Attachment C

Pacific National

Little River Logistics Precinct —

Stormwater Management Plan

FOR / Civil Engineering Services

CLIENT / Pacific National

DOCUMENT NO / VE22064-RPT-WA-0001 REV / K DATE 6/07/23

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CONTENTS

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EXECUTIVE SUMMARY

The Little River Logistics Precinct is a proposed intermodal freight terminal at Little River, Victoria. The site discharges at 4 culvert outlets across the site, draining into tributaries of Ryan Swamp Drain which confluences with Little River. The river itself is part of the Port Phillip Catchment and flows into the Port Phillip Bay Western Shoreline wetland – A Ramsar wetland holding biodiversity values and invaluable habitat for native fish, birds, amphibians, and mammals. Given the proposed change of land use, the management of stormwater discharge quality and quantity is a key consideration for mitigating and managing the impacts of the proposed works.

The development site is located within Wyndham City Council (WCC) local government area (LGA) and therefore, the management of site-specific stormwater run-off will be dictated by the WCC council guidelines and the Engineering Design and Construction Manual (EDCM) under the Victorian Planning Authority.

Melbourne Water takes direct management responsibility for streams/waterways with catchments greater than 60ha – therefore, for the water entering Little River, the water quality is dictated by the guidelines set by Melbourne Water in conjunction with the Environmental Reference Standard (ERS). As such, it is anticipated that the Ryan Swamp Drain tributary that conveys external flows though the site will be a Melbourne Water asset, and as such, designed to Melbourne Water requirements.

The site objective for managing stormwater run-off peak flows is to match pre-development peak flows to emulate the existing flow regime as close as practicably possible. To achieve this objective, a series of on-site stormwater detention (OSD) structures are proposed within the development. OSD will be implemented via a combination of end-of-line structures, in the form of basins and wetlands, and in-line structures.

The OSD basins and wetlands are intended to manage stormwater run-off from the public road network. Future warehouse lots are expected to provide on-lot stormwater detention, most likely in the form of underground or above-ground tanks. The results of managing stormwater quantity are displayed in Appendix E of this report. The analysis of these results demonstrates a slight reduction in the stormwater run-off peak flows discharging from site, which can be seen below.

OUTLET ID:	PRE-DEV PEAK FLOW (m3/s)	POST-DEV PEAK FLOW (m3/s)	POST-DEV DETAINED PEAK FLOW (m3/s)
A	3.08	17.04	2.17
B	11.79	13.43	13.43*
C	2.56	9.63	2.03
D	1.93	4.73	1.89

**Ryan Swamp drain tributary unattenuated to avoid peak flow from Ryan Swamp Drain tributary superimposing with peak flow from Little River.*

Water quality targets from the site are governed by the Victorian Urban Stormwater Best Practice Management Guidelines (CSIRO, 1999 – prepared by Melbourne Water) for total pollutant removal objectives. The document outlines the reduction targets required from a greenfield site in terms of pollutants discharged from site in the context of suspended solids, phosphorous, nitrogen and litter. Section 4 of this report demonstrates how these objectives are met as percentage reduction targets, verified through MUSIC modelling. In addition, pollutant concentrations entering waterways is dictated by the ERS document for receiving waterways in the context of the same pollutants. These targets are met and achieved through bioretention basins, sediment traps and the large, proposed wetland in the south of the site. MUSIC modelling was used to verify these objectives being met and can be found in the summary table below.

POLLUTANT	Receiving Water Objective (mg/L)	Receiving Water Result – Post Development (mg/L)
Total Suspended Solids (mg/L)	80	18.2
Total Phosphorous (mg/L)	0.08	0.078
Total Nitrogen (mg/L)	0.9	0.9

Based on the investigation in this report, the water quantity discharging from the site has resulted in a non-worsening from the proposed development of the site. These results have been verified through calculations and simulated modelling. The selected treatment train for water quality meets the Victorian Urban Stormwater Best Practice Management Guidelines for pollutant reductions.

1 INTRODUCTION

1.1 Purpose of Report

This stormwater management plan is being undertaken in parallel with a land rezoning (Planning Scheme Amendment) and has been prepared to report on the proposed stormwater quantity and quality systems required. This report specifically refers to the site for the proposed Little River Logistics Precinct at Little River Road, Little River Victoria.

This report will address the following requirements:

- Catchment hydrology relevant to the site under existing and developed scenarios, including Rational method calculations.
- Management of increased stormwater/ peak flow rates generated from the site resulting from an increase in impervious area.
- Management of overland flow from external catchments upstream to the proposed development.
- Stormwater quality requirements for the subject development in accordance with "Clause 56" of Victoria EPA; and
- Stormwater quality requirements within the Environmental Reference Standard (2021) indicators and objectives for Port Phillip Bay in terms of pollutant concentrations as a result of the developed works and;
- Concept and functional design of the stormwater drainage system, including on-site detention and overland flow conveyance channels.

This report is to be read in conjunction with the Stage 2 Flood Impact Assessment report VE22064_RPT _002_FIA which addresses flooding impacts in the major storm events.

1.2 Terminology

The flood terminology adopted in this report is consistent with the Australian Rainfall and Runoff 2019 (ARR2019) terminology.

The frequency of a flood event is expressed in terms of its Annual Exceedance Probability (AEP); the probability of an event being equalled or exceeded within a year. Smaller magnitude events are described by Exceedances per Year (EY); the average number of times a year in which the event is likely to be equalled or exceeded. Previously flood probabilities have been described by the Average Recurrence Interval (ARI); that is the average period between occurrences equalling or exceeding a given value. Some documents, such as Development Control Plans and Guidelines still refer to the ARI terminology.

For example, a 1% AEP event has a 1% chance (i.e., a 1 in 100 chance) of being equalled or exceeded in any one year and is equivalent to a 100-year Average Recurrence Interval (ARI) event. In the same way, a 5% AEP event is the equivalent of a 20-year ARI event.

1.3 Design Standards, Codes and Policies

The following documents have been used as part of this review:

- Drainage Design Guidelines – Wyndham City Council (2020).
- Engineering Design and Construction Manual (EDCM) for Subdivision Growth Areas – Victorian Planning Authority (2019).
- Wyndham City Council WSUD Asset Selection and Design Standards Guideline, (2018).
- Wyndham City MUSIC Software Guidelines.
- Land Development Manual – Melbourne Water.
- WSUD Engineering Procedures: Stormwater - CSIRO (2005).
- Urban Stormwater: Best Practice Environmental Management Guidelines (2006).
- Australian Rainfall and Runoff – A Guide to Flood Estimation (2019).
- Austroads Guide to Road Design Parts 5, 5A, 5B (2021).
- Australian Runoff Quality Guidelines.
- SEPP (Waters) (2018).
- Environment Reference Standard, EPA (2021).
- Matters of National Environmental Significance: Significant Impact Guidelines 1.1 (2013).
- Environmental Protection and Biodiversity Conservation Act (1999).
- Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site Management Plan (2018).
- Australian Standard AS3725 – Design for installation of buried concrete pipes.

1.4 Key Stakeholders

These key stakeholders, along with their roles and stake in the project, are described below:

Agency	Accountability	Approvals Required
Local Government: Wyndham City Council	• Urban stormwater management • Urban planning • Building and planning approvals	Council approval is required for the internal drainage strategy and management of on-site stormwater detention and treatment
Water Authority: Melbourne Water	• Waterway Health • Floodplain Management • Major Drainage Systems	Melbourne Water Approval is required for the management of the Ryan Swamp Drain Main Channel and Tributaries and any flow that outlets into Little River. This includes management of the major stormwater drainage systems.
Rail Authority: VicTrack, V/Line and ARTC	• Interfacing design	Coordination and approval for infrastructure within the corridor and any impact which may be experienced as a result of the terminal development

Table 1: Stakeholder Summary

1.5 Available Data

This Stormwater Management Plan has been prepared based on the following data which was available at the time of preparation.

- LiDAR data from the 2017-18 Greater Melbourne LiDAR Project. GDA2020 MGA Zone 55. The LiDAR data has an accuracy of 0.2m horizontal and 0.1m vertical
- 1 to 5m contours: EL_CONTOUR_1TO5M (DELWP, 2020)
- Photogrammetry Survey received from Hellier McFarland
- Available cadastral, transport and hydro data from DataShare (DELWP, 2020)
- Measurements of culvert hydraulic structures taken during site investigation.

1.6 Data Gap Assessment

The following gaps have been identified in the data and these will need to be addressed prior to undertaking further detailed modelling:

- Detailed Feature Survey including invert levels of all cross culverts underneath Little River Road
- Site exfiltration rates at basin locations
- Civil design model incorporating road profiles, pavement designs, and various other civil elements
- Rail design model incorporating general surface design, capping layer design and various other rail elements
- Service proving of utilities within and around the site
- Detailed flood modelling results for the design storm event.

2 SITE CHARACTERISTICS

2.1 Location

The site is located off Little River Road, adjacent to the main interstate freight rail line which is located within the local government area of Wyndham on the western side of Melbourne. The region is predominantly made up of large rural residential lots, open space, and farmland.

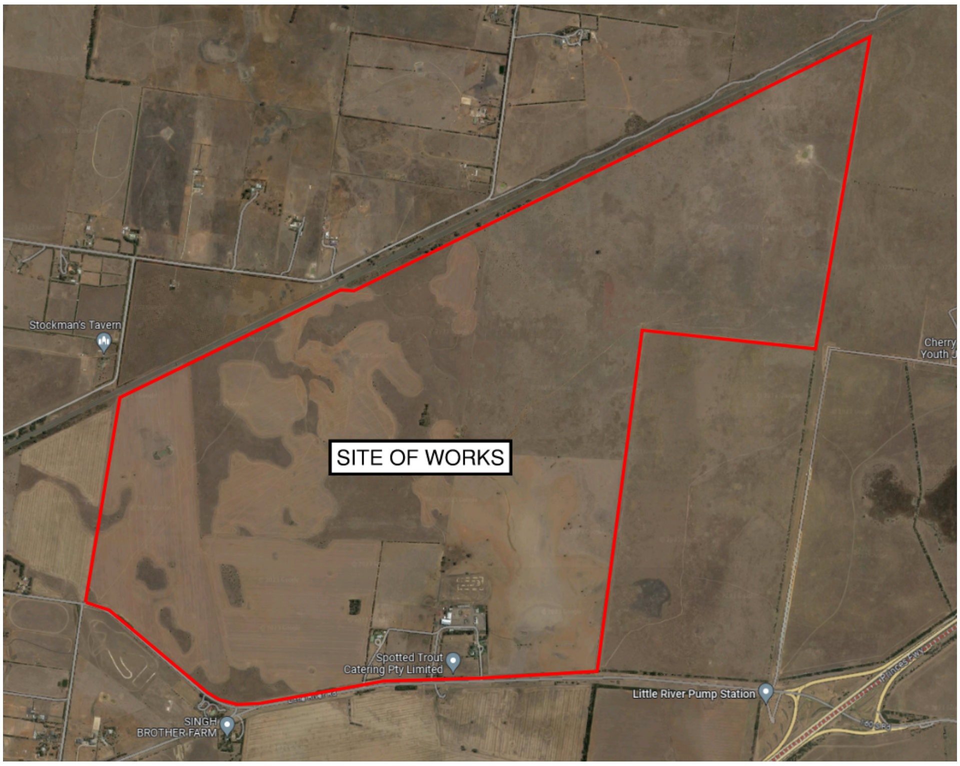


Figure 1 – Locality Plan

2.2 Existing Land Use & Topography

The site is an undeveloped rural site with an area of approximately 547ha and elevations ranging between 15 mAHD and 32 mAHD. The site is traversed by two tributaries of Ryan Swamp Drain, with the main Ryan Swamp Drain running north-south on the western side of the site. Little River is located to the south of the site and confluences with Ryan Swamp Drain to the southeast.

On the northern boundary, parallel to the site, runs the main Interstate Sydney to Perth Freight rail line. The rail line is significantly elevated in comparison to Naraburra Road and there is a trapped low point between Naraburra Road and the rail line that has the potential to pond water on the north side of the rail.

The site boundary with main features is illustrated in Figure 2.

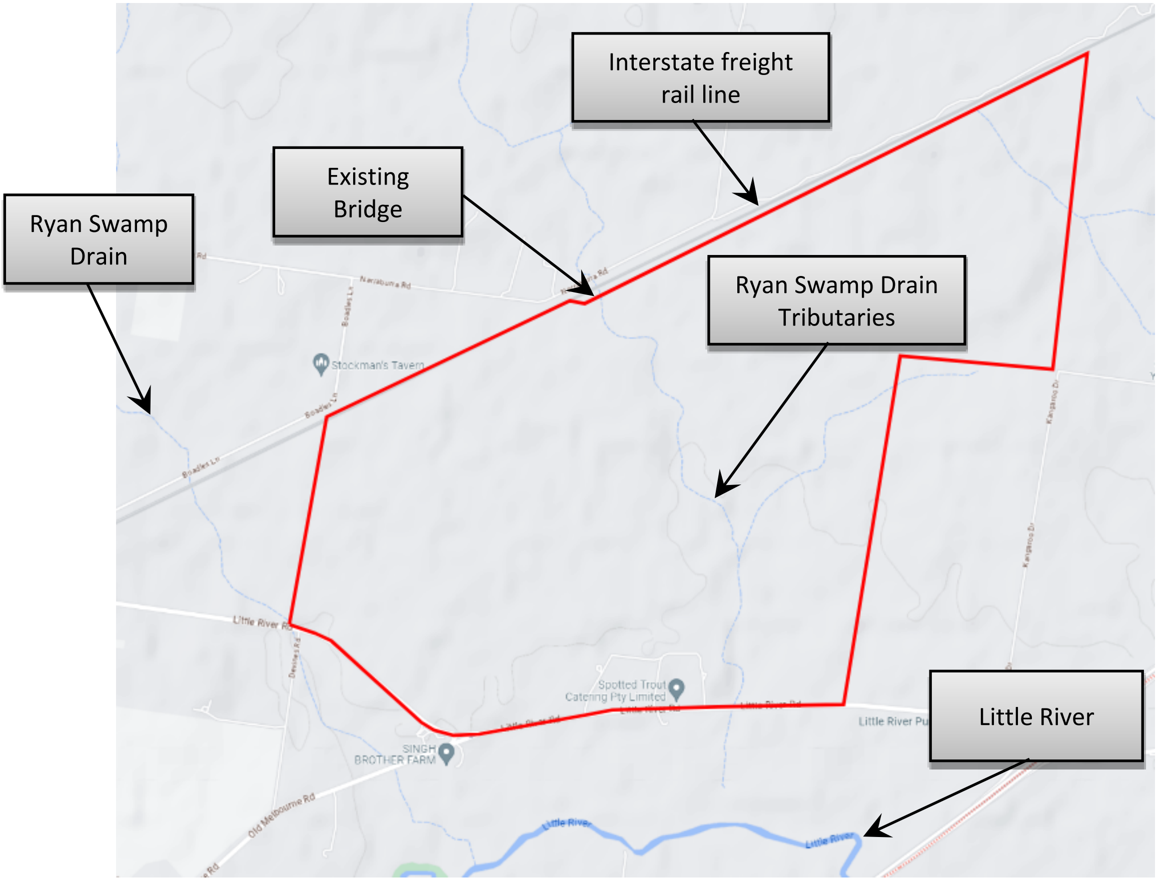


Figure 2 – Site Location and Features

Ryan Swamp Drain

Two tributaries of Ryan Swamp drain traverse the site from north to south. The main tributary enters the site via a bridge that can be seen via Google Imagery in Figure 3 below.

