WALLBRIDGE GILBERT AZTEC

Walker Corporation

Buckland Park Development – Precinct 1 | Stages 1, 2, 3, 6 and 7

STORMWATER MANAGEMENT PLAN

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Revision History

Rev	Date	Issue	Originator	Checker	Approver
0	12/04/2013	Report structure changed following DEWNR feedback	GL	DB	GL
1	07/05/2013	Incorporate Council Comments	GL	DB	DB
2	19/05/2013	Incorporate Walker/Council Comments	GL	DB	DB
3	10/12/2013	Figure 4.2 Amended	DB	DB	DB
4	24/09/2020	Updated to incorporate new Stage Precinct layout	JKL	GL	DB
5	15/12/2020	Updates to Stage Numbering	JKL	DB	DB

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1 INTRODUCTION

The Buckland Park development covers an approximate area of 1,308 hectares. The site is situated approximately 32km north of the Adelaide CBD, bounded by Gawler River to the north, existing Cheetham salt fields to the south and west, Port Wakefield Road to the east

The Riverlea Precinct is part of a proposed staged subdivision located in Buckland Park in northern Adelaide. This report outlines the Stormwater Management Plan for Precinct 1, incorporating Stages 1,2,3,6 and 7 in accordance with the 'Playford Council Development Plan,' October 2011, for the purpose of Council approval. The Stage 1A and 6A engineering design has been lodged with the City of Playford for approval.

The intent of this report is to provide the design basis for the multi-objective management of stormwater on the development based on the following:

- Internal network drainage design
- Design of regional flood conveyance channels
- The management of stormwater quality and its integrated approach within the overall project
- The management of stormwater within an overall risk management framework
- Staged implementation of the stormwater strategy.

A previous stormwater study 'Stormwater Management, Water, Wastewater and Recycled Water – Technical Paper,' prepared by Wallbridge & Gilbert dated March 2009 for the Buckland Park Environmental Impact Assessment has been considered as part of this SMP for the Precinct 1. This previous report developed the strategy for flood protection across the entire site and was at the time reviewed by the relevant State Government agencies including Emergency Services.

This Stormwater Management Plan (SMP) relates to Precinct 1 of the Riverlea Precinct as shown in **Figure 1** below. The site is located between Buckland Road and Port Wakefield Road, Buckland Park.

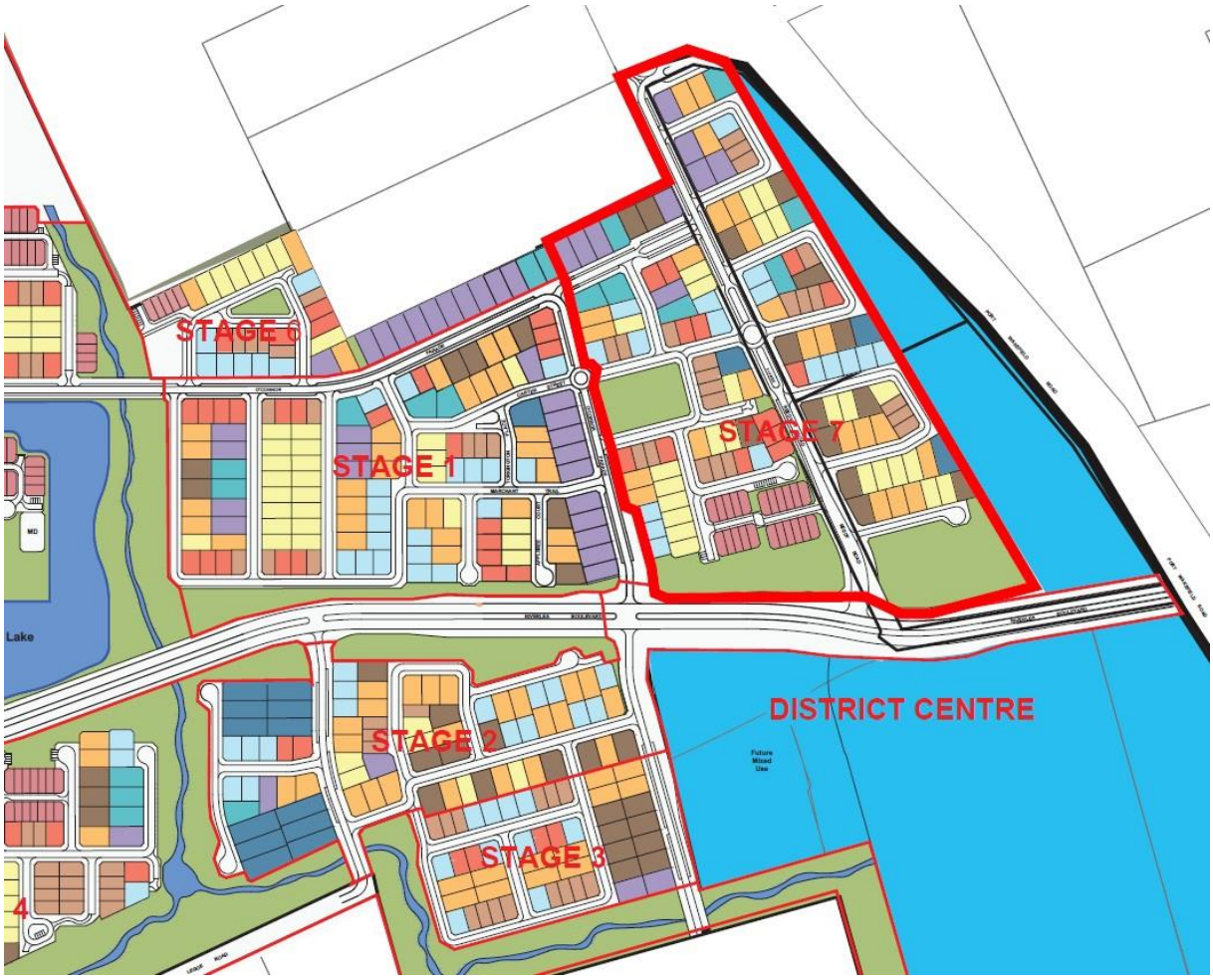

Figure 1 - Plan view of Riverlea Precinct 1

1.1 CHANGES SINCE PREVIOUS REVISION

As the previous revision of this report was prepared in 2013, this section has been incorporated to provide a summary of changes made to the Riverlea Precinct since the previous revision:

- Minor adjustments to the internal road layout within Riverlea Stage 1A
- Small increase in number of proposed residential allotments in Riverlea Stage 2
- Riverlea Stage 7 (east of Stage 1A) land use updated:
  - Formerly land use was earmarked for a mixed-use precinct
  - Stage 7 will now be used for residential development

It is noted that all previous modelling undertaken was based on the assumption of residential rather than mixed-use, therefore the previous revisions of this report had adopted a conservative approach. Furthermore, we note that all modelling results have minor changes resulting from changes in IFD data and modelling parameters in accordance with current practice.

All changes and updates made to this report have been summarised where relevant. Refer to Sections titled “Review to previous modelling” for a summary of key changes and updates.

2 CATCHMENT AREA OVERVIEW

2.1 SOILS AND GROUNDWATER SETTING

The geological survey of South Australia indicates that the majority of the site should be underlain by the Pooraka formation, typically comprising of pale red-brown sandy clay containing calcareous lenses. Bedrock is not expected to occur in the upper 30m depth at the site. Reference is made to a geotechnical investigation undertaken by Coffey (1998) across the majority of the proposed development.

As a part of the initial site investigations ground water mapping was undertaken by Resource and Environmental Management (now SKM). This mapping indicated that the depth to ground water within the site ranges from 0.2 metres to 7 metres below the natural surface level. It can be seen in **Figure 2** that approximately 75% of the site has a depth to ground water of approximately 3 metres below the surface level. Groundwater was found to be saline ranging from 1000ppm to 5000ppm.

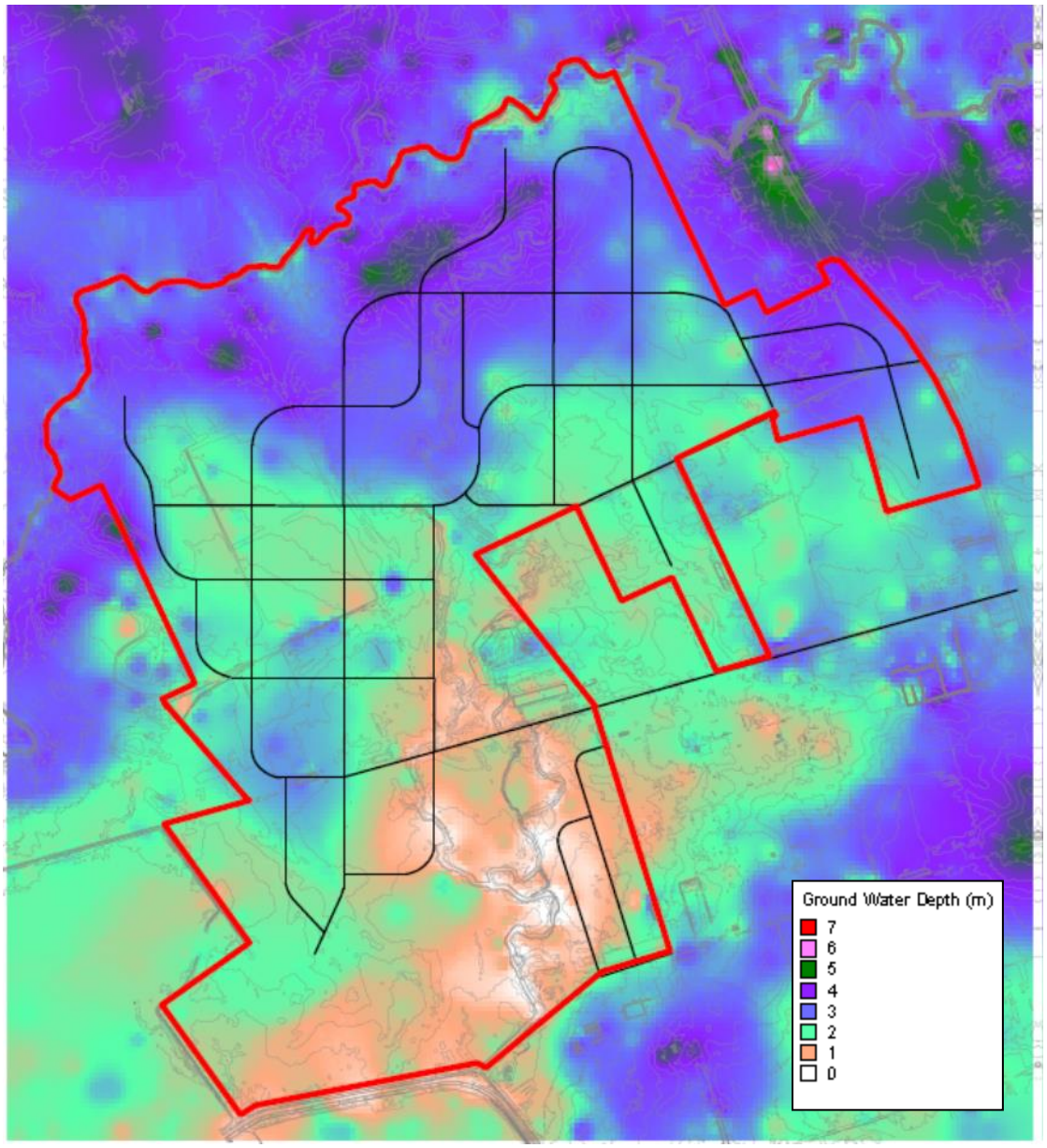

Figure 2 - Depth to Groundwater

2.2 EXISTING CATCHMENT

The Buckland Park site is situated approximately 2.7 kilometres inland of the Gulf St Vincent coastline and it is for this reason it is not considered to be a coastal site. The topography of the site is relatively flat with an approximately fall of 0.2% across the site from east to west. The site also lies within the Gawler River flood plain.

The Buckland Park site generally drains away from the Gawler River in a south westerly direction towards the Thompson Outfall Channel. The Gawler River is situated within the Northern section of the Buckland Park site and is a perched river system. As the banks of the Gawler River are higher than the adjacent floodplain, stormwater runoff from the Buckland Park site will not drain to the Gawler River nor to the Buckland Park Lake System as they are both effectively located upstream of the Buckland Park development area.

Figure 3 shows the site levels in metres to Australian Height Datum (AHD) and shows that the site falls away from the Gawler River towards the Thompson Outfall Channel.

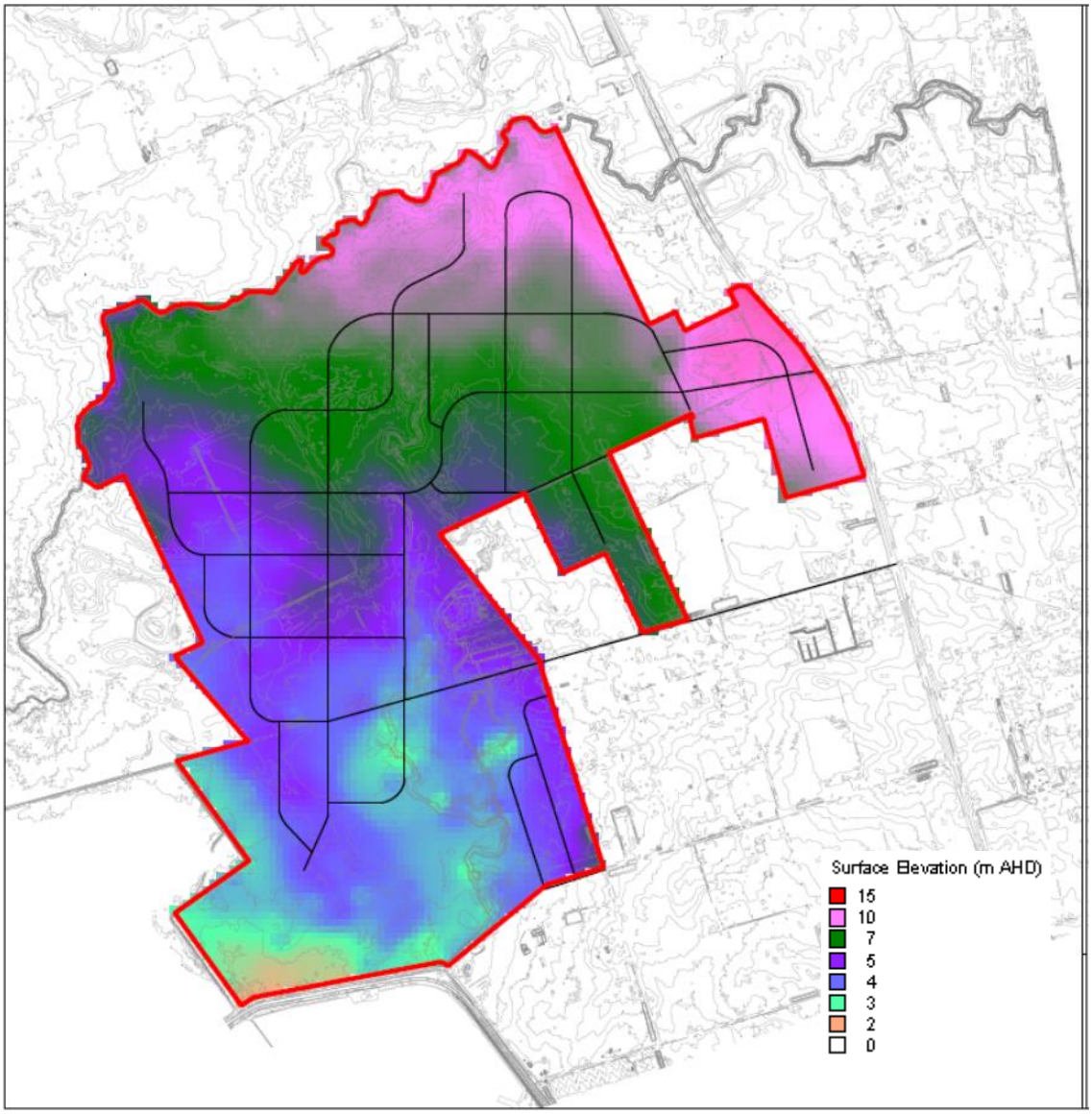

Figure 3 - Existing Site Levels

2.3 DEVELOPMENT

Precinct 1, Stages 1, 2, 3, 6 and 7 are currently greenfield sites with a total area of approximately 69Ha. The development comprises of mixed size urban allotments. In order to facilitate appropriate gradients along proposed roadways and allotments, Precinct 1 allotments will be filled in some areas with material excavated from the extensive open channel network and graded. This allows drainage (above and below ground) to drain to the proposed regional drainage channels through the development. This is required as the overall natural site gradient is flatter than the permissible minimum gradients for kerb and water table and stormwater pipes.

As the site is characterised by relatively flat topography, stormwater drainage from Precinct 1 is proposed to discharge at two distinct locations to a proposed regional channel system which will be extended as future Precincts are developed.

2.4 EXISTING KNOWN ASSETS

The current method of stormwater management within the Buckland Park site relies on a system of natural open channel lines and roadside open drains and culverts to move the stormwater runoff through the catchment and discharge it to the ocean via the Thompson Creek Outfall Channel. It is also understood that some groundwater is pumped to the Thompsons Creek from the Virginia area, however to date, no details have been able to be obtained. As this is a pumped arrangement, the volumes and peak flows are small compared to the predicted ultimate site runoff and this arrangement will not have any significant impact on the flood capacity of the proposed stormwater network.

WGA contacted Tony Fox of the Adelaide and Mount Lofty Ranges Natural Resource Management Board (AMRNRMB) in regard to obtaining further details about the system. Tony confirmed to date none are available. He did confirm that the outlet size from the pump discharge is only a 90mm to 100mm pipe, which confirms that the impact on flood capacity from this discharge is negligible.

3 IDENTIFICATION OF PROBLEMS AND OPPORTUNITIES

3.1 RISK MANAGEMENT

This risk management process aims to determine the potential nature, scale and likelihood of any impacts on water quality during the design, construction and operational phases of the development. This process is undertaken to assist in identifying appropriate management measures to manage the project impacts, and / or determine if intervention is required to manage these risks.

The main steps in the risk management process are:

- Identify risks – as determined by site and its characteristics
- Analyse risks – how likely is it to happen, what are the likely consequences
- Evaluate risks – against the likelihood and consequence matrix
- Treat risks – prioritise, address and mitigate identified risks.

This Risk Management process covers Precinct 1 with additional detail on Stages 1A and 6A of the development. The information sourced to inform this risk management process comes from various technical reports that have been undertaken for the Buckland Park development. These reports have been based on investigations associated with the site characteristics including groundwater, vegetation, soils and other physical aspects. These reports are listed below for reference to provide the background to this process:

- Buckland Park ASR, Groundwater Modelling, AGT (2011)
- Buckland Park Drain Model, AGT (2011)
- Buckland Park Flood Modelling Maps, AWE (2011)
- Buckland Park Biodiversity Strategy, EBS Ecology (2011)
- Bulk earthworks Modelling, W&G (2012)
- Buckland Park Country Township Master Planning Report, Connell Wagner (2007)
- Buckland Park Residential Development Stage 1, Geotechnical Investigation, Coffey Geotechnics (2011)
- Preliminary Acid Sulphate Soils Investigations, Buckland Park, Golder Associates (2008)
- Buckland Park Country Town Development, Thompson Creek Outfall Capacity Assessment, Connell Wagner (2007)

- Riverlea Development - Recycled Water Strategy, WGA (2012)
- Aquifer Storage and Recovery Potential for Buckland park, REM (2008)
- Stage 1A and 6A Flood Management System Modelling, AWE (2012)
- Buckland Park Stage 1 Stormwater Quality Management, WGA (2011)
- Western Catchment Stormwater Master Plan, Tonkin (2008)
- Enviro Development Technical Standards National Version 1, UDIA (2011)

Following a review of the referenced texts above the risk assessment has been prepared for the design, construction and operational phases of the project. This is presented in **Table 2** and **Table 4** inclusive. The likelihood and consequence matrix is provided in **Table 1** for reference.

3.2 STRATEGIES TO MANAGE RISK

The response measures are outlined in the Risk Management **Table 2** to **Table 4** inclusive for Precinct 1 incorporating Stage 1A and 6A. In addition to these management measures, the Construction Contractor will be required to prepare a Construction Environmental Management Plan (CEMP) including a Soil Erosion and Drainage Management Plan (SEDMP).

Water Sensitive Urban Design (WSUD)

A design framework that uses the principles of WSUD to manage risks is a widely accepted approach to manage stormwater in an environmentally sensitive approach. In this regard the design of the regional channels would adopt the multi-objective approach to stormwater management such that the development incorporates corridors not solely for conveyance of flood waters. As part of this project a framework will provide the methodology for the design of the regional channels project.

