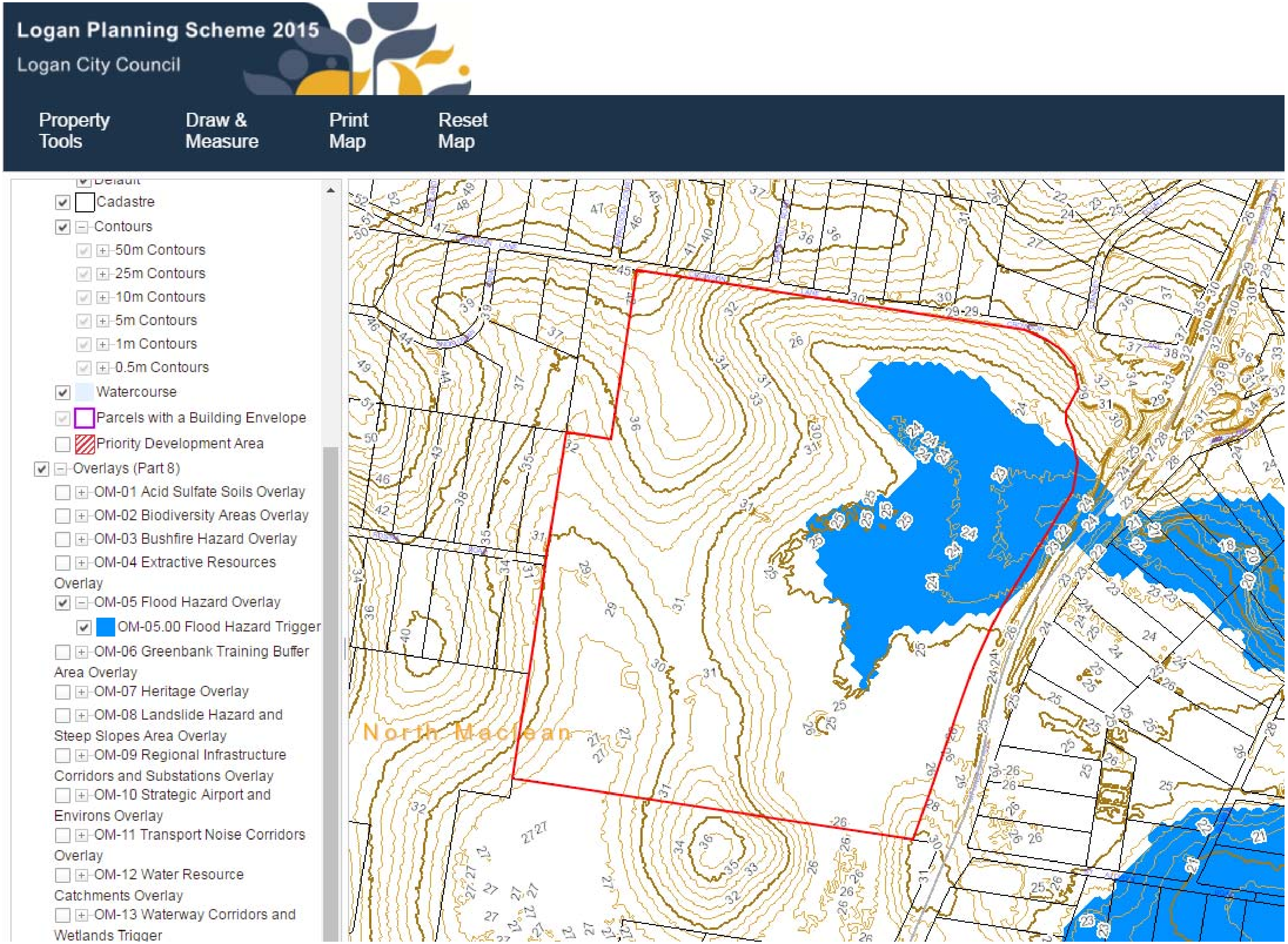
Project
PROPOSED BUSINESS PARK
4499-4651 MT LINDESAY HIGHWAY, NORTH MACLEAN QLD

Drawing Title
PROPOSED DEVELOPMENT LAYOUT PLAN

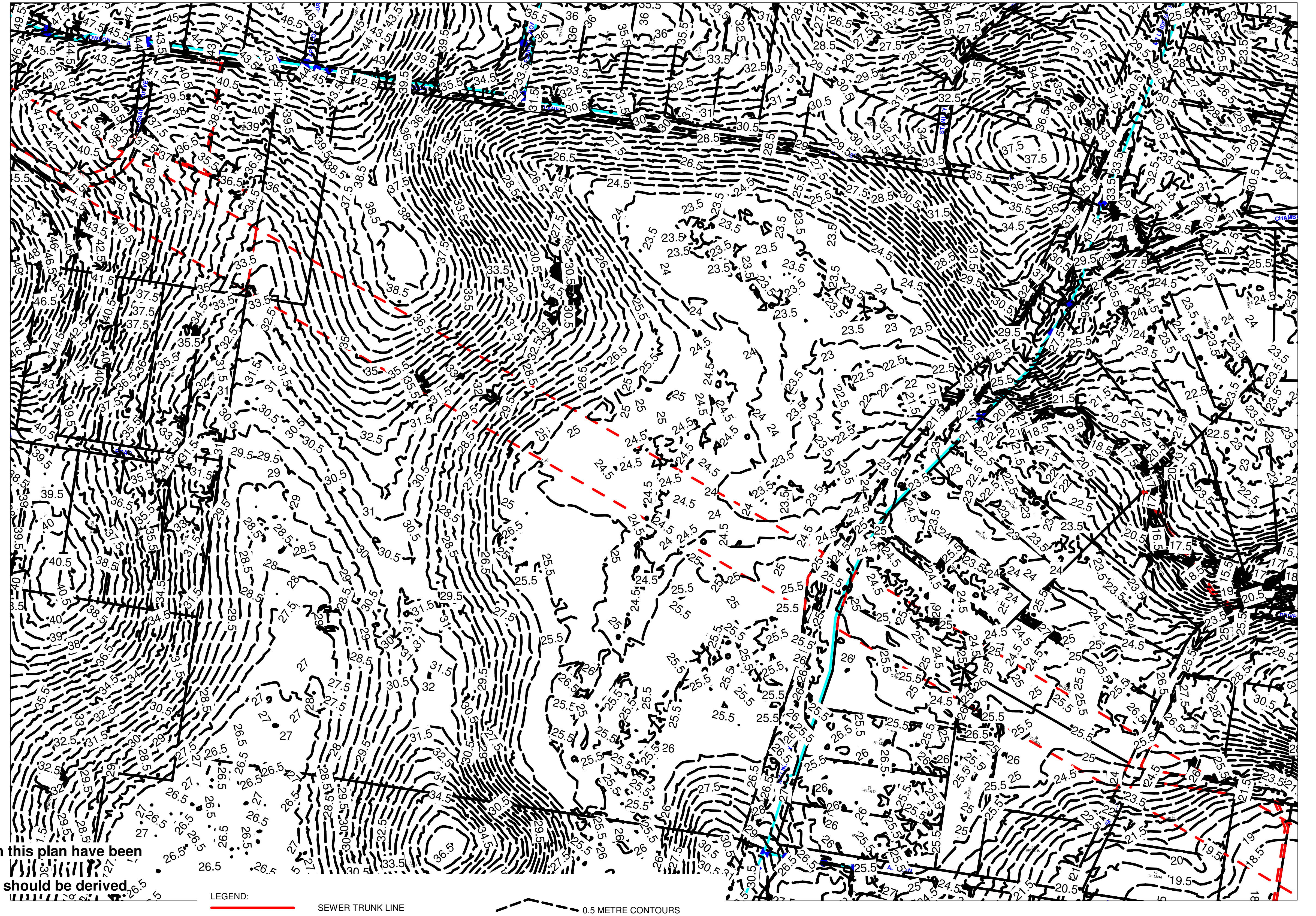
| Scale A1 | Project No. | Dwg. No. | Issue |
|---|---|---|---|
| 1:2500 | TIEL202159.CIV.DA | 010 | H |

Appendix A - LCC PLANNING SCHEME FLOOD MAP



# Appendix A - Site Contour

SCALE 1:70
SEP 2010



The contours shown on this plan have been derived from ALS Data.
Accurate measurement should be derived from ground survey.

LEGEND:

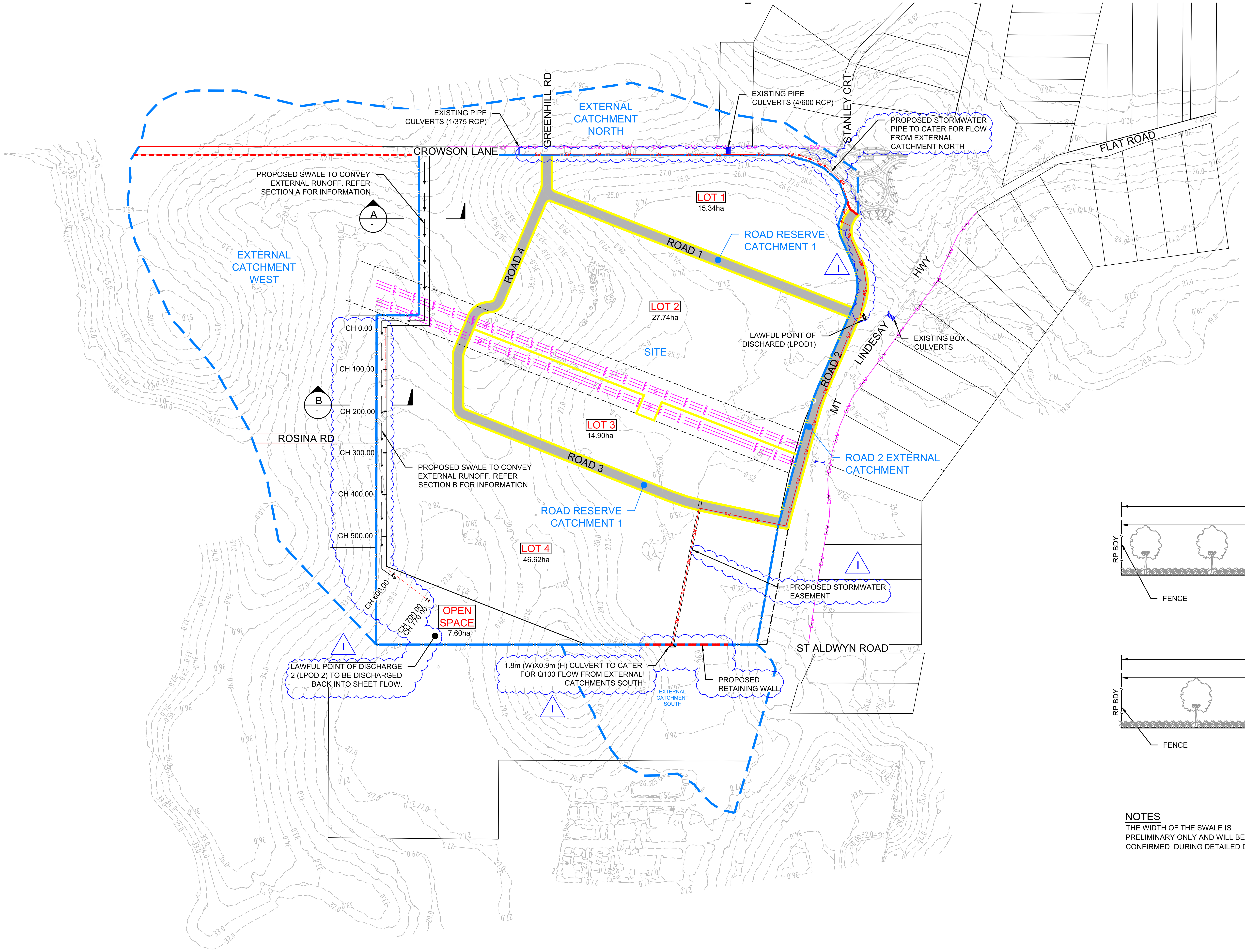
- SEWER TRUNK LINE
- SEWER LINE & MANHOLE
- WATER LINE & POINTS
- STORMWATER LINE, PITS & MANHOLE
- STORMWATER CHANNEL
- 0.5 METRE CONTOURS

NOTE: AERIAL CAPTURED 2008/2009.
NOTE: LOCATION OF ALL SERVICES INDICATED ONLY, AN ASCONSTRUCTED SEARCH SHOULD BE DONE FOR EXACT LOCATIONS.

No Window

s:drafting:wintab:users:deb:CONTOUR MAP SERVICES_AERIAL_LANDSCAPE.WOR

# Appendix B CONCEPT ENGINEERING PLANS

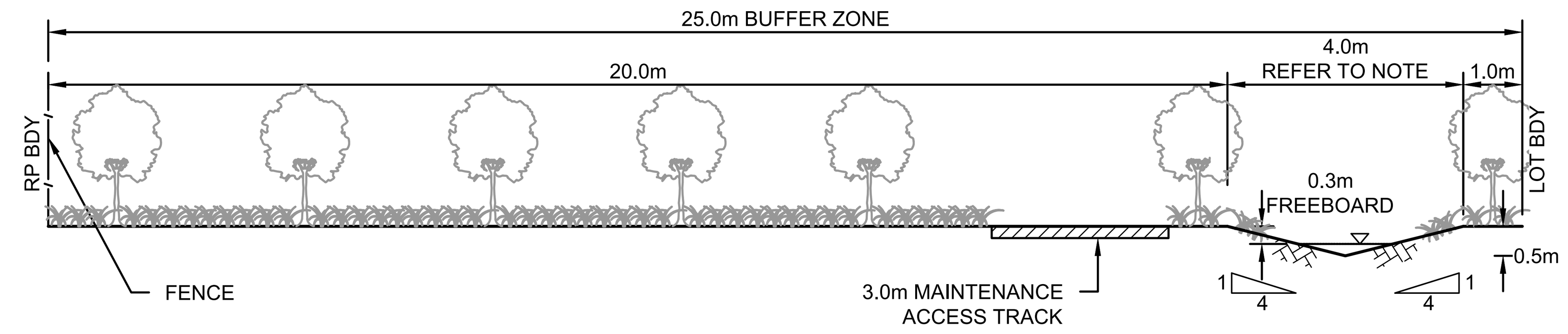



## LEGEND

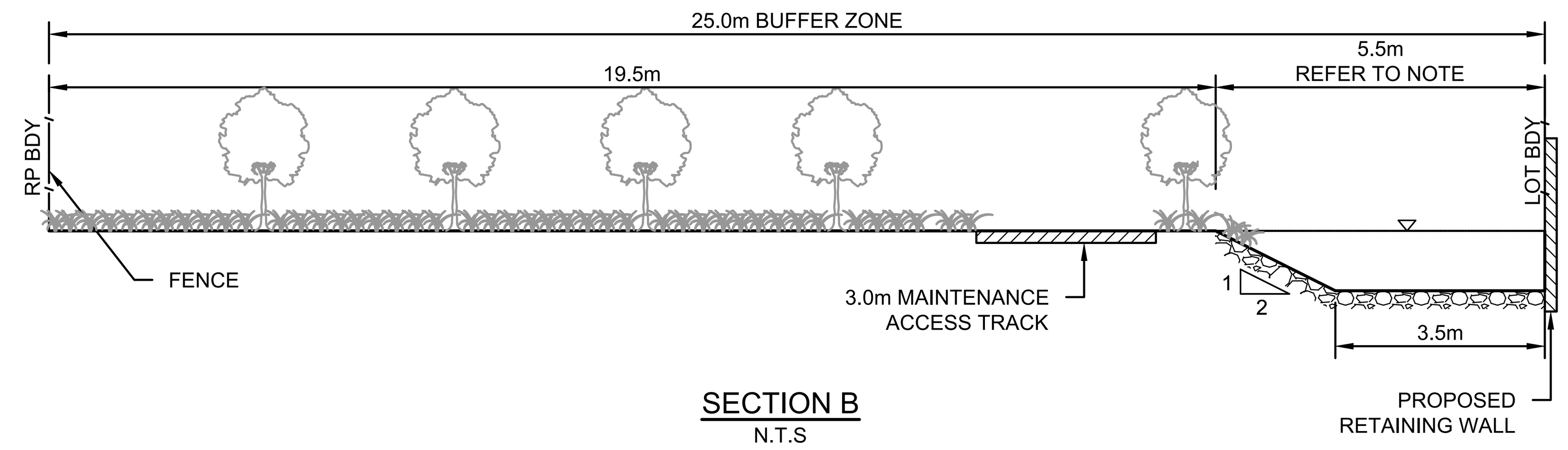
- OVERHEAD TRANSMISSION POWER LINES
- EXISTING CONTOURS
- EXISTING TABLE DRAIN
- EXTERNAL CATCHMENT BOUNDARY
- SITE BOUNDARY
- ROAD RESERVE BOUNDARY
- ROAD RESERVE
- EXISTING WATER MAIN
- PROPOSED STORMWATER FOR EXTERNAL FLOW
- PROPOSED STORMWATER EASEMENT
- PROPOSED SWALE CONTROL LINE

## CATCHMENT TABLE

| CATCHMENT | AREA (ha) |
|---|---|
| SITE | 117.9 |
| EXTERNAL CATCHMENT WEST | 46.34 |
| EXTERNAL CATCHMENT NORTH | 21.23 |
| EXTERNAL CATCHMENT SOUTH | 13.44 |
| ROAD 2 EXTERNAL CATCHMENT | 2.00 |
| ROAD RESERVE CATCHMENT 1 | 7.7 |




SECTION A
N.T.S




SECTION B
N.T.S

NOTES
THE WIDTH OF THE SWALE IS PRELIMINARY ONLY AND WILL BE CONFIRMED DURING DETAILED DESIGN.

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| Issue | Description | Date | Design | Check |
|---|---|---|---|---|
| I | ISSUE FOR DEVELOPMENT APPLICATION | 07/07/2021 | M.M. | J.B. |
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Surveyor

Scales
0 100 200 300 m
SCALE 1:5000 @ A1

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Project
PROPOSED BUSINESS PARK
4499-4651 MT LINDESAY HIGHWAY, NORTH MACLEAN QLD

Drawing Title
CONCEPT CATCHMENT LAYOUT PLAN

| Scale | A1 | Project No. | Dwg. No. | Issue |
|---|---|---|---|---|
| 1:5000 | | TIEL202159.CIV.DA | 008 | I |


| Issue | Description | Date | Design | Check |
|---|---|---|---|---|
| H | ISSUE FOR DEVELOPMENT APPLICATION | 07/07/2021 | M.M. | J.B. |
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| D | ISSUE FOR DEVELOPMENT APPLICATION | 11/07/2018 | M.M. | J.B. |
| C | ISSUE FOR DEVELOPMENT APPLICATION | 12/06/2018 | M.M. | J.B. |

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Surveyor

Scales
0 20 40 60 80 100 120 m
SCALE 1:2500 @ A1

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Drawing Title
CONCEPT STORMWATER DRAINAGE LAYOUT PLAN

| Scale A1 | Project No. | Dwg. No. | Issue |
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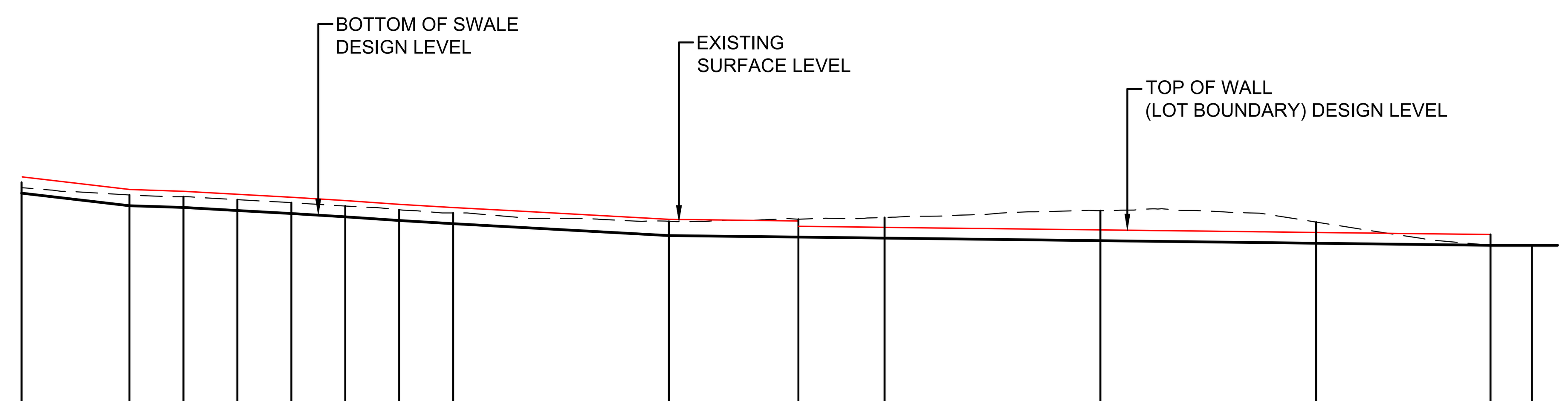
B




VERTICAL GRADE (%): -2.34 | -0.65 | -1.11 | -1.1 | -1.24 | -1.38 | -1.18 | -1.1 | -0.28 | -0.28 | 0

DATUM R.L. 2

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PROPOSED INVERT OF KERB | 31.833 | 30.662 | 30.5 | 30.224 | 29.948 | 29.639 | 29.294 | 29 | 27.9 | 27.758 | 27.664 | 27.427 | 27.191 | 27 | 27 |
| LOT BOUNDARY TOP OF WALL | 33.333 | 32.162 | 32.0 | 31.724 | 31.448 | 31.139 | 30.794 | 30.5 | 29.4 | 29.258 | 29.164 | 28.927 | 28.691 | 28.502 | 27 |
| EXISTING SURFACE | 32.333 | 31.662 | 31.5 | 31.224 | 30.948 | 30.639 | 30.294 | 30 | 29.229 | 29.412 | 29.575 | 30.212 | 29.15 | 27 | 27 |
| CHAINAGE | 0 | 50 | 75 | 100 | 125 | 150 | 175 | 200 | 300 | 360 | 400 | 500 | 600 | 680.809 | 700 |

## SWALE LONGITUDINAL SECTION

SCALE (H) 1:2500
(V) 1:500

NOT FOR CONSTRUCTION

| Issue | Description | Date | Design | Check |
|---|---|---|---|---|
| B | ISSUE FOR DEVELOPMENT APPLICATION | 07/07/2021 | M.M. | J.B. |
| A | ISSUE FOR DEVELOPMENT APPLICATION | 11/02/2020 | M.M. | J.B. |

Client
Wearco Pty Ltd
42 South Street, Jimboomba QLD 4280

Surveyor

Scales
0 20 40 60 80 100 120 m
SCALE 1:2500 @ A1
HORIZONTAL SCALE
0 10 20 30 m
SCALE 1:500 @ A1
VERTICAL SCALE

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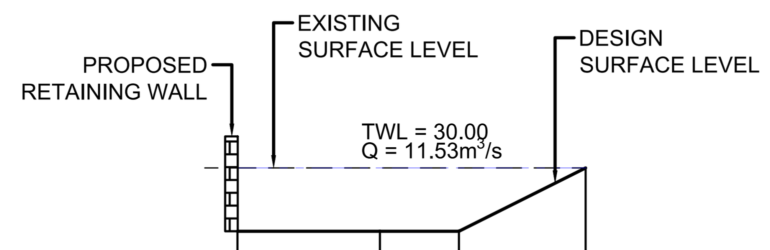
PROPOSED BUSINESS PARK
4499-4651 MT LINDESAY HIGHWAY,
NORTH MACLEAN QLD

Drawing Title
SWALE LONGITUDINAL SECTION

| Scale A1 | Project No. | Dwg. No. | Issue |
|---|---|---|---|
| As Shown | TIEL202159.CIV.DA | 018 | B |

**NOTE:**

- TWL = TOP WATER LEVEL
- Q = 100 YEAR FLOW
- REFER TO REPORT ACE180514.CIV.DA - SBSMP - ISSUE H FOR SWALE CALCULATION

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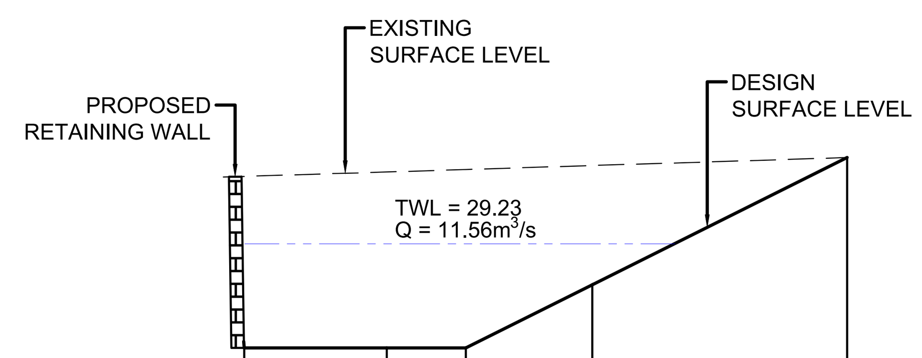
CH. 200.00




DATUM R.L.26.00

| | | | | | |
|---|---|---|---|---|---|
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| EXISTING SURFACE LEVEL | 30.141 | 30.212 | 30.251 | 30.313 | 30.439 |
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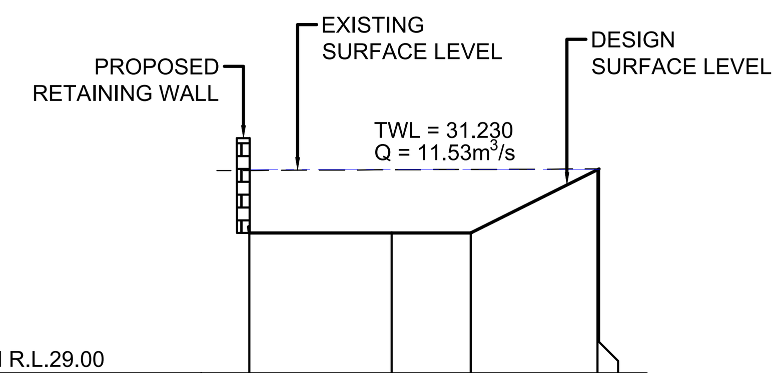
CH. 500.00




