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Wyaralong Transfer System

Wyaralong Transfer System Conceptual Stormwater Management Plan

Seqwater

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Document control record

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1 Executive Summary

Seqwater intends to develop a transfer system on their land close to the Cedar grove weir. This transfer system will initially facilitate the provision of flow from the Seqwater bulk supply grid to the Beaudesert Water Supply Zone and in turn will tie into the future Wyaralong Water Treatment Plant. This Conceptual Stormwater Management Plan proposes an integrated stormwater quality and quantity management approach to provide a basis for developing a detailed design and legislative compliance when the property is developed. This work has been completed to satisfy State Planning Policy and Logan City Council's development guidelines.

The management plan an infrastructure is designed to:

- Separate runoff from undeveloped and developed sections of the site
- Capture and treat all frequent flow (from events of AEP 10% and higher) that runs off the developed area
- Attenuate all flows in peak events (up to and including the AEP 1%) such that in these events the quantity impacts on the downstream receiving waters are no worse than the predevelopment impacts

The proposed management system is described by the conceptual design drawings (Appendix A – Concept Design Drawings) and constitutes the following infrastructure:

- Install a clean water diversion bund (typically 0.8m high with a 1 in 3 slope) around the uphill extents of the proposed development.
- Fit gross pollutant traps to the outfall of hardstand areas and stormwater drainage pipes. The specific trap type and requirements will be determined by detailed design.
- Construct a rock and grass lined channel along the western edge of the development to capture and transport flows from the proposed hardstand areas to the basins. Capture to the bioretention basin to be via a DTMR standard field inlet with a grate positioned in the invert of the channel adjacent the low point of the hardstand area.
- Construct a vegetated bioretention basin, with a minimum base area of 400m^2 and a filter media layer of 0.4m depth, with a 0.2m sand base layer inclusive of underdrains. The basin batters should be no steeper than 1 in 3. A high flow overflow weir should be installed 0.5m above the basin bed with a crest width of 5m and a weir depth (top of adjacent wall to crest of weir) of at least 0.3m. This weir will safely convey flow from rare events that overfill the bioretention basin to the detention basin.
- Downstream of the bioretention basin, construct a grass lined detention basin. The detention basin should have a minimum storage capacity (to outflow weir height) of approximately 450m^3. The proposed design has a base area of 800m^2 and depth to outflow weir of 0.5m. All internal batters should have a 1 in 3 slope. The outflow weir should have a width of 30m with a weir depth of at least 0.3m. This weir will safely convey flow from rare events that overfill the detention basin to grade.

2 Introduction

The Wyaralong Water Treatment Plant (WTP) is planned for 2025 onwards. To supply potable water prior to the construction of the WTP, a transfer system is required to send flows down the South West Pipe (SWP) to the Beaudesert Storages at Helen Street, Beaudesert. The transfer system is a component of the future Wyaralong WTP that will supply water to Beaudesert, Logan and back to the Seqwater Bulk Water Transfer grid. The project is at the preliminary design stage and a business case has been completed and approved by the Seqwater Board. Further approvals are required by Building Queensland (BQ) and Treasury. As the full WTP is not being constructed in this phase, the Wyaralong Transfer System has triggered a MCU (Material Change of Use) application. The future Wyaralong WTP works are not part of this assessment and will be addressed separately at a future date.

2.1 Scope and Purpose

This Conceptual Stormwater Management Plan (CSMP) has been developed by Aurecon on behalf of Seqwater to support a development application for a material change of use from rural to industrial land use. The change of use is proposed to allow for the implementation of a Water Treatment Plant (WTP). The redeveloped land is intended to consist of the introduction of pavement and hardstand areas and is referred to as the Wyaralong Transfer System or WTS herein.

The property is located on Bushland Road, north west of the township of Cedar Grove in the local government area (LGA) of Logan City Council. The property covers approximately 23 hectares of semi forested land on the northern bank of the Logan River. The proposed EW are to be in the western half of the property covering an area of approximately 2.4 hectares.

This CSMP plan has been prepared to address requirements set out in:

- The Queensland Government's Economic Development Act 2012, as at July 2017
- The Queensland Government's State Planning Policy for Water Quality, July 2017;
- The Environmental Protection (Water) Policy 2009, Logan River environmental values and water quality objectives, Basin No 145 (part) including tributaries of Logan River, July 2010; and
- Logan City Council Planning Scheme Policy, policy 5 -Infrastructure, 2015, and referred sub standards and specifications, including but not limited to:
  - The Queensland Urban Drainage Manual (QUDM);
  - Australian Rainfall and Runoff Guidelines (AR&R); and
  - Healthy Waterways Water by Design Guidelines and Standard Drawings.
- The Greater Flagstone Urban Development Area Development Scheme,
- The State Interest for Water Quality and requirements of the Seqwater development guidelines

This CSMP has been developed to identify any impacts associated with the proposed changes to land use on the site from a stormwater runoff quality and quantity point of view. Management measures are then proposed to ensure the development complies with requirements set out in the relevant documents listed above.

Management measures for water quality have been proposed with a suite of measures, applied with a "treatment train" approach to target and remove a range specific stormwater pollutants. Choice, sizing and positioning of appropriate measures, has been determined via water quality and quantity modelling and consideration of site constraints and opportunities.

The application of stormwater quality measures have been coupled with stormwater quantity management measures to manage localised runoff to ensure no adverse impact as a result of any changed runoff conditions. Stormwater quantity has been considered for a range of statistically recurring design storm events including 'frequent' flow events, up to the 10% average exceedance probability (AEP) event, and events up to a 'rare' event the 1% AEP / 100yr average recurrence interval (ARI) event. Assessment consisted of comparison predevelopment and post development scenarios.

3 Background

3.1 Site Description

3.1.1 Location and land use

The Wyaralong Transfer System is proposed for the property at Bushland Road, approximately 2km north west of Cedar Grove in the Logan City LGA. The Logan River runs along the southern boundary of the property. The property is predominantly a greenfield site with some minimal clearing amongst forested areas. There is currently one unsealed road, Bushland Road, along the northern boundary of the property.

3.1.2 Topography and drainage

The majority of the property in northern and mid areas consists of, steep yet evenly graded terrain conducive to sheet flow type runoff until concentration of flows occurs in various gullies forming in the south feeding the Logan River. The site consists of some steep grades of up to approximately 10%, with elevations ranging from approximately 63m AHD along the norther boundary of the property to the banks of the Logan River at approximately 25m AHD.

Overland flow concentrates into various gullies which steepen as they enter the Logan River. The river flows from west to east past the property.

3.1.3 Soils and Geotech

To date only high-level geotechnical and soil condition assessments have been completed at the site. The presence of contaminated land, acid sulphate soils and dispersive soils is considered to be a low risk.

Further consideration of soils and geotechnical conditions to investigated in detailed design. Preparation of a geotechnical report to address issues as identified in the Logan City Planning Scheme Policy, in Schedule 6 relating to geotechnical reports.

3.1.4 Proposed Development

The proposed development is to consist of the regrading of the terrain in the mid areas of the western half of the property to introduce an access road and a flat impervious area for the positioning of large closed top water storage tanks and associated treatment plant infrastructure. The large pad area is to be predominantly impervious with the surrounding batters assumed to be grass lined. Overall the proposed transfer system footprint has been assumed to be approximately 70% impervious.

The proposed development has been assumed to have a piped stormwater drainage system and a low point for surface water runoff at the midpoint of the eastern edge of the flat impervious area.

Figure 1: Proposed Development Location

3.1.5 Lawful Point of Discharge

Logan City Council Planning Scheme Policy, policy 5 -Infrastructure, 2015 specifies under section 3.6.2.3 states that a “Lawful point of discharge” that a development shall discharge to a lawful point of discharge in accordance with Section 3.02 of the Queensland Urban Drainage Manual (QUDM). Additionally, the policy specifies that if the proposed drainage system passes through, or to, a private property, a letter of consent from the owner(s) of the downstream property(ies) must be submitted prior to a development application being submitted to a local government.

QUDM clarifies that the term “lawful point of discharge” does not have a prescribed legal meaning, though specifies criteria for determining where a suitable point of discharge might be from a property where development is occurring.

These criteria apply only where the discharge from the property undergoing change or development alters stormwater discharge characteristics in a manner that may substantially damage a third-party property. If not, then no further steps are required to obtain tenure for a lawful point of discharge.

In this instance, the property being developed on Bushland Road, naturally drains from northeast to south west, across the western property boundary onto an adjoining property and south directly into the Logan River.

The proposed development will redirect runoff away from discharging across the western boundary (which adjoins a neighbouring private property), to a gully discharges directly into the Logan River across the southern boundary. The proposed development, in effect, reduces the total volume and peak flow of runoff from the developed property onto the adjoining property to the west. Substantially damaging third party property on the adjoining property, in this instance, is not considered to be a significant risk.

4 Water Quality Management

4.1 Water Quality Compliance Standards

Increases in stormwater runoff volumes have resulted from increasing urbanisation and the accompanying escalation of impervious surfaces. Urban stormwater is a major contributor to the pollution of rivers and bays.