Through the upper portion of the site, the main tributary to Ryan Swamp Drain appears to be an incised channel with steady grades from the north to south, while the southern portion of the site is flatter terrain.

Figure 3– Photo of Ryan Swamp Drain Bridge – Source: Google Imagery

2.3 Site Overlays

The site sits entirely within a Green Wedge Zone and contains a Heritage Overlay near the north-western corner of the site and an Environmental Significance Overlay (ESO1) which partially encompasses the Ryan Swamp Drain tributary that runs through the site. Additionally, the site is partly within the Special Use Zone for use of service or repair of equipment used in agriculture. Identified within the site are Aboriginal Cultural Heritage Sensitivity areas for consideration.

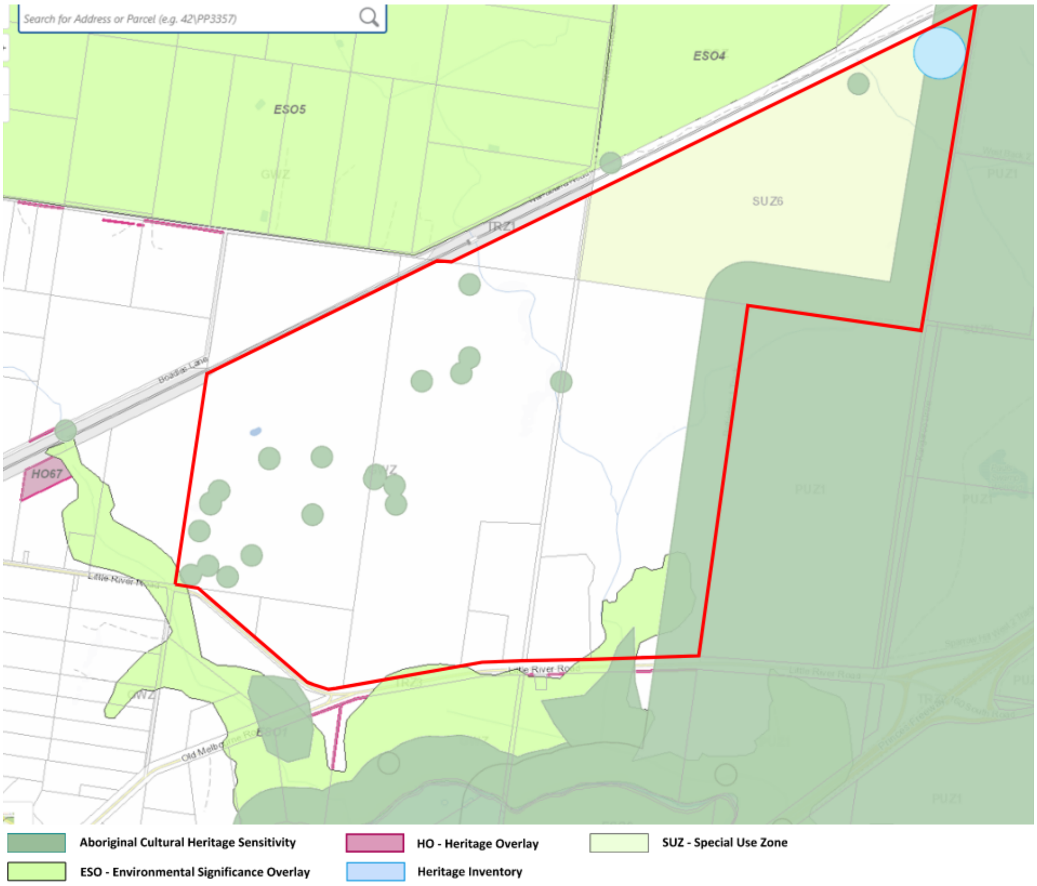


Figure 4 – Site Overlays (Source: mapshare.vic.gov.au/vicplan)

Some of the key objectives of the ESO1 overlay are:

- To preserve Werribee River, Skeleton Creek, Lollypop Creek, Little River and their tributaries by regulating the type, intensity and impacts of development adjacent to those waterways.
- To ensure that the volume of stormwater runoff into waterways is not increased and the quality of runoff improves or remains at established levels where altered land use or development adjacent to waterways occurs.
- To enhance and re-instate the ecological health of Werribee River, Skeleton Creek, Lollypop Creek and Little River, including revegetation and regeneration of disturbed areas.

In developing this Stormwater Management Plan, the drainage design has aimed to match pre-development flow rates into Little River by providing on-site attenuation and also limit pollutants into the waterway via complying with water quality criteria. Further flood modelling will be conducted at subsequent stages of the design to identify any potential impacts to the waterways as a result of the proposed development.

2.4 Existing Drainage Conditions

The existing site typically falls south towards Little River Road where there are numerous culverts that convey flows across the road towards Little River. Most of these culverts are minor (roughly 450x300 box culverts) however there are 3 main crossings across this road which line up with the Ryan South Drain tributaries. These are shown in Figure 4 below.

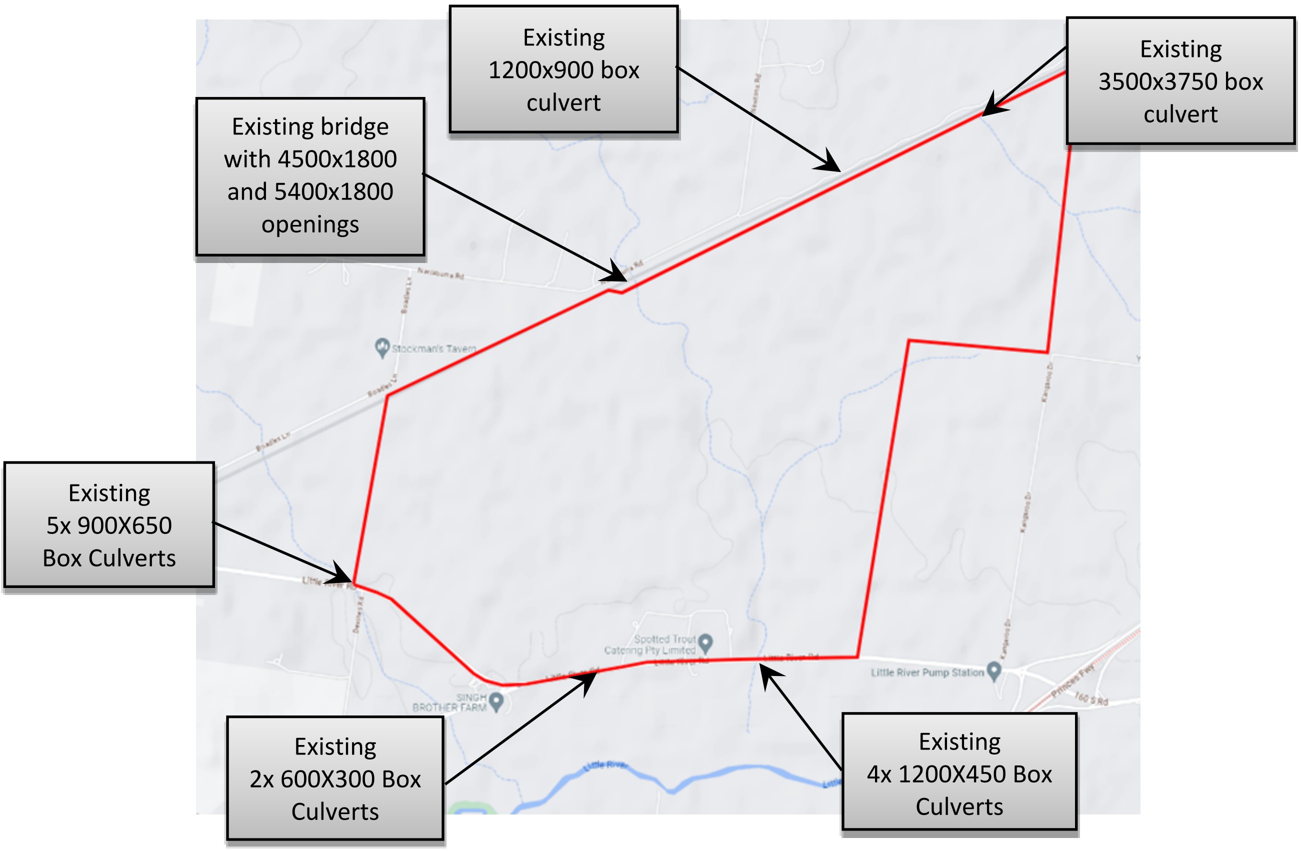


Figure 5– Existing Drainage Conditions

Given that Little River Road is currently owned and maintained by Wyndham City Council, it is assumed that these culverts are also owned and maintained by Wyndham however it should be noted that these culverts are not shown on the Wyndham City Council DBYD plans. Further flood modelling and investigations are required to be undertaken at future design stages to determine whether the existing drainage conditions achieve adequate flood immunity for Little River Road in the 20% AEP event

2.5 Existing Services

Within the vicinity of the scope of works, the existing services that are present include a high-pressure gas transmission pipeline that runs parallel to Kangaroo Road along the eastern end of the development and connects perpendicular to a gas pipeline along Princes Freeway. The high-pressure gas transmission pipeline is operated by APA Group and a gas kiosk is located south of Kangaroo Road and Little River Road.

Telstra conduits at 50 and 80mm run along the southern end of the property from Old Melbourne Road to Kangaroo Road at a depth of approximately 0.4m-1.4m. Telstra pits are found within the property boundary along the southern side every 50m. From 425 Little River Road to 471 Little River Road, an additional Telstra 50mm conduit at approximately 0.5m deep runs parallel to the main conduits within the development.

There is a Great Western Water main that runs along the southern and western boundary of the development. The 300mm main runs along the property boundary at 1.00m in depth. A water supple pump station and ground level tank facilitated by City West Water is located along Little River Road opposite 425 Little River Road.

Low voltage over height cables powered by Powercor are located along the southern boundary of the development providing power to 425 Little River Road and 471 Little River Road.

Refer to document BE22003-REP-U-001 – Utility Service Advice for further information on utilities.

2.6 Proposed Development

The proposal is for an intermodal and freight forwarding terminal as depicted in Figure 5 below. The terminal includes rail head operations which consists of holding lines, double-stack processing lines and gantry modules, truck processing administration and operations, over 30 warehouses, a new interior road layout and a commercial precinct.

Stage 1 is to include Precinct A and B, which consists of the new intermodal terminal, truck processing, 33 warehouses and the internal road network to suit the development. The proposed concept design is outlined in Figure 5 below.

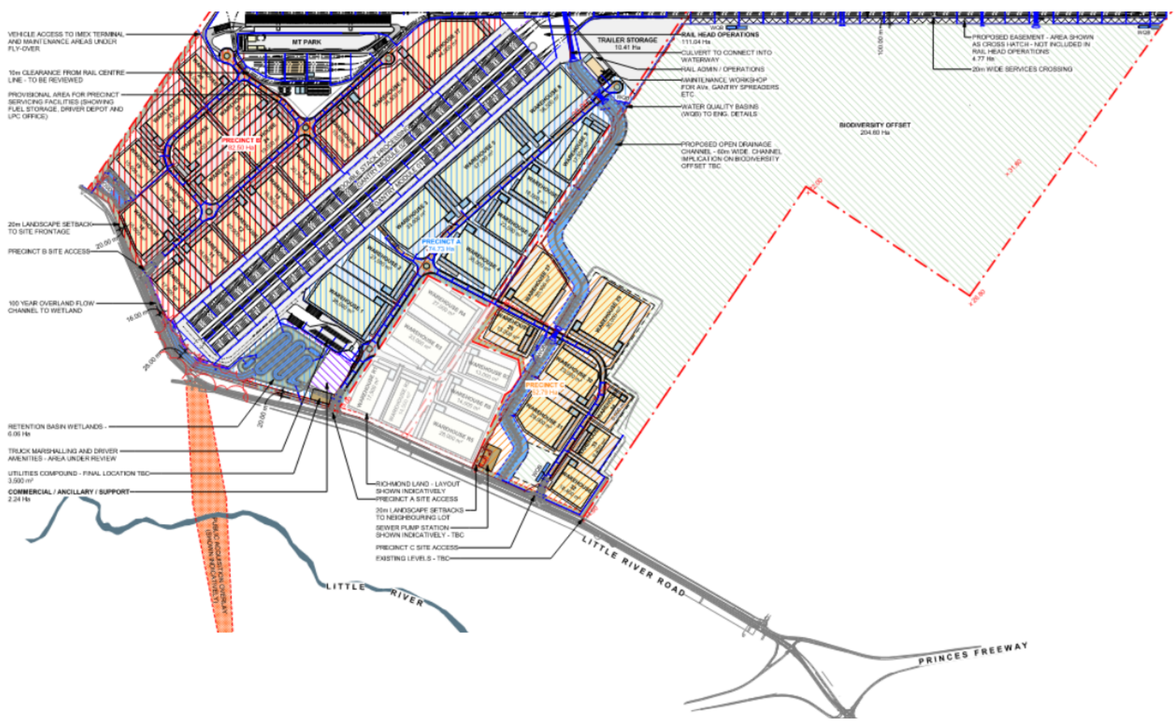


Figure 6 – Concept Design (Source: Tactical Group)

3 STORMWATER QUANTITY ASSESSMENT

3.1 Design Criteria

The drainage design has been undertaken to comply with the criteria outlined in the standards, codes and policies identified within section 1.3.

Given that the proposed development type is identified as a commercial/ industrial development, a design storm event of 10% AEP has been adopted for the stormwater assessment. The 1% AEP event has been adopted as the major storm event and the drainage infrastructure proposed ensures that all gap flows have an overflow route and maintain adequate freeboard to rail infrastructure.

A full list of drainage design criteria can be found in Appendix A.

3.2 Hydrology

The drainage analysis for this project has been conducted utilising 12D Modelling Software (Version 14.0C2k), DRAINS (Version 2022.012) and spreadsheet calculations. The rational method analysis has been used to determine the peak flows within the site. This has been used in conjunction with a dynamic flood model analysis which has been used to determine the sizing of the major flood relief culverts and basins. (Refer to Flood Assessment Report VE22064_RPT_002_FIA). A dynamic analysis will be required to be undertaken at subsequent design stages for detail sizing of the site drainage infrastructure.

Rainfall intensities have been adopted using 2016 IFD data supplied by the Bureau of Meteorology (BOM). At this stage climate change has not been assessed within the drainage network. The requirements for climate change will be further coordinated with the flooding design in subsequent design stages. Refer to the Flood Assessment Report for stormwater events and durations considered.

The outfall summary is as per Figure 7 below.

