Costin Roe Consulting

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CIVIL ENGINEERING REPORT FOR DEVELOPMENT APPLICATION

LOT 2
133-145 LENORE LANE
ERSKINE PARK NSW

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***Rev*: B**

DOCUMENT VERIFICATION

Project Title	Proposed Spec. Facility
Document Title	Civil Engineering Report for Development Application.
Project No.	Co11888.04
Description	Civil engineering report for proposed spec. facility.
Client Contact	Mr Andrew Mead, Logos Property

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Issued by	Mark Wilson	
File Name	11888.04-01a.rpt.docx	

Document History

Date	**Revision**	**Issued to**	**No. Copies**
15 Dec. 2015	DRAFT	Mr Andrew Mead, Logos Property	PDF
16 Dec. 2015	A	Mr Andrew Mead, Logos Property	PDF
8 April 2016	B	Mr James Greener, Logos Property	PDF

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1 INTRODUCTION

1.1 Background

This civil engineering report has been prepared by Costin Roe Consulting in support of a Section 75W modification submission in support of the development of an industrial facility for a speculative tenant. This report provides an addendum to the development submission made in December 2015 for a slightly modified development layout.

1.2 Scope

Costin Roe Consulting Pty Ltd has been commissioned by Logos Property to prepare this Engineering Report in support of the proposed modification on the site.

This report provides a summary of the design principles and planning objectives for the following civil engineering components of the project:

- Earthworks & Retaining Walls;
- Stormwater Management including stormwater quantity and quality; and
- Erosion & Sediment Control.

The engineering objectives for the development are to create a site which, based on the proposed architectural layout, responds to the topography and site constraints to provide an appropriate and economical stormwater management system which incorporates best practice in water sensitive urban design consistent with the requirements of council's water quality objectives.

The proposed development is for a parcel of land, which formed residual land for the SRG Facility to the north. The Super Retail Group (SRG) facility was approved (and now constructed) by the NSW Department of Planning and Environment under SSD 08_0016 dated 12 July 2012 and subsequent S75w application in late 2012. The SRG stormwater management strategy included some allowances for development of the Lot 2 property –this will be discussed in later sections of the report.

A set of drawings have been prepared to show the proposed finished levels, retaining walls, stormwater drainage layout and water quantity and quality requirements for the development. These drawings are for development approval and subject to change during detail design.

1.3 Authority Jurisdiction

The consent authority is the Department of Planning and Environment and the engineering requirements of Penrith City Council (PCC) have been addressed.

1.4 Proposed Development

The proposed development is for a warehouse and distribution facility for a speculative tenant. The proposed construction includes a 7547m2 warehouse, ancillary office space, car parking on the southern (Lenore Drive) frontage, truck loading and circulation areas on the western property.

1.5 Differences between the Current and Previous Application

This application is for an amendment to SSD 08_0016 Mod1. The main component of the amendment is for an adjustment to the approved site layout which involves adjustment to carpark layout and connecting circulation ramps to the SRG facility. Some minor amendments to the building and office are included however the civil engineering adjustments relate mainly to the carpark and circulation areas.

The stormwater strategy, including water quantity and quality management, remains consistent with the approved development.

2 SITE CHARACTERISTICS

2.1 Location

The proposed development is located in the suburb of Erskine Park on Lenore Drive as shown in **Figure 2.1**.

The site is bounded by the SRG Facility to the north, the SRG Facility access drive on the east, Lenore Drive to the south and industrial land to the west.

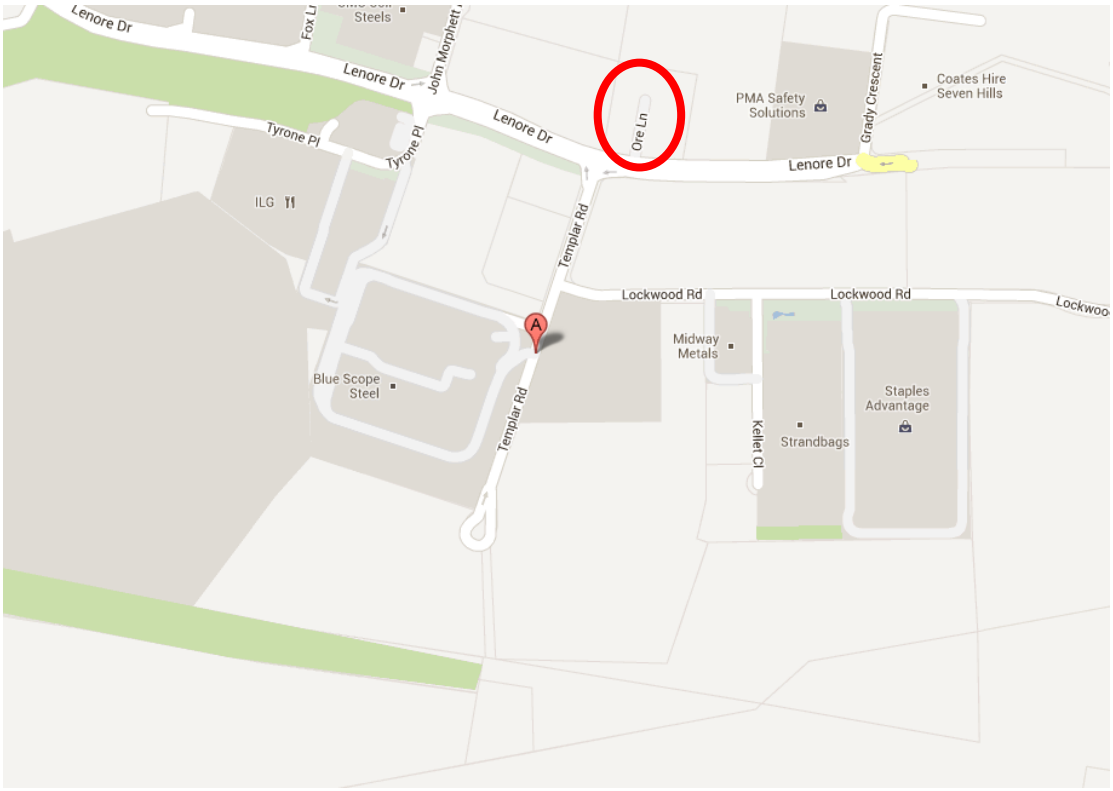

Figure 2.1. Locality Map

2.2 Topography & Description

The Site has been cut and filled to its current levels under the SRG Facility Approval (08_0016). The cut to fill site comprises a pad at approximately RL 59.5m. The site is vacant and has a total area of approximately 1.59 Ha.

A 20m landscape setback is required along the Lenore Drive frontage (south side) which also acts as an above ground detention basin and the legal point of discharge. The detention basin was sized as part of the SSD 08_0016 approval and allows for detention of stormwater from the SRG facility and the current Lot 2 development.

2.3 Existing Stormwater Drainage & Estate Drainage System

An open detention basin exists on the southern landscape zone of the site. As noted this was defined in the SSD 08-0016 development approval and constructed to attenuate stormwater from the Lot 2 and SRG Facility. Stormwater from the SRG facility

(approx. 11 Ha) discharges into the basin, via a 1050mm RCP at the eastern end of the basin. A discharge control pit, which attenuates post developed flows to pre-developed flow, is located on the western end of the basin. Two 825mm RCP outlet pipes convey the stormwater from the control pit to a drainage swale on the property to the east. The basin is required to provide an active detention storage volume of 1200m^3.

Other than the detention basin described above, there is no formal in-ground drainage on the site.

2.4 Proposed Stormwater Drainage System

The proposed stormwater drainage system for the development will comprise a minor and major system to safely and efficiently convey collected stormwater run-off from the development.

The minor system will consist of a piped drainage system designed to accommodate the 1 in 20-year ARI storm event (Q20). This results in the piped system being able to convey all stormwater runoff up to and including the Q20 event. The major system has been designed to cater for storms up to and including the 1 in 100-year ARI storm event (Q100). This major system employs overland flow paths to safely convey excess run-off from the site.

The design of the stormwater system for this site is based on the following:

- Runoff from the canopy will generally be designed in accordance with AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage.
- Overall site runoff and stormwater management will generally be designed in accordance with the Institution of Engineers, Australia publication "Australian Rainfall and Runoff" (1988 Edition), Volumes 1 and 2 (AR&R).
- Design recurrence intervals for major and minor storms will be in accordance with Part C3 of PCC DCP2010.
- On-site detention, water quality measures and flooding requirements will be in accordance with Part C3 of PCC DCP2010 and the strategy agreed and approved as part of SSD 08-0016.
- Stormwater harvesting is based on the requirement of PCC DCP2010 Part C3 and the NSW Department of Environment and Conservation document *Managing Urban Stormwater: Harvesting and Reuse*.

Water quality has been considered in the design, throughout new paved areas, ensuring that any increase in the detrimental effects of pollution are mitigated and PCC Water Quality Objectives are met

Plans of the proposed stormwater drainage layout can be found on drawing **Co11888.04-DA40** in **Appendix A**.

The objectives for the management of stormwater quantity and quality for the proposed application are consistent with the management proposed under the current concept plan approval (08_0016), the DGR's and PCC requirements. Section 5 of this report discusses the proposed water quantity management and Section 6 discusses the proposed water quality management. The means by which these objectives are

achieved are through a stormwater management basin consisting an on-site detention basin combined with a bioretention basin.

- Water Quantity – An on-site detention system is currently constructed on the site and allows for attenuation of stormwater from the SRG facility and the proposed Lot 2 development. The objective for water quantity is to attenuate the post development flows to less than or equal to the pre development flows from the site.
- Water Quality – Treatment of stormwater flows will be performed by a treatment train which comprises of pit inserts and bio-retention. The bio-retention system is proposed to be constructed within the existing detention basin. The overall treatment train being considered in line with the stormwater quantity being discharged from the SRG facility.

The legal point of discharge for the site is located on the south-west boundary of the development site, via the existing 2x 825mm RCP's which discharge to the existing swale drain and then to the council infrastructure system in Lenore Lane.

2.5 External Catchments

The site is affected by flow from the SRG Facility and allowance for this has been made in the final configuration of the detention basin in the landscape zone at the Lenore Lane Frontage and water quality system.

3 SITE WORKS

3.1 Bulk Earthworks

Bulk earthworks will be undertaken to facilitate the construction of the development. The objective for the site is to balance cut and fill earthworks volumes.

As discussed previously, the site has been cut and filled to its current configuration. The cut to fill site comprises a single pad at approximately RL 59.5m and a detention basin, in the 20m landscape setback zone on Lenore Lane.

Allowing for the structural zone of the facility floor, and falls in external levels, some earthworks will be required to the existing pad. Detailed assessment of the earthworks level will be completed during detailed design stage however this is expected to be minor in nature and mainly comprising trimming to final levels, and adjusting the constructed basin to suit the current site arrangements.

Soil erosion and sediment control measures, including sedimentation basins will also be provided for the development – please refer to the Soil and Water Management Plan in Section 7 of this report.

3.2 Embankment Stability

To assist in maintaining embankment stability permanent batter slopes will be no steeper than 3 horizontal to 1 vertical while temporary batters will be no steeper than 2 horizontal to 1 vertical. This is in accordance with the recommended maximum batter slopes for residual clays and shale which are present in the area.

Permanent batters will also be adequately vegetated or turfed which will assist in maintaining embankment stability.

Stability of batters and reinstatement of vegetation shall be in accordance with the submitted drawings and the Soil and Water Management Plan in Section 5.

3.3 Supervision of Earthworks

All geotechnical testing and inspections performed during the earthworks operations will be undertaken to Level 1 geotechnical control, in accordance with AS3798-1996.

3.4 Retaining Walls

The civil engineering objective is to minimise retaining walls within the constraints of the architectural layout and allowable grading (as per AS2890.1 and AS2890.2) through paved areas and batters in landscaped areas.

Retaining walls will be required along the southern side of the car park area, and adjacent to the stormwater detention basin. Reference to drawing **Co11888.04-DA50** shows the location and heights of proposed retaining structures.

The construction of the walls will be performed using a concrete masonry or similar system allowed by Penrith City Council engineering policy.

4 STORMWATER HYDROLGICAL MODELLING AND ANALYSIS

4.1 General Design Principles

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, Penrith City Council and accepted engineering practice as discussed in Section 2.4 of this report.

Storm events for the 2 to 100 Year ARI events have been assessed.

4.2 Minor/ Major System Design

The piped stormwater drainage (minor) system has been designed to accommodate the 20-year ARI storm event (Q20). Overland flow paths (major) which will convey all stormwater runoff up to and including the Q100 event have also been provided which will limit major property damage and any risk to the public in the event of a piped system failure.

4.3 Rainfall Data

Rainfall Intensity Frequency Duration (IFD) data used as a basis for Drains modelling for the 2 to 100 Year ARI events, was taken from *The Bureau of Meteorology Online IFD Tool*.

4.4 Runoff Models

Calculation of the runoff from storms of the design ARI have been calculated with the catchment modelling software DRAINS.

At this stage the modelling performed is to calculate OSD requirements. Detailed hydraulic assessment of the internal drainage system will be calculated at detail/ construction certificate stage.

The design parameters for the Drains model are to be based on typical values and parameters for the area and are as follows:

Model	Model for Design and analysis run	Rational method	
	Rational Method Procedure	ARR87	
	Soil Type-Normal	3.0	
	Paved (Impervious) Area Depression Storage	1	mm
	Supplementary Area Depression Storage	1	mm
	Grassed (Pervious) Area Depression Storage	5	mm
AMC	Antecedent Moisture Condition (ARI=1-5 years)	2.5	
AMC	Antecedent Moisture Condition (ARI=10-20 years)	3.0	
AMC	Antecedent Moisture Condition (ARI=50-100 years)	3.5	
	Sag Pit Blocking Factor (Minor Systems)	0	
	On Grade Pit Blocking Factor (Minor Systems)	0	
	Sag Pit Blocking Factor (Major Systems)	0.5	
	On Grade Pit Blocking Factor (Major Systems)	0.2	
	Minor Storm Pit Freeboard	150	mm

Table 4.1: DRAINS ILSAX Parameters

4.5 Hydraulics

4.5.1 General Requirements

Hydraulic calculations will be carried out utilising DRAINS modelling software during the detail design stage to ensure that all surface and subsurface drainage systems meet or exceed the required standard.

4.5.2 Freeboard

The calculated water surface level in open junctions of the piped stormwater system will not exceed a freeboard level of 150mm below the finished ground level, for the peak runoff from the Minor System runoff. Where the pipes and junctions are sealed, this freeboard is not required.

4.5.3 Public Safety

For all areas subject to pedestrian traffic, the Depth-Velocity product (dV) of the depth of flow, d (in metres), and the velocity of flow, V (in metres per second), will be limited to 0.4, for all storms up to the 100-year ARI.

For other areas, the dV product will be limited to 0.6 for stability of vehicular traffic (whether parked or in motion) for all storms up to the 100-year ARI.

4.5.4 Inlet Pit Spacing

The spacing of inlets throughout the site will be such that the depth of flow, for the major system design storm runoff, will not exceed the top of the kerb (150mm above gutter invert).

4.5.5 Overland Flow

Dedicated flow paths have been designed to convey all storms up to and including the 100-year ARI. These flow paths will convey stormwater from the site to the detention systems prior to discharge.

5 WATER QUANTITY MANAGEMENT

Penrith City Council adopts the principles of water quantity management, also known as "On-site Detention (OSD)", to ensure the cumulative effect of development does not have a detrimental effect on the existing stormwater infrastructure and watercourses located within their LGA downstream from the particular site.

Section 3.3.3 of Councils draft stormwater management policy requires that "*it will be necessary to demonstrate that there will be no increase in runoff from the site as a result of the development for all storms up to and including the 100 year Average Recurrence Interval (ARI) event for all storm durations*".

The strategy for water quantity for the current application was defined as part of the SRG Facility Approval under SSD 08_0016 during 2012. A hydrological analysis which included the overall 11 Ha SRG and Lot 2 development catchments was completed as part of the application. The assessment was undertaken during this approval to estimate the impact of the development of the site on peak flows at the downstream extent of the site. Modelling of stormwater runoff quantity was considered for the pre-existing case and for the operational phase of the development. The analysis was provided in Section 5 of a report by Costin Roe Consulting Pty Ltd**, Co11888.00-02b.rpt** (Rev. B dated 9 November 2012).

A DRAINS hydrological model was used to estimate peak flows from catchments on the sites for various storm durations for Q2 year ARI to Q100 year ARI events. The assessment showed that in order to attenuate stormwater flows from The SRG Facility and Lot 2 development site, that two detention systems with a total storage volume of 3500m3 would be required. These were to be provided in two systems, the first being an underground tank with a volume of 2300m3 and the second detention system having a storage volume of 1200m3. The second system, OSD 2, is located within the 20m landscape setback of the Lot 2 facility. The discharge and storage relationship of OSD 2 is provided below in Table 5.1. Detailed information relating to the SRG facility, as per report **Co11888.00-02b.rpt** (Rev. B dated 9 November 2012) can be found in **Appendix D**.

ARI	Duration (mins)	Peak Flow (m3/s)				Depth (mm)	Storage (m3)
		No Atten.	With attenuation				
			Low	High	Total		
2	120	2.112	0.566	-	0.566	790	700
20	120	3.743	0.627	1.07	1.69	1050	1000
100	120	4.664	0.666	2.83	3.04	1200	1200

Table 5.1 OSD 2 Post Developed Characteristics (Source: Co11888.00-02b.rpt)

Some modifications of the existing detention basin will be required to suit the proposed architectural layout of the development. The proposed car park and truck entry drive will affect the footprint of the basin and the location of the discharge control pit. Some adjustments will be required to suit the current layout. The change in the configuration of the basin will be made such that the approved storage volume and stage discharge relation remains consistent to the approved system defined in SSD 08_0016. The proposed detention basin layout can be seen on drawing **Co11888.04-DA40.**

The existing detention basin will also be adjusted to provide allowances for water quality within the existing detention basin. This will in the form of bio-retention filtration within the base of the detention basin.

6 STORMWATER QUALITY CONTROLS

6.1 Regional Parameters

There is a need to provide a design which incorporates the principles of Water Sensitive Urban Design (WSUD) and to target pollutants that are present in the stormwater so as to minimise the adverse impact these pollutants could have on receiving waters and to also meet the requirements specified by PCC.

PCC has nominated, in Section C3 of their *DCP 2014*, the requirements for stormwater quality to be performed on a catchment wide basis. These are presented in terms of annual percentage pollutant reductions on a developed catchment and are as follows:

Gross Pollutants	70%
Total Suspended Solids	80%
Total Phosphorus	45%
Total Nitrogen	45%
Free Oil and Grease	90%

6.2 Proposed Stormwater Treatment System

Roof, hardstand and other extensive paved areas are required to be treated by the Stormwater Treatment Measures (STM). The STM shall be sized according to the whole catchment area of the Site. The STM's for the development are based on a treatment train approach as discussed in the NSW EPA document *Managing Urban Stormwater: Treatment Techniques* to ensure that all of the objectives above are met.

Components of the treatment train for the development are as follows:

- Primary treatment to hardstand/ paved areas is via Enviropod pit inserts;
- Secondary treatment (overflow event only) is via trash screens and a sediment sump within the OSD system. This has not been included in the MUSIC model; and
- Tertiary treatment of site water will be via a 200m^2 of bio-retention system situated within the on-site detention basin.

The water quality solution, as modelled with MUSIC, is based on achieving the required pollution reduction targets for the overall, SRG and Lot 2 combined catchments. As the SRG facility discharges stormwater into the OSD Basin 2 then the stormwater load from the facility needs to be accounted for in the MUSIC modelling. The Stormwater Management Strategy for the SEG Facility under SSD 08_0016 allowed for water quantity provisions for the current Lot 2 Development however required additional measures for water quality to be provided. The MUSIC modelling completed now, expands on the SRG modelling, allowing for the additional catchment and treatment train measures described above.

6.3 Stormwater Quality Modelling

6.3.1 Introduction

The MUSIC model was chosen to model water quality. This model, released by the Cooperative Research Centre for Catchment Hydrology (CRCCH), is a standard industry model for this purpose. MUSIC (the Model for Urban Stormwater Improvement Conceptualisation) is suitable for simulating catchment areas of up to 100 km^2 and utilises a continuous simulation approach to model water quality.

By simulating the performance of stormwater management systems, MUSIC can be used to predict if the proposed systems and changes to land use are appropriate for their catchments and capable of meeting specified water quality objectives (CRC 2002). The water quality constituents modelled in MUSIC, of relevance to this report, include Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN).

The pollutant retention criteria set out in Part C3 of PCC's DCP and nominated in Section 6.1 of this report were used as a basis for assessing the effectiveness of the selected treatment trains.