The appropriate management of stormwater runoff can reduce the impact that a development has on nearby waterways. The primary purpose of preparing this CSMP is to reduce the potential for runoff from the development to adversely affect the health and quality of nearby waterways. In this case the Logan River.

In accordance with the Environmental protection (Water) Policy 2009, the Logan River environmental values and water quality objectives document (July, 2010) identifies a range of environmental values as significant for the eastern and western Logan River, including; aquatic ecosystems, Irrigation, farm supply and use, stock watering, human consumerism, primary recreation, secondary recreation, visual recreation, drinking water supply industrial use and cultural and spiritual values.

4.1.1 Stormwater Management Design Objectives

The management of stormwater runoff from the site has been developed to comply with the design management objectives outlined in Section 3.6.1.5 of the Logan City Council Planning Scheme Policy 5 – Infrastructure, where; minimum reductions in total pollutant load compared to untreated stormwater runoff is to be achieved. Additionally, in accordance with the policy, the proposed management approach is also to meet the following objectives:

- Provide a total stormwater capture volume in cubic meters (m^3) that is equal to the impervious area (m^2) multiplied by the target design runoff capture depth (mm/day) divided by 1000;
- Manage stormwater capture via the use of infiltration into native soils; and
- Ensuring frequent flow management includes the provision of runoff capture that can be re-instated or maintained each day, therefore be able to drain all captured stormwater within 24hrs.

4.1.2 Water Quality Objectives

The future water treatment plant will draw water from the Logan River for treatment and potable use. As specified in the policy, for the maintenance of water quality in the Logan River for the identified relevant environmental values, particularly drinking water supply, the most stringent water quality objectives for the River are applied. These standards are in accordance with Section 3.2 (Table 13 of the Logan River environmental values and water quality objectives document under the Environmental Protection (Water) Policy 2009.

This CSMP proposes to observe the principles of water sensitive urban design to implement stormwater management measures that will minimise the impact on downstream receiving waters.

The pollutant load reduction requirements for runoff from developed areas within the SEQ region have been adopted for this stormwater treatment assessment and can be found in Table 1.

These include pollutant concentration targets to maintain the environmental values (EVs) of the receiving waterways. Typically, concentration-based criteria are unachievable using standard stormwater treatment devices (e.g. swales and proprietary treatment systems). The concentration-based guidelines are set to reflect the overall water quality of the receiving water body and are therefore not directly applicable to assessing stormwater discharge quality.

Table 1 Pollutant load-based percentage reduction requirements

Stormwater Pollutant	SEQ WQOs
Total Suspended Solids (TSS)	85%
Total Phosphorous (TP)	65%
Total Nitrogen (TN)	45%
Gross Pollutants (GP)	95%

(SPP, Appendix 3, SPP Code: Water Quality)

The design of the proposed stormwater quality treatment measures for the WTP footprint development will be assessed against the pollutant reduction WQO in Table 1.

4.2 Water Quality Management Approach – Operational Phase

The primary purpose of this CSMP is to address the management of stormwater runoff from the site during the operational phase of the early works development.

The following methodology has been applied for assessing the stormwater management requirements for the site:

- Review the proposed site in terms of the site layout, drainage patterns (including stormwater infrastructure) and the pollutants likely to be generated on-site;
- Assess the likely impact of stormwater discharged from the proposed development on the wider surrounding environment, and outline WQO associated with the project area;
- Identify areas where stormwater treatment measures can be implemented to mitigate the impact of stormwater discharged from the site; and
- Prepare a CSWMP to outline the management of stormwater runoff from the proposed development and demonstrate the effectiveness of the treatment measures proposed.

The potential risks and impacts associated the construction phase of the development are also relevant and the requirement for managing stormwater runoff is addressed in Section 4.5.

Traditional stormwater management would typically focus on kerb and channel or piped drainage strategies to manage site stormwater. This approach provides negligible stormwater pollutant removal, therefore alternative drainage options have been identified for the Wyaralong WTP redevelopment. The application of WSUD principles often employ a “treatment train” approach to achieving treatment and design objectives. In the development of a treatment train approach, the following strategies have been considered for incorporation:

Where possible, the stormwater management strategy has considered the following:

- The types of pollutants to be removed or reduced based on the nature of the development and activities during operational phase;
- Identification of types of pollutants for removal with the various types of treatment available, e.g. primary, secondary or tertiary treatments;
- Opportunity to provide pre-treatment to remove sediment and gross pollutants before they enter downstream devices. This improves the life span of secondary / tertiary treatments and reduces maintenance costs;
- Selection of the most appropriate type of primary, secondary or tertiary treatment device for each identified pollutant;
- Develop a staged “treatment train” strategy with primary treatment devices followed by secondary and tertiary treatments targeting finer pollutants if necessary (fine sediment and nutrients);

- Utilising natural pollutant removal processes to support or minimise the requirement for treatment train devices / measures which may screen or provide filtration to remove coarse sediment and biological transformation and uptake to remove nutrients e.g. existing buffer areas (vegetated);
- Planting native, drought and flood tolerant vegetation with low fertiliser requirements;
- Incorporating treatment measures into the landscaping of the site to enhance visual amenity and

The following sections identify the favoured primary, secondary and tertiary stormwater treatments proposed for implementation with the Wyaralong WTP redevelopment.

4.2.1 Identification of Pollutant Sources

Given the nature of the proposed development, several potential pollutants originating stormwater runoff from the site have been identified. These are given in Table 2 and a description of the management of each of the potential pollutant sources is covered in Section 0.

Table 2 Key pollutants and pollutant sources

Pollutant	Source
Chemical Spills	Failure if an on-site dosing facility for potable water treatment (Chlorine & Sodium Hypochlorite)
Sediment	Dust deposition on impervious areas, erosion and vehicle wear
Metals	Vehicle wear, combustion of petroleum products, maintenance materials and catalytic-converter emissions
Hydrocarbons	Vehicles exhausts, fuel, lubricants, asphalt
Nutrients	Detergents and the breakdown of vegetative matter
Gross pollutants	Anthropogenic litter

Note, verification of all pollutant sources and types to be verified during detailed design phase.

4.2.2 Proposed Stormwater Treatment Train

The proposed approach to managing stormwater runoff at the site to satisfy the above objectives include the provision of:

- A clean water diversion bund, to direct upstream flow around and away from the footprint of the proposed WTP footprint / development site;
- All runoff from introduced hardstand pad areas filtered through primary treatment devices/gross pollutant traps (two typical GPTs from Makwater of CM-GPT-SB type were used for this assessment but this decision should be reviewed at the detailed design phase);
- Pre-treatment of fine pollutants and nutrients in flows from gross pollutant traps, by passing them over a grass and rock lined channel before discharging into either tertiary treatment in a bioretention basin (frequent flows) and/or a detention basin (rare flows);
- All frequent flows off the hardstand areas (up to flow rates of approximately 150L/s) are to be captured by a field inlet with a grate in the invert of the rock and grass lined channel. The grate will divert these flows into the bioretention basin.
- Flows above 150L/s are intended to bypass the bioretention basin and continue into a downstream detention basin to prevent aggressive velocities from damaging the filter media and vegetation and avoid excessive sediment loading and clogging in the base of the bioretention basin.
- The bioretention basin has been sized to achieve pollutant removal targets for these frequent flows and to ensure the draw down and emptying of the bioretention system within 24hrs based on assumed (conservative) infiltration rates (hydraulic conductivity of filter layer and base layer of at least 100mm/hr and up to 200mm/hr).
- The detention basin has been sized to achieve quantity compliance targets through attenuation of peak flows. The proposed basin will capture and percolate flows through a large floor area and into subsoils for

all frequent flow events up to the 10% AEP event. In events larger than the 10% AEP, the basin will capture a portion of the peak flow and then spill via a broad weir designed to spread excess runoff at slow velocities into an existing vegetated gully, that will provide additional water quality treatment before discharging into the Logan River across the southern property boundary. Refer to Figure 2 for a concept diagram of the proposed water quality treatment train. Refer to Appendix A – Concept Design Drawings