Principles in this framework are proposed for:

- Reducing mains water usage
- Improving quality runoff
- Managing the rates of runoff
- Managing the volume of runoff.
- Enhancement in amenity, environmental values, habitat and biodiversity

Table 1 - Likelihood and Consequence Matrix

	CONSEQUENCE		
LIKELIHOOD	**Low** Minor adverse social or environmental impact	**Medium** Measurable adverse environmental or social impact. Will result in annoyance or nuisance to community	**High** Significant damage or impact on environmental systems and local community
Low The event could occur only rarely, or is unlikely to occur	Low Risk	Low Risk	Medium Risk (could be high)
Medium The event will occur occasionally or could occur	Low Risk	Medium Risk	High Risk
High The event will occur often or is most likely to occur	Medium Risk	High Risk	High Risk

Table 2 - Design Phase Risk Management Process

1. DESIGN PHASE							
ID	**Issue**	**Potential Impact**	**Likelihood**	**Consequence**	**Level of Risk**	**Response / Management Measure**	**Notes**
A	Flooding - local catchment	Increased flooding potential due increase impervious areas and flat gradients	low	High	Medium	Drainage systems (including culverts, drainage networks, kerb and channel and open drains) shall cater for 1 in 5 Average Recurrence Interval (ARI) storm events, with a one in 100-year ARI storm event checked for overland flooding through flow paths. The system shall have sufficient capacity to accommodate the design drainage flow in accordance with the drainage requirements and without causing damage or nuisance to surrounding landowners and properties. Council requirement to provide detention to reduce post development flows to predevelopment level, which for Precinct 1 will be accommodated within the Stage 1 open channel construction as the volumes that can be contained within this system, which provides protection largely from the Gawler River flooding is significant.	Drainage network designed in accordance with Council standards
B	Flooding - Gawler River	flooding (large magnitude) of low-lying land due to overland flooding from floodwater breaking out of Gawler River	Medium	High	High	Incorporate a network of regional drainage channels in design - elements to be designed to maximise stormwater interception of overland flooding with no flows to surrounding low lying areas. Regional drainage channels to be located and tested with flood plain modelling by AWE Regional channels to be hydraulically sized and modelled as part of the design	
C	Flooding - Increase downstream flooding / exceeding capacity of Outfall channel	flooding of low-lying land and erosion of channel and adjacent area	Medium	High	High	Incorporate a network of regional drainage channels in design - elements to be designed to maximise stormwater interception of overland flooding with no flows to surrounding low lying areas. Detention to control rate of discharge to pre-development levels.	The regional channel will accommodate a large detention volume in the interim phase to hold back urban flows from Precinct 1 and in particular Stage 1A and 6A. Ultimately a detention basin is proposed at the downstream end of the development where it connects to Thompson Outfall channel
D	Erosion at outlets	Scouring and erosion associated with increase velocities, peak, volume of water	Medium	High	High	Drainage outlets to incorporate rock pitching, energy dissipation and vegetation	
E	Shallow ponding / stagnant water conducive to mosquito breeding	Nuisance issues, health risks to community	Medium	High	High	Minimise ponding to controlled areas Incorporate naturalistic design principles to create habit for natural predators in channels and pools Incorporate porous rock riffles that enable pools to drain out slowly after rainfall events Swales and drainage channels designed with longitudinal gradients to avoid stagnant and isolated pools	Regional channels incorporate a pool and riffle sequence for stormwater treatment. The pools are designed to drain out through porous rock riffles. The channel has been designed using naturalistic design principles and incorporates vegetation to create habitat and biodiversity which provides natural control of mosquito population
F	Waterway function - Thompson Outfall channel	Decrease in waterway function due to changes to hydrological regimes, sedimentation, erosion, water quality	Medium	Medium	Medium	The design and layout for stormwater treatment ponds will follow the rationale and design features associated with naturalistic water design, and wetland design. The treatment flow adopted in the design will be based on a three month to one-year ARI peak discharge rate from the local catchment. This will allow for 98 percent of all annual rainfall and daily runoff events from the local catchment will receive treatment to the WSUD standards. Any flows of a higher rate above the one-year ARI would still pass through a stormwater treatment system and receive some treatment. The regional channels are designed to slow the flow of stormwater through the local catchment. The regional channels will accommodate a large retention storage during the interim phase of the development (Precinct 1 incorporating Stages 1 and 2A) which will hold back stormwater.	The regional channel will accommodate a large retention volume in the interim phase to hold back urban flows from Stage 1A and 6A. Ultimately a detention basin is proposed at the downstream end of the development where it connects to Thompson Outfall channel
G	Acid Sulphate Soils	Long term impacts on infrastructure associated with acid (from the disturbance of acid sulphate soils)	Low	Medium	Low	Undertake geotechnical investigations to determine if these soils are present	Acid sulphate soils have not been encountered within the Precinct 1development site
H	Water Sensitive Urban Design	Runoff quality leads to long term water quality impacts to receiving environments **while impacts are operational, unless	Medium	Medium	Medium	Project based treatment design using treatment train approach. The design and layout for stormwater treatment ponds will follow the rationale and design features associated with artificial wetlands and naturalistic waterway design principles. The treatment flow adopted in the design will be based on a three month to one-year ARI peak discharge rate from the Local catchment. This will allow for 98% of all annual rainfall and daily runoff events from the Local catchment will receive treatment to the best practice standards. Any flows of a higher rate above the	**MUSIC modelling used to verify treatment systems adopted in design. Design demonstrates meets targets as specified Using best practice criteria for pollutant

		addressed during design, little chance of addressing impacts during operations				one-year ARI would still pass through a stormwater treatment pond and receive some treatment. Treatment will achieve reductions in total pollutant load from the contributing roadway catchment. The WSUD Guidelines for the Greater Adelaide Region (2013 seeks the following pollutant reduction targets. - 80% reduction of total suspended solids (TSS). - 60% reduction of total phosphorus (TP). - 45% reduction of total nitrogen (TN - 90% reduction of gross pollutants, and retention of litter greater than 50mm for up to the 3-month ARI peak flow. - Oil and grease, no visible oils for flows up to the 3-month ARI peak flow.	reduction targets and checked against EPA Water Quality Policy (2003)
I	Groundwater	Increase in groundwater levels due to increased runoff from paved areas.	Medium	Medium	High	AGT had assessed the likelihood of increased groundwater levels due to the increase in impervious areas in their report titled. *Buckland Park Drain Model, AGT (2011)* and the report suggests there may be some local raising of water levels at the inverts of the open channel system, but that water levels will remain largely unchanged across the site. The open channel system will intercept shallow groundwater in some locations across the site, however, the flow rates of groundwater passing through the extensive open channel system are estimated to be of the order of 200l/s which is considered small given the scale of the network.	
J	Thompson's Creek in private ownership	Modification of the creek by private landowners increasing the risk of flooding	Low	Medium	Medium	There is a section of Thompson's Creek that is outside the development boundary and is in private ownership. There is a risk that private landowners could fill or modify the creek, and impact on its capacity. Modifications to the creek would be a 'Water Affecting Activity' under the Natural Resource Management Act and would require a permit, so there are penalty measures in place should this occur notwithstanding there is still a risk. Ultimately the main channel will be constructed down to the Thompson's Outfall Channel, and the system will not rely on any part of the existing Thompson's Creek, and the risk will be removed. In the short term, the extent of storage provision within the main channel constructed down to Thompson's Creek will result in only very minor flow rates in Thompson's Creek.	

Table 3 - Construction Phase Risk Management Process

2. CONSTRUCTION

ID	Issue	Potential Impact	Likelihood	Consequence	Level of Risk	Response / Management Measure	Notes
A	Sedimentation	Sedimentation impacts on receiving water quality: - increase in turbidity / total suspended solids / total dissolved solids - to aquatic ecosystems by reducing light and smothering organisms	High	Low	Medium	SEDMP	
B	Vegetative matter	Increase in natural organic matter impacts on receiving water quality including: - increase in Nitrogen / Phosphorus and reduced oxygen levels - algae outbreaks and eutrophication - visual / surface scum	Low	Medium	Medium	SEDMP	
C	Gross pollution (litter)	Impacts on receiving waters: - visual / aesthetics - decreased water quality	Medium	Low	Medium	Construction Environmental Management Plan (CEMP) Waste recycling and reuse	
D	Accidental spills (including hazardous materials)	Impacts on receiving water quality: - increased toxicity - aquatic flora death / breakdown and increases in organic matter - aquatic fauna death / breakdown and increases in organic matter	Low	Medium	Medium	CEMP	
E	Hydrocarbons	Impacts to water quality including: - increased toxicity - algae outbreaks and eutrophication - visual / surface scum	Low	Medium	Medium	CEMP	
F	Acid Sulphate Soils	Impacts on receiving water quality including: - decreases in pH - increases in heavy metals - increased toxicity to aquatic flora / fauna - soil contamination along flow lines	Low	High	Medium	Site does not lie in the extent of Coastal acid sulphate soils	
G	Interception of groundwater (<3m unconfined saline aquifer)	Impacts on receiving water quality (associated with dewatering activities)	Low	Low	Medium	CEMP	
H	Accidental spills and/or release of contaminated soil into groundwater systems	Contamination of groundwater	Low	High	Medium	CEMP	
I	Temporary changes in direction and flow of surface water and groundwater	Pooling in undesirable areas, including excavations.	Medium	Low	Low	CEMP	
J	Increased volume of surface water flow	Increased turbidity levels in receiving channels for excessive sediment accumulation within the bed of channel	Medium	Medium	Medium	CEMP Temporary drainage systems required during the construction of the works	Regional channel will retain stormwater without direct discharge to Thompson Outfall channel

Table 4 - Operations (Post Construction) Phase Risk Management Process

3. OPERATIONAL - POST CONSTRUCTION

ID	Issue	Potential Impact	Likelihood	Consequence	Level of Risk	Response / Management Measure	Notes
A	Urban stormwater pollution	Impacts to water quality including: - increased toxicity - accumulation in aquatic sediments	High	Medium	High	Project based treatment design e.g. drains, wetlands, detention basins (interchanges), treatment train approach. Maintenance and monitoring of system to achieve design outcomes.	
B	Hydrocarbons	Impacts to water quality including: - increased toxicity - algae outbreaks and eutrophication - visual / surface scum	High	Medium	High	No runoff from any part of the project shall be discharged out of the road corridor unless it is in an underground or surface drainage system that is intercepted by a treatment wetland prior to entering a watercourse	
C	Sediment	Impacts on receiving water quality: - increase in turbidity / total suspended solids / total dissolved solids - to aquatic ecosystems by reducing light and smothering organisms - release of associated metals and nutrients.	Medium	Medium	Medium	Project based treatment design e.g. sediment ponds. Treatment train response. Existing regional drainage catchments and flow patterns should be maintained where practicable and drainage flows shall not cause scour, damage or nuisance to surrounding landowners and properties.	
D	Nutrients	Impacts on receiving water quality: - increase in Nitrogen / Phosphorus and reduced oxygen levels - aquatic flora death / breakdown and increases in organic matter - aquatic fauna death / breakdown and increases in organic matter	Low	Medium	Low	Design response. Treatment train response (primary treatment)	
E	Vegetative matter	Increase in natural organic matter impacts on receiving water quality including: - increase in Nitrogen / Phosphorus and reduced oxygen levels - algae outbreaks and eutrophication - visual / surface scum	Low	Medium	Low		
F	Gross pollution (litter)	Impacts on receiving waters: - visual / aesthetics - decreased water quality	Medium	Low	Low	Maintenance Provision of gross pollutant traps at stormwater outlets	
G	Increased runoff volumes due to increased impermeable surfaces	Impact to flow regimes and function of receiving waters	High	Medium	High	Using WSUD techniques to slow rate of runoff through swales, soakage systems and pool and riffle sequence in regional channel Revegetate regional channels with indigenous plant species to slow surface water flow, protect from erosion, and restore habitat and environmental values	
H	Rising groundwater levels due to irrigation of playing field and residential properties	Impact on infrastructure, vegetation due to rising saline groundwater	Low	High	Medium	Regional channel intercepts groundwater and therefore water levels remain unchanged	Study report by Australian Groundwater Technology suggests that this is unlikely

3.3 CONSTRUCTION ENVIRONMENT MANAGEMENT PLAN (CEMP)

The CEMP is expected to be developed to mitigate the risks associated with construction and to address risks appropriate avoid impacts to the downstream waterways. The CEMP is expected to have contents similar to that listed as follows:

OVERVIEW

INTRODUCTION

- Project Scope
- Purpose
- Roles and Responsibilities
- Project Environmental Process
- Environmental Management System
- Induction and Training
- Contractor and Subcontractor Management
- Communication
- Feedback and Enquiries
- Document Control
- Monitoring, Inspection and Audits
- Emergency Preparedness and Response
- Incidents/non-Compliance Reporting
- Reporting and Review
- Environmental Control Planning

PROJECT ENVIRONMENTAL OBJECTIVES

KEY ENVIRONMENTAL RISKS AND CONTROLS

- Noise and Vibration
- Air Quality
- Water Quality – Sediment, Erosion and Drainage Management
- Waste Management
- Dangerous Goods Storage
- Energy Use and Greenhouse Gas Emission/Sustainability

CONCLUSION

The Construction Environment Management Plan will be prepared by the Construction Contractor (for each stage of the development) and will be submitted to Council for approval prior to construction. The CEMP will incorporate a SEDMP, which will form an important part of the site management during the

construction phase. It is expected that the SEDMP will be developed using a risk-based approach that considers all contributing site physical factors that contribute soil erosion. The CEMP will be prepared by the Construction Contractor and therefore not covered in this report. A preliminary SEDMP has been prepared to provide guidance. Refer to Appendix G of this report.
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4 STORMWATER MANAGEMENT OBJECTIVES AND STRATEGIES

4.1 OBJECTIVES

The key aspects to achieve in the strategy for the management of stormwater runoff from the development relate to the following:

- Flooding
- Water Quality
- Water Use
- Environmental Protection and Enhancement

From these key aspects, broad objectives for management of stormwater runoff can be developed and are identified as follows:

Objective 1: Flood Management - Provide and maintain flood protection to Precinct 1 and future development based on local catchment (Development) and flooding arising from the broader Gawler River system (Regional).

Objective 2: Water Quality Improvement – Treat stormwater to meet the requirements for protection of the receiving environment to EPA and WSUD standards. Use green infrastructure to manage water quality and to integrate with Objective 4.

Objective 3: Water Use – Capture and use of stormwater runoff for beneficial purposes.

Objective 4: Amenity, Recreation & Environmental Enhancement and Protection - Where possible, develop land used for stormwater management purposes to facilitate recreation use, amenity & environmental enhancement.

The development of the stormwater strategy for Precinct 1 requires these broad objectives to be further refined to identify specific management objectives. These specific objectives are outlined in the following Sections and will then enable targeted management strategies to be identified, assessed and implemented.

4.2 FLOODING

A number of strategies have been implemented to achieve the objectives for flood management set out in Section 5. These strategies are briefly set out below.

Strategy 1: Primary Drainage Infrastructure

The inclusion of a drainage network designed to manage the minor / major principles for Precinct 1 incorporating Stages 1 and 2A. The standards are described in Section 5 have been applied to the detailed design of Stages 1 and 2A and will be applicable for the remained of Precinct 1.

Strategy 2: Regional Flood Management

The inclusion of a network of channels designed to intercept overland flooding from Gawler River. Refer to Section 5 for further detail.

4.3 STORMWATER QUALITY

Strategy 1: Green Infrastructure (WSUD)

The provision of WSUD elements are to be incorporated at key locations in the development for management and treatment of stormwater. The construction of regional drainage channel system for the management of flood flows will provide the opportunity to incorporate linear ephemeral wetland pools for water quality improvement. Based on the significant length of channel and based on their widths, several potential sites are highlighted in Section 6.

Other WSUD opportunities are to be pursued within the development include the use of:

- Vegetative swales
- Infiltration systems

Strategy 2: Interception of Gross Pollutants

The development drains within Stage 1A and 6A include two major outfalls into the regional channels which will ultimately drain out to the Gulf St Vincent. The two outfalls will each accommodate a GPT to intercept gross pollutants, as will any other outlets to the open channel system that are required for the balance of Precinct 1.

4.4 STORMWATER REUSE

Strategy 1: Implement Aquifer Storage and Recovery Scheme

Provision of a stormwater harvesting scheme within Precinct 1 is not considered viable at this early phase of development due to the lack of development and runoff to generate sufficient water. It is envisaged that it may be considered as part of future development of Buckland Park, potentially within Precinct 2.

WGA has prepared a Recycled Water Strategy for the whole of Buckland Park, which includes consideration for a future stormwater harvesting and reuse scheme. Refer to Riverlea Development - Recycled Water Strategy, W&G (2012)

5 STORMWATER DESIGN

5.1 REGIONAL FLOODING

The following risks to the development and environment have been identified along with the strategies to mitigate or address them. Table 2 lists these risks and the strategies or measures adopted to address them.

5.2 CHANNEL DESIGN

General

A system of regional channels has been proposed throughout the Buckland Park Development in order to manage stormwater outflows from the development during short duration events and protect the development from flooding from the Gawler River during the longer duration events. The basis on which the channels were designed is the flood modelling undertaken by Australian Water Environments (AWE).

Appendix C shows flood modelling results provided in AWE floodplain map *'11002 – D057 A1 100ARI DEPTH and WSE Buckland Park 110705'* for the 100-year ARI flood event in the context of Riverlea Precinct 1. This demonstrates that the extent of channel systems proposed to be constructed with Stage 1A and 6A of Precinct 1 will provide protection to Precinct 1. The channel network will need to be extended in the future as further development occurs, but the extent of channel network required will be dependent on the location of the next precinct.

The ultimate regional channel solution is illustrated in schematic purposes in Figure 3. Council's requirement for the Buckland Park Development is that post development outflow does not exceed the pre-development level. The need for an ultimate major detention basin to service the entire development and the basis of its design are discussed in detail in 'Stormwater Management, Water, Wastewater and Recycled Water- Technical Paper,' prepared by Wallbridge & Gilbert, March 2009. The following is a summary of key outcomes from the stated technical paper relating to stormwater detention requirements:

Pre-development peak 100-year ARI flow rate was calculated to be approximately $10m^3/s$,

Post-development peak 100-year ARI flow rate was found to be $92m^3/s$.

The proposed detention basin will be located in the south western corner of the site and will reduce the peak flows from the site to a maximum of $10m^3/s$.

A DRAINS model was used to determine that a detention basin of the order of $250,000m^3$ would be required to attenuate the 1 in 100-year ARI peak flows to a maximum outflow of $10m^3/s$, with the critical duration storm the 90 minute event.

The location for the detention basin is indicatively shown in Figure 4 and was chosen for the following reasons:

- Lowest point on the site
- Low possibility of encountering acid sulphate soils
- Limited development potential of this area as the site elevations are low.

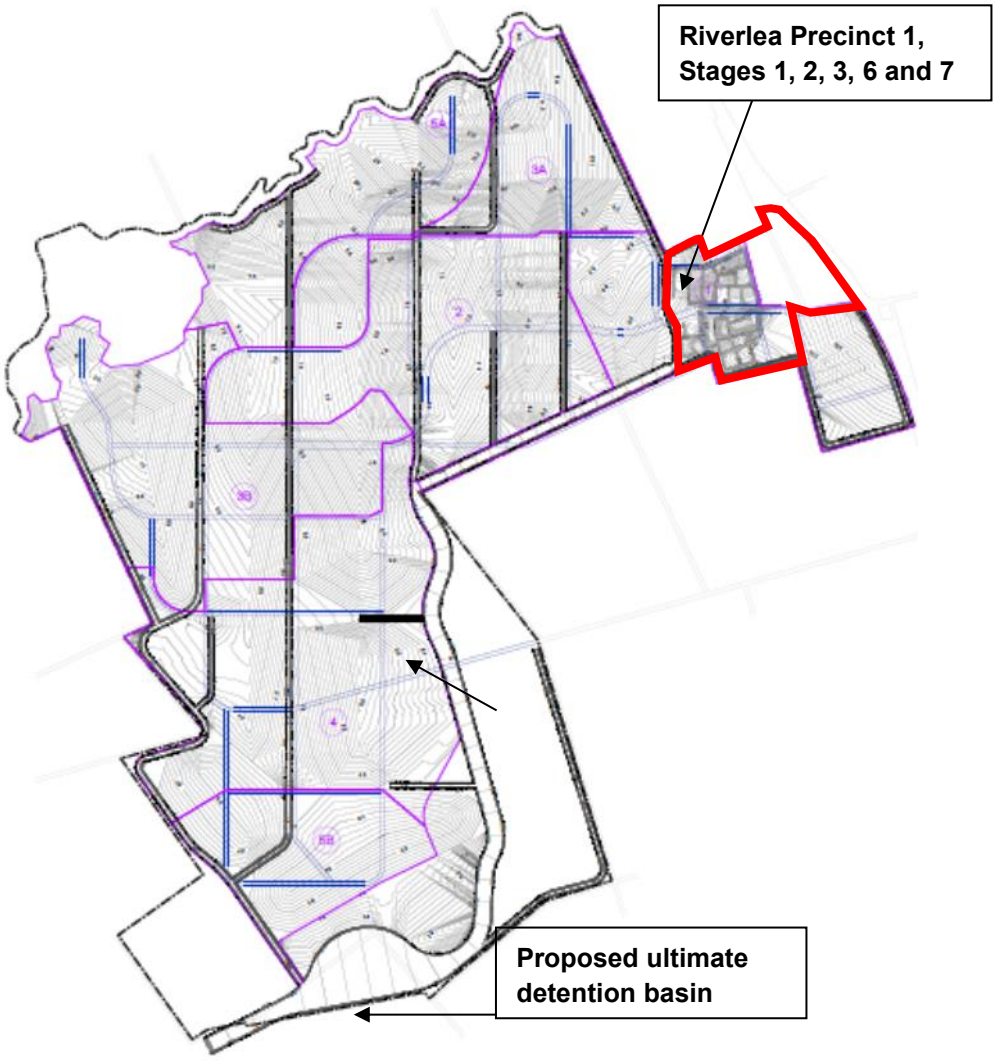


Figure 4 - Proposed Ultimate Channel System

Interim Solution

For the purpose of Precinct 1 incorporating Stage 1A and 6A, it is recommended that construction of the ultimate detention basin is not required, and an interim solution requiring a smaller proportion of channel construction is more appropriate. Figure 5 shows the proposed channel layout for Precinct 1, with the only segments to be constructed shown as Channels 1, 2 and 3.

