STORMWATER MANAGEMENT PLAN

FOR

7 RENSHAW STREET, CRANEBROOK

INDUSTRIAL DEVELOPMENT

REPORT NO. R02216-SWMP
REVISION C

APRIL 2020

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PROJECT DETAILS

Property Address: 7 RENSHAW STREET, CRANEBROOK

Development Proposal: INDUSTRIAL DEVELOPMENT

REPORT CERTIFICATION

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DOCUMENT CONTROL

REVISION	ISSUE DATE	ISSUED TO	ISSUED FOR
A	DECEMBER 2019	CLIENT	INFORMATION
B	MARCH 2020	CLIENT	INFORMATION
C	APRIL 2020	CLIENT	INFORMATION
		COUNCIL	APPROVAL

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1. INTRODUCTION

1.1 Background

This Stormwater Management Plan has been prepared in accordance with the Penrith Council Development Control Plan (DC) to support the Development Application for the proposed development at 7 Renshaw Street, Cranebrook.

The scope of this report includes a comprehensive assessment of the stormwater management requirements for the proposed development. Accordingly, this report includes findings of the assessment and proposes a best practice stormwater management strategy.

The report describes the principles and operation of the proposed stormwater systems as well as the primary components of the drainage system.
The following information and documents were utilised in this investigation:

- Civil Engineering Drawings for the Development Application submission prepared by C&M Consulting Engineers;
- Architectural Plans by N. F. Billyard;
- Penrith Council DCP (2014);
- Penrith Council WSUD Policy (2013);
- "Australian Runoff Quality – A Guide to Water Sensitive Urban Design", Engineers Australia (2006);
- "Australian Rainfall and Runoff – A Guide to Flood Estimation", Institute of Engineers, Australia (2016).

The increase in impervious areas and alteration of the natural topography due to land development has the potential to increase and concentrate peak storm flows. This has the potential to impact on flow regimes and cause erosion of the downstream drainage network and associated waterways.

To avoid any adverse impact on the downstream drainage systems, the site's stormwater management system must be designed to ensure the safe conveyance of flows throughout the site and within the capacity of the downstream trunk drainage systems in a healthy environmental state for Ecological Sustainable Development.

1.2 The Site

The site is located at 7 Renshaw Street, Cranebrook. It is bound by Renshaw Street to the East, a drainage channel to the north and a small lake/pond to the west. It is currently a vacant green field site (Refer to **Figure 1**).

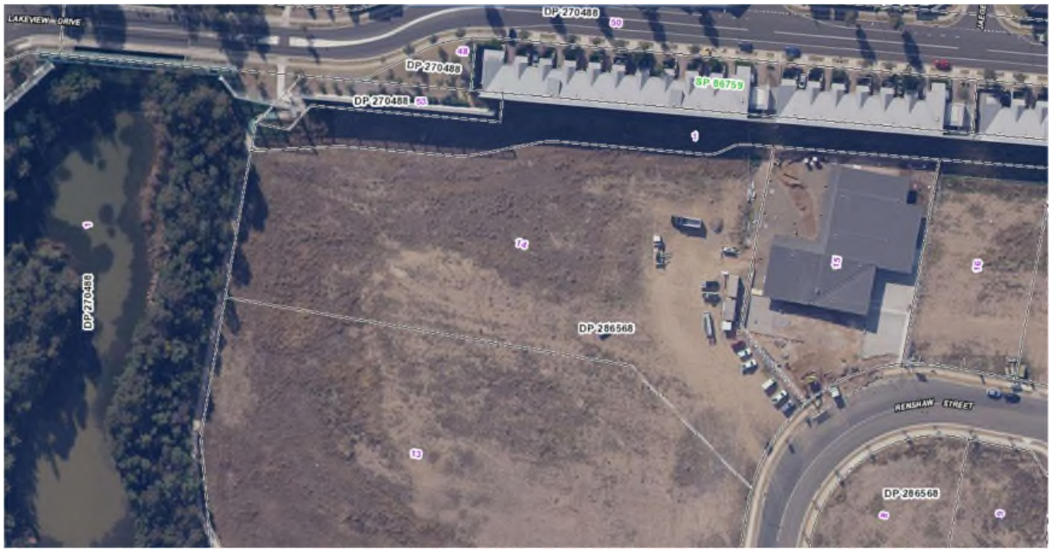


Figure 1 - Aerial Photo of Existing Site
(Source: NSW Six Maps)

The land falls gradually towards the North-West end of the Site. The proposed development includes construction of a number of industrial units including a driveway, stormwater drainage infrastructure and utility services.

1.3 Key Issues

The key issues to be addressed in this report include:

- **Water Quantity** – Increases in impervious areas as a result of development (such as roofs, driveways, etc) has the potential to increase stormwater flows from the site during storm events. To avoid impacting on the site and downstream properties, the site stormwater system must be designed to safely convey flows through the site and within the capacity of the downstream drainage system.

- **Water Quality** – Urban developments have the potential to increase gross pollutants, sediments and nutrient concentrations in storm water runoff. To limit the impact on the downstream water quality, pollution control measures will be provided within the sites stormwater management system prior to discharging into the drainage network.

2. RELEVANT GUIDELINES

2.1 Design Guidelines

The site based stormwater management and planning elements are to be designed and constructed in accordance with the following:

<u>Water Quantity</u>

Guidelines: DCP C3 Water Management

The proposed development increases the total impervious area of the existing site and therefore may increase the discharge rate to the downstream drainage network and waterways. The main objective is to achieve a natural water balance which seeks to approximate the pre-development site conditions to maintain existing conditions as well as controlling erosion and sediment removal.

<u>Water Quality</u>

Guidelines: Penrith Council WSUD Policy (2013)

Urban developments have the potential to increase gross pollutants, sediments and nutrient concentrations in storm water runoff. To limit the impact on the downstream water quality, pollution control measures will be provided within the sites stormwater management system prior to discharging into the drainage network.