DATUM R.L.29.00

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|---|---|---|---|---|---|
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| EXISTING SURFACE LEVEL | 31.213 | 31.224 | 31.229 | 31.236 | 31.237 |
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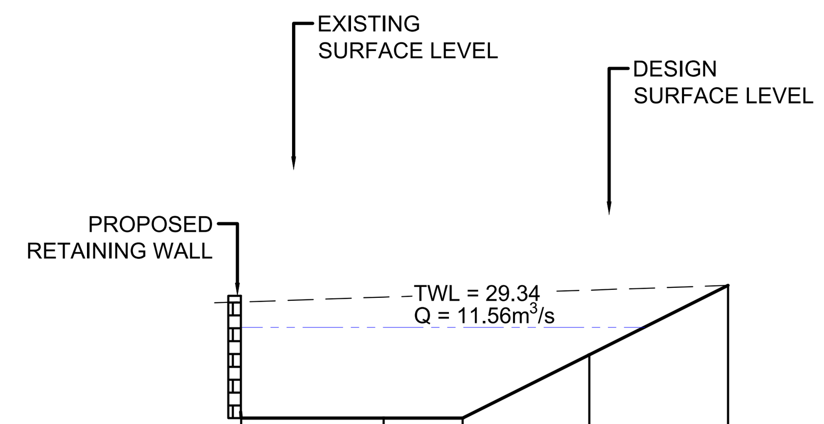
CH. 100.00




DATUM R.L.26.00

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|---|---|---|---|---|---|
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| EXISTING SURFACE LEVEL | 29.498 | 29.575 | 29.617 | 29.685 | 29.760 |
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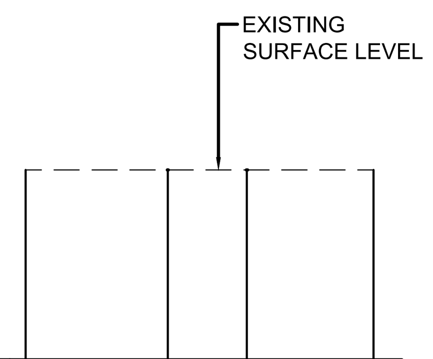
CH. 400.00




DATUM R.L.25.00

| | | | | |
|---|---|---|---|---|
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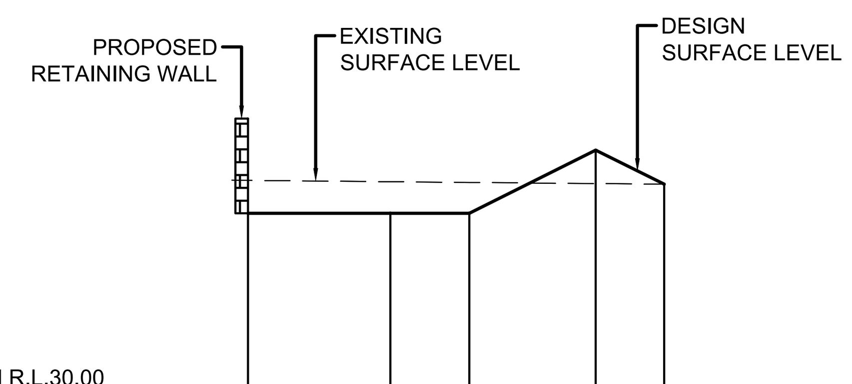
CH. 700.00




DATUM R.L.30.00

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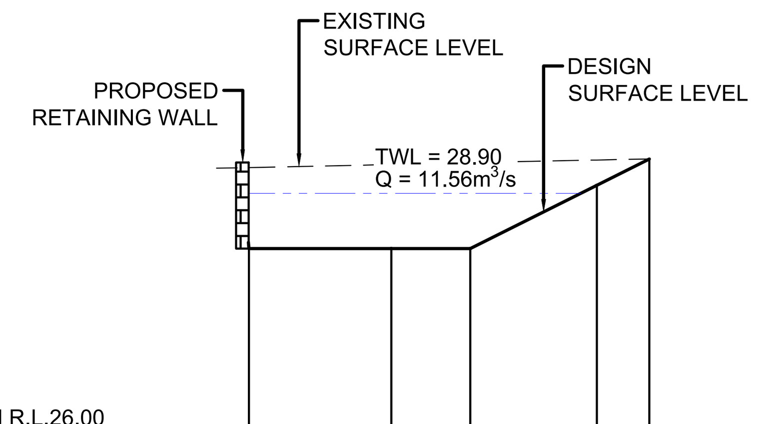
CH. 0.00




DATUM R.L.26.00

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|---|---|---|---|---|---|
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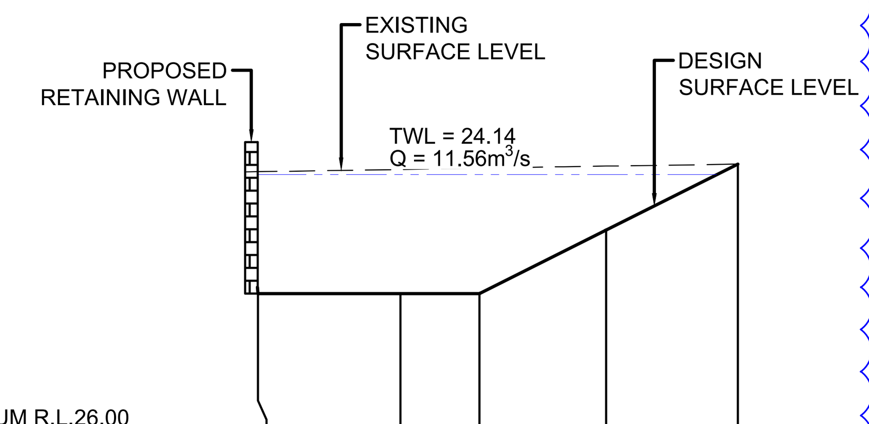
CH. 300.00




DATUM R.L.26.00

| | | | | | |
|---|---|---|---|---|---|
| DESIGN SURFACE LEVEL | 27.191 | 27.191 | 27.191 | 28.191 | 29.234 |
| EXISTING SURFACE LEVEL | 29.114 | 29.150 | 29.170 | 29.202 | 29.234 |
| OFFSET | -2.250 | 0.000 | 1.250 | 3.250 | 5.335 |

CH. 600.00

C

NOT FOR CONSTRUCTION

| Issue | Description | Date | Design | Check |
|---|---|---|---|---|
| C | ISSUE FOR DEVELOPMENT APPLICATION | 07/07/2021 | M.M. | J.B. |
| B | ISSUE FOR DEVELOPMENT APPLICATION | 09/07/2020 | M.M. | J.B. |
| A | ISSUE FOR DEVELOPMENT APPLICATION | 11/02/2020 | M.M. | J.B. |

Client: Wearco Pty Ltd
42 South Street, Jimboomba QLD 4280

Surveyor

Scales: 0 2 4 6 m
SCALE 1:100 @ A1

TELFORD CIVIL
DESIGN & CONSTRUCTION EXCELLENCE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Project: PROPOSED BUSINESS PARK
4499-4651 MT LINDESAY HIGHWAY,
NORTH MACLEAN QLD

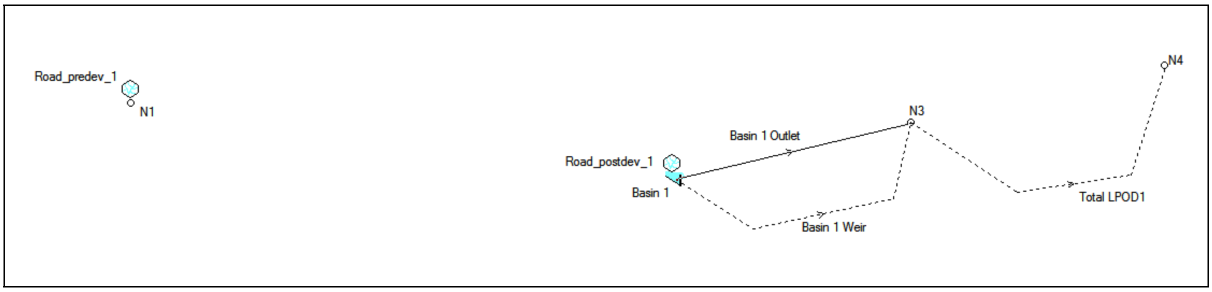
Drawing Title: SWALE CROSS SECTIONS

| Scale | A1 | Project No. | Dwg. No. | Issue |
|---|---|---|---|---|
| 1:100 | | TIEL202159.CIV.DA | 019 | C |

# Appendix C TIME OF CONCENTRATION CALCS

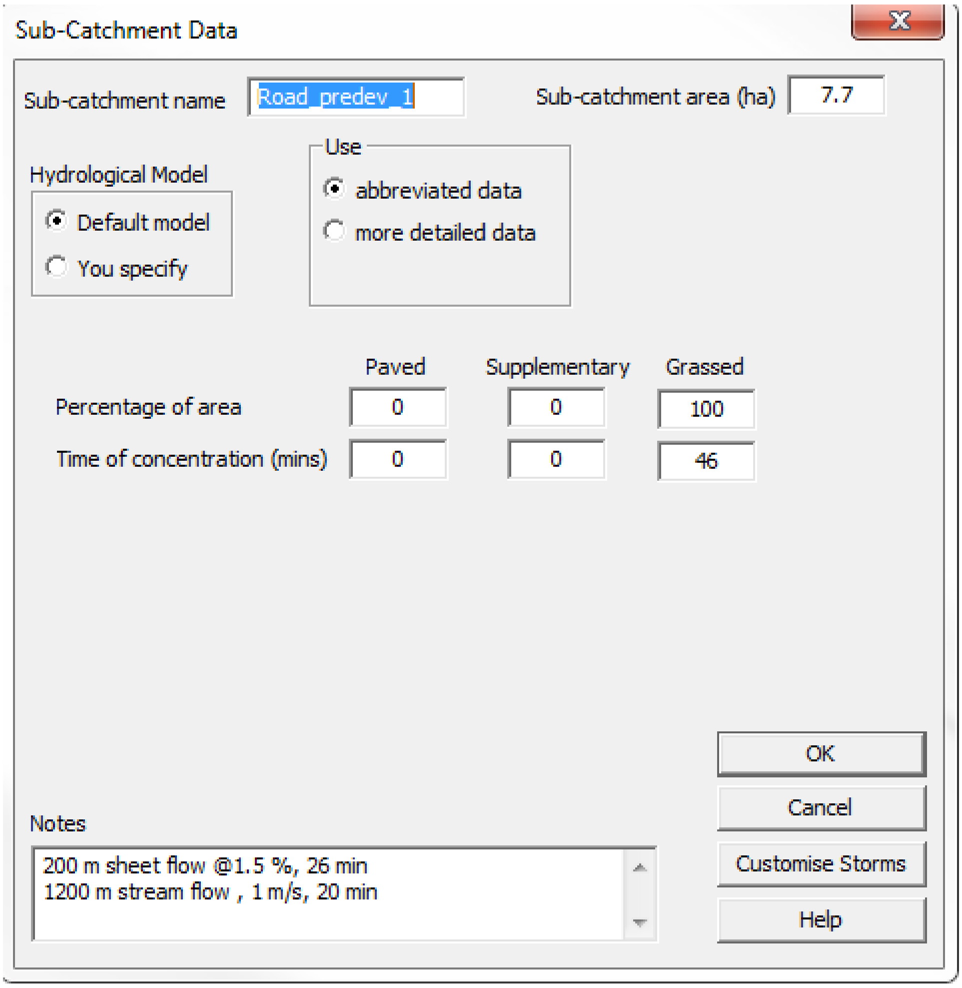
# DRAINS MODEL RESULTS

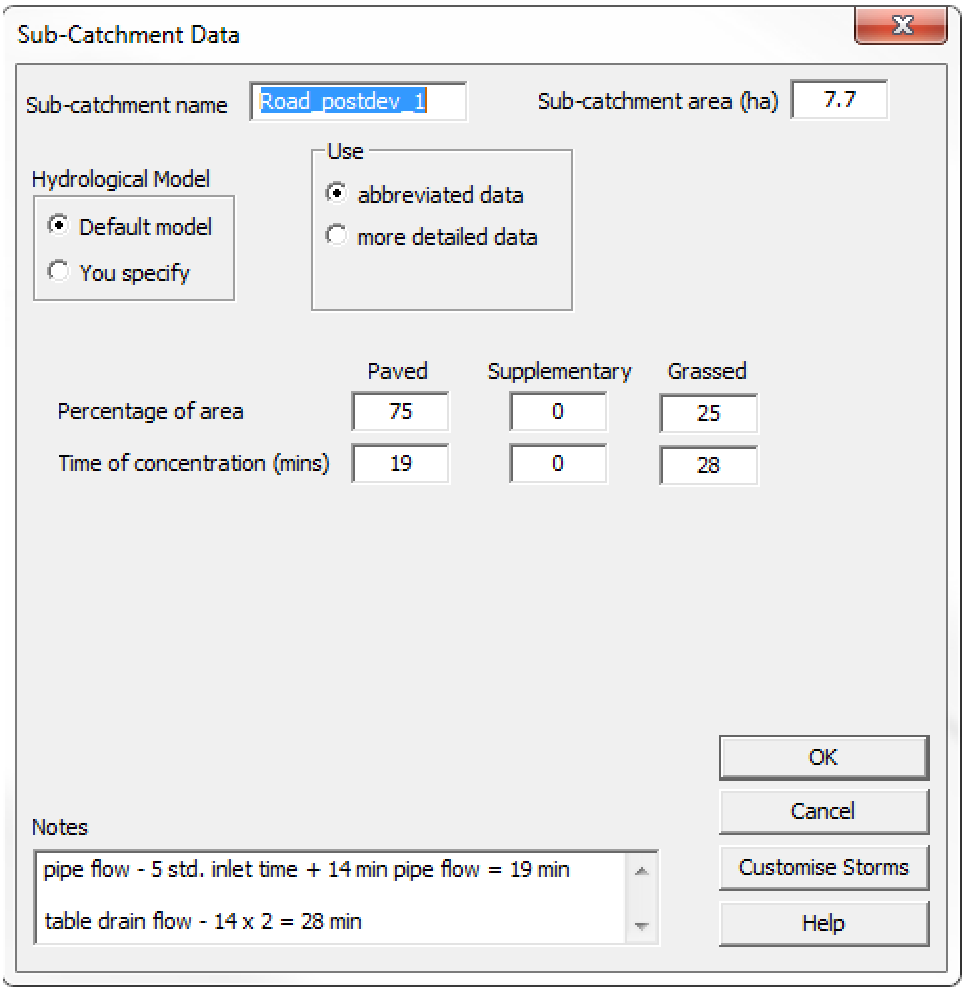
# DRAINS MODEL LAYOUT



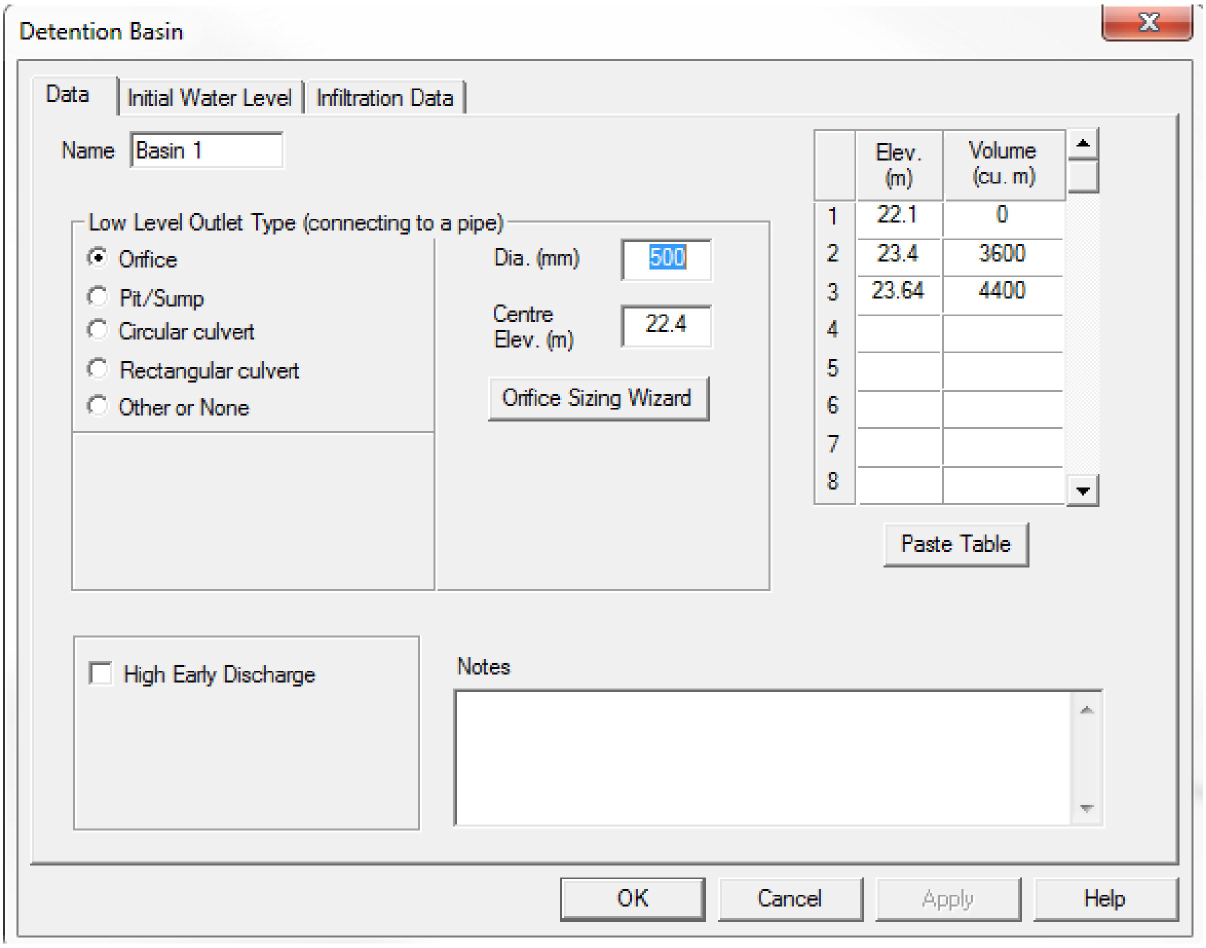

LPOD 1 – DRAINS LAYOUT

# DRAINS INPUT – CATCHMENT DATA – LPOD 1

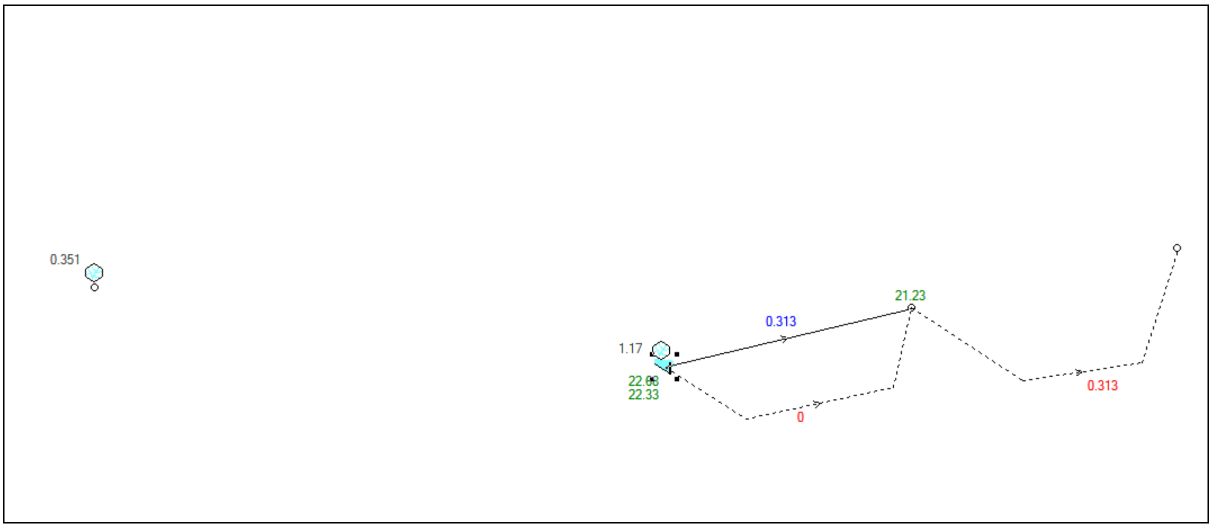



Sub-Catchment Data
Sub-catchment name
Road_postdev_1
Sub-catchment area (ha)
7.7
Hydrological Model
Default model
You specify
Use
abbreviated data
more detailed data
Paved
Supplementary
Grassed
Percentage of area
75
0
25
Time of concentration (mins)
19
0
28
Notes
pipe flow - 5 std. inlet time + 14 min pipe flow = 19 min
table drain flow - 14 x 2 = 28 min
OK
Cancel
Customise Storms
Help

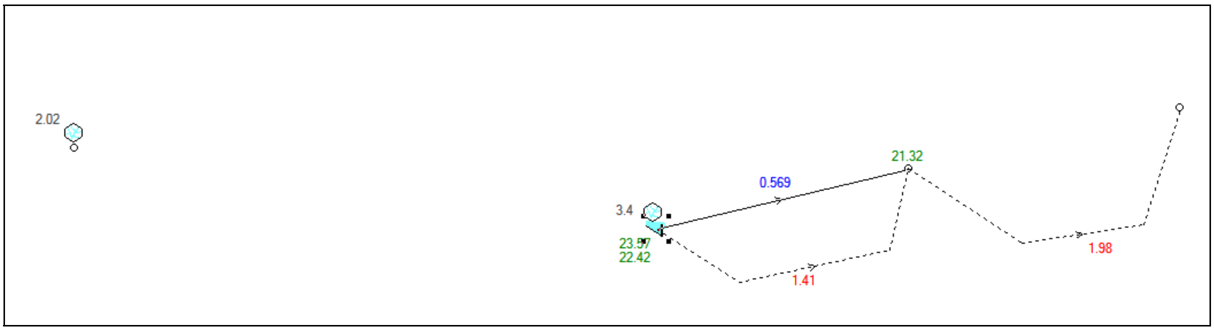
# DRAINS INPUT – BASIN PROPERTIES – LPOD 1



# DRAINS RESULT: NO WORSENING – LPOD 1




63% AEP Storm




1% AEP Storm

# Appendix D HYDRAULIC CALCULATION OF SWALES

TEL202159

**4499 MT LINDESAY HIGHWAY NORTH MACLEAN**

**1.0 Estimation of Peak Discharges (Rational method)**

**External Catchment North : East of Greenhill Road (Catchment of Exist 1/375 Culvert)**

**REFERENCES:**

*Queensland Urban Drainage Manual (QUDM,2013)*

*Catchment Area from AutoCAD*

***1.1 - Time of Concentration (tc)***

**1.1.1 Overland Flow**

| Parameter | Value | Unit | |
|---|---|---|---|
| Catchment Area | 2.90 | ha | |
| Overland sheet flow path length (L) | 116.00 | m | |
| Horton's surface roughness factor (n) | 0.045 | - | Table 4.6 Surface roughness or retardence fa |
| Slope of surface (S) | 2.50 | % | Average slope |
| Time of Concentration (tc) | 19.52 | min | |

**1.1.2 Channel flow**

| | | | Max | Min |
|---|---|---|---|---|
| Fall of channel | m | 10 | 42 | 32 |
| Flow Distance | m | 243 | | |
| Flow travel in channel | minutes | 2 | (Ref Figure 4.8, QUDM 2013) | |
| Delta | | 2 | | |
| Flow travel in natural channel | minuts | 4 | | |

**1.1.3 pipe flow**

| | | | Max | Min |
|---|---|---|---|---|
| Fall of channel | m | 0 | 10 | 8 |
| Flow Distance | m | 0 | | |
| Flow travel in channel | minutes | 0 | (Ref Figure 4.8, QUDM 2013) | |
| Delta | | 0 | | |
| Flow travel in natural channel | minuts | 0 | | |

**1.1.4 Total time of concentration**

| | | |
|---|---|---|
| | minutes | **23.52** |

***1.2 - IDF data from ARR***

| Return (T) (year) | Duration (t) (hr) | I mm/hr |
|---|---|---|
| 1 | 23.5 | 59 |
| 2 | 23.5 | 75 |
| 5 | 23.5 | 95 |
| 10 | 23.5 | 106 |
| 20 | 23.5 | 122 |
| 50 | 23.5 | 143 |
| 100 | 23.5 | 159 |

***1.3 - Frequency Factor and Runoff Coefficient (Table 4.05.2 & 4.05.3, QUDM)***

| | |
|---|---|
| $I_{10}$ | 64.00 |
| C10 | 0.65 |
| $FF_1$ | 0.80 |
| $FF_2$ | 0.85 |
| $FF_5$ | 0.95 |
| $FF_{10}$ | 1.00 |
| $FF_{20}$ | 1.05 |
| $FF_{50}$ | 1.15 |
| $FF_{100}$ | 1.20 |
| $C_1$ | 0.52 |
| $C_2$ | 0.55 |
| $C_5$ | 0.62 |
| $C_{10}$ | 0.65 |
| $C_{20}$ | 0.68 |
| $C_{50}$ | 0.75 |
| $C_{100}$ | 0.78 |

***1.4 - Peak Flows estimated from Rational Method***

| **Return (T)** (year) | **I(T,tc)** (mm/hr) | **$C_T$** | **$Q_T$** $m^3/s$ |
|---|---|---|---|
| 1 | 59 | 0.52 | **0.25** |
| 2 | 75 | 0.55 | **0.33** |
| 5 | 95 | 0.62 | **0.47** |
| 10 | 106 | 0.65 | **0.56** |
| 20 | 122 | 0.68 | **0.67** |
| 50 | 143 | 0.75 | **0.86** |
| 100 | 159 | 0.78 | **1.00** |

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**4499 MT LINDESAY HIGHWAY NORTH MACLEAN**

**1.0 Estimation of Peak Discharges (Rational method)**

**External Catchment North : East of Greenhill Road (From Exist 1/375 Culvert up to Greenhill Ro**

**REFERENCES:**

*Queensland Urban Drainage Manual (QUDM,2013)*

*Catchment Area from AutoCAD*

***1.1 - Time of Concentration (tc)***

**1.1.1 Overland Flow**

| Parameter | Value | Unit | |
|---|---|---|---|
| Catchment Area | 1.30 | ha | |
| Overland sheet flow path length (L) | 220.00 | m | |
| Horton's surface roughness factor (n) | 0.045 | - | Table 4.6 Surface roughness or retardence fa |
| Slope of surface (S) | 4.00 | % | Average slope |
| Time of Concentration (tc) | 21.99 | min | |