Figure 5 - Channel Construction for Precinct 1, Stages 1, 2, 3, 6 and 7

The capacity of the channel system has been checked and deemed adequate for the worst-case flooding scenario. In this scenario, the 100-year ARI flood results from AWE's floodplain map '11002 – D057 A1 100ARI DEPTH and WSE Buckland Park 110705,' for Channel 3 and Channel 1 west of the Channel 3 / Channel 1 intersection were used. Flows in Channel 1 north of this intersection were calculated as the 100-year ARI runoff from the local development. This is considered a conservative approach given that flooding of the Gawler River will occur during long duration events, while peak runoff from the developed Riverlea Precinct will occur during a 1.5-hour event.

Restriction of Post Development Outflows

To determine whether the interim solution shown in Figure 5 is feasible, it was necessary to find whether post development stormwater outflow from Precinct 1 could be restricted to the pre-development level. In order to perform this check, the amount of runoff volume from the post development catchment for a worst case 72-hour storm during a 100-year ARI event was calculated.

Pre-development of Precinct 1 there is an approximate 260 Ha area of greenfield land that will contribute stormwater runoff to the interim channel system. Based on current land use, this area of land has an estimated runoff coefficient of 0.1. Post development of Precinct 1, there will be 29.1 ha of development also contributing to channel flow. The following catchment parameters have been applied to Stage 1 & 2A post development for an overall runoff coefficient of 0.7:

- 60% Impervious
- 10% Supplementary
- 30% Grassed

A weighted post development runoff coefficient can be applied to the whole catchment of:

$$\frac{[(260 - 29.1) \times 0.1] + (29.1 \times 0.7)}{260}$$

C = 0.17

Design storm = 72-hour, 100-year ARI

Rainfall intensity, I72,100 = 1.83 mm/h

A = 260 ha

Rainfall amount = 72 x 1.83

= 132 mm

Rainfall volume = 0.132 x 2,600,000 x 0.17

= 58,345 m3

Once the volume of rain during the worst-case storm event was calculated, the capacity of the interim channel system was attained. The typical dimensions of the channel section downstream of Precinct 1 can be seen in Figure 6. This section of relatively flat channel is 1,340m long and has an approximate depth of 2.0m at a grade of approximately 0.1%. There is also a 1.0 m deep low flow channel in the main channel invert.

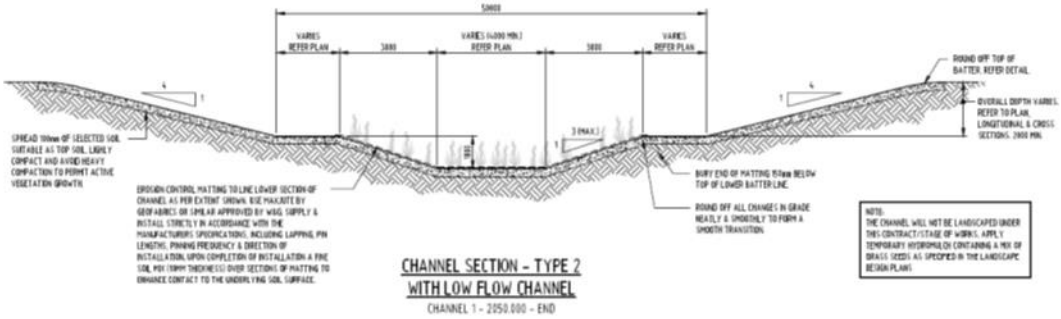


Figure 6 - Typical Channel Dimensions Downstream of Stage 1 & 2A

For a length of 1,340m and cross-sectional area shown in Figure 5, this channel section is calculated to have a capacity of 164,820m3. In a 72 hour storm during a 100 year ARI event post development, there is an estimated 58,345m3 of stormwater runoff flowing to the channel system, which would be easily accommodated within the constructed channel section to a depth of approximately 0.7m above the main channel invert. This result indicates that the ultimate detention basin is not required for the Precinct 1 development on its own and that there is sufficient attenuation provided in the open channel system to reduce the post development flows to predevelopment levels, with this main channel section connecting into Thompsons Creek.

Plantings are proposed within the channel invert to assist with water quality improvements and enhancing ecological outcomes, though the planting density and plant selection will be aimed at providing plants that will not choke the capacity of the system.

Channel Flows

In order to determine the flow in the channel segment adjacent Precinct 1, the entire Buckland Park development was separated into sub-catchments as shown in Appendix D. For the purpose of modelling, the site was considered to be entirely developed, using catchment parameters consistent with Stage 1 & 2A. Travel time for each of the catchments was determined using the kinematic wave equation:

$$t = 6.94 \frac{(L.n)^{0.6}}{I^{0.4}.S^{0.3}}$$

Where:

- t is travel time (minutes),
- L is overland flow path length (m),
- n is the overland flow path Manning's roughness coefficient,
- I is the rainfall intensity (mm/h), and
- S is the overland flow path slope (m/m).

Figures 7 and 8 show the results of DRAINS modelling for the 5- and 100-year ARI events respectively. Only channel sections relevant to this stage of works (shown in Figure 4) were considered in the model, which means only catchments contributing to Precinct 1 as well as those upstream of this Stage have been modelled. Using results from this post development modelling, low flow channels throughout the system were designed to convey runoff from storm events up to and including the 1-year ARI. These flow channels are integrated into the larger regional channels. Refer to Section 5 for further discussion relating to the low flow channels.

Channel connection to Thompson's Creek

The velocities in the main channel are very slow of the order of 0.5m/s. Post Stage 1 construction, due to the considerable amount of flood storage in the main open channel the outflows will be severely attenuated and the velocity of flow into Thompsons Creek can be expected to be significantly slower again.

No scour of significance is therefore expected at this interface, and suitable planting should be sufficient to minimise any adverse effects.

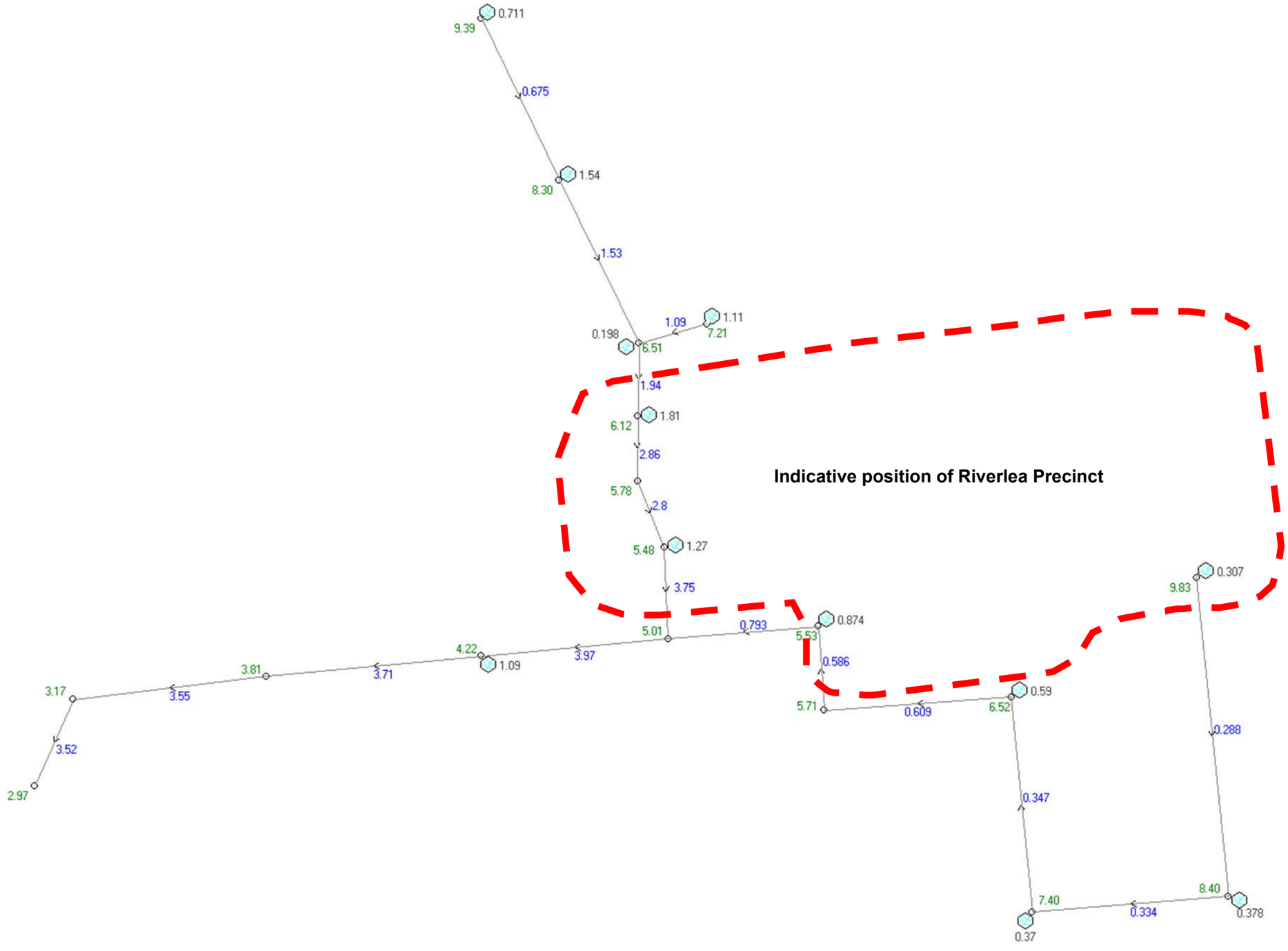


Figure 7 - DRAINS Results for 5 Year ARI Post Development

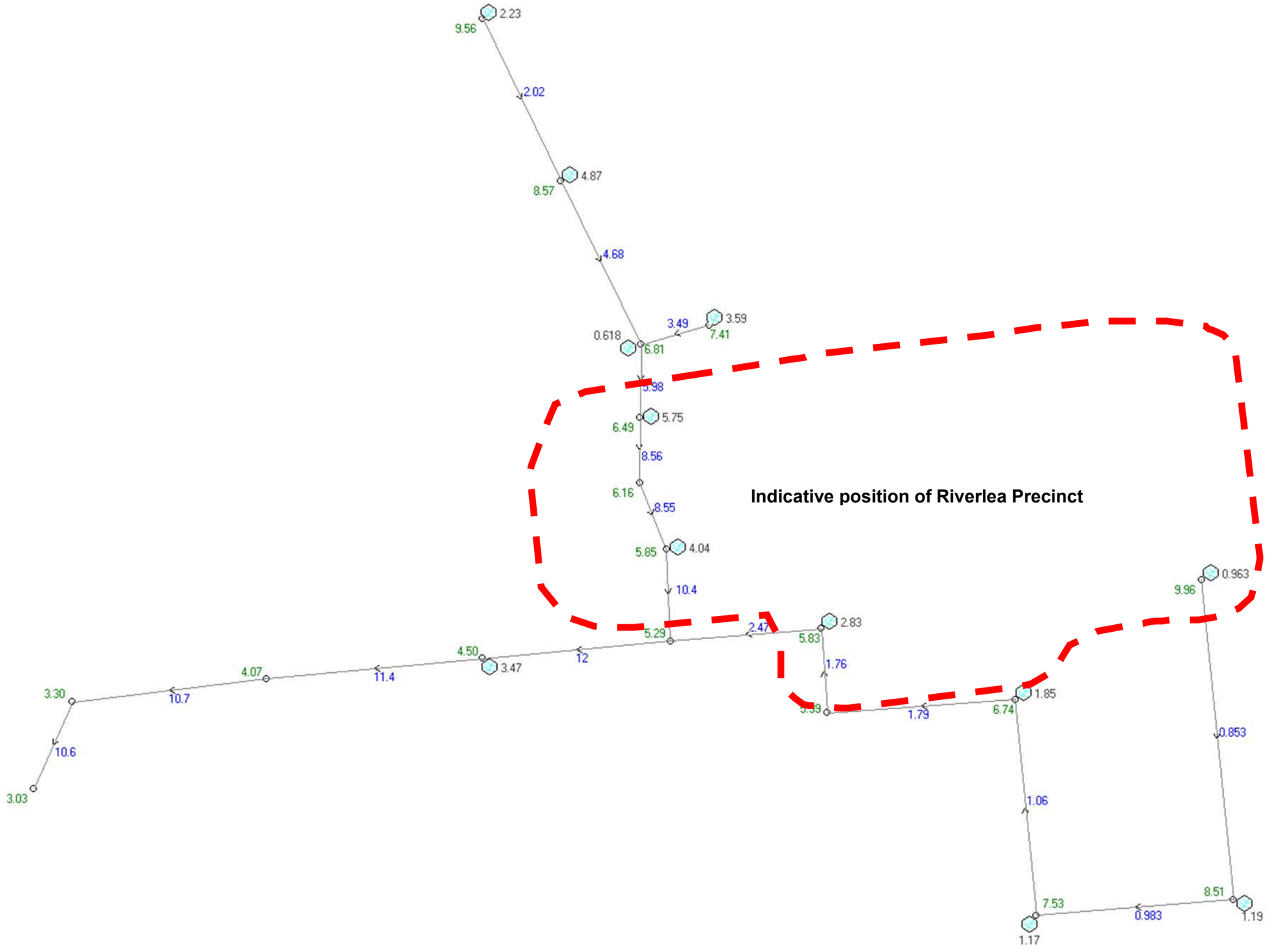


Figure 8 - DRAINS Results for 100 Year ARI Post Development

Areas contributing to the section of Channel 1 west and adjacent to Riverlea Precinct can be seen in Appendix C. For this section of channel, post development flows were attained from the DRAINS modelling results:

Maximum 5-year ARI channel flow = 3.75 m3/s

Maximum 100-year ARI channel flow = 10.4 m3/s

The channel flow rates and dimensions were used in HEC-RAS to determine the operating depth of the channel for minor and major storm events. HEC-RAS long sections can be seen in Figures 7 and 8, and from these figures the maximum water depth at different locations could be determined. The following water depths were attained at the outlets for Stage 1 & 2A within Precinct 1:

Outlet 1

- Maximum 5-year ARI channel water depth = 0.44m
- Maximum 100-year ARI channel water depth = 1.0m

Outlet 2

- Maximum 5-year ARI channel water depth = 0.51m
- Maximum 100-year ARI channel water depth = 1.18m

The water depths attained at each outlet were then set as the tailwater levels for the design of internal drainage (for respective storm events). This allows for the accurate calculation of HGL levels upstream of the outlets. Figures 9 & 10 show. This methodology will apply to the balance of stages within Precinct 1.

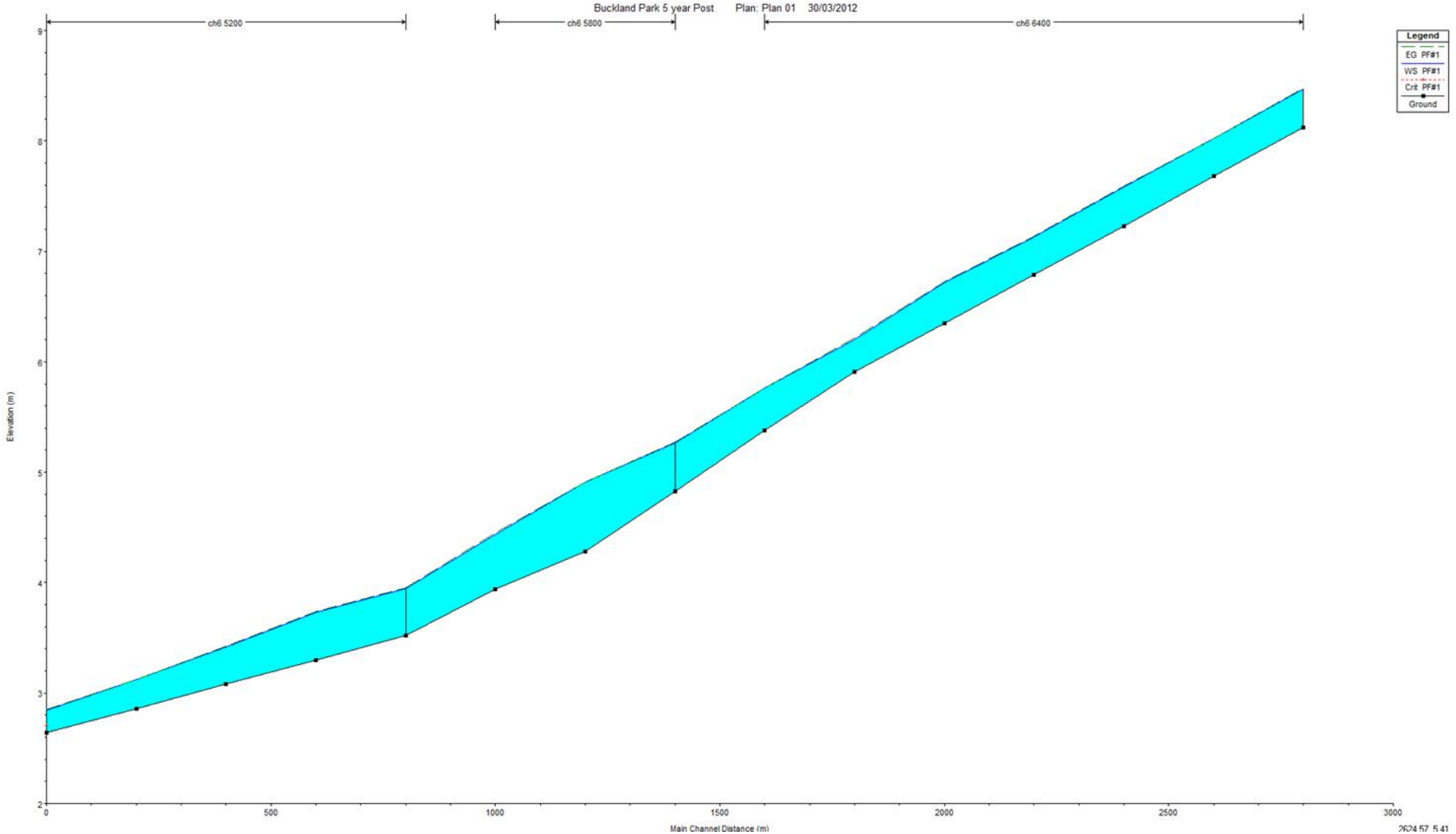


Figure 9 - HEC-RAS Long Section for Channel 1 Relevant to Riverlea Precinct 1, Stages 1, 2, 3, 6 and 7 for 100-year ARI Event

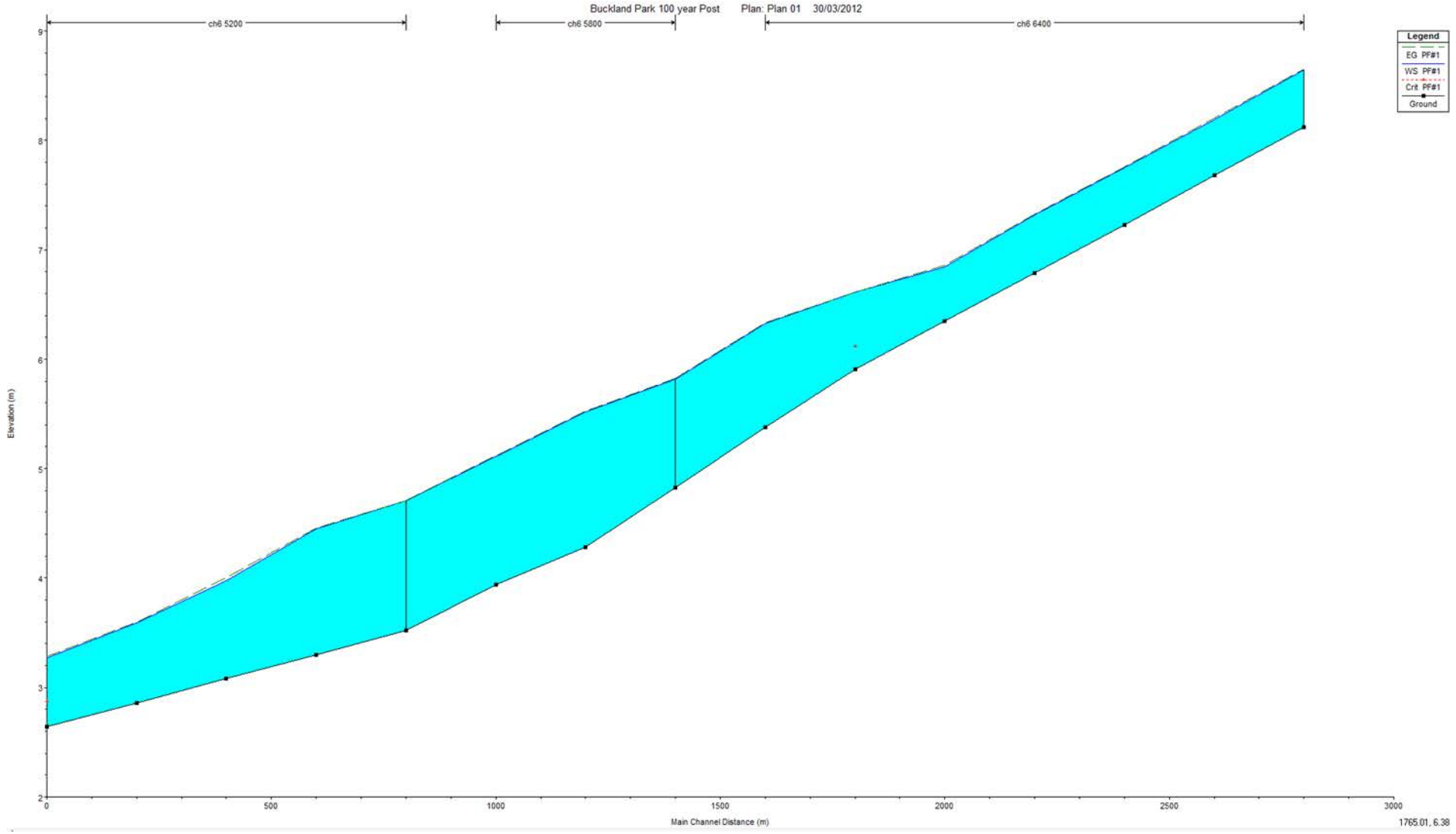


Figure 10 - HEC-RAS Long Section for Channel 1 Relevant to Riverlea Precinct 1, Stages 1, 2, 3, 6 and 7 for 5 Year ARI Event

5.3 DEVELOPMENT HYDROLOGY

ILSAX has been used to model catchment hydrology. The following runoff parameters have been selected for the purpose of stormwater modelling:

Paved (impervious) area depression storage	2mm
Supplementary area depression storage	2mm
Grassed (pervious) area depression storage	40mm
Soil type	3
Antecedent moisture condition	3 (all storms)

Catchment Parameters

Sub-catchment areas have been divided as shown in the catchment plan included in Appendix A. Stormwater runoff from Precinct 1 incorporating Stage 1A and 6A will be generated from residential allotments as well as roadways and road reserves.