Table 1 - Water Quality Reduction Targets

PARAMETERS	CRITERIA
Gross Pollutants	90% reduction of the average annual load
Suspended Solids	85% reduction of the average annual load
Total Phosphorus	60% reduction of the average annual load
Total Nitrogen	45% reduction of the average annual load

2.2 Objectives and Targets

The objective is to provide stormwater controls that ensure that the proposed development does not adversely impact on the quantity or quality of stormwater flows within, adjacent and downstream of the site. Compatible with the legislation, policy and requirements, the objectives and targets for stormwater management are as provided in Table 2.

Table 2 - Stormwater Management Objectives

STORMWATER MANAGEMENT	OBJECTIVES	TARGET
Quantity	▪ The existing runoff flow regimes for the full storm events should be maintained, and provide safe conveyance system for the major storm events. ▪ The existing runoff from the external catchment be safely mitigated through the site.	▪ Maintain existing runoff from development: – Provide safe flood mitigation measures to minimise any impact on the site, and – No adverse impact on downstream properties.
Quality	▪ The full range of typical urban stormwater pollutants shall meet Council requirements.	▪ Runoff from site is to achieve natural dry and wet weather concentrations for the catchment.

2.3 Overall Strategies

The proposed stormwater management strategies to manage runoff and ensure no detriment to the receiving environments have been divided into both short and long term strategies are summarised in Table 3.

Table 3 - Stormwater Management Strategies

STRATEGY	DESCRIPTION
Short Term Strategies	Short term strategies generally refer to control of soil and water erosion during the construction phase. The primary risk occurs while soils are exposed during construction works when suspended sediment and associated pollutants can be washed into downstream waterways. The strategies to prevent this potential degradation include adequate provision of sediment and erosion control measures that are documented on the sediment and erosion control plan included with this submission. The controls will limit movement of sediment in disturbed areas, and are designed to remove sediment from runoff prior to discharge from site.
Long Term Strategies	Long term strategies to maintain stormwater quality discharged from the site include utilisation of a number of permanent treatment measures to remove litter, suspended solids, and nutrients effectively. The main measures to be implemented are gross pollutant traps, rainwater reuse tanks & stormfilter cartridges.

3. STORMWATER QUANTITY CONTROL

3.1 Introduction

The main criterion for the stormwater quantity control is to ensure that the post-developed peak flows do not cause detriment to the downstream waterways and Council's existing drainage network.

3.2 Proposed Drainage System

The drainage system for the proposed development will be designed to collect the majority of concentrated flows from impermeable surfaces such as access ways, parking areas and buildings. Where possible (and practical), runoff from pervious areas will also be collected.

The proposed stormwater management system for the development includes:

- A pit and pipe network to collect minor storm runoff from areas;
- Overland flow paths to carry major storms through the site;
- A below ground OSD tank with orifice & weir control,

3.2.1 On-Site Stormwater Detention Requirements

The OSD was modelled using the runoff routing software DRAINS. A pre vs post development model was set up within DRAINS with the assumption that the predevelopment condition was fully pervious. The permissible site discharge was then limited to the predevelopment flow rates for all storm events up to and including the 1% AEP storm event.

The DRAINS model data and results can be found attached to this report as Appendix A. The DRAINS model file will be made available upon request.

For the proposed development, it is recommended that OSD be provided in the form of a below ground tank with a discharge control pit, orifice and weir control. It is proposed to provide an OSD tank with a minimum storage volume of 270.1m^3.

4. WATER QUALITY CONTROL

4.1 Introduction

The quality of runoff from a catchment depends upon many factors such as land use, degree of urbanisation, population density, sanitation, waste disposal practices, landform, soil types, and climate. Pollutants typically transported by runoff include litter, sediment, nutrients, oil, grease, and heavy metals. Whilst these pollutants have a deterious impact on the receiving water quality, suspended solids and nutrients cause the highest detrimental impact to the environment. Litter, oils, and other surfactants have an aesthetic impact.

Activity within a catchment during urbanisation includes the disturbance of vegetation, removal of topsoil, land shaping, road construction, installation of services, and building works. It is during this phase that the sediment movement is greatest and is estimated that the sediment production levels may be up to 6 times higher than under the existing conditions. However, once development is completed, the sediment loading may return to the existing level or remain at a higher level depending on land management practices.

As with all development projects, soil erosion during the construction phase presents a potential risk to water quality. The primary risk occurs while soils are exposed during earthworks when suspended sediment and associated pollutants can be washed into downstream watercourses.

This section of the report addresses the long term impacts of the development on water quality. For short term effects (i.e. during the construction phase) water quality control is achieved by implementing the measures in the Sedimentation & Erosion Control Plans to be included with future Construction Certificate submissions.

4.2 Water Quality Control Measures

There are a number of measures that can reduce pollutant loadings, varying in effectiveness depending on land use type, topography and the control target.

The adopted Treatment Train will provide the most efficient and manageable measures suited to the subject development setting.

The measures proposed for the redevelopment are summarised in Table 4.