The MUSIC model "*11888.04_DA Rev1.sqz*" was set up to examine the effectiveness of the water quality treatment train and to predict if PCC requirements have been achieved. The layout of the MUSIC model is presented in **Appendix B**.

As discussed, the water quality solution, as modelled with MUSIC, is based on achieving the required pollution reduction targets for the overall, SRG and Lot 2 combined catchments. As the SRG facility discharges stormwater into the OSD Basin 2 then the stormwater load from the facility needs to be accounted for in the MUSIC modelling.

6.3.2 Rainfall Data

Six minute pluviographic data for the nearby Liverpool (Whitlam) weather station was sourced from the Bureau of Meteorology (BOM) as nominated below. Evapo-transpiration data for the period was sourced from the Sydney Monthly Areal PET data set supplied with the MUSIC software.

Input	**Data Used**
Rainfall Station	67035 Liverpool (Whitlam)
Rainfall Period	1 January 1967 – 31 December 1976 (10 years)
Mean Annual Rainfall (mm)	857
Evapotanspiration	Sydney Monthly Areal PET
Model Timestep	6 minutes

6.3.3 Rainfall Runoff Parameters

Parameter	**Value**
Rainfall Threshold	1.40
Soil Storage Capacity (mm)	170
Initial Storage (% capacity)	30
Field Capacity (mm)	70
Infiltration Capacity Coefficient a	210
Infiltration Capacity exponent b	4.7
Initial Depth (mm)	10
Daily Recharge Rate (%)	50
Daily Baseflow Rate (%)	4
Daily Seepage Rate (%)	0

6.3.4 Pollutant Concentrations & Source Nodes

In the absence of specific PCC requirements, pollutant concentrations for source nodes are based on parameters adopted by the adjacent LGA Blacktown City Council land use parameters as per the **Table 6.1**.:

Flow Type	Surface Type	TSS (log_{10} values)		TP (log_{10} values)		TN (log_{10} values)	
		Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Baseflow	Roof	1.20	0.17	-0.85	0.19	0.11	0.12
	Roads	1.20	0.17	-1.11	0.48	0.14	0.12
Stormflow	Roof	1.30	0.32	-0.89	0.25	0.30	0.19
	Roads	2.43	0.32	-0.30	0.25	0.34	0.19

Table 6.1. Pollutant Concentrations

The MUSIC model has been setup with a treatment train approach based on the pollutant concentrations in **Table 6.1** above.

6.3.5 Treatment Nodes

Bio-retention, rainwater tank and SW360 Enviropod nodes have been used in the modelling of the development. The existing SRG facility was constructed with Tumblemate TMISF400 system as the primary and tertiary treatment system. The approved MUSIC model configuration for the SRG facility was used to determine the final water quality solution for the overall SRG and Lot 2 development sites.

There is one bio-retention basin proposed which will be provided in accordance with industry best practice and the guidelines of the Monash University Facility for Advancing Water Biofiltration with the following parameters:

Bioretention		
Parameter	**Value**	
Storage Properties		
Extended Detention Depth	300	mm
Storage Surface Area	200	m^2 (minimum)
Filter and Media Properties		
Filtration Area	200	m^2
Saturated Hydraulic Conductivity	100	mm/hr
Filter Depth	500	mm

6.3.6 Results

Table 6.2 shows the results of the MUSIC analysis. The reduction rate is expressed as a percentage and compares the post-development pollutant loads without treatment versus post-development loads with treatment.

	Source	**Residual Load**	**% Reduction**
Total Suspended Solids (kg/yr)	13200	2330	82.3
Total Phosphorus (kg/yr)	26.9	10.9	59.4
Total Nitrogen (kg/yr)	177	92	47.9
Gross Pollutants (kg/yr)	2030	0	100

Table 6.2. MUSIC analysis results

The model results indicate that, through the use of the STM in the treatment train, pollutant load reductions for Total Suspended Solids, Total Phosphorous, Total Nitrogen and Gross Pollutants will meet the requirements of C3 of PCC's DCP 2013 on an overall catchment basis.

6.3.7 Modelling Discussion

MUSIC modelling has been performed to assess the effectiveness of the selected treatment trains and to ensure that the pollutant retention requirements of C3 of PCC's DCP2013 have been met.

The MUSIC modelling has shown that the proposed treatment train of STM will provide stormwater treatment which will meet PCC requirements in an effective and economical manner.

Hydrocarbon and oil & grease removal cannot be modelled with MUSIC software. As a refuelling facility it is expected to have a reasonable level of hydrocarbons. However bunding and a separate containment system is proposed for the area in which refuelling occurs. This is separate to the stormwater system and management of pollutants from the area is not required to be addressed in stormwater management or MUSIC modelling. Potential sources of hydrocarbons and/or oil & grease which drain to the stormwater system would be limited to leaking engine sumps or for accidental fuel

spills/leaks and leaching of bituminous pavements (car parking only). The potential for these pollutants is low and published data from the CSIRO indicates that average concentrations from industrial sites are in the order of 10mg/L and we would expect source loading from this site to be near to or below this concentration. Hydrocarbon pollution would also be limited to surface areas which will be treated via bioretention which is known to be effective in the treatment of hydrocarbons in stormwater.

Given the expected low source loadings of hydrocarbons and oil/grease and removal efficiencies of the treatment devices we consider the DGR's and PCC requirements have been met.

6.4 Stormwater Harvesting

Stormwater harvesting refers to the collection of stormwater from the developments internal stormwater drainage system for re-use in non-potable applications. Stormwater from the stormwater drainage system can be classified as either rainwater, where the flow is from roof areas only, or stormwater where the flow is from all areas of the development.

Rainwater harvesting is not proposed for this development due to the limited reuse applications. No toilets are proposed for the development and landscaping with low water use has been proposed for the landscaped areas. As such no rainwater reuse has been allowed for.

6.5 Maintenance and Monitoring

It is important that each component of the water quality treatment train is properly operated and maintained. In order to achieve the design treatment objectives, an indicative maintenance schedule has been prepared (refer to **Table 6.5** below).

Note that inspection frequency may vary depending on site specific attributes and rainfall patterns in the area. In addition to the maintenance requirements below it is also recommended that inspections are made following heavy rainfall or major storm events. Event heavy rain inspections should be carried out as soon as practicable following an intense period of rainfall, (i.e. greater than 100mm over 48 hours), as measured at Prospect Dam Weather Station No. 67019.

Table 6.5. Indicative Maintenance Schedule

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
SWALES/ LANDSCAPED AREAS			
Check density of vegetation and ensure minimum height of 150mm is maintained. Check for any evidence of weed infestation	Six monthly	Maintenance Contractor	Replant and/or fertilise, weed and water in accordance with landscape consultant specifications
Inspect swale for excessive litter and sediment build up	Six monthly	Maintenance Contractor	Remove sediment and litter and dispose in accordance with local authorities' requirements.
Check for any evidence of channelisation and erosion	Six monthly/ After Major Storm	Maintenance Contractor	Reinstate eroded areas so that original, designed swale profile is maintained
Weed Infestation	Three Monthly	Maintenance Contractor	Remove any weed infestation ensuring all root ball of weed is removed. Replace with vegetation where required.
Inspect swale surface for erosion	Six Monthly	Maintenance Contractor	Replace top soil in eroded area and cover and secure with biodegradable fabric. Cut hole in fabric and revegetate.
RAINWATER TANK			
Check for any clogging and blockage of the first flush device	Monthly	Maintenance Contractor	First flush device to be cleaned out
Check for any clogging and blockage of the tank inlet - leaf/litter screen	Six monthly	Maintenance Contractor	Leaves and debris to be removed from the inlet leaf/litter screen
Check the level of sediment within the tank	Every two years	Maintenance Contractor	Sediment and debris to be removed from rainwater tank floor if sediment level is greater than the maximum allowable depth as specified by the

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
			hydraulic consultant
INLET & JUNCTION PITS			
Inside Pit	Six Monthly	Maintenance Contractor	Remove grate and inspect internal walls and base, repair where required. Remove any collected sediment, debris, litter.
Outside of Pit	Four Monthly/ After Major Storm	Maintenance Contractor	Clean grate of collected sediment, debris, litter and vegetation.
STORMWATER SYSTEM			
General Inspection of complete stormwater drainage system	Bi-annually	Maintenance Contractor	Inspect all drainage structures noting any dilapidation in structures and carry out required repairs.
OSD SYSTEM			
Inspect and remove any blockage from orifice	Six Monthly	Maintenance Contractor/ Owner	Remove grate and screen to inspect orifice.
Inspect trash screen and clean	Six Monthly	Maintenance Contractor/ Owner	Remove grate and screen if required to clean it.
Inspect flap valve and remove any blockage.	Six Monthly	Maintenance Contractor/ Owner	Remove grate. Ensure flap valve moves freely and remove any blockages or debris.
Inspect pit sump for damage or blockage.	Six Monthly	Maintenance Contractor/ Owner	Remove grate & screen. Remove sediment/ sludge build up and check orifice and flap valve is clear.
Inspect storage areas and remove debris/ mulch/ litter etc likely to block screens/ grates.	Six Monthly	Maintenance Contractor/ Owner	Remove debris and floatable materials.
Check attachment of orifice plate and screen to wall of pit	Annually	Maintenance Contractor	Remove grate and screen. Ensure plate or screen mounted securely, tighten fixings if required. Seal gaps if required.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
Check orifice diameter is correct and retains sharp edge.	Five yearly	Maintenance Contractor	Compare diameter to design (see Work-as-Executed) and ensure edge is not pitted or damaged.
Check screen for corrosion	Annually	Maintenance Contractor	Remove grate and screen and examine for rust or corrosion, especially at corners or welds.
Inspect overflow weir and remove any blockage	Six monthly	Maintenance Contractor/ Owner	Ensure weir is free of blockage.
Inspect walls for cracks or spalling	Annually	Maintenance Contractor	Remove grate to inspect internal walls, repair as necessary.
Check step irons	Annually	Maintenance Contractor	Ensure fixings are secure and irons are free from corrosion.

7 EROSION & SEDIMENT CONTROL PLAN

An erosion and sediment control plan (ESCP) is included in drawings **Co11888.04-DA20,** and **DA25**. These plans show the works can proceed without polluting receiving waters. A detailed plan will be prepared after development consent is granted and before works commence.

7.1 General Conditions

1. The ESCP is to be read in conjunction with the engineering plans, and any other plans or written instructions that may be issued by the site manager, council inspector or other authorised representative in relation to development at the subject site.
2. Contractors will ensure that all soil and water management works are undertaken as instructed in this report and constructed following the guidelines stated in Managing Urban Stormwater, Soils and Construction (1998) and PCC's specifications.
3. All subcontractors will be informed by the site manager of their responsibilities in minimising the potential for sedimentation and soil erosion.

7.2 Land Disturbance

1. Where practicable, the soil erosion hazard on the site will be kept as low as possible and as recommended in **Table 7.1**.

Land Use	Limitation	Comments
Construction areas	Limited to 5 (preferably 2) metres from the edge of any essential construction activity as shown on the engineering plans.	All site workers will clearly recognise these areas that, where appropriate, are identified with barrier fencing (upslope) and sediment fencing (downslope), or similar materials.
Temporary construction access	Limited to a maximum width of 5 metres	The site manager will determine and mark the location of these zones onsite. All site workers will comply with these restrictions.
Remaining lands	Entry prohibited except for essential management works	

Table 7.1 Limitations to access

7.3 Erosion & Sediment Control Conditions

1. Clearly visible barrier fencing shall be installed as shown on drawing **Co11888.04-DA20** and elsewhere at the discretion of the site superintendent to ensure traffic control and prohibit unnecessary site disturbance. Vehicular access to the site shall be limited to only those essential for construction work and they shall enter the site only through the stabilised access points.
2. Soil materials will be replaced in the same order they are removed from the ground. It is particularly important that all subsoils are buried and topsoils (landscaped areas only) remain on the surface at the completion of works.
3. The construction program should be scheduled so that period of time from starting land disturbance to stabilisation is minimised.
4. Land recently established with grass species will be watered regularly until an effective cover has properly established and plants are growing vigorously. Further application of seed might be necessary later in areas of inadequate vegetation establishment.
5. Where practical, foot and vehicular traffic will be kept away from all recently established areas
6. Earth batters shall be constructed in accordance with the Geotechnical Engineers Report or with as law a gradient as practical but not steeper than:
    - 2H:1V where slope length is less than 7 metres
    - 2.5H:1V where slope length is between 7 and 10 metres
    - 3H:1V where slope length is between 10 and 12 metres
    - 4H:1V where slope length is between 12 and 18 metres
    - 5H:1V where slope length is between 18 and 27 metres
    - 6H:1V where slope length is greater than 27 metres
7. All earthworks, including waterways/drains/spillways and their outlets, will be constructed to be stable in at least the design storm event of 1 in 2 year ARI (Q2).
8. During windy weather, large, unprotected areas will be kept moist (not wet) by sprinkling with water to keep dust under control. In the event water is not available in sufficient quantities, soil binders and/or dust retardants will be used or the surface will be left in a cloddy state that resists removal by wind.

7.4 Pollution Control Conditions

1. Stockpiles will not be located within 5 metres of hazard areas, including likely areas of high velocity flows such as waterways, paved areas and driveways.
2. Sediment fences will:
   a) Be installed where shown on the drawings, and elsewhere at the discretion of the site superintendent to contain the coarser sediment fraction (including aggregated fines) as near as possible to their source.
   b) Have a catchment area not exceeding 720 square metres, a storage depth (including both settling and settled zones) of at least 0.6 metres, and internal dimensions that provide maximum surface area for settling, and
   c) Provide a return of 1 metre upslope at intervals along the fence where catchment area exceeds 720 square meters, to limit discharge reaching each section to 10 litres/second in a maximum 20 year t_c discharge.
3. Sediment removed from any trapping device will be disposed of in locations where further erosion and consequent pollution to down slope lands and waterways will not occur.
4. Water will be prevented from directly entering the permanent drainage system unless it is relatively sediment free (i.e. the catchment area has been permanently landscaped and/or likely sediment has been treated in an approved device). Nevertheless, stormwater inlets will be protected.
5. Temporary soil and water management structures will be removed only after the lands they are protecting are fully stabilised.

7.5 Waste Management Conditions

Acceptable bind will be provided for any concrete and mortar slurries, paints, acid washings, lightweight waste materials and litter. Clearance services are to be provided by the respective contractors at least weekly.

7.6 Site Inspection and Maintenance

1. A self-auditing program will be established based on a check sheet (refer **Appendix D**). A site inspection using the check sheet will be made by the site manager:
   - At least weekly;
   - Immediately before site closure; and
   - Immediately following rainfall events in excess of 5mm in any 24 hour period.

The self- audit will include:

- Recording the condition of every sediment control device;
- Recording maintenance requirements (if any) for each sediment control device;

- Recording the volumes of sediment removed from sediment retention systems, where applicable;
- Recording the site where sediment is disposed; and
- Forwarding a signed duplicate of the completed Check Sheet to the project manager/developer for their recording.

2. In addition, the site manager will be required to oversee the installation and maintenance of all soil and water management works on the site. The person shall be required to provide a short monthly written report to the superintendent. The responsible person will ensure that:
   - The plan is being implemented correctly;
   - Repairs are undertaken as required; and
   - Essential modifications are made to the plan if and when necessary.

   The report shall include a certificate that works have been carried out in accordance with the plan.
3. Waste bins will be emptied as necessary. Disposal of waste will be in a manner approved by the Site Superintendent.
4. Proper drainage will be maintained. To this end, drains (including inlet and outlet works) will be checked to ensure that they are operating as intended, especially that:
   - No low points exist that can fill and overtop in a large storm event;
   - Areas of erosion are repaired (e.g. lined with a suitable material) and/or velocity of flow is reduced appropriately through construction of small check dams and installing additional diversion upslope; and
   - Blockages are cleared (these night occur because of sediment pollution, sand/soil/spoil being deposited in or too close to them, breached by vehicle wheels, etc.).
5. Sand/soil/spoil materials placed closer than 2 metres from hazard areas will be removed. Such hazard areas include areas of high velocity water flows (e.g. waterways and gutters), paved areas and driveways.
6. Recently stabilised lands will be checked to ensure that erosion hazard has been effectively reduced. Any repairs will be initiated as appropriate.
7. Excessive vegetation growth will be controlled through mowing or slashing.
8. All sediment detention systems will be kept in good working condition. In particular, attention will be given to:
   a) Recent works to ensure they have not resulted in diversion of sediment laden water away from them;
   b) Degradable products to ensure they are replaced as required; and
   c) Sediment removal, to ensure the design capacity remains in the settling zone.
9. Any pollutants removed from sediment basins or litter traps will be disposed of in areas where further pollution to down slope lands and waterways should not occur.

10. Additional erosion and/or sediment control works will be constructed as necessary to ensure the desired protection is given to down slope lands and waterways, i.e. make ongoing changes to the plan where it proves inadequate in practice or is subjected to changes in conditions at the work site or elsewhere in the catchment.
11. Erosion and sediment control measures will be maintained in a functioning condition until all earthwork activities are completed and the site fully stabilised.
12. Litter, debris and sediment will be removed from the gross pollutant traps and trash racks as required.

8 CONCLUSION

This Civil Engineering Report has been prepared to support a section 75W modification for a proposed warehouse facility for a speculative tenant at Lenore Lane, Erskine Park.

A civil engineering strategy for the site has been developed which provides a best practice solution within the constraints of the existing landform, proposed development layout and existing approvals which affect the land. Within this strategy a stormwater quantity and quality management strategy has been developed to reduce both peak flows and pollutant loads in stormwater leaving this site. The stormwater management for the development has been designed in accordance with Penrith City Council's Section C3 of DCP2013.

Management of Stormwater Quantity was defined in the approval for the Super Retail Group (SRG) Facility under SSD 08_0016. The hydrological assessment completed as part of this application and now constructed proves local post development flows from the site will be less than pre-development flows and demonstrates that the site discharge will not adversely affect any land, drainage system or watercourse as a result of the development. Some modifications to the layout of the existing detention basin will be required however the storage volume ($1200m^3$) and discharge relationship will remain consistent with the approved designs.

During the construction phase, a Sediment and Erosion Control Plan will be in place to ensure the downstream drainage system and receiving waters are protected from sediment laden runoff.

During the operational phase of the development, a treatment train incorporating the use of a pit inserts and a bio-retention system (within the existing detention basin) is proposed to mitigate the increase in stormwater pollutant load generated by the development. MUSIC modelling results indicate that the proposed STM are effective in reducing pollutant loads in stormwater discharging from the site and meet the requirements of Council's pollution reduction targets. Best management practices have been applied to the development to ensure that the quality of stormwater runoff is not detrimental to the receiving environment.

It is recommended the management strategies in this report be approved and incorporated into the future detailed design.

9 REFERENCES

- Managing Urban Stormwater: Harvesting and Reuse – 2006 (NSW DEC);
- Managing Urban Stormwater: Source Control – 1998 (NSW EPA);
- Managing Urban Stormwater: Treatment Techniques – 1997 (NSW EPA);
- Managing Urban Stormwater: Soils & Construction – 2004 (LANDCOM);
- Penrith City Council – DCP 2013 (Part C3); and
- Water Sensitive Urban Design – "Technical Guidelines for Western Sydney" by URS Australia Pty Ltd, May 2004

Appendix A

DRAWINGS BY COSTIN ROE CONSULTING

PROPOSED DEVELOPMENT

LOT 2, 133-145 LENORE LANE

ERSKINE PARK

DRAWING LIST:

DRAWING NO.	DRAWING TITLE
C08753.11-DA10	DRAWING LIST & GENERAL NOTES
C08753.11-DA20	EROSION & SEDIMENT CONTROL PLAN
C08753.11-DA25	EROSION & SEDIMENT CONTROL DETAILS-SHEET 1
C08753.11-DA26	EROSION & SEDIMENT CONTROL DETAILS-SHEET 2
C08753.11-DA40	DRAINAGE/MUSIC CATCHMENT PLAN
C08753.11-DA41	STORMWATER DRAINAGE PLAN
C08753.11-DA45	STORMWATER DRAINAGE DETAILS-SHEET 1
C08753.11-DA46	STORMWATER DRAINAGE DETAILS-SHEET 2
C08753.11-DA50	FINISHED LEVELS PLAN

GENERAL NOTES:

G1 THESE DRAWINGS SHALL BE READ IN CONJUNCTION WITH ALL ARCHITECTURAL AND OTHER CONSULTANTS' DRAWINGS AND SPECIFICATIONS AND WITH SUCH OTHER WRITTEN INSTRUCTIONS AS MAY BE ISSUED DURING THE COURSE OF THE CONTRACT. ANY DISCREPANCY SHALL BE REFERRED TO THE ENGINEER BEFORE PROCEEDING WITH THE WORK.