In order to reflect the levels of runoff expected from areas of differing permeability, the following parameters have been applied:

- 60% Impervious
- 10% Supplementary
- 30% Pervious

A nominal 5-minute time of entry has been applied to directly and indirectly connected paved areas, and 20 minutes to grassed areas. This is considered appropriate given the typically small catchments.

Landscaped areas and road reserves, adjacent Riverlea Boulevard, have varying catchment parameters depending on their composition of impervious area.

Design Basis

The internal stormwater system was designed for the following average recurrence intervals (ARI's):

Minor storms (internal underground drainage)	5-year ARI
Major storms (overland flow)	100-year ARI

Internal Drainage Calculations and Design

Design Parameters

Minimum grade:

- Internal drainage system 0.30%
- Adjacent channel system 0.16%

Minimum pipe size:

- Reinforced concrete pipe 375mm dia
- uPVC pipe (allotment connections) 150mm dia
- Minimum freeboard (minor storm) 150mm

Internal Drainage

The underground internal drainage system has been designed to accommodate flows from a 5-year ARI storm event with no surcharging. A minimum freeboard at pits for minor storms of 150mm has been adopted so that the hydraulic grade line (HGL) is at least 150mm beneath all pit openings. The HGL has been shown in the drainage long sections provided in the drawings.

Overland flow paths were defined for the 100-year ARI storm event. Overland flow in Stage 1A and 6A has been calculated to be contained within the respective road cross sections without inundation of adjoining allotments. The minimum floor level for dwellings is also required to be 150mm higher than the top of kerb.

Internal stormwater runoff from Stage 1A & 6A is discharged at two locations into the regional stormwater channel system as indicated in Figure 11. Each outlet is proposed to be fitted with a gross pollutant trap (GPT) in order to satisfy primary stormwater treatment requirements, so that stormwater runoff is improved and pollutant transfer to receiving waters is minimised. The treatment flow for each GPT was calculated using the 3-month ARI storm event and they have been sized on this basis.

This design basis will be applicable to Stages 1B, 2, 3, 6B and 7.

Localised Soakage Pit Design

Soakage pits have been provided at two locations on the main entry road. These pits cater for localised runoff from the roadway which is directed into the median strip to prevent stormwater flows across the roadway. This junction will ultimately be converted to a signalised intersection with significant modifications to the pavement hence, the localised soakage treatments here are considered short term, say approximately 10 years, at which time the intersection will undergo significant changes.

The design of the soakage pits is based on using a conservative approach by adopting parameters that ensures that they will operate effectively. Refer to the spreadsheet provided in Appendix H. The soakage pit sizes have been based on using the following parameters:

- Soil profile – medium to heavy clay K = 1 x 10^{-7} m/s
- Storm frequency – 5-year ARI 30-minute storm volume
- Catchment area A = 80m^2

The results indicate that a soakage pit size of 3.5 x 2 x 0.5m Deep is required, with an emptying time of 0.60 day (<2 days) which is considered satisfactory.

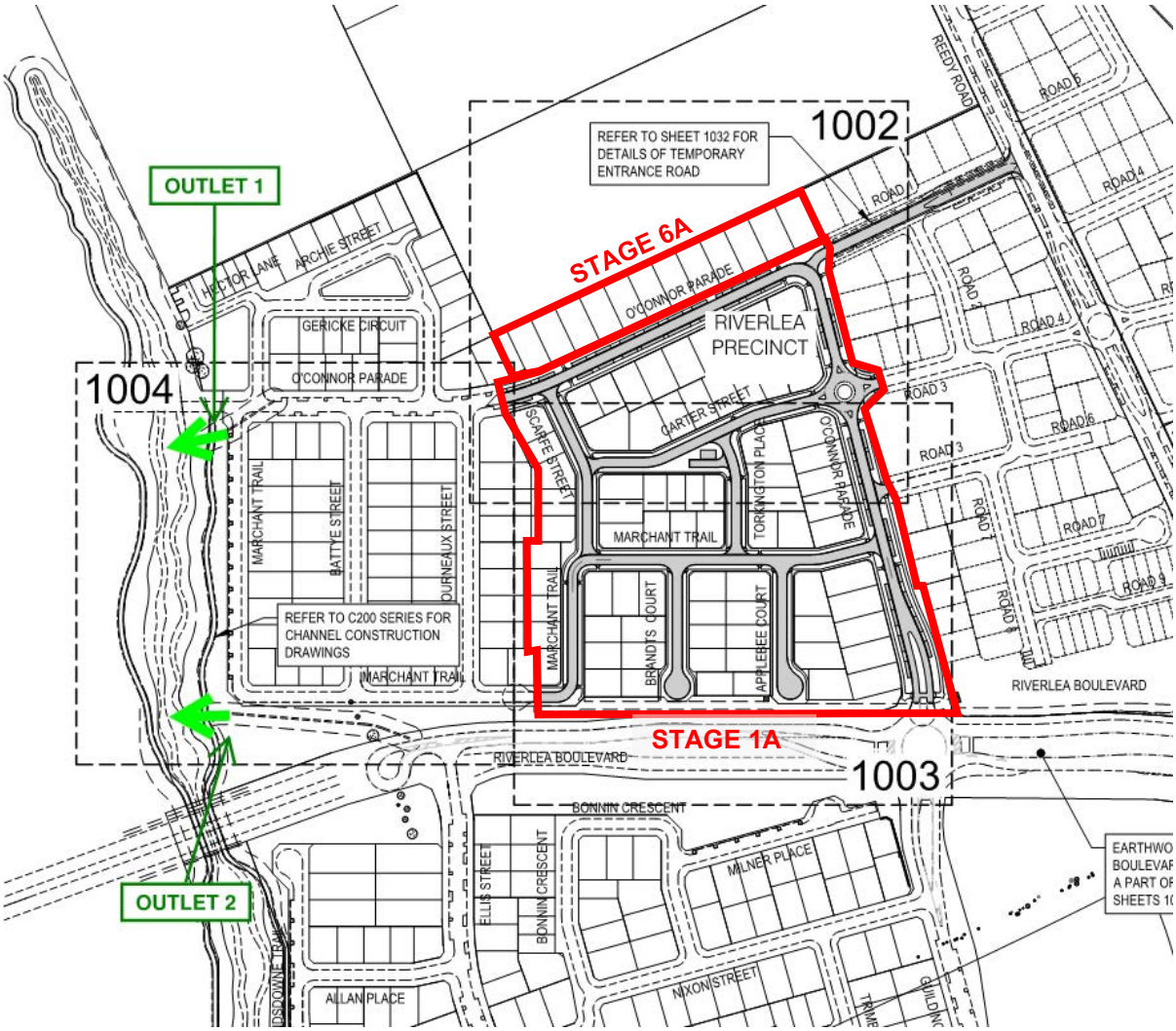


Figure 11 - Outlet Locations for Stage 1A and 6A of Precinct 1

As well as developed sub-catchments within Stage 1A and 6A, it was necessary to take into account Stage 2B and the remainder of Precinct 1 for the purposes of this Stormwater Masterplan. The grading of adjoining future stages has not yet been accurately determined, so it is not known at precisely which point outflow from these areas will enter the proposed open channel system, however the design basis is expected to be consistent with that adopted for Stage 1A and 6A which has proceeded to detailed design. . As seen in the catchment plan provided in Appendix A, areas of contingency have been allowed based on existing topography in order to account for this (i.e. the upstream catchments connecting into Stage 1A and 6A have been oversized on the basis that a road and pipe network has yet to be determined, therefore the location of the outfalls may vary to some degree)

There is a proposed lake in Precinct 1, Stage 5, adjoining Stages 1 and 6 to the west. A stub has been provided in order to collect overflow that might occur from the lake, however it is not expected that this overflow will occur at the same time as the peak internal runoff and as a result will not impact on the capacity of the system.

Outlet 1 as indicated on Figure 2 is a 1200mm diameter reinforced concrete pipe (RCP) required to convey a maximum 5-year ARI outflow of 1.9m^3/s. The 3-month ARI flow through the outlet is 605 L/s and is the design treatment used to size the GPT.

Outlet 2 as shown on Figure 11 is a 600mm diameter RCP required to covey a maximum 5-year ARI outflow of 435 L/s. The 3-month ARI flow through the outlet is 290 L/s and is the design treatment flow used to size the GPT.

Appendix B includes the detailed DRAINS network for Stage 1A and 6A, with peak flows through each pipe run and HGL levels at pits. This methodology will be consistent with the balance of Precinct 1.

5.4 REVIEW OF PREVIOUS MODELLING

A review of the previous DRAINS modelling (outlined above) indicated that the minor layout changes to the Riverlea Precinct, since the previous revision of this report, will have a minor impact on the stormwater design.

The existing model has been updated to the latest version of DRAINS. By doing so, the previous design has now been modelled against updated guidelines and parameters, including updated 2016 BOM IFD data and curves.

Key findings from this review include:

- The mixed-use precinct catchment area, which is now incorporated into Precinct 1 as Stage 7, was previously modelled with an impervious area percentage of 60%
  - This is considered conservative as it represents the impervious catchment percentage typically used to model residential catchments
  - Based on the above, previous modelling undertaken has assumed residential development at the mixed-use precinct, and therefore the Stage 7 residential land division will not change modelling results
- The Stage 2 and Stage 3 layouts have not been changed since the previous revision
- In the existing DRAINS model, concrete pipes have been modelled with a manning's roughness coefficient of 0.015
  - DRAINS typically utilises a default manning's roughness coefficient of 0.2
  - Therefore, the existing DRAINS model is relatively conservative
- An updated revision of the existing DRAINS model reveals that flows are safe in the minor and major flow events
- Therefore, it is considered the previous DRAINS model can be considered fit for purpose for this report and strategy.

6 WATER SENSITIVE URBAN DESIGN

6.1 STRATEGY

The implementation of a water sensitive urban design (WSUD) strategy is based on the following considerations:

- Selection of techniques that suit the site's physical, climatic and environmental setting
- Selecting techniques that are robust and sustainable, and therefore will suit the water regimes
- Locating techniques such that they are maintainable
- Development of a strategy that is integrated within the site, and contributes to deliver multi-objective outcomes for the development

Further discussion about the WSUD is outlined below and in this Section.

The overall WSUD and water quality management strategy has been based on the inclusion of the following key elements into Precinct 1 of the development, noting that detailed design has been progressed for Stages 1A and 6A of Precinct 1:

- Gross pollutant traps at major stormwater outlets.
- Integration of vegetated swales for localised sub catchments
- Linear ephemeral wetland pools which have been incorporated into pool and riffle sequences within the low flow channels of the larger regional drainage channels.
- Design the regional channels to incorporate naturalistic waterway design principles. (See further information below with regards to the multi objective approach)

The key WSUD design features for the development is the design of the regional drainage channels. Their design adopts a multi-objective approach within the development to incorporate functions that go beyond flood conveyance. These are summarised in the following points:

- The design adopts a landscape design approach that aims to enhance existing environmental values while adding to create new habitat opportunities through restoration and revegetation using local indigenous species.
- Development of wetland habitat pools into the low flow channels and riparian areas along the regional drainage channels to enhance their function as habitat, biodiversity and ecological corridors.

- The integration of the above features into passive recreation uses for the community through the inclusion of share path networks and linkages.
- Avoiding the direct connection of stormwater drainage systems into existing waterways downstream of the development by limiting the number of outlets and locating these at treatment pools within the regional channel. These outlets have been designed with rock and plantings to reduce their visual impact and prevent erosion.
- The regional drainage channels have been designed to operate as living ephemeral streams through the incorporation of design features that mimic natural waterways. Such design features include;
  - Incorporation of pool and riffle sequences within the low flow channels which facilitate stormwater treatment from the development.
  - Creating batters of varying slopes.
  - Ensuring velocities are managed appropriately to prevent bed and bank erosion.
  - Revegetation to facilitate filtering, sediment deposition, nutrient uptake and while also providing opportunities for habitat and visual amenity.
  - Inclusion of porous rock riffles which aim to allow stormwater to be released from the online wetland pools at a slow rate in order to facilitate treatment while reducing risks associated with mosquito breeding.

The functionality of the online wetland pools is discussed in detail in Section 5.2. The treatment performance of the online wetland pools and other associated WSUD elements are presented in Section 5.4. A general layout plan showing the location of the treatment wetland pools together with the WSUD strategy is provided in Appendix F.

Ephemeral Wetland Treatment Pools

A series of online ephemeral wetland pools have been designed and integrated as part of the low flow channels which are within the regional drainage channels. These pools are densely vegetated shallow water bodies of 200 to 300mm depth that provide treatment of urban stormwater from the development. Their treatment function provides enhanced sedimentation, fine filtration, adhesion and biological uptake, and chemical processes to remove pollutants from urban stormwater.

The online pools consist of a macrophyte zone which is a shallow densely vegetated (reed bed) which is wide and shallow. The pools are controlled by a porous rock riffle which allows water to be held within the pond for a sufficient duration to facilitate treatment. These riffles are porous, in that they have been designed to incorporate an open rock structure to allow seepage through the voids, which provides a detention time of approximately 4 to 10 hours for each pool. The pools lie in succession along the channel and therefore a total detention time of approximately 2 to 3 days is provided which follows the principles of wetland design. It is expected that the pools will dry out following the emptying time.

The porous rock riffle designs offer an effective and sustainable means of controlling water levels within the pools using an informal approach. The riffles are of a robust design comprising of an open graded rock matrix along the crest to facilitate seepage, while the base or apron will comprise of a densely well graded matrix of rock which is held into position by a row of toe rock (rock key which anchors the riffle) to prevent downstream migration of rock.

The wetland systems will dry out seasonally which mimics natural flood plains. Such systems are considered to be highly biologically productive that provide habitat and ecological value within an urban setting.

As the wetland pools are located online, treatment effectiveness is limited by the ability of the pools and vegetation to entrain pollutants and assimilate them to prevent transfer downstream. In this regard it is necessary to ensure that the 100-year storm flow velocity through the regional drainage channel resulting from a major flood within the Gawler River catchment is not in excess of 0.5m/s. This follows the recommendations contained in the "Constructed Wetland Guidelines – Melbourne Water, April 2010". The guidelines suggest that the flow velocity during the major storm flow should not exceed 0.5m/s for online systems to avoid the removal of trapped pollutants to downstream environments. This design requirement has been checked using Mannings equation for normal flow and Hec ras hydraulic river model, and it has been confirmed that the requirement is met. Further to this point, given that the maximum velocity does not exceed 0.5m/s, there is no risk associated with erosion along the channel and loss of plantings.

Sedimentation processes associated with coarse particles within the low flow channel / online pools is expected to occur upstream of the treatment systems. Coarse sediments that may enter the regional channel at the upstream of the development from the broader Gawler River catchment are expected to drop out of suspension quickly as a result of deep flow and low velocity. Coarse sediments require velocities not exceeding approximately 0.8m/s to settle out of suspension. Once they are entrained into the bottom of the main channel, it is expected that they cannot be re-entrained into the flow due to the low velocities of less than 0.5m/s. As is the case with similar regional channels and constructed urban wetland systems, it is envisaged that the channel and online pools will require dredging of sediments and removal of decayed vegetation at approximately 20-year frequencies. This process is not uncommon for vegetative stormwater treatment systems within an urban setting.

It is noted that there are two groups of pools that are located on the upstream and downstream side of the main road bridge crossing. These pools have been designed using similar principles as per other ephemeral wetland pools, however they differ in that they incorporate a pool storage volume that is semi-permanent. Council have raised a concern with regards to the potential for these pools to create favourable conditions for mosquito breeding.

It is expected that these pools will dry out, however as the water level drops, it is expected that groundwater intrusion will replace the stormwater and hence maintain aquatic fauna. Mosquito control is reliant upon maintaining a healthy population of aquatic fauna. Hence it is concluded that a permanent water body that is maintained by groundwater and stormwater can provide an environment whereby aquatic fauna can survive and provide a natural means of control.

Gross Pollutant Traps

There are two gross pollutant traps (GPT) proposed, located at each of the two outlets for Stage 1A and 6A with this methodology to be applied for all future outlets into the open channel system. Details of the gross pollutant traps proposed for use in this stage can be found in the associated Stage 1A and 6A drawings. These GPT will provide an effective means of pre-treatment to trap debris and coarse sediments prior to entering the downstream system.

6.2 MODELLING AND RESULTS

This section summarises the water quality simulation carried out using MUSIC software and compares the outcomes to the EPA Water Policy and WSUD treatment guidelines for pollutant reduction targets as defined in the WSUD Guidelines for the Greater Adelaide Region (2013).

MUSIC modelling is utilised to conceptually confirm the required surface areas of the wetland treatment pools to ensure that the treatment requirements can be met from for the development of Precinct 1. Refer to Appendix E showing the extent of the modelled catchment that is covered within

the MUSIC model. The extent of modelling includes future stages beyond Stage 1A and 6A which ensures that this strategy considers the ultimate development of Precinct 1.

MUSIC version 6 has been used to assess the performance of the design. The model layout has been included in Appendix E and shows that adjacent / future catchments have been included in the model to provide proof of concept that the treatment strategy will accommodate the immediate adjacent future stages of development.

MUSIC Software

MUSIC is the Model for Urban Stormwater Improvement Conceptualisation, developed by the CRC for Catchment Hydrology in Victoria. MUSIC provides the ability to simulate both quantity and quality of runoff from catchments ranging from a single house block and urban areas up to many square kilometres, and the effect of a wide range of treatment facilities on the quantity and quality of runoff downstream. MUSIC predicts the performance of the stormwater quality management systems.

This simulation is based on an assessment of the treatment systems required for the development of Stages 1A and 6A. Preliminary pool sizes were developed using first design principles for wetland design, and this formed the basis for testing and modelling in MUSIC to ensure that the space requirement for treatment can be met for the development.

MUSIC Modelling

Stage 1A and 6A development characteristics and parameters have been entered into the MUSIC model based on the sub catchments. Refer to Appendix E for screen output of the model showing catchment nodes and treatment systems graphically displayed. The treatment elements of the system, including gross pollutant trap, vegetated swales and ephemeral wetland pools are all included in the model as per their adopted design configurations shown on the design drawings. MUSIC model uses climatic data comprising of daily rainfall interval and evaporation data from Edinburgh RAAF from 1979 to 2010. This data is used to simulate the rainfall runoff on site and the subsequent treatment performance for the development. The results and outcomes are in this Section.

The parameters entered into MUSIC model for the source and treatment nodes are summarised in Table 5. The table is not intended to provide details of each node within the model, instead it provides a general overview of the typical parameters used for the source and treatment nodes. It this case the source nodes are represented by “urban nodes”, and the treatment nodes are represented by, gross pollutant trap, vegetated swales, and wetland ponds.

Table 5 - MUSIC Modelling Parameters

Node Types	Parameters				
Urban	Soil storage capacity 40mm	1 mm depression storage	Typical impervious fraction 60%	Stochastically generated pollutants	Initial storage capacity % of capacity 30%
Treatment	**Parameters**				
Low Flow Swale	Gradient 0.2%	Vegetation height 250mm	Base width varies 3 to 20m	Infiltration loss 3mm/hr	Batter 1 in 3 Depth 0.6 to 1.0m
GPT	Treatment flow to the 3-month ARI	TSS removal rate 70%	TP removal rate ZERO	TN removal rate ZERO	Gross pollutant removal rate 90%
Online wetland ponds	Typical surface area 200 to 300m^2	Permanent pool volume 0m^3	Extended detention depth 200 to 300mm	Infiltration loss 0.36mm/hr	Detention time in the range of 30 to 45 mins

Treatment Requirements

The design of the site treatment system aims to treat stormwater in accordance with the standards as defined by:

The South Australian EPA water quality policy WSUD targets

WSUD best management practice pollutant reduction targets as defined in the WSUD Guidelines for the Greater Adelaide Region

The pollutant treatment criteria are presented in Tables 3 and 4 which have been compared to the simulated results using MUSIC.

Stormwater Quality Simulation Results

The results presented in this section demonstrate water quality compliance in accordance with the target values specified. These are assessed against the standards defined in the tables below. These standards were entered into the model to enable a direct comparison to be made. The results have been reported at the downstream node located at the development stage boundary.

Based on the EPP Water Quality limiting concentrations, the model results are presented in Table 6 and compared to the target values.

The results were also compared to the WSUD Guidelines for the Greater Adelaide Region, which are based on recognised Australian best practice. These are presented in Table 6 along with the results achieved.

Table 6 - Water Quality Results Compared to Best Practice Standards

Pollutant Type	TP	TN	TSS	Gross Pollutants / Litter
Target percentage reduction (%)	60%	45%	80%	>50mm and retention in 3-month ARI
Pollutant reductions achieved (%)	71	53	87%	100% trapped (averaged over the simulated period

The results summarised in Table 6 demonstrate that the suspended solids, TP and TN reductions will meet the required performance criteria. Whilst other pollutant loads are not considered due to the limitations of MUSIC, the software assumes that other pollutants would be effectively removed and or treated. The rationale is based on the premise that very fine pollutants are attached to other particulate pollutants such as phosphorous (TP) and total suspended solids (TSS). Therefore, while targeting TP and TSS, it is reasonable to expect that many more pollutants are in fact being removed, trapped and or treated.