Table 4 - Water Quality Control Measures

MEASURES	DESCRIPTIONS
Filter Cartridges	▪ StormFilter is a proprietary device containing multiple cartridge units in a single system thereby suitable for larger catchments ▪ One of the advantages of using StormFilter is that the cartridges come with various filtration media available to target site-specific pollutants ▪ Each cartridge consists of a PhosphoSorb media which is a lightweight media built from a Perlite base that removes total phosphorus (TP) by adsorbing dissolved-P and filtering particulate-P simultaneously. It not only removes phosphorous but is also designed to capture TSS, Oil and Grease, soluble metals, and nutrients. ▪ There will be total of 10 x 690mm PSORB Stormfilter Cartridges within a chamber of the OSD system as detailed in the engineering drawings.
Gross Pollutant Traps	▪ An *EnviroPod* is a catch basin insert installed inside inlet pits. It is effective in removing trash, debris and other pollutants from runoff. ▪ *EnviroPods* proposed for the project utilise a 200 micron filter system. These filter baskets will be installed in all surface inlet pits for the proposed development.
Rainwater Tank	▪ Rainwater tanks are effective in the removal of pollutant loads at source. The pollutant removal process occurs by harvesting runoff for reuse, thereby limiting the nutrients that are discharged into the waterways. ▪ Harvested rainwater will be plumbed to each unit for external taps and toilet flushing. Toilet Flushing – 28 toilets at a usage of 0.1kl/day/toilet = 2.8kl/day (Distribution: Uniform) ▪ It is proposed to provide a common rainwater reuse tank with a minimum effective volume of 100kL for the development. Only 80% of the total volume has been allowed for within the MUSIC model.

4.3 Strategy Effectiveness

The effectiveness of the proposed water quality measures has been assessed using numerical modelling. The results were assessed against the established Council requirements to determine the effectiveness of the proposed strategy.

4.4 Water Quality Modelling

4.4.1 *MUSIC Program*

The water quality model adopted for this project is the MUSIC (Model for Urban Stormwater Improvement Conceptualisation version 6) water quality numerical model developed by the MUSIC Development Team of the Cooperative Research Centre for Catchment Hydrology (CRCCH). MUSIC is an event basis model, and will simulate the performance of a group of stormwater management measures, configured in series or in parallel to form a “treatment train”.

The MUSIC User Manual suggests that the time-step should not be greater than the time of concentration of the smallest sub-catchment, but consideration should also be given to the smallest detention time of treatment nodes in the system. To accurately model the performance of the treatment nodes, a 6-minute time step was chosen.

The MUSIC model was generated using the historical 6-minute rainfall and monthly evapotranspiration data for Penrith (BOM Station No. 67113) for a period of 10 years from 1999 to 2008.

Catchment characteristics were defined using a combination of roof areas and non-roof catchments with varying imperviousness ratios to replicate the catchment for the development condition. The respective catchment areas are shown in Table 6.

The MUSIC model layout and results are shown in Appendix B of this report. The MUSIC model will be made available upon request.

4.4.2 *Event Mean Concentration*

MUSIC uses different event mean concentrations (EMC) to determine the pollutant loads generated by different land uses. The standard EMCs adopted within MUSIC were based on research undertaken by Duncan (1999) through the CRCCH and the results are reproduced in Australian Runoff Quality – A Guide to Water Sensitive Urban Design (ARQ). Table 5 summarises the parameters used for the development site.

Table 5 - EMC Parameters

LAND USE	MEAN BASE FLOW CONCENTRATION PARAMETERS Log10 (mg/L)			MEAN STORM FLOW CONCENTRATION PARAMETERS Log10 (mg/L)		
	TSS	TP	TN	TSS	TP	TN
Roof Areas	Not Applicable*Note 1			1.300	-0.890	0.300
Impervious Areas	1.200	-0.850	0.110	2.150	-0.600	0.300
Pervious Areas	1.200	-0.850	0.110	2.150	-0.600	0.300

*Note 1 – Roof areas consists of 100% impervious area so there is no base flow generated from this area.

4.4.3 *Configuration*

Table 6 and Table 7 provide the treatment configurations used in the MUSIC model:

Table 6 - Catchment Areas

LAND USE	DEVELOPED CONDITIONS		LAND USE CATCHMENTS (%)
	AREA (m^2)	IMPERVIOUSNESS (%)	
Roof	5079	100	50
Other Impervious	5166	100	50
Totals	10245	100	100

Table 7 - Stormwater Quality Improvement Devices (SQID)

STORMWATER QUALITY IMPROVEMENT DEVICE (SQID)	QUANTITY OF SQID
Stormfilters (Supplier: Ocean Protect)	10 x 690mm PSORB
Enviropods (Supplier: Ocean Protect)	11 x 200micron
Rainwater Tank	100kL

4.4.4 *Results*

The results of the MUSIC modelling are summarised in Table 8. The total pollutant loads from the development are expressed in kilograms per year. The reduction rate is expressed as a percentage and compares the pollution from the post developed site to that of the existing developed state of the site.

Table 8 - Summary of Music Model Results

POLLUTANT	EXISTING SITE LOADS (KG/YR)	POST DEVELOPMENT WITH TREATMENT (KG/YR)	REDUCTION (%)	TARGET ACHIEVED (Yes/No)
GP	**170**	**0**	**100**	**Yes**
TSS	**645**	**73.3**	**88.6**	**Yes**
TP	**1.37**	**0.464**	**66.2**	**Yes**
TN	**13.4**	**6.64**	**50.4**	**Yes**

GP = Gross Pollutants
TSS = Total Suspended Solids
TP = Total Phosphorus
TN = Total Nitrogen

In all instances, the proposed water quality control measures enabled the reduction targets to be achieved for all key stormwater pollutants. Therefore, by implementing the proposed treatment train measures within the proposed development there will be no detrimental effect on the quality of stormwater running off from the site.

5. RECOMMENDATIONS

The proposed development of the site could potentially lead to significant changes in water quantity and quality if a water sensitive urban design approach is not adopted as part of the development strategy. The traditional stormwater management and investigation that only considers impacts of flooding and flood mitigation is a thing of the past. Stormwater management practices must now also consider water quality, aquatic habitats, riparian vegetation, recreation, aesthetic and economic issues.