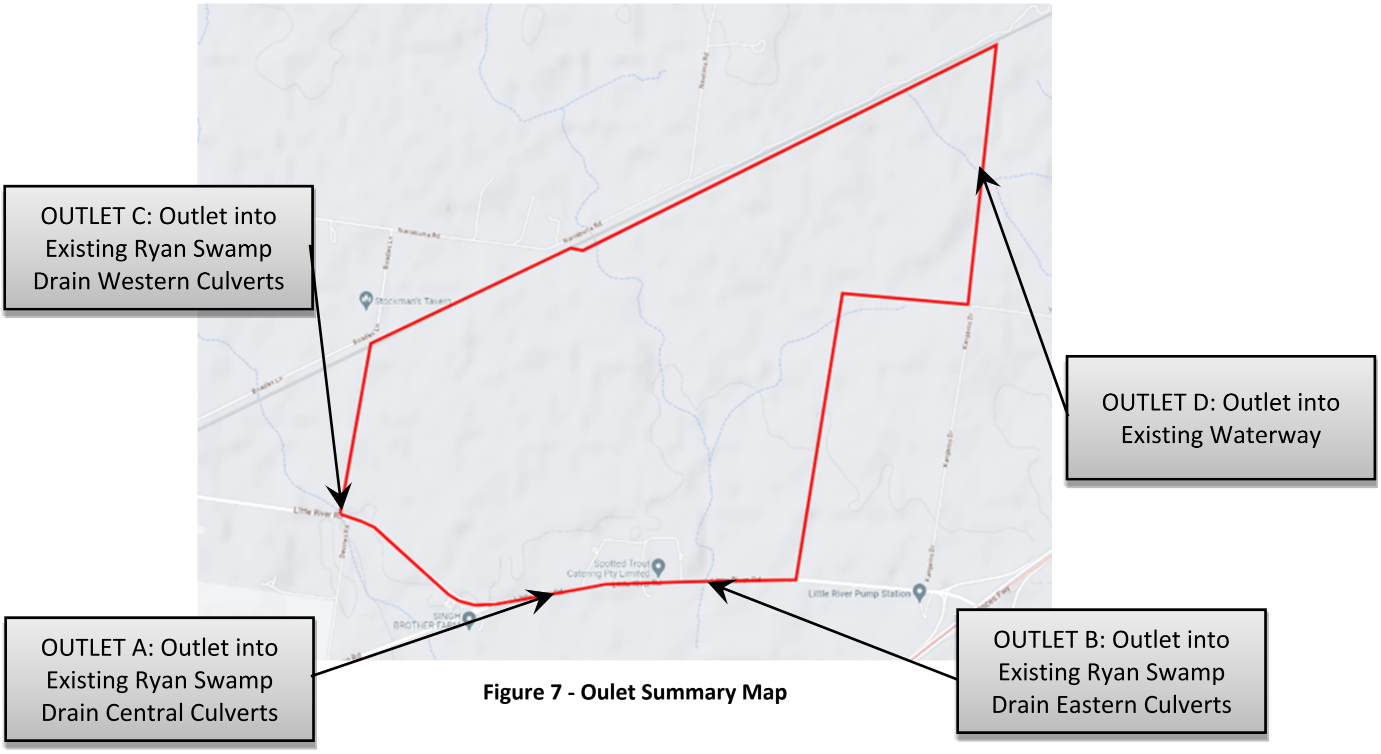


Figure 7 - Oulet Summary Map

3.3 Catchments

In pre-developed conditions, the site is observed to be split into 4 separate catchments. The proposed earthworks and drainage strategy aim to mimic the existing catchments as can be seen in Table 1. It should be noted that each warehouse will be responsible for detaining and treating water on their site to pre-development conditions and therefore in making the below catchment summary, the post development catchment areas for each of these warehouses are treated as undeveloped. Refer to Appendix C – Site Catchment Plan for further information on the post-development catchment areas.

OUTLET ID:	PRE IMP (ha)	PRE PER (ha)	PRE-TOTAL (ha)	POST IMP (ha)	POST PER (ha)		POST TOTAL (ha)
A	0	93.87	**93.87**	71.13	73.54	49%	**144.67**
B	0	359.29	**359.29**	31.09	269.27	10%	**300.36**
C	0	59.10	**59.10**	23.43	40.63	37%	**64.06**
D	0	34.60	**34.60**	9.71	28.06	64%	**37.77**
TOTAL	**0**	**546.86**	**546.86**	**135.36**	**411.5**	28%	**546.86**

Table 1: Pre Development vs Post Development Catchment Areas

Table 2 summarises the increase in peak flow within the 1% AEP stormwater event as a result of the increase in impervious area.

OUTLET ID:	PRE-DEV PEAK FLOW (m3/s)	POST-DEV PEAK FLOW (m3/s)	CHANGE IN PEAK FLOW (m3/s)
A	3.08	17.04	13.96
B	11.79	13.43	1.64
C	2.56	9.63	7.07
D	1.93	4.73	2.79

Table 2: Pre Development vs Post Development Peak Flow

3.4 Stormwater Detention

As per the Wyndham City Council Drainage Guidelines, the requirement is to detain flows on site up to the 10% AEP event, however Melbourne Water requires afflux to be controlled in the 1% AEP event. As such, detention basins have been proposed at outlets A and C and are currently sized to limit discharge to predevelopment flow rates in the 1% AEP event. The required volumes of the detention basins are shown in Table 3 below:

Outlet ID:	10% AEP Detention Volume Required (m3)	1% AEP Detention Volume Required (m3)	1% AEP Detention Designed (m3)
A	14152	28974	
C	2986	6147	7600
D	941	1909	

Table 3: Detention Volumes

In addition to this, Melbourne Water requires the development to achieve five core flood protection criteria as a minimum. The development must:

- Not affect floodwater flow capacity
- Not reduce floodwater storage capacity
- Meet minimum floor level height (above flood level) relevant to development location (freeboard)
- Not occur where the depth and flow of floodwaters would create a hazard
- Not occur in circumstances where the depth and flow of floodwater affecting access to the property is hazardous.

Further to this, recent experience with Melbourne Water demonstrates that they typically require “zero” afflux and apply a strict policy to maintain no flood level changes, particularly in private property.

Detention has not been proposed at outlet B. The outlet is linked to the proposed 50m drainage channel that is expected to convey a substantial existing external catchment north of the rail corridor (main tributary to Ryan Swamp Drain). Detaining internal site flows at this location would result in the peak flow rate from the site catchment being delayed such that it coincides with the peak flow rate from the external catchment. As such, by not providing detention, the peak flow from the site discharges well before the peak flow from the external catchment arrives and therefore there is no change in overall peak flow rate. Refer Section 5.3.3 of the Flood Assessment report (VE22064_RPT_002_FIA) for further information.

3.5 Drainage Design

The internal drainage strategy primarily comprises primarily of underground pipes in conjunction with above ground drainage in the form of open channels and basins. The drainage network has been sized to cater for the 10% AEP event with major storms being conveyed via the road network which will act as an overland flow path. Drainage pits will be required at frequent intervals to limit flow widths to acceptable parameters. This will be further coordinated in the next design stage.

The terminal area, comprising of a complex interplay of automated gantries, track formation, access roads and interfacing to adjacent warehousing. The terminal is constrained by the warehousing arrangement proposed, constricting the possibility for overland flow paths to discharge high level flood scenarios from the vicinity. The terminal end to end spans just under two kilometres. With few options for overland flow paths, this area faces a potential risk of inundation in greater storm events than 10% AEP. Given the nature of land use and being subject to a higher risk profile to the client, it is proposed that the underground pipe network for the terminal area provides immunity to the 2% AEP event.

Where drainage outlets into water treatment devices, it is proposed to split flows such that flows greater than the 3 month storm bypass around treatment devices to prevent scouring/ damage of the treatment train. Within the rail corridor, a trafficable (i.e., shallow, wide) overland flow arrangement is proposed. More information such as proposed rail profile, capping layer design and detail catchment splits are required to determine exact dimensions of such overland flow paths to contain flows beneath the capping layer for compliance.
Locations immediately upstream of outlet A to D have water storage and quality treatment areas. These locations use one or a combination of sediment basins, bioretention basins, wetlands along with other outlet structures to sufficiently control outflows.

Around outlet B, there is a large external catchment that is proposed to be conveyed under the site via box culverts. It is proposed to keep the site drainage separate from these external flows to prevent external flows from draining into the proposed treatment basins. There is a large external catchment that flows towards outlet B from pre-development conditions. This flow path extends from the private property adjacent to the site and intersects with the proposed site development. To manage this risk, it is proposed to the keep the site drainage separate from the external flows to prevent flows from draining into the proposed treatment basins. As such, these flows will be conveyed by box culverts at the perimeter of the site and directed into the main tributary to Ryan Swamp Drain.

As mentioned previously, it is assumed that each warehouse will be responsible for the provision of detention and treatment of stormwater on their site to pre-development conditions and therefore all drainage infrastructure has been designed assuming pre-development flow rates from these warehouse areas.

Detailed drainage design is to be undertaken at later design stages to confirm the safety of flow over the entire road network system, including intersections as well as the exact detention/water quality treatment arrangements. Refer to Appendix B for the concept stormwater drainage layout.

Flood Relief Culverts

The first iteration of the flood mitigation strategy has incorporated three design culverts to convey the upstream catchment flows through the site. The main culvert is located downstream of the rail bridge on the tributary of Ryan Swamp Drain, the second culvert is located at a minor upstream catchment to the east and the third culvert is in the north-east corner of the site to convey flows from a tributary outside of the main catchment. Further investigation and coordination are required with the flood model to confirm the sizing of these culverts.

The main culvert comprises of 5X3000X1200mm Box Culverts and is designed to convey a large volume of external flows from upstream of the site down to the natural waterway which has been cut off as a result of the proposed development. The length of these culverts are approximately 300m each and will therefore require inspection openings at every 200m intervals. The natural waterway is proposed to be formalised to a 50m wide channel to direct runoff toward its natural site discharge location at outlet B.

As aforementioned, there is a large external catchment which flows through a natural waterway towards Precinct C in the eastern boundary. A run of 3X1200X600mm box culverts are proposed to circumnavigate warehouses 32-34 and discharge at outlet B. These culverts have a length of 700m and will also require inspection openings at 200m intervals as per Melbourne Water requirements.

Refer to Flood Assessment Report (VE22064_RPT_002_FIA) for further information on these culverts.

4 STORMWATER QUALITY ASSESSMENT

4.1 Stormwater Quality Objectives

Urbanisation of land affects stormwater quantity due to an increase in impervious (impenetrable) surface area, removing the natural filtration and storage of stormwater in soil. Rebuking the function of natural ground results in additional run-off on surfaces increasing the quantity of water for treatment prior to discharge. Activities such as transportation, logistics and increased traffic loading generate multiple sources of pollutants to run-off water that otherwise would not be present in the pre-developed site conditions.

The proposed site development at Little River will significantly alter the land use from a rural grass plain area into a commercial hub. Consequentially, modification of a substantial land area from undeveloped to complete urbanisation imposes new challenges to established wildlife, flora, fauna, rivers and estuaries. The mechanisms through which these effects are experienced are through increased overall water quantity discharging from the site in conjunction with a degradation of water quality.

Section three of this report addresses the management of stormwater quantity resulting from increased run-off from the fully developed site. The objective of this section on stormwater quality is to demonstrate the effects of the proposed measures for the protection of environmental values and physical characteristics of receiving waters from deterioration due to stormwater.

This section aims to identify the proposed water quality systems that reduce the impact of stormwater on the holistic drainage network. Systems designed to filter sediment, waste, and pollutants from stormwater prior to discharge from the site in compliance with the Urban Stormwater: Best Practice Environmental Management Guidelines (CSIRO, 2006).

4.2 Stormwater Quality Treatment Strategy

To achieve stormwater quality pollutant concentrations as close to pre-development conditions, quality system measures must be integrated at each site allotment. From a master planning perspective, the site allotments are broken down into warehousing, rail terminal, roads and the IMEX terminal. Within each of the nominated land use zones, specific water quality measures are to be adopted as detailed below.

Warehousing

Each warehouse is expected to perform as an industrial and commercial use zone, likely to result in litter, sediments, toxicants, and nutrients. The philosophy of the warehouse water quality strategy is that each warehouse is to be responsible for meeting pre-development water quality and quantity levels within their respective sites. As can be seen in the figure below, the total warehouse area of the site is the largest, and thus is not reasonably practicable for water treatment external to the allotment without significant compromise of site layout and master planning. To meet best practice guidelines, the suggested treatment train is an upstream gross-pollutant trap (GPT) to a downstream bio-basin. The GPT should function as a trap to capture litter and larger pollutants, while the bio-basin will treat the finer particle matter. As stated previously, each warehouse is responsible for their own on-site detention (OSD) which is to be incorporated into any effective treatment train within warehouse allotments. Any additional water sensitive urban design (WSUD) treatment will be subject to further design phases.

Figure 8 – Warehouse Catchments from Master Plan

Rail Terminal

The rail terminal area will be subject to pollutants resulting from logistical movements within the intermodal terminal. Due to the size and imperviousness of the terminal area, the catchment exceeds what is possible to be treated practicably through smaller treatment trains. The proposed treatment for the rail terminal and corresponding catchment A is a 23,000m^2 wetland in the south of the project site. The flows incoming to the wetland are subject to pre-treatment through a large GPT and sediment trap prior to discharge into the wetland. Upstream of the GPT is a weir pit that diverts high flows directly into the wetland, bypassing the sediment pond as to not damage the filtration media from high velocity flows. Weir pits are used typically across the site to protect the water quality basins. In addition, the wetland also acts as a large storage area for flows prior to discharge from the site to control flows to pre-development levels.

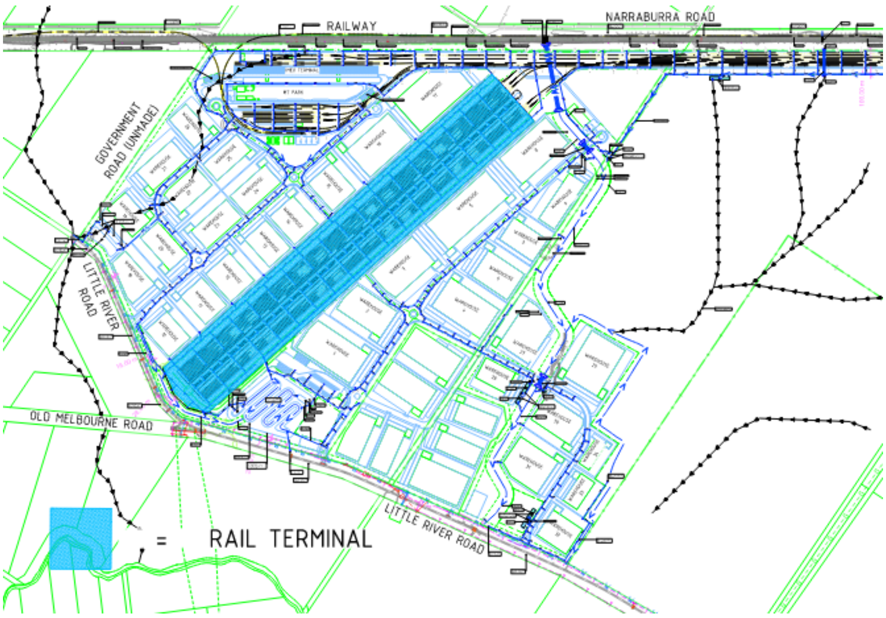


Figure 9 – Rail Terminal Catchment from Master Plan

Roads

Across the project site, the road network acts as overland flow paths for flood conveyance in major storm events. Given this condition, the road network is subject to pollutants of all variations across the site. As a stipulation for the site, all stormwater run-off from the roads must pass through a treatment train of a GPT, sediment trap and bio-basin prior to discharge at each of the three major outlets to the south of the project site.