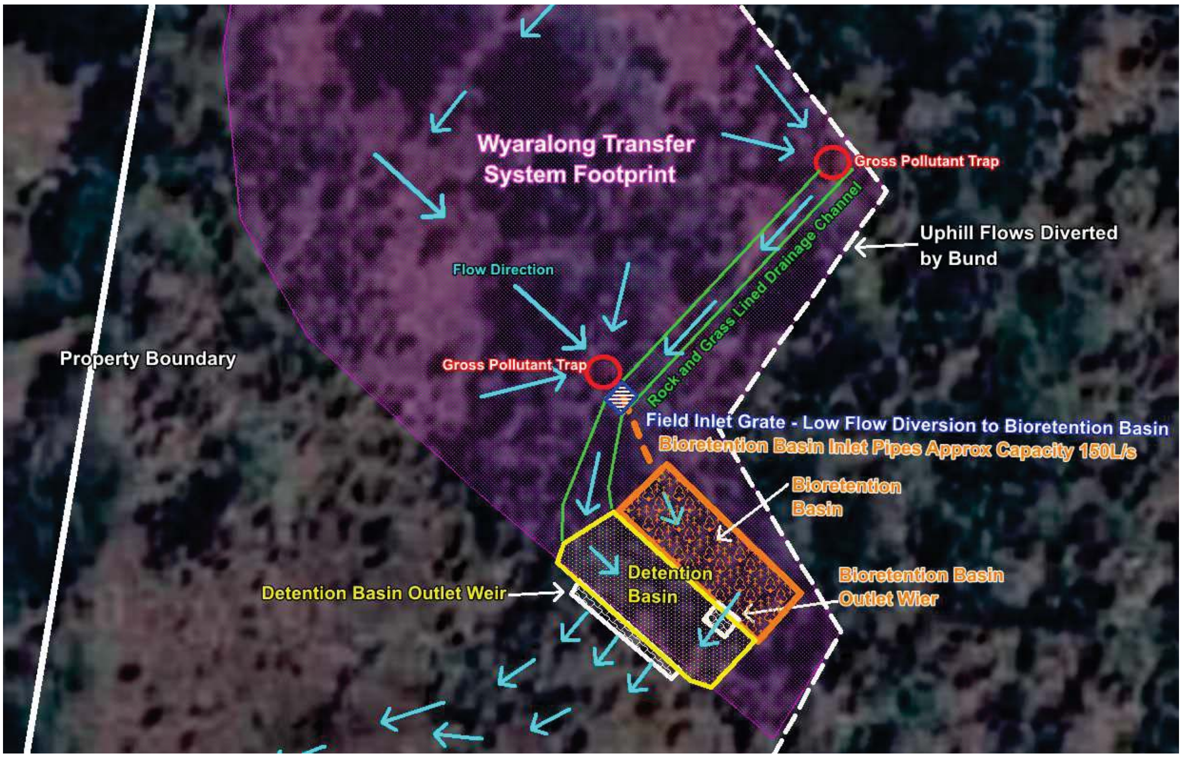

Figure 2: Concept Diagram of Proposed Water Quality Treatment Train

4.2.3 Primary treatment – Gross Pollutant Traps

Primary treatment aims to remove stormwater pollutants before reaching downstream treatment devices. By incorporating primary treatment devices into the treatment train, the efficiency of downstream devices is improved, and maintenance requirements reduced.

In-ground proprietary stormwater treatment devices are useful for treatment of stormwater on sites that are constrained by available area for larger-scale vegetated stormwater treatment systems. These devices are installed underground and target a range of pollutants in stormwater, including TSS, soluble heavy metals, hydrocarbons, oil and grease, and particulate bound nutrients.

Primary treatment proposed for the Wyaralong site includes:

- Measures to manage the risk of chemical spills associated with chemical dosing at the potable water storage tanks on the hardstand areas; and
- Gross pollutant traps with oil and sediment separators at the outfall of the hardstand areas.

The types of measures implemented to manage the risk of dosing failure and spills are identified as also being a human health risk and management measures are to be covered in the safety in design documentation for the development.

Gross pollutant traps are effective in removing anthropologic litter and large objects, while oil and sediment separators are effective at removing oil, hydrocarbons and sediment from the trafficable areas.

Secondary treatment measures have not been proposed with this CSMP.

4.2.4 Tertiary Treatment - Bioretention Basin

Tertiary treatment devices such as bioretention systems can provide a substantial improvement in stormwater quality. Bioretention systems operate by filtering stormwater runoff through densely planted surface vegetation which then percolates through a prescribed filter media. During percolation, pollutants are retained through fine filtration, adsorption and some biological uptake. Bioretention systems are effective at removing both sediment and nutrients from stormwater runoff. Literature also supports the use of vegetated measures for the treatment of hydrocarbons in runoff from car parks, roadways and paved areas.

Bioretention systems can easily be distributed throughout the development via incorporation in the base of swales or as a basin that accepts stormwater as an end of pipe device.

A bioretention basin is proposed downstream to the east of the hardstand areas. A field inlet with grate, chamber and low flow inflow pipes are proposed for positioning in the base of the rock and grass lined channel at the low point of all hardstand area drainage to capture all frequent flows up to approximately 150L/s (flows greater than 150L/s will bypass the field inlet and run directly to the detention basin). The basin is proposed to be fed by three 225mm diameter inflow pipes to evenly distribute flows onto the filtration media area on the floor of the basin. The basin floor area will have an area of approximately 400m^2 to provide:

- space for planting a sufficient amount and density of nutrient removal vegetation;
- an acceptable duration to empty (less than 24hrs), provided percolation through the base of the system can be maintained to at least 100mm/hr and preferably 200mm/hr; and
- sufficient filtration media to achieve the target pollutant reduction percentages to be compliant.

The bioretention basin was modelled in accordance with the MUSIC Modelling Guidelines Version 3.0 for South East Queensland, (Water by Design, 2018).

4.3 Effectiveness of Water Quality Management Approach

4.3.1 Water Quality Modelling

A quantitative assessment of stormwater treatment has been undertaken to assess the pollutant removal efficiencies of the treatment systems employed. This quantitative assessment has been undertaken using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) software.

The MUSIC modelling package developed by eWater (Version 6.2) estimates the impacts of development and evaluates the relative performance of various treatment options.

The model can be used to generate both pollutant concentrations and long-term pollutant loads and is recognised as the most appropriate modelling software for the planning of stormwater treatment measures for urban catchments. The model can generate pollutant loads and event mean concentrations for TSS, TP, and TN.

4.3.2 MUSIC Modelling Guidelines

The following guidelines were used to aid in MUSIC modelling:

- Music Modelling Guidelines for South East Queensland, Version 3.0, (Water by Design, 2018)
- WSUD Technical Design Guidelines for South East Queensland: Version 1, (Healthy Waterways, 2006)

4.3.3 MUSIC Model Input Data

The stormwater treatment train (i.e. use of various stormwater treatment measures in series) was developed to treat stormwater runoff generated from the redevelopment area.

The model data input consists of the following:

- Meteorological data from South East Queensland (covering a 10-year period) was sourced, and a 6-minute time step employed as per the recommendations in the MUSIC Modelling Guidelines;
- Catchment parameters including percentage impervious, rainfall-runoff parameters and pollutant generation rates – adopted as per design drawings and the values specified within the MUSIC Modelling Guidelines; and
- Catchment areas were identified based on the preliminary design drawings for the proposed WTP and property boundaries.

4.3.4 MUSIC Model Setup

The project area was split into various sub-catchments for the purpose of modelling. Table 3 details the key sub-catchment parameters.

Table 3 Summary of sub catchment parameters

Sub Catchment	Land area (ha)	Impervious percentage (%)
Existing Case		
Forest Node	10.550	0
Proposed Case		
Forest Node	8.163	0
Industrial Node (Transfer System Footprint)	2.325	70
Bioretention Basin Node*	0.062	0

*This is an approximate minimum footprint of the proposed bioretention basin including base area plus associated batters/embankments. Note that for MUSIC model calculations, the floor of the bioretention basin, where filter media is to be installed, has been set to 400m².

Figure 3 MUSIC Model Setup Schematic Diagram – Existing Case

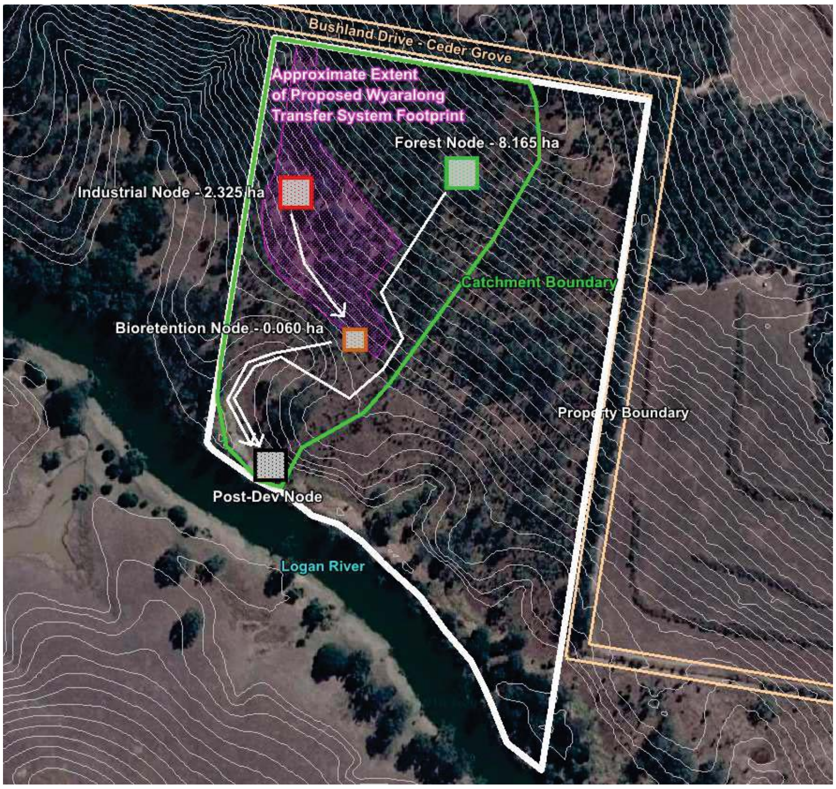

Figure 4 MUSIC Model Setup Schematic Diagram – Proposed Case

4.3.5 Modelling Results and Discussion

This section outlines and interprets the MUSIC modelling results for the proposed stormwater treatment system. Table 4 displays the pollutant load reductions performed by the bioretention basin to treat runoff from the hardstand area.

