Costin Roe Consulting

PRECISION | COMMUNICATION | ACCOUNTABILITY

CIVIL ENGINEERING REPORT
INCORPORATING
WATER CYCLE MANAGEMENT STRATEGY

SSD 10436

CSR ESTATE STAGE 2 MASTERPLAN
HORSLEY PARK NSW

Prepared For:
ESR Australia
Level 29
20 Bond Street
SYDNEY NSW 2000

Prepared by:
Costin Roe Consulting
Level 1, 8 Windmill Street
WALSH BAY NSW 2000

***Rev*: C**

DOCUMENT VERIFICATION

Project Title	CSR Estate Stage 2 Masterplan
Document Title	Civil Engineering Report Incorporating Water Cycle Management Strategy
Project No.	Co12990.05
Description	SSD report for future industrial estate
Client Contact	Mr Paul Jewiss, ESR

	Name	**Signature**
Prepared by	Terry Fong	
Checked by	Mark Wilson	
Issued by	Mark Wilson	
File Name	12990.05-02c.rpt.docx	

Document History

Date	**Revision**	**Issued to**	**No. Copies**
20 Mar. 2020	DRAFT	Mr Paul Jewiss, ESR	PDF
30 Mar. 2020	A	Mr Paul Jewiss, ESR	PDF
24 June. 2020	B	Mr Paul Jewiss, ESR	PDF
16 July 2020	C	Mr Paul Jewiss, ESR	PDF

TABLE OF CONTENTS

1 INTRODUCTION & SCOPE 4

2 SITE DESCRIPTION AND PROPOSED DEVELOPMENT 6

2.1 Site Description 6

2.2 Proposed Development 7

2.3 CSR Estate Development Discussion 7

3 EARTHWORKS & FOUNDATIONS 10

3.1 Site Geography 10

3.2 Estate Earthworks 10

3.3 Site Earthworks 11

3.4 Groundwater 11

3.5 Embankment Stability 12

3.6 Supervision of Earthworks 12

4 ESTATE ROADS & ACCESS 13

6 WATER CYCLE MANAGEMENT STRATEGY & DRAINAGE METHODOLOGY 14

6.1 Key Areas and Objectives 14

6.2 Existing/ Estate Drainage System 17

6.3 Proposed Development Drainage System 18

6.4 Climate Change 18

6.5 Site Water Balance Objectives 19

6.6 Water Use Management Features 19
6.6.1 Existing 19
6.6.2 Proposed 19

6.7 Water Balance Assessment 21
6.7.1 Internal Base Water Demand 21
6.7.2 Fire Services Base Demand 21
6.7.3 Irrigation Base Water Demand 21
6.7.4 Rainwater Tank Sizing 22
6.7.5 Overall Water Cycle Management 23

6.8 Operational Impact Assessment 23

7 WATER QUANTITY MANAGEMENT 24

8 STORMWATER QUALITY CONTROLS 25

8.1 Pollution Target Parameters 25

8.2 Proposed Stormwater Treatment System 25

8.3 Stormwater Quality Modelling 26
8.3.1 Introduction 26
8.3.2 Rainfall Data 26
8.3.3 Rainfall Runoff Parameters 27
8.3.4 Pollutant Concentrations 27
8.3.5 Treatment Nodes 27
8.3.6 Results 28
8.3.7 Modelling Discussion 29

8.4 Stormwater Harvesting 30

8.5 Maintenance and Monitoring 30

9 FLOODING 36

10 EROSION & SEDIMENT CONTROL PLAN 38

10.1 General Conditions 38

10.2 Land Disturbance 38

10.3 Erosion & Sediment Control Conditions 39

10.4 Pollution Control Conditions 40

10.5 Waste Management Conditions 40

10.6 Site Inspection and Maintenance 40

11 SEAR'S & AGENCY RESPONSE ITEMS 43

11.1 SEAR's Response Items 43

12 CONCLUSION 46

13 REFERENCES 47

1 INTRODUCTION & SCOPE

Costin Roe Consulting Pty Ltd has been commissioned by ESR Australia to undertake a *Civil Engineering Report & Water Cycle Management Strategy* (WCMS) to accompany a State Significant Development Application (SSDA) with the NSW Department of Planning, Industry and Environment (DPIE) for the future industrial development of the land. This report presents a civil engineering assessment of a property. The site is located on the southern side of Burley Road, Horsley Park, Sydney, NSW. The proposed development is for the construction of industrial facilities on the four lots present on the site. Each industrial facility comprises a warehouse, office space, provision for truck loading, unloading and circulation, and for passenger vehicle parking. The development will be referred to The CSR Stage 2 Estate (CSRS2E) in this report.

This report provides an assessment of the civil engineering characteristics of the development site and technical considerations of the following aspects:

- Earthworks & geotechnical considerations;
- Roads and Access;
- Water Cycle Management Strategy (WCMS).

The WCMS comprises several key areas of stormwater and water management which are provided below. These key areas have been established with the aim to reduce impacts from the CSRS2E development on the surrounding environment and neighbouring properties and other stages within the ESR Estate. The water cycle management strategy identifies the management measures required to meet the targets set. The key water cycle management areas assessed in this report are:

- Storm Water Quantity;
- Storm Water Quality;
- Water Supply and Reuse;
- Flooding; and
- Erosion and Sediment Control

This engineering analysis is based on the development for industrial warehouse and logistic facilities consistent with industrial estates in the surrounding areas and Masterplan provided by ESR.