In summary, the resultant pollutant concentrations attained from the simulations revealed that each fall within the average (mean) limits set by the EPA in South Australia in addition to complying with the best management performance targets set in the referenced codes and guidelines Therefore the design of the site treatment system is satisfactory in terms of meeting the required performance limits of pollutant concentrations.

6.3 REVIEW OF PREVIOUS MODELLING

A review of the previous MUSIC model has been undertaken as part of the latest revision of this report. Key findings from this review include:

- Utilising the same design methodology and strategy as outlined, the stormwater quality requirements for the precinct are expected to be met
- The review indicates that the mixed use precinct, now Stage 7 resdiential, catchment area has been modelled using a residential node with 60% impervious area
  - This is a conservative approach given mixed use precincts typically have much larger pervious areas
  - The previous model assumed residential development at the Stage 7 site.
- MUSIC modelling parameters have been updated to reflect current modelling practice with regards to:
  - TP target is 60%
  - GPT assumes no nutrient removal from the CDS GPT
  - The results indicate compliance to pollutant reduction targets
- Therefore, the previous MUSIC model is deemed up to date with current standards within the latest revision of this report

6.4 MANAGEMENT OF SEDIMENT LOADS

Land Division Construction Phase SEDMP

During the construction phase of the development a Stormwater, Erosion and Drainage Management Plan (SEDMP) shall be implemented in accordance with the Environment Protection Act 1993. A plan has been prepared to meet the requirements in accordance with the Code of Practice for the Construction and Building Industry (1999). Refer to Appendix G. This plan is submitted as part of the Engineering approval process attached to this report.

The SEDMP encompasses surface stormwater management practices that shall be implemented during the construction phase by the constructor. The SEDMP provides a guide to the constructor to plan site management measures that should be implemented in order to prevent sediment and pollutant exports during the construction stages. Whilst the site's conditions will change as the construction progresses, it is the environmental duty of the constructor to ensure that the site SEDMP is progressively maintained and upgraded to suit changing site conditions and stages of construction.

The SEDMP has been prepared to include several techniques to be implemented during the land division construction phase. Typical techniques include (but are not be limited to), sediment traps / basins, silt fences, diversion swales to control site flow, single site access point with shaker pad and other measures as deemed necessary. It is noted that the SEDMP will not be limited to the adoption of sediment basins within the regional channels, the SEDMP will require a sequence of management techniques to work collectively. The Contractor shall consider other techniques that form part of the strategy within the SEDMP. This includes:

- The minimisation of cleared land to minimised exposure to wind and rain
- Focussing efforts on minimising soil loss through erosion
- Techniques to minimise the generation of airborne dust

It should be noted that the proposed in-line pools within the channels will be constructed during the early phase of construction and can function as a sediment capture basin during the major earthworks and roadwork construction phases. In this regard these will ensure that all site generated runoff will pass through the pools prior to discharge downstream from the development. Upon completion of the development works, these pools will be reinstated in accordance with the design documentation to ensure that their ultimate design function of stormwater treatment is restored in accordance with the design intent.

The SEDMP will form a key component of the constructor's environmental management plan (CEMP) that will be developed prior to construction.

Post Land Division Construction Phase SEDMP (Private House Building Phase)

It is widely acknowledged and understood that sediment loads and debris resulting from individual house building can be quickly conveyed via the stormwater network. These pollutant loads can be significant. However, the amount of pollution generated by individual house builders is highly dependent upon their level of compliance to the EPA Codes of Practice for building sites.

The SEDMP has been developed to provide provisions to manage this issue to ensure that the impacts during the house building phase are appropriately addressed to prevent downstream impacts. In this regard, the provisions include:

- Gross pollutant traps on the two major stormwater outlets into the regional channel. These will trap debris and coarse sediment.
- Sedimentation traps located at each of the two stormwater outlets into the regional channels. These will trap medium to finer sediment.

The sediment traps should remain functional for a period of time not less than to the equivalent of 70% of the houses completed or as advised by Council. Upon this timeframe, the sediment traps should be removed, and the channel should be reinstated in accordance with the design documentation.

Dust Control

During the land division construction phase of the development an Environmental Management Plan (EMP) will be prepared by the constructor and implemented in accordance with the Environment Protection Act 1993 and its associated regulations (2009). The plan shall also be prepared to meet the requirements in accordance with the Code of Practice for the Construction and Building Industry (1999).

The contractor shall implement measures to minimise and manage nuisance issues associated with the mobilisation of dust resulting from earthworks and construction activities undertaken on site as part of the land division construction phase. Measures to control dust shall be implemented and maintained at all times. Measures will include but not be limited to the following:

- Minimise the area of land that is cleared and exposed to wind any given time during the construction phase.
- Perimeter dust filter screen attached to fencing.
- Covering stockpiles with mulch.
- Maintain adequate moisture levels to all site access tracks and earthworks areas.
- Adopting a proactive approach to dust control by remaining informed of forecast weather conditions and preparing strategies in advance of high-risk days.
- Hydro seeding areas left exposed for periods of time.

Refer to the SEDMP provided in Appendix G for Stage 1A and 6A of Precinct 1. The same methodology will be extended for the balance of Precinct 1.

Post Land Division Construction Phase Sediment Loading

In consultation with approval authorities, concerns have been raised in relation to the absence of a sedimentation basin to trap sediments from the local catchment (Buckland Park development). Sediment loads have been estimated and used to assess the potential depth of sediment expected to accumulate within the ephemeral wetland pools over time.

Sediment loads from developing and established catchments can vary significantly depending upon a number of factors. According to the widely adopted text “Managing Urban Stormwater, Soils and Construction, Landcom NSW (2006), a developing catchment can be expected to discharge between 50m3/ha and 200m3/ha of sediment each year. In a developed catchment, the annual sediment export is generally one to two orders of magnitude lower with an expected mean annual rate of 1.60m3/ha. These rates are adopted as standard practice in NSW.

Therefore, it is acknowledged that these loading rates are based on the climatic conditions experienced along the east coast of Australia where higher rainfall intensity and annual totals vary considerably from local conditions in Buckland Park. It is envisaged that these rates would be lower for South Australian conditions.

For the purpose of this exercise, we have adopted a loading rate of 1.60m3/ha, while acknowledging that this rate is based on conditions experienced along the east coast of Australia and is therefore expected to provide a conservative estimate. The calculation of estimated potential sediment load and depth along the regional channels is outlined below.

Catchment area = 29 Ha

Sediment loading rate = 1.60m^3/ha/a

Volume of sediment / annum = 46m^3

Length of channel in Stages 1 and 2A = 1500m

Annual depth of sediment accumulation (assuming uniform distribution) = 5mm

Estimated depth accumulation in 5 years = 25mm

These estimates are only intended to provide a guide only.

6.5 REVEGETATION GUIDE - PLANTING LIST

A study report prepared by EBS Ecology titled “Buckland Park Significant Environmental Benefit (SEB) 5 Revegetation Management Plan, September 2012” has been prepared to define the vegetation communities to be incorporated into the regional drainage network. The aim is to establish a functioning ecosystem while also meeting the requirements of the Native Vegetation Council to provide SEB offset areas associated with the residential development. The Development open space areas will be subsequently revegetated with a range of indigenous flora species that will contribute to improvement of biodiversity values in the regional landscape.

The revegetation of the regional channels and ephemeral pools are intended to provide a vegetation community of native vegetation that aims to restore pre-European ecosystems and biodiversity. The revegetation management plan sets out the vegetation communities for each zone associated with the regional channels. These zones generally correspond to the water regimes and aspect associated with the channels.

The following species lists in Tables 8 to 11 have been provided by EBS Ecology for each vegetation zone. These are intended to provide general information only.

Table 6 - Revegetation Species Aquatic Zone

Stratum	Species Name	Common Name
Understorey <1m	*Bulboschoenus caldwellii*	Salt Club Rush
	Cyperus gymnocaulos	Spike rush
	Cyperus vaginatus	Stiff Flat-sedge
	Juncus kraussii	Sea Rush
	Juncus subsecundus	Finger Rush
	Muehlenbeckia florulenta	Lignum
	Phragmites australis	Common Reed

Revegetation within the aquatic zone has been designed to re-establish reed bed / sedgeland vegetation within the aquatic and riparian zones. These zones will become self-regulating over time based on seasonal variation.

Table 7 - Revegetation Species for the Riparian Zone

Stratum	Species Name	Common Name
Understorey <1m	*Atriplex paludosa* ssp. *cordata*	Marsh Saltbush
	Atriplex semibaccata	Berry Saltbush
	Chenopodium pumilio	Small Crumbweed
	Disphyma crassifolium ssp. *clavellatum*	Round-leaf Pig-face
	Einadia nutans	Climbing Saltbush
	Enchylaena tomentosa var. tomentosa	Ruby Saltbush
	Maireana aphylla	Leafless Cotton-bush
	Maireana brevifolia	Short-leaf Bluebush
	Rhagodia candolleana	Sea-berry Saltbush
	Suaeda australis	Austral Sea-blight
	Threlkeldia diffusa	Coast Bone-fruit
	Vittadinia cuneata	Fuzzy New Holland Daisy

Riparian - is intended to provide a buffer of 1-2m around the aquatic zone which will allow some self-transitioning of the vegetation dependent on seasonal flows and storm events. These will not significantly reduce flow rates of the drainage network. These shrubs will provide increased habitat values for small birds and reptiles while also outcompeting alien species which are expected to invade from storm water transport and upstream run-off flows.

Table 8 - Revegetation Species List for Upper Slope Zone

Stratum	Species Name	Common Name
Understorey <1m	*Austrostipa scabra*	Spear Grass
	Themeda triandra	Kangaroo Grass
	Aristida behriana	Brush Wire grass
	Chloris truncata	Windmill Grass
	Rhytidosperma setacea	Wallaby Grass
	Rhytidosperma caespitosa	Wallaby Grass

Upper Slopes - include the banks from the riparian zone to the top of the bank.

Table 9 - Revegetation Species for Buffer Zone

Stratum	Species Name	Common Name
Overstorey	*E. camaldulensis* var. *camaldulensis*	River Red Gum
Small trees / large shrubs >1m	*Acacia pycnantha*	Golden Wattle
	Pittosporum angustifolium	Native Apricot
	Callitris gracilis	Southern Cypress Pine
	Dodonaea viscosa ssp. *spatulata*	Sticky Hop-bush
Understorey <1m	*Aristida behriana*	Brush Wire-grass
	Atriplex semibaccata	Berry Saltbush
	Rhytidosperma setacea	Small-flower Wallaby-grass
	Chloris truncata	Windmill Grass
	Convolvulus remotus	Grassy Bindweed
	Dianella brevifolia	Black-anther Flax-lily
	Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush
	Maireana brevifolia	Short-leaf Bluebush
	Rhagodia parabolica	Mealy Saltbush
	Themeda triandra	Kangaroo Grass

Buffers- will serve important ecological functions in the drainage network. Primarily, it will act as an amenity for the drains with this section providing a break in the flat landscape and greening the site significantly. It will also serve as a buffer for weed invasion with the natural mulched surface being readily maintainable for weed management.

7 CLIMATE CHANGE

The CSIRO report titled "Climate Change in South Australia" is one of a number of publications that considers change to rainfall patterns. It presents a view that the average rainfall is likely to reduce but intensities of individual storms increase only marginally. These effects have been considered in the planning and design phases of the development.

The effect of climate change will have two potential impacts on the SMP, as follows:

- Sea level rise will influence the water levels in the regional flood conveyance channels and accordingly the hydraulic design for new infrastructure. The design has taken this into account by adopting higher ‘tail’ water conditions at the coastal outfall as adopted in the Gawler River Floodplain Mapping Study undertaken by Australian Water Environments.
- Rainfall (temporal) pattern variations will impact on regional hydrology and consequently stormwater harvesting. However, it was noted that the rainfall intensities are not expected to increase, whereas the frequency of large events may do so.

8 IMPLEMENTING THE STRATEGY

8.1 PRIORITIES AND TIMEFRAMES

The staging of the works will depend on the timing of land releases into the future. It is anticipated that the overall development will have a completion timeframe in the order of 20 to 30 years.

The key priorities for Precinct 1, are based on achieving the key objectives outlined in Section 4 of this report. In this regard these are:

- Flood protection from local catchment and regional catchment (Gawler River). The release of stormwater to pre-development flow rates to the Thompson Creek outfall channel.
- Water Quality management from the current land release to meet the required standards defined in Section 6
- Water reuse to be addressed in future precincts as there will be insufficient runoff from Precinct 1 alone to justify and stormwater harvesting and reuse scheme.
- Environmental Protection and Enhancement by using a multi-objective approach to stormwater management such that it contributes to the delivery of this objective.

The scope outlined in this report sets out to deliver these priorities. It is intended that all subsequent land releases will set to deliver the same objectives set for Stages 1A and 6A of Precinct 1.

Assuming that the timing of future land releases is not a limiting factor, we would anticipate the following key stormwater infrastructure elements could be implemented within the sequence and timeframes as outlined below:

- Year 2013 – Stages 1A and 6A
  - Channels 1, 2 and 3
  - In-channel treatment systems to service Stages 1A and 6A including immediately surrounding future land releases located directly adjacent to Channels 1, 2 and 3. Refer to Appendix E for the catchment plan used for the MUSIC model
- Years 2020 to 2035 – Extensions to the network of regional flood conveyance channels with integrated online treatment systems
- Year 2025 – Detention basin and wetland downstream of Buckland Park at connection with Thomson Creek outfall channel. Further modelling work is required to determine the likely timing for this basin which will largely depend on the rate of development.

These works are discussed in more detail in Sections 8.2 and 8.3.

8.2 INTERIM WORKS

The interim works relate to permanent stormwater infrastructure elements that will be constructed as part of Stage 1A and 6A works. These works include:

- Stormwater drainage infrastructure associated with the road network to collect and convey runoff to the regional channel at two outlet points.
- Regional drainage channels 1, 2 and 3 as discussed in Section 5. The extent of channel will provide flood protection to Stages 1A and 6A and the entire Precinct 1. The extent of works is shown in Figure 7 in Section 5.
- Stormwater treatment systems integrated into Channels 1, 2 and 3 as discussed in Section 6 of this report.

8.3 FUTURE WORKS

Ultimately the full extent of regional channels proposed will provide flood protection to all subsequent developed stages of Buckland Park. Further studies will be required to determine the staging of future drainage requirements and their timing.

An additional Ephemeral Treatment Pool will be required at toward once the Precinct 1 development begins on the western side of Channel 1 as shown in the plan in Appendix E.

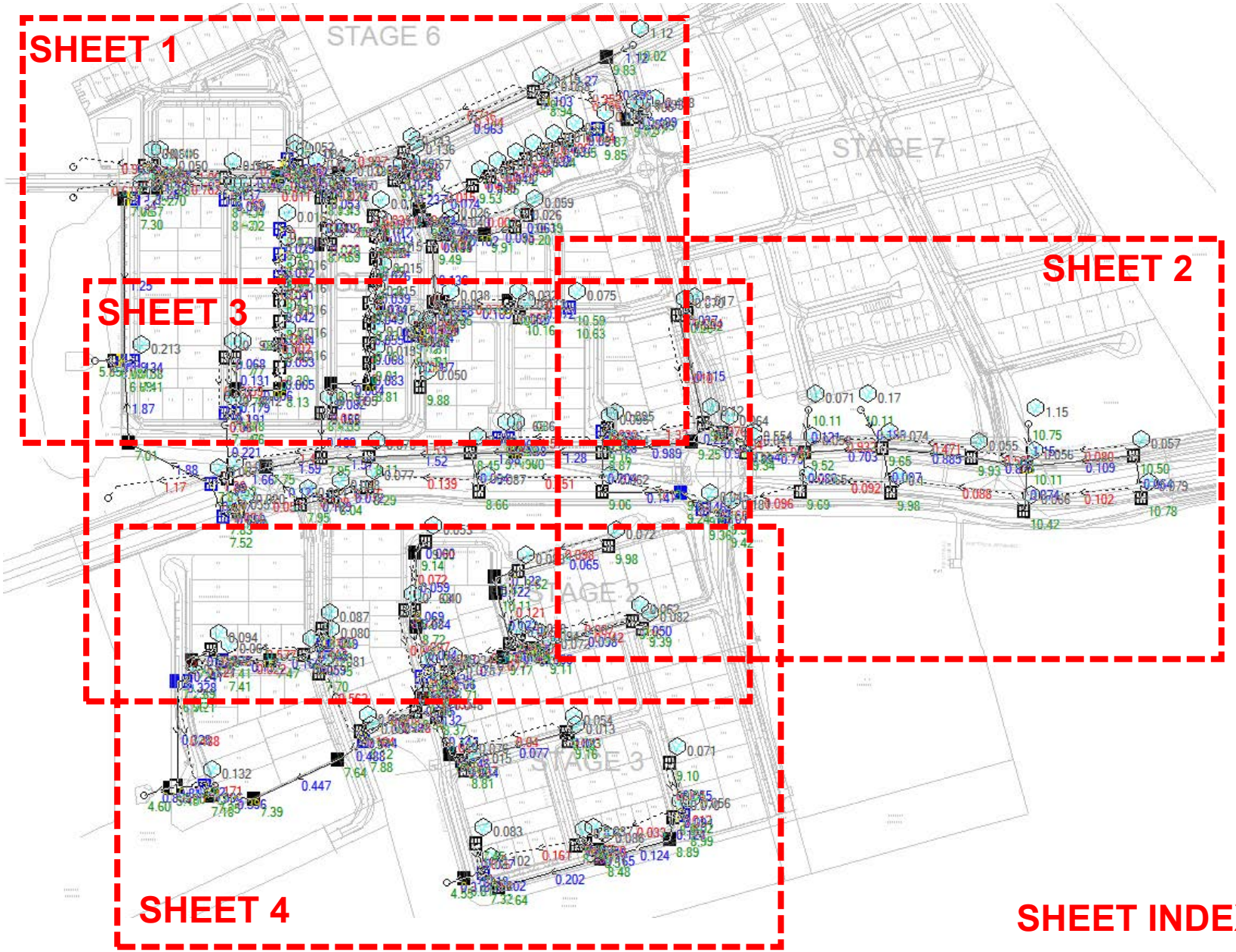
APPENDIX A

CATCHMENT PLAN

69,680 m²
(Including contingency below)
27,000 m²
(Including contingency below)
AREA ADDED TO NORTHERN & SOUTHERN CONNECTIONS AS A CONTINGENCY
AREA ADDED TO NORTHERN & SOUTHERN CONNECTIONS AS A CONTINGENCY
80,000 m²
(Including contingency above)
30,000 m²
(Including contingency above.)
STAGE 2A
STAGE 2B
STAGE 1