Table 4 Bioretention basin Estimated annual pollutant reduction efficiencies

Pollutant	Pollutant Reduction Targets (%)	Annual pollutant reduction efficiencies (%)
Total Suspended Solids	80	88.0
Total Phosphorus	60	81.2
Total Nitrogen	45	63.0
Gross Pollutants	90	95.3

Table 4 shows that the proposed treatment measures can be expected to achieve the target pollutant removal efficiencies for TSS, TP, TN and Gross Pollutants (litter). On this basis, the proposed treatment measures are considered to provide an appropriate level of treatment for the runoff generated within the proposed redevelopment.

Not only does the bioretention basin meet the pollutant reduction targets, it achieves this with redundancy, as some features of the system were not included in the model (for simplicity). For example, infiltration will likely occur along the rock and grass lined channel, acting like a grass lined swale. Additionally, whilst the base of the detention basin does not have filter media or specific vegetation planted for nutrient uptake, the basin is intended to be grass lined and will infiltrate flow for steady percolation of water into the subsoil, allowing emptying of the detention basin within 24 hrs. As such, additional settling of sediment is expected to occur in the detention basin.

4.4 Water Quality Management Maintenance Requirements

For the ongoing effective performance of the proposed water quality management measures, appropriate maintenance is required. Required maintenance has been addressed separately below for each management measure or component of the treatment train system with general commentary.

4.4.1 Measures to Minimise Risk of Chemical Spill

Refer to procedures outlined in safety in design and operational procedures for chemical dosing facilities onsite. The isolation measures contained therein (to mitigate risk of injury) will also mitigate the risk of overflow into onsite stormwater capture and drainage networks.

Should the chemical spill containment systems fail, and the bioretention basin collect harmful chemicals, repair of the basin (i.e. flushing, relaying of grass etc.) may be required depending on the severity of the spill.

4.4.2 Gross Pollutant Traps

It is essential that gross pollutant traps are cleared regularly to maintain capacity to continue to capture gross pollutants, continue to convey flow capacity and prevent re-suspension of pollutants where building up occurs. Refer to proprietary product maintenance guides from the manufacturer for best maintenance practices.

4.4.3 Bioretention Basin

The proposed bioretention system relies on the removal of pollutants for infiltration of frequent flows and removal of pollutants via sediment capture and nutrient uptake via vegetation. It is therefore essential to monitor the performance of the bioretention system by regular maintenance activities to prevent blockage of biofiltration filter media and survival of nutrient removing vegetation in the floor of the basin.

Refer to the relevant healthy waterways guidelines for industry standard recommendations for the management of bioretention systems.

4.5 Proposed Approach to Water Quality Management – Construction Phase

This stormwater management plan is conceptual and has been prepared to cover the site configuration for the Wyaralong Transfer System only. Whilst it is acknowledged that the site will likely change over time and be subject to renewed construction activities, the proposed measures in this management plan have considered the construction works associated with early works.

In accordance with State Planning Policy and Logan City Planning Scheme Policy (Version 5.1, 2015), it is recommended that an erosion and sediment control plan be prepared for construction works. The plan is to be prepared is to be compliant with best practice measures and techniques as specified in best practice guidelines, as in the International Erosion Control Association (IECA) Best Practice Erosion and Sediment Control (BPESC) document.

The potential impacts on water quality during the construction phase of the development are likely to be:

- Elevated suspended solids and turbidity in stormwater runoff
- Hydrocarbon pollutants, primarily from vehicles used
- Generation of toxic materials such as concrete runoff

Potential impacts associated with contamination from spills and leaks will be managed in accordance with the mitigation measures detailed in the Concept Erosion and Sediment Control Plan (CESCP)

The following objectives will be applied to ensure that stormwater is managed to protect the existing nearby water quality during the construction phase:

- The integration of permanent and temporary water quality control measures into the design
- Reduce the potential for erosion and subsequent sedimentation
- Ensure adequate drainage and pollution control measures are implemented to manage runoff from disturbed areas of the site
- Ensure materials that may contaminate waters are not released to any waters either in a direct or indirect manner because of construction activities

The stormwater management measures proposed in this CSMP consist of onsite detention of runoff, which is a measure commonly used for management of sediment runoff during construction works. Opportunity may exist to establish stormwater management devices such as sediment basins during construction phase for erosion and sediment control for re-use / upgrade to become permanent stormwater management devices for early works e.g. detention basins.

These objectives align within State Planning Policy (SPP) Code for water quality (Department of State Development, Infrastructure and Planning, July 2014) and are outlined in more detail in the CESCP.
The CESCP has been prepared as part of the Development Application documentation. This plan outlines the controls that can be implemented during the construction phase to minimise both offsite and onsite water quality impacts and has been prepared in accordance with Best Practice Erosion and Sediment Control (IECA, 2008).

5 Stormwater Quantity Management

5.1 Water Quantity Compliance Standards

As per the Logan city Planning Scheme Policy (version 5.1 2015). the following compliance standards are identified as key to the development site from a water quantity perspective:

5.1.1 Stormwater Runoff

- Section 3.6.2.10 – "No Worsening"
  - The development must achieve the principle of "*no worsening*", as per the Queensland Urban Drainage Manual., where:
    - The development does not result in a detrimental impact on the flooding, or flood risk of any area;
    - Does not result in adverse impacts of any other property;
    - Does not result in an increase in peak discharge from the development site;
    - Ensures the time of concentration of the peak of the event does not decrease or increase the likelihood of coincidence peaks occurring with adjoining catchments.
- Section 3.6.2.11 – Estimation of stormwater runoff
  - Where the catchment is larger than 5 hectares,
    - Estimation of runoff is to be calculated using an appropriate rainfall-runoff modelling software package; and
    - An analysis of storage capacity (e.g. basin storage / stage discharge relationship) is required for an existing or proposed basin.

5.1.2 Detention Systems

3.6.6.1 "Detention Systems" specifies the following in relation to detention systems:

a. A variety of different detention systems are acceptable for use, provided they are suitable for site constraints, development type and ownership.

b. Detention basins are an acceptable type of system except where attenuated flood peaks from tributaries coincide with the main flood path in a manner that causes or worsens 'overfloor' flooding downstream.

3.6.6.2 Location of Detention systems;

1. Detention systems are required to be designed and constructed to be at or above the 2% AEP local and regional flood level.

3.6.6.8 Detention basin size;

2. Detention basin size shall:

   (a). be determined using an appropriate computer model;

   (b) consider the function of the detention system within the catchment;

   (c) assess safety requirements for no worsening for the full range of AEP storm events up to and including the 1% AEP event.

5.2 Water Quantity Management Approach

The proposed water quantity management approach for the proposed development is made up of two components, to satisfy the compliance standards detailed in Section 5.1:

1. Diversion of upstream overland flows around the proposed development site, to prevent excess flooding on the development hardstand areas and to minimise the quantity of runoff from the proposed hardstand areas within the proposed WTP footprint area. The sizing of the bund to be designed so as not to overflow in the 1% AEP event and be of an easily maintainable form.
2. Installation of a detention system, to prevent the increase of peak runoff flows off the development site which includes the introduction of hardstand areas / increased imperious area.

5.2.1 Clean Water Flow Diversion Bund

The purpose of the introduction of the diversion bund is to reduce the frequency and quantity of flows from upstream / uphill areas of the property from traversing the proposed WTP site. To assess for the required bund height to ensure no overtopping in events up to the 1% AEP event, an overland flow hydraulic model was developed covering the local catchment using industry standard two-dimensional flow simulation software TUFLOW.

The TUFLOW model was setup with a rain on grid approach, which applies design event rainfall directly onto the terrain, where levels, velocities and flow magnitudes, timing, direction, as well as locations of flow concentration are produced by the model outputs.

Further detail regarding TUFLOW model setup is included in of the model is described in Hydraulic Modelling Section 5.5.

An existing case scenario and developed case scenario (including the flow diversion) bund were setup in TUFLOW. The peak flows were compared at various locations, as the bund intercepts runoff and redirects flow to outfall from the property into the Logan River in different locations in the design case scenario. Refer to Figure 5 and Figure 6 for a plan view of flow distribution for the existing case scenario before and after the introduction of the flow diversion bund. It was found that, whilst flow was redirected, and outflow was increased / focused into a central gully, the overall runoff volume from the property has not been increased by the introduction of the bund. Refer to Figure 7 for a typical section of the proposed bund. Note that the bund alignment shown in figures is approximate and height of bund exact alignment will be subject to finalisation in detailed design. Refer to Appendix A – Concept Design Drawings.