A request for SEAR's has been completed by ESR. Reference to **Appendix C** should be made for SSD_10436 SEAR's dated June 2020, and **Section 11** of this report for specific responses to civil engineering and water management related items included in the SEAR's.

The design has been completed in accordance with the *Stormwater Management Strategy* set as part of the approved *CSR Industrial Estate* as documented in Brown Consulting (now Calibre) *Stormwater Concept Plan (Ref: X13044 dated December 2013).* It is noted that the adopted Stormwater Management Strategy is consistent with the requirements of the site-specific *Development Control Plan* for the site "*Western City Employment Area – Fairfield City Council Development Control Plan 2016, Lot 1 DP106143, 327-335 Burley Road, Horsley Park"* dated March 2016.

The consent authority the DPIE, however noting due consideration to Fairfield City Council (FCC) requirements and the engineering and policy requirements of FCC, included in their *Stormwater Management Policy September 2017*, have also been considered in the design, where relevant. It is noted that some differences are present in the above noted DCP and current FCC policy. The engineering design has been completed in accordance with the DCP where differing requirements are present.

2 SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 Site Description

Lot 1 of DP1228114 is located on the southern side of Burley Road in the suburb of Horsley Park as shown in **Figure 2.1.** In 2013, Development Application DA893.1/2013 was approved. The parcel of land being reviewed as part of this assessment comprises Stage 2 of the original CSR Estate subdivision approval (refer **Section 2.3**).

Figure 2.1. Locality Plan (Nearmap, 2019)

Review of the historical survey information shows that the land had varying levels across the entire site. The highest level on the site, at approximately RL83.00m AHD, is located on the western side of the site and the lowest level, at approximately RL 74.00m AHD, is in the middle portion of the site. It is noted that initial earthworks and grading works have been commenced by CSR for Lot 2 as per Nearmap image update.

Reference should be made to **Section 2.2** for the proposed development works and **Section 2.3** for discussion regarding the CSR Estate Works.

2.2 Proposed Development

The proposed development is for the construction of five (5) industrial buildings over 4 lots, comprising an area of 20.8 Ha. The masterplan layout is shown in **Figure 2.2**.

The masterplan layout shows development lots will vary between 4 Ha and 7.7 Ha in size with buildings varying between approximately 7,800m^2 to 43,000m^2 in size.

Developments generally comprise large steel framed warehouse/ distribution type building with associated office space, car parking, fire access roads, truck circulation and truck loading and unloading areas.

Access to all lots would be made via CSR Estate Access Road (refer **Section 2.3**).

Infrastructure works (including bulk earthworks, provision of services, drainage connections, road & intersection construction) are to be completed by CSR under separate FCC approval as discussed in **Section 2.3**.

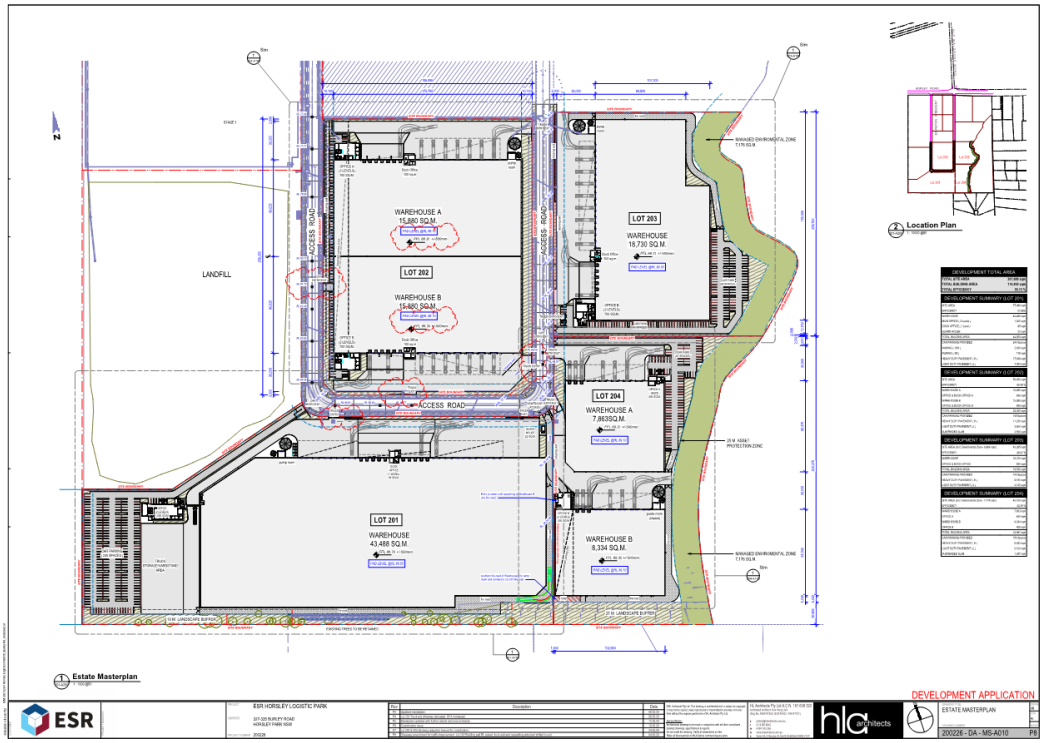


Figure 2.2. Proposed Development

2.3 CSR Estate Development Discussion

DA893.1/2013 was lodged with FCC in December 2013 & approved by the Land and Environment Court in July 2015. The approved DA included the proposed development of the 74.48 Ha estate which is proposed to be constructed in three stages.