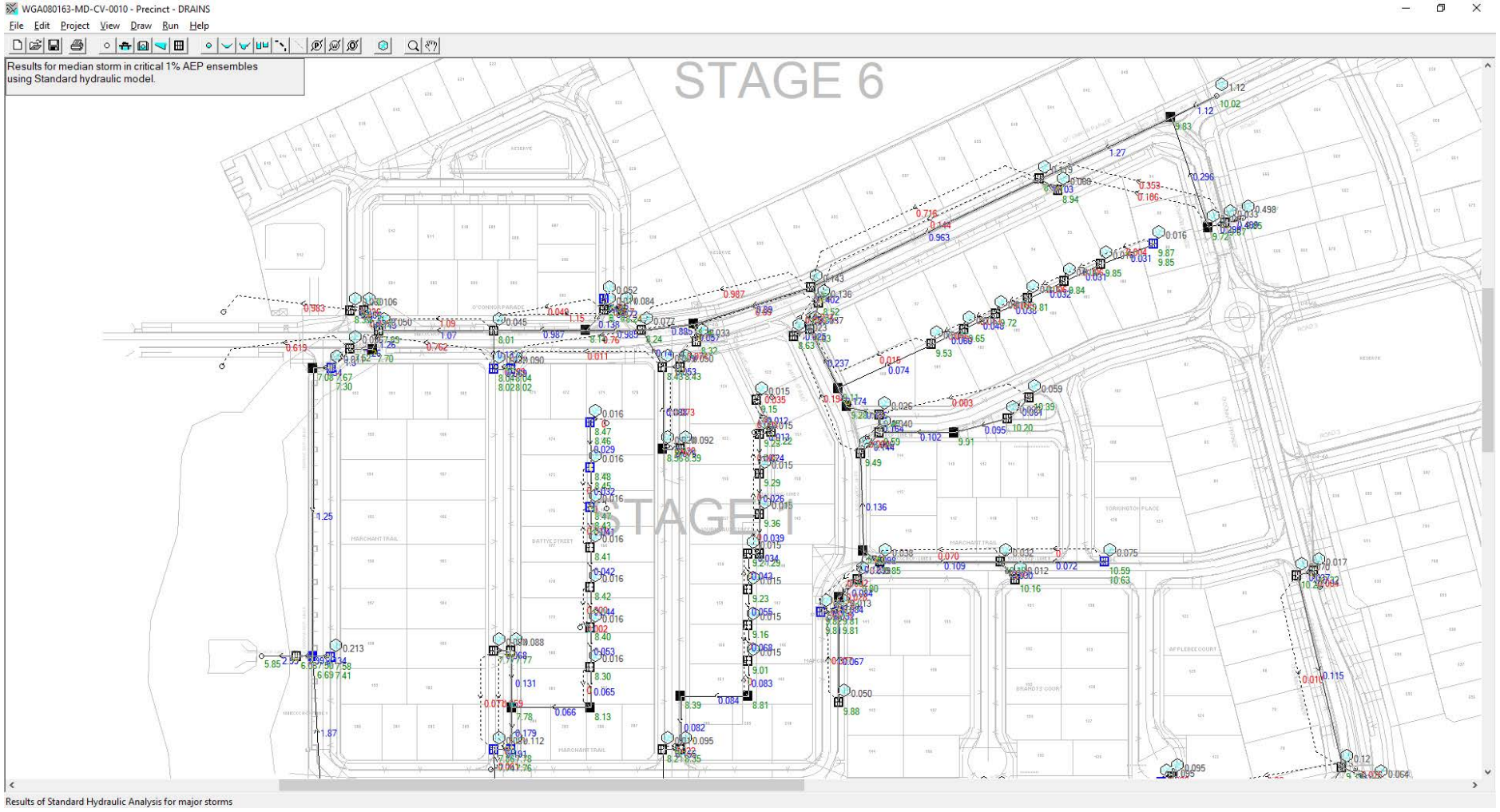
APPENDIX B

DRAINS RESULTS



SHEET INDEX

SHEET 1 – 1% AEP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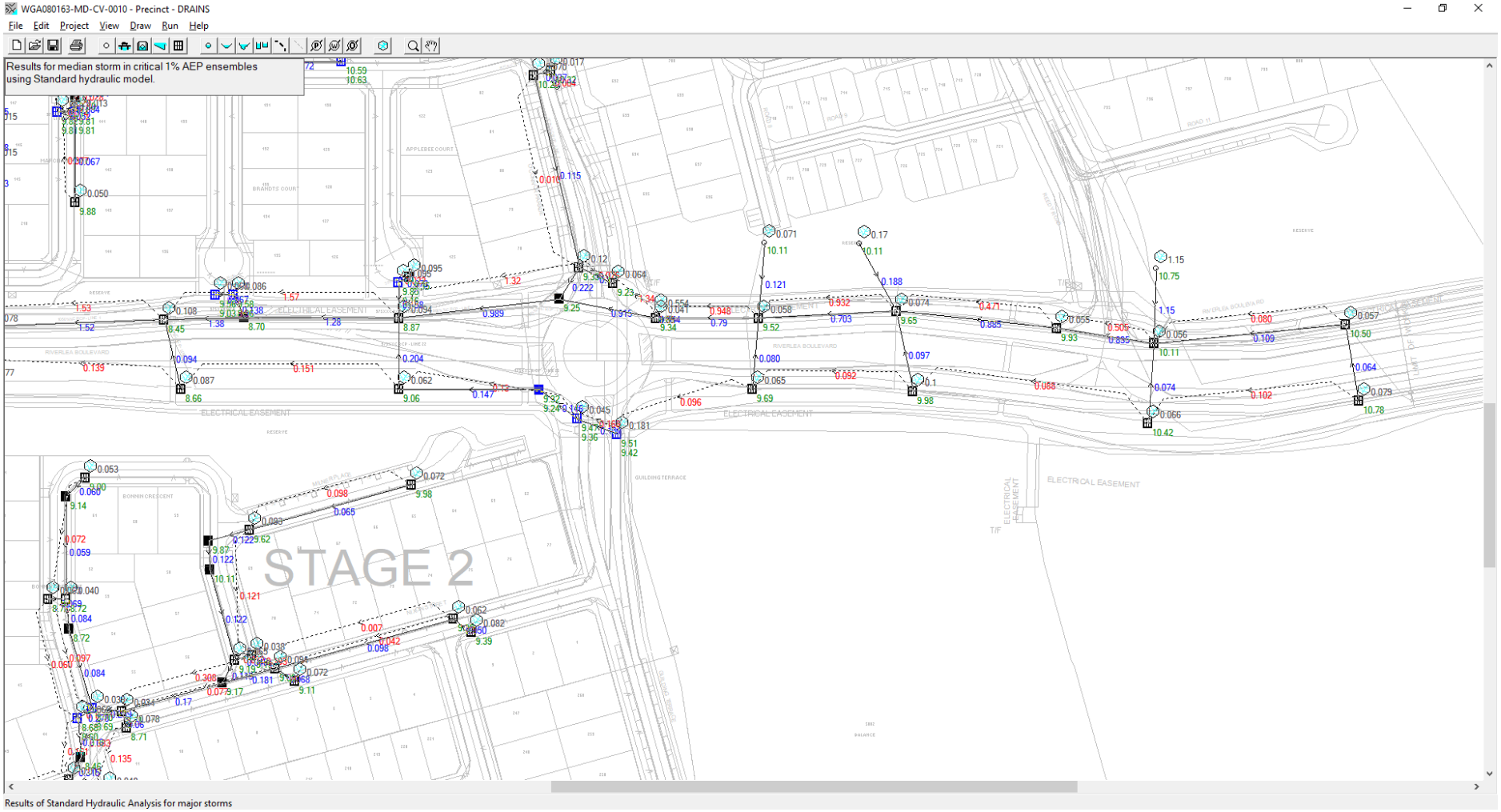
Results for median storm in critical 1% AEP ensembles using Standard hydraulic model.
STAGE 6
STAGE 1
Results of Standard Hydraulic Analysis for major storms

SHEET 2 – 1% AEP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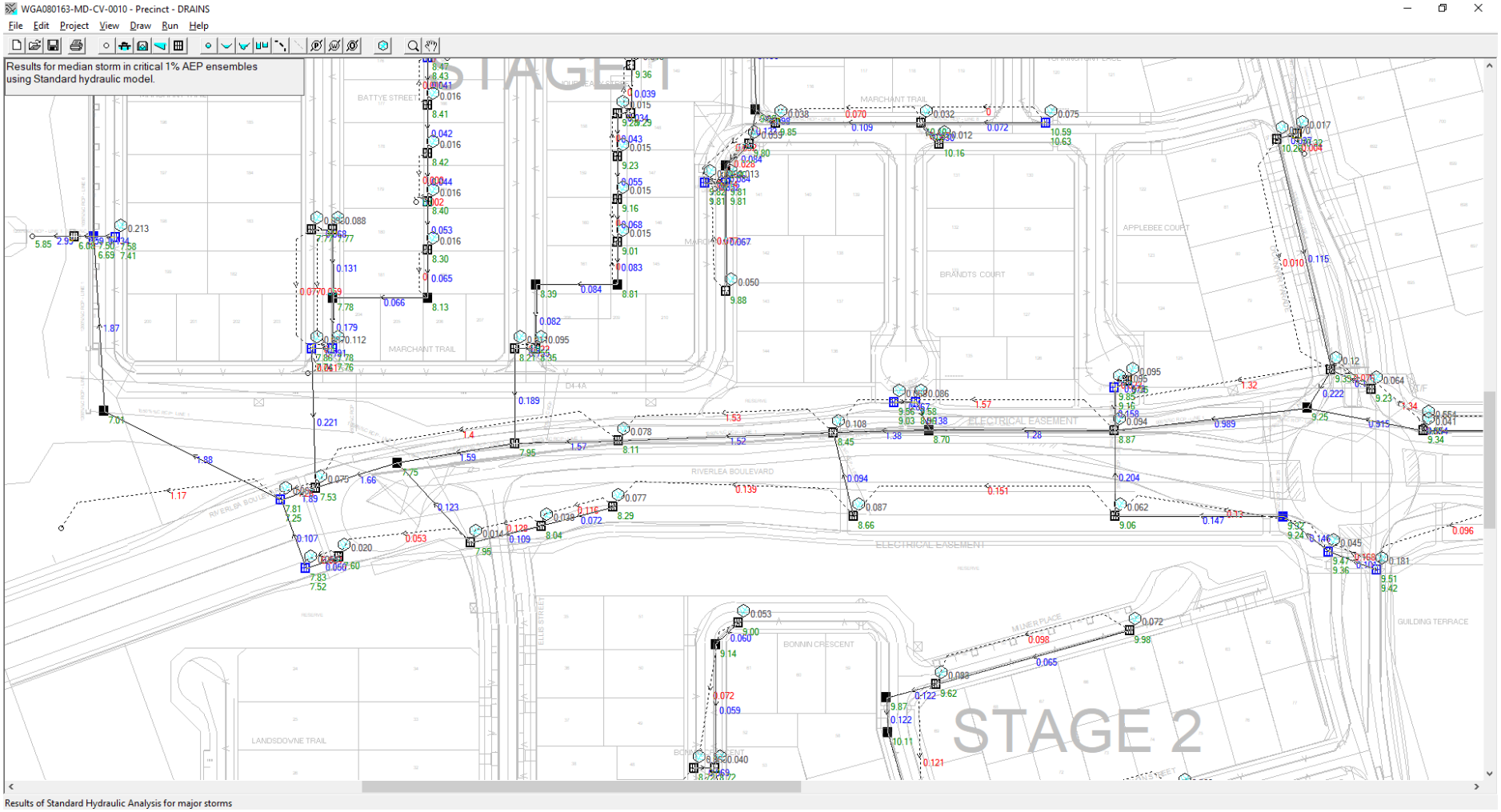
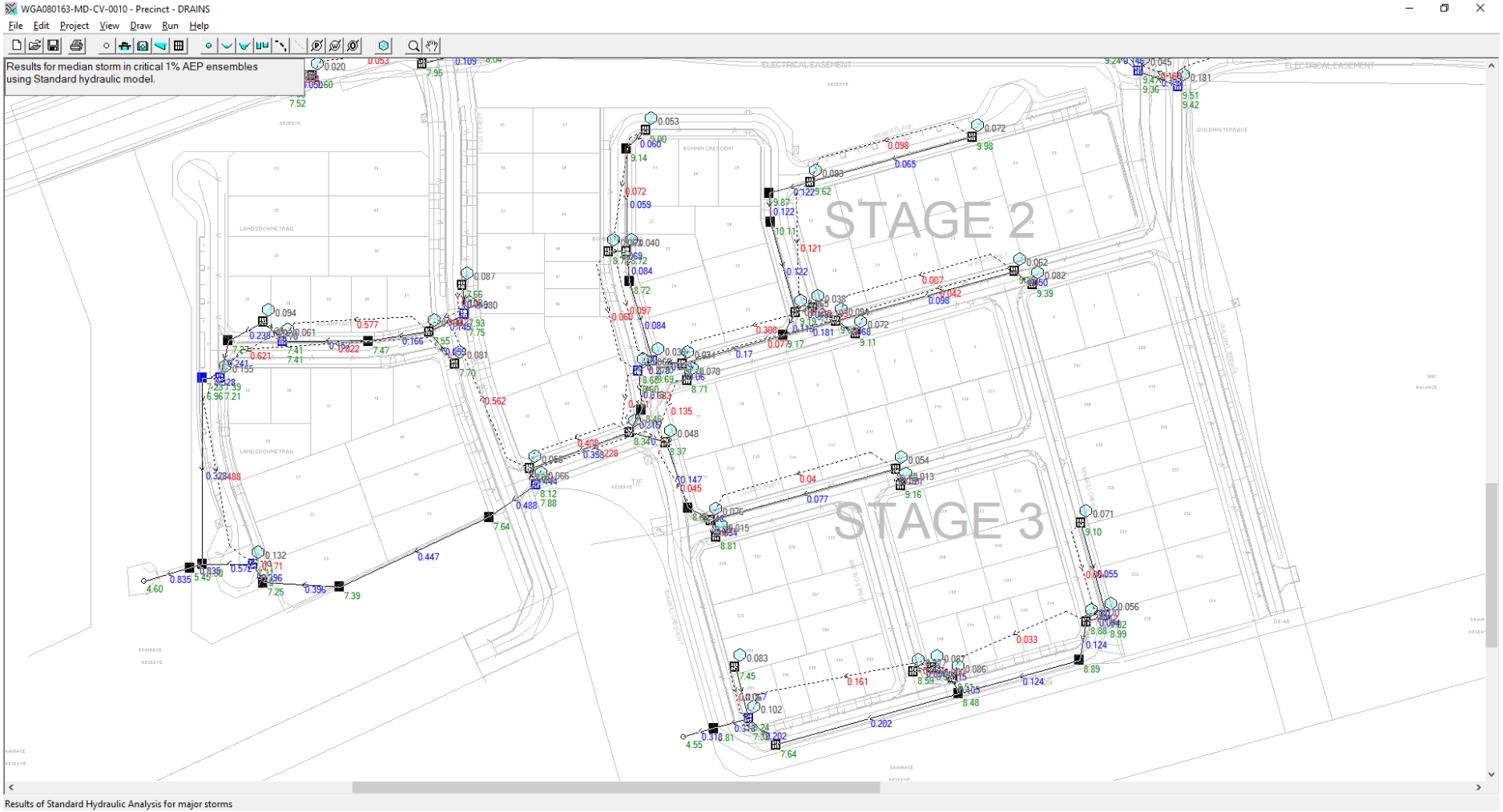
Results for median storm in critical 1% AEP ensembles using Standard hydraulic model.
STAGE 2
ELECTRICAL EASEMENT
RIVERLEA BOULEVARD
Results of Standard Hydraulic Analysis for major storms

SHEET 3 – 1% AEP


WGA080163-MD-CV-0010 - Precinct - DRAINS
File Edit Project View Draw Run Help
Results for median storm in critical 1% AEP ensembles using Standard hydraulic model.
STAGE1
STAGE 2
MARCHANT TRAIL
BATTYE STREET
APPLEBEE COURT
BRANDTS COURT
RIVERLEA BOULEVARD
ELECTRICAL EASEMENT
BONNIN CRESCENT
LANDSDOWNE TRAIL
ELLIS STREET
MUIRFIELD PLACE
GUILDING TERRACE
Results of Standard Hydraulic Analysis for major storms

SHEET 4 – 1% AEP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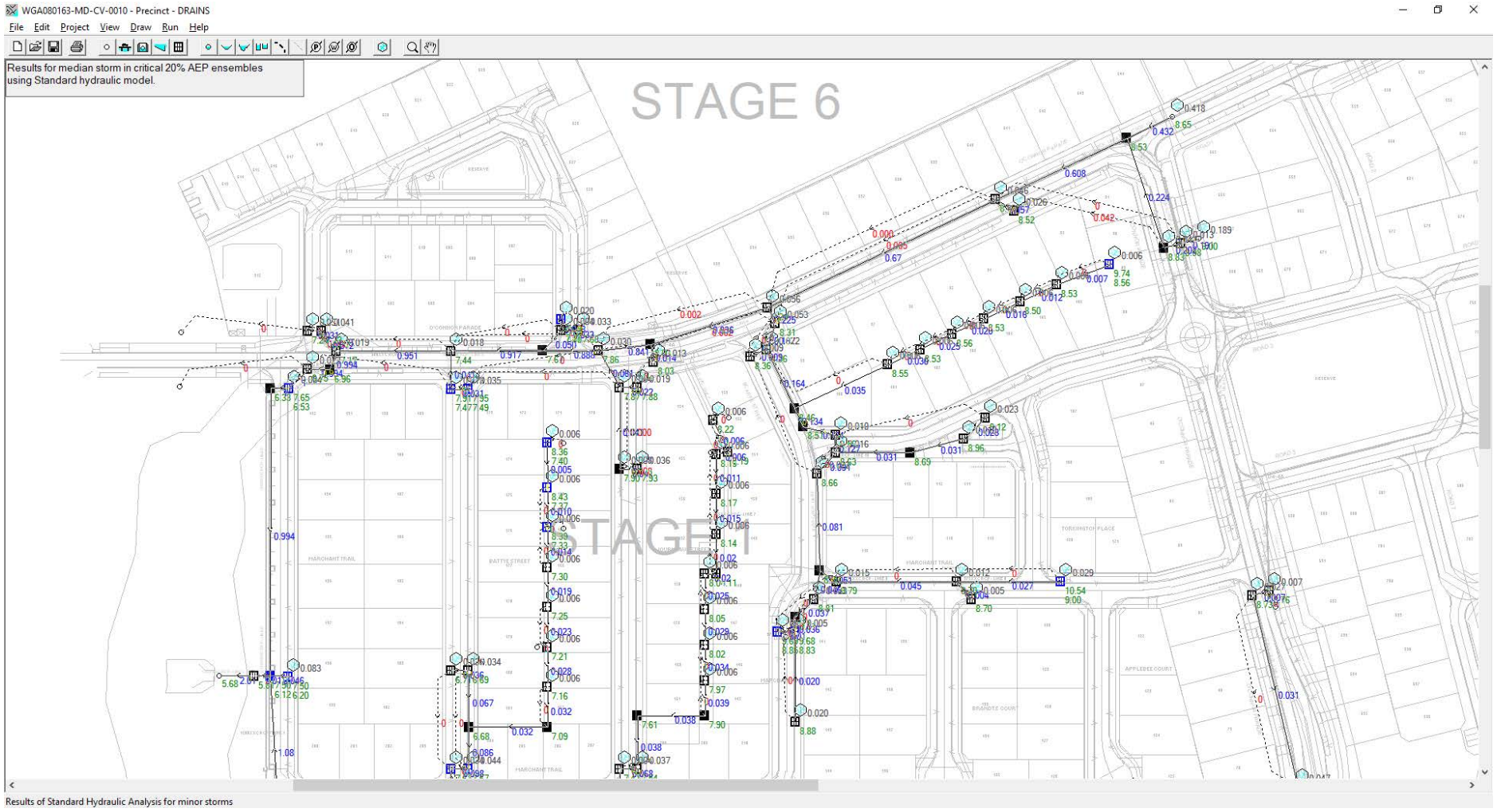
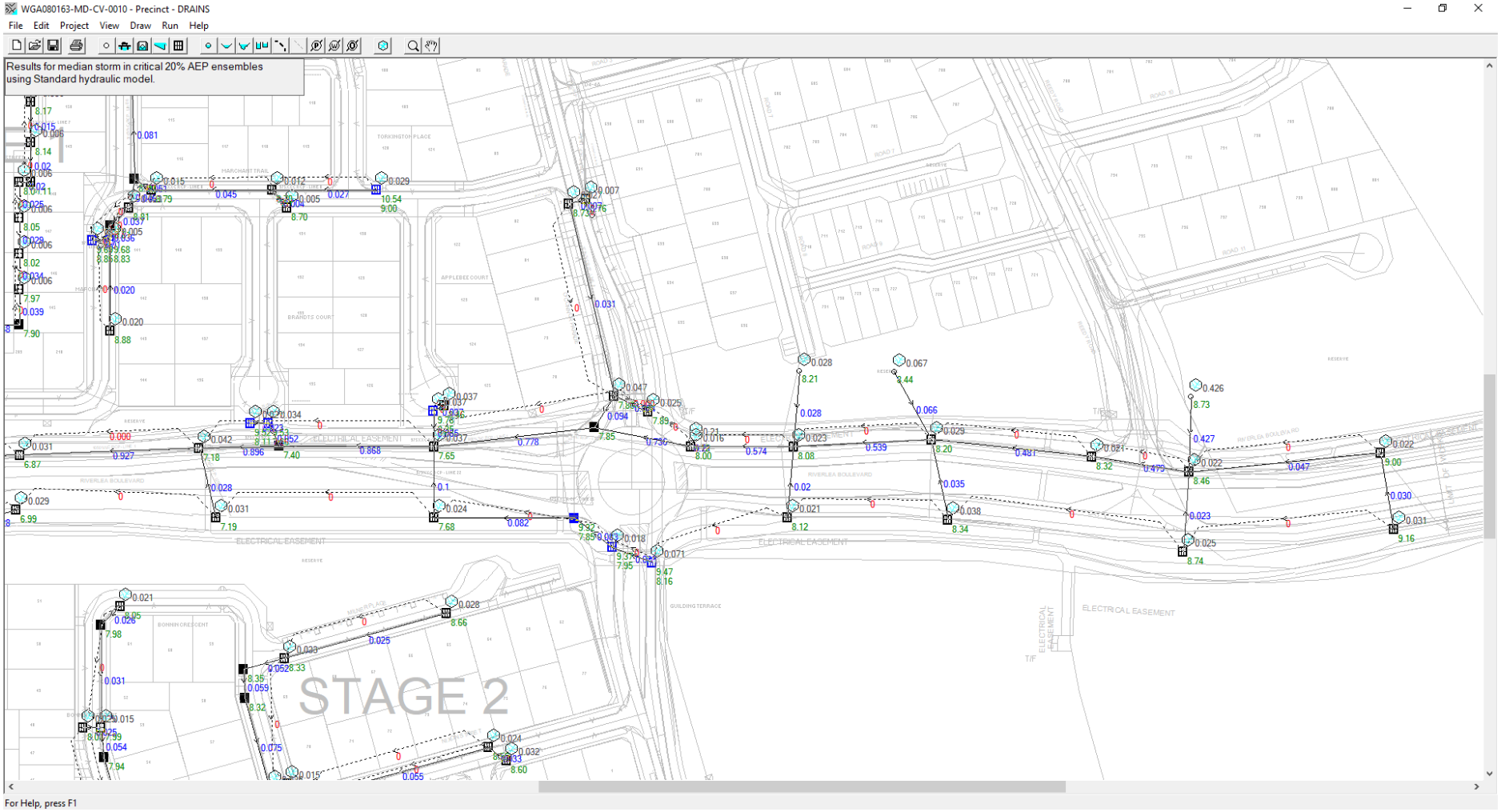
Results for median storm in critical 1% AEP ensembles using Standard hydraulic model.
STAGE 2
STAGE 3
Results of Standard Hydraulic Analysis for major storms