G2 ALL MATERIALS AND WORKMANSHIP SHALL BE IN ACCORDANCE WITH THE RELEVANT AND CURRENT STANDARDS AUSTRALIA CODES AND WITH THE BY-LAWS AND ORDINANCES OF THE RELEVANT BUILDING AUTHORITIES EXCEPT WHERE VARIED BY THE PROJECT SPECIFICATION.

G3 ALL DIMENSIONS SHOWN SHALL BE VERIFIED BY THE BUILDER ON SITE. ENGINEER'S DRAWINGS SHALL NOT BE SCALED FOR DIMENSIONS. ENGINEER'S DRAWINGS ISSUED IN ANY ELECTRONIC FORMAT MUST NOT BE USED FOR DIMENSIONAL SETOUT. REFER TO THE ARCHITECT'S DRAWINGS FOR ALL DIMENSIONAL SETOUT INFORMATION.

G4 DURING CONSTRUCTION THE STRUCTURE SHALL BE MAINTAINED IN A STABLE CONDITION AND NO PART SHALL BE OVERSTRESSED. TEMPORARY BRACING SHALL BE PROVIDED BY THE BUILDER TO KEEP THE WORKS AND EXCAVATIONS STABLE AT ALL TIMES.

G5 UNLESS NOTED OTHERWISE ALL LEVELS ARE IN METRES AND ALL DIMENSIONS ARE IN MILLIMETRES.

G6 ALL WORKS SHALL BE UNDERTAKEN IN ACCORDANCE WITH ACCEPTABLE SAFETY STANDARDS & APPROPRIATE SAFETY SIGNS SHALL BE INSTALLED AT ALL TIMES DURING THE PROGRESS OF THE JOB.

ELECTRONIC INFORMATION NOTES:

1. THE ISSUED DRAWINGS IN HARD COPY OR PDF FORMAT TAKE PRECEDENCE OVER ANY ELECTRONICALLY ISSUED INFORMATION, LAYOUTS OR DESIGN MODELS.
2. THE CONTRACTOR'S DIRECT AMENDMENT OR MANIPULATION OF THE DATA OR INFORMATION THAT MIGHT BE CONTAINED WITHIN AN ENGINEER-SUPPLIED DIGITAL TERRAIN MODEL AND ITS SUBSEQUENT USE TO UNDERTAKE THE WORKS WILL BE SOLELY AT THE DISCRETION OF AND THE RISK OF THE CONTRACTOR.
3. THE CONTRACTOR IS REQUIRED TO HIGHLIGHT ANY DISCREPANCIES BETWEEN THE DIGITAL TERRAIN MODEL AND INFORMATION PROVIDED IN THE CONTRACT AND/OR DRAWINGS AND IS REQUIRED TO SEEK CLARIFICATION FROM THE SUPERINTENDENT.
4. THE ENGINEER WILL NOT BE LIABLE OR RESPONSIBLE FOR THE POSSIBLE ON-GOING NEED TO UPDATE THE DIGITAL TERRAIN MODEL, SHOULD THERE BE ANY AMENDMENTS OR CHANGES TO THE DRAWINGS OR CONTRACT INITIATED BY THE CONTRACTOR.

SITE PREPARATION NOTES:

1. ALL EARTHWORKS SHALL BE COMPLETED GENERALLY IN ACCORDANCE WITH THE GUIDELINES SPECIFIED BY THE GEOTECHNICAL REPORT.
2. EXISTING LEVELS ARE BASED ON INFORMATION PROVIDED BY BARKER RYAN STEWART TITLED 13030E2.01 DATED 22 NOVEMBER 2013.
3. STRIP ANY TOP SOIL OR DELETERIOUS MATERIAL AND BLEND INTO BATTER TOPSOIL MATERIAL OR STORE AS DIRECTED.
4. COMPLETE CUT TO FILL EARTHWORKS TO ACHIEVE THE REQUIRED LEVELS AS INDICATED ON THE DRAWINGS WITHIN A TOLERANCE OF +0mm/-10mm THROUGH BUILDING PADS/PAVEMENTS AND +0mm/-20mm ELSEWHERE.
5. TOP 1000mm ROCK BELOW BULK EARTHWORKS LEVEL (BEL) IN AREAS OF CUT TO BE RIPPED AND RECOMPACTED IN ACCORDANCE WITH GEOTECHNICAL ADVICE AS 'SITE WON FILL'.
6. IN AREAS OF FILL, THE TOP 500mm IS TO COMPRISE OF SELECT CRUSHED ROCK, SITE WON FROM AREAS OF CUT IN ROCK.
7. PREPARE STEEP BATTERS TO RECEIVE FILL BY CONSTRUCTING BENCHING TO FACILITATE FILL PLACEMENT AND COMPACTION.
8. AREAS TO RECEIVE FILL (THAT ARE NOT ON BENCHED BATTERS) AND AREAS IN CUT SHALL BE PROOF ROLLED TO IDENTIFY ANY SOFT HEAVING MATERIAL. SOFT MATERIAL SHALL BE BOXED OUT AND REMOVED PRIOR TO FILL PLACEMENT.
9. SITE WON FILL TO BE PLACED IN MAXIMUM 300mm LOOSE LAYERS AND COMPACTED TO 100% STANDARD AND WITHIN 2% OF OPTIMUM MOISTURE CONTENT.
10. IMPORTED FILL SHALL BE PLACED IN MAXIMUM 300mm LOOSE LAYERS AND COMPACTED TO 100% STANDARD AND WITHIN 2% OF OPTIMUM MOISTURE CONTENT.
11. MAXIMUM PARTICLE SIZE TO BE THE SMALLER OF 150mm OR HALF THE (LOOSE) LAYER THICKNESS AND/OR TWO THIRDS THE LAYER THICKNESS AFTER COMPACTION.
12. ALL EARTHWORKS SHALL BE COMPLETED UNDER LEVEL 1 CONTROL IN ACCORDANCE WITH AS 3798-2007.
13. PRIOR TO ANY EARTHWORKS, EROSION CONTROL AS OUTLINED IN THE EROSION AND SEDIMENTATION CONTROL PLAN SHALL BE COMPLETED.
14. EXISTING ROCK, IF ANY, SHALL BE REMOVED BY HEAVY ROCK BREAKING OR RIPPING.
15. MATCH EXISTING LEVELS AT BATTER INTERFACE.
16. CONTRACTOR TO MATCH EXISTING LEVELS AT THE INTERFACE OF EARTHWORKS AND EXISTING SURFACE AT BATTER LOCATIONS OR WHERE NO RETAINING WALLS ARE PRESENT. ANY DISCREPANCY BETWEEN DESIGN AND EXISTING LEVELS TO BE REFERRED TO THE ENGINEER FOR DIRECTION OR ADJUSTMENTS TO DESIGN LEVELS.

LOCALITY PLAN
NOT TO SCALE

FOR S75W APPROVAL

AMENDMENTS	DATE	ISSUE
ISSUED FOR S75W APPROVAL	08.04.16	C
ISSUED FOR REVIEW	16.12.15	B
ISSUED FOR REVIEW	15.12.15	A

ARCHITECT

CLIENT
LOGOS PROPERTY
SUITE 02, LEVEL 12
167 MACQUARIE STREET
SYDNEY NSW

PROJECT
PROPOSED DEVELOPMENT
LOT 62/133-145 LENORE LANE,
ERSKINE PARK NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	SD			A1	AS SHOWN	11888.04-DA10

Costin Roe Consulting Pty Ltd.
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CostinRoe Consulting
Value in Engineering and Management

DRAWING TITLE
DRAWING LIST & GENERAL NOTES

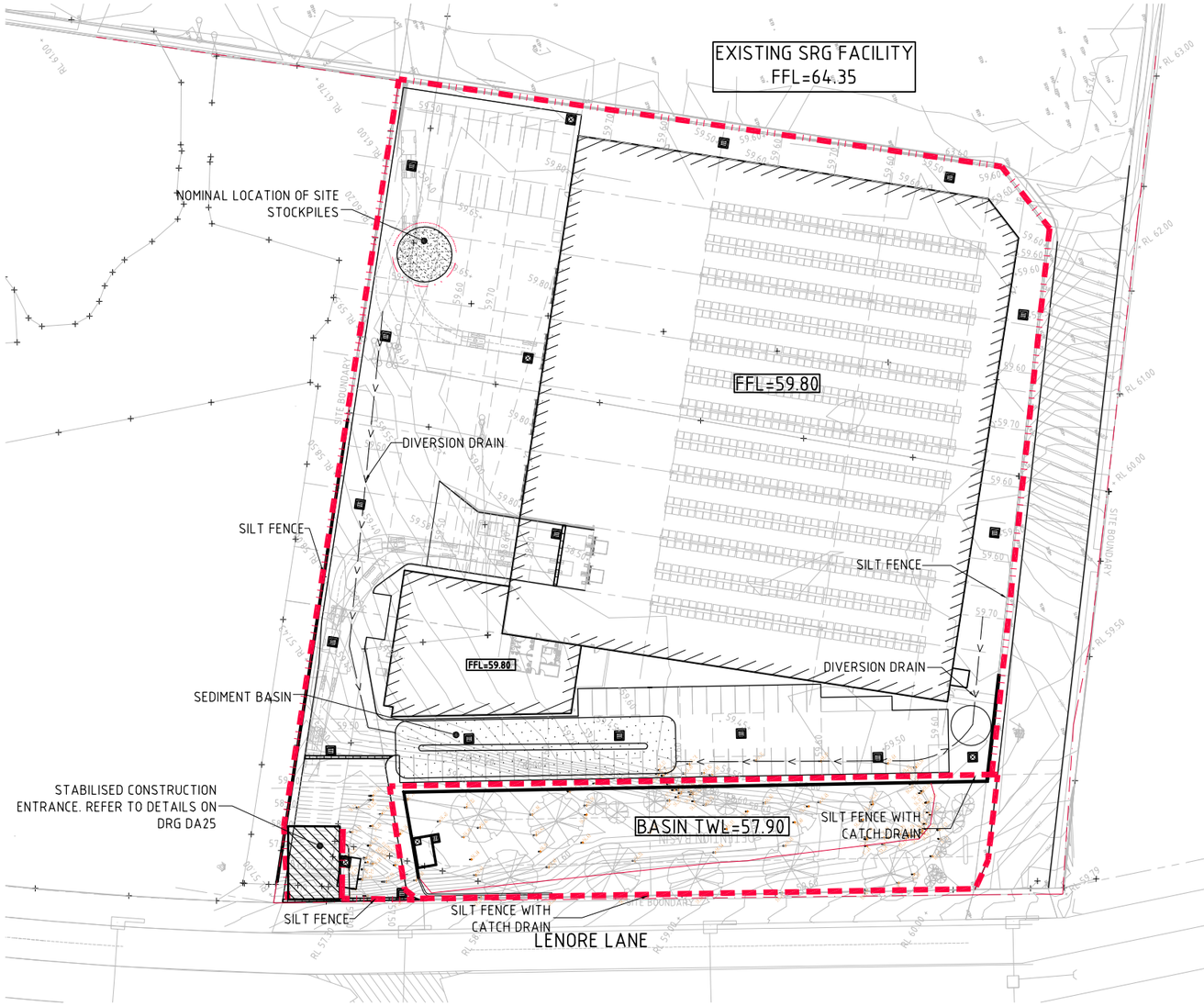
DRAWING No C011888.04-DA10

ISSUE C

EROSION CONTROL NOTES

ALL CONTROL WORK INCLUDING DIVERSION BANKS AND CATCH DRAINS, V-DRAINS AND SILT FENCES SHALL BE COMPLETED DIRECTLY FOLLOWING THE COMPLETION OF THE EARTHWORKS.

1. SILT FENCES AND SILT FENCE RETURNS SHALL BE ERECTED CONVEX TO THE CONTOUR TO POND WATER.
2. HAY BALE BARRIERS AND GEOFABRIC FENCES ARE TO BE CONSTRUCTED TO TOE OF BATTER, PRIOR TO COMMENCEMENT OF EARTHWORKS, IMMEDIATELY AFTER CLEARING OF VEGETATION AND BEFORE REMOVAL OF TOP SOIL.
3. ALL TEMPORARY EARTH BERMS, DIVERSION AND SILT DAM EMBANKMENTS ARE TO BE MACHINE COMPACTED, SEEDED AND MULCHED FOR TEMPORARY VEGETATION COVER AS SOON AS THEY HAVE BEEN FORMED.
4. CLEAR WATER IS TO BE DIVERTED AWAY FROM DISTURBED GROUND AND INTO THE DRAINAGE SYSTEM.
5. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING AND PROVIDING ON GOING ADJUSTMENT TO EROSION CONTROL MEASURES AS REQUIRED DURING CONSTRUCTION.
6. ALL SEDIMENT TRAPPING STRUCTURES AND DEVICES ARE TO BE INSPECTED AFTER STORMS FOR STRUCTURAL DAMAGE OR CLOGGING, TRAPPED MATERIAL IS TO BE REMOVED TO A SAFE, APPROVED LOCATION.
7. ALL FINAL EROSION PREVENTION MEASURES INCLUDING THE ESTABLISHMENT OF GRASSING ARE TO BE MAINTAINED UNTIL THE END OF THE DEFECTS LIABILITY PERIOD.
8. ALL EARTHWORKS AREAS SHALL BE ROLLED ON A REGULAR BASIS TO SEAL THE EARTHWORKS.
9. ALL FILL AREAS ARE TO BE LEFT WITH A BUND AT THE TOP OF THE SLOPE AT THE END OF EACH DAYS EARTHWORKS. THE HEIGHT OF THE BUND SHALL BE A MINIMUM OF 200MM.
10. ALL CUT AND FILL SLOPES ARE TO BE SEEDED AND HYDROMULCHED WITHIN 10 DAYS OF COMPLETION OF FORMATION.
11. AFTER REVEGETATION OF THE SITE IS COMPLETE AND THE SITE IS STABLE IN THE OPINION OF A SUITABLY QUALIFIED PERSON ALL TEMPORARY WORK SUCH AS SILT FENCE, DIVERSION DRAINS ETC SHALL BE REMOVED.
12. ALL TOPSOIL STOCKPILES ARE TO BE SUITABLY COVERED TO THE SATISFACTION OF THE SITE MANAGER TO PREVENT WIND AND WATER EROSION.
13. ANY AREA THAT IS NOT APPROVED BY THE CONTRACT ADMINISTRATOR FOR CLEARING OR DISTURBANCE BY THE CONTRACTOR'S ACTIVITIES SHALL BE CLEARLY MARKED AND SIGN POSTED, FENCED OFF OR OTHERWISE APPROPRIATELY PROTECTED AGAINST ANY SUCH DISTURBANCE.
14. ALL STOCKPILE SITES SHALL BE SITUATED IN AREAS APPROVED FOR SUCH USE BY THE SITE MANAGER. A 6m BUFFER ZONE SHALL EXIST BETWEEN STOCKPILE SITES AND ANY STREAM OR FLOW PATH. ALL STOCKPILES SHALL BE ADEQUATELY PROTECTED FROM EROSION AND CONTAMINATION OF THE SURROUNDING AREA BY USE OF THE MEASURES APPROVED IN THE EROSION AND SEDIMENTATION CONTROL PLAN.
15. ACCESS AND EXIT AREAS SHALL INCLUDE SHAKE-DOWN OR OTHER METHODS APPROVED BY THE SITE MANAGER FOR THE REMOVAL OF SOIL MATERIALS FORM MOTOR VEHICLES.
16. THE CONTRACTOR IS TO ENSURE RUNOFF FROM ALL AREAS WHERE THE NATURAL SURFACE IS DISTURBED BY CONSTRUCTION, INCLUDING ACCESS ROADS, DEPOT AND STOCKPILE SITES, SHALL BE FREE OF POLLUTANTS BEFORE IT IS EITHER DISPERSED TO STABLE AREAS OR DIRECTED TO NATURAL WATERCOURSES.
17. THE CONTRACTOR SHALL PROVIDE AND MAINTAIN SLOPES, CROWNS AND DRAINS ON ALL EXCAVATIONS AND EMBANKMENTS TO ENSURE SATISFACTORY DRAINAGE AT ALL TIMES WATER SHALL NOT BE ALLOWED TO POND ON THE WORKS UNLESS SUCH PONDING IS PART OF AN APPROVED ESCP / SWMP.



EROSION AND SEDIMENT CONTROL PLAN
SCALE 1:500

LEGEND:

PROVIDE 1m RETURNS TO SILT FENCE AT 30m MAX. INTERVALS. TYPICAL (N.S.O.P.)

- SILT FENCE WITH CATCH DRAIN
- SILT FENCE ONLY
- DIVERSION DRAIN

SEDIMENTATION BASIN NOTE:

FOR SEDIMENT & EROSION CONTROL DETAILS REFER TO DRAWING C011888.04-DA25 & DA26.

SEDIMENTATION BASIN SIZING BASED ON RECOMMENDATIONS OF 'SOILS AND CONSTRUCTION, MANAGING URBAN STORMWATER-THE BLUE BOOK'. CAPACITY BASED UPON 5 DAY RAINFALL DEPTH AT 85th PERCENTILE INTENSITY (32.2mm).

APPROXIMATE AREA OF DISTURBED SITE = 1.38Ha

SEDIMENTATION BASINS TO COLLECT RUN-OFF IN EXTREME RAINFALL EVENTS. COLLECTED RUN-OFF TO BE ASSESSED BY A QUALIFIED LABORATORY FOR DOUSING RATES OF ALUM OR GYPSUM TO ENSURE COAGULATION OF SEDIMENTS PRIOR TO WATER BEING DISCHARGED TO COUNCIL STORMWATER SYSTEM.

EACH BASIN IS TO HAVE A MARKER PLACED AS PER THE DETAIL TO INDICATE WHEN SEDIMENT IS TO BE REMOVED. REMOVED SEDIMENT IS TO BE CLASSED AND DEWATERED PRIOR TO REMOVAL FROM SITE.

ALLOWANCE TO BE MADE DURING BENCHING OF SITE TO ENSURE RUN-OFF IS DIRECTED TO SEDIMENTATION BASINS.

NOTES:
1. ASSUME TYPE D SOIL (CLAY/SILTY CLAY)
2. ASSUME GROUP D SOIL (HIGH PLASTICITY AND SHRINK/SWELL PROPERTIES)

SOIL TYPE ASSESSED FROM GEOTECHNICAL REPORT.

SEDIMENT BASIN 1:

CATCHMENT AREA	= 1.38ha
REQUIRED BASIN VOLUME	= 333m³
BASE DIMENSION (LxB)	= 40.0m x 1m
TOP DIMENSION (LxB)	= 49.0m x 10.0m
MAX SIDE SLOPE	= 1V:3H
DEPTH	= 1.5m
PROVIDED BASIN VOLUME	= 335m³

NOTE: ALL LEVELS ARE INDICATIVE (±500mm) & MAY BE SUBJECT TO MINOR VARIATION TO SUIT DETAILED DESIGN.