Stage 1 has been completed and is currently being developed by others under separate approvals with FCC.

Stages 2 is located in the southern portion of the overall estate and includes the area subject to this application. Stage 3 has not commenced construction and is noted to be outside the scope of this report.

The infrastructure works for Stage 1 and 2 include bulk earthworks and infrastructure servicing construction including estate roadways, trunk drainage and individual drainage connections, water supply, sewer, power and telecommunications.

Bulk Earthworks plans provided by Calibre Group have been applied and approved through a Section 4.55 application with FCC for the infrastructure works (refer **Appendix D**). These works are currently being constructed and will be finalised, or close to be finalised, prior to possession of the development lots by ESR.

The Stage 1 & 2 works will encompass the construction of the proposed 20m wide access road off the Burley Road reserve and a temporary turning head and stormwater infrastructure as shown in **Figure 2.3**. The general arrangement of the handover conditions for Stage 2 are shown in **Figure 2.4**.

The indicative master-planning for the site after the completion of all 3 stages incorporates an access road which loops the site, intersecting with Burley Road & the Reserved Road and provides access to development lots within the site. The new access road and associated intersections will be constructed to FCC requirements and ownership transferred to Fairfield Council. Large development lots will flank either side of the access road. Development lots will vary in size, typically in the order of 1.51 Ha to 13.35 Ha. The final layout will be subject to market demands and the preferred architectural layout. Development lots will be sympathetic to the topography of the land.

The requirements for future developments and sites within the CSR land have been included in the site-specific *Development Control Plan* for the site "*Western City Employment Area – Fairfield City Council Development Control Plan 2016, Lot 1 DP106143, 327-335 Burley Road, Horsley Park"* dated March 2016. These include stormwater management requirements for water quantity and quality as set out in **Sections 7 & 8** of this report.

The Stage 2 to be completed by CSR are documented on Calibre Consulting "*Stage 2A & 2B Subdivision Design*" package 15-001115.13 and these drawings are included for information in **Appendix D**.

Figure 2.3. Lot Layout Plan As Approved Under DA893.1/2013

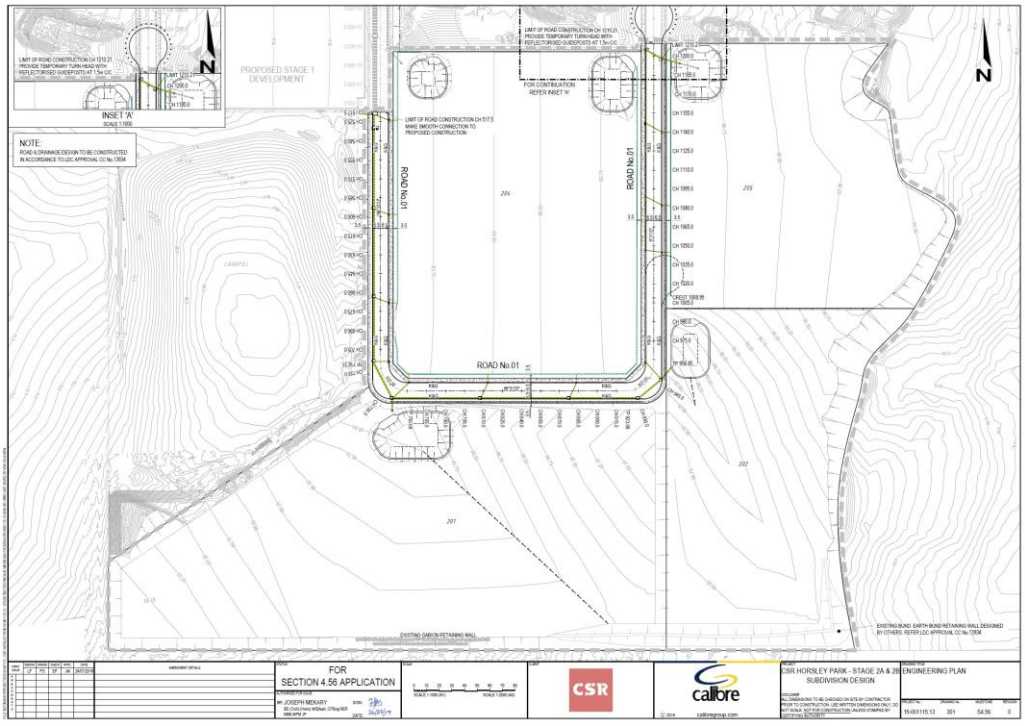


Figure 2.4. Stage 2 Handover Arrangement

3 EARTHWORKS & FOUNDATIONS

3.1 Site Geography

The site has historically (since mid-1970s) been utilised for extractive industry to enable the manufacturing of bricks. Prior to this it is expected that the ground surface once exhibited undulating terrain that was most likely covered in natural bush or grassland. Since the development of the brick manufacturing plant extensive excavation has occurred, reportedly up to 35m deep.