The key strategies to be adopted for this development include the following:

1. A pit and pipe network to collect minor storm runoff from surface areas which will minimise nuisance flooding;

2. Overland flow paths to carry major storms through and around the site without causing damage to property from flooding;

3. A below ground OSD tank with orifice and weir control with a storage capacity of 270.1m^3 to maintain peak flows;

4. 100kL Rainwater harvesting and retention systems to allow rainwater reuse while at the same time providing improvement to the quality of stormwater runoff from the site and also providing some level of stormwater detention;

5. 11 x STW360 EnviroPods in all grated surface inlet pits will form part of the water quality treatment train, removing gross pollutants;

6. 10 x 690mm PSORB stormfilter cartridges (STW360) fitted in a StormFilter chamber within the OSD tank to treat the water prior to it leaving the site.

The results from the investigations and modelling for this project that have been summarised in this report indicate that the development with the proposed WSUD strategy and management can provide a safe and ecologically sustainable environment.

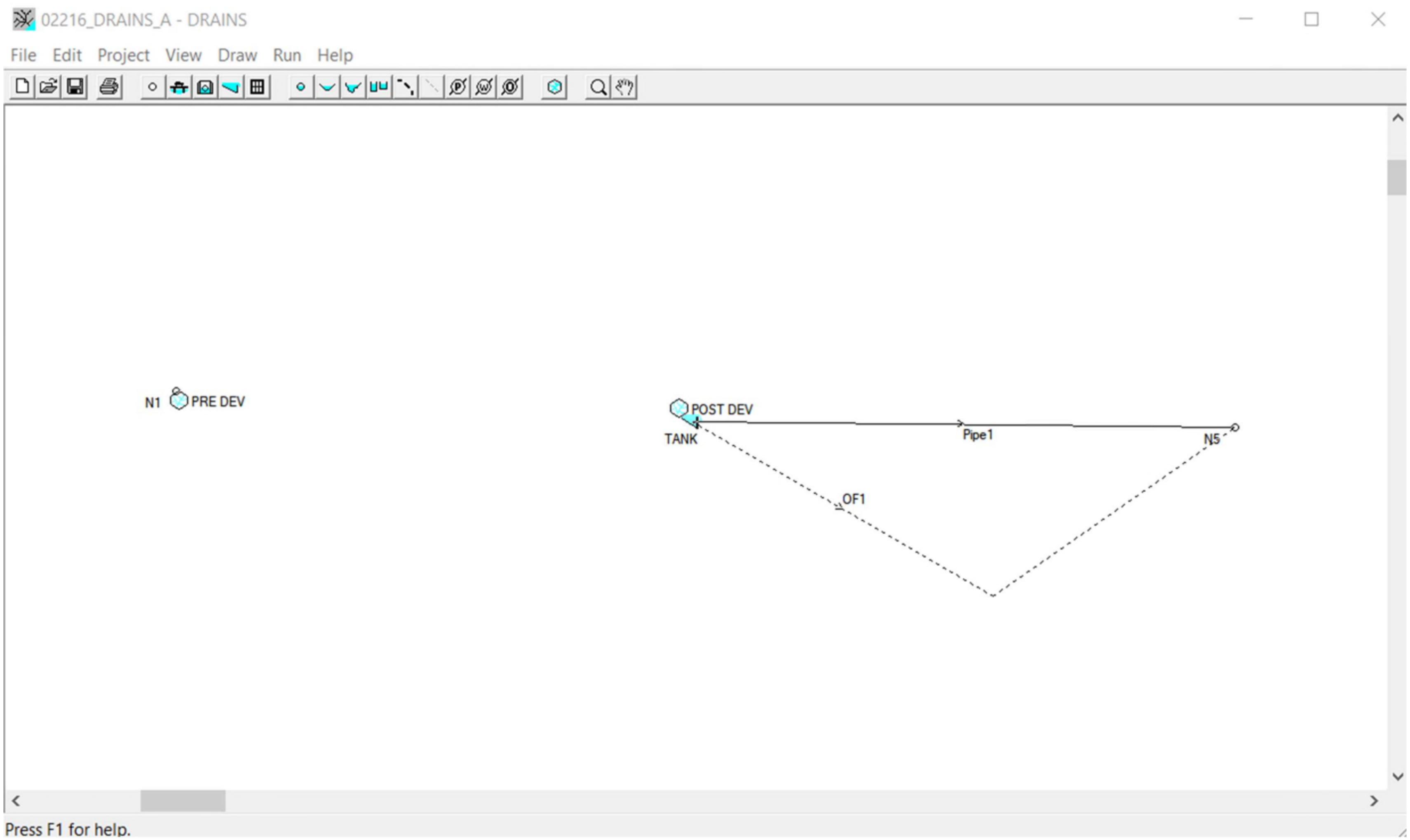
6. REFERENCES

- Civil Engineering Drawings for the Construction Certificate submission prepared by C&M Consulting Engineers;
- Architectural Plans by N. F. Billyard;
- Penrith Council DCP (2014);
- Penrith Council WSUD Policy (2013);
- "Australian Runoff Quality – A Guide to Water Sensitive Urban Design", Engineers Australia (2006);
- "Australian Rainfall and Runoff – A Guide to Flood Estimation", Institute of Engineers, Australia (2016);
- Watercom – *DRAINS Software Version 2018.09;*
- eWater – *MUSIC Version 6.2 (Build 1.1592).*