5m 0 10 20 30 40 50m
SCALE 1:500 AT A1 SIZE SHEET

FOR S75W APPROVAL

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ISSUED FOR REVIEW	16.12.15	B
ISSUED FOR REVIEW	15.12.15	A

ARCHITECT

CLIENT
LOGOS PROPERTY
SUITE 02, LEVEL 12
167 MACQUARIE STREET
SYDNEY NSW

PROJECT
PROPOSED DEVELOPMENT
LOT 62/133-145 LENORE LANE,
ERSKINE PARK NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	SD			A1	AS SHOWN	11888.04-DA20

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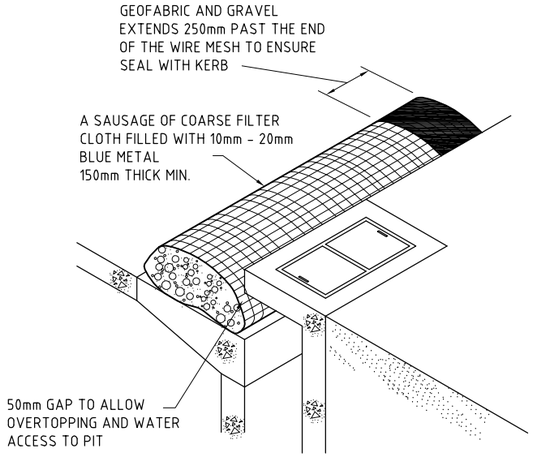
Costin Roe Consulting
Value in Engineering and Management

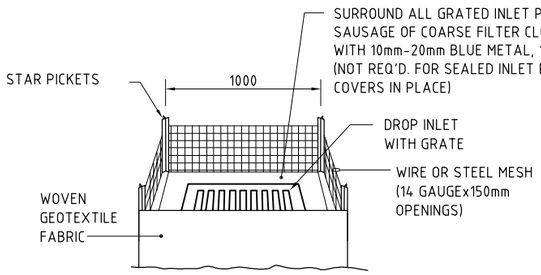
DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN

DRAWING No C011888.04-DA20

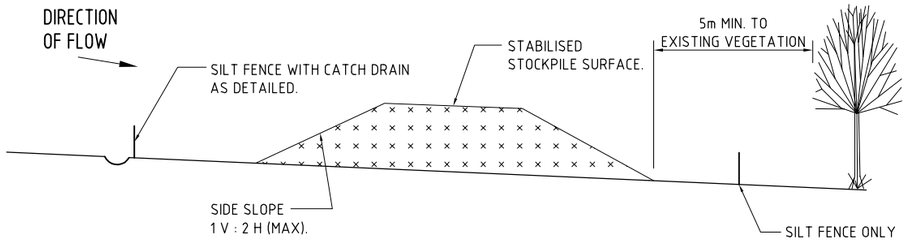
ISSUE C



KERB INLET PIT CONTROL
N.T.S



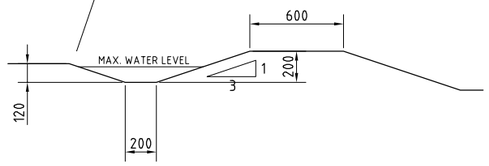
GRATED INLET PIT FILTER DETAIL
N.T.S



TYPICAL STOCKPILE DETAIL
N.T.S.

NOTE : ADOPT ABOVE DETAILS AROUND ALL PITS WITHIN AREA ENCOMPASSED BY SILT FENCE & TO PITS ON THE ROAD ADJACENT TO SITE BOUNDARY.

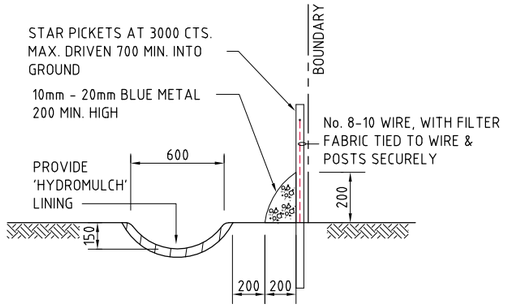
DIVERSION CHANNEL CAPACITY
Q2month = 23.2 l/s (A=0.21Ha MAX.)
MANNINGS n=0.02, MIN. SLOPE = 0.5%
CHANNEL CAPACITY (d=100mm) = 27 l/s + 50mm FREEBOARD
VELOCITY = 0.5 m/s < 1.0 m/s THEREFORE NO SCOUR PROTECTION REQ'D.



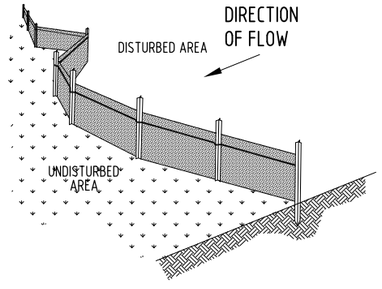
TYPICAL DIVERSION DRAIN SECTION
SCALE 1:20

STOCKPILE NOTES

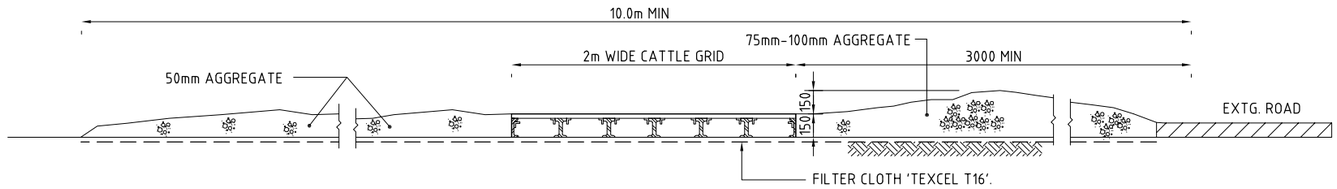
1. PLACE ALL STOCKPILES IN LOCATIONS MORE THAN 5m FROM EXISTING VEGETATION, ROADS & HAZARD AREAS.
2. CONSTRUCT ON THE CONTOUR AS LOW, FLAT ELONGATED MOUNDS. SIDE SLOPE TO BE 1 V: 2 H MAX.
3. WHERE THERE IS SUFFICIENT AREA, TOPSOIL STOCKPILES SHALL BE LESS THAN 2m IN HEIGHT.
4. WHERE STOCKPILES ARE TO BE IN PLACE FOR MORE THAN 10 DAYS, STABILISE USING WOOD CHIP MULCH - 16 TONNE/Ha.
5. CONSTRUCT SILT FENCE WITH CATCH DRAIN ON UPSLOPE SIDE TO DIVERT WATER AROUND STOCKPILES & SILT FENCE ONLY 1 TO 2m DOWNSLOPE AS SHOWN.



TYPICAL OPEN DRAIN & SILT FENCE
SCALE 1:20



TYPICAL SILT FENCE DETAIL
N.T.S.
PROVIDE 1m RETURNS AT 30m INTERVALS.
TYPICAL



SECTION 1:20 (1 / DA20) : STABILISED CONSTRUCTION ENTRANCE 'TRUCK SHAKER'

200mm 0 500 1000 1500 2000mm
SCALE 1:20 AT A1 SIZE SHEET

FOR S75W APPROVAL

AMENDMENTS	DATE	ISSUE
ISSUED FOR S75W APPROVAL	08.04.16	C
ISSUED FOR REVIEW	16.12.15	B
ISSUED FOR REVIEW	15.12.15	A

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PROJECT
PROPOSED DEVELOPMENT
LOT 62/133-145 LENORE LANE,
ERSKINE PARK NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	SD			A1	AS SHOWN	11888.04-DA25

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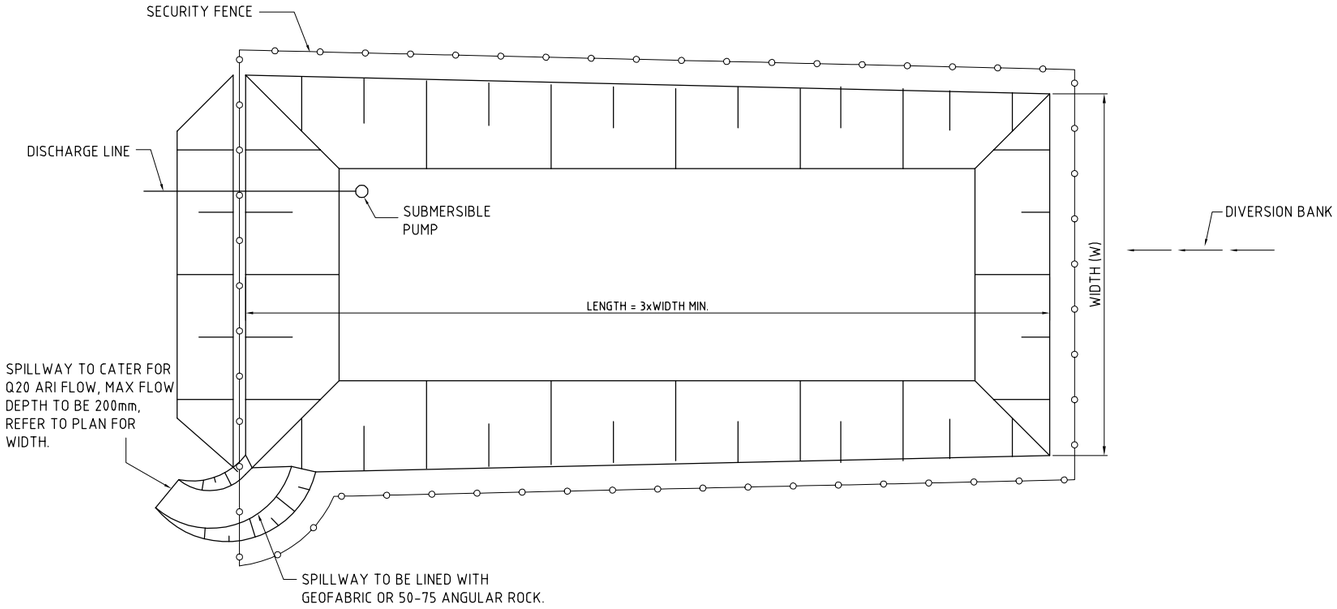
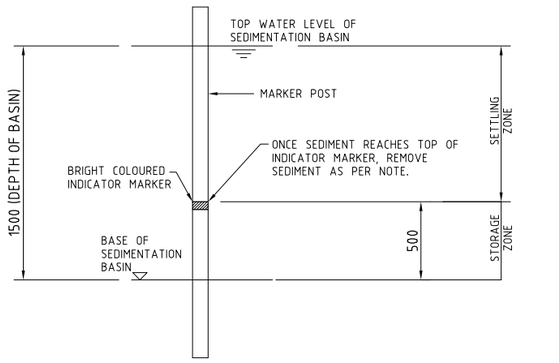
DRAWING TITLE
EROSION AND SEDIMENT CONTROL
DETAILS-SHEET 1

DRAWING No C011888.04-DA25
ISSUE C

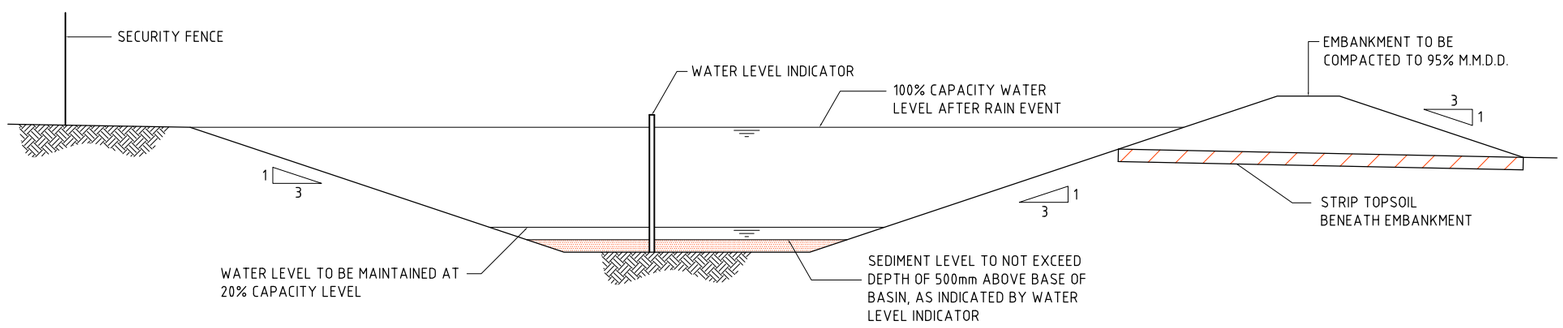


SEDIMENT CONTROL POND NOTES:

1. TYPE D BASIN IS REQUIRED.
2. VOLUME OF TYPE D POND SHALL BE AS NOMINATED ON DRAWING DA20. NOMINAL POND LOCATIONS AND NOMINAL DIMENSIONS.
3. SEDIMENT BUILD UP TO NOT EXCEED 33% TOTAL CAPACITY OF POND.
4. WATER LEVEL TO BE MAINTAINED AT 20% CAPACITY DURING SETTLING PERIOD.
5. LENGTH TO WIDTH RATIO TO BE 3:1 MIN. TYPICAL DEPTH TO BE 1.5m.
6. PROVIDE SECURITY FENCE TO POND FOR SAFETY.
7. DEWATERING OF POND TO BE PERFORMED TO THE BOTTOM OF THE SEDIMENT SETTLING ZONE FOLLOWING ACHIEVEMENT OF WQO's. MANAGEMENT OF DOSAGE AND DISCHARGE TO BE ACHIEVED IN A TIMELY MANNER BEFORE THE NEXT RAIN EVENT AND WITHIN 5 DAYS OF THE INITIAL RAINFALL EVENT.
8. WATER TO BE DOSED WITH GYPSUM TO ACCELERATE SETTLEMENT OF SUSPENDED SOLIDS
9. GYPSUM DOSAGE RATE TO BE APPLIED AT APPROX. 32kg PER 100 CUBIC METRE OF COLLECTED RUNOFF.
10. THE USE OF ALUM AS A FLOCULANT IS NOT RECOMMENDED AND IS TO BE USED ONLY FOLLOWING CONSULTATION WITH AND ACCEPTANCE FROM GOLD COAST CITY COUNCIL ESC OFFICERS.
11. DISCHARGE FROM POND IS PERMISSIBLE WHEN THE WATER PH IS 6.5-8.5 AND IS CLARIFIED TO AT OR BELOW A TSS OF 50mg/L (75 NTU). CLARIFICATION WOULD GENERALLY BE ACHIEVED IN 36-72 HOURS WITH THE USE OF GYPSUM.
12. DEWATERING SHALL BE DONE IN SUCH A MANNER AS TO REMOVE THE RELATIVELY CLEAN WATER WITHOUT REMOVING OR DISTURBING THE SEDIMENT THAT HAS SETTLED. THE PUMP INTAKE PIPE IS NOT TO REST ON THE SETTLED SEDIMENT LAYER.
13. IF WATER EXCEEDS TSS OF 50mg/L (75 NTU) DURING DEWATERING, PUMPING IS TO CEASE.
14. RECORDS ARE TO BE KEPT (ON-SITE AT ALL TIMES) OF ALL MEASUREMENT PRIOR TO, DURING AND AFTER DISCHARGE. RECORDS TO BE MADE AVAILABLE TO COUNCIL OFFICERS UPON REQUEST.



SEDIMENT STORAGE MARKER
SCALE 1:20



TYPICAL SEDIMENT CONTROL BASIN SECTION
SCALE 1:50

200mm 0 500 1000 1500 2000mm
SCALE 1:20 AT A1 SIZE PLOT
500mm 0 1 2 3 4 5m
SCALE 1:50 AT A1 SIZE PLOT
2m 0 5 10 15 20 25m
SCALE 1:250 AT A1 SIZE PLOT

FOR S75W APPROVAL

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ISSUED FOR REVIEW	15.12.15	A

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MW	SD			A1	AS SHOWN	11888.04-DA26

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DRAWING TITLE
EROSION AND SEDIMENT CONTROL DETAILS-SHEET 2

DRAWING No C011888.04-DA26
ISSUE C

DRAINAGE/MUSIC CATCHMENT PLAN
SCALE 1:500

1. ALL STORMWATER WORKS TO BE COMPLETED IN ACCORDANCE WITH AUSTRALIAN STANDARD AS3500.3:2003 PLUMBING AND DRAINAGE, PART 3: STORMWATER DRAINAGE.
2. THE MINOR (PIPED) SYSTEM HAS BEEN DESIGNED FOR THE 1 IN 20 YEAR ARI STORM EVENT AND THE MAJOR (OVERLAND) SYSTEM HAS BEEN DESIGNED FOR THE 1 IN 100 YEAR ARI STORM EVENT.
3. ALL FINISHED PAVEMENT LEVELS SHALL BE AS INDICATED ON FINISHED LEVELS PLANS DA51 &DA52 .
4. PIT SIZES SHALL BE AS INDICATED IN THE SCHEDULE WHILE PIPE SIZES AND DETAILS ARE PROVIDED ON PLAN.
5. EXISTING STORMWATER PIT LOCATIONS AND INVERT LEVELS TO BE CONFIRMED BY SURVEY PRIOR TO COMMENCING WORKS ON SITE.
6. ALL STORMWATER PIPES Ø375 OR GREATER SHALL BE CLASS 2 REINFORCED CONCRETE WITH RUBBER RING JOINTS UNLESS NOTED OTHERWISE.
7. ALL PIPES UP TO AND INCLUDING Ø300 TO BE uPVC GRADE SN8 UNO.
8. PIPE CLASS NOMINATED ARE FOR IN-SERVICE LOADING CONDITIONS ONLY. CONTRACTOR IS TO MAKE ANY NECESSARY ADJUSTMENTS REQUIRED FOR CONSTRUCTION CONDITIONS.
9. ALL CONCRETE PITS GREATER THAN 1000mm DEEP SHALL BE REINFORCED USING N12-200 EACH WAY CENTERED IN WALL AND BASE. LAP MINIMUM 300mm WHERE REQUIRED. ALL CONCRETE FOR PITS SHALL BE F'c 25 MPA. PRECAST PITS MAY BE USED WITH THE APPROVAL OF THE ENGINEER.
10. IN ADDITION TO ITEM 6 ABOVE, ALL CONCRETE PITS GREATER THAN 3000mm DEEP SHALL HAVE WALLS AND BASE THICKNESS INCREASED TO 200mm.
11. PIPES SHALL BE LAID AS PER PIPE LAYING DETAILS. PARTICULAR CARE SHALL BE TAKEN TO ENSURE THAT THE PIPE IS FULLY AND EVENLY SUPPORTED. RAM AND PACK FILLING AROUND AND UNDER BACK OF PIPES AND PIPE FAUCETS, WITH NARROW EDGED RAMMERS OR OTHER SUITABLE TAMPING DETAILS.
12. WHERE PIPE LINES ENTER PITS, PROVIDE 2m LENGTH OF STOCKING WRAPPED SLOTTED Ø100 uPVC TO EACH SIDE OF PIPE.
13. ALL SUBSOIL DRAINAGE LINES SHALL BE Ø100 SLOTTED uPVC WITH APPROVED FILTER WRAP LAID IN 300mm WIDE GRANULAR FILTER UNLESS NOTED OTHERWISE. LAY SUBSOIL LINES TO MATCH FALLS OF LAND AND/OR 1 IN 200 MINIMUM. PROVIDE CAPPED CLEANING EYE (RODDING POINT) AT UPSTREAM END OF LINE AND AT 30m MAX. CTS. PROVIDE SUBSOIL LINES TO ALL PAVEMENT/ LANDSCAPED INTERFACES, TO REAR OF RETAINING WALLS (AS NOMINATED BY STRUCTURAL ENGINEER) AND AS SHOWN ON PLAN.
14. ALL PIPE GRADES 1 IN 100 MINIMUM UNO.
15. PROVIDE STEP IRONS IN PITS DEEPER THAN 1000mm.
16. MIN. 600 COVER TO PIPE OBVERT BENEATH ROADS & MIN. 400 COVER BENEATH LANDSCAPED AND PEDESTRIAN AREAS.
17. PIT COVERS IN TRAFFICABLE PAVEMENT SHALL BE CLASS D 'HEAVY DUTY', THOSE LOCATED IN NON-TRAFFICABLE AREAS SHALL BE CLASS B 'MEDIUM DUTY' U.N.O.
18. PROVIDE CLEANING EYES (RODDING POINTS) TO PIPES AT ALL CORNERS AND T-JUNCTIONS WHERE NO PITS ARE PRESENT.
19. DOWN PIPES (DP) TO BE AS PER HYDRAULIC ENGINEERS DETAILS WITH CONNECTOR TO MATCH DP SIZE U.N.O. ON PLAN. PROVIDE CLEANING EYE AT GROUND LEVEL.
20. PIPE LENGTHS NOMINATED ON PLAN OR LONGSECTIONS ARE MEASURED FROM CENTER OF PITS TO THE NEAREST 0.5m AND DO NOT REPRESENT ACTUAL LENGTH. THE CONTRACTOR IS TO ALLOW FOR THIS.

PIT SCHEDULE

PIT No.	GRATE RL	TYPE	SIZE	COMMENT
PIT A01	59.50	SGGP	600x600	⊕
PIT A02	59.50	SGGP	900x900	⊕
PIT A03	58.70	SJP	900x900	
PIT A04	59.40	SGGP	900x900	⊕
PIT A05	59.40	SGGP	900x900	⊕
PIT A06	59.40	SGGP	900x900	⊕
PIT A07	59.45	SGGP	900x900	⊕
PIT A08	59.30	SGGP	900x900	⊕
PIT A09	59.43	SGGP	900x900	⊕
PIT A10	59.80	SJP	900x900	
PIT A11	58.45	SGGP	600x600	⊕
PIT A12	59.50	SGGP	600x600	⊕
PIT A13	59.50	SGGP	900x900	⊕
PIT A14	59.70	SJP	900x900	
PIT A15	59.50	SGGP	900x900	⊕
PIT A16	59.45	SGGP	900x900	⊕
PIT A17	59.45	SGGP	900x900	⊕
PIT A18		DCP		REFER DA46
PIT A19	57.40	SJP		
PIT A20	57.60	SGGP	900x900	⊕

⊕ DENOTES PIT TO BE FITTED WITH STORMWATER 360 ENVIROPOD 200 INSERT.