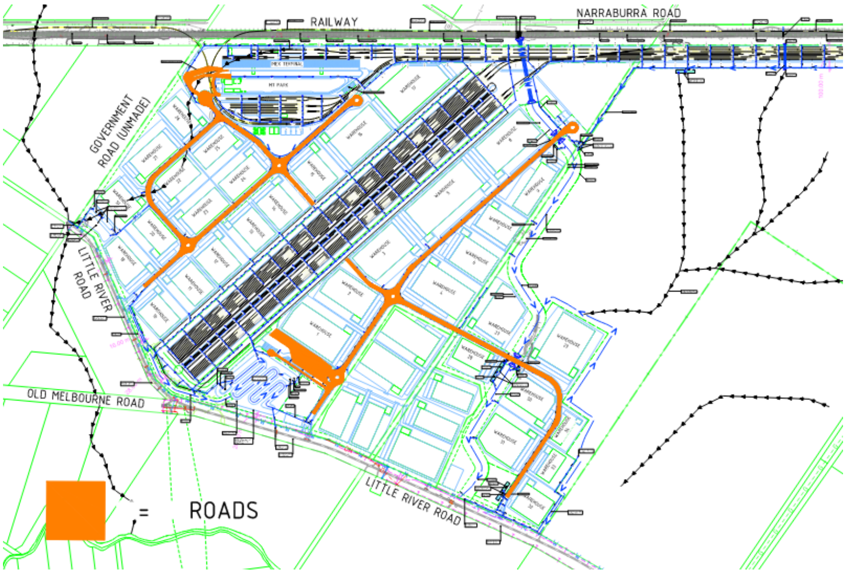


Figure 10 - Road Catchments from Master Plan

IMEX Terminal

The IMEX terminal catchment is subject to an in-line treatment train at outlet C of the site (western boundary) which consists of a large GPT which transmits flows into a sediment basin and then to a bio-retention basin. The change in imperviousness resulting from the works requires an additional large detention basin to control outflows to pre-development conditions.

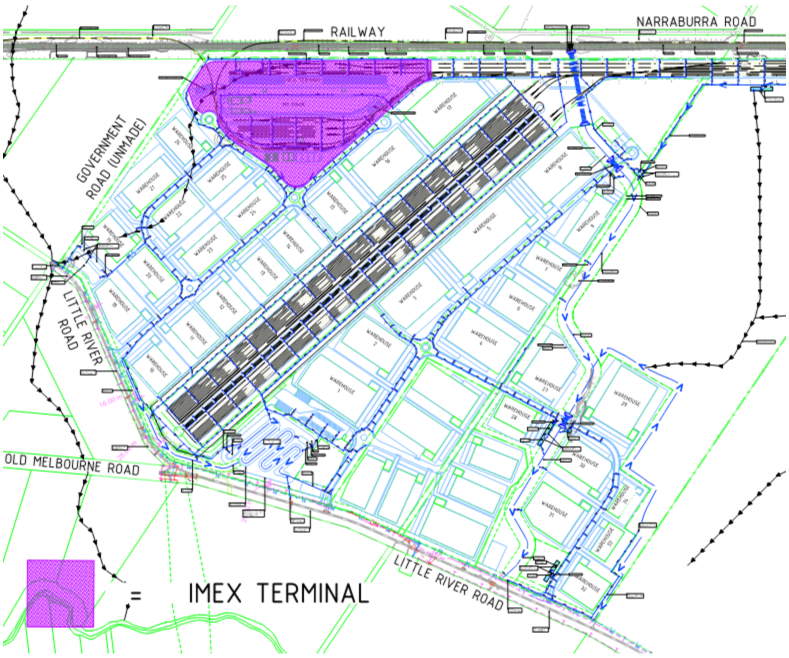


Figure 11 – IMEX Terminal Catchment from Master Plan

4.3 Stormwater Quality Modelling

Stormwater discharge has been assessed for water quality purposes using MUSIC modelling software (version 6) in accordance with the Wyndham City Council Drainage Guidelines. The MUSIC model developed to analyse the water quality from the proposed development is shown in Appendix D. The stormwater runoff for the entirety of the project ultimately discharges into Little River via the Ryan Swamp Drain Tributaries.

4.3.1 Water Quality Modelling Parameters

The design incorporates end of line treatment in the form of sedimentation basins, bioretention basins, swales and a wetland that services a large portion of the water quality requirements of the project catchment area.

Treatment has been sized under the assumption that each warehouse will be responsible for treating their own lot areas, and therefore, each warehouse area has been treated as a pre-developed catchment (100% pervious). Given that the average size of the lots is 3 ha, it is anticipated that each warehouse lot will be required to provide a 500m^2 bio retention basin and an upstream GPT within their lot to meet treatment objectives. The treatment objectives per lot will be subject to future design stages for further development.

As per Wyndham MUSIC guidelines, a sediment trap has been proposed upstream of all bioretention basins to reduce the risk of clogging. It should be noted that the maximum size of a bioretention basin is 500m^2 according to the Wyndham WSUD asset selection guidelines. Where numerous bioretention basins are required to treat a catchment, the total area of the bioretention basins have been combined into a single node within the MUSIC model. This is due to MUSIC only allowing one primary drainage link from an upstream catchment/ treatment device and it is typically proposed to utilise one large sediment basin upstream of numerous bioretention basins.

As discussed, for all outlet nodes, there is a proposed sediment trap (gross pollutant trap or sediment basin) and bioretention basin prior to discharge to the outlet. The proposed basins provided on site are not intended as permanent ponds and as such, all water being stored within the basins will discharge into one of four outlet nodes with the ultimate discharge into Little River.

The following parameters have been adopted for each form of treatment:

Properties	Value	Reference
SWALE		
Exfiltration Rate	0m/s	Wyndham City MUSIC guidelines 2017
Vegetation Height	0.005m	Wyndham City MUSIC guidelines 2017
Length	-	Half of actual swale length has been adopted to reflect a continuous inlet capture system.
SEDIMENTATION BASIN		
Particle Size	Very Fine Sand (125)	Wyndham City MUSIC guidelines 2017
Settling Velocity	11mm/s	Wyndham City MUSIC guidelines 2017
Sediment Loading Rate	1.6m3/ha/yr	Wyndham City MUSIC guidelines 2017
Capture Efficiency	95%	Wyndham City MUSIC guidelines 2017

Clean Out Frequency	5 years	Wyndham City MUSIC guidelines 2017
Turbulence	2	Wyndham City MUSIC guidelines 2017
Extended Detention Depth	0.35m	Wyndham City MUSIC guidelines 2017
Permanent Pool Depth	1.5m	Wyndham City MUSIC guidelines 2017
Exfiltration Rate	0mm/hr	Wyndham City MUSIC guidelines 2017
Evaporative Loss as % of PET	75	Default
BIORETENTION BASIN		
Extended Detention Depth	0.3	Wyndham City MUSIC guidelines 2017
Surface Area	-	As required
Filter Area	-	As required
Saturated Hydraulic Conductivity	100mm/hr	Modelled as 100mm/hr to account for clogging and blockage but is to be 200mm/hr. Wyndham City MUSIC guidelines 2017.
Filter Depth	0.5m	Wyndham City MUSIC guidelines 2017
TN Content of Filter Media	800mg/kg	Default
Orthophosphate Content of Filter Media	55.0mg/kg	Default
Exfiltration Rate	0.1	Conservative approach given unlined basin design. To be refined pending further geotechnical advice.
Submerged Zone	0.45m	Wyndham City MUSIC guidelines 2017
WETLAND		
Inlet Pond Volume	-	Calculated as per the same criteria as Sediment Basins
Surface Area	-	As Required
Extended Detention Depth	0.35m	Wyndham City MUSIC guidelines 2017
Permanent Pool Volume	-	Initial Permanent Pool Volume taken as 0.4 * Surface Area as per Wyndham City MUSIC guidelines 2017
Vegetation Cover	50% of Surface Area	Default
Exfiltration Rate	0mm/hr	Wyndham City MUSIC guidelines 2017
Evaporative Loss as % of PET	125	Default
Notional Detention Time	72hrs	Wyndham City MUSIC guidelines 2017
No of CSTR Cells	4	Default

Table 4 – Treatment Parameters

The location of the treatment devices is shown indicatively on the plans in Appendix B and is summarised below.

Catchment	Catchment Area (ha)	Stormwater Treatment Type	Surface Area of Treatment (m2)	Additional Information
A	121.82	Wetland	23000	
		Sed. Basin	1900	
B1	14.69	Sed. Basin	400	
		Bio. Basin	1000	
B2	7.15	Sed. Basin	200	
		Bio. Basin	500	
B3	39.03	Sed. Basin	400	
		Bio. Basin	500	
B4	46.3	Sed. Basin	500	
		Bio. Basin	500	
B5	204.36	-	-	Existing Catchment remains unchanged
C	60	Sed. Basin	900	
		Bio. Basin	1000	
D	35	Sed. Basin	400	
		Bio. Basin	500	

Table 5 – Treatment Requirements

Given the large catchment being treated by each of these treatment devices, it is recommended that future iterations of the drainage design explore the management of inflow velocities in order to minimise scour and preserve vegetation within the treatment devices.

4.3.2 Best Practice Results

According to the Victorian Urban Stormwater Best Practice Management Guidelines, the best practice stormwater pollutant removal objectives are as follows:

(A) suspended solids 80% retention of the typical urban annual load.

(B) total phosphorus 45% retention of the typical urban annual load.

(C) total nitrogen 45% retention of the typical urban annual load; and

(D) litter 70% retention of the typical urban annual load.

The intent of the design is to comply with the above best practice objective which is achieved as shown in Figure 12 below.

Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	500	459	8.3
Total Suspended Solids (kg/yr)	85000	8360	90.2
Total Phosphorus (kg/yr)	141	69.5	50.9
Total Nitrogen (kg/yr)	1060	547	48.3
Gross Pollutants (kg/yr)	20800	0	100

Figure 12 – MUSIC Treatment Results

Meteorological data utilised is as per the Melbourne Water rainfall templates for Little River (Little River – 6 min -1992-2001). This complies with Wyndham MUSIC guidelines which specifies this rainfall time period. The detailed catchment areas, catchment impervious percentages and overall layout can be found in Appendix D.

These results are also comparable to the ERS water objectives for post construction flows entering waterways. Table 7 below demonstrates the receiving water objectives and the results of site modelling meeting these objectives. As can be seen from these results, there is room for further refinement of water quality objectives towards nitrogen removal, to be developed in further design stages.

POLLUTANT	Receiving Water Objective	Receiving Water Result – Pre Dev	Receiving Water Result – Post Dev
Total Suspended Solids (mg/L)	Not exceed the 90th percentile of 80mg/L	1.5	18.2
Total Phosphorous (mg/L)	Base flow concentration not to exceed 0.08mg/L	0.028	0.078
Total Nitrogen (mg/L)	Base flow concentration not to exceed 0.9mg/L	0.433	0.9

Table 7 – Receiving Waters Objectives

4.4 Comparison with Existing Conditions

A MUSIC model was set up and run to assess the total pollutants generated from the site from the existing conditions. The results for the pre-development conditions are shown in Figure 13 below.

Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	7.28	7.28	0
Total Suspended Solids (kg/yr)	102	102	0
Total Phosphorus (kg/yr)	1.9	1.9	0
Total Nitrogen (kg/yr)	29.7	29.7	0
Gross Pollutants (kg/yr)	0	0	0

Figure 13 – Existing MUSIC results

Comparing the results with Figure 12 shows that there is a substantial increase in pollutants. This is expected and is due to the increase in imperviousness and consequential to urbanisation. This expected increase, as discussed in Section 4.3.2, satisfactorily meets the best practice treatment objectives for the site wide water quality.

4.5 Ramsar Wetlands Assessment

As discussed in this report, the ultimate receiving node for all catchments from the developed works is Little River, which runs downstream of the site. The river itself discharges into a larger overall catchment at Port Phillip Bay Western Shoreline, which is one of over 2000 wetlands recognised as having international importance under the 'Ramsar Convention on Wetlands'. Given the international status of the Port Phillip Bay Western Shoreline wetland, there are certain obligations of the site to maintain its ecological character. The regulatory body responsible for upholding the ecological character of the wetland is the local water management authorities.

The catchment for the 547 hectare site at Little River sits within a larger 20,000 hectare Port Phillip Catchment which is a part of Melbourne Water's jurisdiction. The governing body therefore predicates the requirements of water quality as it pertains to the discharge water quality of receiving water objectives to be met. The Melbourne Water Receiving Water Objectives are to be used in conjunction with the MNES: Significant Impact Guidelines. These guidelines are designed to assist the decision-making process on whether assessment and approval is required under the Environmental Protection and Biodiversity Conservation Act (EPBC Act, 1999) by the Australian Government Environment Minister.

Within the guidelines, a set of significant impact criteria is defined in regard to matters of national environmental significance. Where significant impact is defined as:

"…An impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts."

Significant Impact Criteria

An action is likely to have a significant impact on the ecological character of a declared Ramsar wetland if there is a real chance or possibility that it will result in:

- *Areas of the wetland being destroyed or substantially modified*

No areas of the wetland are being modified as a result of the works. The post-development outflow from the site is designed to match the pre-development flow with consideration to meeting water quality objectives as specified in this report overseen by the water authority.

- *A substantial and measurable change in the hydrological regime of the wetland, for example, a substantial change to the volume, timing, duration and frequency of ground and surface water flows to and within the wetland*

The hydrological regime of the wetland will not be substantially impacted/altered. The outflows into Little River as discharged from the site have been checked via flood modelling and are compliant with Melbourne Water guidelines.

- *The habitat or lifecycle of native species, including invertebrate fauna and fish species, dependent upon the wetland being seriously affected*

Pollutants from the site are managed within the site and control measures such as oil separators, bioretention basins and internal wetlands are proposed to be implemented to prevent foreign particle matter from discharging from the site affecting the habitats of invertebrate fauna and fish species.

- *A substantial and measurable change in the water quality of the wetland – for example, a substantial change in the level of salinity, pollutants, or nutrients in the wetland, or water temperature which may adversely impact on biodiversity, ecological integrity, social amenity or human health, or*

An assessment has been undertaken quantitively for water quality utilising Music Modelling to identify and address impacts regarding water quality as they relate to Melbourne Water's guidelines. These can be found in Table 7 of this report. This table shows the results of site modelling and explicate a change in water quality, but one that is compliant within regulations for receiving waters and hence it is not proposed to investigate further ecological impacts.

- *An invasive species that is harmful to the ecological character of the wetland being established (or an existing invasive species being spread) in the wetland*

The site wetland, upstream to the Ramsar wetland, will utilise native species with respect to the water treatment train of the wetland and therefore it is not proposed that invasive species are being introduced downstream.

5 EROSION AND SEDIMENT CONTROL

The following outlines the proposed erosion and sediment control measures to be adopted for the permanent design and construction phase.

5.1 Dust Control

Dust generated as a result of bulk earthworks are to be minimised where necessary during the construction phase. Water trucks or other methods are to be employed in time to provide effective dust suppression.