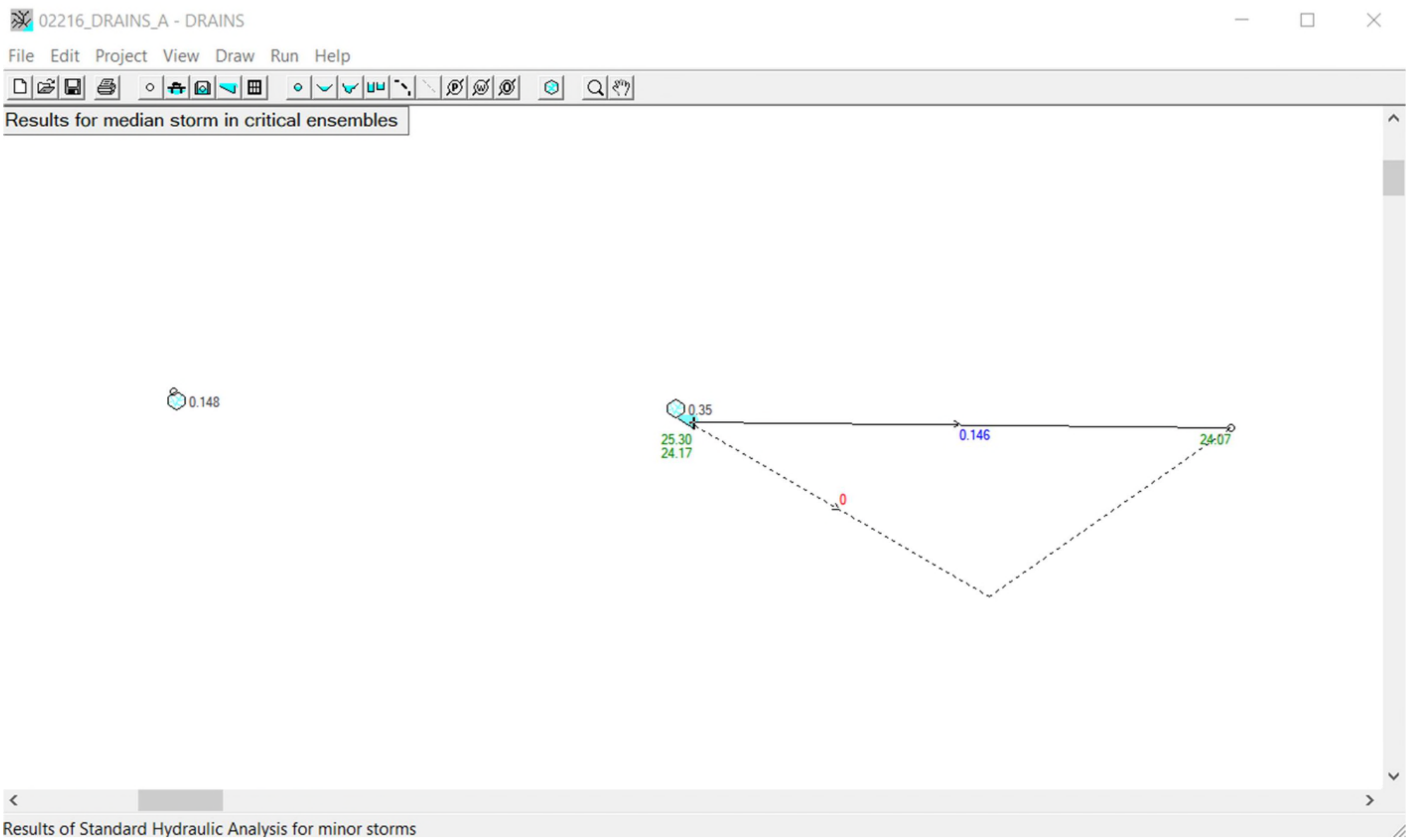
APPENDIX A

DRAINS MODEL LAYOUT & RESULTS

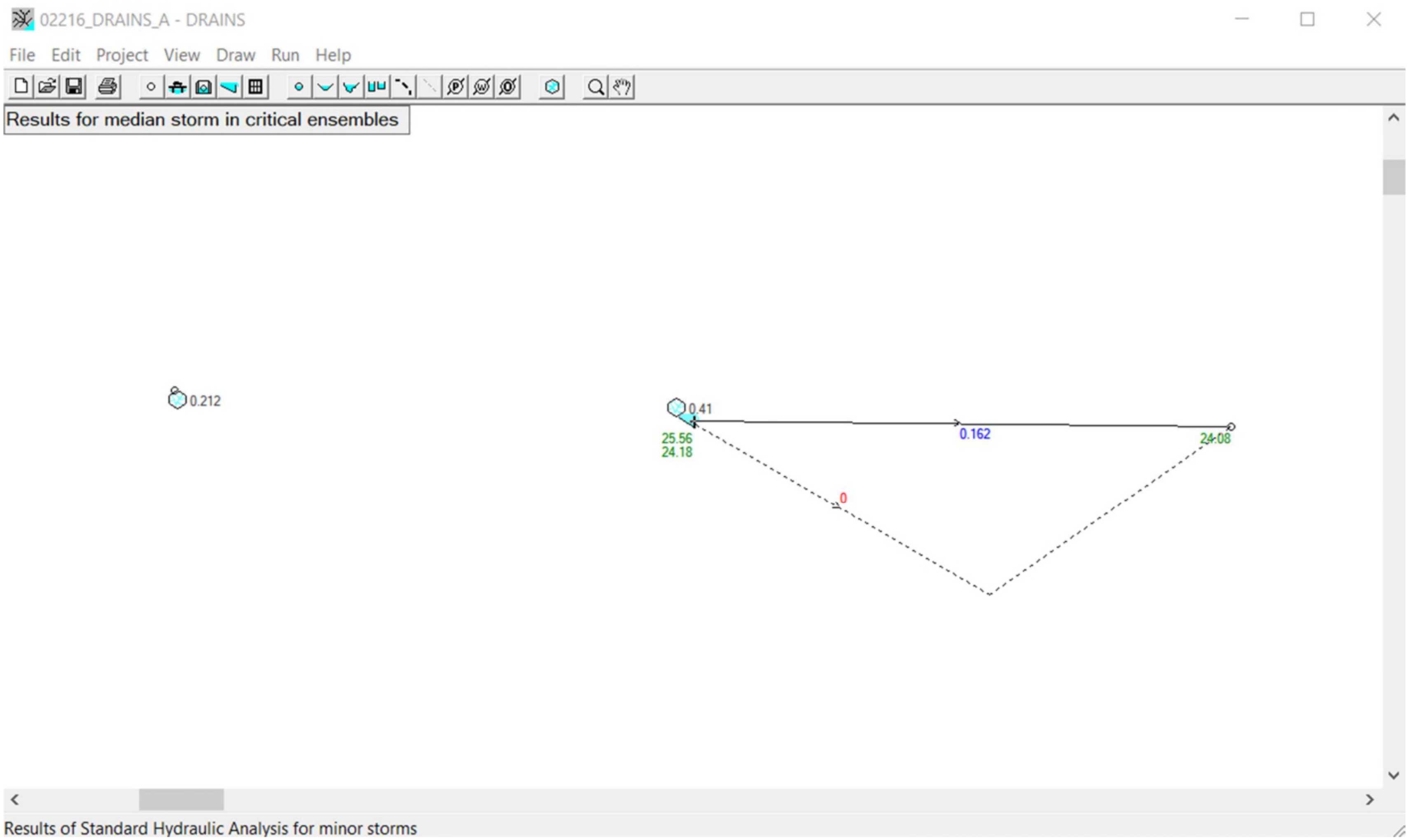
DRAINS OSD LAYOUT



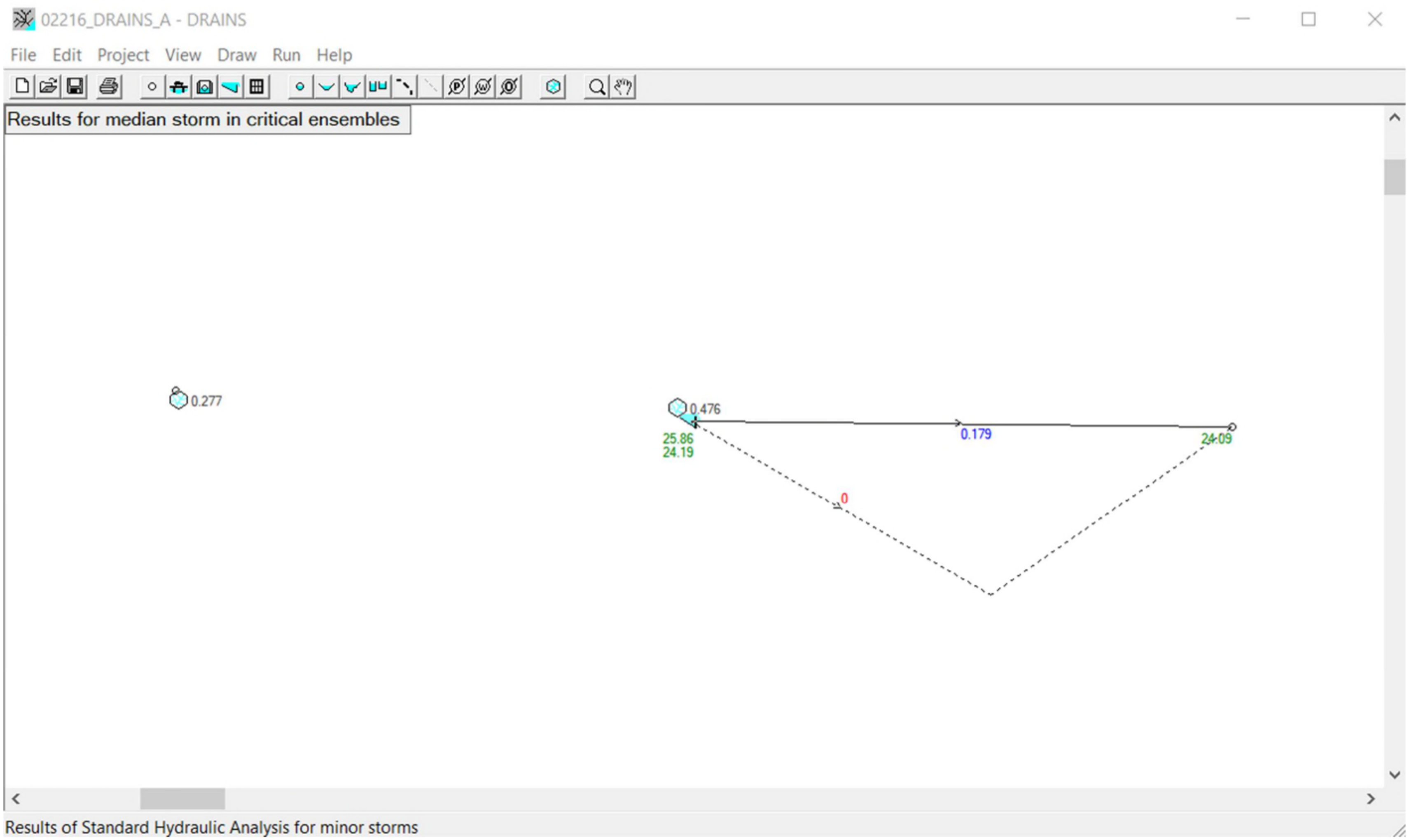