A preliminary geotechnical investigation was performed by Douglas Partners (DP) during October 2013. Furthermore, in the Statement of Environmental Effects for a Subdivision (December 2012) report by Brown Consulting, an analysis of the geotechnical report by Douglas Partners has been undertaken. The following summary is based on information contained in the Brown Consulting Report (December 2015).

"The geotechnical investigation by Douglas Partners was carried out to assess the subsurface conditions, which included a combination of cone penetration and boreholes, in order to provide information on:

- Depth of quarry pits;
- Preliminary extent of quarry pits;
- Composition of back fill material;
- Site preparation and earthworks; and
- Anticipated construction difficulties and potential solutions.

The report identifies several geotechnical constraints to the development on the site including:

- The presence of deep brick pits;
- The partial backfilling of the brick pits with large volumes of uncontrolled filling;
- The presence of many large stockpiles of soil and ripped rock (mostly clay and shale) situated both within the brick pits and scattered across the surrounding site areas; and
- The effects of the kilns on the soils below and surrounding the kilns within the existing brick manufacturing plant.

These geotechnical constraints do not include the existing brick manufacturing facility which includes several large warehouse and office buildings, kilns and areas of hardstand pavements which have not been assessed as part of the preliminary assessment as it was understood that they would be retained for some time in the future.

3.2 Estate Earthworks

Bulk earthworks are currently being performed throughout the Stage 2 development area to facilitate the development of individual development site in the estate for industrial warehouse distribution use. The works have been approved by FCC and are being completed by CSR. The approved design has been documented on Calibre Consulting "*Stage 2A & 2B Subdivision Design*" package 15-001115.13 (refer **Appendix D**).

The earthworks are being undertaken with the objective to provide large flat building pads, facilitate site access & to drain the site stormwater via gravity and to fill previous brick pits and other quarry works associated with CSR activities on the land.

Earthworks being performed for the Stage 2 development area include pads with nominal grading and levels between RL 90.5m AHD to RL 83.5m AHD. Site generally grade from the south-east to north/ north-west of the stage area. Estate Erosion and Sediment Controls have been nominated on the Calibre design package and these measures should remain in place throughout the works period.

Retaining walls are also being constructed on the perimeter of the site to allow for future building works.

These works, as noted, are ongoing and will be finalised prior to development of individual development lots by ESR.

3.3 Site Earthworks

Minor earthworks only will be required as part of the industrial building development works. These works would include final trimming and shaping of the site to suit the detailed architectural site layout, final pavement and coordination of subgrade levels with slab profiles and grading to suit drainage requirements.

Details of earthworks would be provided during detail design/ construction certificate stages of the development. Detailed assessment of the earthworks level will be completed during detailed design stage and some adjustment to the final pad and building floor levels (within +/-500mm of those nominated on masterplan layouts) may be required subject to final geotechnical testing, topsoil assessments and bulking/compaction allowances. It is noted that Lots 201 and 204 have maximum heights as set through Land and Environment Court decision and this is noted to limit any increase in height noted above.

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.

Any site-specific soil erosion and sediment control measures required to suit the ESR development layout will be performed in accordance with *Landcom Managing Urban Stormwater, Soils and Construction (1998) – The Blue Book*. Please refer to the Soil and Water Management Plan in **Section 10** of this report.

Cut earthworks over the site will be minor, and no major changes or impacts to groundwater is expected because of these works.

3.4 Groundwater

Given the proposed works involve minor changes to the earthworks levels completed as part of separate approvals, the impact on the overall groundwater system as a result of the proposed earthworks over the site is expected to be low.

The effect on impact is considered to meet the requirements of the SEARS and initial responses by the NSW DPI.

3.5 Embankment Stability

To assist in maintaining embankment stability, permanent batter slopes in clay 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 10**.

3.6 Supervision of Earthworks

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

4 ESTATE ROADS & ACCESS

All development lots will gain access off CSR Estate Access Road. The estate road and associated infrastructure is currently being constructed by CSR under separate FCC approvals. This access road is noted to emanate from Reserved Road and Burley Road via a 20m wide internal loop road.

A road reserve width of 20m has been adopted for the estate from the typical local road from Fairfield City Council's Industrial Development Control Plan and can accommodate the turning paths for industrial vehicles. The local road section includes a 13m wide carriageway and 3.5m footways. The proposed loop road has two access points, creating an intersection with Reserved Road and an intersection on Burley Road. The intersection with Burley Road is positioned to create a four-way intersection with Old Wallgrove Road in accordance with the future regional road.

The road comprises a 13.0m wide crowned carriageway with concrete kerb and gutter and carriageway surface finished with asphaltic concrete as per the requirements of Fairfield City Council. The typical section is shown below.

It is noted that no road construction is proposed as part of this SSDA. Information contained in this section is provided for information only.

Refer to **Appendix D** for Stage 2 road engineering designs currently being constructed by CSR under separate FCC approvals.