For details regarding extent of earthworks, and cut and fill areas, refer to the Bulk earthworks design package.

5.2 Erosion Control

Erosion matter is triggered by the unintended energy mismanaged by the movement of surface runoff. The following engineering features are expected to be provided as part of the civil works package to ensure that the erosion by surface runoff is minimised:

- <u>Rock Beaching</u>
  Rock Beaching is to be provided at the upstream and downstream ends of all culverts and within key locations where high velocities are anticipated to prevent scouring of the surface.

- <u>Erosion Matting:</u>
  Erosion Matting is to be considered as an interim measure during construction until ground cover and or rock protection has been implemented.

- <u>Geotextile:</u>
  Geotextiles are to be considered, where deemed necessary, to manage the impact caused by the kinetic energy carried with the runoff. This should be considered at key locations such as acting as a separation layer between the rock mattress and underlying soil and or protecting basin batters from erosion.

- <u>Catch Drains:</u>
  Catch Drains are to be considered at the top of all embankments where a large amount of flow is expected to run over the batter. The catch drain (swale drain) will help to minimise soil disturbance as a result of larger flows running off over the batter.

- <u>Vegetation/ Ground Cover</u>
  The primary erosion control measure across the site is established ground cover, which will largely remove the potential for erosion. Vegetation will be further coordinated with landscapers in subsequent design stages. This applies all areas where higher flow velocities and/or water ponding is expected to occur such as drainage channels and basins.

Other measures such as rock lined weirs within open channels and/or drowned pipe networks will need to be explored in subsequent submissions as a solution to reduce flow velocity especially upstream of treatment basin locations.

5.3 Sediment Control

Sediment control measures have been outlined as follows:

- Stabilised entry/exits:
  This is to be implemented at the entry location of all construction working areas to ensure that the sediments do not continue to be carried in or out of the site onto the road network.

- Wash down areas
  A specific area on the site shall be designated for washing down construction plant. The wash down area should be contained (via earth bunds or similar). There should be no wastewater discharged from the site during construction.

- Sediment basins:

  A sediment basin is an effective end of line sediment control measure designed to settle out particles within runoff and prevent them from continuing downstream. These basins have been proposed at all outlets. Furthermore, the design considers Gross Pollutant Traps upstream of sediment basins in order to intercept litter.

- Vegetation/ Ground Cover

  Aside from providing erosion protection during rainfall events, vegetation also acts to trap sediment within shallow slow-moving water.

5.4 Spill Control

Spill containment has been provided within the project in the form of Gross Pollutant Traps and have been located at key locations where oil spills are likely to occur and upstream of all treatment basins. Design storage requirements are to be further coordinated with the relevant authorities at subsequent design stages.

5.5 Management of Contaminated Soils

The site is not listed as having Acid Sulphate Soils or Contaminated Land. However, in the event that Acid Sulphate Soils or Contaminated Land is found on site, a management plan is to be implemented and maintained by a suitably qualified professional.

6 ASSUMPTIONS AND LIMITATIONS

It is assumed:

- In determining the peak post development flow rates, each warehouse lot will be responsible for detaining and treating stormwater flow within their lot boundary. Given this, the warehouse precinct areas have been treated as permeable as per the existing conditions. This condition is inclusive of the IMEX terminal (Refer Appendix C for the site catchment plan).
- Governing body for the internal site is Wyndham City council. The drainage strategy takes into consideration the respective guidelines.
- No special requirements specific to Little River are set and that the typical council requirements for water quality and quantity are deemed sufficient.
- By meeting pre-development flow rates at each of the outlets, there will be no worsening of the flood immunity across Little River Road. Further flood modelling will be required to determine whether Little River Road complies with flood immunity requirements in the minor storm event.
- All internal roads will be kerbed and will drain via an underground pit and pipe network. Changes to this strategy may impact water treatment and storage requirements.
- Rail and surrounding industrial areas are allowed to combine stormwater flows and be detained/ treated at a common location.
- Spill containment is required for this project and will be developed further within design stages.
- The major culverts across Little River Road are owned and maintained by Wyndham City Council
- Rail corridor is treated as impervious urban area for water quality assessments. Exact input parameters for water quality model to be obtained via further liaison with approving body.

The following limitations have been identified as part of this stormwater management plan:

- The major drainage culverts have been modelled using 12D Modelling software with input from the relevant TUFLOW flood model for the concept strategy. Rational method spreadsheet calculations have been utilised for the internal site drainage systems alongside high-level checks for outlet compatibility. This assessment typically covers primary trunk drainage only. A fully constructed drainage model and dynamic hydraulic assessment in accordance with ARR2019 will need to be undertaken at subsequent design stages to confirm pipe sizing as well as preferred outlet treatment arrangements.
- All pre-outlet treatment land requirements are subject to further detail design earthworks and drainage modelling, including more detail inflow velocity mitigation strategies.
- At this stage we have not assessed climate change within the internal drainage network. The requirements for climate change will be further coordinated with the flooding design in subsequent design stages.
- Design levels have been attained via Lidar information and photogrammetry survey. A detailed feature survey has not been received at this stage of the project. Changes to existing surface levels may impact detention requirements.
- Surface design to which the drainage strategy follows has been completed to a high level and it is expected that the drainage network will change to account for further detailing of the surface design.
- This stormwater management plan has been created in conjunction with the flood management plan. It is noted that changes to the flood management plan will impact this stormwater management plan.

7 CONCLUSION

Stormwater Quantity

- The proposed development aims to mimic the existing discharge points for the site, discharging the major internal catchments to the southern boundary of the site towards the existing culverts under Little River Road.
- The internal drainage network will convey internal site flows up to a 10% AEP event with the excess flows from a major event (referred to as 'gap flow') conveyed overland via the road network.
- The stormwater impact as a result of the proposed development results in approximately 133ha of new impervious area and 23.01 m3/s of additional peak flow in the 1% AEP event. Given this, it is recommended to detain flows on-site at Outlet A, C and D.
- Given the major waterway flowing through the site at Outlet B, it is recommended to forego detention as this will prevent coinciding the peak flow from the site with the peak flow from the external catchment.
- The primary form of drainage conveyance is recommended to be an underground pipe network utilising a reinforced concrete pipes and flood conveyance swales into one of several on-site detention facilities.

Stormwater Quality

- Given the increase in impervious area, it is recommended to adopt approximately 0.25ha of bioretention filter area and 2.3ha of Wetland surface area. This equates to approximately 0.5% of the total site area. Sediment ponds are required upstream of all treatment devices to minimise the risk of clogging and blockages.
- This strategy has been prepared with the assumption that each individual warehouse lot will be responsible for the detention and treatment of stormwater within their site to predevelopment conditions.
- Inflow velocity at each of the treatment basins will be further explored and managed at subsequent design stages.

It is understood this report adequately demonstrates that the proposed development provides an acceptable solution for stormwater management, in general accordance with the requirements of Melbourne Water and City of Wyndham.

APPENDIX A

Drainage Design Criteria

Project:	Tasman Terminal
Project Number:	BE22003
Document:	Drainage Criteria
Prepared By:	M Ferreira
Date:	8/04/2022

BG &E

Drainage Element	Design Criteria	Reference/ Notes
Connection to Melbourne Water Asset (Waterway)	Melbourne Water Standards and Guidelines	
Stormwater Detention/ Treatment	Melbourne Water Wetland Design Standards and Guidelines	
Internal Drainage System	Wyndham City Council Standards and Guidelines	
Minor Storm Average Recurrence Interval (AEP)	10%	EDCM Section 13.5 - Average Exceedance Probability Industrial and Commercial Areas
Major Storm Average Recurrence Interval (AEP)	1%	EDCM Section 13.5 - Average Exceedance Probability Floodway's/ Gap Flows
Flow Width	3.0m in the design storm event	EDCM Section 13.22.1 – Surface Drainage
Pipe Cover (Under Roads)	750mm below surface or 150mm below the underside of pavement.	EDCM Section 13.11 - Minimum Cover
Pipe Cover (Elsewhere)	450mm or PipeClass check and/or Manufacturer Specifications	EDCM Section 13.11 - Minimum Cover
Pipe Friction (Manning/Colebrook)	0.013 / 0.6	EDCM Section 13.12 - Pipe Friction
Pipe Minimum Size	225mm/ 300mm (under road)	EDCM Section 13.13 - Minimum Pipe Size
Pipe Min. & Max. Velocity	1.0m/s (Desirable Minimum - Full) 0.6m/s (Flat Terrain) 4.0m/s (Desirable Maximum)	EDCM Section 13.15 - Pipe Flow Velocity and Grade
Pit Maximum Spacings	Pipes < 1200mm = 120m	AGRD Part 5A Section 5.3.4 - Inlet Locations
Pit Blockage Factor (Sags) (Major Storm)	50% (Grated Pits) 80% (Side Entry Pits)	AGRD Part 5A Table 5.4 - Provision for Pit Blockage
Pit Blockage Factor (On-grade) (Major Storm)	50% (Grated Pits) 80% (Side Entry Pits)	AGRD Part 5A Table 5.4 - Provision for Pit Blockage
Pit Drops	50mm	EDCM Section 13.17 - Alignment at Pits
SSD Minimum Pipe Size	100mm	EDCM Standard Drawing 202
Runoff Estimation - Minimum Tc	5 min (Impervious) 10 min (Pervious)	

Runoff Coefficient – (Paved Area)	0.9	
Runoff Coefficient – (Grassed Area)	0.2 (Pre Dev) 0.2 (Post Dev)	
HGL Pit Inlet Freeboard	300mm	EDCM Section 13.9 - Hydraulic Grade Line
Minimum Pipe Class	Class 2 RCP/ HDPE - Not under Pavement Class 3/ Class 4 RCP - Under Pavement	AS3725 - Design for installation of buried concrete pipes
Pipe Class Assessment	"PipeClass" Software from CPAA	
Pipe Traffic loads	SM1600	
Channel (Grassed) Manning's n	0.03	Melbourne Water Floodway Safety Criteria
Pollutant Load Reductions	Suspended Solids = 80% Phosphorus = 45% Nitrogen = 45% Litter = 70%	EDCM Section 1.7.12 - Stormwater and Water Sensitive Urban Design

APPENDIX B

Proposed Drainage Design

LEGEND

CADASTRAL BOUNDARY	PROPOSED HEADWALL
PROPOSED STORMWATER DRAINAGE	PROPOSED PIT
PROPOSED CHANNEL	BIORETENTION BASIN
EXISTING CHANNEL	DETENTION BASIN

0 50 150 250 350 450m
SCALE 1:7500 AT A1 SIZE

BG&E

DATE	02.02.23
SCALE	1:7500
GRID	MGA20Z55
PREPARED	SJ
SHEET	1 OF 1
PROJECT	TASMAN TERMINAL
TITLE	OVERALL GENERAL ARRANGEMENT PLAN CONCEPT DESIGN
PROJECT No.	BE22003
SKETCH No.	SK-CI-0430
REV	B

APPENDIX C

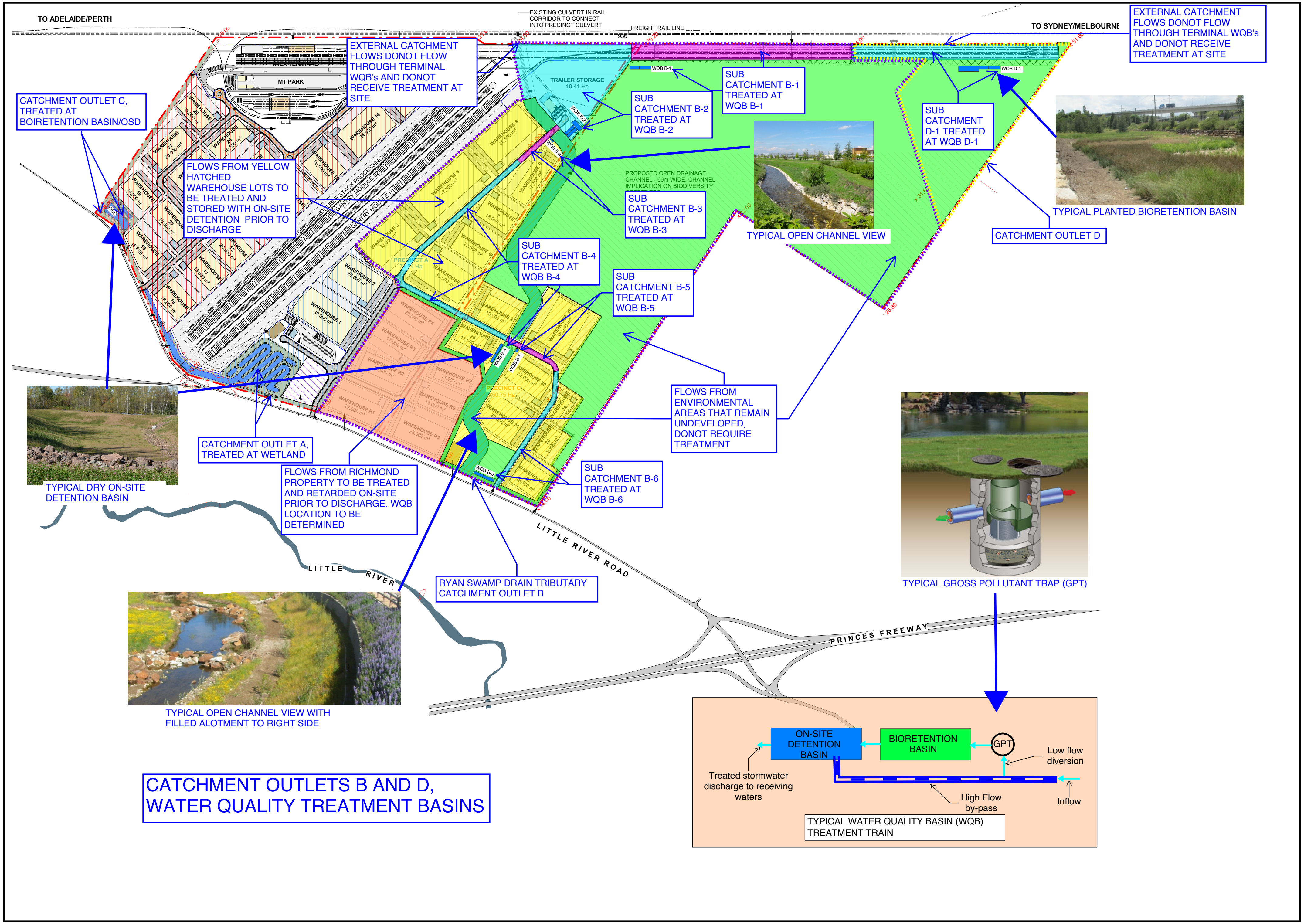
Site Catchment Plan

BG&E

DATE	27/10/22	PROJECT	TASMAN TERMINAL
SCALE	1:7500@A1	TITLE	DRAINAGE CATCHMENT PLAN
GRID	MGA20Z55		
PREPARED	N.H.		
SHEET	1 OF 1	PROJECT No. BE22003	SKETCH No. SK-CI-0410 REV D