**1.1.2 Channel flow**

| | | | | |
|---|---|---|---|---|
| | | | Max | Min |
| Fall of channel | m | 2 | | |
| Flow Distance | m | 75 | | |
| Flow travel in channel | minutes | 0.5 | (Ref Figure 4.8, QUDM 2013) | |
| Delta | | 2 | | |
| Flow travel in natural channel | minuts | 1 | | |

**1.1.3 pipe flow**

| | | | | |
|---|---|---|---|---|
| | | | Max | Min |
| Fall of channel | m | 0 | 10 | 8 |
| Flow Distance | m | 0 | | |
| Flow travel in channel | minutes | 0 | (Ref Figure 4.8, QUDM 2013) | |
| Delta | | 0 | | |
| Flow travel in natural channel | minuts | 0 | | |

**1.1.4 Total time of concentration**

| | | |
|---|---|---|
| | minutes | **22.99** |

***1.2 - IDF data from ARR***

| Return (T) (year) | Duration (t) (hr) | I mm/hr |
|---|---|---|
| 1 | 23.0 | 59 |
| 2 | 23.0 | 75 |
| 5 | 23.0 | 95 |
| 10 | 23.0 | 106 |
| 20 | 23.0 | 122 |
| 50 | 23.0 | 143 |
| 100 | 23.0 | 159 |

***1.3 - Frequency Factor and Runoff Coefficient***
***(Table 4.05.2 & 4.05.3, QUDM)***

| | | |
|---|---|---|
| $I_{10}$ | 64.00 | |
| C10 | 0.65 | |
| $FF_1$ | 0.80 | |
| $FF_2$ | 0.85 | west |
| $FF_5$ | 0.95 | ` |
| $FF_{10}$ | 1.00 | |
| $FF_{20}$ | 1.05 | |
| $FF_{50}$ | 1.15 | |
| $FF_{100}$ | 1.20 | |
| $C_1$ | 0.52 | |
| $C_2$ | 0.55 | |
| $C_5$ | 0.62 | |
| $C_{10}$ | 0.65 | |
| $C_{20}$ | 0.68 | |
| $C_{50}$ | 0.75 | |
| $C_{100}$ | 0.78 | |

***1.4 - Peak Flows estimated from Rational Method***

| Return (T) (year) | I(T,tc) (mm/hr) | $C_T$ | $Q_T$ m³/s |
|---|---|---|---|
| 1 | 59 | 0.52 | **0.11** |
| 2 | 75 | 0.55 | **0.15** |
| 5 | 95 | 0.62 | **0.21** |
| 10 | 106 | 0.65 | **0.25** |
| 20 | 122 | 0.68 | **0.30** |
| 50 | 143 | 0.75 | **0.39** |
| 100 | 159 | 0.78 | **0.45** |

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**4499 MT LINDESAY HIGHWAY NORTH MACLEAN**

**1.0 Estimation of Peak Discharges (Rational method)**
**External Catchment North : East of Greenhill Road**

**REFERENCES:**
*Quennsland Urban Drainage Manual (QUDM,2013)*
*Catchment Area from AutoCAD*

***1.1 - Time of Concentration (tc)***

**1.1.1 Overland Flow**

| Parameter | Value | Unit | |
|---|---|---|---|
| Catchment Area | 8.73 | ha | |
| Overland sheet flow path length (L) | 133.00 | m | |
| Horton's surface roughness factor (n) | 0.045 | - | Table 4.6 Surface roughness or retardence fa |
| Slope of surface (S) | 3.00 | % | Average slope |
| Time of Concentration (tc) | 19.70 | min | |

**1.1.2 Channel flow**

| | | | Max | Min |
|---|---|---|---|---|
| Fall of channel | m | 13 | 42 | 29 |
| Flow Distance | m | 837 | | |
| Flow travel in channel | minutes | 7 | (Ref Figure 4.8, QUDM 2013) | |
| Delta | | 2 | | |
| Flow travel in natural channel | minuts | 14 | | |

**1.1.3 pipe flow**

| | | | Max | Min |
|---|---|---|---|---|
| Fall of channel | m | 0 | 10 | 8 |
| Flow Distance | m | 0 | | |
| Flow travel in channel | minutes | 0 | (Ref Figure 4.8, QUDM 2013) | |
| Delta | | 0 | | |
| Flow travel in natural channel | minuts | 0 | | |

**1.1.4 Total time of concentration**

| | | |
|---|---|---|
| | minutes | **33.70** |

***1.2 - IDF data from ARR***

| Return (T) (year) | Duration (t) (hr) | I mm/hr |
|---|---|---|
| 1 | 33.7 | 47 |
| 2 | 33.7 | 60 |
| 5 | 33.7 | 75 |
| 10 | 33.7 | 85 |
| 20 | 33.7 | 97 |
| 50 | 33.7 | 114 |
| 100 | 33.7 | 127 |

***1.3 - Frequency Factor and Runoff Coefficient***
***(Table 4.05.2 & 4.05.3, QUDM)***

| | |
|---|---|
| $I_{10}$ | 64.00 |
| C10 | 0.65 |
| $FF_1$ | 0.80 |
| $FF_2$ | 0.85 |
| $FF_5$ | 0.95 |
| $FF_{10}$ | 1.00 |
| $FF_{20}$ | 1.05 |
| $FF_{50}$ | 1.15 |
| $FF_{100}$ | 1.20 |
| $C_1$ | 0.52 |
| $C_2$ | 0.55 |
| $C_5$ | 0.62 |
| $C_{10}$ | 0.65 |
| $C_{20}$ | 0.68 |
| $C_{50}$ | 0.75 |
| $C_{100}$ | 0.78 |

***1.4 - Peak Flows estimated from Rational Method***

| **Return (T)** (year) | **I(T,tc)** (mm/hr) | $C_T$ | $Q_T$ $m^3/s$ |
|---|---|---|---|
| 1 | 47 | 0.52 | **0.59** |
| 2 | 60 | 0.55 | **0.80** |
| 5 | 75 | 0.62 | **1.13** |
| 10 | 85 | 0.65 | **1.33** |
| 20 | 97 | 0.68 | **1.61** |
| 50 | 114 | 0.75 | **2.07** |
| 100 | 127 | 0.78 | **2.40** |

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**4499 MT LINDESAY HIGHWAY NORTH MACLEAN**

**1.0 Estimation of Peak Discharges (Rational method)**
**External Catchment 1**

**REFERENCES:**
*Quennsland Urban Drainage Manual (QUDM,2013)*
*Catchment Area from AutoCAD*

***1.1 - Time of Concentration (tc)***

**1.1.1 Overland Flow**

| Parameter | Value | Unit | |
|---|---|---|---|
| Catchment Area | 33.22 | ha | |
| Overland sheet flow path length (L) | 200.00 | m | |
| Horton's surface roughness factor (n) | 0.045 | - | Table 4.6 Surface roughness or retardence fa |
| Slope of surface (S) | 3.00 | % | Average slope |
| Time of Concentration (tc) | 22.56 | min | |

**1.1.2 Channel flow**

| | | | | | |
|---|---|---|---|---|---|
| | | | Max | Min | |
| Fall of channel | m | 9 | 42 | 33 | |
| Flow Distance | m | 577 | | | |
| Flow travel in channel | minutes | 6 | (Ref Figure 4.8, QUDM 2013) | | |
| Delta | | 3 | | | |
| Flow travel in natural channel | minuts | 18 | | | |

**1.1.3 pipe flow**

| | | | | | |
|---|---|---|---|---|---|
| | | | Max | Min | |
| Fall of channel | m | 0 | 10 | 8 | |
| Flow Distance | m | 0 | | | |
| Flow travel in channel | minutes | 0 | (Ref Figure 4.8, QUDM 2013) | | |
| Delta | | 0 | | | |
| Flow travel in natural channel | minuts | 0 | | | |

**1.1.4 Total time of concentration**

| | | |
|---|---|---|
| | minutes | **40.56** |

***1.2 - IDF data from ARR***

| Return (T) (year) | Duration (t) (hr) | I mm/hr |
|---|---|---|
| 1 | 40.6 | 43 |
| 2 | 40.6 | 56 |
| 5 | 40.6 | 70 |
| 10 | 40.6 | 79 |
| 20 | 40.6 | 91 |
| 50 | 40.6 | 107 |
| 100 | 40.6 | 119 |

***1.3 - Frequency Factor and Runoff Coefficient***
***(Table 4.05.2 & 4.05.3, QUDM)***

| | |
|---|---|
| $I_{10}$ | 64.00 |
| C10 | 0.65 |
| $FF_1$ | 0.80 |
| $FF_2$ | 0.85 |
| $FF_5$ | 0.95 |
| $FF_{10}$ | 1.00 |
| $FF_{20}$ | 1.05 |
| $FF_{50}$ | 1.15 |
| $FF_{100}$ | 1.20 |
| $C_1$ | 0.52 |
| $C_2$ | 0.55 |
| $C_5$ | 0.62 |
| $C_{10}$ | 0.65 |
| $C_{20}$ | 0.68 |
| $C_{50}$ | 0.75 |
| $C_{100}$ | 0.78 |

***1.4 - Peak Flows estimated from Rational Method***

| Return (T) (year) | I(T,tc) (mm/hr) | $C_T$ | $Q_T$ $m^3/s$ |
|---|---|---|---|
| 1 | 43 | 0.52 | **2.06** |
| 2 | 56 | 0.55 | **2.86** |
| 5 | 70 | 0.62 | **3.99** |
| 10 | 79 | 0.65 | **4.74** |
| 20 | 91 | 0.68 | **5.73** |
| 50 | 107 | 0.75 | **7.38** |
| 100 | 119 | 0.78 | **8.57** |

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**4499 MT LINDESAY HIGHWAY NORTH MACLEAN**

**1.0 Estimation of Peak Discharges (Rational method)**
**External Catchment 2**

**REFERENCES:**
*Quennsland Urban Drainage Manual (QUDM,2013)*
*Catchment Area from AutoCAD*

***1.1 - Time of Concentration (tc)***

**1.1.1 Overland Flow**

| Parameter | Value | Unit | |
|---|---|---|---|
| Catchment Area | 46.04 | ha | |
| Overland sheet flow path length (L) | 200.00 | m | |
| Horton's surface roughness factor (n) | 0.045 | - | Table 4.6 Surface roughness or retardence fa |
| Slope of surface (S) | 3.00 | % | Average slope |
| Time of Concentration (tc) | 22.56 | min | |

**1.1.2 Channel flow**

| | | | | |
|---|---|---|---|---|
| | | | Max | Min |
| Fall of channel | m | 9 | 42 | 33 |
| Flow Distance | m | 577 | | |
| Flow travel in channel | minutes | 6 | (Ref Figure 4.8, QUDM 2013) | |
| Delta | | 3 | | |
| Flow travel in natural channel | minuts | 18 | | |

**1.1.3 pipe flow**

| | | | | |
|---|---|---|---|---|
| | | | Max | Min |
| Fall of channel | m | 3 | 33 | 30 |
| Flow Distance | m | 291 | | |
| Flow travel in channel | minutes | 5 | (Ref Figure 4.8, QUDM 2013) | |
| Delta | | 2 | | |
| Flow travel in natural channel | minuts | 10 | | |

**1.1.4 Total time of concentration**

| | | |
|---|---|---|
| | minutes | **50.56** |

***1.2 - IDF data from ARR***

| Return (T) (year) | Duration (t) (hr) | I mm/hr |
|---|---|---|
| 1 | 50.6 | 38 |
| 2 | 50.6 | 49 |
| 5 | 50.6 | 62 |
| 10 | 50.6 | 70 |
| 20 | 50.6 | 81 |
| 50 | 50.6 | 95 |
| 100 | 50.6 | 106 |

***1.3 - Frequency Factor and Runoff Coefficient***
***(Table 4.05.2 & 4.05.3, QUDM)***

| | |
|---|---|
| $I_{10}$ | 64.00 |
| C10 | 0.65 |
| $FF_1$ | 0.80 |
| $FF_2$ | 0.85 |
| $FF_5$ | 0.95 |
| $FF_{10}$ | 1.00 |
| $FF_{20}$ | 1.05 |
| $FF_{50}$ | 1.15 |
| $FF_{100}$ | 1.20 |
| $C_1$ | 0.52 |
| $C_2$ | 0.55 |
| $C_5$ | 0.62 |
| $C_{10}$ | 0.65 |
| $C_{20}$ | 0.68 |
| $C_{50}$ | 0.75 |
| $C_{100}$ | 0.78 |

***1.4 - Peak Flows estimated from Rational Method***

| Return (T) (year) | I(T,tc) (mm/hr) | $C_T$ | $Q_T$ m³/s |
|---|---|---|---|
| 1 | 38 | 0.52 | **2.53** |
| 2 | 49 | 0.55 | **3.46** |
| 5 | 62 | 0.62 | **4.90** |
| 10 | 70 | 0.65 | **5.82** |
| 20 | 81 | 0.68 | **7.07** |
| 50 | 95 | 0.75 | **9.08** |
| 100 | 106 | 0.78 | **10.57** |

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**4499 MT LINDESAY HIGHWAY NORTH MACLEAN**

**1.0 Estimation of Peak Discharges (Rational method)**

**External Catchment West : Downstream of Lot 26 - Last section**

**REFERENCES:**

*Quensland Urban Drainage Manual (QUDM,2013)*

*Catchment Area from AutoCAD*

***1.1 - Time of Concentration (tc)***

**1.1.1 Overland Flow**

| Parameter | Value | Unit | |
|---|---|---|---|
| Catchment Area | 55.00 | ha | |
| Overland sheet flow path length (L) | 200.00 | m | |
| Horton's surface roughness factor (n) | 0.045 | - | Table 4.6 Surface roughness or retardence fa |
| Slope of surface (S) | 3.00 | % | Average slope |
| Time of Concentration (tc) | 22.56 | min | |

**1.1.2 Channel flow**

| | | | Max | Min |
|---|---|---|---|---|
| Fall of channel | m | 9 | 42 | 33 |
| Flow Distance | m | 577 | | |
| Flow travel in channel | minutes | 6 | (Ref Figure 4.8, QUDM 2013) | |
| Delta | | 3 | | |
| Flow travel in natural channel | minuts | 18 | | |

**1.1.3 pipe flow**

| | | | Max | Min |
|---|---|---|---|---|
| Fall of channel | m | 5 | 33 | 28 |
| Flow Distance | m | 761 | | |
| Flow travel in channel | minutes | 10 | (Ref Figure 4.8, QUDM 2013) | |
| Delta | | 2 | | |
| Flow travel in natural channel | minuts | 20 | | |

**1.1.4 Total time of concentration**

| | | |
|---|---|---|
| | minutes | **60.56** |

***1.2 - IDF data from ARR***

| Return (T) (year) | Duration (t) (hr) | I mm/hr |
|---|---|---|
| 1 | 60.6 | 25 |
| 2 | 60.6 | 45 |
| 5 | 60.6 | 57 |
| 10 | 60.6 | 64 |
| 20 | 60.6 | 74 |
| 50 | 60.6 | 87 |
| 100 | 60.6 | 97 |

***1.3 - Frequency Factor and Runoff Coefficient***
***(Table 4.05.2 & 4.05.3, QUDM)***

| | |
|---|---|
| $I_{10}$ | 64.00 |
| C10 | 0.65 |
| $FF_1$ | 0.80 |
| $FF_2$ | 0.85 |
| $FF_5$ | 0.95 |
| $FF_{10}$ | 1.00 |
| $FF_{20}$ | 1.05 |
| $FF_{50}$ | 1.15 |
| $FF_{100}$ | 1.20 |
| $C_1$ | 0.52 |
| $C_2$ | 0.55 |
| $C_5$ | 0.62 |
| $C_{10}$ | 0.65 |
| $C_{20}$ | 0.68 |
| $C_{50}$ | 0.75 |
| $C_{100}$ | 0.78 |

***1.4 - Peak Flows estimated from Rational Method***

| Return (T) (year) | I(T,tc) (mm/hr) | $C_T$ | $Q_T$ $m^3/s$ |
|---|---|---|---|
| 1 | 25 | 0.52 | **1.99** |
| 2 | 45 | 0.55 | **3.80** |
| 5 | 57 | 0.62 | **5.38** |
| 10 | 64 | 0.65 | **6.36** |
| 20 | 74 | 0.68 | **7.72** |
| 50 | 87 | 0.75 | **9.94** |
| 100 | 97 | 0.78 | **11.56** |

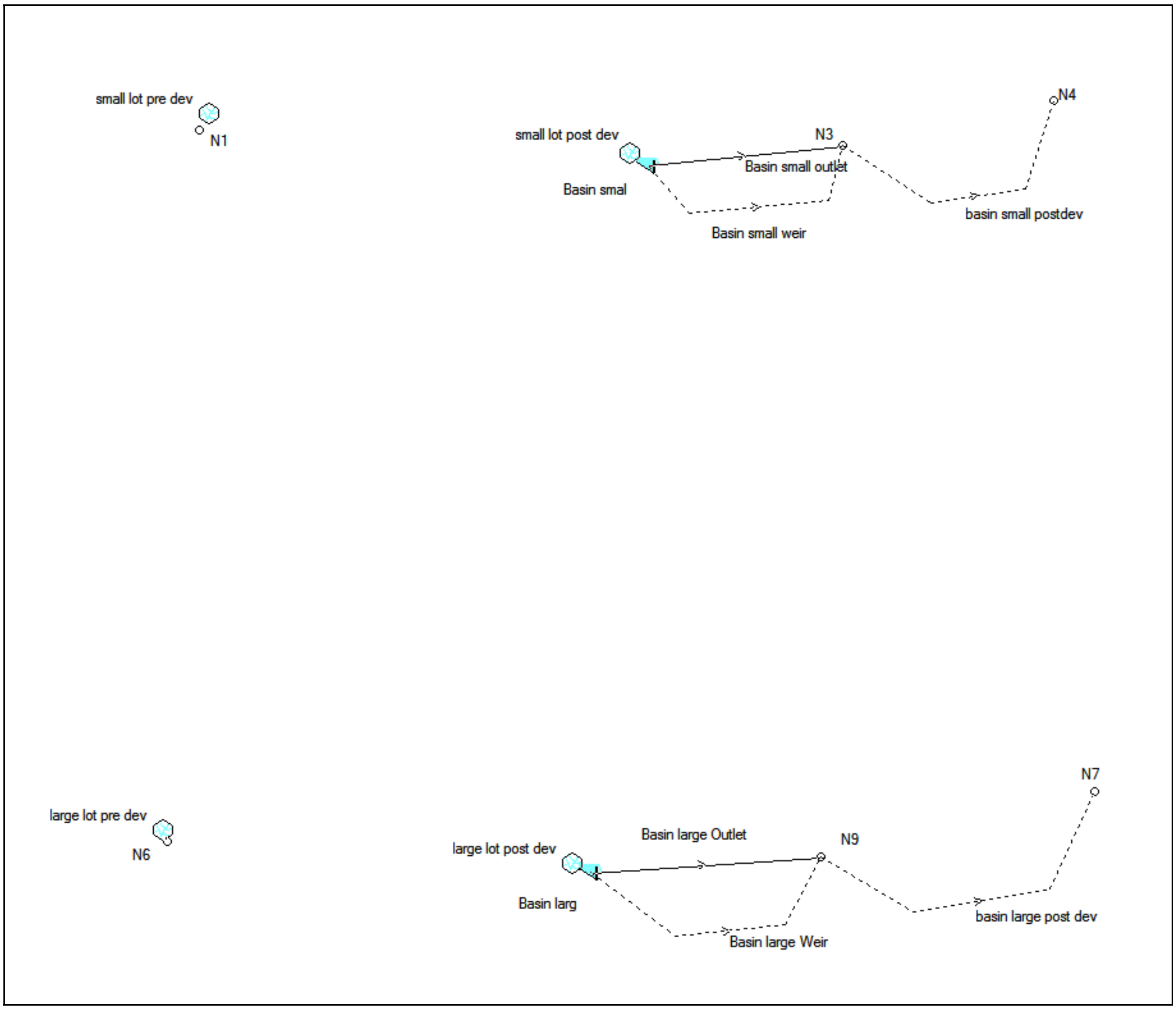
**Trapazoidal Channel Flow**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Job** | Proposed Business Park North Maclean | | | | | |
| **Job No** | TEL202159 | | | | | |
| **Date** | | | | | | |
| **Designer** | | | | | | |
| **Description** | Design of Swale - West - Q100 = 11.6 m3/s | | | | | |
| | dV > 0.6 m2/s - need to be fenced | | | | | |
| | **Mannings** | 0.025 | | | | |
| | **Slope** | 0.75 | % 1 in | 133.3 | | |
| **Left Slope 1 in** | | 2 | | | Initial depth guess | 0.5 m |
| **Bottom Width** | | 5 | | | Interval | 0.05 m |
| **Right Slope 1 in** | | 2 | | | | |
| Depth | 1.1 | Width | 9.4 | m | | |
| Q50 less Q5 | 0.5 | | 18,34 AND 41 | ($m^3$/s) | | |

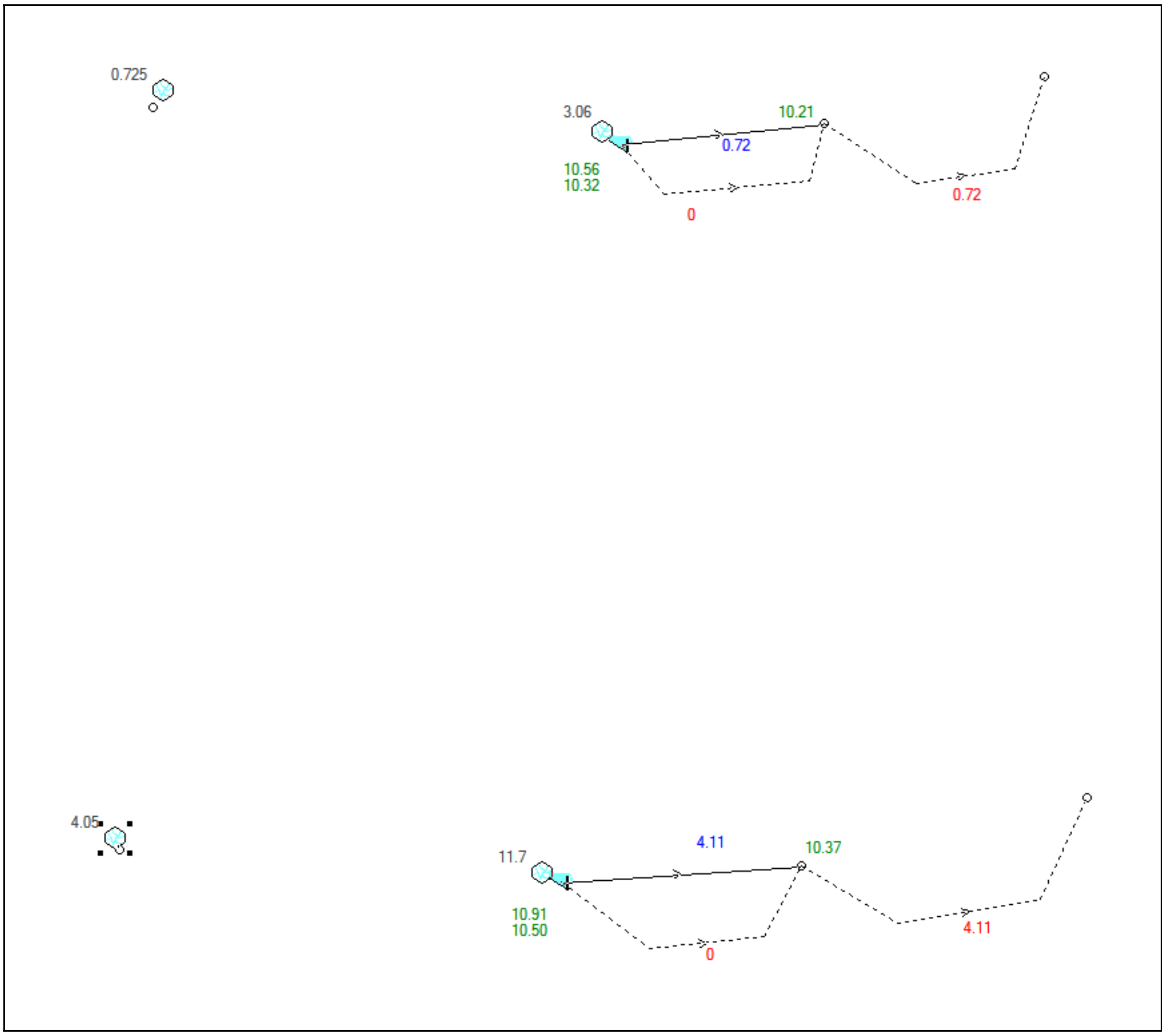
| Flow Depth (m) | Area ($m^2$) | WP (m) | HR (m) | V (m/s) | Q ($m^3$/s) | dV ($m^2$/s) |
|---|---|---|---|---|---|---|
| 0.500 | 3.000 | 7.236 | 0.415 | 1.926 | 5.778 | 0.963 |
| 0.550 | 3.355 | 7.460 | 0.450 | 2.033 | 6.822 | 1.118 |
| 0.600 | 3.720 | 7.683 | 0.484 | 2.136 | 7.946 | 1.282 |
| 0.650 | 4.095 | 7.907 | 0.518 | 2.234 | 9.148 | 1.452 |
| 0.700 | 4.480 | 8.130 | 0.551 | 2.328 | 10.431 | 1.630 |
| 0.750 | 4.875 | 8.354 | 0.584 | 2.419 | 11.793 | 1.814 |
| 0.800 | 5.280 | 8.578 | 0.616 | 2.507 | 13.235 | 2.005 |
| 0.850 | 5.695 | 8.801 | 0.647 | 2.592 | 14.759 | 2.203 |
| 0.900 | 6.120 | 9.025 | 0.678 | 2.674 | 16.364 | 2.406 |
| 0.950 | 6.555 | 9.249 | 0.709 | 2.754 | 18.051 | 2.616 |
| 1.000 | 7.000 | 9.472 | 0.739 | 2.832 | 19.821 | 2.832 |
| 1.050 | 7.455 | 9.696 | 0.769 | 2.907 | 21.675 | 3.053 |
| 1.100 | 7.920 | 9.919 | 0.798 | 2.981 | 23.613 | 3.280 |
| 1.150 | 8.395 | 10.143 | 0.828 | 3.054 | 25.636 | 3.512 |
| 1.200 | 8.880 | 10.367 | 0.857 | 3.124 | 27.745 | 3.749 |
| 1.250 | 9.375 | 10.590 | 0.885 | 3.194 | 29.942 | 3.992 |
| 1.300 | 9.880 | 10.814 | 0.914 | 3.262 | 32.226 | 4.240 |
| 1.350 | 10.395 | 11.037 | 0.942 | 3.328 | 34.598 | 4.493 |
| 1.400 | 10.920 | 11.261 | 0.970 | 3.394 | 37.060 | 4.751 |
| 1.450 | 11.455 | 11.485 | 0.997 | 3.458 | 39.613 | 5.014 |
| 1.500 | 12.000 | 11.708 | 1.025 | 3.521 | 42.257 | 5.282 |