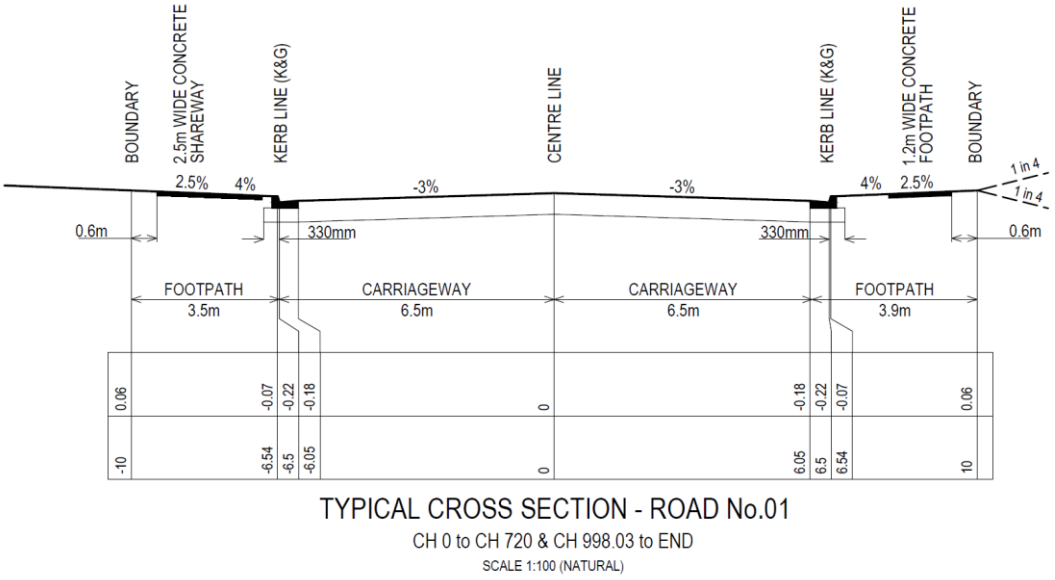


Figure 4.2. Estate Road – Typical Cross Section (as adopted)

6 WATER CYCLE MANAGEMENT STRATEGY & DRAINAGE METHODOLOGY

6.1 Key Areas and Objectives

Water Cycle Management (WCM) is a holistic approach that addresses competing demands placed on a region's water resources, whilst optimising the social and economic benefits of development in addition to enhancing and protecting the environmental values of receiving waters.

Developing a WCMS at the SSDA stage of the land development process provides guidance on urban water management issues to be addressed for the estate and development as a whole.

This WCMS has been prepared to inform the DPIE and FCC that the development is able to provide and integrate WCM measures into the stormwater management strategy for estate. It presents guiding principles for WCM across the precinct which includes establishing water management targets and identifying management measures required for future building developments to meet these targets, and to confirm consistency with the *Western City Employment Area – Fairfield City Council Development Control Plan 2016, Lot 1 DP106143, 327-335 Burley Road, Horsley Park.*

Several WCM measures have been included in the WCMS and engineering design, which are set out in this report and the attached drawings. The key WCM elements and targets which have been adopted in the design are included in **Table 6.1** following.

<table>
<tr><th>Element</th><th>Target</th><th>Reference</th></tr>
<tr><td>Water Quantity</td><td>Maintaining or improving the volume of stormwater flows to estate infrastructure from development lots.

Storage Requirement (SSR) and Permissible Site Discharge (PSD) based on the individual lot areas as outlined below:
<table><tr><th>Attribute</th><th>5 year ARI</th><th>100 year ARI</th></tr><tr><td>PSD* ($m^3/s/ha$)</td><td>0.15</td><td>0.28</td></tr><tr><td>SSR* (m^3/ha)</td><td>170</td><td>290</td></tr></table></td><td>DPI

Table 3 of Western City Employment Area – Fairfield City Council Development Control Plan 2016, Lot 1 DP106143, 327-335 Burley Road, Horsley Park</td></tr>
<tr><td>Water Quality</td><td>Load-based pollution reduction targets based on an untreated urbanised catchment for whole of Estate:

Gross Pollutants 90%
Total Suspended Solids 85%
Total Phosphorus 65%
Total Nitrogen 45%
Total Hydrocarbons 90%

Load-based pollution reduction targets based on an untreated urbanised catchment for individual lots:

Gross Pollutants 90%
Total Suspended Solids 93%
Total Phosphorus 74%
Total Nitrogen 48%
Total Hydrocarbons 90%</td><td>Western City Employment Area – Fairfield City Council Development Control Plan 2016, Lot 1 DP106143, 327-335 Burley Road, Horsley Park</td></tr>
<tr><td>Flooding</td><td>Buildings and road set 500mm above 1% AEP.

No affectation to upstream downstream or adjoining properties as a result of development</td><td>NSW Floodplain Development Manual.</td></tr>
<tr><td>Water Supply</td><td>Reduce water consumption in non-residential properties by 40% consistent with the BASIX Scheme</td><td>FCC Stormwater Policy 2017</td></tr>
<tr><td>Erosion and Sediment Control</td><td>Appropriate erosion and sedimentation control measures must be described in the environmental assessment for all stages of construction to mitigate potential impacts to downstream areas.</td><td>Landcom Blue Book Fairfield City Council DPI</td></tr>
</table>

Table 6.1. WCM Targets

A summary of the how each of the WCM objectives will be achieved are described below. Reference to the relevant sections of the report should be made for further and technical details relating to the WCM measures:

- *Stormwater Quantity Management (Refer **Section 7**)*

  The intent of this criterion is to reduce the impact of urban development on existing drainage system by limiting post-development discharge within the receiving waters to the pre-development peak, and to ensure no affectation of upstream, downstream or adjacent properties.

  Attenuation of stormwater runoff from the development is proposed to be managed via a series of measures provided on-lot for each individual development site.