APPENDIX D

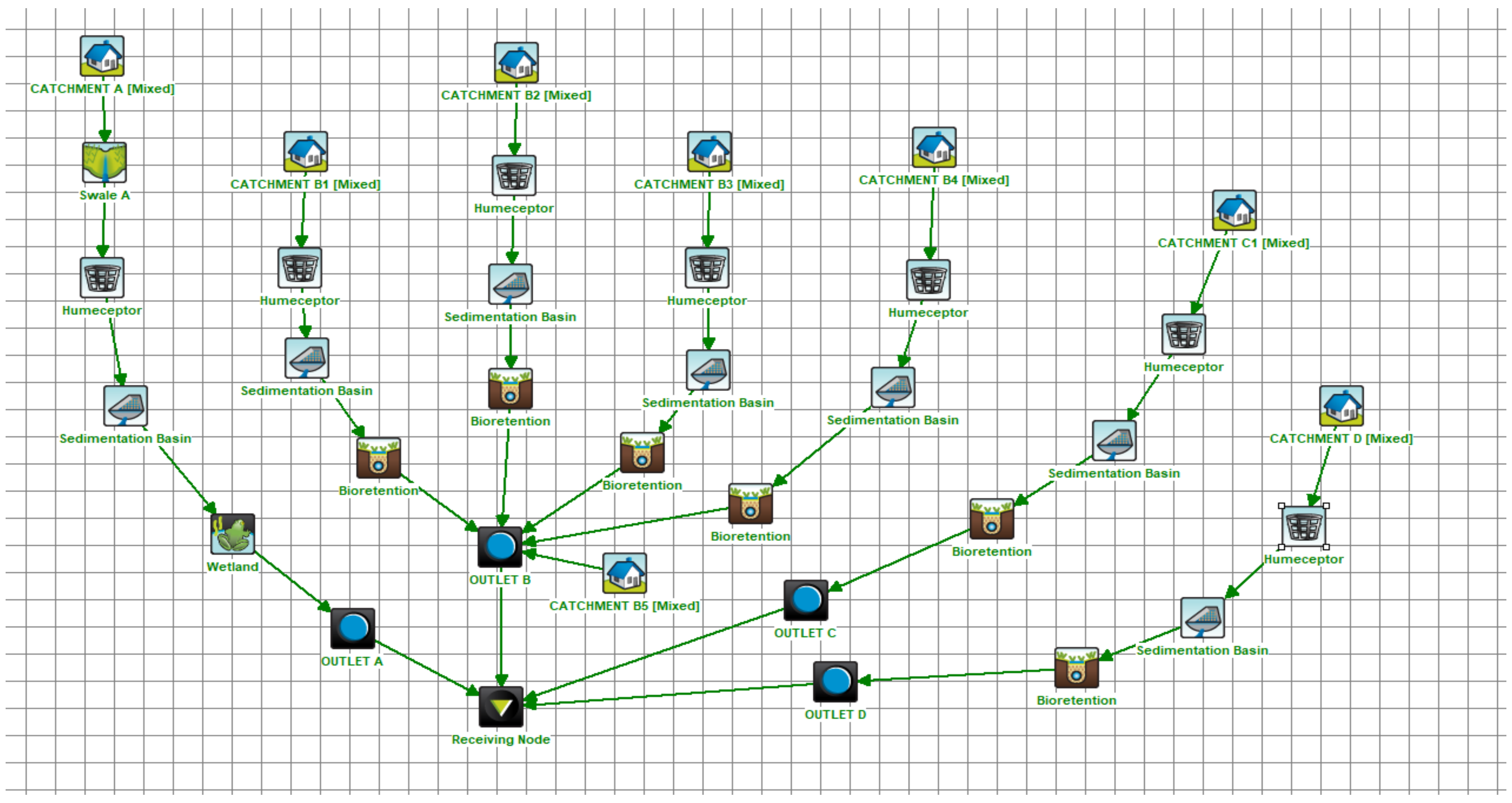
Water Quality Details



CATCHMENT OUTLETS B AND D, WATER QUALITY TREATMENT BASINS

MUSIC CATCHMENTS

MUSIC MODEL - CONCEPT DESIGN



Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	534	485	9.1
Total Suspended Solids (kg/yr)	91800	4620	95
Total Phosphorus (kg/yr)	150	67.3	55.3
Total Nitrogen (kg/yr)	1130	505	55.4
Gross Pollutants (kg/yr)	22300	0	100

OUTLET A: WESTERN CULVERTS - WETLAND

CATCHMENT A	
IMPERVIOUS AREA:	71.13
PERVIOUS AREA:	73.54
TOTAL AREA:	144.67
% IMP	49%
Swale Actual Length	670
MUSIC Length (Continuous Inlet)	335

OUTLET B: RYAN SWAMP DRAIN - EASTERN MAIN DRAIN

CATCHMENT B1	
IMPERVIOUS AREA:	14.406
PERVIOUS AREA:	0
TOTAL AREA:	14.406
% IMP	100%

CATCHMENT B2	
IMPERVIOUS AREA:	10.118
PERVIOUS AREA:	0
TOTAL AREA:	10.118
% IMP	100%

CATCHMENT B3	
IMPERVIOUS AREA:	3.915
PERVIOUS AREA:	39.584
TOTAL AREA:	43.499
% IMP	9%

CATCHMENT B4	
IMPERVIOUS AREA:	2.318
PERVIOUS AREA:	36.314
TOTAL AREA:	38.632
% IMP	6%

CATCHMENT B5	
IMPERVIOUS AREA:	0
PERVIOUS AREA:	192.3
TOTAL AREA:	192.3
% IMP	0%

OUTLET C: RYAN SWAMP DRAIN - WESTERN DRAIN

CATCHMENT C

IMPERVIOUS AREA:	23.702
PERVIOUS AREA:	40.358
TOTAL AREA:	64.06
% IMP	37%

OUTLET D: NORTH-EAST DRAIN

CATCHMENT D

IMPERVIOUS AREA:	9.71
PERVIOUS AREA:	0
TOTAL AREA:	9.71
% IMP	100%

APPENDIX E

Drainage Calculations

Project:	TASMAN TERMINAL
Project Number:	BE22003
Document:	Drainage Calculations
Prepared By:	DUSHAN SIMICH
Date:	26/10/2022

Design AEP	1.0%
Climate Change Factor (%)	0.0%

BG &E

Annual Exceedance Probability (AEP) Coefficients							
	63.20%	**39%**	**20%**	**10%**	**5%**	**2%**	**1%**
C0	0.19169556	0.33396176	0.70108378	0.9048993	1.0804987	1.2865325	1.428691
C1	0.6401509	0.64702857	0.6546092	0.62171102	0.59413511	0.52600837	0.47869846
C2	0.20178844	0.18543266	0.15820161	0.19070235	0.21842071	0.29641193	0.35146496
C3	-0.13326432	-0.12200423	-0.10096616	-0.1116421	-0.12107023	-0.15317014	-0.17632629
C4	0.028771862	0.025644615	0.019507684	0.020941133	0.022301082	0.028364636	0.032855779
C5	-0.00269179	-0.002324967	-0.001586573	-0.001663307	-0.001747906	-0.002285776	-0.002695537
C6	9.22E-05	7.70E-05	4.58E-05	4.69E-05	4.87E-05	6.69E-05	8.11E-05

DESIGN AEP
1%
1.428691
0.47869846
0.35146496
-0.17632629
0.032855779
-0.002695537
8.10551E-05

	PRE	POST
	546.860	546.860
TOTAL IMP	0.000	135.360
TOTAL PER	546.860	411.5

0.000

Catchment Description:		Pre Development:									Post Development:							
ID	Description	Impervious (A) (ha)	10% AEP Coefficient (C10)	Pervious (A) (ha)	10% AEP Coefficient (C10)	Time of Concentration (tc)	Frequency Factor	Design Rainfall Depth d (mm)	Rainfall Intensity Corresponding to tc (mm/hr)	Rainfall Intensity Including Climate Change	Impervious (A) (ha)	10% AEP Coefficient (C10)	Pervious (A) (ha)	10% AEP Coefficient (C10)	Time of Concentration (tc)	Frequency Factor	Duration	Design Rainfall Depth d (mm)
A	EASTERN CULVERTS	0.000	0.0	93.870	0.200	45.0	1.20	36.9	49.2	49.2	71.127	0.9	73.543	0.200	30.000	1.20	5.0	13.0
																	10.0	20.1
																	15.0	24.7
																	20.0	28.0
																	30.0	32.5
																	45.0	36.9
																	60.0	40.1
																	90.0	44.9
																	120.0	48.6
																	180.0	54.8
																	-	-
C	WESTERN CULVERTS	0.000	0.0	59.100	0.200	30.0	1.20	32.5	64.9	64.9	23.434	0.9	40.634	0.200	20.000	1.20	5.0	13.0
																	10.0	20.1
																	15.0	24.7
																	20.0	28.0
																	30.0	32.5
																	45.0	36.9
																	60.0	40.1
																	90.0	44.9
																	120.0	48.6
																	180.0	54.8
																	-	-
B	PRECINCT C			359.290	0.200	45.0	1.20	36.9	49.2	49.2	31.089	0.9	269.266	0.200	45.000	1.20	5.0	13.0
																	10.0	20.1
																	15.0	24.7
																	20.0	28.0
																	30.0	32.5
																	45.0	36.9
																	60.0	40.1
																	90.0	44.9
																	120.0	48.6
																	180.0	54.8
																	-	-
D	NORTH EAST OF PROJECT SITE			34.600	0.200	20.0	1.20	28.0	83.9	83.9	9.710	0.9	28.057	0.200	15.000	1.20	5.0	13.0
																	10.0	20.1
																	15.0	24.7
																	20.0	28.0
																	30.0	32.5
																	45.0	36.9
																	60.0	40.1
																	90.0	44.9
																	120.0	48.6
																	180.0	54.8
																	-	-
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Project:	TASMAN TERMINAL
Project Number:	BE22003
Document:	Drainage Calculations
Prepared By:	DUSHAN SIMICH
Date:	26/10/2022

Design AEP	1.0%
Climate Change Factor (%)	0.0%

	Annual Exce
	63.20%
C0	0.19169556
C1	0.6401509
C2	0.20178844
C3	-0.13326432
C4	0.028771862
C5	-0.00269179
C6	9.22E-05