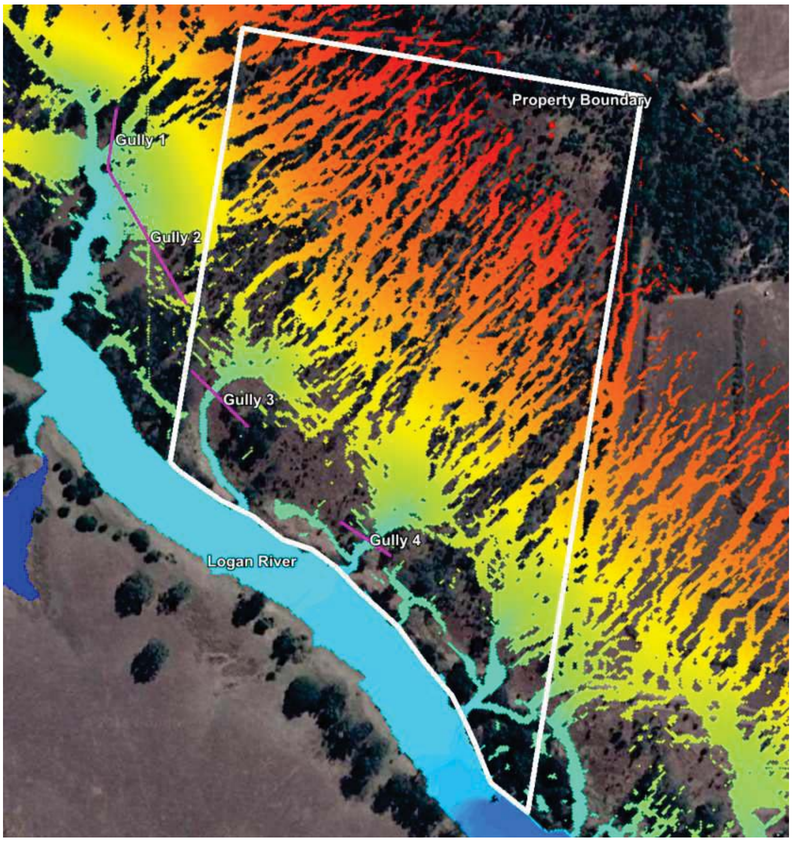

Figure 5 Approximate extents of runoff existing site conditions 1%AEP

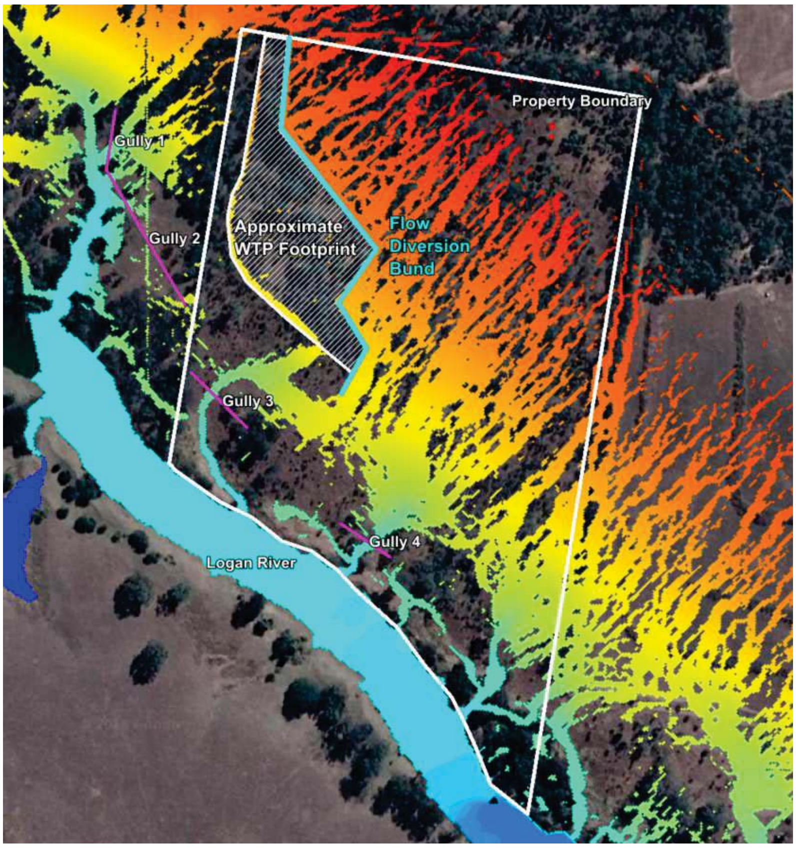

Figure 6 Approximate extents of runoff with diversion bund 1% AEP

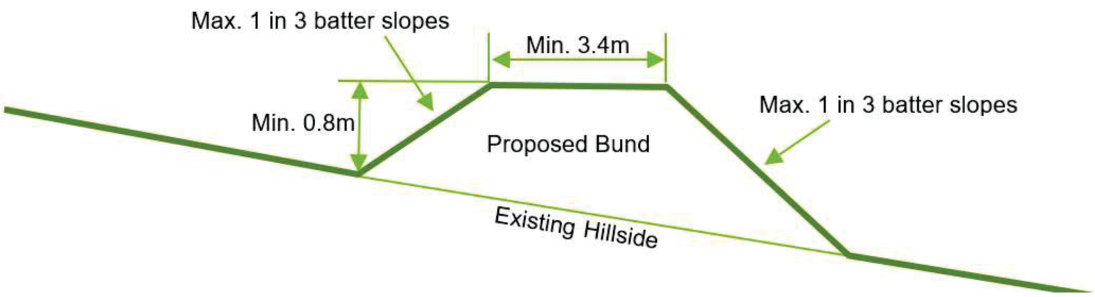

Figure 7 Typical Section of Flow Diversion Bund

5.2.2 Flow Detention System

To be compliant with the water quantity compliance criteria, the purpose of the system of detention is to prevent the increase in peak flow runoff from the site because of the increased impervious associated with the proposed development. Events assessed included the 10% AEP and up to the rarer 1% AEP event.

The proposed system utilises the capacity of both the bioretention basin and the detention basin to attenuate peak runoff and volumes. The capacity of the bioretention basin has be set to capture 150L/s for the entirety of the critical duration 1% AEP (15 min) storm. The capacity of the detention basin, coupled with the detention provided by the bioretention basin, has been sized to reduce the peak flow of the critical duration 1% AEP (15min) storm so there is no increase when compared to existing conditions. This approach ensures both a reduction in total runoff volume and a reduction in peak runoff from the hardstand site for all events up to the 1% AEP event.

To ensure no adverse impacts to the gully downstream of the proposed detention basin, a wide (30m) overflow weir has been proposed. Installing a wide detention basin overflow weir aims to ensure slow, shallow flow depths when the basin overtops. Distributing flows reduces the risk of downstream erosion on the basin overflow chute on the downhill batter of the basin wall and in the gully further downstream. A wide weir also increases the available outflow capacity through the 0.3m deep weir, to allow extreme events (events larger/rarer than the 1% AEP) to pass through the system with a significantly reduced risk overtopping and threat to the structural integrity of the detention basin walls. Refer to Appendix A – Concept Design Drawings

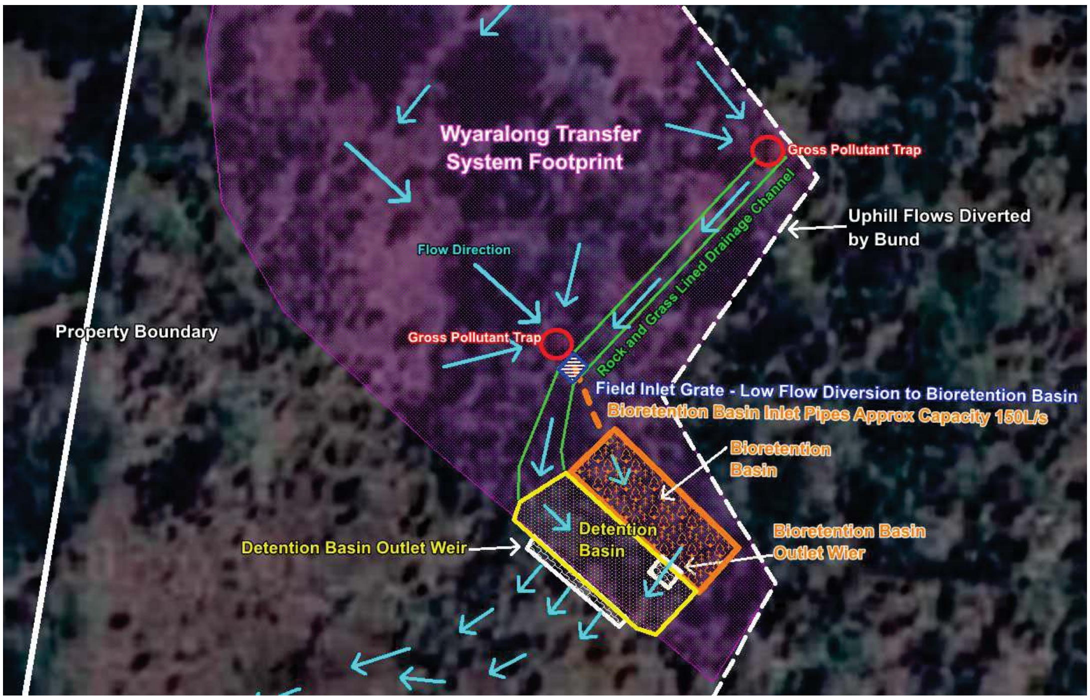

Figure 8 Conceptual Diagram of Proposed Stormwater Detention System

Table 5 Approximate elevations of proposed basins (Bioretention and Detention)

Basin	Base Elevation (m2)	Outflow Weir Elevation Above Floor of Basin (m)	Outflow Weir Elevation (m AHD)	Depth of Overflow Weir (m)	Overflow Weir Crest Width (m)	Elevation of top of Basin Bund (m AHD)
Bioretention Basin	35.95	0.5	36.45	0.3	5	36.75
Detention Basin	33.50	0.5	34.00	0.3	30	34.30

Table 6 Approximate areas and volumes of proposed basins (Bioretention and Detention)

Basin	Base Area (m2)	Storage Volume to outflow weir elevation (m3)	Internal Batter Slopes of Basin	Overflow Weir Batter Slopes	Storage Volume to Overflow Weir Elevation (m3)	Total Storage Volume to Top of Basin Embankment (m3)
Bioretention Basin	400	254	1 in 3	1 in 3	254	663
Detention Basin	800	447	1 in 3	1 in 3	447	764

Note that all dimensions are approximates based on generalised trapezoidal basin shapes. Updated dimensions for actual shapes of basins are shown preliminary/conceptual design drawings, which have been developed to observe and maintain the minimum capacities and sizing indicated above.