SHEET 1 – 20% AEP



SHEET 2 – 20% AEP



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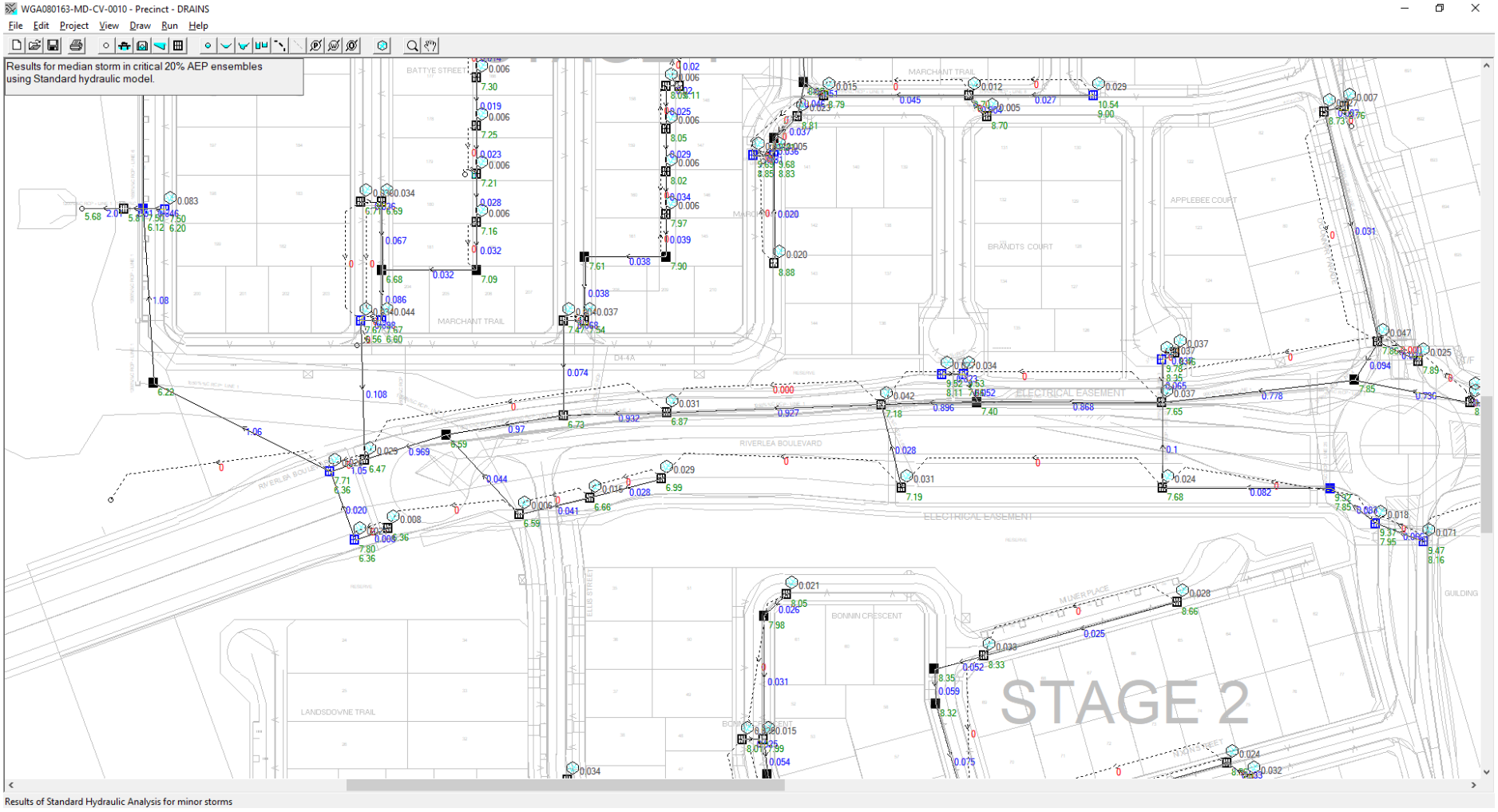
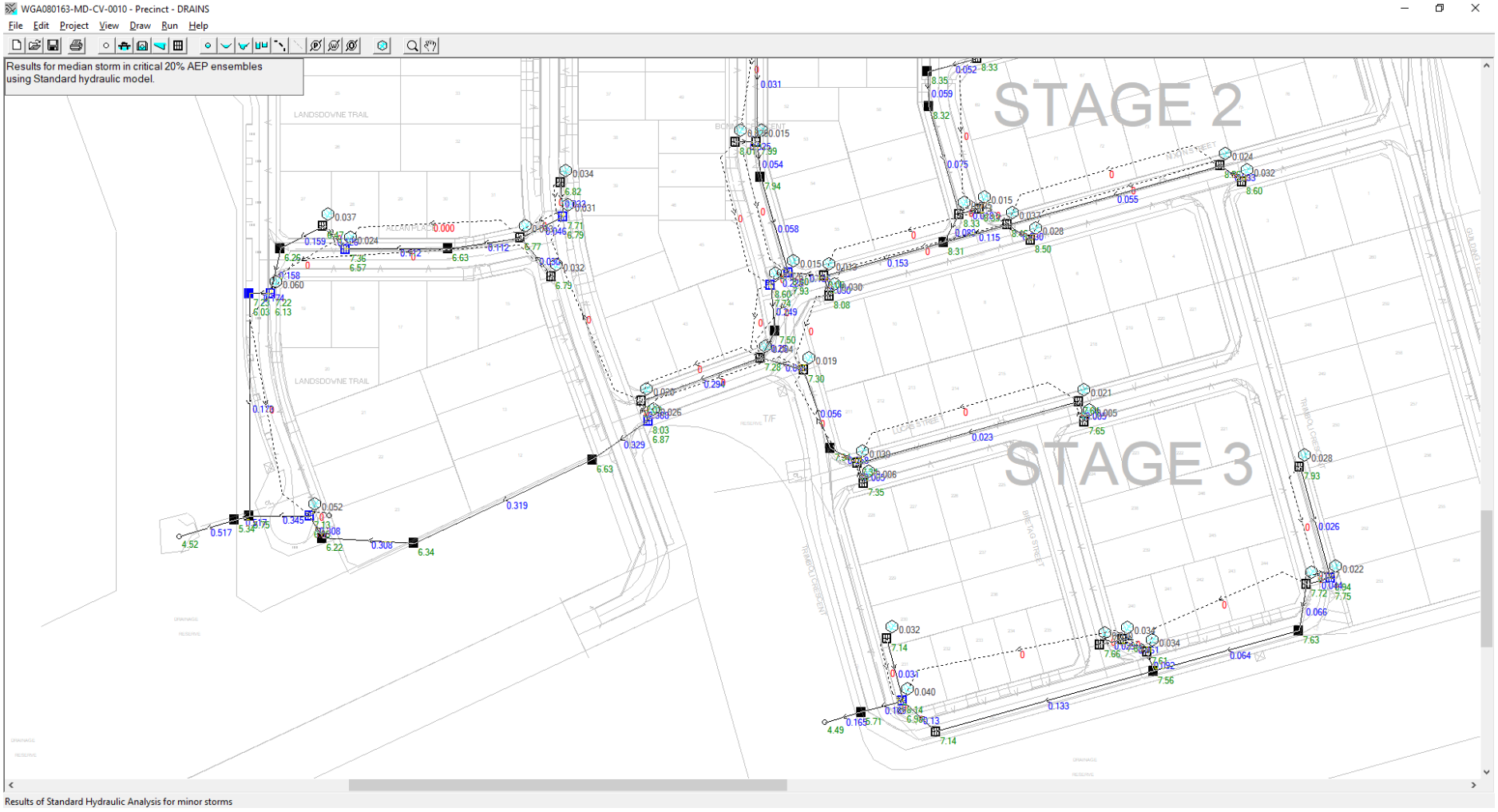
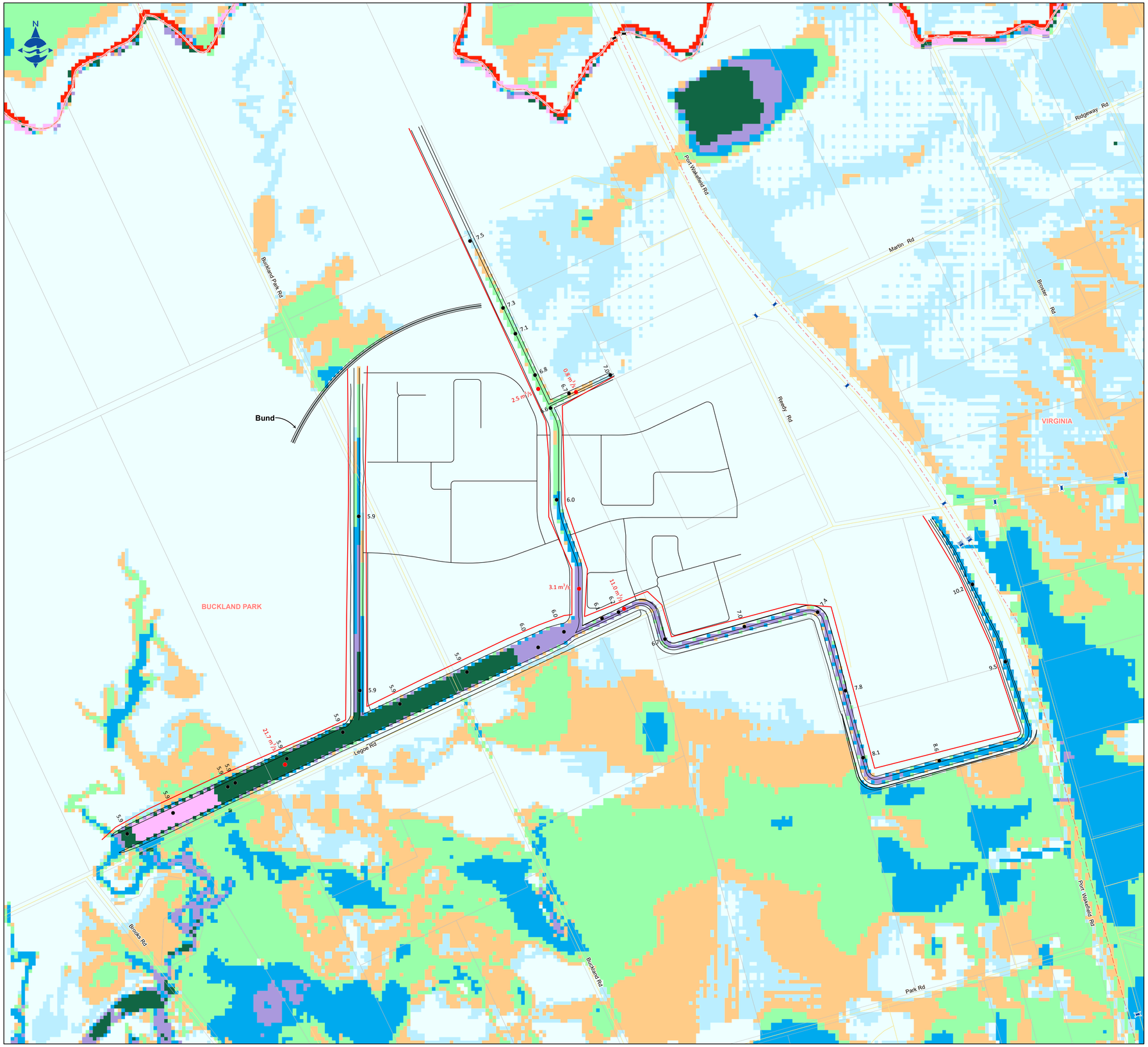


SHEET 4 – 20% AEP



APPENDIX C

AWE FLOODPLAIN MAP



Notice To Readers Of This Map

This map must be read in conjunction with the following information and in the context of the flood management design process undertaken for the proposed development.

Flood behaviour
A flood occurs when a pipe, channel or creek cannot carry the volume of water entering from a catchment. When this occurs, floodwaters travel across the surface of the land potentially damaging property built upon the floodplain and potentially threatening the safety of people in the floodplain. Flooding is a natural event.

Annual Exceedance Probability (AEP)
The AEP is the likelihood of occurrence of a flood of given size or larger in any one year. This is expressed as a ratio, for example 1:100 or 1%. There is a 1% chance that the 1:100 AEP flood will be equalled or exceeded in any one year. Similarly, there is a 5% chance that a 1:20 AEP flood will be exceeded in any one year.

Alternatively, flood risk can be considered in terms of average recurrence interval (ARI). This is the number of years on average, within which a given flood will be equalled or exceeded. A 1:100 AEP flood will be equalled or exceeded once in 100 years on average. A 1:20 AEP flood will be equalled or exceeded once in 20 years on average, and so on.

Due to the random nature of floods, however, a 1:100 year flood need not occur in every 100 years and conversely, several floods which exceed the 1:100 year flood could occur within any one period of 100 years.

Storm durations
The flooding response of a catchment is dependent on the duration of any storm event. Generally shorter, more intense storms produce the greatest flows from urban areas. Longer duration, but less intense storms, produce the greatest flows from undeveloped hills areas.

Impact on buildings
The flood extents shown are a prediction of land affected for the specific level of risk and do not necessarily indicate a threat to buildings located on that land.

Basis of mapping
The modelling reflects current practice, but it must be realised that there are uncertainties and assumptions associated with the data and the processes on which the models are based, and the flood extents shown on this map cannot be regarded as exact predictions.

The flood extents are not based on actual historical floods.

Scope of the mapping
The limit of flooding shown on this map is not a boundary between flood prone and flood free land.

Land outside the flood extent shown on this map could be affected by:

- flooding from the mapped flood that extends beyond the area that has been mapped;
- larger storms;
- flooding from local drainage systems which can occur as a result of localised heavy rainfall or drain blockage;
- storms with a different Annual Exceedance Probability.

Areas of very shallow flooding
In areas shown as being affected by flood depths of less than .1m (100mm) fences, walls, landscaping and buildings will affect the flow of floodwaters. Resolution to this level of detail is beyond the capabilities of the modelling process and consequently the level of certainty in relation to flood depths in these areas is reduced.

Changes to the catchment
The flood extent shown on the maps is based on the flood management system and land filling currently proposed for the site at 2011. Further development, earthworks and other changes to the catchment may affect the actual flood extents.

Disclaimer

This map is provided on the basis that those responsible for preparation and publication do not accept any responsibility for any loss or damage alleged to be suffered by anyone as a result of the publication of the map and the notations on it, or as a result of the use or misuse of the information provided herein.

LEGEND

- Culvert greater than 449 mm / Ford
- Bridge
- Water Surface Elevation (mAHD)
- Site with flow values noted
- Stage 1: Road and Channel Design
- Existing Road
- Suburb Boundary
- Fill Pad Edge
- Cadastral Parcel
- Local Government Boundary

Flood Depth (m):

- 0 - 0.10
- 0.11 - 0.25
- 0.26 - 0.50
- 0.51 - 1.00
- 1.01 - 1.50
- 1.51 - 2.50
- 2.51 - 5.00
- Greater than 5.00

Data Source:
Existing Roads from Primary Industries and Resources SA (PIRSA), District Council of Mallala and City of Playford; Road Culverts and Bridges from Dept of Transport, Energy and Infrastructure (DTEI) and Australian Rail Track Corporation (ARTC Rail); Locality data from Geoscience Australia; Fill Pad Edge created by Australian Water Environments (AWE) based on data supplied by Water Technology; Stage 1 Road and Channel Design, Q Sites and 1 in 100 ARI Flood Inundation Data supplied by Water Technology.

0 100 200 300 400 500

Metres (1:5,500 A1 Sheet)

Australian WATER Environments

WATER TECHNOLOGY
WATER, COASTAL & ENVIRONMENTAL CONSULTANTS

Buckland Park Flood Modelling

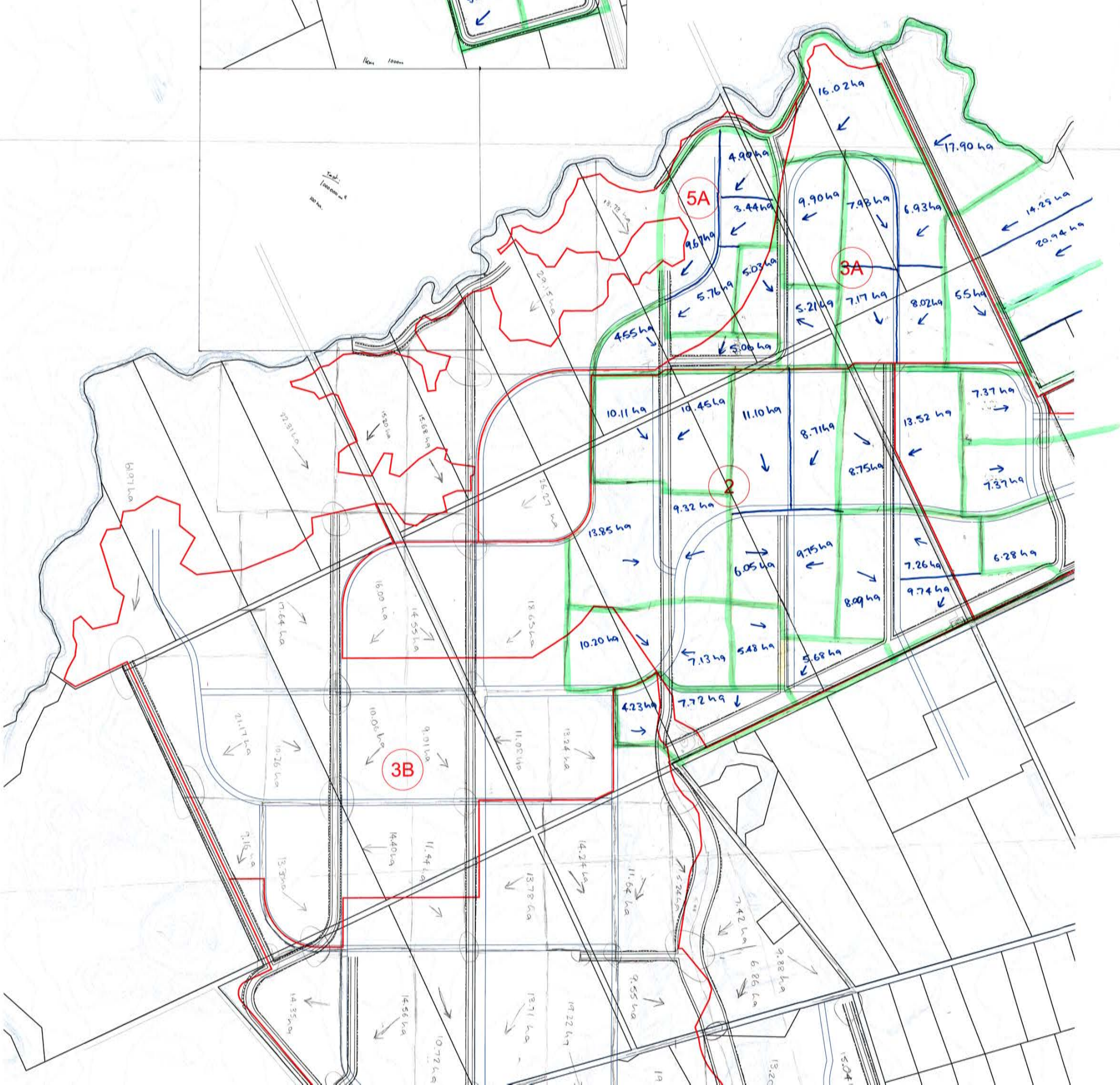
1 in 100 ARI Flood Inundation and Water Surface Elevation Stage 1 Flood Management Design

Job No. 11002 - D057
110705

APPENDIX D

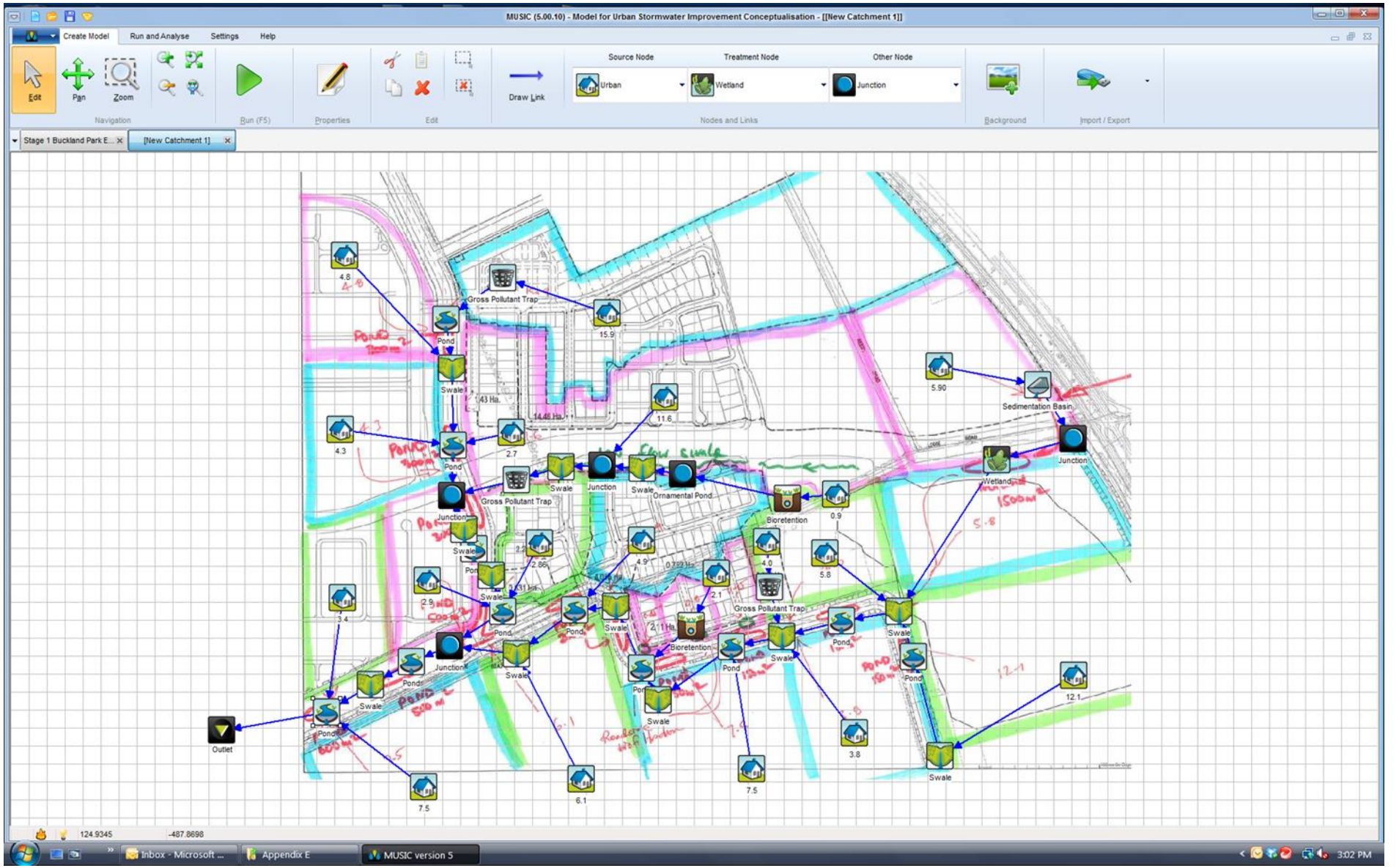
PRELIMINARY CATCHMENT PLAN FOR WHOLE SITE