  The intention is for water quantity measures to be provided on each development lot. This will mean that the development can be assessed, approved and constructed without the need for estate level detention basins.

  The site storage rate and site discharge rate has been defined for development lots in the estate DCP and allows for post development discharge to be limited to pre-development discharge, and also considers the roadways which do not include attenuation.

  Reference to drawings **Co12990.05-SSDA40 to SSDA44** should be made for each of the lot's stormwater management plans. These drawings are provided to demonstrate how the stormwater management objectives can be achieved. It is noted that these drawing are provided for information only and the final system for each individual development would depend on site constraints and final layout. It is noted that although a different system may be adopted, the required stormwater management objectives are to be met for all developments.

  Refer to **Section 7** of the document for detailed sizing of detention systems.

- *Stormwater Quality Management (Refer **Section 8**)*

  There is a need to target pollutants that are present in stormwater runoff to minimise the adverse impact these pollutants could have on downstream receiving waters.

  The required pollutant reductions are included in **Table 6.1** of this document and MUSIC modelling has been completed to confirm the reduction objectives can be met for the development.

  A series of Stormwater quality improvement devises (SQID's) have been incorporated in the design of the estate. The proposed management strategy will include the following measures:

  - Development sites will require full on lot treatment. Individual lots will need to design and model stormwater treatment measures (which meet objectives per **Table 6.1**).
  - Individual measures have been proposed for each development lot and include treatment trains of gross pollutant traps (GPT's) in the form of pit inserts, proprietary filters and raingardens/ bio-retention. Reference to drawing **Co12990.05-SSDA40** should be made for a typical stormwater development strategy for a typical warehouse site.

Reference to **Section 8** of this document should be made for detailed Stormwater Quality modelling and measures.

- *Flood Management (refer **Section 9**)*

  The proposed development and CSR Estate is noted to be free from any known flooding or overland flow paths. Limited consideration to flooding and/ or overland flow from large rainfall events is required for the development.

- *Water Demand Reduction/ Rainwater Reuse*

  Rainwater reuse measures will be provided as part of future building development designs. Rainwater reuse will be required to provide a minimum rainwater tank which reduces demand on non-potable uses by at least 40%. The reduction in demand will target non-potable uses such as toilet flushing and irrigation. Refer to **Section 6.6**.

6.2 Existing/ Estate Drainage System

Lot 1 DP1228114 in which the CSR Estate is located had limited pre-existing formal drainage systems. As part of previous site uses, there was a warehouse facility and a brick quarry surrounded by dams & natural vegetation. The pre-construction site primarily drains to a small tributary of Ropes Creek on the north of the estate, which connects to the main Ropes Creek channel downstream of the Sydney Water Pipeline, approximately 1km northwest of the site.

A trunk drainage system for minor storm events through a conventional pit and pipe system has now been constructed as part of the estate infrastructure and Stage 1 & 2 construction. Multiple lot discharge connection points, in the form of RCP pipe stubs, have been provided as part of the constructed estate drainage system for allowance for discharge and conveyance of individual lot developments. Refer **Section 2.3** and **Appendix D** for the estate drainage layout.

The minor system within the estate roads consists of a piped drainage system which has been designed and constructed to accommodate the 1 in 5-year ARI storm event (Q5), which is the minimum required by Fairfield City Council. Normal industry practice for an industrial facility is that the in-ground pipe system would be designed to cater for the 1 in 20-year ARI storm event (Q20) event to ensure suitable operation of the facility during the majority of storm events. The difference in design ARI's will result in the reduced ability for the site drainage to discharge effectively to the infrastructure drainage system. There is also the potential for surcharging of the site drainage system within the property or at the interface of the site and infrastructure drainage systems during storms in the range of 1 in 5 to 1 in 20-year ARI.

6.3 Proposed Development Drainage System

As per general engineering practice, the client requirements, the guidelines of FCC and the Estate DCP, the proposed stormwater drainage system for the estate development will comprise a minor and major system to safely and efficiently convey collected stormwater run-off from the development to the legal point of discharge.

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 will be designed to cater for storms up to and including the 1 in 100-year ARI storm event (Q100). The major system will employ the use of defined overland flow paths, such as roads and open channels, 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 management measures as set out in **Table 6.1** are to adopted to address water quality, quantity and re-use requirements are to be considered in the design to ensure that any increase in the detrimental effects of pollution are mitigated, Water Quantity Objectives are met and that the demand on potable water resources is reduced.

The legal point of discharge is a point specified by Council (or other appropriate consent authority) where stormwater from a property can be discharged. The legal point of discharge is usually Council's stormwater infrastructure (where available), the street kerb and channel for smaller developments or downstream receiving waters like an existing stream or gully, lake, pond or waterbody.

Legal discharge for each development lot is to trunk drainage constructed by CSR as described in **Section 2.3** and **Appendix D**. Refer Costin Roe Consulting drawings included in **Appendix A** for site specific drainage layout, stormwater management measures and civil engineering considerations.

6.4 Climate Change

An assessment has been undertaken for the effect of climate change on the development. The assessment takes into consideration potential effect from increased rainfall intensity and sea level rise.

The effect on development has been assessed for a 10% increase in rainfall intensity. This increase is considered representative of potential climate change impacts for the Western Sydney area (being consistent with projected rainfall increases in accordance with the New South Wales Department of Environment and Climate Change (DECC) 'Floodplain

Risk Management Guideline Practical Consideration of Climate Change' (Table 1, October 2007).