5.3 Effectiveness of Water Quantity Management Approach

5.3.1 Clean Water Flow Diversion Bund

Table 7 and Figure 9 show the impact of the introduction of the flow diversion bund on the behaviour of overland flow across the property. Notably:

- No significant increase to the volume of runoff from the property is created;
- The resultant peak water level along the uphill toe of the proposed bund will not overtop the proposed bund typical section shown in Figure 7;
- Velocities along the uphill toe of the proposed bund are limited to a maximum of 1.75m/s in the peak design event. This velocity is not believed to represent a scour risk to the bund (the short duration of the event and grass cover of the bund are expected to allow protection up to 2m/s). The bund height has not been optimised and could be reduced along some sections of the extent subject to detailed design.
- Flow through gullies that are not on the Seqwater site (Gullies 1 and 2) is not increased by the diversion bund (actually experiences slight decrease).

Table 7 Peak Flow and Runoff Volume comparison with introduction of diversion bund

Gully Location	Existing Conditions (E006) 1% AEP Event Peak Flow (m3/s)	Existing Conditions + Diversion Bund (D013) 1% AEP Event Peak Flow (m3/s)	Existing Conditions (E006) 1% AEP Event Volume Runoff (m3)	Existing Conditions + Diversion Bund (D013) 1% AEP Event Volume Runoff (m3)
Gully 1 (DS4)	2.0	1.7	2768	2270
Gully 2 (DS3)	2.1	0.7	2650	851
Gully 3 (DS7)	2.5	3.4	3223	5037
Gully 4 (DS8)	3.4	3.5	4459	4604
Total runoff volume of all gullies before and after introduction of flow diversion bund*			**13100**	**12762**

* Note that these flow totals are for those flows traversing the lines indicated in Figure 5 and Figure 6 to demonstrate no significant increase in flow volumes off the property as a result of flow redirection. These figures show only those flows with a depth above a reporting cut off depth, which has been set at 20 mm. There is also sheet flow that occurs in between the cross-section locations for flow magnitude reporting, which will account for the ~3% reduction in modelled runoff through all gullies from existing to developed case scenarios.

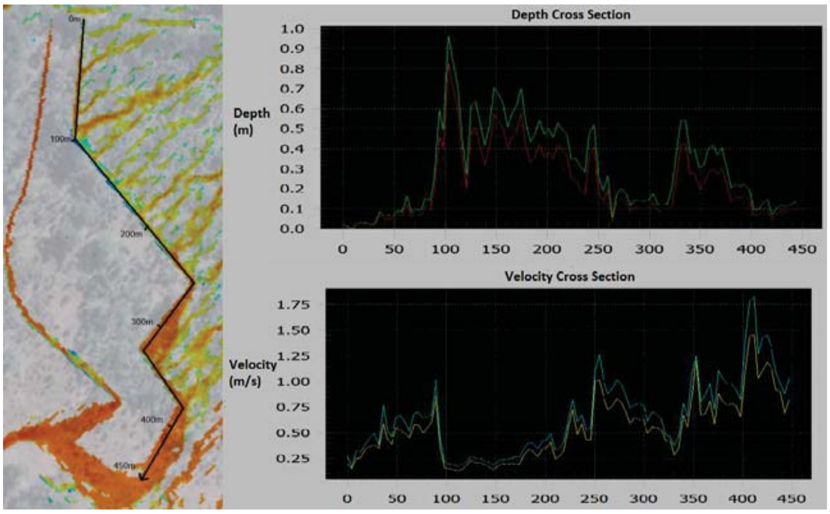

Figure 9 1% AEP (100yr) 30min storm depth and velocity of diverted flows around bund

5.3.2 Flow Detention System Effectiveness

The proposed detention system has been designed to capture additional runoff created by the hardstand on the WTS footprint by positioning the bioretention basin and the detention basin immediately to the east, upstream of Gully 3.

Figure 10 shows a diagrammatic representation of the direction of flows in the proposed case scenario for the detention system.

The routing of inflow WTS footprint runoff hydrographs for existing and proposed conditions (generated by TUFLOW modelling) though the proposed detention system was achieved by routing inflow hydrographs into each storage while using a broad crested weir equation to estimate the outflow from the detention basin for various depths of flow (levels in the basin) above the weir. Industry standard hydrologic modelling package XP-RAFTS was used to carry out the attenuation effect of the basin and weir arrangement on the post development input hydrographs. Figure 10 and Figure 11 show the routed inflow and outflow hydrographs for the proposed detention system for the 1% and 10% AEP events.

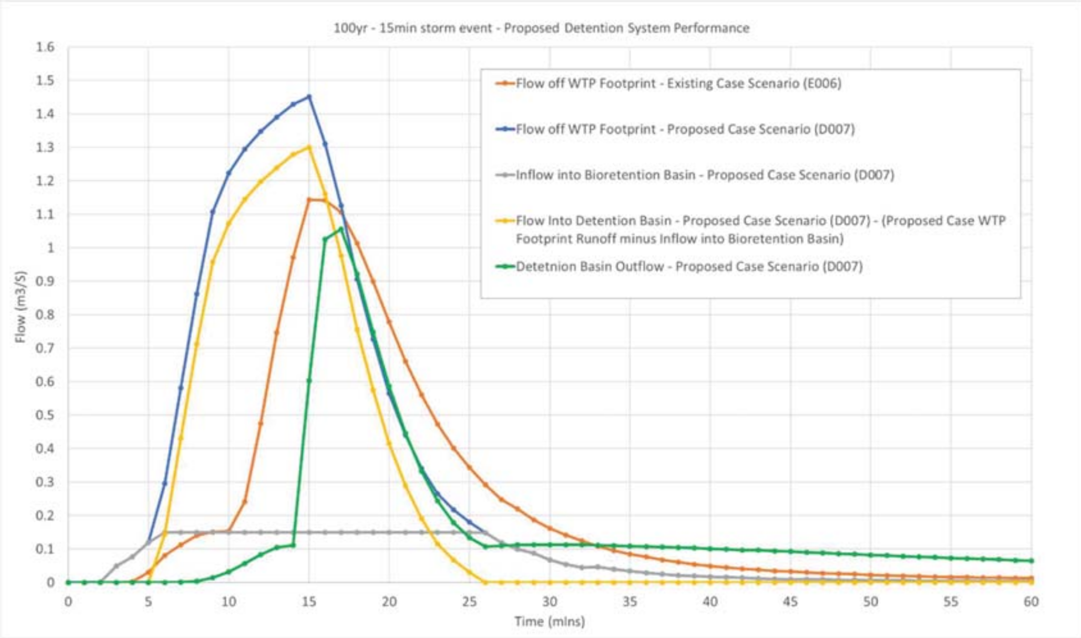

Figure 10 Performance of detention features capturing 1% AEP runoff from hardstand areas

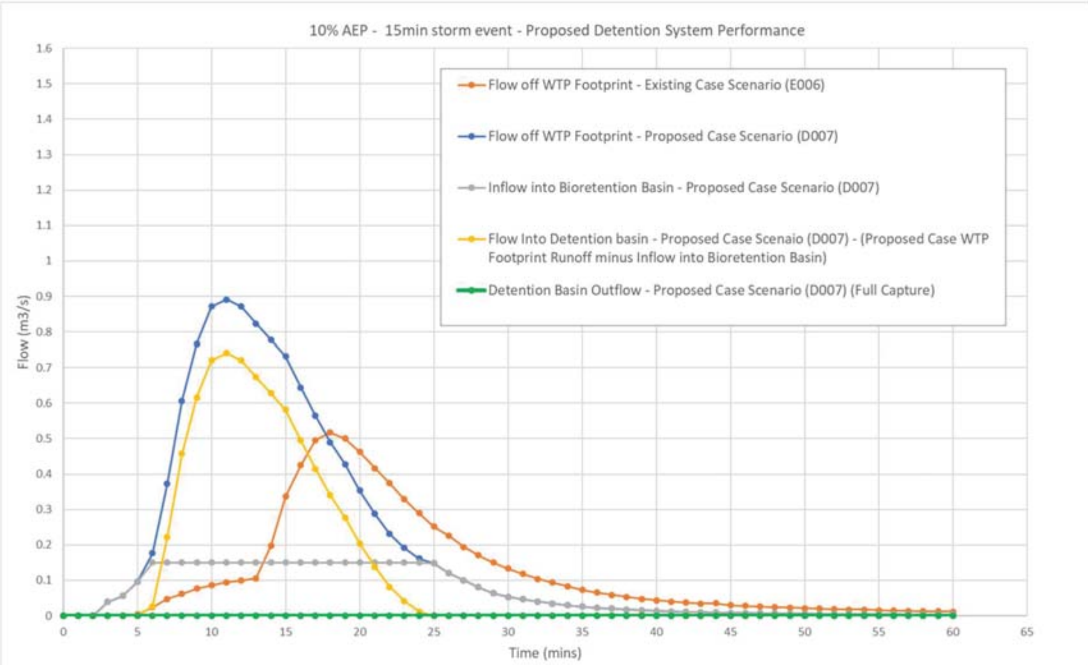

Figure 11 Performance of detention features capturing 10% AEP runoff from hardstand areas