NOTE: ALL LEVELS ARE INDICATIVE (±500mm) & MAY BE SUBJECT TO MINOR VARIATION TO SUIT DETAILED DESIGN.

5m 0 10 20 30 40 50m

SCALE 1:500 AT A1 SIZE SHEET

FOR S75W APPROVAL

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LOT 62/133-145 LENORE LANE,
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DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	SD			A1	AS SHOWN	11888.04-DA40

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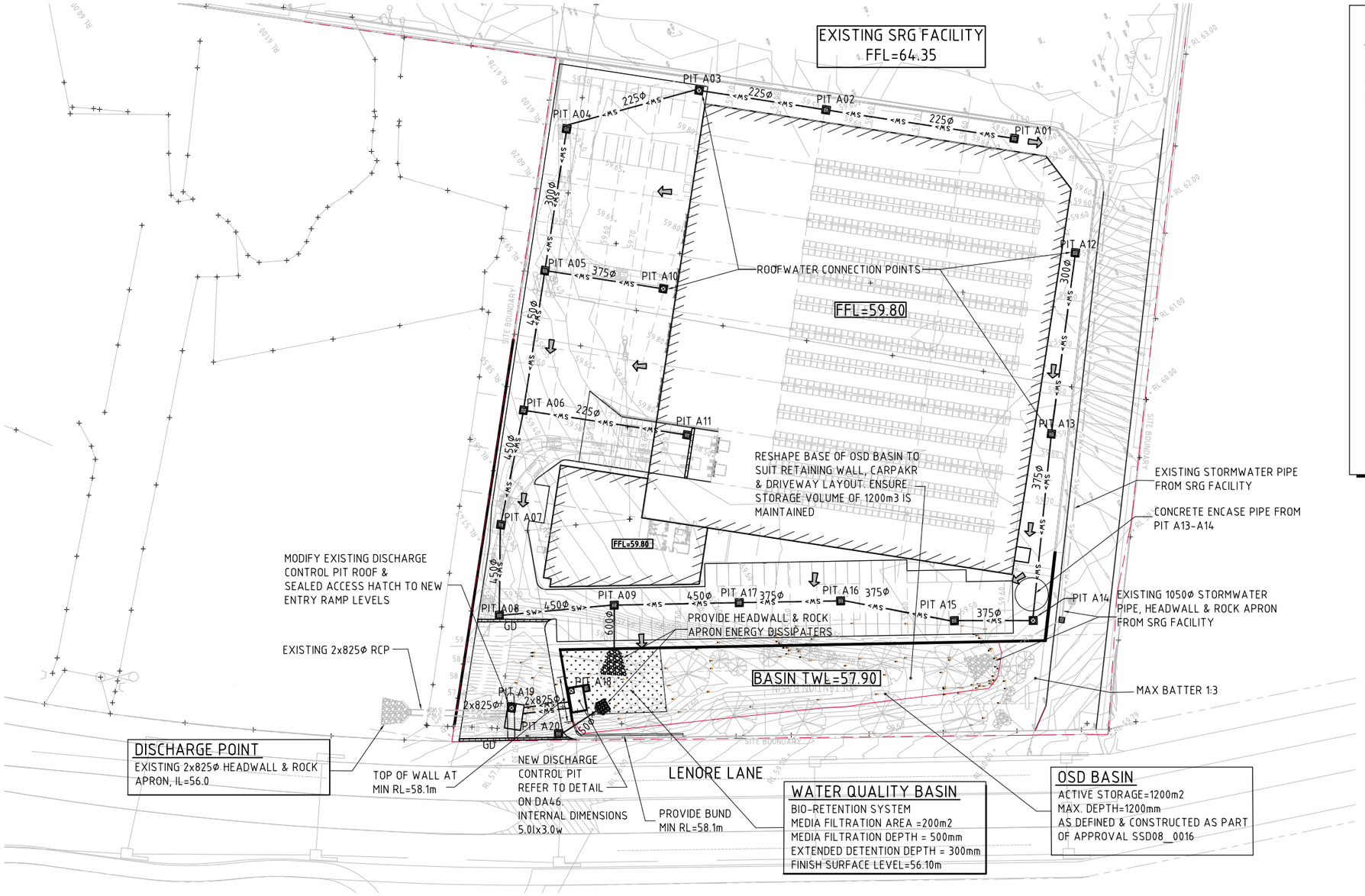
DRAWING TITLE
DRAWING/MUSIC CATCHMENT PLAN

DRAWING No C011888.04-DA40

ISSUE C



LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED.

- SGGP, SINGLE GRATED GULLY PIT
- SJP, SEALED JUNCTION PIT
- KIP, KERB INLET PIT
- DRAINAGE LINE
- EXISTING DRAINAGE LINE
- SUBSOIL LINE
- ROOFWATER LINE
- SIPHONIC LINE
- OVERLAND FLOW DIRECTION
- FINISHED PAVEMENT CONTOUR (MAJOR) 0.5m INTERVALS
- FINISHED PAVEMENT CONTOUR (MINOR) 0.1m INTERVALS

STORMWATER DRAINAGE PLAN

SCALE 1:500

NOTE:
REFER TO DRAWING DA40 FOR DRAINAGE NOTES & PIT SCHEDULE

NOTE: ALL LEVELS ARE INDICATIVE (±500mm) & MAY BE SUBJECT TO MINOR VARIATION TO SUIT DETAILED DESIGN.

5m 0 10 20 30 40 50m

SCALE 1:500 AT A1 SIZE SHEET

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DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	SD			A1	AS SHOWN	11888.04-DA41

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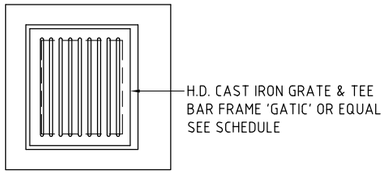
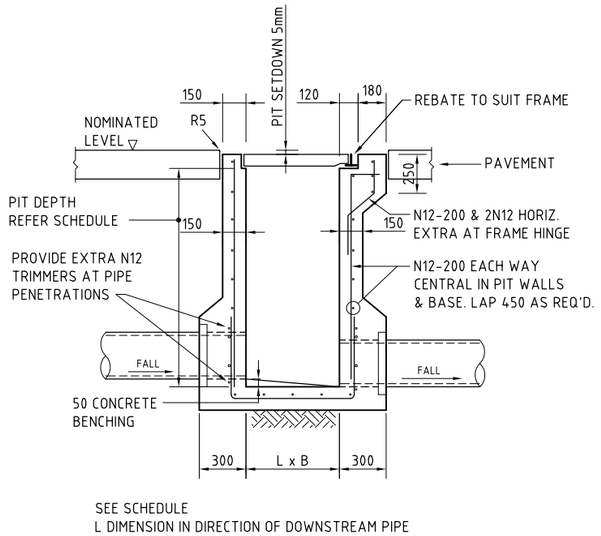
DRAWING TITLE
STORMWATER DRAINAGE PLAN

DRAWING No C011888.04-DA41

ISSUE C



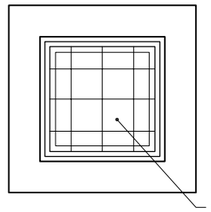
PLAN
SCALE 1:20



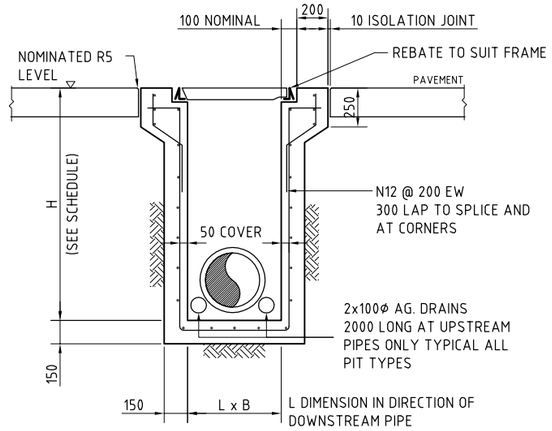
SEE SCHEDULE
L DIMENSION IN DIRECTION OF DOWNSTREAM PIPE

SECTION
SCALE 1:20

SINGLE GRATED GULLY PIT - SGGP

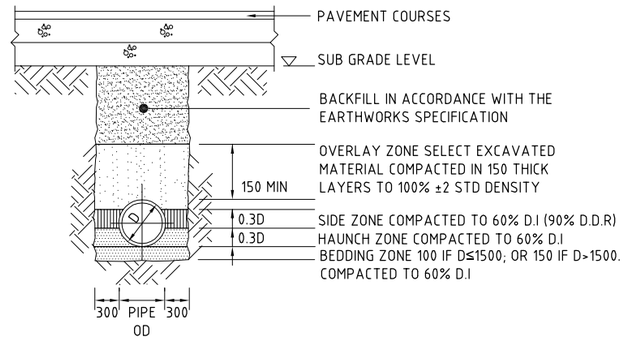


PLAN
1:20

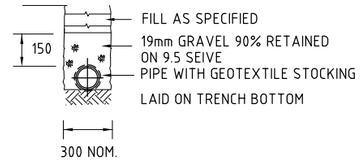


SECTION
SCALE 1:20

SEALED JUNCTION PIT - SJP



TYPE HS2 SUPPORT TO CONCRETE PIPES UNDER PAVEMENT



SUPPORT TO AG. DRAIN

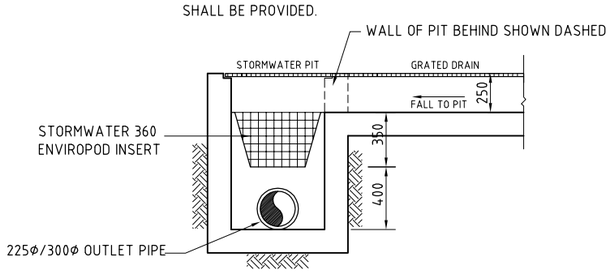
SIDE ZONE MATERIAL GRADING	
SIEVE SIZE	WEIGHT PASSING(%)
75	100
9.5	100 TO 50
2.36	100 TO 30
0.60	50 TO 15
0.075	25 TO 0

SELECT FILL MATERIAL IN ACCORDANCE WITH TABLE 1 AS 3725

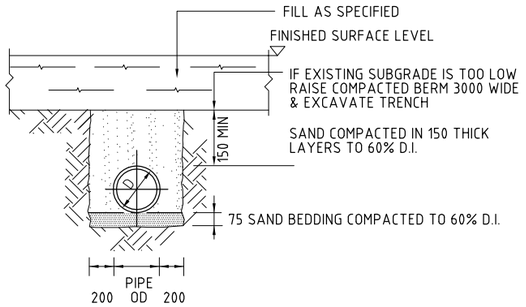
BEDDING & HAUNCH MATERIAL GRADING	
SIEVE SIZE	WEIGHT PASSING(%)
19	100
2.36	100 TO 50
0.60	90 TO 20
0.30	60 TO 10
0.15	25 TO 0
0.075	10 TO 0

NOTES:

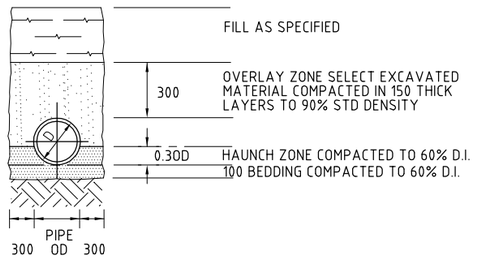
1. WHERE GULLY PIT IS LOCATED ON KERB RETURNS OR BULB OF CUL-DE-SACS PROVIDE CURVED PRECAST CONCRETE LINTELS.
2. SAG PITS SHALL HAVE LINTEL PLACED CENTRALLY ABOUT THE GRATE.
3. ALL REINFORCING TO HAVE 30 MIN. CLAER CONCRETE COVER.
4. FOR PITS DEEPER THAN 1200mm CLIMB RAILS SHALL BE PROVIDED.



GRATED DRAIN/STORMWATER PIT WITH ENVIROPOD CONFIGURATION
SCALE 1:20



SUPPORT TO uPVC PIPES



TYPE H1 SUPPORT TO CONCRETE PIPES AT LANDSCAPED AREAS

PIPE LAYING DETAILS

SCALE 1:20

200mm 0 500 1000 1500 2000mm

SCALE 1:20 AT A1 SIZE SHEET

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DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	SD			A1	AS SHOWN	11888.04-DA45

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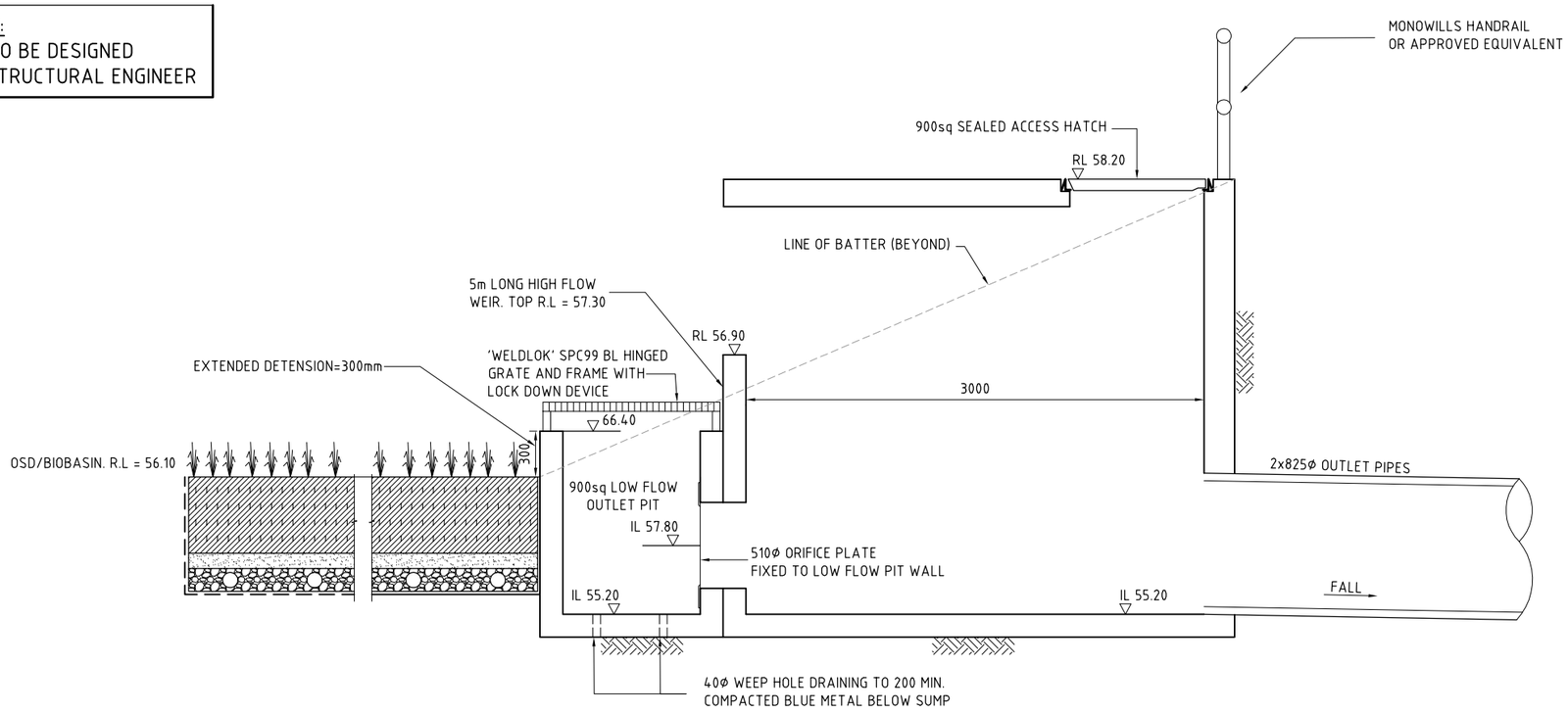
DRAWING TITLE
CONCEPT STORMWATER DETAILS-SHEET 1

DRAWING No C011888.04-DA45

ISSUE C

NOTE:
PIT TO BE DESIGNED
BY STRUCTURAL ENGINEER



OSD/BIO-RETENTION BASIN DISCHARGE CONTROL PIT TYPICAL DETAIL
SCALE 1:20

BIO-RETENTION NOTES:

FILTER MEDIA TO BE LOAMY SAND WITH A PERMEABILITY NOT LESS THAN 200mm/hr. FILTER MEDIA TO BE FREE OF RUBBISH, DELETERIOUS MATERIAL, TOXICANTS, DECLARED PLANTS AND LOCAL WEEDS, AND IS TO NOT BE HYDROPHOBIC.

FILTER MEDIA TO HAVE THE FOLLOWING COMPOSITION RANGE:

CLAY & SILT (<0.05mm)	<3%
VERY FINE SAND (0.05-0.15mm)	5-30%
FINE SAND (0.15-0.25mm)	10-30%
MEDIUM TO COARSE SAND (0.25-1.00mm)	40-60%
COARSE SAND (1.0-2.0mm)	7-10%
FINE GRAVEL (2.0-3.4mm)	<3%

FILTER MEDIA THAT DOES NOT MEET THE FOLLOWING CRITERIA SHALL BE REJECTED:

a. ORGANIC MATTER CONTENT TO BE IDEALLY WITHIN 1% TO 3% (W/W) AND TO BE NO GREATER THAN 5%(W/W).
b. PH TO BE BETWEEN 5.5 AND 7.5
c. PHOSPHOROUS CONTENT TO BE NO GREATER THAN 35mg/kg

FILTER MEDIA TO BE ASSESSED BY QUALIFIED HORTICULTURALIST TO ENSURE CAPABILITY OF SUPPORTING PLANT LIFE.

DRAINAGE LAYER TO BE CLEAN GRAVEL 5-7mm.

PLANTS TO BE IN ACCORDANCE WITH PENRITH COUNCIL WSUD HANDBOOK PART 5 - VEGETATION SELECTION GUIDE, WITH A MINIMUM OF SIX DIFFERENT SPECIES.

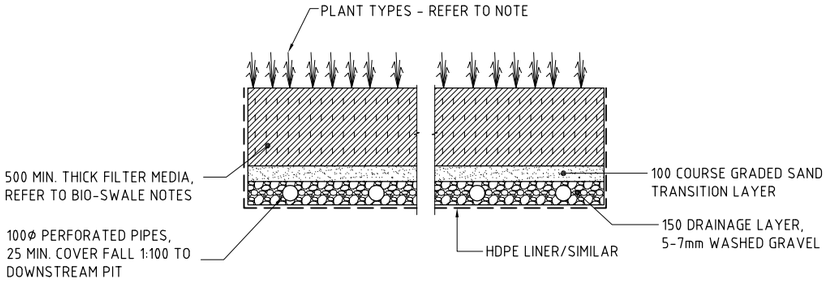
PROVIDE 100mm TOPSOIL AND TEMPORARY EROSION PROTECTION (JUTEMASTER OR EQUIV) TO SWALE BATTER SLOPES AND ADJACENT LANDSCAPED AREAS. NOTE THAT NO TOPSOIL IS TO BE PLACED OVER FILTRATION MEDIA. PROVIDE SILT FENCE TO TOP OF BANK UNTIL SUCH TIME AS THIS STABILISING AND VEGETATION HAS BEEN COMPLETED.