Catchment Description:				**Pre Vs Post Analysis**						**Storage:**						
ID	Description	Rainfall Intensity Corresponding to tc (mm/hr)	Rainfall Intensity Including Climate Change	Pre-development Peak Flow (Q) m3/s	Post Development Peak Flow (Q) m3/s	Change in Peak Flow (Q)	% increase	Reduction Ratio (r) - AGRD Part 5A	Inflow Volume (Vi) (m3)	Basha - Storage Volume (Vs) (m3)	Culp - Storage Volume (Vs) (m3)	Boyd - Storage Volume (Vs) (m3)	Carroll - Storage Volume (Vs) (m3)	Adopted Storage Volume (Vs) (m3)	Adopted Storage Volume + 20% Conservative Factor (Vs) (m3)	Notes:
A	EASTERN CULVERTS	**156.3**	**156.3**	3.08	41.03	37.947	1232.0	0.925	15178.9	13687.992	13336.651	14039.334	13380.569	13336.651	16003.982	
		120.9	**120.9**	3.08	31.72	28.637	929.7	0.903	22909.68726	20015.238	19345.641	20684.834	19429.341	19345.641	23214.770	
		98.8	**98.8**	3.08	25.93	22.855	742.0	0.881	27425.55807	23211.514	22254.716	24168.312	22374.316	22254.716	26705.659	
		83.9	**83.9**	3.08	22.01	18.932	614.6	0.860	30291.36159	24837.479	23622.289	26052.669	23774.188	23622.289	28346.747	
		64.9	**64.9**	3.08	17.04	13.962	453.3	0.819	33509.04282	25798.756	24144.839	27452.673	24351.578	24144.839	28973.806	**CRITICAL STORM EVENT**
		49.2	**49.2**	3.08	12.92	9.836	319.3	0.762	35408.33041	24820.595	22677.112	26964.079	22945.048	22677.112	27212.535	
		40.1	**40.1**	3.08	10.53	7.445	241.7	0.707	35736.77103	22812.685	20346.799	25278.570	20655.035	20346.799	24416.159	
		29.9	**29.9**	3.08	7.85	4.773	154.9	0.608	34362.24779	18153.290	15422.764	20883.817	15764.079	15422.764	18507.316	
		24.3	**24.3**	3.08	6.38	3.303	107.2	0.517	31704.76795	13765.841	11126.984	16404.698	11456.841	11456.841	13748.209	
		18.3	**18.3**	3.08	4.79	1.712	55.6	0.357	24646.57836	6917.170	5030.843	8803.497	5266.634	6917.170	8300.604	
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	
C	WESTERN CULVERTS	**156.3**	**156.3**	2.56	15.23	12.668	495.1	0.832	5067.274064	3979.590	3743.444	4215.737	3772.962	3743.444	4492.133	
		120.9	**120.9**	2.56	11.77	9.213	360.0	0.783	7370.229096	5350.185	4932.237	5768.132	4984.481	4932.237	5918.685	
		98.8	**98.8**	2.56	9.63	7.067	276.2	0.734	8479.997151	5673.995	5122.317	6225.673	5191.276	5122.317	6146.780	**CRITICAL STORM EVENT**
		83.9	**83.9**	2.56	8.17	5.611	219.3	0.687	8977.355398	5521.831	4878.124	6165.538	4958.587	4878.124	5853.748	
		64.9	**64.9**	2.56	6.33	3.766	147.2	0.595	9039.047629	4656.464	3930.659	5382.270	4021.385	4021.385	4825.662	
		49.2	**49.2**	2.56	4.79	2.235	87.3	0.466	8045.165452	3083.263	2415.897	3750.629	2499.318	2499.318	2999.182	
		40.1	**40.1**	2.56	3.91	1.348	52.7	0.345	6468.275479	1744.106	1256.909	2231.302	1317.808	1744.106	2092.927	
		29.9	**29.9**	2.56	2.91	0.356	13.9	0.122	2560.555355	221.006	129.566	312.446	140.996	312.446	374.935	
		24.3	**24.3**	2.56	2.37	-0.190	-7.4	-0.080	-1823.324258	~~93.551~~	~~40.915~~	~~146.186~~	~~47.494~~	~~146.186~~	~~175.423~~	
		18.3	**18.3**	2.56	1.78	-0.780	-30.5	-0.439	-11238.06989	~~2566.343~~	~~201.120~~	~~4931.567~~	~~496.773~~	~~4931.567~~	~~5917.881~~	
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	
B	PRECINCT C	**156.3**	**156.3**	11.79	42.65	30.859	261.7	0.724	12343.58574	8108.404	7285.421	8931.386	7388.294	7285.421	8742.505	
		120.9	**120.9**	11.79	32.97	21.181	179.7	0.642	16944.75264	9588.176	8290.682	10885.671	8452.869	8290.682	9948.818	**CRITICAL STORM EVENT**
		98.8	**98.8**	11.79	26.96	15.170	128.7	0.563	18203.99219	8750.146	7256.998	10243.295	7443.642	7443.642	8932.370	
		83.9	**83.9**	11.79	22.88	11.092	94.1	0.485	17747.96907	7126.030	5648.405	8603.655	5833.108	5833.108	6999.730	
		64.9	**64.9**	11.79	17.72	5.926	50.3	0.335	14222.66996	3702.277	2646.888	4757.665	2778.812	3702.277	4442.732	
		49.2	**49.2**	11.79	13.43	1.637	13.9	0.122	5891.829848	507.983	297.765	718.201	324.042	718.201	861.841	
		40.1	**40.1**	11.79	10.94	-0.848	-7.2	-0.078	-4071.922565	~~202.316~~	~~88.919~~	~~315.713~~	~~103.093~~	~~315.713~~	~~378.855~~	
		29.9	**29.9**	11.79	8.16	-3.627	-30.8	-0.444	-26111.09417	~~6015.643~~	~~431.021~~	~~11600.265~~	~~1129.099~~	~~11600.265~~	~~13920.318~~	
		24.3	**24.3**	11.79	6.63	-5.155	-43.7	-0.777	-49483.91292	~~15673.495~~	~~-7096.088~~	~~38443.079~~	~~-4249.890~~	~~38443.079~~	~~46131.694~~	
		18.3	**18.3**	11.79	4.98	-6.808	-57.7	-1.367	-98041.65665	~~28282.229~~	~~-77444.635~~	~~134009.094~~	~~-64228.777~~	~~134009.094~~	~~160810.913~~	
		-	-	-	-	-	-	-	-	-	-	-	-	-	-	
D	NORTH EAST OF PROJECT SITE	**156.3**	**156.3**	1.93	7.48	5.544	286.5	0.741	2217.578971	1502.078	1360.312	1643.843	1378.032	1360.312	1632.374	
		120.9	**120.9**	1.93	5.78	3.847	198.8	0.665	3077.436726	1819.112	1590.700	2047.524	1619.252	1590.700	1908.840	**CRITICAL STORM EVENT**
		98.8	**98.8**	1.93	4.73	2.793	144.3	0.591	3351.249509	1709.561	1439.483	1979.639	1473.243	1473.243	1767.892	
		83.9	**83.9**	1.93	4.01	2.078	107.4	0.518	3324.271471	1444.581	1167.908	1721.253	1202.492	1202.492	1442.991	
		64.9	**64.9**	1.93	3.11	1.172	60.6	0.377	2812.05178	840.390	620.197	1060.582	647.721	840.390	1008.468	
		49.2	**49.2**	1.93	2.35	0.419	21.7	0.178	1510.116614	195.345	121.640	269.050	130.853	269.050	322.860	
		40.1	**40.1**	1.93	1.92	-0.016	-0.8	-0.008	-78.16829812	~~0.440~~	~~0.217~~	~~0.663~~	~~0.245~~	~~0.663~~	~~0.796~~	
		29.9	**29.9**	1.93	1.43	-0.503	-26.0	-0.352	-3625.042911	~~700.519~~	~~126.038~~	~~1275.000~~	~~197.848~~	~~1275.000~~	~~1530.000~~	
		24.3	**24.3**	1.93	1.16	-0.771	-39.9	-0.663	-7405.787722	~~2188.275~~	~~-533.644~~	~~4910.194~~	~~-193.404~~	~~4910.194~~	~~5892.233~~	
		18.3	**18.3**	1.93	0.87	-1.061	-54.9	-1.215	-15285.05078	~~4859.073~~	~~-8856.170~~	~~18574.316~~	~~-7141.765~~	~~18574.316~~	~~22289.179~~	
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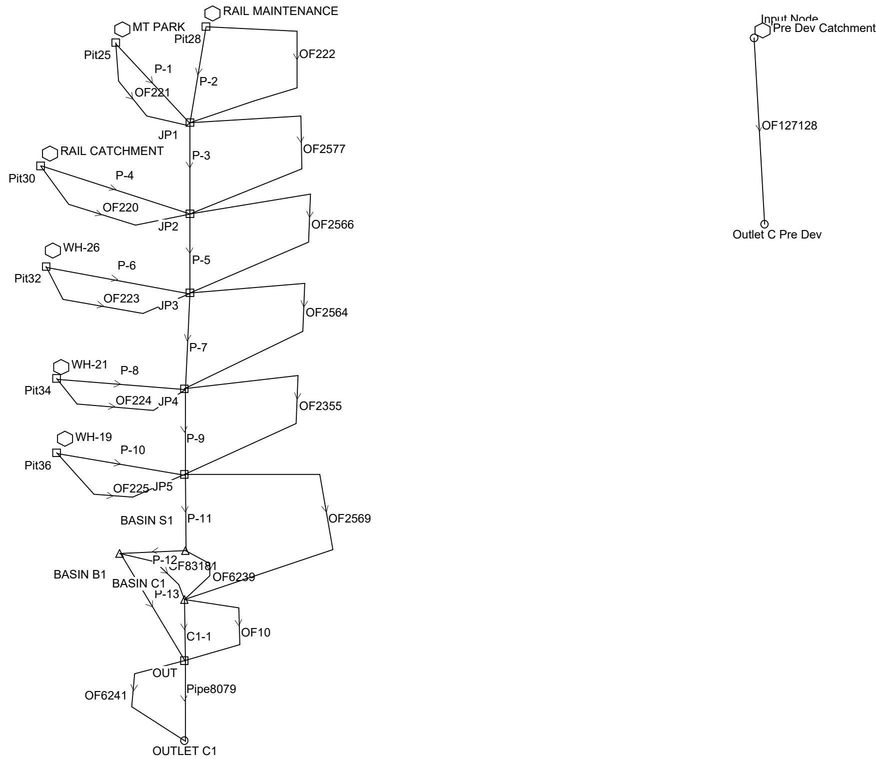

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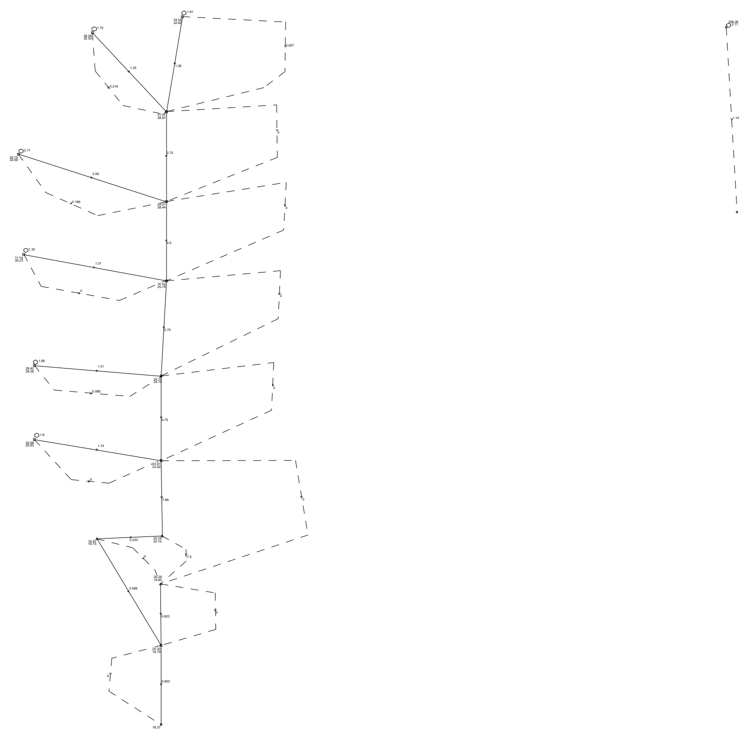

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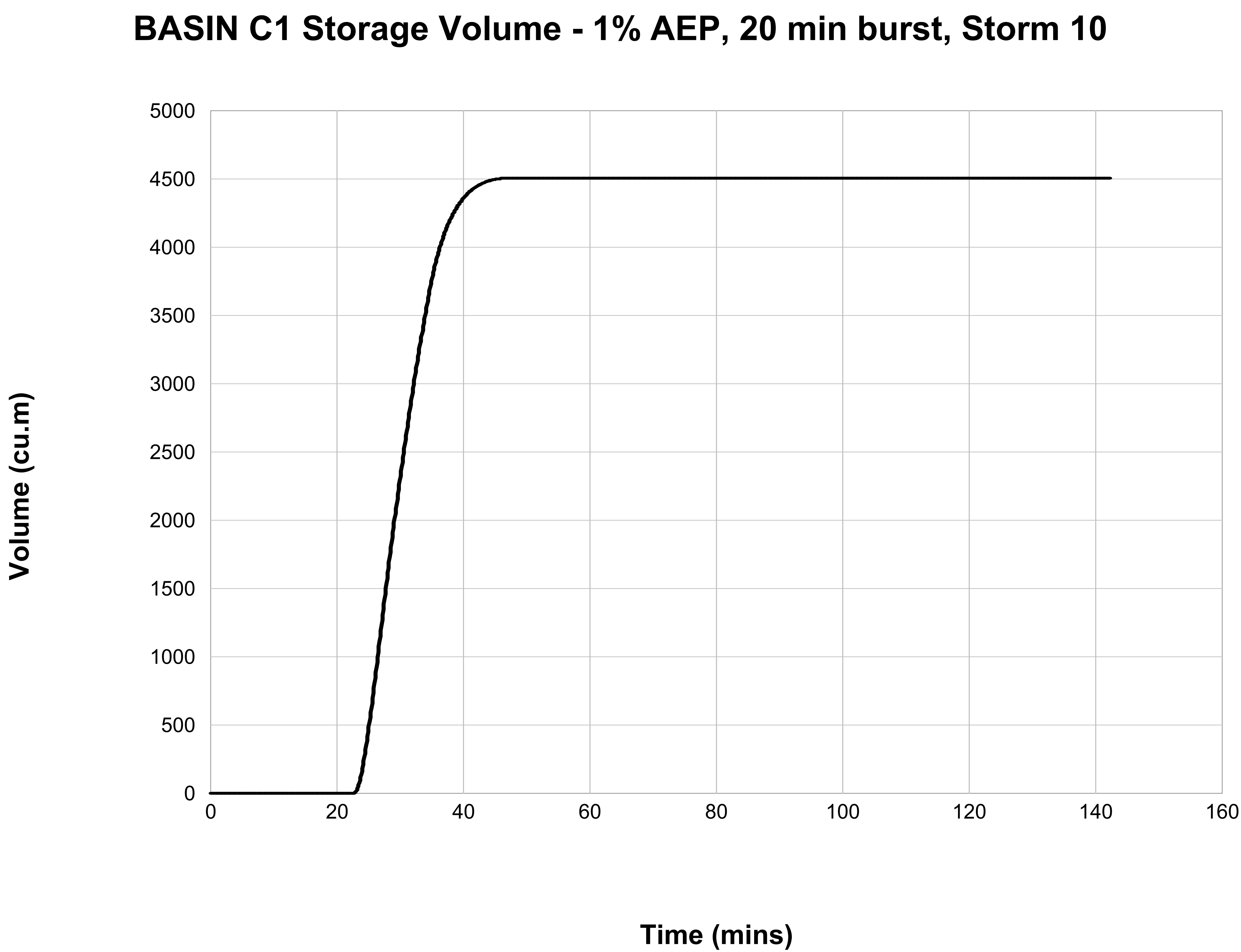
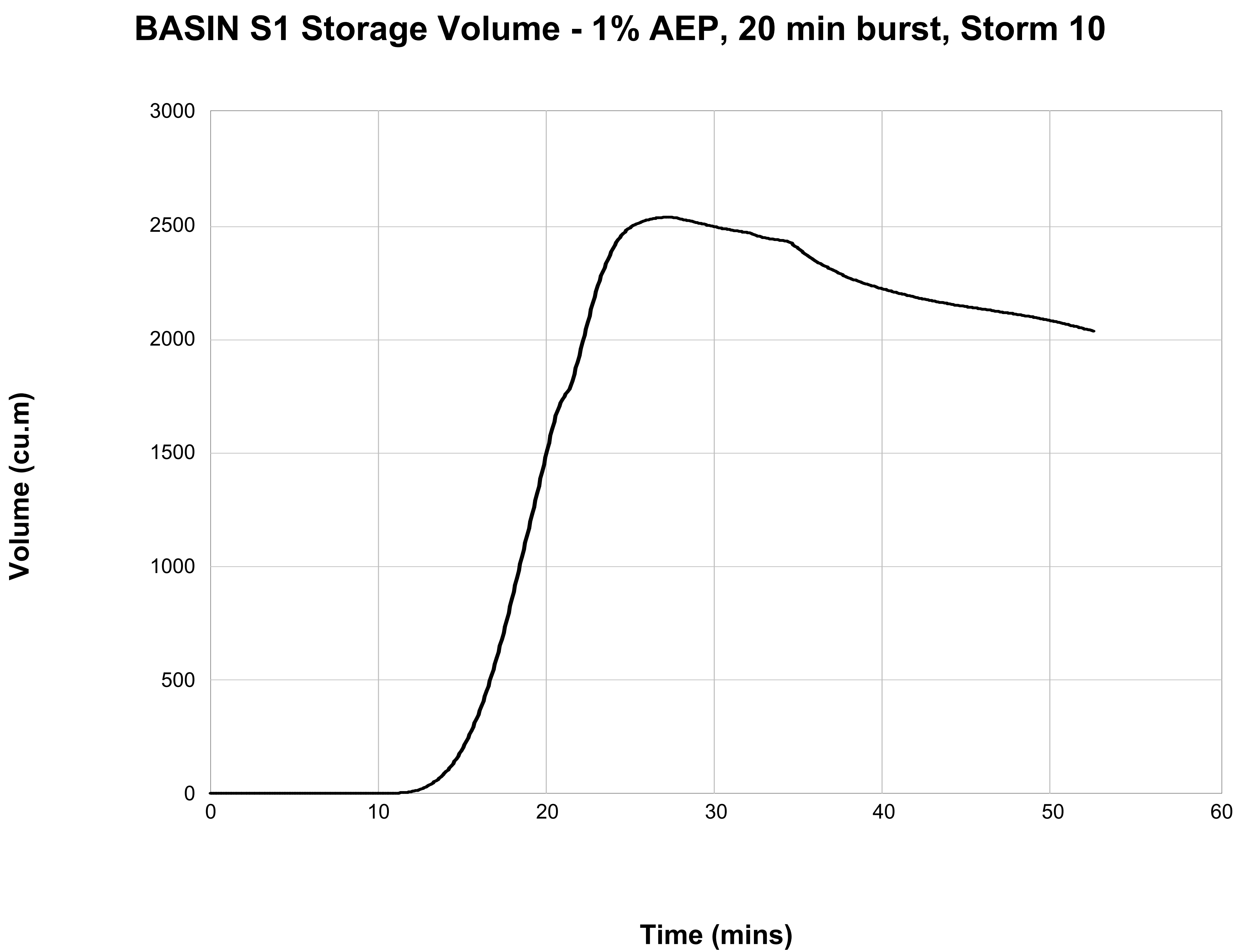
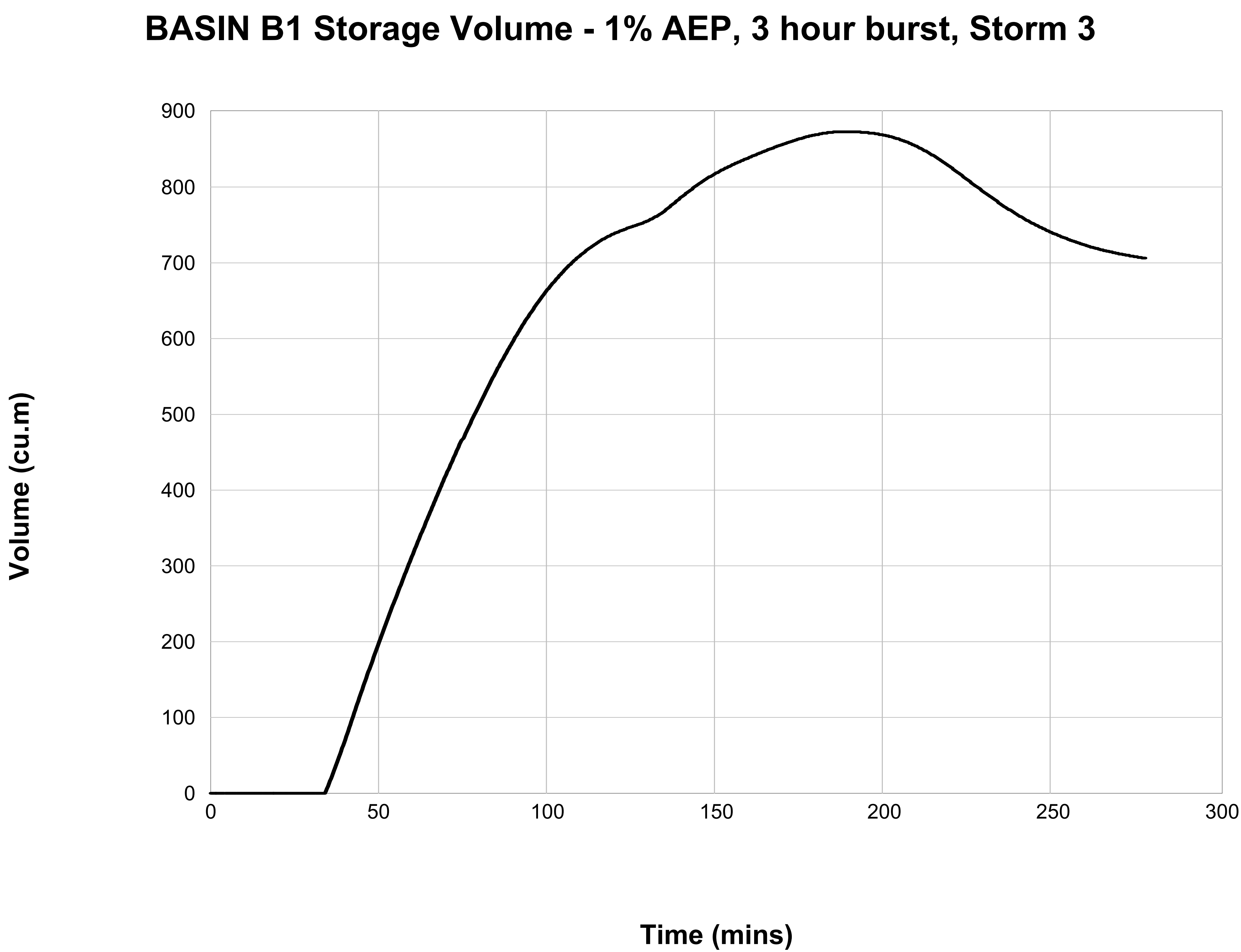
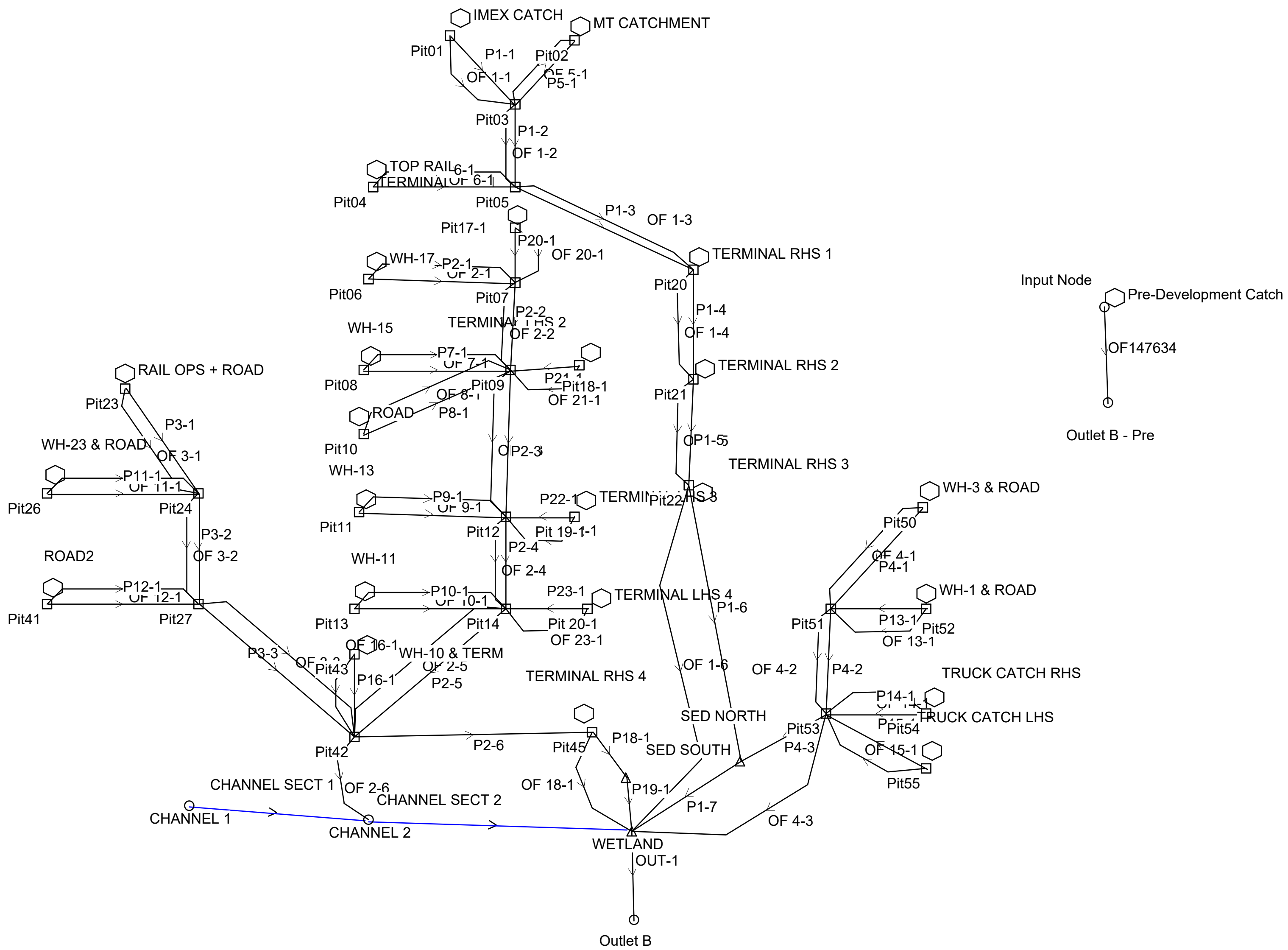