Table 8 Proposed Detention System Performance – Peak Flows and Total Volumes

	1% AEP 15min Storm		10% AEP 15min Storm	
	Peak Flow (m^3/s)	Runoff Volume (m^3)	Peak Flow (m^3/s)	Runoff Volume (m^3)
Flow off WTP Footprint – Existing Case Scenario (E006)	1.14	844	0.52	436
Flow off WTP Footprint – Proposed Case Scenario (D007)	1.45	1098	0.89	684
Flow into Detention Basin – Proposed Case Scenario (D007) (proposed Case WTP Footprint Runoff minus Inflow into Bioretention basin)	1.30	843	0.74	444
Inflow into Bioretention Basin – Proposed Case Scenario (D007)	0.15	254	0.15	240
Detention Basin Outflow – Proposed Case Scenario	1.06	695	0*	0*

*(10% AEP flow and total volume captured completely within detention basin)

As in Table 8, the implementation of the detention basin with the proposed sizing will attenuate flows so that the 1% AEP peak flow from the WTP footprint area for existing case (1.14m/s) will not be exceeded in the proposed condition, where a peak outflow of 1.06m^3/s has been approximated. Similarly, the total volume of runoff has also been reduced for the 1% AEP event from 844m^3 to 695m^3.

For the 10% AEP event, the proposed basin size has been selected to be of sufficient size to completely capture the hardstand runoff. Given that the peak outflow has not increased between the 1% and 10% AEP events, it is assumed that it will not be increased in the intermediate events (the 2% AEP and 5% AEP events) either.

5.4 Water Quantity Management Maintenance Requirements

To ensure the ongoing desired level of service from water quantity management features (the flow diversion bund and detention system), appropriate maintenance of the basin and associated components should be observed.

The following components are key components to maintain to ensure ongoing functionality of the detention system and the flow diversion bund.

5.4.1 Blockage of filed inlet grate, stormwater pits and GPTs

It is desirable to regularly clean inlet grate situated in the drainage channel such that it does not become blocked for a significant period. The flow diverted into the bioretention basin does also contribute to the overall attenuation of peak flow events for all events.

5.4.2 Integrity of detention basin overflow weir

The integrity of the overflow weir from the detention basin is critical to ensure the risk of basin overflow erosion and failure risk is minimised. The rock placed along the crest of the weir and down the nape should be maintained such that the coverage remains uniform across the intended extent.

5.4.3 Integrity of the flow diversion bund

The flow diversion bund has been designed be able to be maintained via mowing, with a 3.4m top with and 1 in 3 batters. Grass should not be mowed to short as dead or very short patches can create 'weak' points where higher velocities can cause scour. The bund should be maintained with a uniform covering of grass.

5.5 Hydraulic Modelling

5.5.1 TUFLOW Model Data Input

The following data inputs were used for development of the TUFLOW hydraulic model for assessment.

- Topographic Data was collected from digital elevation data obtained from the Geosciences Australia ELVIS portal. The data collected consisted of 5m Digital Elevation Model (DEM) derived from LiDAR datasets.
- Aerial photography was sourced from Google Satellite Imagery and processed within QGIS spatial software.
- An assessment of the potential hydrologic parameters was undertaken according to the recommendations and methods outlined in the Australian Rainfall and Runoff (AR&R 2016) Guidelines. This involved the determination of rainfall parameters (intensity, frequency and duration (IFD) coefficients), potential losses and potential losses for the assessment area.

5.5.2 TUFLOW Model Setup

A 2-dimensional hydraulic model was developed using the TUFLOW software to simulate the flood behaviour within the project area. 2D modelling utilises a square element mesh to represent the creek and floodplain, thus allowing multi-directional flows and more realistic predictive capacity for complex channel and floodplain interaction.

The hydraulic modelling was undertaken using a 2 m x 2 m grid resolution. This resolution was selected to allow for adequate representation of topographical details within the model, including watercourses and overland flow areas, while maintaining manageable and practical runtimes.

The 2D time step used in the 2m cell-size model was 0.5 seconds. This is acceptable for a model of this nature, considering the grid cell-size and the flow depths encountered throughout the 2D domain. Losses and material roughness parameters for the model layers can be seen below.

Table 9 TUFLOW adopted model losses and roughness parameters

Material Layer	Model Losses		Roughness 1 (<0.01 m Depth)	Roughness 2 (>0.015 m Depth)
	IL (mm)	CL (mm/hr)		
Fields/Scattered Brush	10	2	0.03	0.04
Medium Dense Vegetation	10	2	0.1	0.1
Hardstand Area	0	1	0.02	0.015

A tailwater boundary was modelled at the downstream extent of the model, as a hydraulic gradient (HQ) condition, utilising a 0.05 m/m water surface slope

A critical duration of 15 minutes was predicted for the hardstand area (1 in 100 and 1 in 10 AEP events), with a critical duration of 30 minutes for the bunded area (1 in 100 and 1 in 10 AEP events)

5.5.3 TUFLOW Model Scenarios Run

For the purposes of:

- estimating the likely increases in runoff due to the proposed increase in impervious in the catchment;
- determining the magnitude of redirected flows on site (for diversion bund sizing); and
- determining inflow hydrographs to detention system features (the bioretention and detention basins),

the following TUFLOW model scenarios were setup and run (as in Table 10).

Table 10 Hydraulic model scenarios run

Run Number	Run Description
E006	Existing Case Scenario with No changes to undeveloped impervious and roughness values across the model terrain. No changes to terrain to represent WTP footprint or bunding
D013	Existing Case Scenario with No changes to undeveloped impervious and roughness values across the model terrain. Inclusion of flow diversion bund to model terrain Inclusion of flow capture bund around the bottom of the proposed WTP footprint (for estimating runoff from footprint without impervious introduced).
D007	Proposed Case Scenario with Updated impervious and roughness values to represent the introduction of the proposed WP footprint area Inclusion of flow diversion bund to model terrain Inclusion of flow capture bund around the bottom of the proposed WTP footprint with (for estimating runoff from footprint with impervious / hardstand areas introduced).

6 Assumptions and Limitations

The following assumptions and limitations are relevant to the preparation of this CSMP and associated recommendations for management measures, sizing and performance outputs:

- All modelled results are subject to the assumptions and limitations of the software packages used for calculations and the quality and availability of appropriate input data for use;
- All methodologies adopted for the design of treatment measures are subject to the best practice guidelines referred to compliance policy;
- The proposed management measures proposed in this CSMP are approximate and not suitable for substitute for detailed design; and
- Management measures proposed have been designed based on the latest preliminary drawings and proposed land use for the property at the time of preparation of this plan.

7 Conclusions

This Conceptual Stormwater Management Plan (CSMP) proposes an integrated stormwater quality and quantity management approach with measures to provide a basis for developing a detailed design and legislative compliance when the property is developed. This work has been completed to satisfy State Planning Policy and Logan City Council's development guidelines. Whilst an appropriate level of detail has been included for the design to date, it is noted that the measures proposed remain approximate and do not constitute a detailed design.

Seqwater must capture and treat runoff from hardstand areas to maintain appropriate water quality targets. Similarly, Seqwater must attenuate peak flow runoff from developed areas to manage water quantity impacts. The recommended measures to achieve these two goals are as follows:

- Install a clean water diversion bund (typically 0.8m high with a 1 in 3 slope) around the uphill extents of the proposed development.
- Fit gross pollutant traps to the outfall of hardstand areas and stormwater drainage pipes. The specific trap type and requirements will be determined by detailed design.
- Construct a rock and grass lined channel along the western edge of the development to capture and transport flows from the proposed hardstand areas to the basins. Capture to the bioretention basin to be via a DTMR standard field inlet with a grate positioned in the invert of the channel adjacent the low point of the hardstand area.
- Construct a vegetated bioretention basin, with a minimum base area of 400m^2 and a filter media layer of 0.4m depth, with a 0.2m sand base layer inclusive of underdrains. The basin batters should be no steeper than 1 in 3. A high flow overflow weir should be installed 0.5m above the basin bed with a crest width of 5m and a weir depth (top of adjacent wall to crest of weir) of at least 0.3m. This weir will safely convey flow from rare events that overfill the bioretention basin to the detention basin.
- Downstream of the bioretention basin, construct a grass lined detention basin. The detention basin should have a minimum storage capacity (to outflow weir height) of approximately 450m^3. The proposed design has a base area of 800m^2 and depth to outflow weir of 0.5m. All internal batters should have a 1 in 3 slope. The outflow weir should have a width of 30m with a weir depth of at least 0.3m. This weir will safely convey flow from rare events that overfill the detention basin to grade.