BIO-RETENTION TO BE PARTIALLY INSTALLED, FOLLOWING COMPLETION OF THE ROAD, WITH THE TOP 75-100mm OF FILTER MEDIA REPLACED WITH A FINE TO COARSE SAND UNDERLAIN WITH A GEOTEXTILE LAYER (REFER TO DETAIL). FOLLOWING COMPLETION OF THE UPSTREAM DEVELOPMENT AND SITE STABILISATION, THE SAND IS TO BE REMOVED, REPLACED WITH FILTER MATERIAL AND PLANTED OUT. REFER TO TEMPORARY BIO-BASIN DETAIL

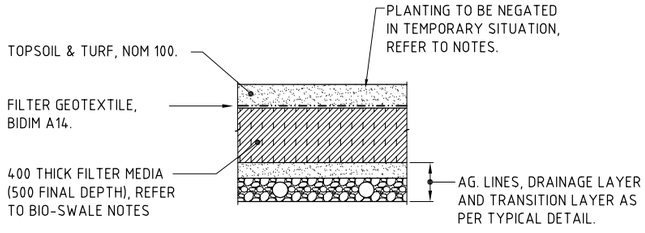
PRIOR TO PLANTING, THE TOP 100mm OF THE BIORETENTION FILTER MEDIA IS TO BE AMELIORATED WITH APPROPRIATE ORGANIC MATTER, FERTILISER AND TRACE ELEMENTS TO AID PLANT ESTABLISHMENT AS PER THE TABLE BELOW:

TABLE: RECIPE FOR AMELIORATING TOP 100mm OF BIORETENTION FILTER MEDIA

CONSTITUENT	QUANTITY (kg/m2 OF FILTER AREA)
GRANULATED POULTRY MANURE FINES	50
SUPERPHOSPHATE	2
MAGNESIUM SULPHATE	3
POTASSIUM SULPHATE	2
TRACE ELEMENT MIX	1
FERTILISER NPK (16.4.14)	4
LIME	20

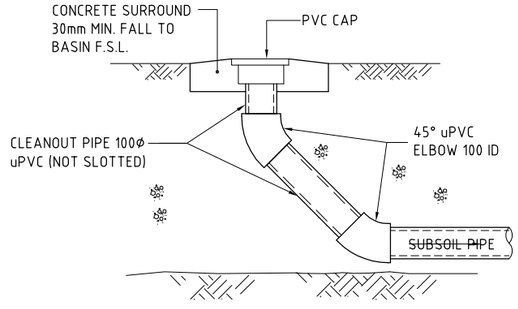


TYPICAL BIO-RETENTION DETAIL
SCALE 1:20



TEMPORARY BIO-RETENTION PROTECTION DETAIL
SCALE 1:20
TEMPORARY CONSTRUCTION REQUIREMENT DETAIL -
REFER TO NOTES FOR IMPLEMENTATION PERIODS.

BIO-RETENTION BASIN DETAILS
SCALE 1:20



BIORETENTION CLEANOUT EYE ELEVATION
SCALE 1:20
DENOTED C.E. ON PLAN

200mm 0 500 1000 1500 2000mm
SCALE 1:20 AT A1 SIZE PLOT

FOR S75W APPROVAL

AMENDMENTS	DATE	ISSUE
ISSUED FOR S75W APPROVAL	08.04.16	C
ISSUED FOR REVIEW	16.12.15	B
ISSUED FOR REVIEW	15.12.15	A

ARCHITECT

CLIENT
LOGOS PROPERTY
SUITE 02, LEVEL 12
167 MACQUARIE STREET
SYDNEY NSW

PROJECT
PROPOSED DEVELOPMENT
LOT 62/133-145 LENORE LANE,
ERSKINE PARK NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	SD			A1	AS SHOWN	11888.04-DA46

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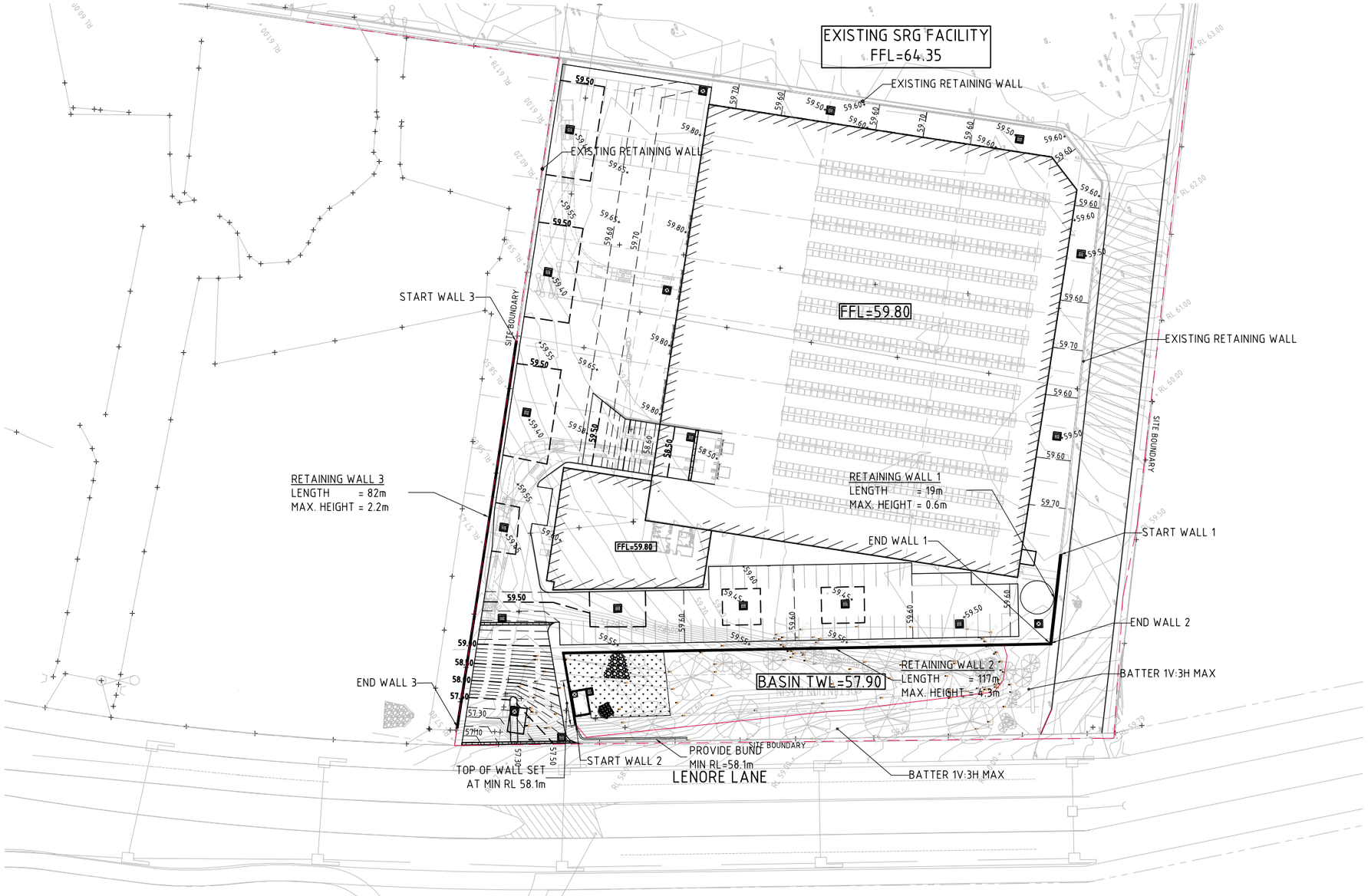
Value in Engineering and Management

DRAWING TITLE
CONCEPT STORMWATER
DETAILS-SHEET 2

DRAWING No C011888.04-DA46
ISSUE C



FINISHED LEVELS PLAN
SCALE 1:500

LEGEND:

LEVELS DATUM IS AHD.

EXISTING SITE LEVELS AND DETAILS BASED ON SURVEY INFORMATION PROVIDED.

- SGGP, SINGLE GRATED GULLY PIT
- SJP, SEALED JUNCTION PIT
- 50.00 – FINISHED PAVEMENT CONTOUR (MAJOR) 0.5m INTERVALS
- 50.10 – FINISHED PAVEMENT CONTOUR (MINOR) 0.1m INTERVALS

FINISHED LEVELS PLAN NOTES:

1. LEVELS DATUM IS A.H.D.
2. ALL CONTOUR LINES & SPOT LEVELS INDICATE FINISHED PAVEMENT LEVELS U.N.O. ON PLAN.
3. THE MAJOR CONTOUR INTERVAL IS 0.5m
4. THE MINOR CONTOUR INTERVAL IS 0.1m.
5. MINIMUM PAVEMENT GRADE IS TO BE 1:100 (1%).
6. MAXIMUM PAVEMENT GRADE IS TO BE 1:20 (5%) IN CARPARKING AREAS AND 1:25 (4%) ELSEWHERE.
7. MAXIMUM RAMP GRADES ARE TO BE 1:12 (8.3%) U.N.O. ON PLAN
8. PROVIDE MINIMUM 3.0m LONG TRANSITION WHERE CHANGES GRADE EXCEDE 1:20 (5%).
9. PERMANENT BATTER SLOPES ARE TO HAVE A MAXIMUM GRADE OF 1V:3H.
10. ALL BATTER SLOPE WITH GRADES AT OR EXCEDING 1V:6H ARE TO BE TURFED IMMEDIATELY OR APPROPRIATE EROSION CONTROL IS TO BE PROVIDED TO THE SATISFACTION OF THE ENGINEER.
11. THE ACCESS ROAD TO THE HARDSTAND AREA IS TO HAVE A CROSSFALL OF 2% AS INDICATED ON PLAN.
12. ALL FOOTPATHS ARE TO FALL AWAY FROM THE BUILDING AT 2.5% NOMINAL. GRADE.
13. ALL PAVEMENTS ARE TO BE SET AT 50mm BELOW THE FINISHED FLOOR LEVEL OF THE WAREHOUSE AND OFFICE AREAS.

NOTE: ALL LEVELS ARE INDICATIVE (±500mm) & MAY BE SUBJECT TO MINOR VARIATION TO SUIT DETAILED DESIGN.

5m 0 10 20 30 40 50m

SCALE 1:500 AT A1 SIZE SHEET

FOR S75W APPROVAL

AMENDMENTS	DATE	ISSUE
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PROJECT
PROPOSED DEVELOPMENT
LOT 62/133-145 LENORE LANE,
ERSKINE PARK NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	SD			A1	AS SHOWN	11888.04-DA50

CONSULT AUSTRALIA

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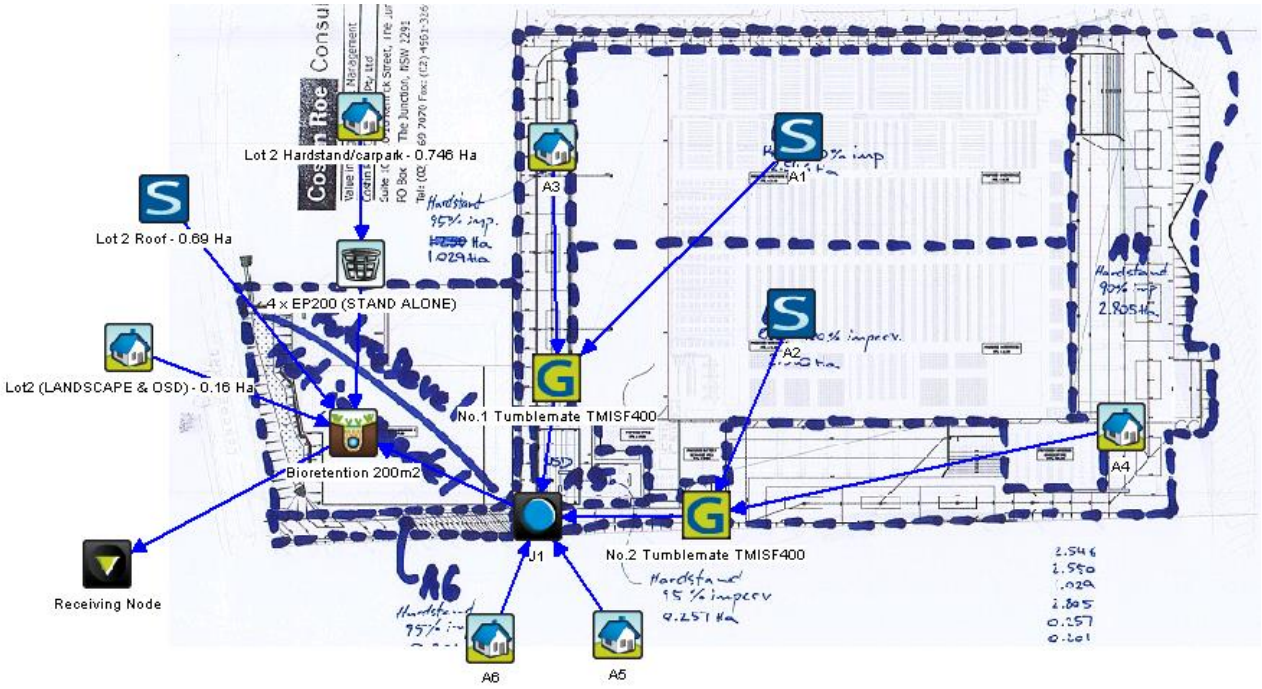
DRAWING TITLE
FINISHED LEVELS PLAN

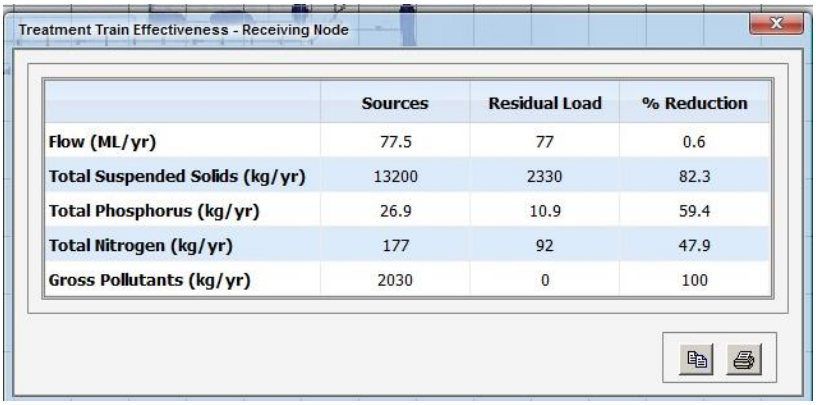
DRAWING No C011888.04-DA50

ISSUE C

Appendix B

MUSIC MODEL CONFIGURATION





	Sources	Residual Load	% Reduction
Flow (ML/yr)	77.5	77	0.6
Total Suspended Solids (kg/yr)	13200	2330	82.3
Total Phosphorus (kg/yr)	26.9	10.9	59.4
Total Nitrogen (kg/yr)	177	92	47.9
Gross Pollutants (kg/yr)	2030	0	100

Appendix C

EROSION CONTROL CHECK SHEET

EROSION AND SEDIMENT CONTROL

WEEKLY SITE INSPECTION SHEET

LOCATION .....

INSPECTION OFFICER ..... **DATE** .....

SIGNATURE .....

Legend: OK Not OK N/A Not applicable

Item	Consideration	Assessment
1	Public roadways clear of sediment.	.....
2	Entry/exit pads clear of excessive sediment deposition.	.....
3	Entry/exit pads have adequate void spacing to trap sediment.	.....
4	The construction site is clear of litter and unconfined rubbish.	.....
5	Adequate stockpiles of emergency ESC materials exist on site.	.....
6	Site dust is being adequately controlled.	.....
7	Appropriate drainage and sediment controls have been installed prior to new areas being cleared or disturbed.	.....
8	Up-slope "clean" water is being appropriately diverted around/through the site.	.....
9	Drainage lines are free of soil scour and sediment deposition.	.....
10	No areas of exposed soil are in need of erosion control.	.....
11	Earth batters are free of "rill" erosion.	.....
12	Erosion control mulch is not being displaced by wind or water.	.....
13	Long-term soil stockpiles are protected from wind, rain and stormwater flow with appropriate drainage and erosion controls.	.....
14	Sediment fences are free from damage.	.....
15	Sediment-laden stormwater is not simply flowing "around" the sediment fences or other sediment traps.	.....
16	Sediment controls placed up-slope/around stormwater inlets are appropriate for the type of inlet structure.	.....
17	All sediment traps are free of excessive sediment deposition.	.....
18	The settled sediment layer within a sediment basin is clearly visible through the supernatant prior to discharge such water.	.....
19	All reasonable and practicable measures are being taken to control sediment runoff from the site.	.....
20	All soil surfaces are being appropriately prepared (i.e. pH, nutrients, roughness and density) prior to revegetation.	.....
21	Stabilised surfaces have a minimum 70% soil coverage.	.....
22	The site is adequately prepared for imminent storms.	.....
23	All ESC measures are in proper working order.	.....

Appendix D

Super Retail Group (SRG) Facility Engineering Report: Co11888.00-02b.rpt

Costin Roe Consulting

Value in Engineering and Management

CIVIL ENGINEERING REPORT FOR S75W AMENDMENT TO AN APPROVED DEVELOPMENT

PROPOSED DEVELOPMENT AT LOT 62 DP 1090695 LENORE LANE ERSKINE PARK NSW

Prepared For:
XAct Solutions
Unit 27, 37 Nicholas Street
BALMAIN EAST NSW 2041

Prepared by:
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Level 1, 8 Windmill Street
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***Rev*: B**

DOCUMENT VERIFICATION

Project Title	Super Retail Group, Erskine Park
Document Title	Civil Engineering Report for S75w Amendment to Approved Development
Project No.	Co11888.00
Description	Civil engineering report for proposed industrial development.
Client Contact	Mr Adam Demetriou, XAct Solutions

	Name	**Signature**
Prepared by	Mark Wilson	
Checked by	Grant Roe	
Issued by	Mark Wilson	
File Name	11888.00-02b.rpt.docx	

Document History

Date	**Revision**	**Issued to**	**No. Copies**
30 Oct. 2012	DRAFT_1	XAct Solutions – Mr Adam Demetriou	PDF
7 Nov. 2012	A	XAct Solutions – Mr Adam Demetriou	PDF
9 Nov. 2012	B	XAct Solutions – Mr Adam Demetriou	PDF

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1 INTRODUCTION

1.1 Background

XAct Solutions, on behalf of Logos Group, propose to construct a warehouse and office facility for Super Retail Group at Lot 62 DP 1090695, Lenore Lane, Erskine Park, NSW.

Works involve construction of a large single level warehouse with ancillary offices, truck circulation and loading areas and associated parking.

Lot 62 is subject to a development approval, 08_0016 dated 12 July 2012, under Part 3A of the NSW *Environmental Planning and Assessment Act 1979*.

1.2 Scope

Costin Roe Consulting Pty Ltd has been commissioned by XAct Solutions to prepare this Engineering Report in support of the proposed application for S75w Amendment to Approved Development 08_0016 for the site.

This report provides a summary of the design principles and planning objectives for the following civil engineering components of the project:

- Earthworks & Retaining Walls;
- Stormwater Management including stormwater quantity and quality; and
- Erosion Control.

The engineering objectives for the development are to create a site which, based on the proposed architectural layout, responds to the topography and site constraints and to provide an appropriate and economical stormwater management system which incorporates best practice in water sensitive urban design and is consistent with the requirements of council's water quality objectives.

The current architectural layout differs from the original development approved under Part 3A however the general engineering objectives, particularly stormwater management, will remain consistent with the approved design.

A set of drawings have been prepared to show the proposed finished levels, retaining walls, stormwater drainage layout, water quantity and water quality requirements for the development. These drawings are conceptual only and subject to change during detail design.

1.3 Authority Jurisdiction

The consent authority is The NSW Department of Planning and Infrastructure as the proposal is an amendment to a Major Project Approval. However as the subject site is located within Penrith City Council area, the requirements of the Penrith City Council (PCC) also apply.

1.4 Proposed Development

The proposed development is for a single level warehouse distribution facility for Super Retail Group. The development will include ancillary office space, car parking areas and truck loading/ circulation areas.

2 SITE CHARACTERISTICS

2.1 Location

The proposed development is located in the suburb of Erskine Park on Lot 62 DP 1090695, Lenore Lane as shown in Figure 2.1.

The site is bounded by an existing industrial development to the east, Lenore Lane to the south, industrial land to the west and residential development to the north.

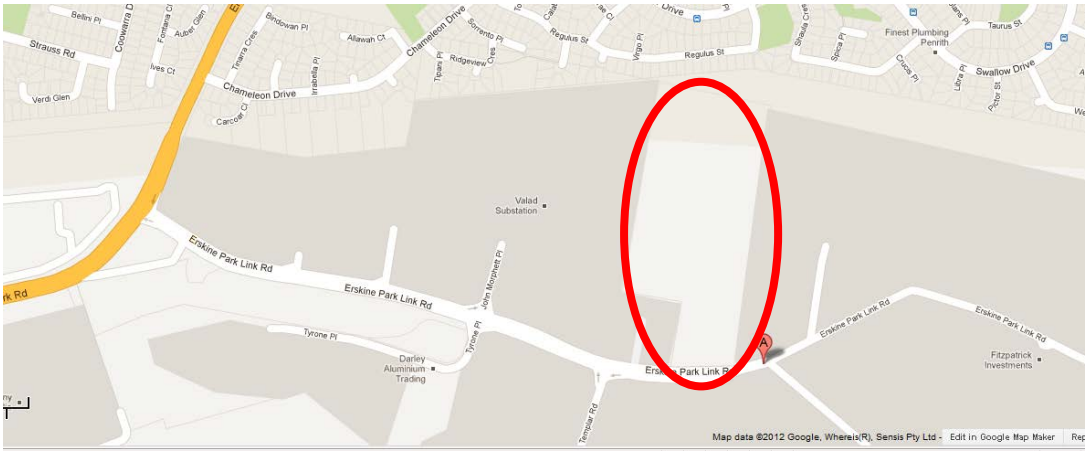


Figure 2.1. Locality Map

2.2 Topography & Description

The site is has been cut and filled to its current levels based on the design for the currently approved development. The cut to fill site comprises a large level pad at approximately RL 63.40m. The site has a total area of 13.49 Ha however the total development area is 11.0 Ha.