BASIN C1 Storage Volume - 1% AEP, 20 min burst, Storm 10
Volume (cu.m)
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
0
20
40
60
80
100
120
140
160
Time (mins)


BASIN S1 Storage Volume - 1% AEP, 20 min burst, Storm 10
Volume (cu.m)
3000
2500
2000
1500
1000
500
0
0
10
20
30
40
50
60
Time (mins)


BASIN B1 Storage Volume - 1% AEP, 3 hour burst, Storm 3
Volume (cu.m)
900
800
700
600
500
400
300
200
100
0
0
50
100
150
200
250
300
Time (mins)



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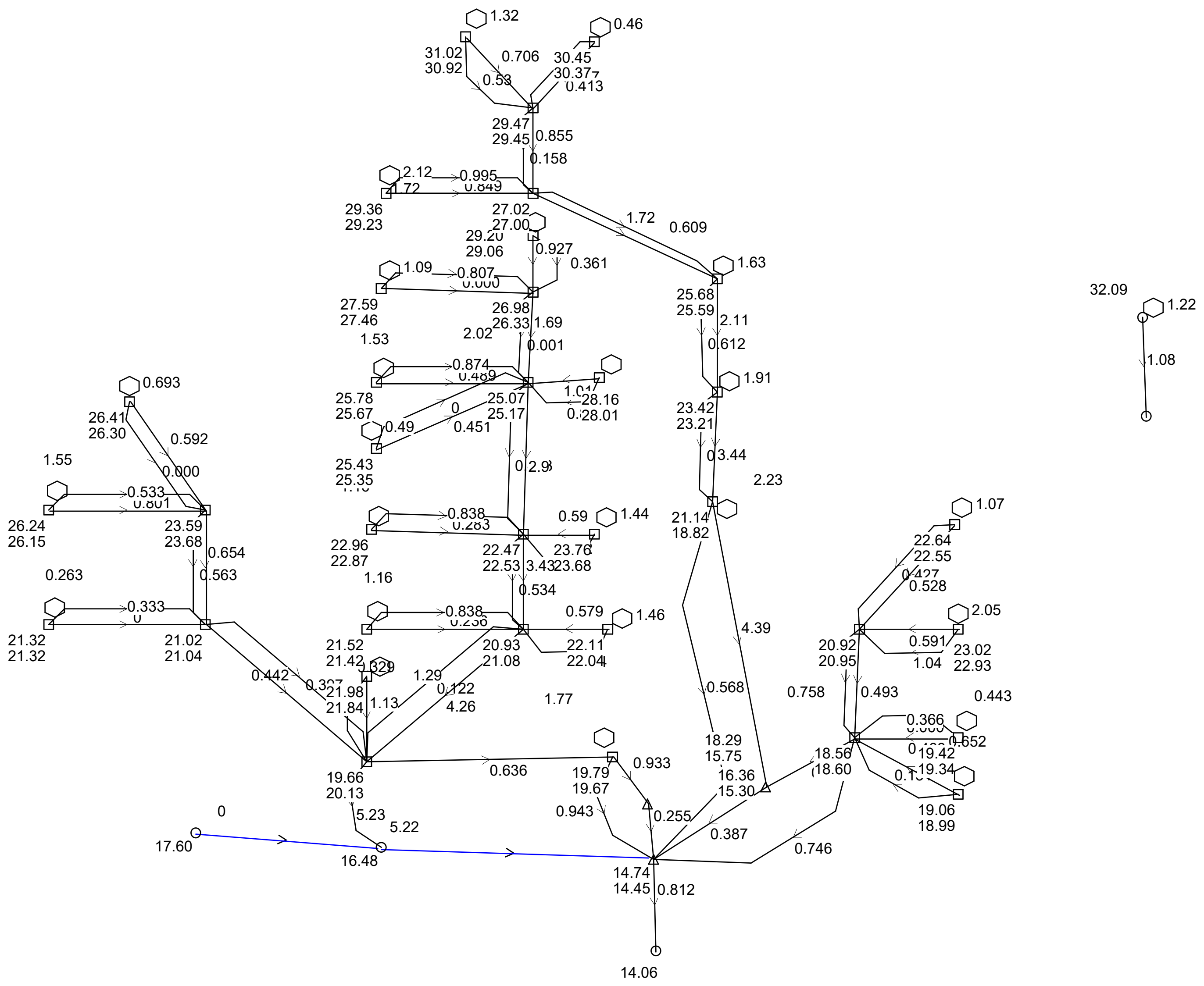

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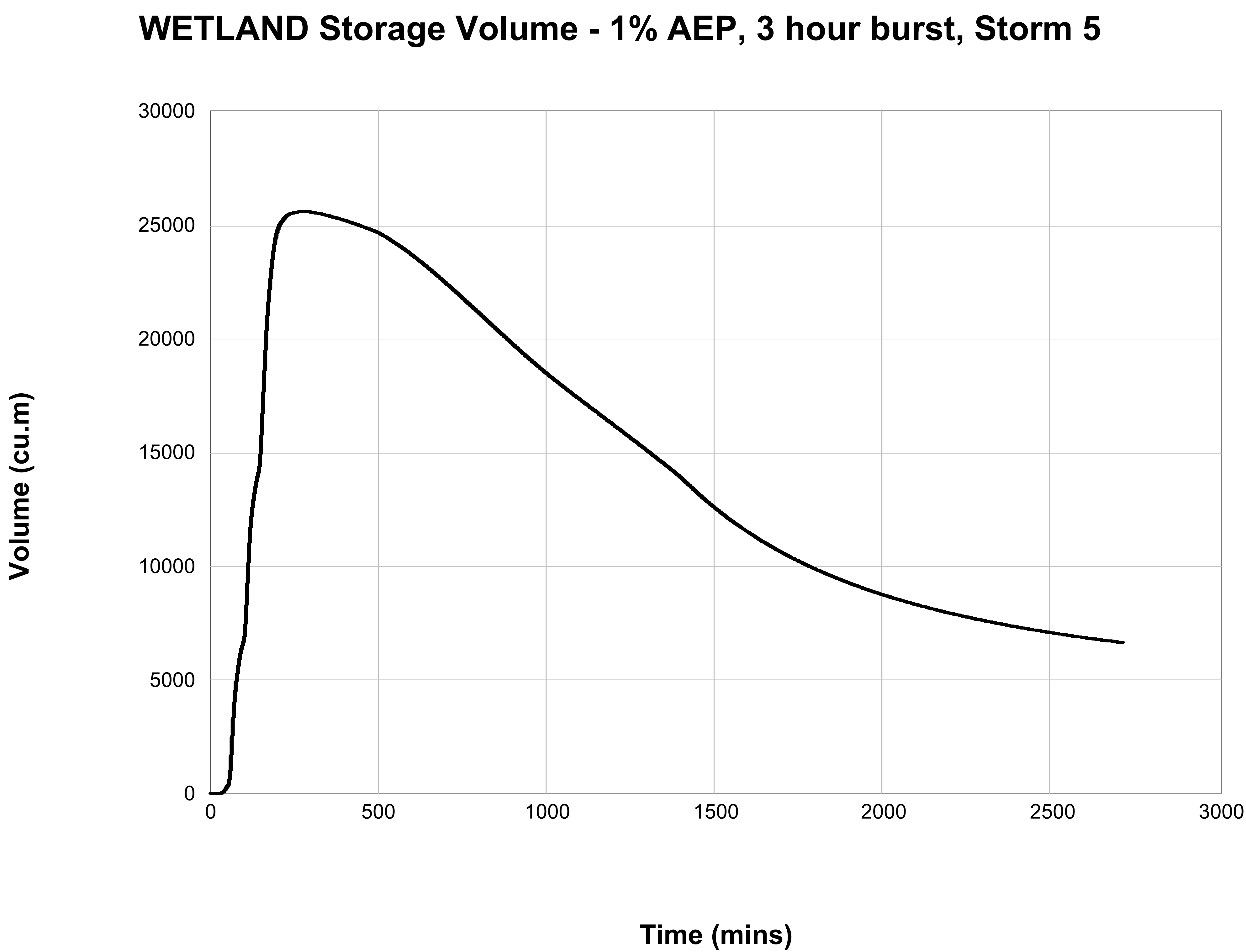
WETLAND Storage Volume - 1% AEP, 3 hour burst, Storm 5
30000
25000
20000
15000
10000
5000
0
0
500
1000
1500
2000
2500
3000
Volume (cu.m)
Time (mins)