# Appendix E LOT-BASED DETENTION AND BIO-RETENTION CALCULATION

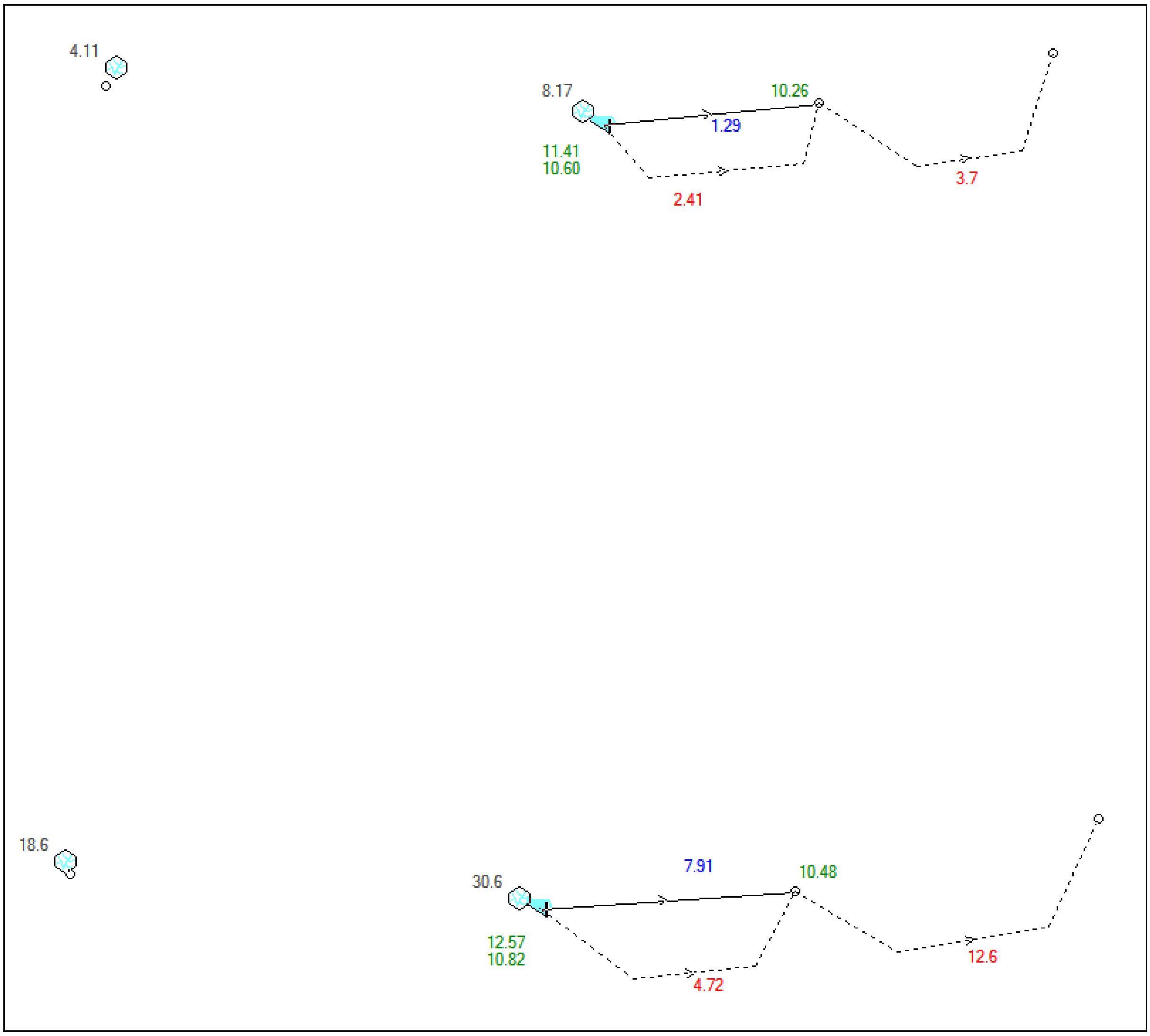
# LOT-BASED DRAINS MODEL - LAYOUT



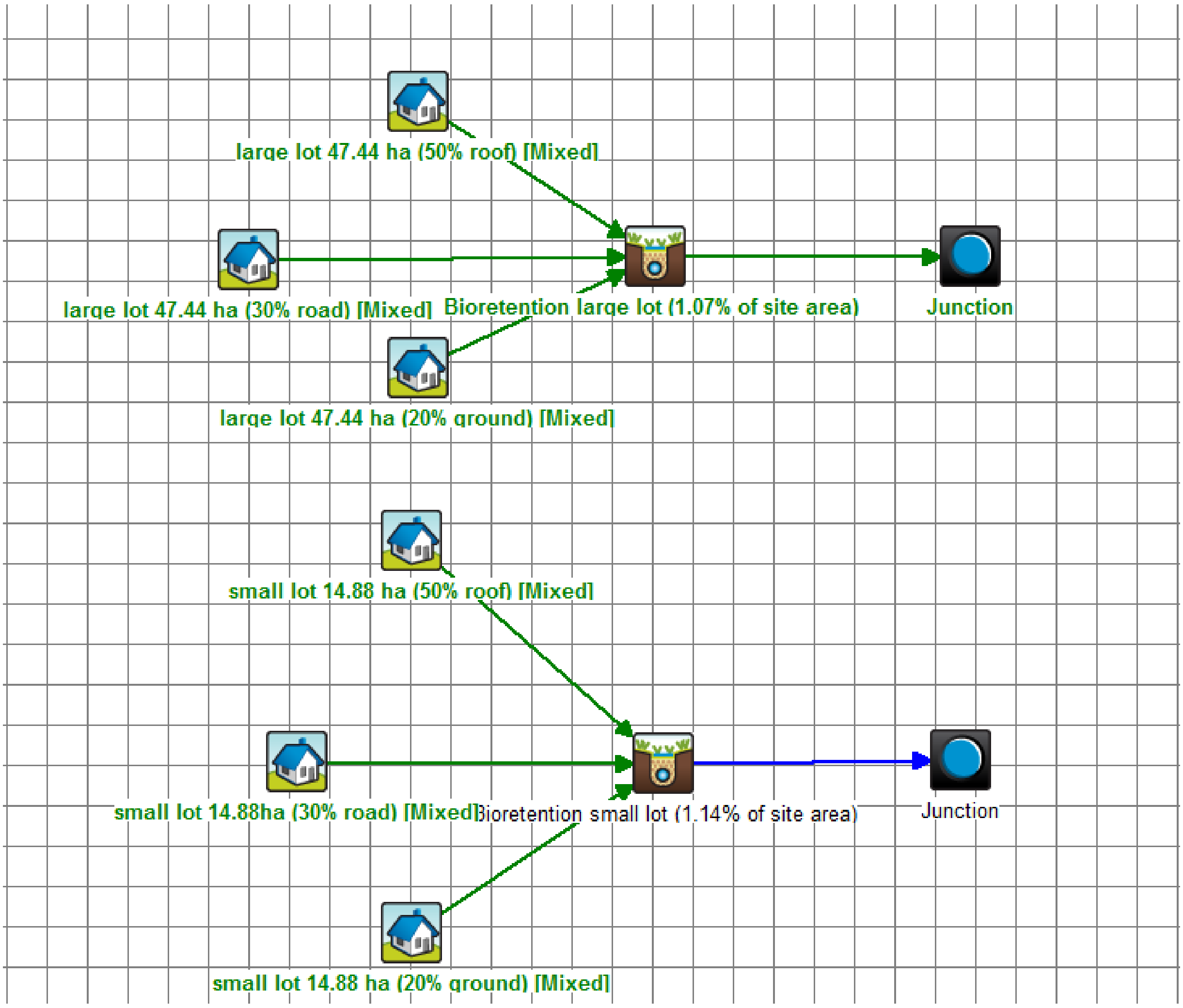
# LOT-BASED DRAINS MODEL – RESULTS
## 63% AEP STORM

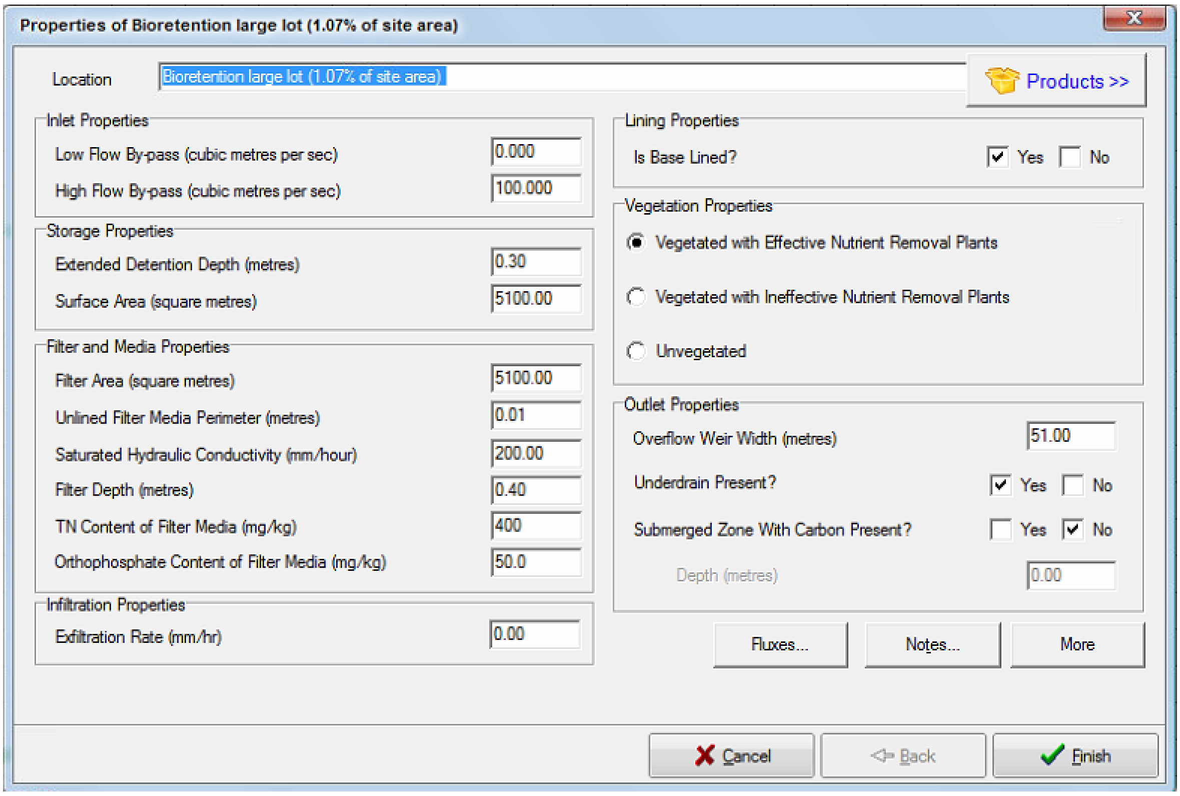


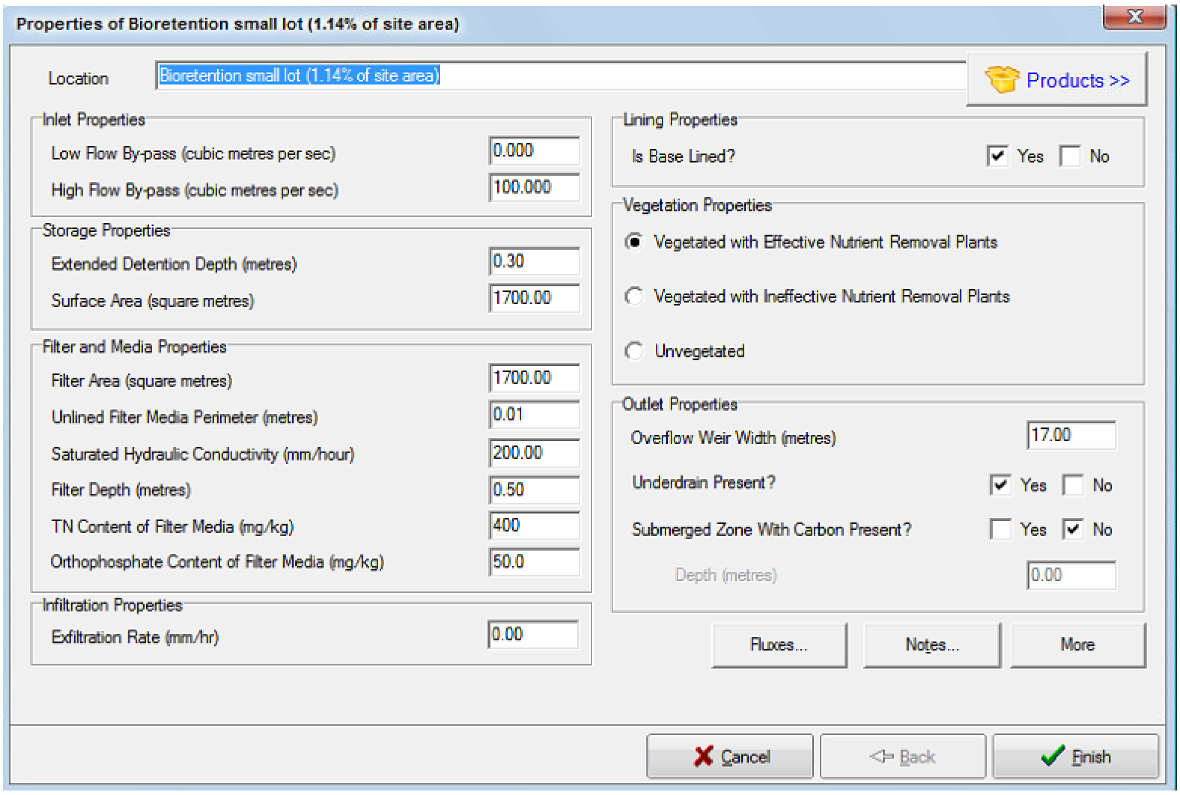
# LOT-BASED DRAINS MODEL – RESULTS
## 1% AEP STORM



## LOT-BASED BIO-RETENTION CALCULATION - LAYOUT, INPUT AND RESULTS




Properties of Bioretention large lot (1.07% of site area)
Location
Bioretention large lot (1.07% of site area)
Products >>
Inlet Properties
Low Flow By-pass (cubic metres per sec)
0.000
High Flow By-pass (cubic metres per sec)
100.000
Storage Properties
Extended Detention Depth (metres)
0.30
Surface Area (square metres)
5100.00
Filter and Media Properties
Filter Area (square metres)
5100.00
Unlined Filter Media Perimeter (metres)
0.01
Saturated Hydraulic Conductivity (mm/hour)
200.00
Filter Depth (metres)
0.40
TN Content of Filter Media (mg/kg)
400
Orthophosphate Content of Filter Media (mg/kg)
50.0
Infiltration Properties
Exfiltration Rate (mm/hr)
0.00
Lining Properties
Is Base Lined?
Yes
No
Vegetation Properties
Vegetated with Effective Nutrient Removal Plants
Vegetated with Ineffective Nutrient Removal Plants
Unvegetated
Outlet Properties
Overflow Weir Width (metres)
51.00
Underdrain Present?
Yes
No
Submerged Zone With Carbon Present?
Yes
No
Depth (metres)
0.00
Fluxes...
Notes...
More
Cancel
Back
Finish


Properties of Bioretention small lot (1.14% of site area)
Location
Bioretention small lot (1.14% of site area)
Products >>
Inlet Properties
Low Flow By-pass (cubic metres per sec)
0.000
High Flow By-pass (cubic metres per sec)
100.000
Storage Properties
Extended Detention Depth (metres)
0.30
Surface Area (square metres)
1700.00
Filter and Media Properties
Filter Area (square metres)
1700.00
Unlined Filter Media Perimeter (metres)
0.01
Saturated Hydraulic Conductivity (mm/hour)
200.00
Filter Depth (metres)
0.50
TN Content of Filter Media (mg/kg)
400
Orthophosphate Content of Filter Media (mg/kg)
50.0
Infiltration Properties
Exfiltration Rate (mm/hr)
0.00
Lining Properties
Is Base Lined?
Yes
No
Vegetation Properties
Vegetated with Effective Nutrient Removal Plants
Vegetated with Ineffective Nutrient Removal Plants
Unvegetated
Outlet Properties
Overflow Weir Width (metres)
17.00
Underdrain Present?
Yes
No
Submerged Zone With Carbon Present?
Yes
No
Depth (metres)
0.00
Fluxes...
Notes...
More
Cancel
Back
Finish

Treatment Train Effectiveness - Junction

| | Sources | Residual Load | % Reduction |
|---|---|---|---|
| **Flow (ML/yr)** | 295 | 289 | 1.9 |
| **Total Suspended Solids (kg/yr)** | 50200 | 8080 | 83.9 |
| **Total Phosphorus (kg/yr)** | 110 | 44.2 | 60 |
| **Total Nitrogen (kg/yr)** | 694 | 319 | 54.1 |
| **Gross Pollutants (kg/yr)** | 7430 | 0 | 100 |

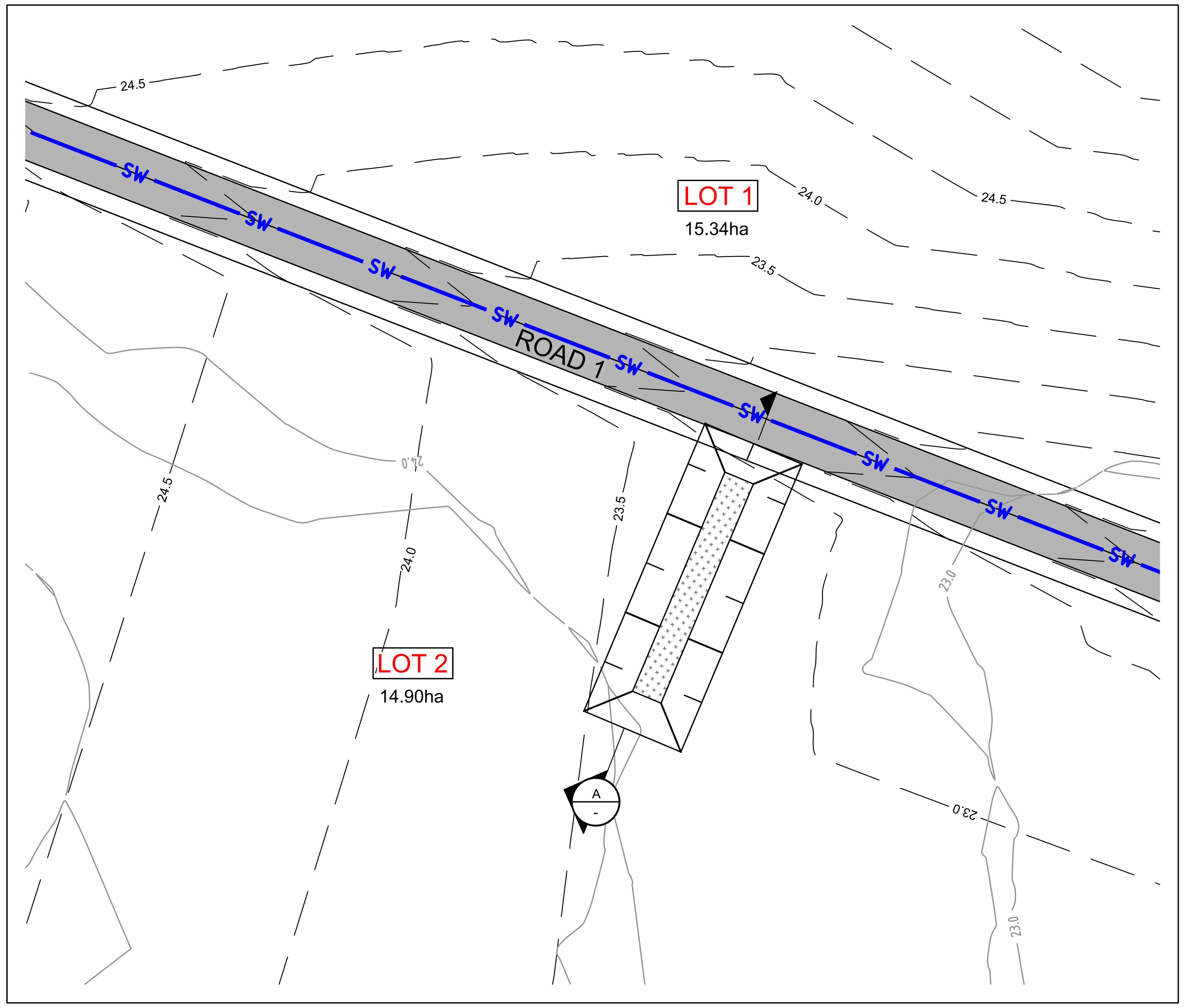
Treatment Train Effectiveness - Junction

| | Sources | Residual Load | % Reduction |
|---|---|---|---|
| **Flow (ML/yr)** | 92.5 | 90.6 | 2.1 |
| **Total Suspended Solids (kg/yr)** | 15700 | 2450 | 84.4 |
| **Total Phosphorus (kg/yr)** | 33.9 | 13.4 | 60.6 |
| **Total Nitrogen (kg/yr)** | 213 | 95.1 | 55.4 |
| **Gross Pollutants (kg/yr)** | 2330 | 0 | 100 |

# Appendix F LOT-BASED DETENTION AND BIO-RETENTION OPTION

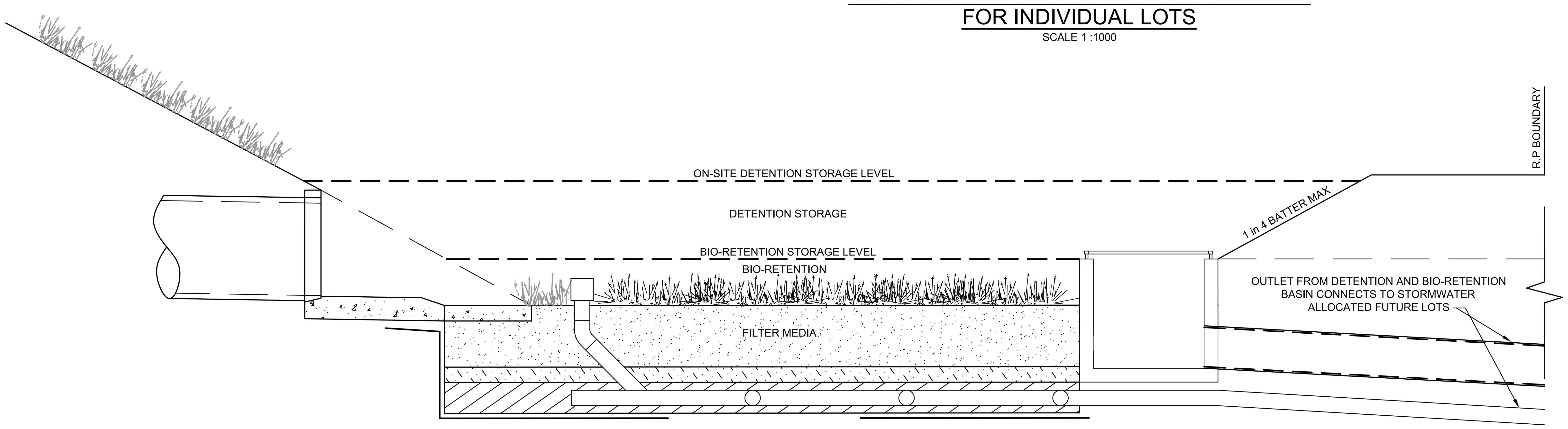
## LEGEND

- E —— E: OVERHEAD TRANSMISSION POWER LINES
- 30.00: EXISTING CONTOURS
- 30.00 (G): DESIGN CONTOURS
- SW: PROPOSED STORMWATER FOR ROAD RESERVE
- PROPOSED ROAD PAVEMENT



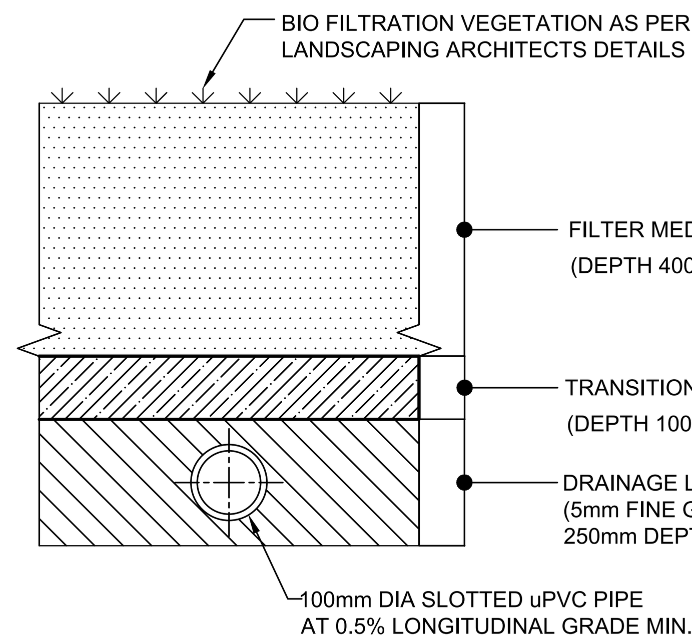

OPTION 1 COMBINED DETENTION AND BIO-RETENTION STORAGE ABOVE GROUND FOR INDIVIDUAL LOTS

SCALE 1 :1000




TYPICAL BASIN DETAIL SECTION A

N.T.S




FILTER MEDIA TYPICAL CROSS SECTION

N.TS

NOT FOR CONSTRUCTION

| Issue | Description | Date | Design | Check |
|---|---|---|---|---|
| G | ISSUE FOR DEVELOPMENT APPLICATION | 07/07/2021 | M.M. | J.B. |
| F | ISSUE FOR DEVELOPMENT APPLICATION | 18/12/2020 | M.M. | J.B. |
| E | ISSUE FOR DEVELOPMENT APPLICATION | 28/11/2019 | M.M. | J.B. |
| D | ISSUE FOR DEVELOPMENT APPLICATION | 01/03/2019 | M.M. | J.B. |
| C | ISSUE FOR DEVELOPMENT APPLICATION | 11/07/2016 | M.M. | J.B. |
| B | ISSUE FOR DEVELOPMENT APPLICATION | 12/06/2016 | M.M. | J.B. |