The northern portion of the site is burdened by a wide easement for electricity transmission. High voltage transmission lines associated with this easement are present. The land is also affected by a 20m landscaping setback fronting Lenore Lane.

The pre-existing site comprises undeveloped rural land. The sites natural gradient drops 15m from the high point in the north-west corner and the headwall draining the site at the south west corner. A spur type ridge was located in the northern portion of the site which head in a north-west to south-east direction. A number of localised depressions and dams were also present in the south and south-west of the site. The highest elevation is approximately RL 70.5m (AHD) and the lowest at RL 55.5m.

2.3 Existing Stormwater Drainage

Existing formalised drainage on the site is limited and is generally confined to the southern portion of the site adjacent to Lenore Lane where a pipe culvert is present. The culvert which drains the site crosses the neighbouring site's driveway on the south-west corner and discharges into an open swale fronting Lenore Lane and conveys stormwater flows overland to second large culvert system prior to discharge on the opposite side of Lenore Lane.

2.4 Proposed Stormwater Drainage System

As per general engineering practice and the guidelines of PCC, the proposed stormwater drainage system for the development will comprise a minor and major system to safely and efficiently convey collected stormwater run-off from the development.

The minor system is to consist of a piped drainage system which has been designed to accommodate the 1 in 20-year ARI storm event (Q20). This results in the piped system being able to convey all stormwater runoff up to and including the Q20 event. The major system through new paved areas has been designed to cater for storms up to and including the 1 in 100-year ARI storm event (Q100). The major system employs the use of defined overland flow paths to safely convey excess run-off from the site.

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, the standards of PCC and accepted engineering practice. Runoff from buildings will generally be designed in accordance with AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage. Overall site runoff and stormwater management will generally be designed in accordance with the Institution of Engineers, Australia publication "Australian Rainfall and Runoff" (1988 Edition), Volumes 1 and 2 (AR&R).

Water quality and re-use are to be considered in the design, throughout new paved areas, to ensure that any increase in the detrimental effects of pollution are mitigated, PCC Water Quality Objectives are met and that the demand on potable water resources is reduced.

Plans of the proposed stormwater drainage layout can be found on drawings **Co11888.00-C41** through **C45** and are located in **Appendix A**.

The objectives for the management of stormwater quantity and quality for the proposed S75w Application are consistent with the management proposed under the current Major Project Approval. Section 5 of this report discusses the proposed water quantity management and Section 6 discusses the proposed water quality management. The means to which these objectives are achieved differ in approach as follows:

- Water Quantity – The S75w system consolidates the multiple above ground and tanked on-site detention system proposed in the Major Project Approval into a

tank and above ground basin system. This simplifies construction and increases the operational capacity of the facility which was subject to ponding in truck circulation areas which were proposed for on-site detention storage. The objectives of attenuating the post development flows to less than pre development flows are consistent for both systems.

- Water Quality – The S75w system proposes the use of an end-of-line proprietary stormwater quality improvement device (SQID) to perform the water quality management for the development whereas the Major Project Approval was based on the use of a gross pollutant trap and bioretention basin. The objectives for pollution reduction are consistent for both systems and the proposed SQID is accepted by Penrith City Council as meeting the objectives for stormwater quality improvement.

3 SITE WORKS

3.1 Bulk Earthworks

Bulk earthworks will be performed to facilitate the construction of the warehouse. The objective for the site is to perform a cut to fill balance for the development.

As discussed previously the site has been cut and filled to its current configuration which contains a large single pad at approximate level of 63.4m. This work was performed several years ago under Penrith City Council Development Approval No. 07/1527.01 dated 25 March 2008. The architectural layout for the current development comprises a larger footprint than the previously approved development and additional cut will be required through the northern portion of the site. In order to accommodate the additional cut volume, without exporting material, it is proposed to increase the earthworks pad level by 400mm from RL 63.40m to RL 63.80m.

Allowing for a 200mm structural zone for the facility floor from the proposed earthwork level of RL 63.80m will result in a finished floor level of RL 64.00m. This is 400mm higher than the previously approved finished floor level of 63.60m.

Soil Erosion and Sediment Control measures including sedimentation basins will also be provided for the development – please refer to the Soil and Water Management Plan in Section 5 of this report.

3.2 Embankment Stability

To assist in maintaining embankment stability permanent batters slopes will be no steeper than 3 horizontal to 1 vertical while temporary batters will be no steeper than 2 horizontal to 1 vertical. This is in accordance with the recommended maximum batter slopes for residual clays and shale which are present in the area.

Permanent batters will also be adequately vegetated or turfed which will assist in maintaining embankment stability.

Stability of batters and reinstatement of vegetation shall be in accordance with the submitted drawings and the Soil and Water Management Plan in Section 5.

3.3 Supervision of Earthworks

All geotechnical testing and inspections performed during the earthworks operations will be undertaken to Level 1 geotechnical control, in accordance with AS3798-1996.

4 STORMWATER HYDROLGICAL MODELLING AND ANALYSIS

4.1 General Design Principles

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, Penrith City Council and accepted engineering practice.

Runoff from buildings will generally be designed in accordance with AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage.

Overall site runoff and stormwater management will generally be designed in accordance with the Institution of Engineers, Australia publication "Australian Rainfall and Runoff" (1987 Edition), Volumes 1 and 2 (AR&R).

Storm events for the 2 to 100 Year ARI events have been assessed.

4.2 Minor/ Major System Design

The piped stormwater drainage (minor) system has been designed to accommodate the 20-year ARI storm event (Q20). Overland flow paths (major) which will convey all stormwater runoff up to and including the Q100 event have also been provided which will limit major property damage and any risk to the public in the event of a piped system failure.

4.3 Rainfall Data

Rainfall intensity Frequency Duration (IFD) data used as a basis for ILSAX modelling for the 2 to 100 Year ARI events, was taken from *The Bureau of Meteorology Online IFD Tool*.

4.4 Runoff Models

Calculation of the runoff from storms of the design ARI will be calculated with the catchment modelling software DRAINS.

The design parameters for the ILSAX model are to be based on typical values and parameters for the area and are as follows:

Model	Model for Design and analysis run	Rational method	
	Rational Method Procedure	ARR87	
	Soil Type-Normal	3.0	
	Paved (Impervious) Area Depression Storage	1	mm
	Supplementary Area Depression Storage	1	mm
	Grassed (Pervious) Area Depression Storage	5	mm
AMC	Antecedent Moisture Condition (ARI=1-5 years)	2.5	
AMC	Antecedent Moisture Condition (ARI=10-20 years)	3.0	
AMC	Antecedent Moisture Condition (ARI=50-100 years)	3.5	
	Sag Pit Blocking Factor (Minor Systems)	0	
	On Grade Pit Blocking Factor (Minor Systems)	0	
	Sag Pit Blocking Factor (Major Systems)	0.5	
	On Grade Pit Blocking Factor (Major Systems)	0.2	
	Minor Storm Pit Freeboard	150	mm

Table 4.1: DRAINS ILSAX Parameters

4.5 Hydraulics

4.5.1 General Requirements

Hydraulic calculations will be carried out utilising DRAINS modelling software during the detail design stage to ensure that all surface and subsurface drainage systems perform to or exceed the required standard.

4.5.2 Freeboard

The calculated water surface level in open junctions of the piped stormwater system will not exceed a freeboard level of 150mm below the finished ground level, for the peak runoff from the Minor System runoff. Where the pipes and junctions are sealed, this freeboard would not be required.

4.5.3 Public Safety

For all areas subject to pedestrian traffic, the product (dV) of the depth of flow d (in metres) and the velocity of flow V (in metres per second) will be limited to 0.4, for all storms up to the 100-year ARI.

For other areas, the dV product will be limited to 0.6 for stability of vehicular traffic (whether parked or in motion) for all storms up to the 100-year ARI.

4.5.4 Inlet Pit Spacing

The spacing of inlets throughout the site will be such that the depth of flow, for the Major System design storm runoff, will not exceed the top of the kerb (150mm above gutter invert).

4.5.5 Overland Flow

Dedicated flow paths have been designed to convey all storms up to and including the 100-year ARI. These flow paths will convey stormwater from the site to the detention basin adjacent to Lenore Lane and trunk drainage system.

4.6 External Catchments and Flooding

There are no external catchments being directed through the development site. For this reason, only flows from the development site have been considered in the sizing of the stormwater system for the development.

5 WATER QUANTITY MANAGEMENT

5.1 General Design Principles

Penrith City Council (in common with many other local authorities) adopts the principles of Water Quantity Management, also known as "On-site Detention (OSD)", to ensure the cumulative effect of development does not have a detrimental effect on the existing stormwater infrastructure and watercourses located within their LGA downstream from the particular site.

Section 3.3.3 of Councils DRAFT stormwater management policy requires that "*it will be necessary to demonstrate that there will be no increase in runoff from the site as result of the development for all storms up to and including the 100 year Average Recurrence Interval (ARI) event for all storm durations*".

5.2 Methodology

A hydrological analysis was undertaken to estimate the impact of the development of the site on peak flows at the downstream extent of the site. Modelling of stormwater runoff quantity was considered for the pre-existing (natural) case and for the operational phase of the development.

In order to assess the existing and operational phase peak discharges from the development site, a DRAINS hydrological model was used to estimate peak flows from catchments on the site for various storm durations for Q2 year ARI to Q100 year ARI events.

Although the site between Lot 62 and Lenore Lane is subject to separate future development application the water quantity requirements for this site have been allowed for in our assessment.

5.3 Existing & Post Development Peak Flows

Table 5.2 shows the existing and developed flows at the downstream boundary (adjacent to the culvert crossing at the site discharge point adjacent to Lenore Lane).

ARI	Design Storm Duration	Peak Flow (m3/s)		
		Undeveloped	Developed	
		Site	Site (no atten.)	**Site (+ atten.)**
2	30	0.510	2.18	**0.502**
	60	0.743	1.855	**0.548**
	120	0.768	2.112	**0.566**
20	30	1.9	4.079	**0.747**
	60	2.18	3.333	**1.58**
	120	2.32	3.743	**1.69**
100	30	2.91	5.002	**2.19**
	60	3.05	4.163	**2.81**
	120	3.08	4.664	**3.04**

Table 5.2. Q2, Q20 & Q100 ARI Peak Flows from Development

The post development (with site attenuation) flows can be seen to be lower than the pre-developed flows. The required detention storage for the development site is discussed in the following section.

5.4 Proposed Water Quantity Management

As previously discussed, detention storage on the development site is required to reduce local outflows. The proposed site layout allows for provision of two OSD systems configured in series. The ultimate discharge location will be to the culvert adjacent to Lenore Lane via piped stormwater outlets for minor system storm events and overland flow via overflow weirs during major system events.

The proposed OSD systems are an underground tank (OSD1) located in the car park and an open basin (OSD2) located within the 20m landscape setback area adjacent to Lenore Lane. In accordance with PCC requirements, the depth of water in the open basin will

be limited to 1200mm. We note that temporary batters for the basin are proposed which extend past the 20m setback zone however the required storage and top water level is contained within the 20m setback zone. The final configuration of levels beyond the 20m setback zone is subject to a separate development application and design.

A number of combinations of storages and outlet arrangements have been trialled. The adopted arrangement assumes the following basin configuration and the proposed layout can also be observed on drawings **Co11888.00-C41** through **C45**.

ARI	Duration (mins)	Peak Flow (m3/s)				Depth (mm)	Storage (m3)
		No Atten.	With attenuation				
			Low	High	Total		
2	120	1.78	0.634	-	0.634	1240	1050
20	120	3.14	0.828	0.991	1.819	2500	2100
100	120	3.92	0.862	2.22	3.052	2740	2300

Table 5.3 OSD 1 Characteristics (Post Developed)

ARI	Duration (mins)	Peak Flow (m3/s)				Depth (mm)	Storage (m3)
		No Atten.	With attenuation				
			Low	High	Total		
2	120	2.112	0.566	-	0.566	790	700
20	120	3.743	0.627	1.07	1.69	1050	1000
100	120	4.664	0.666	2.83	3.04	1200	1200

Table 5.4 OSD 2 Characteristics (Post Developed)

The hydrologic analysis shows that, with the provision of the two on-site detention basins detailed above, the peak flow from the site are reduced following development and hence the requirements of PCC have been met.

6 STORMWATER QUALITY CONTROLS

6.1 Regional Parameters

There is a need to provide design which incorporates the principles of Water Sensitive Urban Design (WSUD) and to target pollutants that are present in the stormwater so as to minimise the adverse impact these pollutants could have on receiving waters and to also meet the requirements specified by Penrith City Council.

PCC have nominated, in Section C3 of their *DCP 2010*, the requirements for stormwater quality to be performed on a catchment wide basis. These are presented in terms of annual percentage pollutant reductions on a developed catchment and are as follows:

Gross Pollutants	70%
Total Suspended Solids	80%
Total Phosphorus	45%
Total Nitrogen	45%
Free Oil and Grease	90%

6.2 Proposed Stormwater Treatment System

Roof, hardstand, car parking, roads and other extensive paved areas are required to be treated by the Stormwater Treatment Measures (STM's). The STM's shall be sized according to the whole catchment area of Lot 62. The STM's for the development shall be based on a treatment train approach as discussed in the NSW EPA document *Managing Urban Stormwater: Treatment Techniques* to ensure that all of the objectives above are met.

Components of the treatment train for the development are as follows:

- Primary and tertiary treatment to parking, hardstand and roof areas is to be performed via Tumblemate TSFM system; and
- Secondary treatment will be performed via trash screens and sump within the tanked OSD1 system and settling within the open basin OSD2 system.
- Tertiary treatment of a portion of the roof will also be performed via the proposed rainwater reuse tanks. This has not been included in the MUSIC model.

6.3 Stormwater Quality Modelling

6.3.1 Introduction

The MUSIC model was chosen to model water quality. This model has been released by the Cooperative Research Centre for Catchment Hydrology (CRCCH) and is a standard industry model for this purpose. MUSIC (the Model for Urban Stormwater Improvement Conceptualisation) is suitable for simulating catchment areas of up to 100 km^2 and utilises a continuous simulation approach to model water quality.

By simulating the performance of stormwater management systems, MUSIC can be used to predict if these proposed systems and changes to land use are appropriate for their catchments and are capable of meeting specified water quality objectives (CRC 2002). The water quality constituents modelled in MUSIC and of relevance to this report include Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN).

The pollutant retention criteria set out in Part R of BCC's DCP2006 and nominated in Section 5.1 of this report were used as a basis for assessing the effectiveness of the selected treatment trains.

The MUSIC model "*11888.00_Rev1.sqz*" was set up to examine the effectiveness of the water quality treatment train and to predict if PCC requirements have been achieved. The layout of the MUSIC model is presented in Appendix B.

6.3.2 Rainfall Data

Six minute pluviographic data for the nearby Liverpool (Whitlam) weather station was sourced from the Bureau of Meteorology (BOM) as nominated below. Evapo-transpiration data for the period was sourced from the Sydney Monthly Areal PET data set supplied with the MUSIC software.

Input	**Data Used**
Rainfall Station	67035 Liverpool (Whitlam)
Rainfall Period	1 January 1967 – 31 December 1976 (10 years)
Mean Annual Rainfall (mm)	857
Evapotanspiration	Sydney Monthly Areal PET
Model Timestep	6 minutes

6.3.3 Rainfall Runoff Parameters

Parameter	**Value**
Rainfall Threshold	1.40
Soil Storage Capacity (mm)	170
Initial Storage (% capacity)	30
Field Capacity (mm)	70
Infiltration Capacity Coefficient a	210
Infiltration Capacity exponent b	4.7
Initial Depth (mm)	10
Daily Recharge Rate (%)	50
Daily Baseflow Rate (%)	4
Daily Seepage Rate (%)	0

6.3.4 Pollutant Concentrations & Source Nodes

Pollutant concentrations for source nodes are based on parameters adopted by the adjacent LGA Blacktown City Council land use parameters as per the Table 6.1.:

Flow Type	Surface Type	TSS (log_{10} values)		TP (log_{10} values)		TN (log_{10} values)	
		Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Baseflow	Roof	1.20	0.17	-0.85	0.19	0.11	0.12
	Roads	1.20	0.17	-1.11	0.48	0.14	0.12
Stormflow	Roof	1.30	0.32	-0.89	0.25	0.30	0.19
	Roads	2.43	0.32	-0.30	0.25	0.34	0.19

Table 6.1. Pollutant Concentrations

The MUSIC model has been setup with a treatment train approach based on the pollutant concentrations in Table 6.1 above and the catchments shown on drawing Co11888.00-C40.

6.3.5 Treatment Nodes

Buffers, rainwater tank and Tumblemate nodes have been used in the modelling of the development.

6.3.6 Results

Table 6.2 shows the results of the MUSIC analysis. The reduction rate is expressed as a percentage and compares the post-development pollutant loads without treatment versus post-development loads with treatment.

	Source	Residual Load	% Reduction
Flow (ML/yr)	66.8	66.8	0.0
Total Suspended Solids (kg/yr)	11300	2200	80.5
Total Phosphorus (kg/yr)	22.8	8.28	63.7
Total Nitrogen (kg/yr)	153	80.7	47.1
Gross Pollutants (kg/yr)	1760	175	90.0

Table 5.2. MUSIC analysis results

The model results indicate that, through the use of the STM's in the treatment train, pollutant load reductions for Total Suspended Solids, Total Phosphorous, Total Nitrogen and Gross Pollutants will meet the requirements of C3 of PCC's DCP 2010 on an overall catchment basis.

6.3.7 Modelling Discussion

MUSIC modelling has been performed to assess the effectiveness of the selected treatment trains and to ensure that the pollutant retention requirements of C3 of PCC's DCP2010 have been met.

The MUSIC modelling has shown that the proposed treatment train of SQID's will provide stormwater treatment which will meet BCC requirements in an effective and economical manner.

Hydrocarbon removal cannot be modelled with MUSIC software. Although the end use of this site is not known it would be expected to be a distribution or storage facility with low source loadings of hydrocarbons. Potential sources of hydrocarbons would be limited to leaking engine sumps or for accidental fuel spills/leaks and leaching of bituminous pavements (car parking only). The potential for hydrocarbon pollution is low and published data from the CSIRO indicates that average concentrations from Industrial sites are in the order of 10mg/L and we would expect source loading from this site to be near to or below this concentration. Hydrocarbon pollution would also be limited to surface areas which will be treated via bio-retention swales which are predicted to achieve a 90% reduction of this pollutant.

Given the expected low source loadings of hydrocarbons and removal efficiencies of the treatment devices we consider that the requirements of the Penrith City Council have been met.

6.4 Stormwater Harvesting

6.4.1 Introduction

Stormwater harvesting refers to the collection of stormwater from the developments internal stormwater drainage system for re-use in non-potable applications. Stormwater from the stormwater drainage system can be classified as either rainwater where the flow is from roof areas only, or stormwater where the flow is from all areas of the development.

For the purposes of this development, we refer to a rainwater harvesting system, where benefits of collected stormwater from roof areas over a stormwater harvesting system can be made as rainwater is generally less polluted than stormwater drainage.

Rainwater harvesting is proposed for this development with re-use for non-potable applications. Internal uses include such applications as toilet flushing while external applications will be used for irrigation. The aim is to reduce the water demand for the development and to satisfy the requirements of PCC DCP2010.

In general terms the rainwater harvesting system will be an in-line tank for the collection and storage of rainwater. At times when the rainwater storage tank is full rainwater can pass through the tank and continue to be discharged via gravity into the stormwater drainage system. Rainwater from the storage tank will be pumped for distribution throughout the development in a dedicated non-potable water reticulation system.

Rainwater tanks have been sized with reference to the NSW Department of Environment and Conservation document *Managing Urban Stormwater: Harvesting and Reuse*, using a simple water balance analysis to balance the supply and demand, based on the below base water demands and the requirement of PCC DCP2010 Part C3 to provide a reduction in non-potable water demand with a minimum 100,000 litre rainwater tank.

6.4.2 Internal Base Water Demand

Indoor water demand has been based on each employee using 15 litres of potable water per day for toilet flushing which is typical of an office environment which uses energy efficient flushing devices. As the proposed building populations are not currently known these have been based on 1 person every 350m2 for warehouse areas and 1 person every 30m2 for office areas.