This assessment shows that the proposed stormwater drainage system and stormwater management systems (including the proposed detention system) would have sufficient capacity to manage the increased peak flows and water volume with minor increase in hydraulic grade line and peak water level within the basins. We confirm the increase in rainfall intensities will achieve the required minimum 0.5m freeboard to the proposed building pad levels in relation to local overland flow paths in and around the estate as nominated on the design drawings.

The site is noted to be situated well upstream from any tidally influenced receiving waters including expected potential sea level rise of 0.3m. We confirm the development will not affect or be affected by potential sea level rise due to the distance from the tidal influence river or stream system and/ or the Pacific Ocean.

An assessment on the stormwater on-site detention basin confirms that the current basin design has sufficient capacity to cater for a rainfall intensity increase of 10% from current rainfall intensities.

6.5 Site Water Balance Objectives

A daily site water balance analysis was undertaken to determine the feasibility of the proposed rain and stormwater harvesting scheme and in particular the effects of various storage sizes for stormwater harvesting along with changes to demand.

The water balance utilised flows generated using a simple runoff calculation using historical rainfall data, analysed for various rainfall patterns including dry, mean and wet rainfall years. The purpose for modelling dry, mean and wet years was to assess the performance of various tank sizes given the changes to rainfall patterns.

6.6 Water Use Management Features

6.6.1 Existing

Existing water use features comprise Sydney Water Mains supply.

There are no existing rainwater harvesting systems, or water extractions as the proposed site is currently vacant.

There are no current irrigated landscaped areas.

6.6.2 Proposed

Proposed management measures for water use are as follows:

- Existing Sydney Water mains supply is proposed to be maintained throughout the duration of the proposed site operation;
- Stormwater harvesting throughout rainwater reuse to reduce demand on non-potable water uses;
- Sprinkler water storage via Sydney Water mains.

A concept diagram for the proposed re-use scheme on site is shown in **Figure 6.1** below.

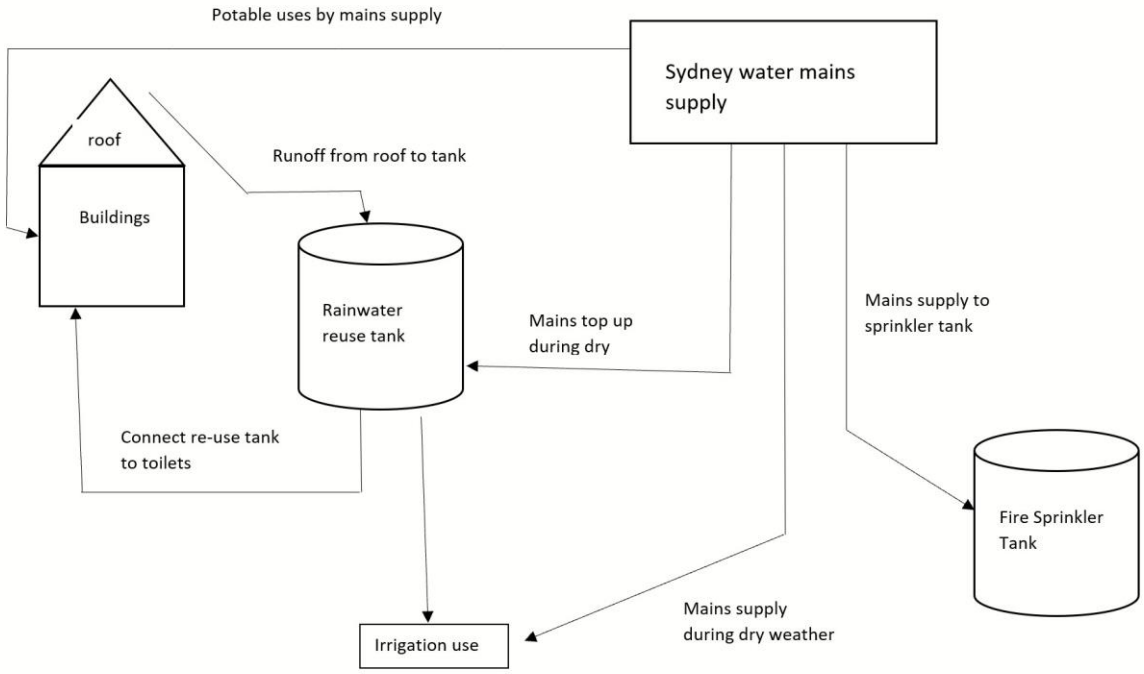


Figure 6.1. Water Cycle Management Schematic

A short description of the expected stormwater harvesting for the development is described below.

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 proposed for this development, and rainwater tank sizing will be designed during detail design stage by the hydraulic consultant via a water balance assessment. Rainwater tanks are to be 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 base water demands and the requirements of Council.

The water balance assessment will be based on local rainfall data and specific utilisation rates for the facility for re-use of non-potable applications. The expected reuse applications include internal uses such as toilet flushing, and external applications including irrigation. The aim is to reduce the water demand for the development by 40% as required in FCC Stormwater Policy 2017.