8 References

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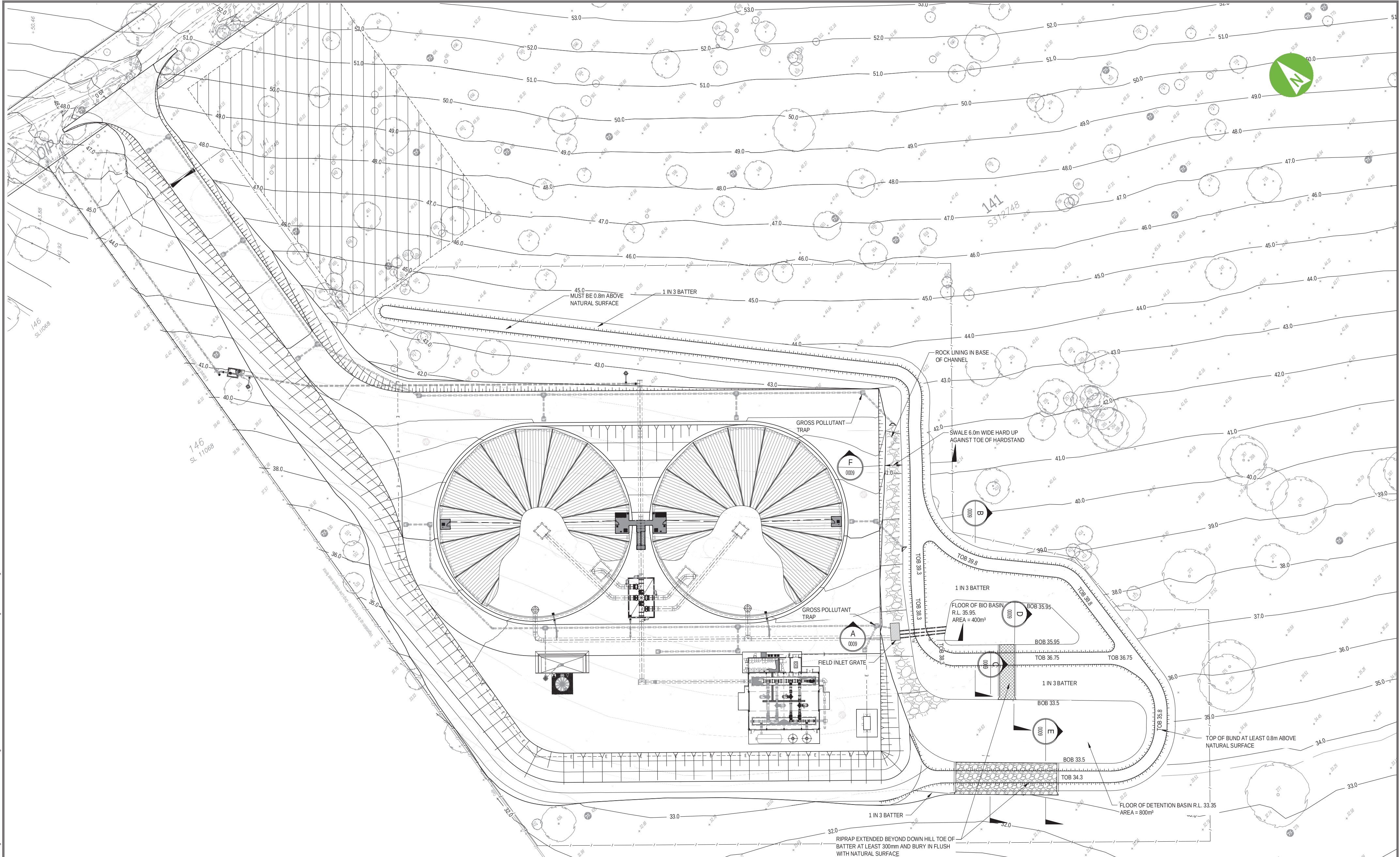
Appendix A – Concept Design Drawings



Indicative updates to Transfer system layout to reflect updated stormwater management system

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CHECKED	APPROVED	DATE
H. SALMON		21.01.2019

SCALES — 100mm ON ORIGINAL DRAWING
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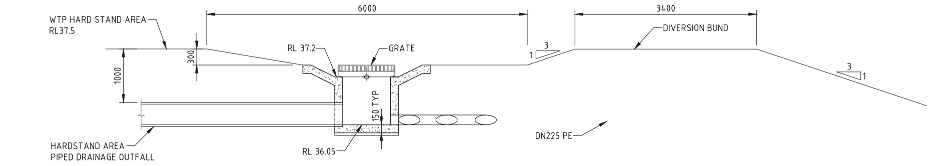

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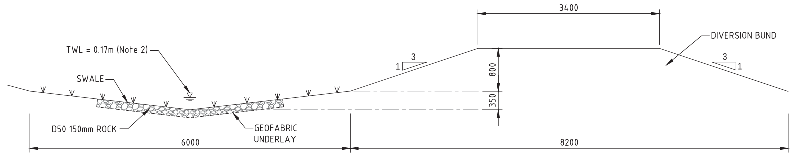

TYPICAL SWALE AND DIVERSION BUND SECTION F – F
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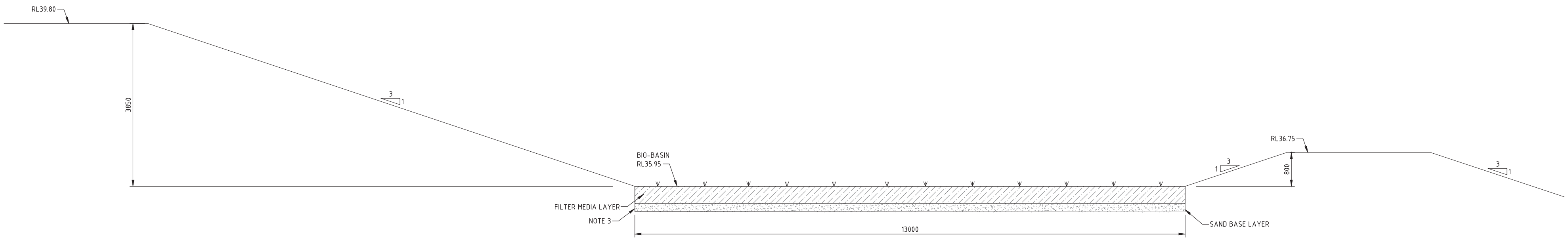

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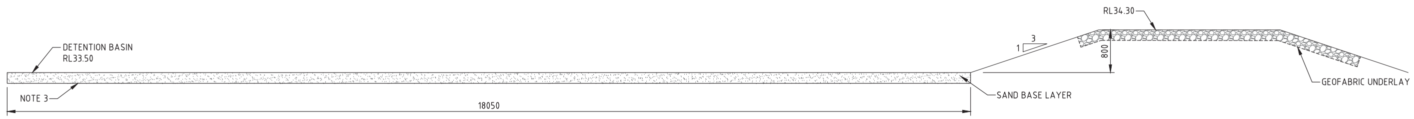

DETENTION BASIN SECTION C – C
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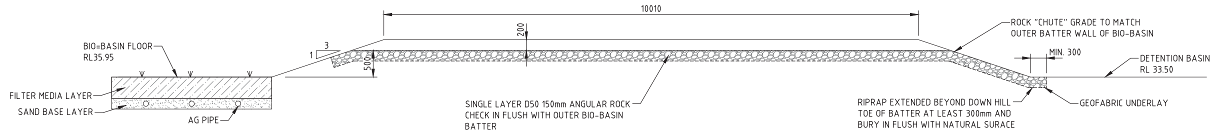

BIO-BASIN WEIR SECTION D – D
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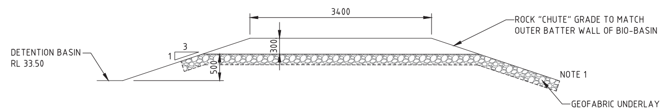

DETENTION BASIN WEIR SECTION E – E
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NOTES:

1. EXTEND ROCK PROTECTION TO THE TOE OF THE EMBANKMENT WALL AND BEYOND BY AT LEAST 300mm.
2. TWL IN DESIGN 100YR ARI EVENT.
3. DRAINAGE PIPE TO BE INCLUDED IN THE BASE AT 1.5m CENTRES TO FACILITATE DRAINAGE BENEATH THE BASINS.

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H. GLEESON	J. LUCK	
CHECKED	APPROVED	DATE
H. SALMON		21.01.2019

SCALES — 100mm ON ORIGINAL DRAWING
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Indicative updates to Transfer system sections to reflect updated stormwater management system

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