Client: Wearco Pty Ltd
42 South Street, Jimboomba QLD 4280

Surveyor

Scales: 0 20 40 60 80 100 120 m
SCALE 1:2500 @ A1

TELFORD CIVIL
DESIGN & CONSTRUCTION EXCELLENCE


Level 4, 470 Church Street,
Parramatta NSW 2150
PO BOX 3579 Parramatta 2124
Email : info@telfordcivil.com.au
PHONE : 02 7809 4931

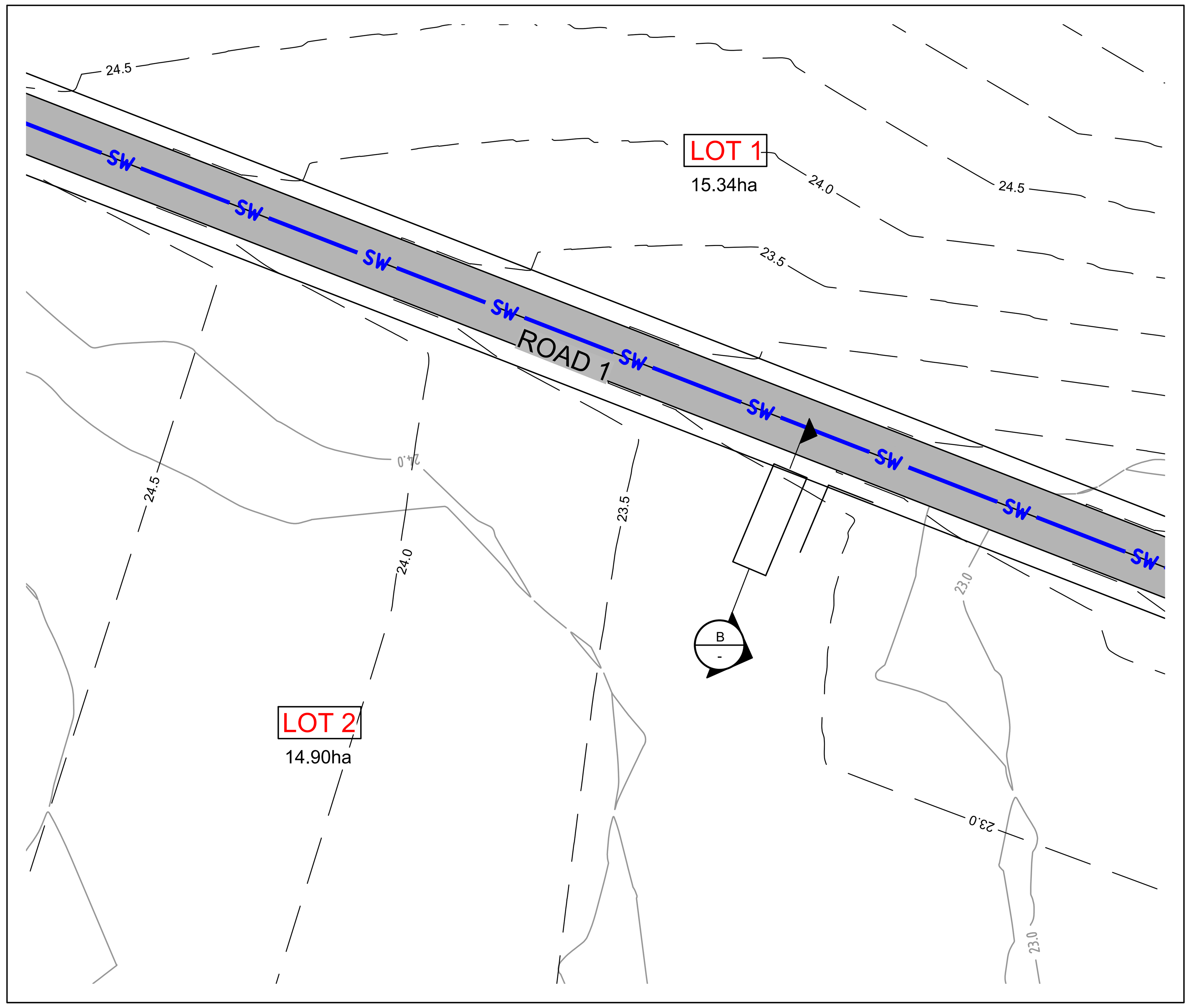

Project: PROPOSED BUSINESS PARK
4499-4651 MT LINDESAY HIGHWAY,
NORTH MACLEAN QLD

Drawing Title: CONCEPT LOT BASED TREATMENT OPTION 1
LAYOUT PLAN

| Scale | A1 | Project No. | Dwg. No. | Issue |
|---|---|---|---|---|
| 1:2500 | | ACE180514.CIV.SK | 017 | F |

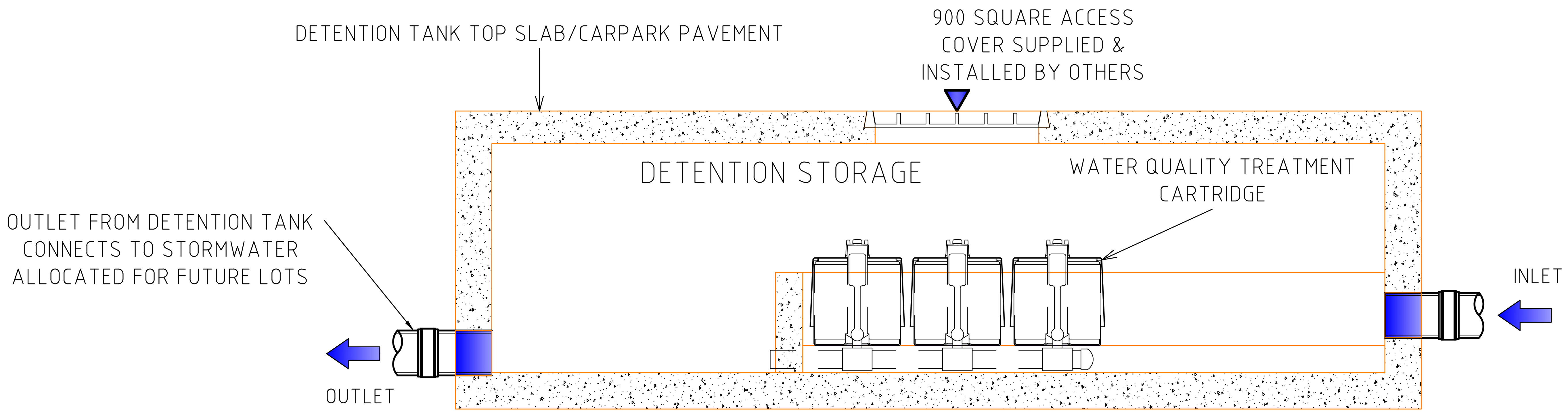
## LEGEND

- OVERHEAD TRANSMISSION POWER LINES
- EXISTING CONTOURS
- DESIGN CONTOURS (G)
- PROPOSED STORMWATER FOR ROAD RESERVE
- PROPOSED ROAD PAVEMENT

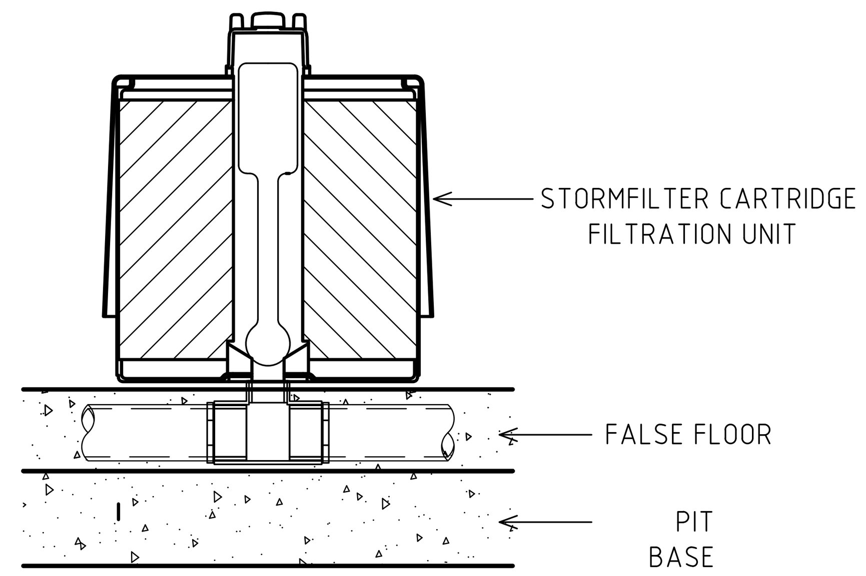



OPTION 2 COMBINED UNDER GROUND TANK ( PREFERABLY UNDER CARPARK ) WITH DETENTION STORAGE AND WATER QUALITY TREATMENT CARTRIDGE SYSTEM FOR INDIVIDUAL LOTS

SCALE 1 :100




SECTION B




**STORMFILTER CARTRIDGE DETAIL**

NOT FOR CONSTRUCTION

| Issue | Description | Date | Design | Check |
|---|---|---|---|---|
| G | ISSUE FOR DEVELOPMENT APPLICATION | 07/07/2021 | M.M. | J.B. |
| F | ISSUE FOR DEVELOPMENT APPLICATION | 18/12/2020 | M.M. | J.B. |
| E | ISSUE FOR DEVELOPMENT APPLICATION | 28/11/2019 | M.M. | J.B. |
| D | ISSUE FOR DEVELOPMENT APPLICATION | 01/03/2019 | M.M. | J.B. |
| C | ISSUE FOR DEVELOPMENT APPLICATION | 11/07/2016 | M.M. | J.B. |
| B | ISSUE FOR DEVELOPMENT APPLICATION | 12/06/2016 | M.M. | J.B. |

Client
Wearco Pty Ltd
42 South Street, Jimboomba QLD 4280

Surveyor

Scales
0 20 40 60 80 100 120 m
SCALE 1:2500 @ A1


TELFORD CIVIL
DESIGN & CONSTRUCTION EXCELLENCE
Level 4, 470 Church Street, Parramatta NSW 2150
PO BOX 3579 Parramatta 2124
Email : info@telfordcivil.com.au
PHONE : 02 7809 4931


Project
PROPOSED BUSINESS PARK
4499-4651 MT LINDESAY HIGHWAY, NORTH MACLEAN QLD

Drawing Title
CONCEPT LOT BASED TREATMENT OPTION 2
LAYOUT PLAN

| Scale A1 | Project No. | Dwg. No. | Issue |
|---|---|---|---|
| 1:2500 | ACE180514.CIV.SK | 018 | G |

# Bioretention
# Technical Design Guidelines

Version 1.1, October 2014

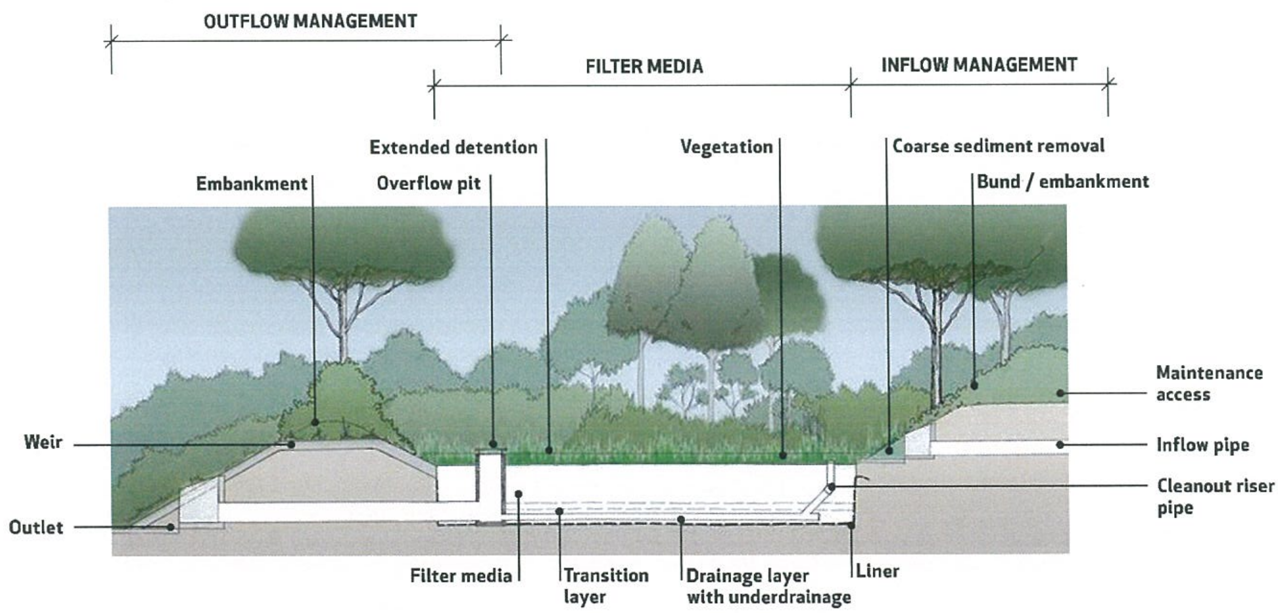
Water by Design is a program of Healthy Waterways Ltd

## 2.1 What are bioretention systems?

Bioretention systems are shallow depressions in the urban landscape designed to collect and treat stormwater. Figure 2 depicts a typical bioretention system. Stormwater conveyed to a bioretention system is treated by filtering the stormwater through a densely vegetated, biologically active sand and loam filter media. As the water percolates through the filter media, pollutants are captured by fine filtration, adsorption and biological processing by both soil microbes and plants. Treated water discharges to groundwater or is conveyed via slotted or perforated pipes to downstream drainage systems such as waterways, channels or pipes.

As well as removing pollutants, bioretention systems also help manage changes in hydrology that occur as a result of urbanisation. For example, runoff from small rainfall events is captured above the filter media surface, in the extended detention zone, and slowly percolates through the bioretention system's filter media. By delaying the release of stormwater, bioretention systems can mimic aspects of pre-development hydrology such as baseflow regimes and reduce pressures on urban streams. The volume of runoff is also reduced through evapotranspiration or infiltration into the surrounding soil.

**Figure 2 Components of a typical bioretention system**



The main components of a bioretention system are:

- **Filter Media** - a sand and loam mix that supports vegetation and removes stormwater pollutants. Filter media is typically 500–1000 mm deep. The minimum recommended filter media depth to support vegetation is 400 mm; however, this depth should only be considered in exceptional circumstances. The filter media surface is generally flat, except for bioretention swales.
- **Transition Layer**- coarse sand located under the filter media as a 'bridging' layer to prevent finer filter media particles migrating into the drainage layer, perforated underdrainage pipes, downstream waterway and the surrounding soil.
- **Underdrainage** – a combination of fine aggregate and slotted or perforated underdrainage pipes that allows treated stormwater to leave the bioretention system. The exact configuration of the underdrainage depends on the type of bioretention system being designed (see Section 2.4).
- **Liner** – a layer surrounding either or both the base and sides of bioretention systems. Liners can be either permeable or impermeable. The need for a liner is dependent on the type of bioretention system being designed (see Section 2.4).
- **Hydraulic Structures** – typically an inflow pipe, overflow pit, outlet and weir, hydraulic structure serve to convey stormwater into the bioretention system, and discharge it after treatment.
- **Bunds and Embankments** – earthen structures necessary to integrate bioretention systems within the surrounding topography. They vary in size and slope depending on the location, size and context of the system, and serve to detain water prior to filtration.
- **Extended Detention** - a 100–300 mm layer above the bioretention system's surface that temporarily stores stormwater before it infiltrates into the filter media. The extended detention is created by raised pits, weirs, or other hydraulic structures. Its purpose is to spread flows over the surface of the filter media and increase the volume of stormwater runoff that can be treated.
- **Vegetation** – in conjunction with soil biology, is the 'biological' component of bioretention systems. Vegetation is critical for stormwater treatment. Vegetation takes up nutrients, supports biological growth (critical for pollutant removal), maintains and enhances the porosity of soil, and continuously breaks up the surface of the filter media to help to prevent surface clogging. Vegetation in bioretention systems (grasses, sedges, shrubs and trees) must be tolerant to extended dry periods and periodic inundation.
- **Coarse Sediment Removal** – a dedicated area to capture and store coarse sediment. Coarse sediment removal is comprised of either a coarse sediment forebay or an inlet pond. It also helps dissipate energy and protect against scour around inlets.
- **Maintenance Access** – a dedicated access to the bioretention system which allows for easy and cost effective maintenance.
- **Cleanout Riser Pipe** – an unperforated upright pipe connected to the ends of each underdrainage pipe to allow inspection and cleaning of the underdrainage.

## 2.2 Context in the landscape

Bioretention systems are flexible in size, shape and appearance. They can be readily integrated into a range of landscapes including individual development sites, allotments, streetscapes, civic spaces and forecourts, parklands and adjacent to riparian and bushland settings. Bioretention systems can be designed to seamlessly integrate with the local landscape or they can be a prominent landscape feature. The following categories of bioretention system are provided to showcase the range of applications, locations and contexts within which bioretention systems can be applied.

## 2.2.1 Within allotments

Bioretention systems may be located within allotments, on private land. Figure 3 depicts a bioretention system located within an allotment. Bioretention systems within allotments can take the form of raingardens on individual residential lots or small bioretention basins on commercial, industrial and multi-unit developments. They have shallow surfaces, usually less than 750mm below their surroundings, and accept stormwater via surface flow and shallow, small diameter pipes. They typically have a total filter media surface area of 5–200 m².

**Figure 3 Examples of bioretention systems within allotments**

Photo: Shaun Leinster, DesignFlow

Photo: Jack Mullaly, Healthy Waterways

Photo: Robin Allison, DesignFlow

Photo: Jack Mullaly, Healthy Waterways

## 2.3 Configurations

The multiple contexts that bioretention basins are used in (see Section 2.2) require bioretention configurations that can adapt to the nature of the site in which they are located. Selecting the appropriate configuration for the site is important to ensure it integrates into the surrounding landscape, functions effectively and allows for easy and cost effective maintenance. There are four main configurations of bioretention system:

- Bioretention Basins
- Bioretention Swales
- Biopods
- Bioretention Street Trees.

### 2.3.1 Bioretention basins

Bioretention basins are an end-of-pipe bioretention system. They can vary in size greatly, typically from 100-800m$^2$ of filter media surface area. Bioretention basins are often located adjacent to parkland or natural areas (Figure 9). The vegetation used reflects the location. For example, bioretention basins located adjacent to parkland include vegetation compatible with other landscaping in the parkland, while bioretention basins adjacent to natural areas use species which reflect the ecosystem of that natural area.

**Figure 9 Examples of bioretention basins**

Photo: Shaun Leinster, DesignFlow

Photo: Shaun Leinster, DesignFlow

Photo: Paul Dubowski, BMT WBM

Photo: Jack Mullaly, Logan City Council

# Filtration

StormFilter® | SFEP Treatment Train


Stormwater360
AUSTRALIA

> For almost two decades the Stormwater Management StormFilter® has helped meet the most stringent stormwater requirements. The system has been continually tested and refined to ensure maximum reliability and performance.

# Stormwater Filtration

## The right stormwater solution for every site

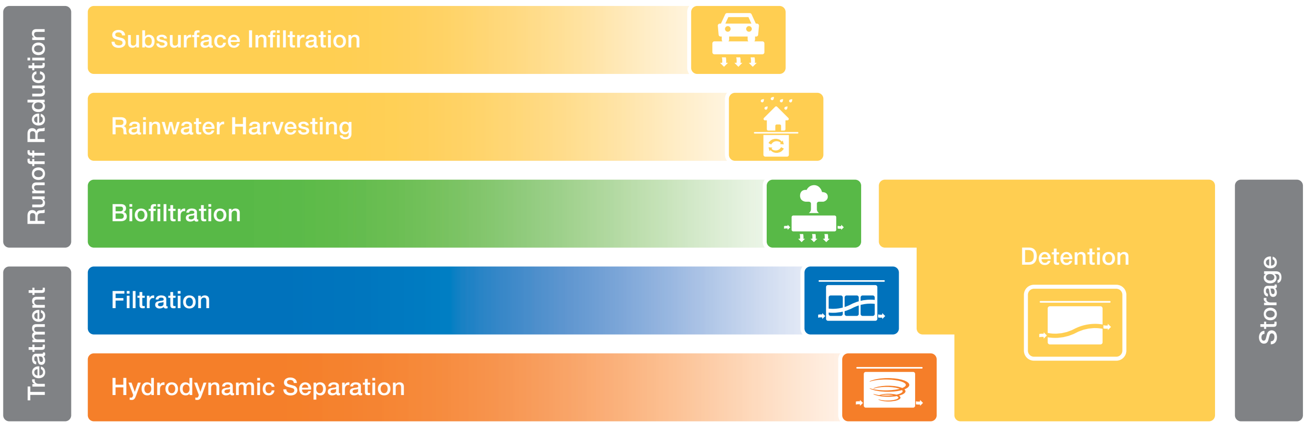
The Stormwater360 UrbanGreen Staircase simplifies the process of integrating a water sensitive urban design (WSUD) that achieves your runoff goals. Its aims are to manage stormwater runoff close to the source and to replicate the site's pre-development hydrology, as much as possible.

The first step in the design process is to select the runoff management practices that best suit your site, such as infiltration and harvesting. Particular attention also needs to be given to pre-treatment needs. If the entire design storm cannot be retained through runoff reduction methods, a best management practice (BMP) is required to manage the balance. Finally, a detention system is selected to address any outstanding downstream erosion.

## Highly effective pollutant removal

Meeting pollutant reduction goals for stormwater runoff typically requires a technology that is highly effective at removing solids and associated pollutants. In most cases, the technology must also be capable of removing dissolved pollutants such as metals, nitrogen and phosphorus.

By combining a variety of media and filtration systems, Stormwater360 can help you meet these pollutant removal objectives through products such as the Stormwater Management StormFilter, which has helped meet the most stringent stormwater requirements of hundreds of sites in urbanised areas of countries such as Australia, New Zealand and the United States of America.



# Selecting an appropriate filtration system

The performance and longevity of media filtration systems is governed by a number of variables that must be carefully considered when evaluating systems. These variables include the type of media used and its gradation as well as its hydraulic loading rate. Understanding these variables requires careful testing and the development of performance and longevity data to support proper filter design.

## Media surface area

Filtration flow rates are typically expressed as a surface area specific operating rate such as L/s/m$^2$ of surface area. Lower specific operating rates translate to better performance and longer maintenance cycles. Specific operating rates higher than 2 L/s/m$^2$ of media surface area negatively impact performance and longevity.

## Surface versus radial cartridge filtration

When assessing filtration systems, it is important to consider whether filtration occurs primarily at the media surface or throughout a bed of media, such as with radial-cartridge filters. All else equal, radial-cartridge filters are longer lasting, since pollutants are captured and stored throughout the bed, as opposed to predominantly on the media surface. Radial cartridge filters capture more mass of pollutants per unit area of filter surface. Surface filters, such as sand or flat bed media filters, are prone to rapid failure through clogging. Pollutants are prone to occluding the media surface, which will then require frequent back washing or more costly and intensive maintenance.

> Understanding the hydraulics of the media selected is a key factor in determining the effectiveness of the filtration system in achieving site-specific pollutant removal objectives.

## Media hydraulic conductivity and flow control

Filtration media is able to pass more flow per unit of media when it is new than when it has been in operation for a while. With time, pollutants accumulate in the media bed and reduce its hydraulic capacity. It is critical that filtration devices are designed with excess hydraulic capacity to account for this loss. Also, while finer media gradations remove finer particles, they have a lower hydraulic capacity and occlude more rapidly. High performance and superior longevity can be achieved by controlling the flow through a more coarse media bed.

### Performance: Laboratory testing

While laboratory testing provides a means to generate hydraulic and basic performance data, it should also be complemented with long-term field data. Laboratory performance trials should be executed with a fine sediment gradation such as Sil-Co-Sil 106, which has a median particle size of 22 microns. Testing with coarser gradations is not likely to be representative of field conditions.

### Performance: Field testing

Long-term field evaluations should be conducted on all filtration devices. As a minimum, field studies should generally comply with the Technology Acceptance Reciprocity Partnership (TARP) or the Technology Assessment Protocol – Ecology (TAPE) in the USA, as no recognised protocols exist within Australia. To be considered valid, all field monitoring programs should replicate local pollutant concentrations including soluble fractions together with rainfall, and should be peer reviewed by a reputable third-party.

Stormwater360 has undertaken such field testing in Kuranda, Australia, with the assistance of Queensland University of Technology and James Cook University.

### Longevity

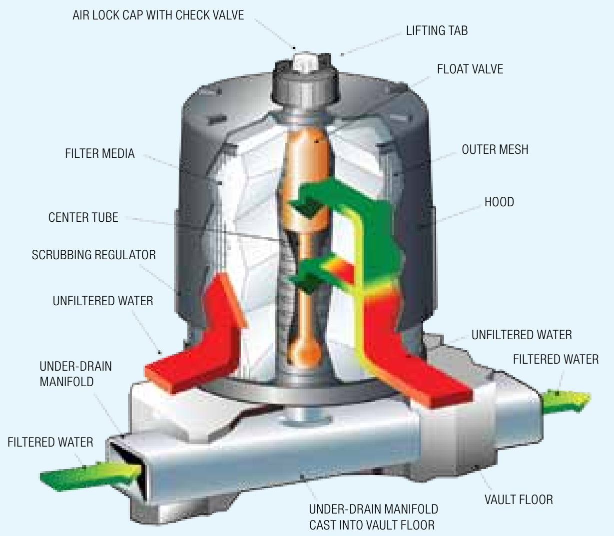
It is essential that loading trials be conducted to evaluate the longevity of a media filter. These trials must be executed with “real” stormwater solids and not silica particles. Reliance on silica particles to assess longevity grossly overstates the loading capacity of the media and the results of such trials should not be relied on. Knowing how much mass a media filter can capture before failure allows it to be sized for a desired maintenance interval by estimating the pollutant load that will be delivered to the filter.

### Maintenance

The primary purpose of the media filtration system is to filter out and prevent pollutants from entering our waterways. Like any effective filtration system, these pollutants must be periodically removed to restore the system to its full efficiency and effectiveness. Maintenance requirements and frequency are dependent on the pollutant load characteristics of each site. Maintenance activities may be required in the event of a chemical spill or due to excessive sediment loading from site erosion or extreme storms. Similarly, the system should be inspected after major storm events.