These rates give the following internal non-potable demand:

Proposed Development 175 People 2.625 kL/day

6.4.3 External Base Water Demand

External water consumption within each landscaping system varies depending upon the nature of the irrigation system, species of planting, and the prevailing climate. For this development, the base case outdoor potable water demand has been modelled using a simple rainwater balance. The proposed irrigation system will be a drip fed system with application rates averaging 10 l/m2 (i.e. 10 mm/m2). For the purposes of our analysis the average of this application rate has been used, in conjunction with the application regime shown in Table 6.3, to determine the monthly and total yearly demand.

Month	**No. of Applications**
January	12
February	12
March	10
April	9
May	8
June	4
July	4
August	4
September	8
October	9
November	10
December	12

Table 6.3. External Irrigation Application Schedule

The above regime for the landscaped area for the site gives the following yearly outdoor water demands:

Proposed Development Area=4000m^2 4080 kL/year

6.4.4 Rainwater Tank Sizing

The use of rainwater reduces the mains water demand and the amount of stormwater runoff. By collecting the rainwater run-off from roof areas, rainwater tanks provide a valuable water source suitable for flushing toilets and landscape irrigation.

Rainwater tanks have been designed, using a simple water balance calculation to balance the supply and demand, based on the calculated base water demands and proposed roof catchment areas. Allowances in the calculation have been made for efficiency of collection, absorption/ evaporation losses and the like.

Tank	Roof Catchment to Rainwater Tank (m2)	Tank Size (kL)	Predicted Demand Reduction (%)
	6500	100	80

Table 6.4. Rainwater Reuse Requirements

The water balance calculation, results summarised in Table 6.4, predicts that the requirements of PCC DCP2010 (min. tank size of 100,000 litres and reduction in non-potable water demand) will be met for the development with the provision a 100kL.

6.5 Maintenance and Monitoring

It is important that each component of the water quality treatment train is properly operated and maintained. In order to achieve the design treatment objectives, an indicative maintenance schedule has been prepared (refer to **Table 5.5** below) to assist in the effective operation and maintenance of the various water quality components.

Note that inspection frequency may vary depending on site specific attributes and rainfall patterns in the area. In addition to the below nominated frequency it is recommended that inspections are made following large storm events.

Table 5.5. Indicative Maintenance Schedule

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
SWALES/ LANDSCAPED AREAS			
Check density of vegetation and ensure minimum height of 150mm is maintained. Check for any evidence of weed infestation	Six monthly	Maintenance Contractor	Replant and/or fertilise, weed and water in accordance with landscape consultant specifications
Inspect swale for excessive litter and sediment build up	Six monthly	Maintenance Contractor	Remove sediment and litter and dispose in accordance with local authorities' requirements.
Check for any evidence of channelisation and erosion	Six monthly/ After Major Storm	Maintenance Contractor	Reinstate eroded areas so that original, designed swale profile is maintained
Weed Infestation	Three Monthly	Maintenance Contractor	Remove any weed infestation ensuring all root ball of weed is removed. Replace with vegetation where required.
Inspect swale surface for erosion	Six Monthly	Maintenance Contractor	Replace top soil in eroded area and cover and secure with biodegradable fabric. Cut hole in fabric and revegetate.
RAINWATER TANK			
Check for any clogging and blockage of the first flush device	Monthly	Maintenance Contractor	First flush device to be cleaned out
Check for any clogging and blockage of the tank inlet - leaf/litter screen	Six monthly	Maintenance Contractor	Leaves and debris to be removed from the inlet leaf/litter screen
Check the level of sediment within the tank	Every two years	Maintenance Contractor	Sediment and debris to be removed from rainwater tank floor if sediment level is greater than the maximum allowable depth as specified by the

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
			hydraulic consultant
INLET & JUNCTION PITS			
Inside Pit	Six Monthly	Maintenance Contractor	Remove grate and inspect internal walls and base, repair where required. Remove any collected sediment, debris, litter.
Outside of Pit	Four Monthly/ After Major Storm	Maintenance Contractor	Clean grate of collected sediment, debris, litter and vegetation.
STORMWATER SYSTEM			
General Inspection of complete stormwater drainage system	Bi-annually	Maintenance Contractor	Inspect all drainage structures noting any dilapidation in structures and carry out required repairs.
OSD TANK			
Inspect and remove any blockage from orifice	Six Monthly	Maintenance Contractor/ Owner	Remove grate and screen to inspect orifice.
Inspect trash screen and clean	Six Monthly	Maintenance Contractor/ Owner	Remove grate and screen if required to clean it.
Inspect flap valve and remove any blockage.	Six Monthly	Maintenance Contractor/ Owner	Remove grate. Ensure flap valve moves freely and remove any blockages or debris.
Inspect pit sump for damage or blockage.	Six Monthly	Maintenance Contractor/ Owner	Remove grate & screen. Remove sediment/ sludge build up and check orifice and flap valve is clear.
Inspect storage areas and remove debris/ mulch/ litter etc likely to block screens/ grates.	Six Monthly	Maintenance Contractor/ Owner	Remove debris and floatable materials.
Check attachment of orifice plate and screen to wall of pit	Annually	Maintenance Contractor	Remove grate and screen. Ensure plate or screen mounted securely, tighten fixings if required. Seal gaps if required.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
Check orifice diameter is correct and retains sharp edge.	Five yearly	Maintenance Contractor	Compare diameter to design (see Work-as-Executed) and ensure edge is not pitted or damaged.
Check screen for corrosion	Annually	Maintenance Contractor	Remove grate and screen and examine for rust or corrosion, especially at corners or welds.
Inspect overflow weir and remove any blockage	Six monthly	Maintenance Contractor/ Owner	Ensure weir is free of blockage.
Inspect walls for cracks or spalling	Annually	Maintenance Contractor	Remove grate to inspect internal walls, repair as necessary.
Check step irons	Annually	Maintenance Contractor	Ensure fixings are secure and irons are free from corrosion.

7 EROSION & SEDIMENT CONTROL PLAN

An erosion and sediment control plan (ESCP) is shown on drawings Co11888.00-C20 and C21. These are conceptual plans only providing sufficient detail to clearly show that the works can proceed without undue pollution to receiving waters. A detailed plan will be prepared once consent is given and before works start.

7.1 General Conditions

1. The ESCP will be read in conjunction with the engineering plans, and any other plans or written instructions that may be issued in relation to development at the subject site.

2. Contractors will ensure that all soil and water management works are undertaken as instructed in this specification and constructed following the guidelines stated in Managing Urban Stormwater, Soils and Construction (1998) and PCC specifications.

3. All subcontractors will be informed of their responsibilities in minimising the potential for soil erosion and pollution to down slope areas.

7.2 Land Disturbance

1. Where practicable, the soil erosion hazard on the site will be kept as low as possible and as recommended in Table 1

Land Use	Limitation	Comments
Construction areas	Limited to 5 (preferably 2) metres from the edge of any essential construction activity as shown on the engineering plans.	All site workers will clearly recognise these areas that, where appropriate, are identified with barrier fencing (upslope) and sediment fencing (downslope), or similar materials.
Access areas	Limited to a maximum width of 5 metres	The site manager will determine and mark the location of these zones onsite. They can vary in position so as to best conserve existing vegetation and protect downstream areas while being considerate of the needs of efficient works activities. All site workers will clearly recognise these boundaries.
Remaining lands	Entry prohibited except for essential management works	

Table 1 Limitations to access

7.3 Erosion Control Conditions

1. Clearly visible barrier fencing shall be installed as shown on the plan and elsewhere at the discretion of the site superintendent to ensure traffic control and prohibit unnecessary site disturbance. Vehicular access to the site shall be limited to only those essential for construction work and they shall enter the site only through the stabilised access points.

2. Soil materials will be replaced in the same order they are removed from the ground. It is particularly important that all subsoils are buried and topsoils remain on the surface at the completion of works.

3. Where practicable, schedule the construction program so that the time from starting land disturbance to stabilisation has a duration of less than six months.

4. Notwithstanding this, schedule works so that the duration from the conclusion of land shaping to completion of final stabilisation is less than 20 working days.

5. Land recently established with grass species will be watered regularly until an effective cover has properly established and plants are growing vigorously. Further application of seed might be necessary later in areas of inadequate vegetation establishment.

6. Where practical, foot and vehicular traffic will be kept away from all recently established areas

7. Earth batters shall be constructed in accordance with the Geotechnical Engineers Report or with as law a gradient as practical but not steeper than:

    - 2H:1V where slope length is less than 7 meters
    - 2.5H:1V where slope length is between 7 and 10 meters
    - 3H:1V where slope length is between 10 and 12 meters
    - 4H:1V where slope length is between 12 and 18 meters
    - 5H:1V where slope length is between 18 and 27 meters
    - 6H:1V where slope length is greater than 27 meters

8. All earthworks, including waterways/drains/spillways and their outlets, will be constructed to be stable in at least the design storm event.

9. During windy weather, large, unprotected areas will be kept moist (not wet) by sprinkling with water to keep dust under control. In the event water is not available in sufficient quantities, soil binders and/or dust retardants will be used or the surface will be left in a cloddy state that resists removal by wind.

7.4 Pollution Control Conditions

1. Stockpiles will not be located within 5 meters of hazard areas, including likely areas of high velocity flows such as waterways, paved areas and driveways.

2. Sediment fences will:

   a) Be installed where shown on the drawings, and elsewhere at the discretion of the site superintendent to contain the coarser sediment fraction (including aggregated fines) as near as possible to their source.

   b) Have a catchment area not exceeding 720 square meters, a storage depth (including both settling and settled zones) of at least 0.6 meters, and internal dimensions that provide maximum surface area for settling, and

   c) Provide a return of 1 meter upslope at intervals along the fence where catchment area exceeds 720 square meters, to limit discharge reaching each section to 10 litres/second in a maximum 20 year t_c discharge.

3. Sediment removed from any trapping device will be disposed in locations where further erosion and consequent pollution to down slope lands and waterways will not occur.

4. Water will be prevented from directly entering the permanent drainage system unless it is relatively sediment free (i.e. the catchment area has been permanently landscaped and/or likely sediment has been treated in an approved device). Nevertheless, stormwater inlets will be protected.

5. Temporary soil and water management structures will be removed only after the lands they are protecting are stabilised.

7.5 Waste Management Conditions

Acceptable bind will be provided for any concrete and mortar slurries, paints, acid washings, lightweight waste materials and litter. Clearance service will be provided at least weekly.

7.6 Site Inspection and Maintenance

1. A self-auditing program will be established based on a Check Sheet. A site inspection using the Check Sheet will be made by the site manager:

   - At least weekly.
   - Immediately before site closure.
   - Immediately following rainfall events in excess of 5mm in any 24 hour period.

The self audit will include:

- Recording the condition of every sediment control device
- Recording maintenance requirements (if any) for each sediment control device
- Recording the volumes of sediment removed from sediment retention systems, where applicable
- Recording the site where sediment is disposed
- Forwarding a signed duplicate of the completed Check Sheet to the project manager/developer for their information

2. In addition, a suitably qualified person will be required to oversee the installation and maintenance of all soil and water management works on the site. The person shall be required to provide a short monthly written report. The responsible person will ensure that:

   - The plan is being implemented correctly
   - Repairs are undertaken as required
   - Essential modifications are made to the plan if and when necessary

   The report shall carry a certificate that works have been carried out in accordance with the plan.

3. Waste bins will be emptied as necessary. Disposal of waste will be in a manner approved by the Site Superintendent.

4. Proper drainage will be maintained. To this end drains (including inlet and outlet works) will be checked to ensure that they are operating as intended, especially that,

   - No low points exist that can overtop in a large storm event
   - Areas of erosion are repaired (e.g. lined with a suitable material) and/or velocity of flow is reduced appropriately through construction of small check dams of installing additional diversion upslope.
   - Blockages are cleared (these night occur because of sediment pollution, sand/soil/spoil being deposited in or too close to them, breached by vehicle wheels, etc.).

5. Sand/soil/spoil materials placed closer than 2 meters from hazard areas will be removed. Such hazard areas include and areas of high velocity water flows (e.g. waterways and gutters), paved areas and driveways.

6. Recently stabilised lands will be checked to ensure that erosion hazard has been effectively reduced. Any repairs will be initiated as appropriate.

7. Excessive vegetation growth will be controlled through mowing or slashing.

8. All sediment detention systems will be kept in good, working condition. In particular, attention will be given to:

a) Recent works to ensure they have not resulted in diversion of sediment laden water away from them

b) Degradable products to ensure they are replaced as required, and

c) Sediment removal, to ensure the design capacity or less remains in the settling zone.

9. Any pollutants removed from sediment basins or litter traps will be disposed of in areas where further pollution to down slope lands and waterways should not occur.

10. Additional erosion and/or sediment control works will be constructed as necessary to ensure the desired protection is given to down slope lands and waterways, i.e. make ongoing changes to the plan where it proves inadequate in practice or is subjected to changes in conditions at the work site or elsewhere in the catchment.

11. Erosion and sediment control measures will be maintained in a functioning condition until all earthwork activities are completed and the site stabilised

12. Litter, debris and sediment will be removed from the gross pollutant traps and trash racks as required.

8 CONCLUSION

This Civil Engineering Details Report has been prepared to support the application for a S75w amendment to the previously approved Part 3A Development 08_0016 dated 12 July 2010 over Lot 62 Lenore Lane Erskine Park.

A civil engineering strategy for the site has been developed which provides a best fit solution within the constraints of the existing landform and proposed architectural layout. Within this strategy a stormwater quantity and quality management strategy has been developed to reduce both peaks flows and pollutant loads in stormwater leaving this site. The stormwater management for the development has been designed in accordance with the Penrith City Councils *Section C3 of DCP2010*.

The hydrological assessment showed that the local post development flows from the site will be less than pre-development flows hence this demonstrates that the site discharge would not adversely affect any land, drainage system or watercourse as a result of the development.

During the construction phase, a Sediment and Erosion Control Plan will be in place which ensures the downstream drainage system and receiving waters are protected from sediment laden runoff.

During the operational phase of the development, a treatment train incorporating the use of the proprietary Tumblemate system is proposed to mitigate the likely increase in stormwater pollutant load generated by the development. MUSIC modelling results indicate that the proposed SQIDs are effective in reducing pollutant loads in stormwater discharging from the site and meet the requirements of council pollutant based reductions. Best Management Practices have been applied to the development to ensure that the quality of stormwater runoff is not detrimental to the receiving environment.

It is recommended that the management strategies mentioned in this report be incorporated into the future detailed design. Detailed design may result in changes to the concept however design criteria will be followed.

9 REFERENCES

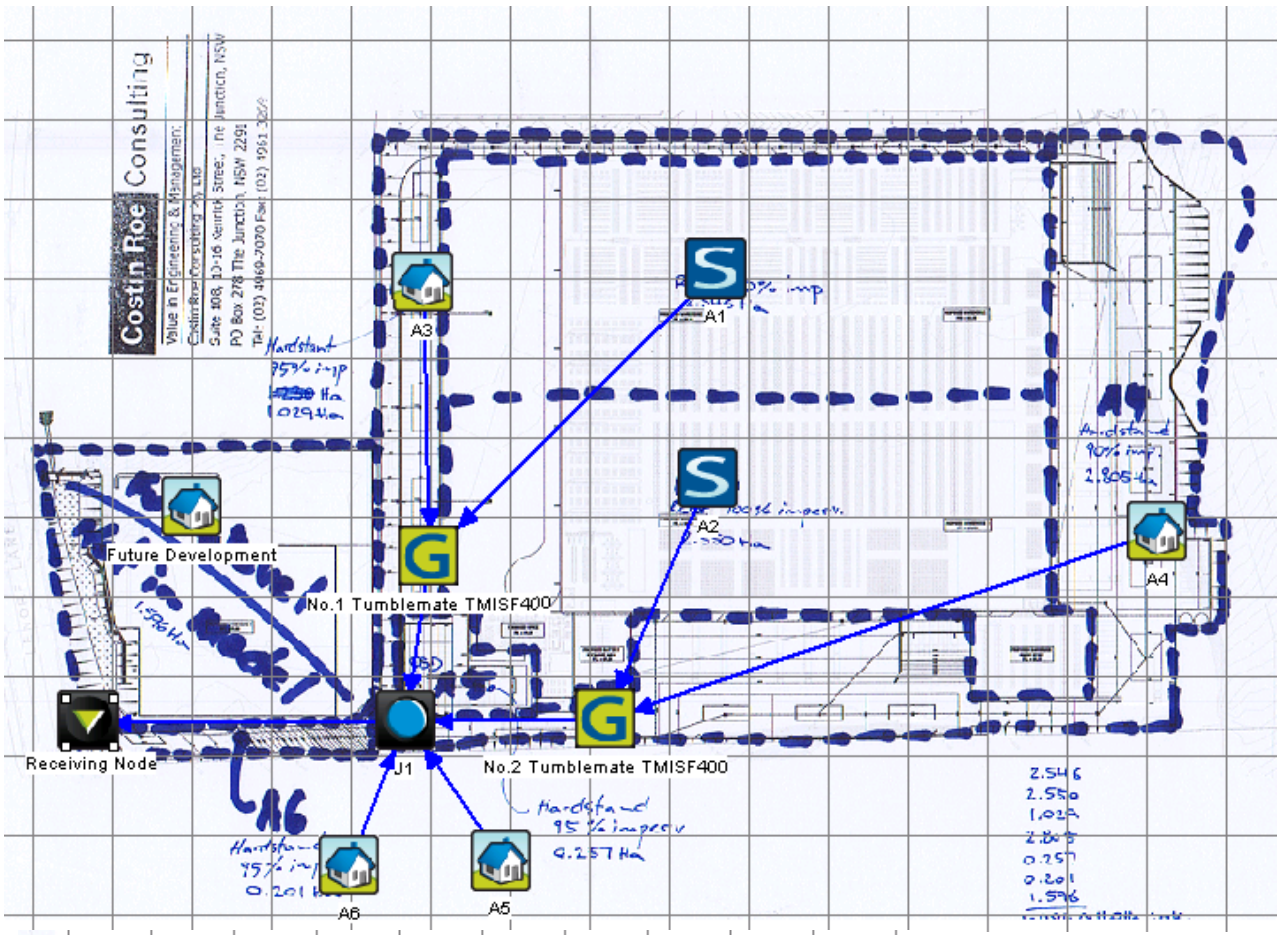
- Managing Urban Stormwater: Harvesting and Reuse – 2006 (NSW DEC);
- Managing Urban Stormwater: Source Control – 1998 (NSW EPA);
- Managing Urban Stormwater: Treatment Techniques – 1997 (NSW EPA);
- Managing Urban Stormwater: Soils & Construction – 2004(LANDCOM);
- Penrith City Council – DCP 2010 (Part C3); and
- Water Sensitive Urban Design – "Technical Guidelines for Western Sydney" by URS Australia Pty Ltd, May 2004

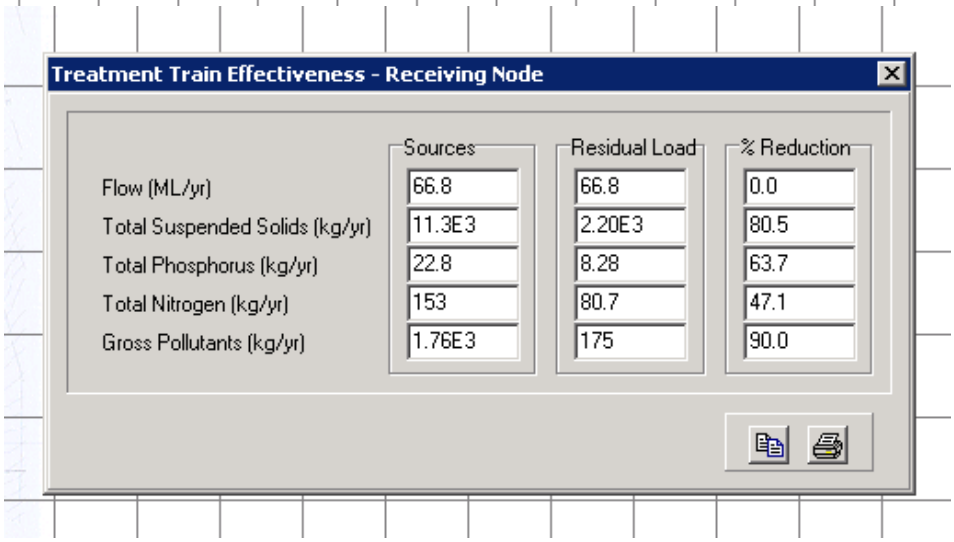
Appendix A

DRAWINGS BY COSTIN ROE CONSULTING

Appendix B

MUSIC MODEL CONFIGURATION





Appendix C

DRAINS MODEL CONFIGURATION