14.28 ha
20.94 ha
13.97 ha
8.86 ha
2.90 ha
5.73 ha
7.10 ha
1
7.87 ha
12.28 ha
2.16 ha
2.88 ha
11.69 ha
6.22 ha
14.82 ha
8.40 ha
7.04 ha
5.94 ha


16.02 ha
17.90 ha
4.90 ha
5A
3.44 ha
9.90 ha
7.98 ha
6.93 ha
14.29 ha
20.94 ha
9.67 ha
5.03 ha
3A
5.76 ha
5.21 ha
7.17 ha
8.02 ha
5.5 ha
4.55 ha
5.06 ha
10.11 ha
10.45 ha
11.10 ha
8.71 ha
13.52 ha
7.37 ha
2
9.32 ha
13.85 ha
9.75 ha
7.26 ha
6.28 ha
6.05 ha
8.09 ha
9.74 ha
10.20 ha
7.13 ha
5.48 ha
5.68 ha
4.23 ha
7.72 ha
3B
7.37 ha

APPENDIX E

MUSIC MODEL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Create Model
Run and Analyse
Settings
Help
Edit
Pan
Zoom
Navigation
Run (F5)
Properties
Edit
Draw Link
Source Node
Urban
Treatment Node
Wetland
Other Node
Junction
Nodes and Links
Background
Import / Export
Stage 1 Buckland Park E...
[New Catchment 1]
Gross Pollutant Trap
Pond
Swale
Junction
Ornamental Pond
Bioretention
Wetland
Sedimentation Basin
Outlet
124.9345
-487.8698
Inbox - Microsoft ...
Appendix E
MUSIC version 5
3:02 PM

APPENDIX F

WSUD STRATEGY LAYOUT

W&G
WALLBRIDGE & GILBERT
Consulting Engineers
60 Wyatt Street Adelaide South Australia 5000
Telephone (08) 8223 7433 Facsimile (08) 8232 0967
Email adelaide@wgeng.com

BUCKLAND PARK DEVELOPMENT
STAGE 1
STORMWATER QUALITY MANAGEMENT STRATEGY
C080163-SK104-A

LEGEND

- 7.5 Ha. — CATCHMENT AREA
- PROPOSED STORMWATER OUTLET
- PROPOSED GROSS POLLUTANT TRAP
- 200m² — PROPOSED EPHEMERAL TREATMENT POND (APPROX. SURFACE AREA)

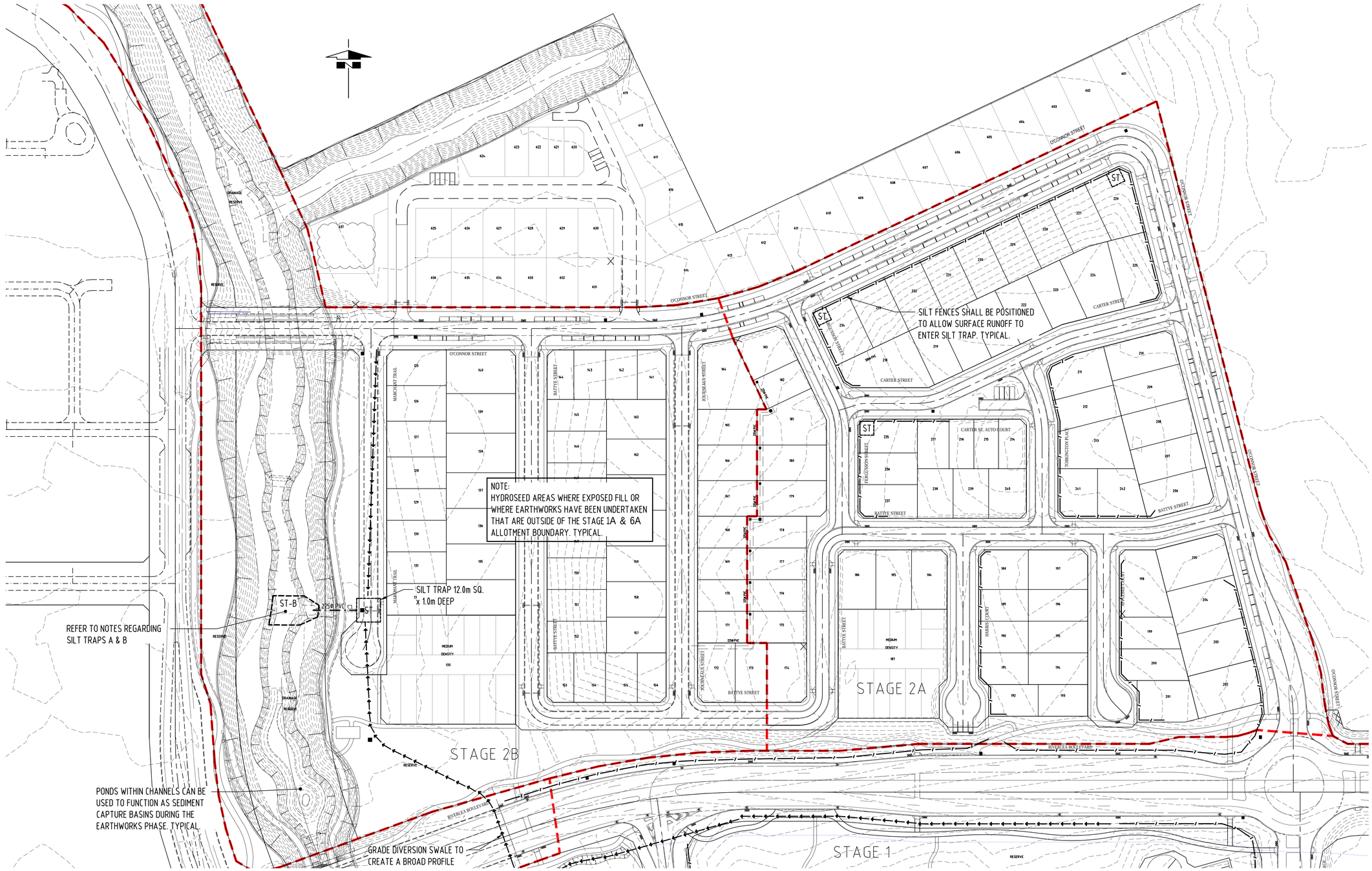
PORT WAKEFIELD ROAD
REEDY ROAD
ANGLE VALE ROAD
LEGOE ROAD
LEGOE ROAD
GPT
SEDIMENT POND
WETLAND
LOW FLOW SWALE
LOW FLOW SWALE
REGIONAL FLOW PATH/CHANNEL
REGIONAL FLOW PATH/CHANNEL
ROADSIDE BIOFILTRATION SYSTEMS
ROADSIDE BIOFILTRATION SYSTEMS
GPT
GPT
GPT
300m²
300m²
300m²
200m²
200m²
150m²
150m²
500m²
500m²
600m²
4.8 Ha.
4.3 Ha.
3.4 Ha.
2.9 Ha.
2.8 Ha.
15.9 Ha.
11.6 Ha.
4.9 Ha.
0.95 Ha.
0.8 Ha.
0.5 Ha.
4.0 Ha.
5.9 Ha.
5.8 Ha.
12.1 Ha.
3.8 Ha.
6.1 Ha.
7.5 Ha.
7.5 Ha.

80 40 0 80 160
SCALE 1:4000

APPENDIX G

SEDMP

BUCKLAND PARK



20 10 0 20 40

SCALE 1:1000

LEGEND:

- DESIGN CONTOURS
- SILT FENCE
- TEMPORARY CONSTRUCTION EXIT
- DIVERSION DRAIN
- ST — SILT TRAP 7.0mx7.0mx0.7m DEEP UNLESS NOTED OTHERWISE

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9. SPREAD MULCH RESULTING FROM TREE REMOVAL OVER AREAS TO REDUCE STORMWATER RUNOFF AND SUPPRESS DUST.

MAINTENANCE NOTES:

1. THE SEDIMENTATION BASIN AND SILT TRAPS SHALL BE CLEANED OUT WHEN THE ACCUMULATED SEDIMENT HAS REDUCED THEIR CAPACITY BY 60%. THIS LEVEL SHALL BE INDICATED BY PLACING A MARK ON A RISER.
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SILT TRAP A & B NOTES

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UPON COUNCIL APPROVAL TO REMOVE SILT TRAP, THE CHANNELS VEGETATION SHALL BE REINSTATED IN ACCORDANCE WITH THE DESIGN.

THESE SILT TRAPS ARE TO BE CONSTRUCTED TO FIT THE PLAN AREA OF THE FINAL ROCK PITCHING PLAN. REFER TO DETAIL.

Issue	Description	Drwn	Ckd.	Appd.	Date
A	COUNCIL APPROVAL	MJ	GL	DB	4.05.12

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Title

BUCKLAND PARK DEVELOPMENT
RIVERLEA PRECINCT STAGE 1 & 2A
SEDIMENT & EROSION PLAN 1/3

Status

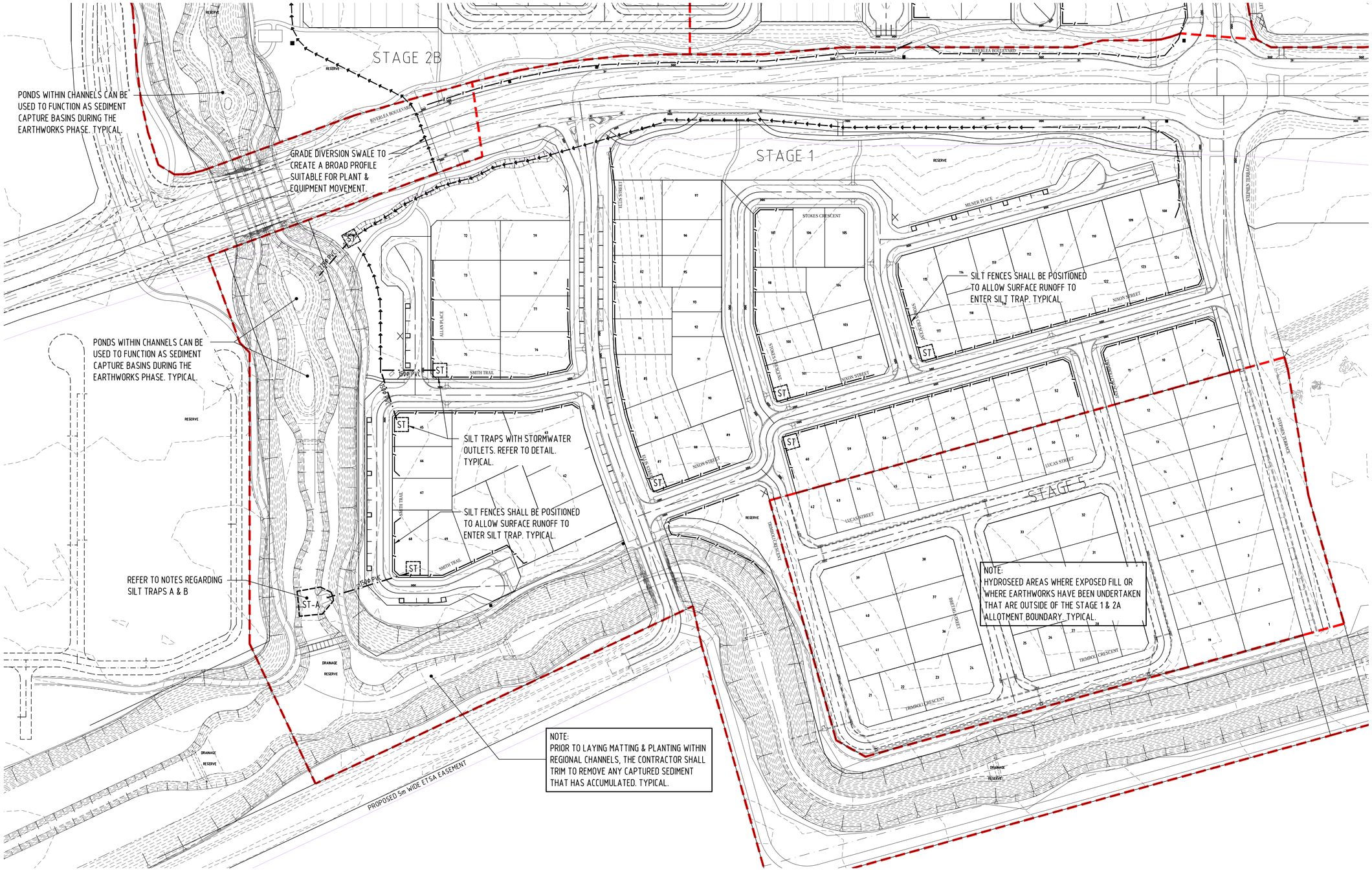
PRELIMINARY ISSUE

Scale (A1)	Datum
1:500 @ A1 1:1000 @ A3	AHD
Drawn: MWRJ	Designed: GL

Project Code	Drawing No.	Issue
C080163	C164	A

100mm On Original A1

©



BUCKLAND PARK

SCALE 1:1000

Issue	Description	Drwn	Ckd.	Appd.	Date
A	COUNCIL APPROVAL	MJ	GL	DB	4.05.12

LEGEND:

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100mm On Original A1

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Title

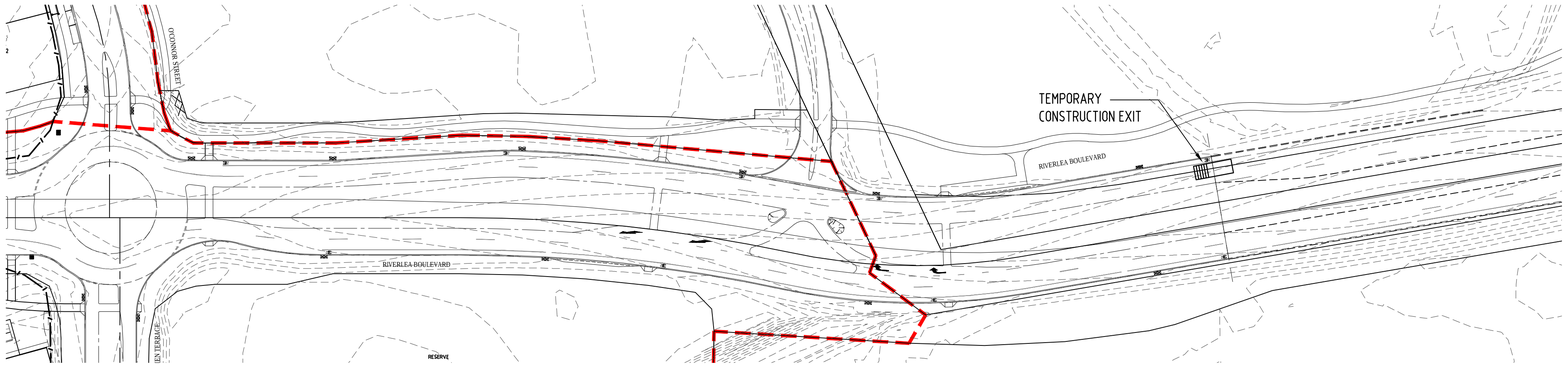
BUCKLAND PARK DEVELOPMENT
RIVERLEA PRECINCT STAGE 1 & 2A
SEDIMENT & EROSION PLAN 2/3

Status

PRELIMINARY ISSUE

Scale (A1) 1:500 @ A1 1:1000 @ A3	Datum AHD
Drawn MWRJ	Designed GL
Project Code C080163	Drawing No. C165
	Issue A

©



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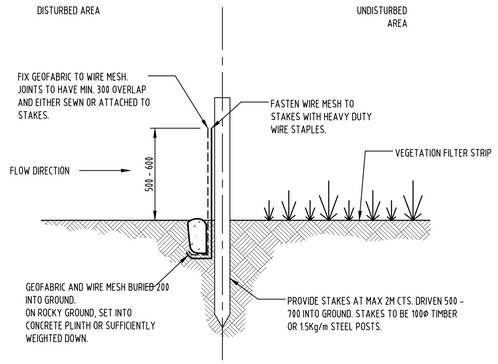
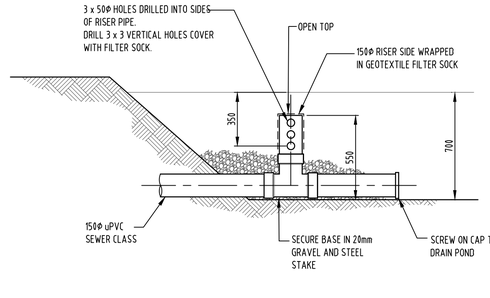


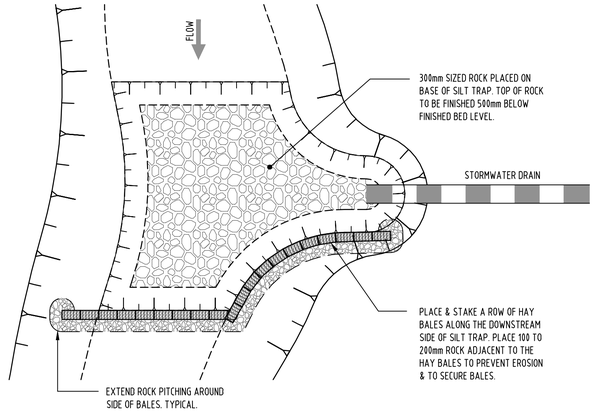
SILT FENCE DETAIL

SCALE 1:20



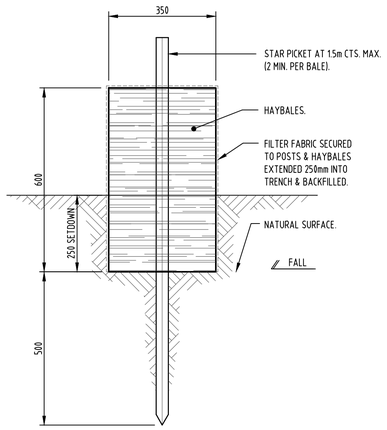
SILT TRAP RISER OUTLET DETAIL

SCALE 1:20



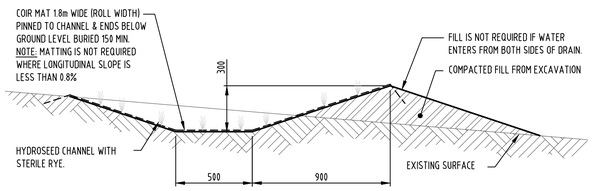
SILT TRAP A & B PLAN

SCALE 1:200



HAYBALE BARRIER DETAIL

SCALE 1:10



DIVERSION DRAIN DETAIL

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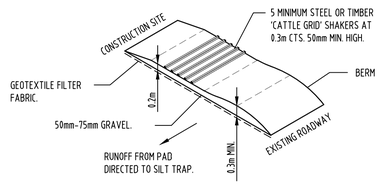

TEMPORARY CONSTRUCTION EXIT

N.T.S.

100mm On Original A1

BUCKLAND PARK

SCALE 1:1000

Issue	Description	Drwn	Ckd.	Appd.	Date
A	COUNCIL APPROVAL	MJ	GL	DB	4.05.12

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Title

BUCKLAND PARK DEVELOPMENT
RIVERLEA PRECINCT STAGE 1 & 2A
SEDIMENT & EROSION PLAN 3/3

Status

PRELIMINARY ISSUE

Scale (A1)	Datum
1:500 @ A1 1:1000 @ A3	AHD
Drawn: MWRJ	Designed: GL
Project Code: C080163	Drawing No.: C166
	Issue: A

APPENDIX H

SOAKAGE PIT CALCULATIONS

Soakage Pit Design

Volume of runoff calc						
Impervious area = 80 m2						
Volume of runoff from 5 yr 0.5 hour storm =	1.3 m3					
DESIGN OF SOAKAGE TRENCH (Gravel filled)						
Volume of Runoff m3	Es	b	H	Kh	T (tor) =Tc +tc	U (sandy clay)
1.3	0.35	2	0.5	0.000005	30	1
	V/ Es x b x H + 60 x (5x10^-5) x T x (b + H/2) x U					
	2.25					
	0.02025					
	0.35					
	0.37025					
Length of soakage trench required (m)	**3.5**					
Emptying Time calculation						
Criteria: Emptying time < = 1.0 day for ARI =	< 2years					
Parameters						
T = emptying time (s)						
Length (L) m	3.5					
Trench width b (m)	2					
Trench height H (m)	0.5					
Void space ratio e(s)	0.35					
Soil hydraulic conductivity K (h)	0.000005					
	-205145.7976					
	7.022282242					
	12.53342336					
	0.560284452					
	-0.251591429					
	51612.92438	seconds				
	14.33692344	hours				
Emptying Time	**0.60**	**days**				

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CIVIL ENGINEER

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