DRAINS OSD: 20% AEP STORM



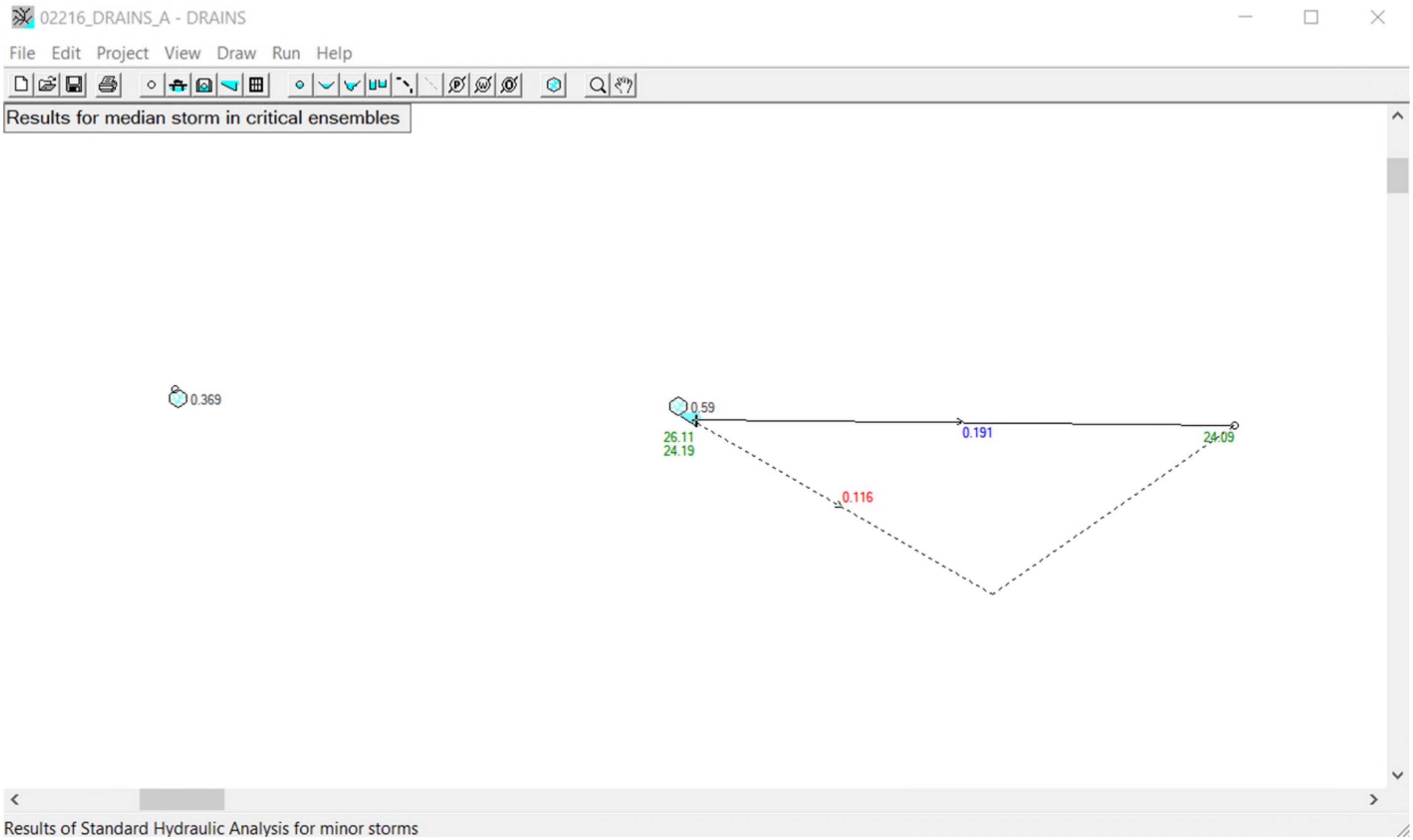
DRAINS OSD: 10% AEP STORM



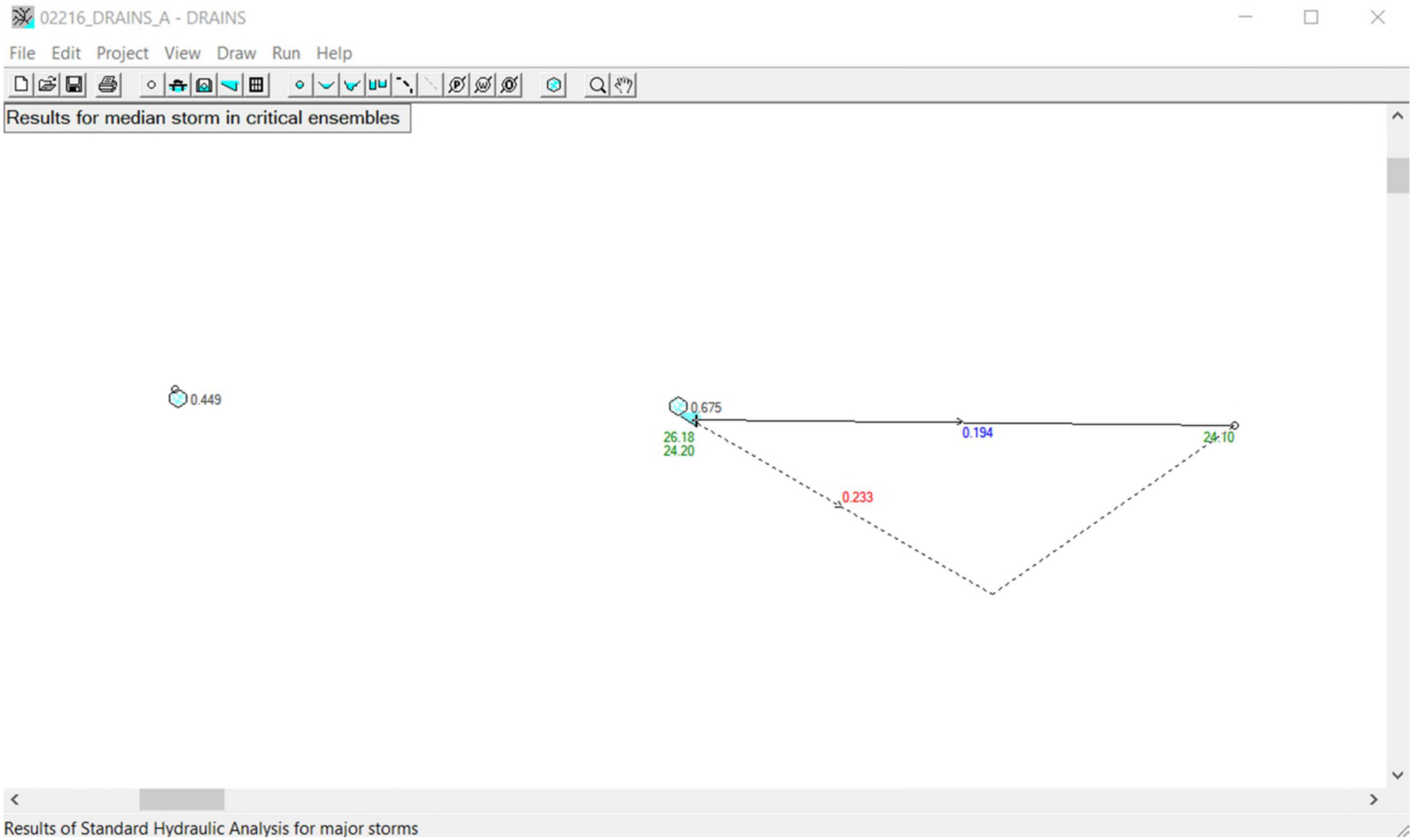
DRAINS OSD: 5% AEP STORM



DRAINS OSD: 2% AEP STORM