Stormwater360 offers a number of suitable maintenance plans for all our stormwater products. Visit www.stormwater360.com.au or call us on 1300 354 722 to discuss the most suitable plan for your system.

# The Stormwater Management StormFilter




## Removing the most challenging target pollutants

The Stormwater Management StormFilter is a best management practice (BMP) designed to meet stringent regulatory requirements. It removes the most challenging target pollutants – including fine solids, soluble heavy metals, oil, and total nutrients (inc. soluble) – using a variety of media. For more than two decades, StormFilter has helped clients meet their regulatory needs and through product enhancements the design continues to be refined for ease of use.

## Why StormFilter is the best filter available

### Superior hydraulics

- External bypass – protects treatment chamber from high flows and ensures captured pollutants are not lost during low frequency, high intensity storm events
- Multiple cartridge heights – minimises head loss to fit within the hydraulic grade line and shrink system size, reducing installation costs
- Multiple StormFilter configurations in use across the country

### Reliable longevity

- One-of-a-kind self-cleaning hood – prevents surface blinding, ensures use of all media, and prolongs cartridge life
- Customised maintenance cycles – fewer maintenance events compared to similar products, which reduces costs over the lifetime of the system
- 12 years of maintenance experience – predictable long-term performance comes standard

### Proven performance

- Only filter on the Australian market tested within Australia achieving best practice guidelines, for TSS, TP and TN
- Qualifies for a minimum 2 EMI 5 Green star credits
- Achieve water quality goals with confidence – easy approval speeds development assessment process
- 8th generation product – design refined and perfected over two decades of research and experience

### Maximising your land use and development profitability

StormFilter systems are utilised in below ground systems. The advantages this offers over above ground systems includes:

- Land space saving that enable an increase in development density and reduce sprawl
- The potential to add car parking, increase building size, and develop out parcels

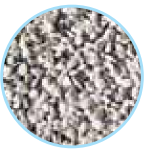
In addition, StormFilter's compact design reduces construction and installation costs by limiting excavation.

## Media options

Our filtration products can be customised using different filter media to target site-specific pollutants. A combination of media is often recommended to maximise pollutant removal effectiveness.

**PhosphoSorb™** is a lightweight media built from a Perlite-base that removes total phosphorus (TP) by adsorbing dissolved-P and filtering particulate-P simultaneously.

**Perlite** is naturally occurring puffed volcanic ash. Effective for removing TSS, oil and grease.



**Zeolite** is a naturally occurring mineral used to remove soluble metals, ammonium and some organics.

**GAC (Granular Activated Carbon)** has a micro-porous structure with an extensive surface area to provide high levels of adsorption. It is primarily used to remove oil and grease and organics such as PAHs and phthalates.

| | PhosphoSorb | Perlite | ZPG | Zeolite | GAC |
|---|---|---|---|---|---|
| Sediments | • | • | • | | |
| Oil and Grease | • | • | • | | |
| Soluble Metals | • | | • | • | |
| Organics | | | • | • | • |
| Nutrients | • | • | • | • | • |
| **Total Phosphorus** | • | | • | | |

Note: Indicated media are most effective for associated pollutant type. Other media may treat pollutants, but to a lesser degree.

ZPG™ media, a proprietary blend of zeolite, perlite, and GAC.

## Cartridge options

With multiple cartridge heights available, you now have a choice when fitting a StormFilter system onto your site.

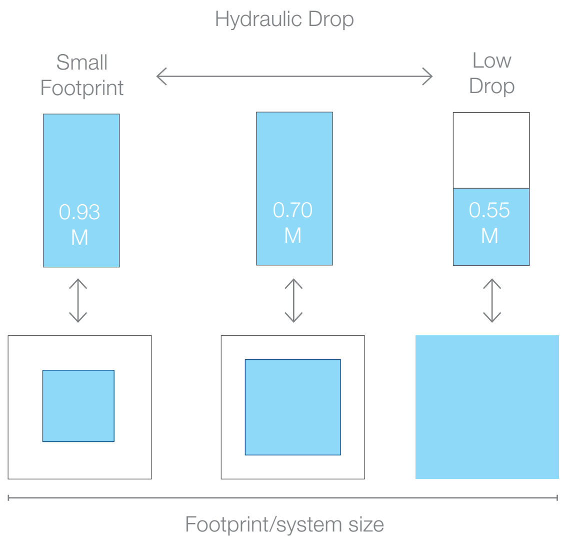
The 69cm cartridge provides 50% more treatment than the previously standard 46cm cartridge, which enables you to meet the same treatment standards with fewer cartridges, and via a smaller system.

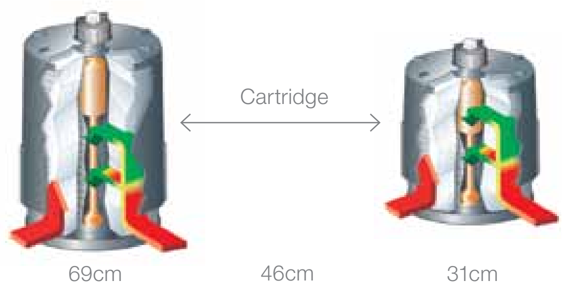
If you are limited by hydraulic constraints, the low drop cartridge provides filtration treatment with only 0.55m of headloss.

### Cartridge flow rates

| Cartridge Type | Hydraulic Drop | Treatment Capacity (l/sec) | |
|---|---|---|---|
| | | 0.7 l/s/m² | 1.4 l/s/m² |
| StormFilter 69cm | 0.93 m | 0.71 | 1.42 |
| StormFilter 46cm | 0.70 m | 0.47 | 0.95 |
| StormFilter Low Drop | 0.55 m | 0.32 | 0.63 |

### Selecting cartridge height



# Configurations and applications

The StormFilter technology can be configured to meet your unique site requirements. Here are a few of the most common configurations, however many other configurations are available. A Stormwater360 engineer can assist you evaluate the best options for your site or you can find out more by downloading the StormFilter Configuration Guide from www.stormwater360.com.au

## Upstream treatment configurations

The following suite of StormFilter configurations are easily incorporated on sites where WSUD is recommended. These low-cost, low-drop, point-of-entry systems also work well when you have a compact drainage area.

### GullyPit StormFilter

Combines a gullypit, a high flow bypass device, and a StormFilter cartridge in one shallow structure.

- Treats sheet flow
- Uses drop from the inlet grate to the conveyance pipe to drive the passive filtration cartridge
- No confined space required for maintenance

### Gully inlet

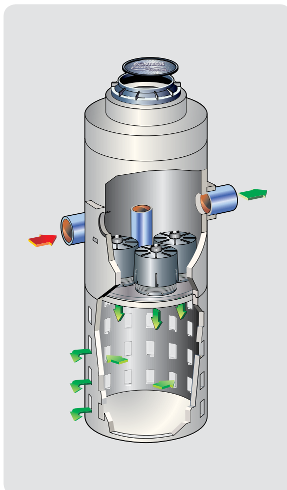
- Accommodates kerb inlet openings from 900 to 3000mm long
- Uses drop from the kerb inlet to the conveyance pipe to drive the passive filtration cartridges

### Linear grate

- Can be designed to meet volume based sizing requirements
- Can be installed in place of and similar to a typical gullypit
- No confined space entry required for maintenance
- Accommodates up to 29 StormFilter cartridges

## Infiltration/retrofit configuration infiltration

- Provides treatment and infiltration in one structure
- Available for new construction and retrofit applications
- Easy to install
- Re-charge groundwater and reduces run-off



# Roof runoff treatment configuration

## Down pipe

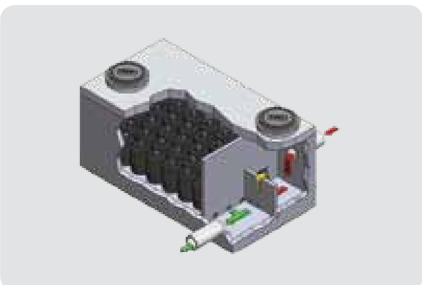
- Easily integrated into existing gutter systems to treat pollution from rooftop runoff
- Fits most downpipe configurations and sizes; single or dual-cartridge models available
- Treats up to 1300m$^2$ of rooftop area per dual-cartridge system

# Downstream treatment configurations

Conventional stormwater treatment involves collecting, conveying and treating stormwater runoff with an end-of-pipe treatment system before discharging off-site. StormFilter configurations suitable for these applications are listed below and can be engineered to treat a wide range of flows.

## Peak diversion

- Provides off-line bypass and treatment in one structure
- Eliminates material and installation cost of additional structures to bypass peak flows
- Reduces the overall footprint of the treatment system, avoiding utility and right-of-way conflicts
- Internal weir allows high peak flows with low hydraulic head losses
- Accommodates large inlet and outlet pipes (up to 900mm) for high flow applications



## Vault / manhole

- Treats small to medium sized sites
- Simple installation – arrives on-site fully assembled
- May require off-line bypass structure

## High flow

- Treats flows from large sites
- Consists of large, precast components designed for easy assembly on-site
- Configurations available, include, Panel Vault and Cast-In-Place

## Volume

- Meets volume-based stormwater treatment regulations
- Captures and treats specific water quality volume (WQv)
- Provides treatment and controls the discharge rate
- Can be designed to capture all, or a portion, of the WQv

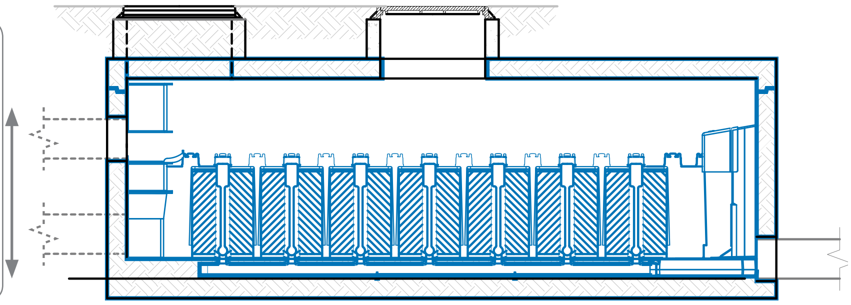
# Filtration for low drop sites

## Designing for limited drop

In some cases, site constraints limit the hydraulic drop that is available to drive the passive filtration cartridges. Following are a variety of solutions to either create the required drop or work around the limited drop without impacting the performance of the system.

**Flexible inlet positions**

0.55m from inlet to outlet for low drop configurations, 0.7m for 46cm cartridges and 0.93m for 69cm cartridges



**StormFilter configuration using low drop cartridges**

0.55m from inlet to outlet (compared to 0.7m for 46cm cartridges or 0.93m for 69cm cartridges)

## Solutions for Low Drop Sites

### Site modifications

#### Reduce pipe slope

Use an alternate pipe material with a lower Manning's n value for a portion of the site and reduce the pipe slope.

#### Reduce pipe cover

Use controlled density fill (CDF) at the front-end of the conveyance system to minimise pipe cover and raise the conveyance system. CDF, a method of pouring concrete with fine aggregate (sand vs. gravel) around pipe, allows the use of most pipe materials with limited cover.

#### Drain inlet treatment

Substitute several shallow inlet configurations for the single end-of-pipe system. Shallow options include the Catchpit/Gullypit StormFilter, CurbInlet StormFilter, Manhole StormFilter and the Linear StormFilter. These systems still require the normal drop (0.7m for 46cm cartridges) but utilise the drop into the conveyance system to drive the cartridges.

#### Provide pumping system

Stormwater360 offers the Integrated Pumping System (IPS), which can be designed in tandem with filtration system sizing.

### Treatment system modifications

#### Use low drop cartridges

The StormFilter can be configured with low drop cartridges that activate at 31cm, reducing the overall head loss to only 0.55m, compared to 0.7m for the 46cm cartridge or 0.93m for the 69cm cartridge.

#### Surcharge the inlet pipe

Backing-up water into the conveyance system can create the necessary drop to drive the StormFilter cartridges. This will affect the HGL and increase the volume of water required to activate the cartridges, which could have a detrimental effect on system longevity. The following design modifications mitigate these risks:

- Confer with a Stormwater360 design engineer before surcharging the inlet pipe
- Verify this is an acceptable practice in your local jurisdiction
- Modify the overall system design to accommodate the increased HGL
- Calculate the additional treatment volume and consider using more cartridges

# SFEP Treatment Train

## Screening and enhanced filtration treatment in series

Most consent authorities within Australia have established pollution removal targets be achieved prior to discharge from urban catchments for an array of pollutants from debris coarse & fine sediments down soluble nutrients. In general each pollutant is removed from the water column using a specific physical, chemical or biological process. Arranging these processes in sequence provides a "treatment train" approach that addresses and treats the whole spectrum of stormwater pollutants.

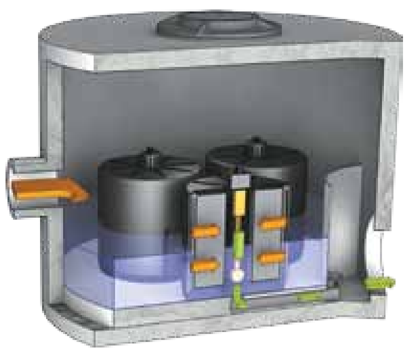
In order to meet these demands, Stormwater360 provides the StormFilter and EnviroPod (SFEP) as a series of products within a treatment train. The EnviroPod Filter is a gully pit insert designed to be easily retrofitted into new and existing stormwater gully pits, requiring no construction and no land take. Located at the source of stormwater contaminates the EnviroPod Filter has a interchangeable and re-useable bag with 200 micron pore size. The EnviroPod (gully pit basket) is designed to remove gross pollutants, coarse sediment and associated pollutants (hydrocarbons, metals and nutrients) at high flows and is typically located within each gully inlet pit. The EnviroPod filter also holds captured material dry thereby reducing the amount of nutrient leachate from the organic material stored within the bag.

StormFilter operates at a much lower flow rate than the EnviroPod insert – this is necessary in order to achieve extremely high levels of removal efficiency of fine and soluble contaminants. StormFilter cartridges are located typically within a concrete storage structure with the type and media determined by configuration and design. The StormFilter technology is designed to remove both particulate bound and soluble pollutants, and is located near the outlet of the catchment. The SFEP StormFilter technology utilises Stormwater360's patented ZPG media blend containing both zeolite and carbon. This blend specifically targets ammonium and soluble organic nitrogen typically found within Stormwater flows and any nitrogen leachate from organic material held upstream within the EnviroPod filters. The ability of the StormFilter cartridge to retain nitrogen is further enhance as the captured material is again stored dry reducing the amount of nutrient leachate.

### Screening

Multiple EnviroPods would be required for a typical site

### Enhanced filtration



## Features and benefits:

- Turnkey solution – modelling, design, supply and service/maintenance contracts available
- Immediate activation – no need for system "maturity"; starts treating stormwater after filters and cartridges are installed
- Field proven technologies – installations within local conditions for 10 years
- Field proven removal capability – performance data peer reviewed and published in a scientific journal
- Cost effective – comparative cost to traditional vegetated systems
- Increases Development Yield – can be located under carparks and roads. Reduces the need for batters or special maintenance access which further decrease development yield
- Multiple configurations available – meets site specific needs
- Simple, cost effective and recognised maintenance practices
- Ideal solution for infield developments – can be housed close to building footings, pavements and embankments. Reduces the need for ancillary structures such as retaining walls
- Flexible payment options – system can be supplied with zero capital cost upfront on a service inclusive lease with flexible payment options

# Comprehensive strategic pollutant removal sequence

## Gross pollutants

- Majority of flows treated by EnviroPod with all debris removed from stormwater and held dry, reducing nutrient leachate

## Coarse sediment

- Majority of flows treated by EnviroPod whilst removing most sediment above 100μm
- Significantly reduces load and maintenance costs on StormFilter system downstream

## Fine sediment

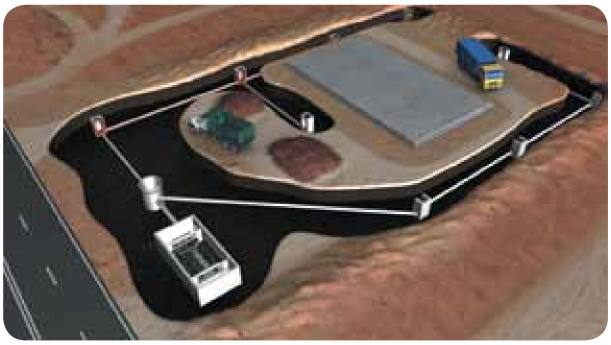
- Custom or specific lower flows treated, targeting particles down to 10μm
- Cartridge back-flush prevents surface clogging avoiding unnecessary maintenance
- Pollutants stored dry reducing nitrogen leachate

## Soluble pollutants

- Enhanced filtration by chemical processes (e.g. cation exchange, absorption & adsorption) deep within the cartridge away from the initial screening surface StormFilter cartridge

## How to use SFEP Treatment Train?

Typical site with Biofiltration



SFEP Treatment Train

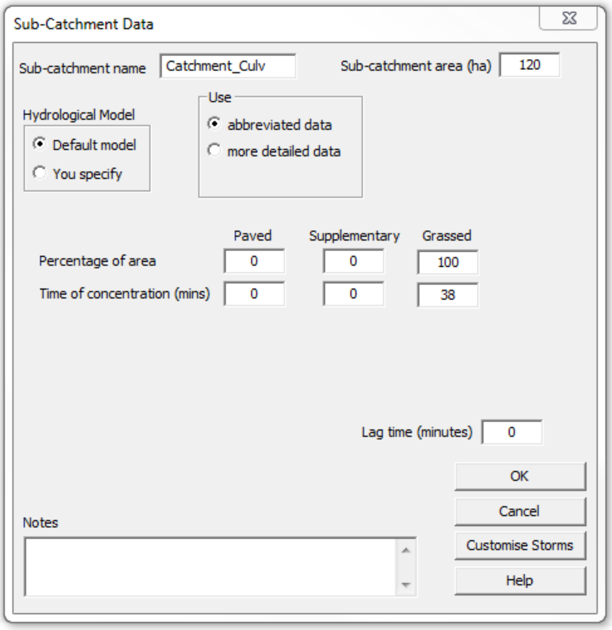
Screening EnviroPod – located with each gully pit

Enhanced Filtration through StormFilter

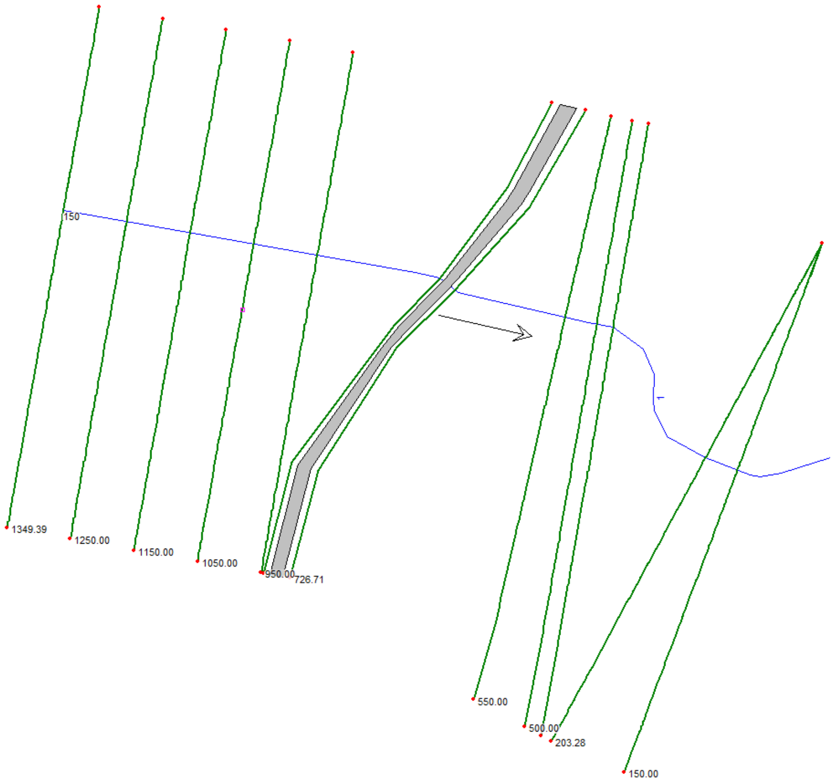
SFEP can provide additional space for carparks

SFEP can maximise building platforms and increase development yields

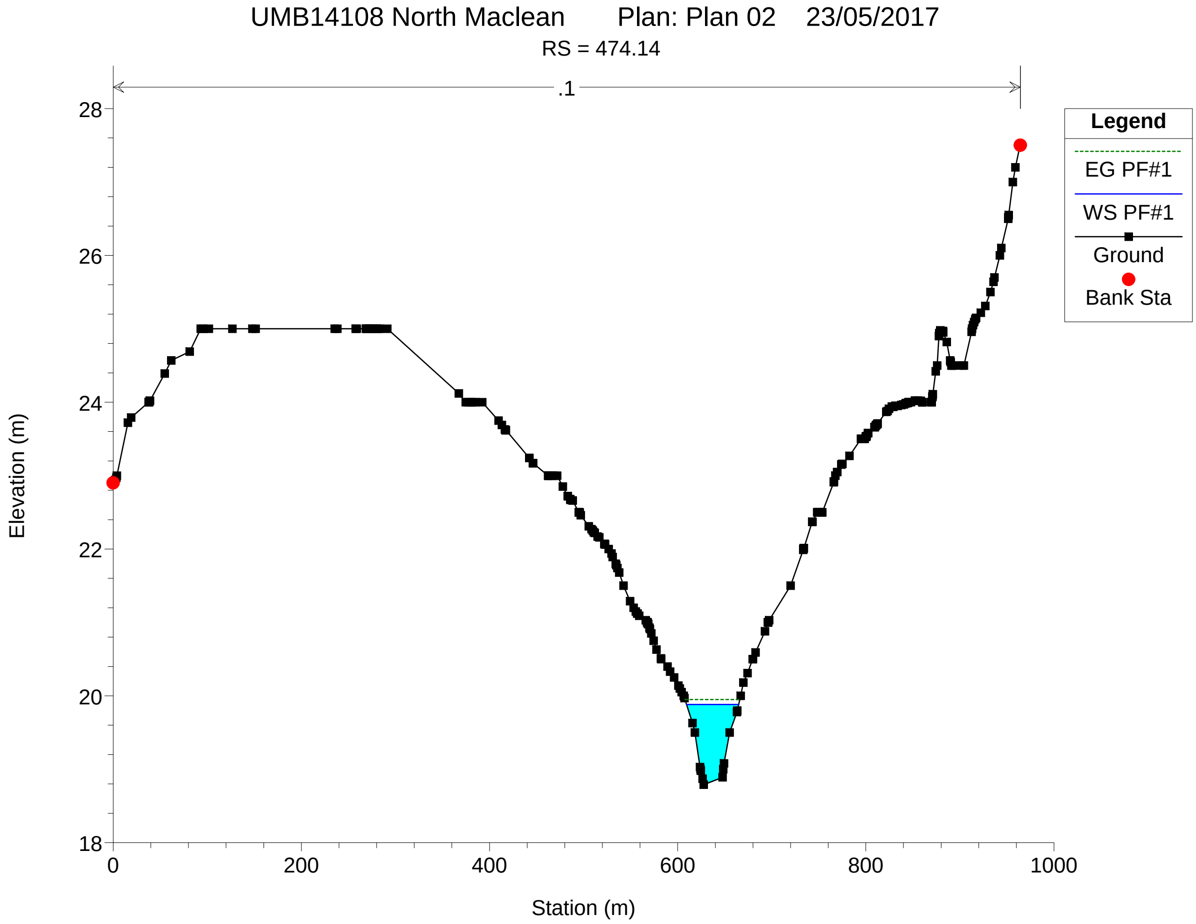
# Appendix G HEC-RAS MODEL LAYOUT AND RESULTS


DRAINS Catchment hydrology results to calculate 100 yr ARI flow




HEC-RAS Model Layout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RS = 474.14
.1
Legend
EG PF#1
WS PF#1
Ground
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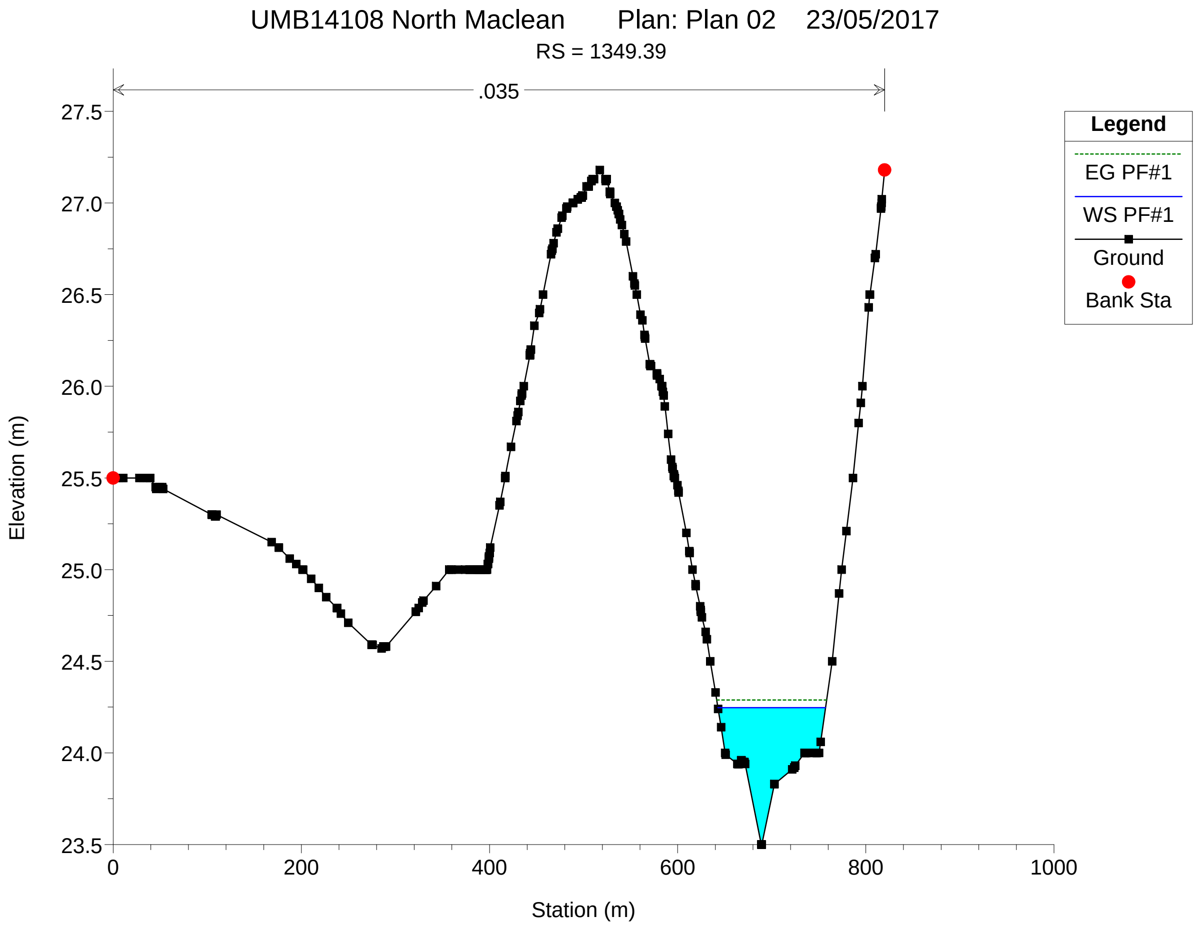
Station (m)
18
20
22
24
26
28
0
200
400
600
800
1000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Legend
EG PF#1
WS PF#1
Ground
Bank Sta
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Station (m)
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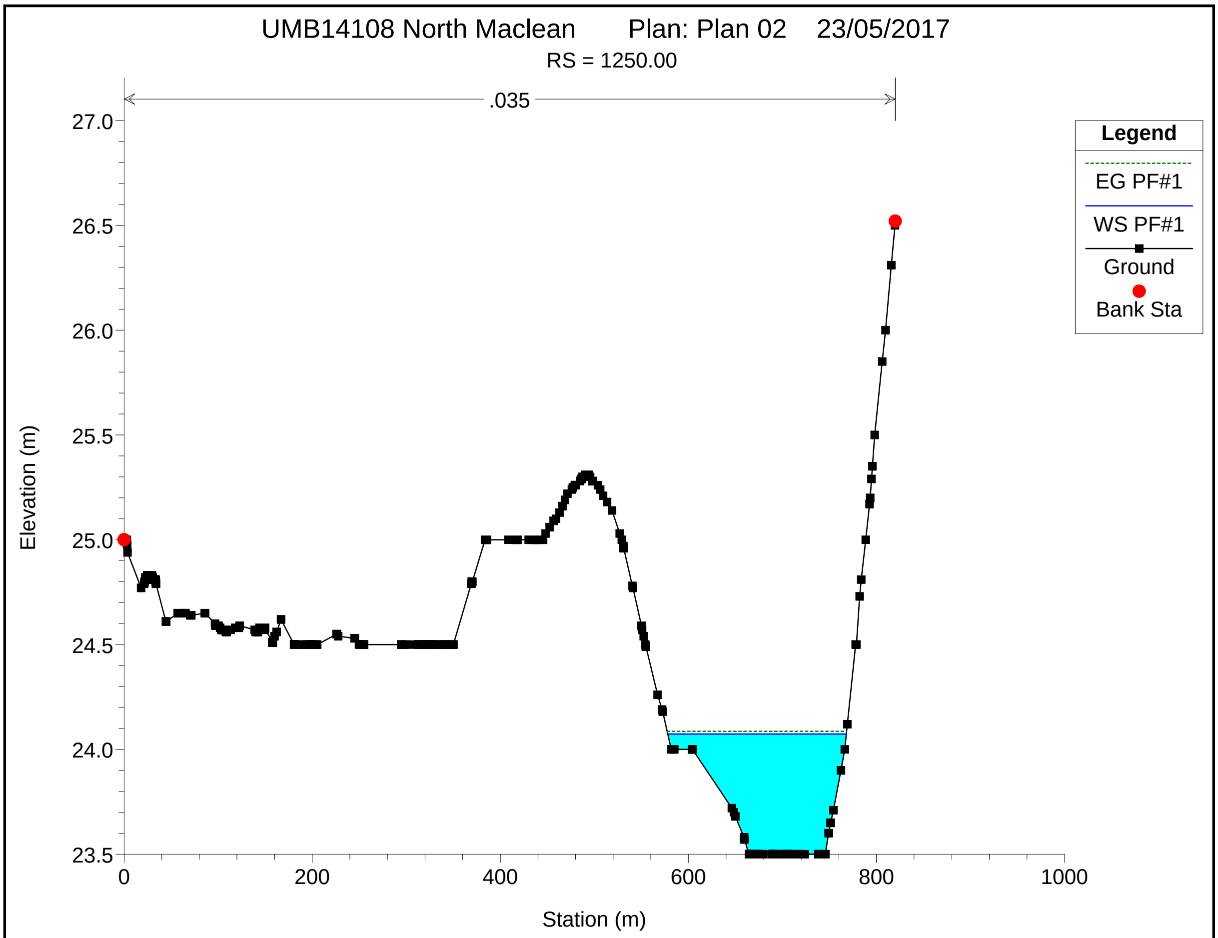
24.0
24.5
25.0
25.5
26.0
26.5
27.0
27.5
0
200
400
600
800
1000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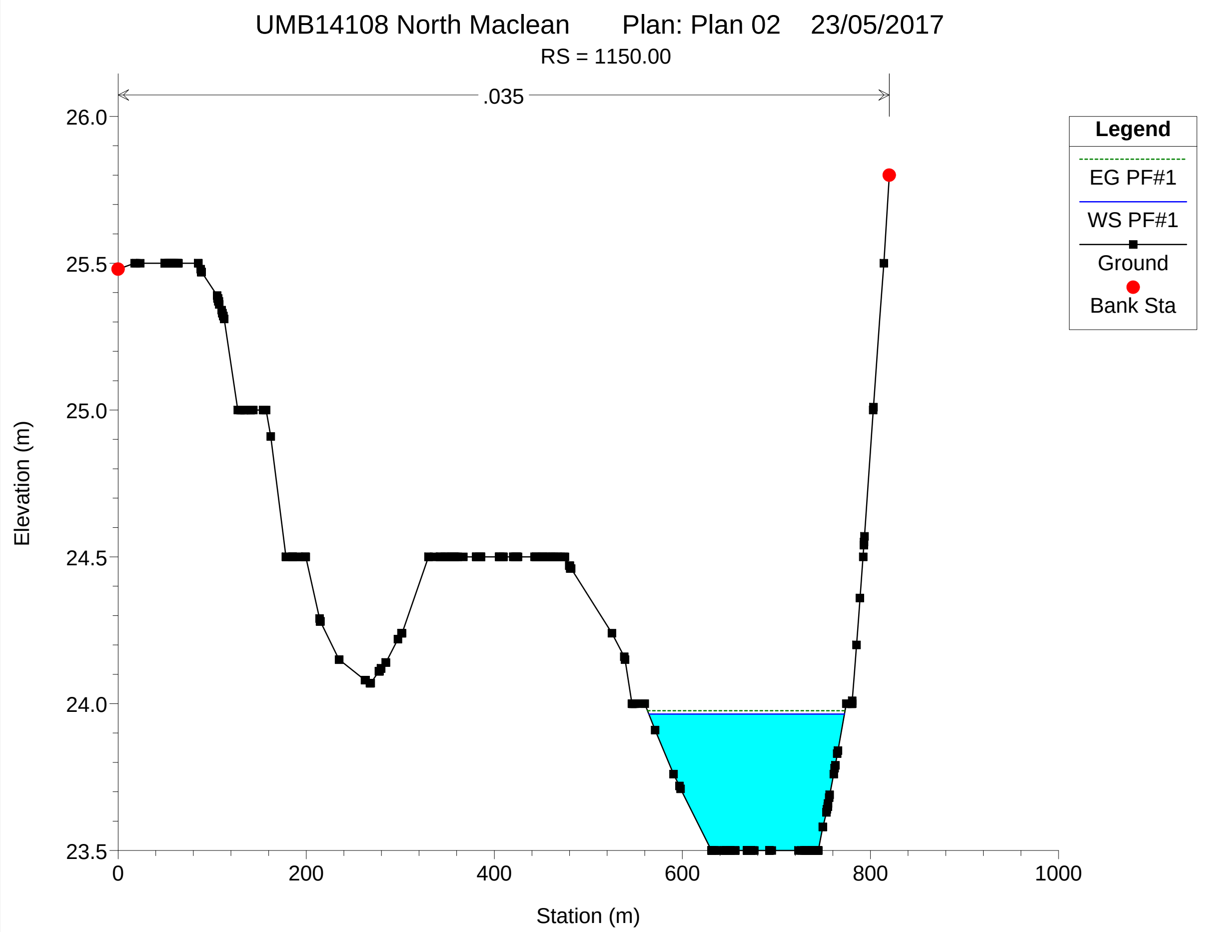
.035
Elevation (m)
27.0
26.5
26.0
25.5
25.0
24.5
24.0
23.5
0
200
400
600
800
1000
Station (m)
Legend
EG PF#1
WS PF#1
Ground
Bank Sta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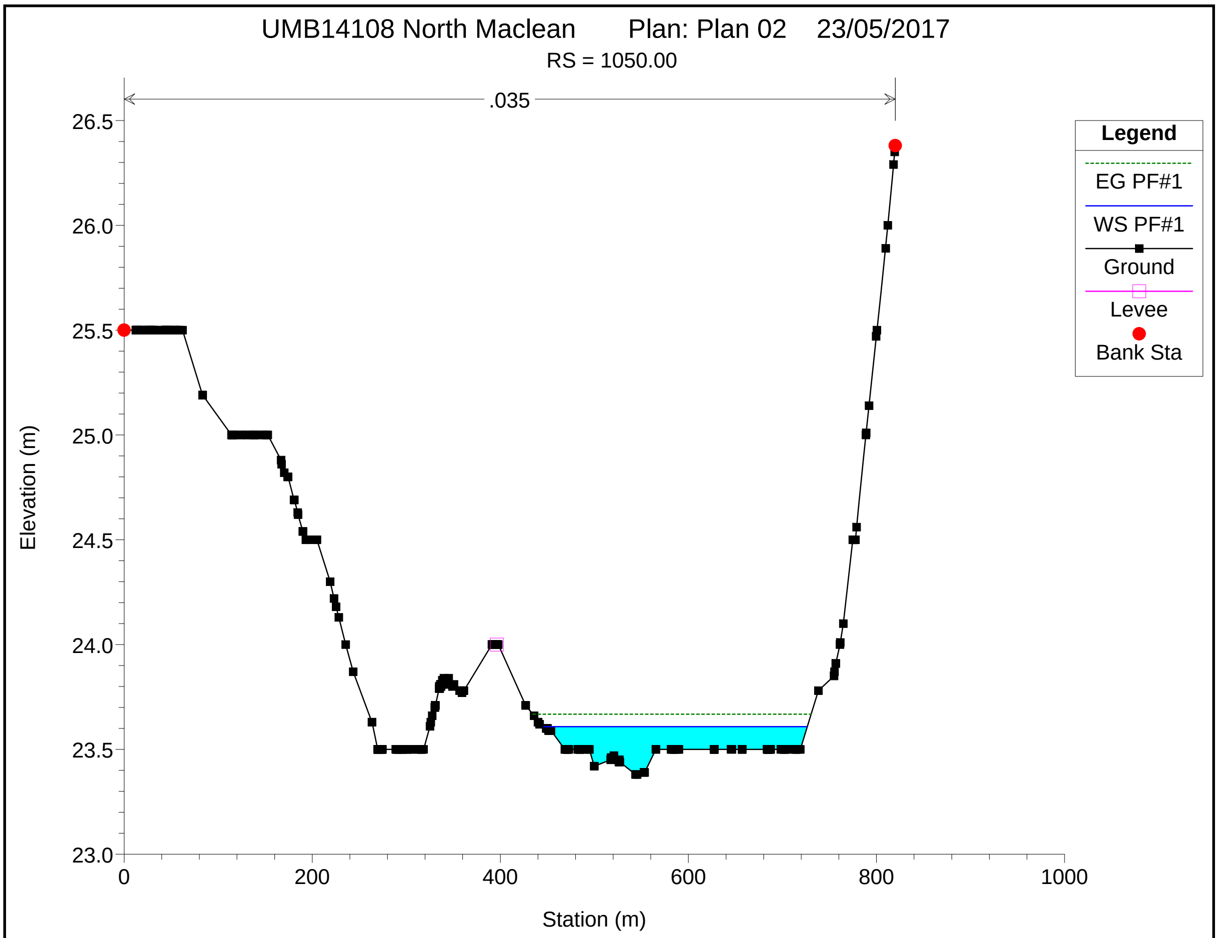
26.0
25.5
25.0
24.5
24.0
23.5
0
200
400
600
800
1000
Station (m)
Legend
EG PF#1
WS PF#1
Ground
Bank Sta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RS = 1050.00
.035
Legend
EG PF#1
WS PF#1
Ground
Levee
Bank Sta
Elevation (m)
Station (m)
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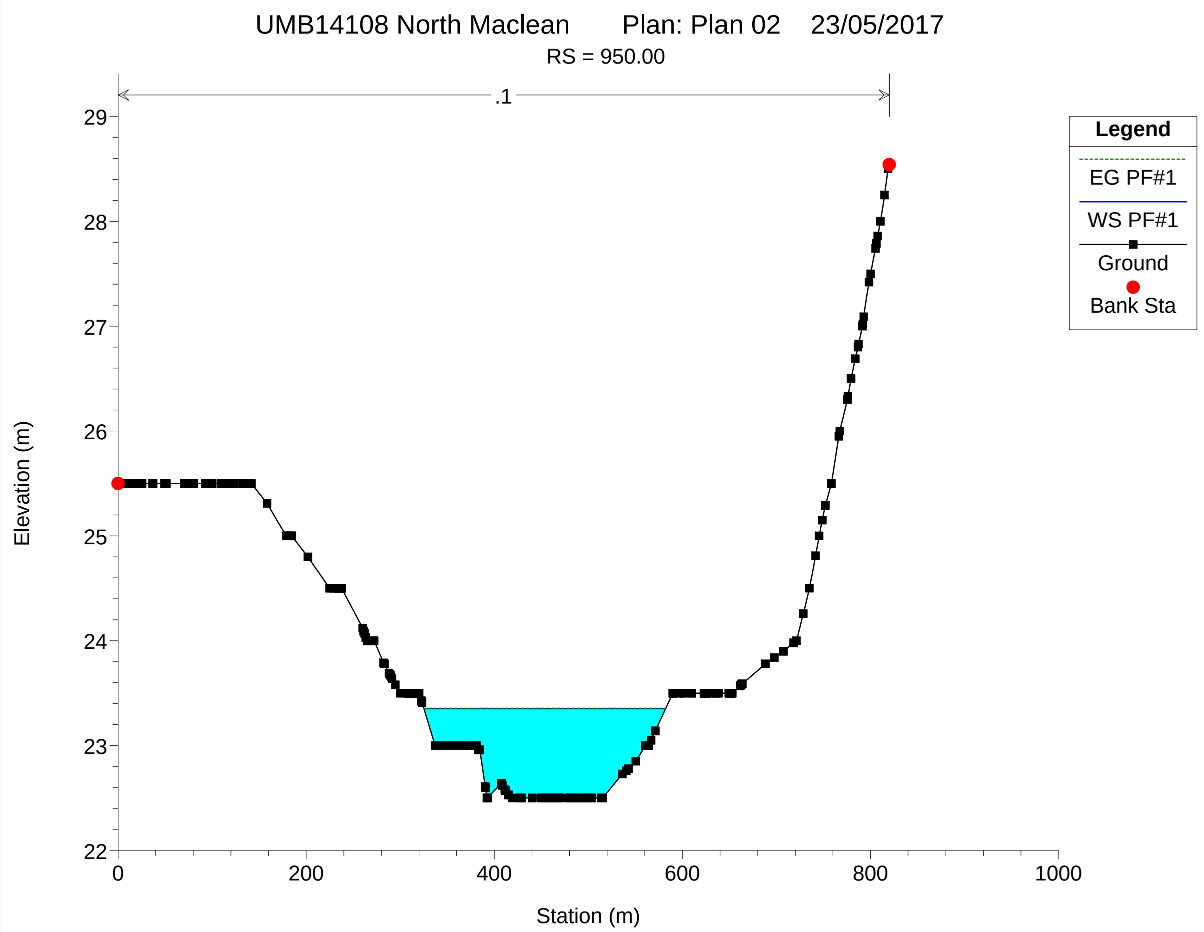
26.0
25.5
25.0
24.5
24.0
23.5
23.0
0
200
400
600
800
1000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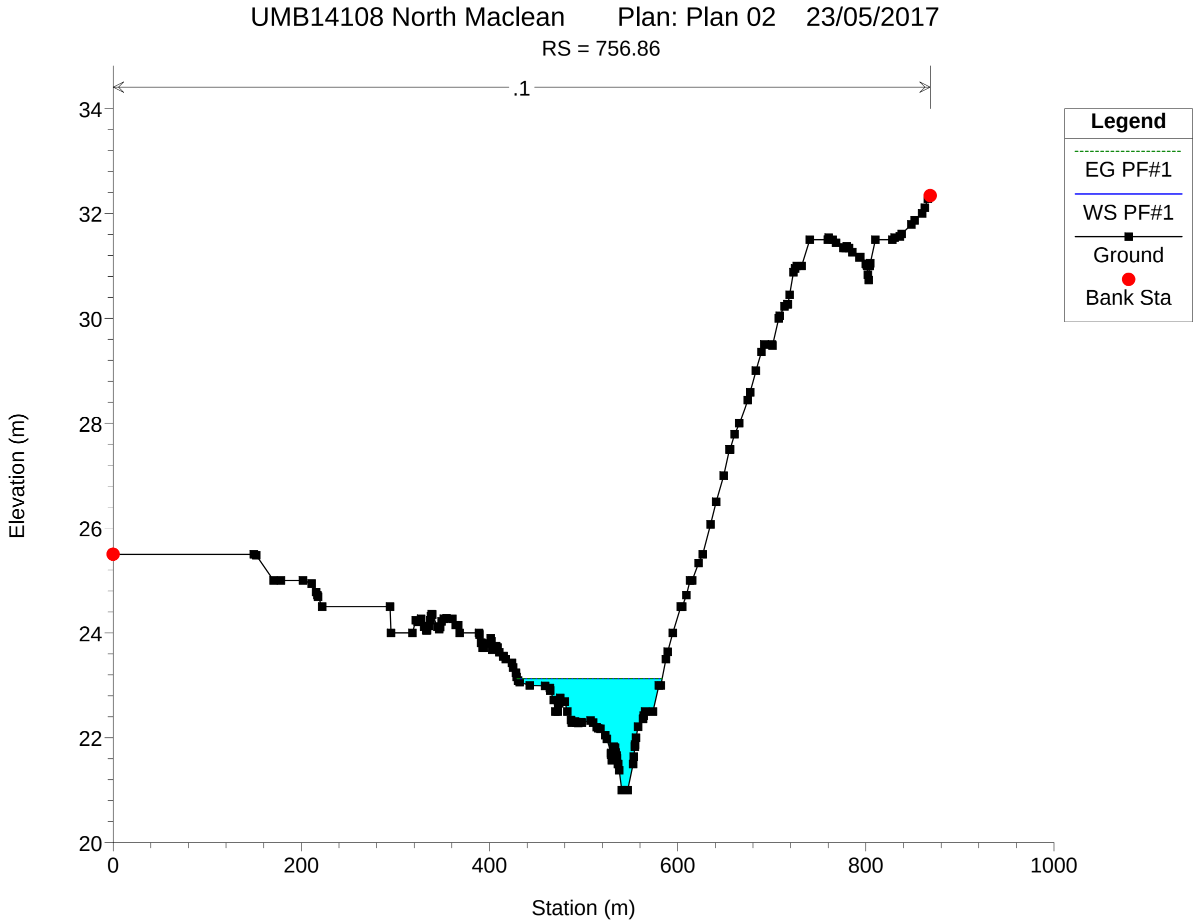
RS = 950.00
.1
Legend
EG PF#1
WS PF#1
Ground
Bank Sta
Elevation (m)
Station (m)
29
28
27
26
25
24
23
22
0
200
400
600
800
1000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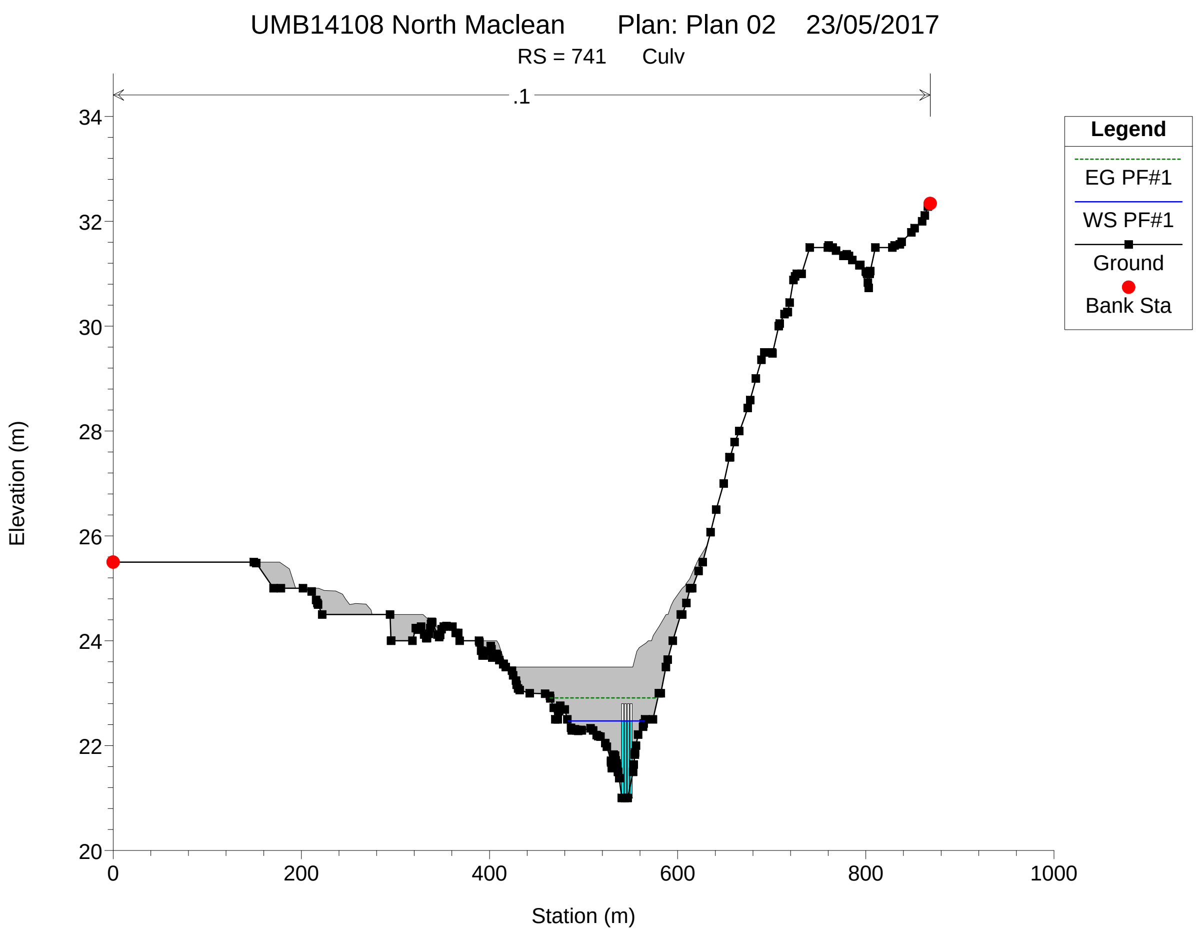
Elevation (m)
Station (m)
Legend
EG PF#1
WS PF#1
Ground
Bank Sta
20
22
24
26
28
30
32
34
0
200
400
600
800
1000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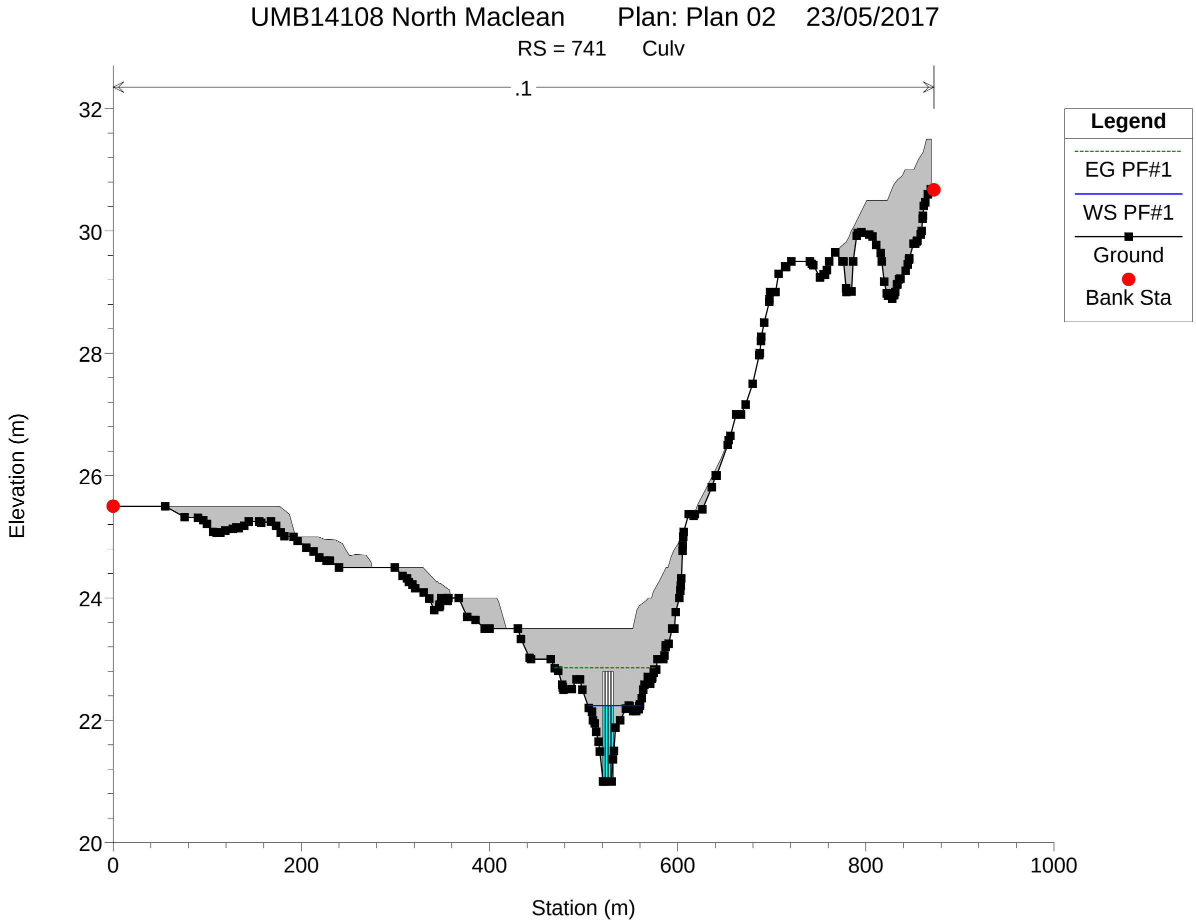
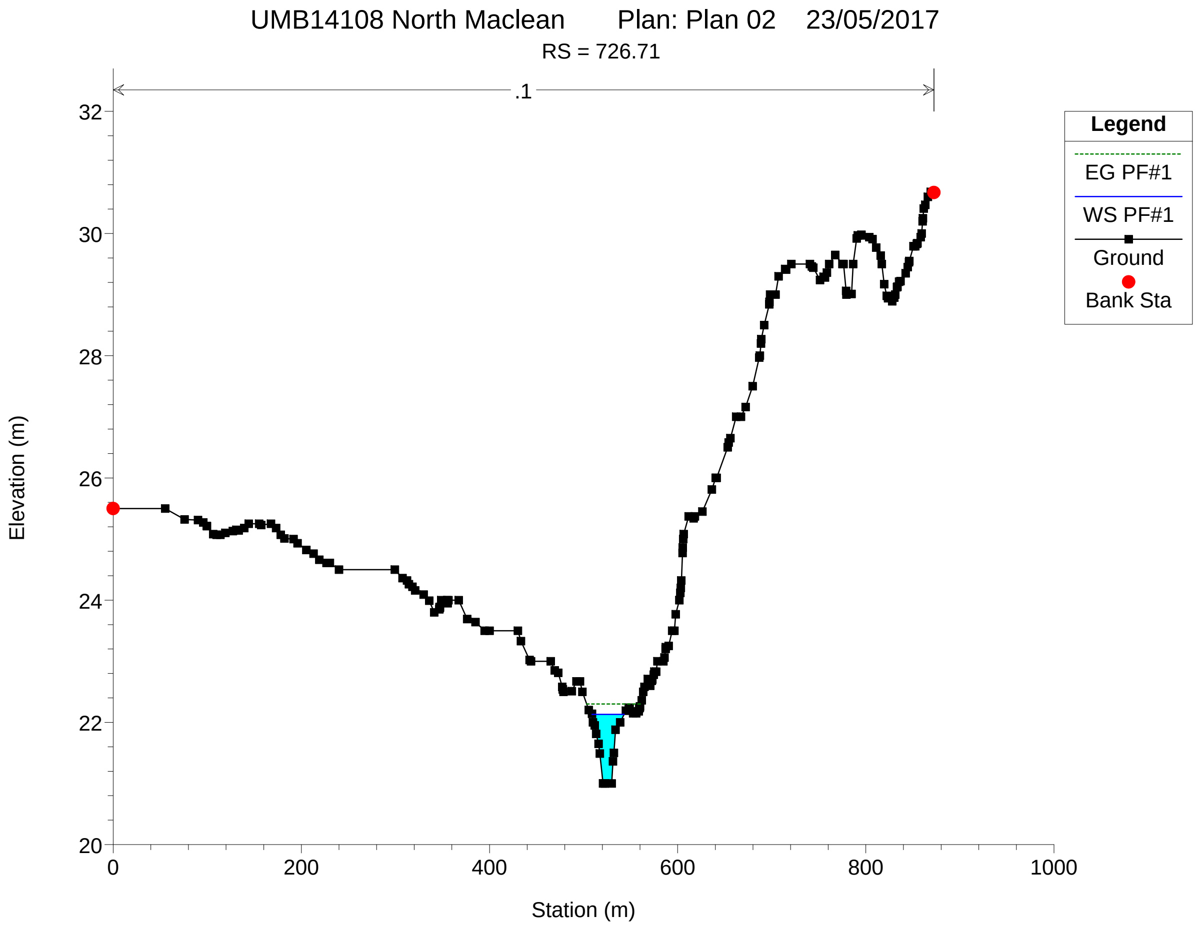
Elevation (m)
Station (m)
Legend
EG PF#1
WS PF#1
Ground
Bank Sta
20
22
24
26
28
30
32
34
0
200
400
600
800
1000