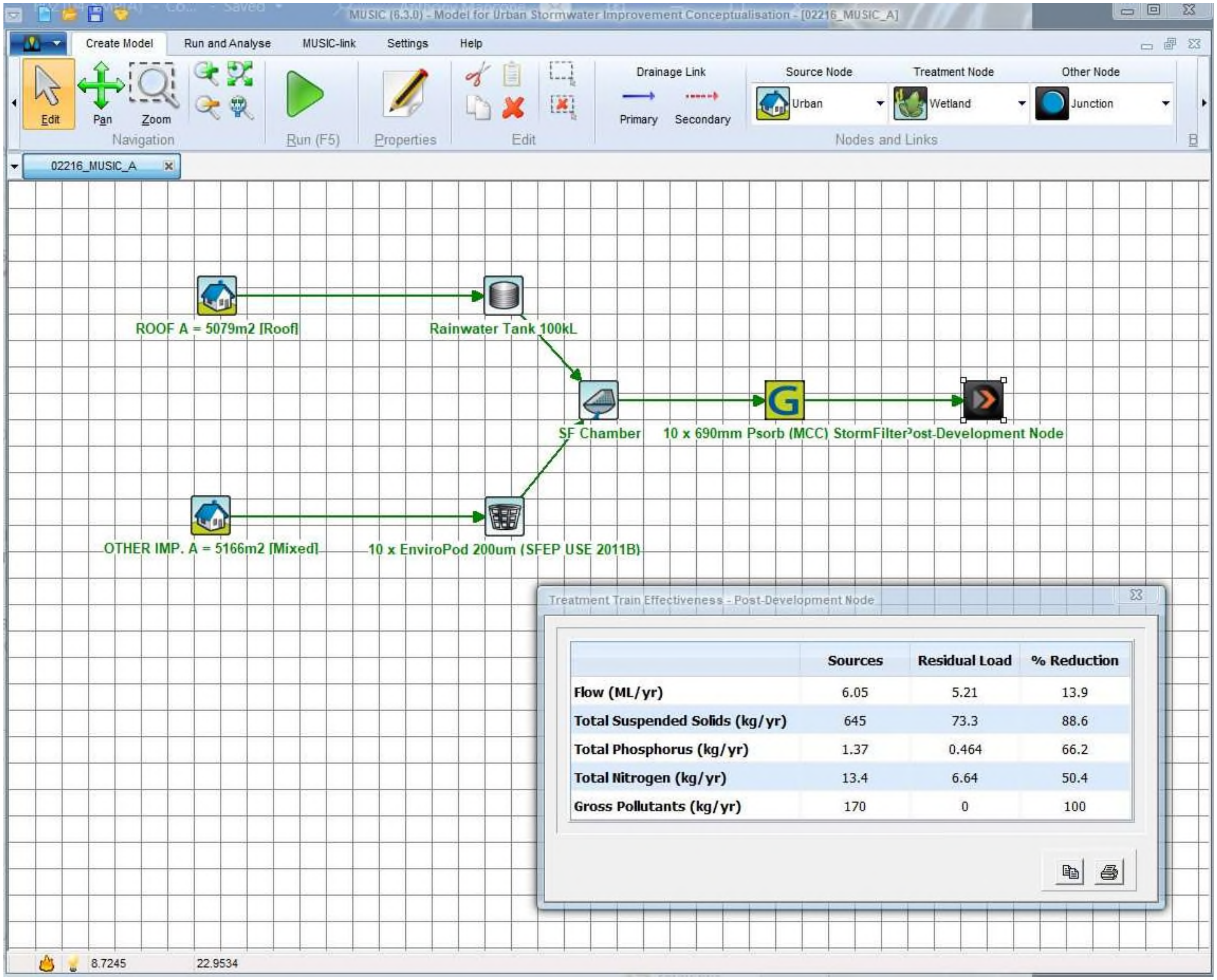
DRAINS OSD: 1% AEP STORM



APPENDIX B

MUSIC MODEL LAYOUT AND RESULTS

MUSIC MODEL LAYOUT & RESULTS



	Sources	Residual Load	% Reduction
Flow (ML/yr)	6.05	5.21	13.9
Total Suspended Solids (kg/yr)	645	73.3	88.6
Total Phosphorus (kg/yr)	1.37	0.464	66.2
Total Nitrogen (kg/yr)	13.4	6.64	50.4
Gross Pollutants (kg/yr)	170	0	100