UMB14108 North Maclean Plan: Plan 02 23/05/2017
RS = 741 Culv
.1
Legend
EG PF#1
WS PF#1
Ground
Bank Sta
Elevation (m)
32
30
28
26
24
22
20
0
200
400
600
800
1000
Station (m)

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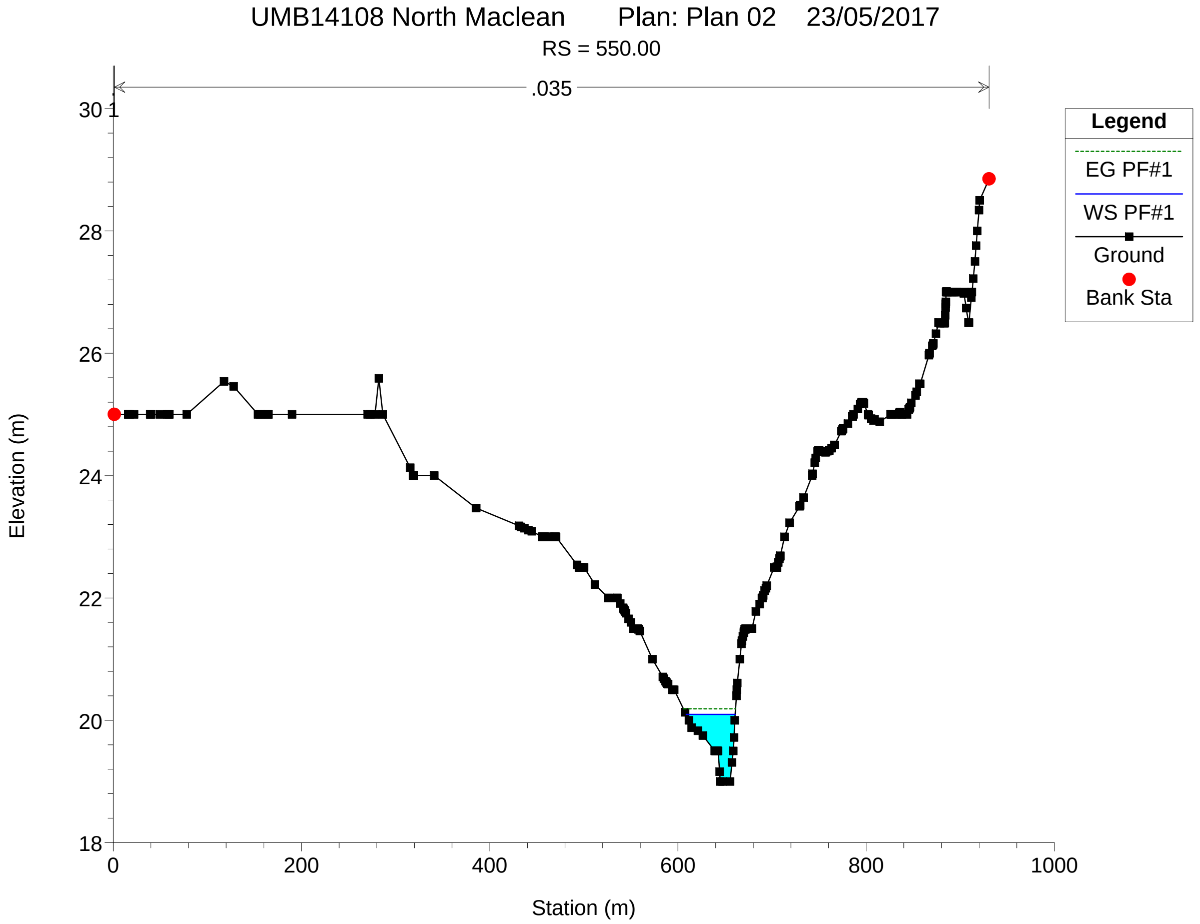
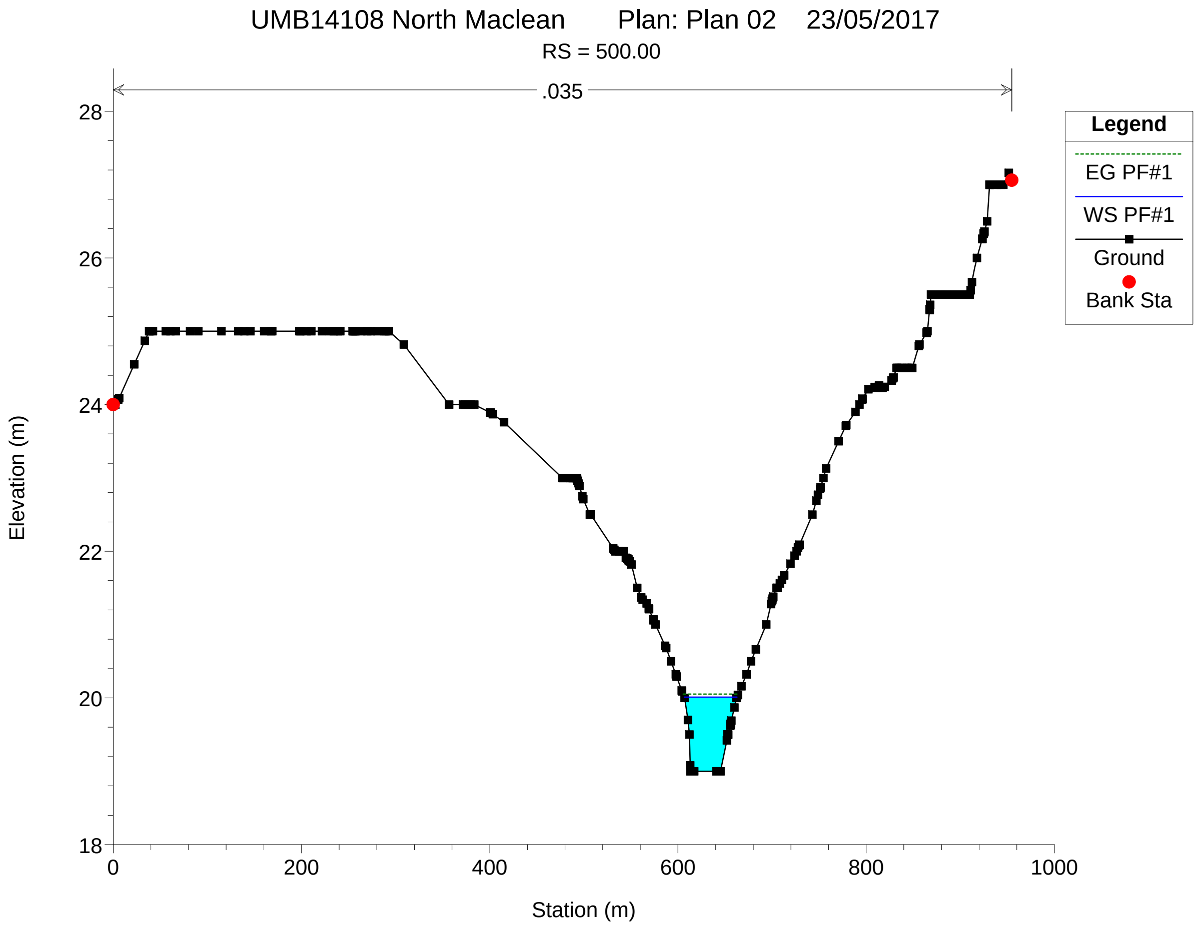
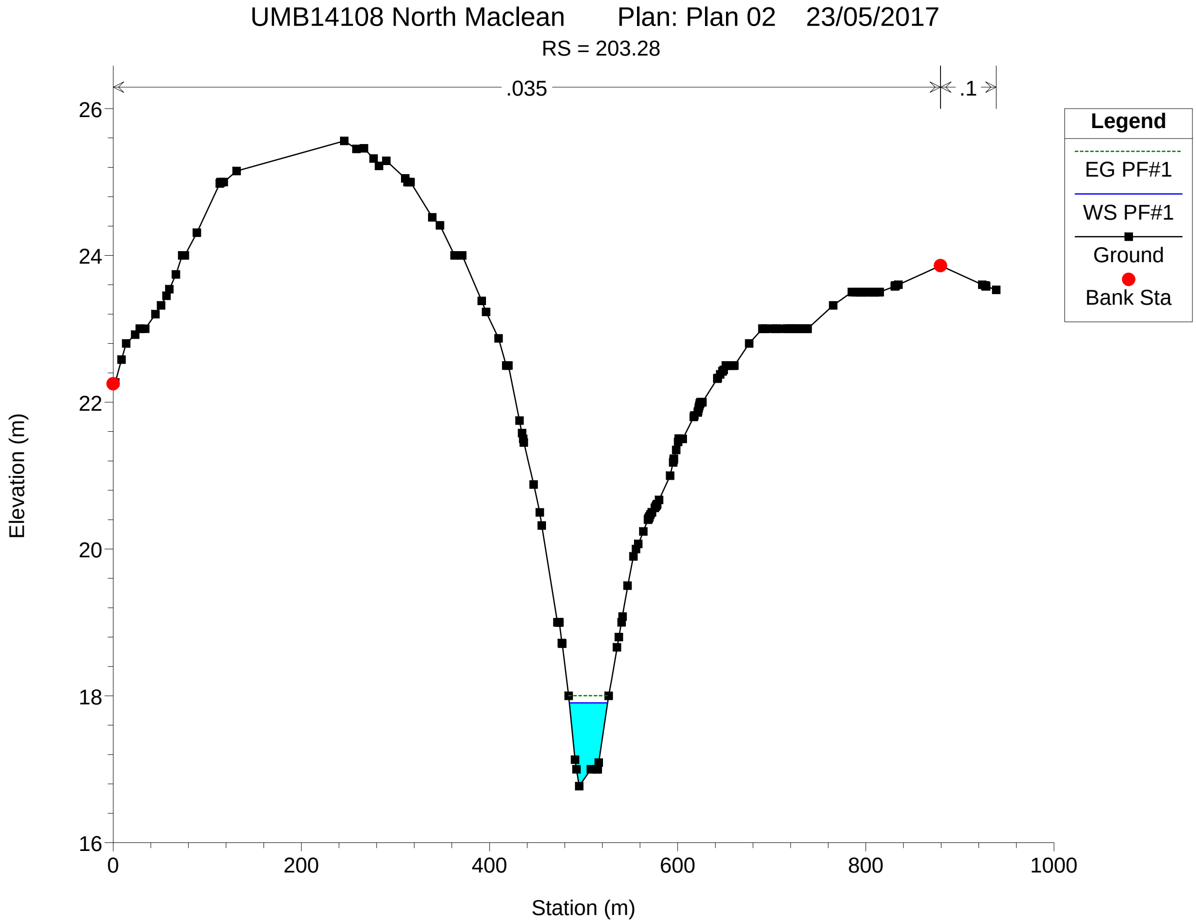
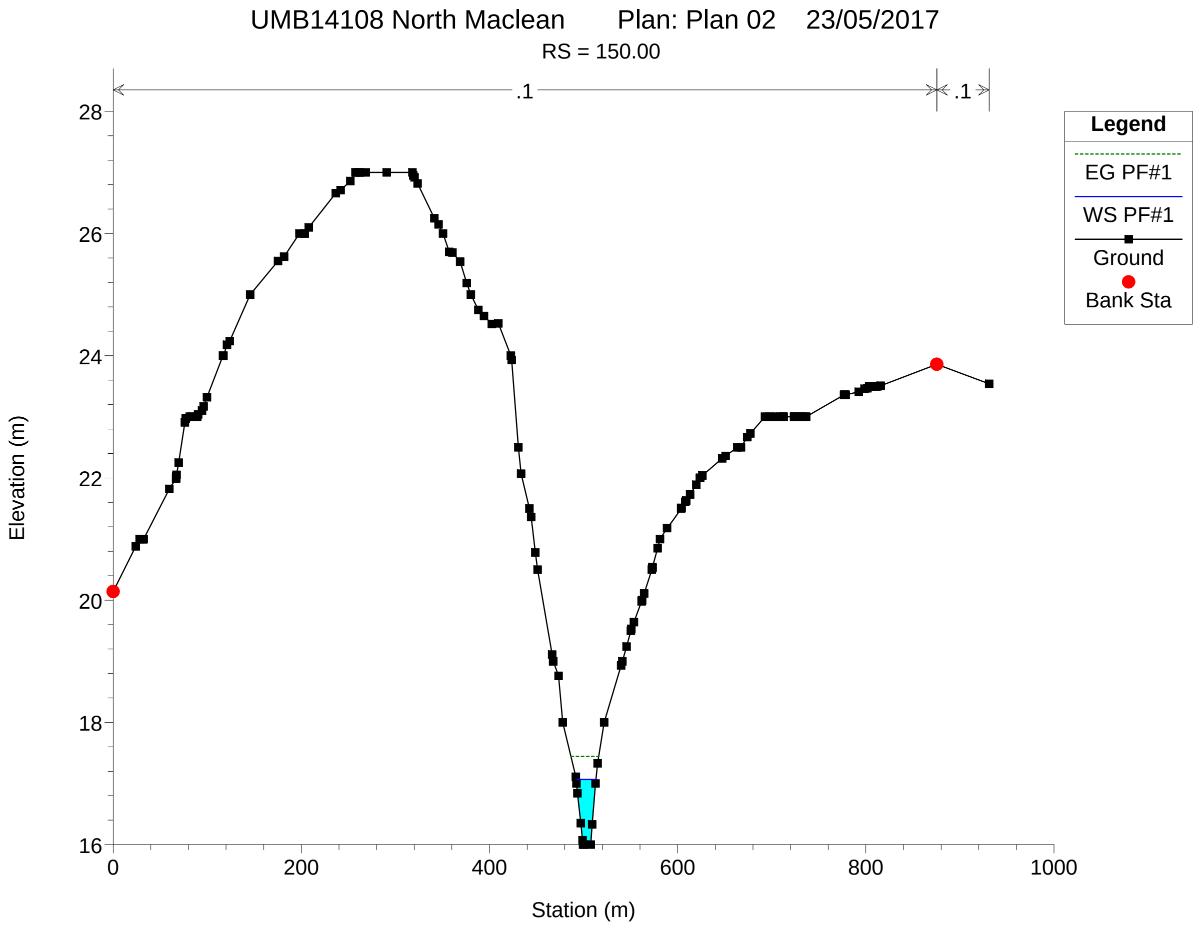
RS = 726.71
.1
Legend
EG PF#1
WS PF#1
Ground
Bank Sta
Elevation (m)
32
30
28
26
24
22
20
0
200
400
600
800
1000
Station (m)


UMB14108 North Maclean Plan: Plan 02 23/05/2017
RS = 550.00
.035
Legend
EG PF#1
WS PF#1
Ground
Bank Sta
Elevation (m)
Station (m)
30
28
26
24
22
20
18
0
200
400
600
800
1000

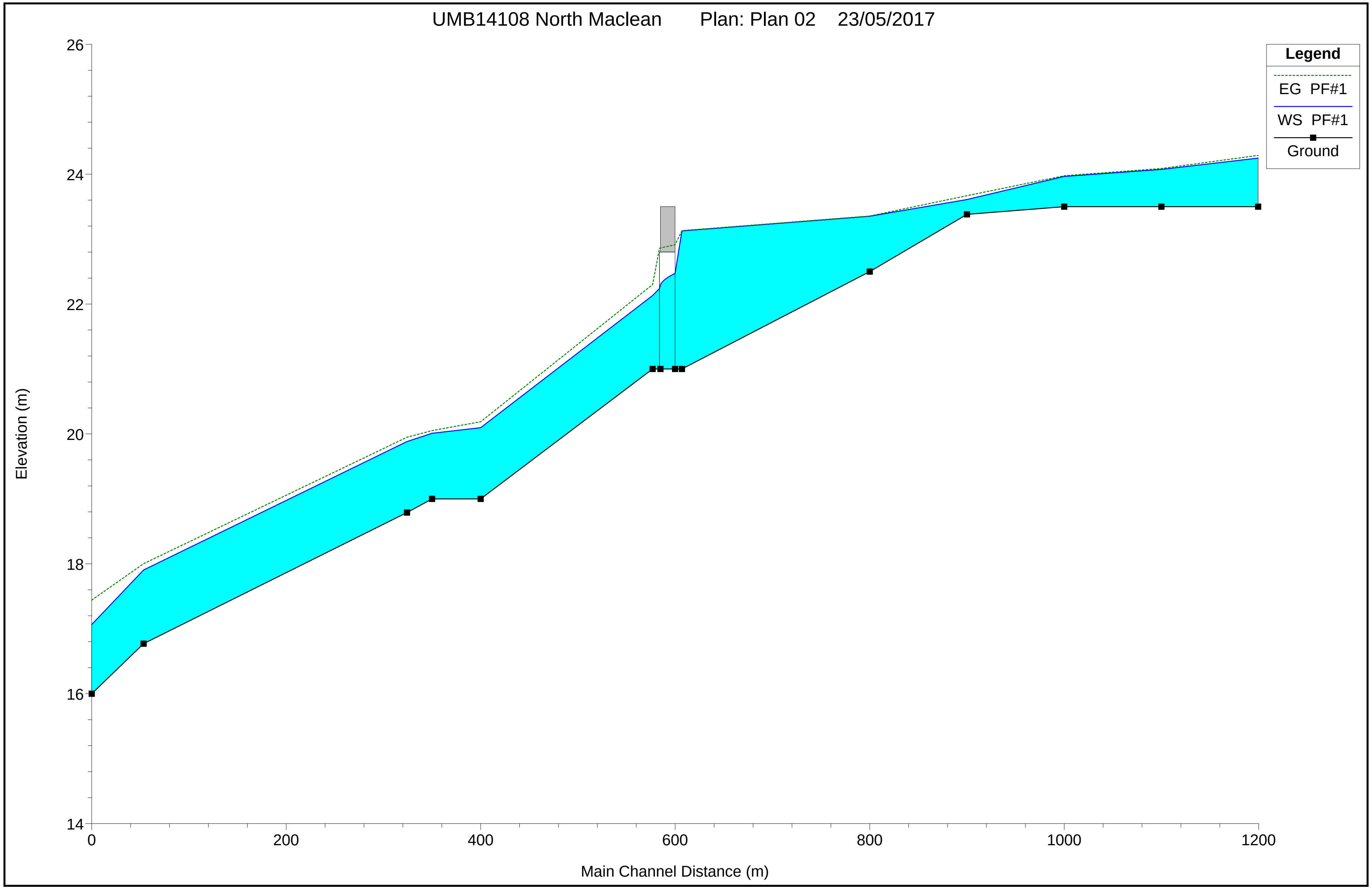

UMB14108 North Maclean Plan: Plan 02 23/05/2017
RS = 500.00
.035
Legend
EG PF#1
WS PF#1
Ground
Bank Sta
Elevation (m)
Station (m)
28
26
24
22
20
18
0
200
400
600
800
1000



UMB14108 North Maclean Plan: Plan 02 23/05/2017
RS = 203.28
.035
.1
Legend
EG PF#1
WS PF#1
Ground
Bank Sta
Elevation (m)
Station (m)
16
18
20
22
24
26
0
200
400
600
800
1000

UMB14108 North Maclean Plan: Plan 02 23/05/2017
RS = 150.00
.1
.1
Legend
EG PF#1
WS PF#1
Ground
Bank Sta
Elevation (m)
Station (m)
16
18
20
22
24
26
28
0
200
400
600
800
1000



UMB14108 North Maclean Plan: Plan 02 23/05/2017
Legend
EG PF#1
WS PF#1
Ground
Elevation (m)
Main Channel Distance (m)
26
24
22
20
18
16
14
0
200
400
600
800
1000
1200

HEC-RAS  Plan: Plan 02   River: 1   Reach: 150    Profile: PF#1

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (m3/s) | (m) | (m) | (m) | (m) | (m/m) | (m/s) | (m2) | (m) | |
| 150 | 1349.39 | PF#1 | 36.30 | 23.50 | 24.25 | 24.10 | 24.29 | 0.004138 | 0.91 | 39.88 | 114.41 | 0.49 |
| 150 | 1250.00 | PF#1 | 36.30 | 23.50 | 24.07 | | 24.09 | 0.001122 | 0.50 | 72.25 | 189.90 | 0.26 |
| 150 | 1150.00 | PF#1 | 36.30 | 23.50 | 23.96 | | 23.98 | 0.001086 | 0.48 | 75.66 | 208.03 | 0.25 |
| 150 | 1050.00 | PF#1 | 36.30 | 23.38 | 23.61 | 23.61 | 23.67 | 0.024259 | 1.08 | 33.58 | 280.46 | 1.00 |
| 150 | 950.00 | PF#1 | 36.30 | 22.50 | 23.35 | 22.71 | 23.36 | 0.000987 | 0.23 | 159.10 | 256.98 | 0.09 |
| 150 | 756.86 | PF#1 | 36.30 | 21.00 | 23.13 | 21.95 | 23.13 | 0.001394 | 0.31 | 116.92 | 153.90 | 0.11 |
| 150 | 741 | | Culvert | | | | | | | | | |
| 150 | 726.71 | PF#1 | 36.30 | 21.00 | 22.13 | | 22.30 | 0.068109 | 1.82 | 19.95 | 34.09 | 0.76 |
| 150 | 550.00 | PF#1 | 38.50 | 19.00 | 20.10 | | 20.19 | 0.004920 | 1.34 | 28.67 | 52.06 | 0.58 |
| 150 | 500.00 | PF#1 | 38.50 | 19.00 | 20.01 | | 20.05 | 0.001424 | 0.90 | 42.78 | 55.92 | 0.33 |
| 150 | 474.14 | PF#1 | 42.10 | 18.79 | 19.88 | | 19.95 | 0.023232 | 1.15 | 36.52 | 55.47 | 0.45 |
| 150 | 203.28 | PF#1 | 42.10 | 16.77 | 17.90 | | 18.00 | 0.003442 | 1.38 | 30.44 | 40.52 | 0.51 |
| 150 | 150.00 | PF#1 | 42.10 | 16.00 | 17.07 | 17.07 | 17.44 | 0.112756 | 2.71 | 15.51 | 21.17 | 1.01 |