In general terms the rainwater harvesting system will be comprised the following elements:

- In-line tank for the collection and storage of rainwater.
- Overflow to the in-ground stormwater drainage system sized to cater for the catchment being drained to the tank. This will operate at times when the rainwater storage tank is full so that 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 to toilets and external irrigation areas, and any other uses as defined in the Construction Certificate stage of the design.
- Mains top up to Sydney Water system for prolonged periods of dry weather.
- First flush diverter and filters to ensure adequate quality of reuse water.
- Tank material will be steel or polymer and appropriately located to minimise visual impact.

6.7 Water Balance Assessment

6.7.1 Internal Base Water Demand

The proposed development is expected generate 441 operational jobs. Assuming a two-shift roster, it is expected that there will be 220 employees on site per operational day.

Potable water demand is based on each employee using 25 litres per day for showering and inside tap use.

These rates give the following internal non-potable demand:

Potable Water	220 People	5.5 kL/day

Indoor non-potable 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.

These rates give the following internal non-potable demand:

Toilet Flushing	220 People	3.3 kL/day

6.7.2 Fire Services Base Demand

The four proposed sprinkler tanks for fire services require a storage of 550 kL each. These are expected to be serviced twice yearly, hence total yearly demand of 4400 kL has been allowed.

Fire Services	12.1 kL/day

6.7.3 Irrigation 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/m^2 (i.e. 10 mm/m^2). For the purposes of our analysis the average of this application rate has been used, in conjunction with the application regime shown in **Table 6.2**, to determine the monthly and total yearly demand.

Table 6.2. External Irrigation Application Schedule

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

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

Proposed Development	Area=3500m^2	3570 kL/year
		9.8 kL/day

6.7.4 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.

Table 6.3. Rainwater Reuse Requirements

Lot	Roof Catchment to Rainwater Tank (m2)	Tank Size (kL)	Predicted Non-Potable Demand Reduction (%)
201	8950	77	40
202	8360	50	40

203	5150	40	40
204	4170	40	40

The water balance assessment predicts 40% reduction in non-potable will be met for the developments with the provision of rainwater tanks as specified in **Table 6.3** above.

We note that the final configuration and sizing of the rainwater tanks is subject to detail design considerations and optimum site utilisation.

6.7.5 Overall Water Cycle Management

The following **Table 6.4** shows overall water cycle and each water source.

Table 6.4. Overall Water Cycle

Area	**Daily Demand (kL/ Day)**	
	Via Harvesting/ Reuse	**Via Mains**
Internal	1.32	7.48
External	3.92	5.88
Fire	-	12.1
Total	5.24	25.46

6.8 Operational Impact Assessment

Rainwater harvesting is proposed to reduce demand on non-potable applications.

An existing and reliable water supply is available during operations.

Impact on environment from water use is considered to be acceptable.

7 WATER QUANTITY MANAGEMENT

Stormwater attenuation is required to limit post development flow rates to pre-development flow rates. This can be achieved through water quantity management via stormwater detention or "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 site.

As set out in **Table 6.1**, Site Storage Requirement (SSR) and Permissible Site Discharge (PSD) are based on controls included in the site-specific *Development Control Plan* (DCP) for the site "*Western City Employment Area – Fairfield City Council Development Control Plan 2016, Lot 1 DP106143, 327-335 Burley Road, Horsley Park"* dated March 2016.

The requirements for detention as approved are set out in *Table 3 in Section 3.2* of the DCP, as originally formulated in the Stormwater Management Strategy completed by Brown Consulting is for each lot to construct their own detention system with based on the individual lot areas as outlined in excerpt **Table 7.1** below.

Attribute	5 year ARI	100 year ARI
PSD* ($m^3/s/ha$)	0.15	0.28
SSR* (m^3/ha)	170	290

Table 7.1-PSD & SSR - Brown Consulting (June 2014) & Table 3 of DCP2016

Attenuation of stormwater runoff from the whole of the development is proposed to be managed through individual OSD systems on development lots. The sizing of the development lot detention systems is noted to account for the road catchments remaining un-attenuated such that the total post-development runoff from the whole of the CSR estate is less than or equal to pre-development runoff as required of the DCP.

Refer to drawings included in **Appendix A** for location and general arrangement of detention systems, and **Table 7.2** below which shows PSD and SSR for each development lot.

Lot	**Area (Ha)**	**PSD (m3/s)**		**SSR (m3)**	
		5yr ARI	**100yr ARI**	**5yr ARI**	**100yr ARI**
201	7.71	1.157	2.159	1310	2235
202	5.04	0.756	1.411	857	1462
203	4.02	0.603	1.126	685	1166
204	4.0	0.60	1.12	680	1160

Table 7.2. PSD and SSR for Development Lots

8 STORMWATER QUALITY CONTROLS

8.1 Pollution Target 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 to minimise the adverse impact these pollutants could have on receiving waters and to also meet the requirements specified by FCC.

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:

Table 8.1. Estate Pollution Reduction Targets

Gross Pollutants	90%
Total Suspended Solids	85%
Total Phosphorus	60%
Total Nitrogen	45%
Total Hydrocarbons	90%
Free Oil and Grease	90%

As set out in **Table 6.1 & 8.2**, target rates for individual sites are greater than the base rates noted above, due to development sites being required to provide offset for untreated portions of the overall estate (e.g. the estate road and any other area which bypass treatment) so that the overall estate achieves the required pollution reductions.

Brown Consulting have used the MUSIC software package to model the water quality treatment, allowing for the untreated roads and other bypass areas, have quoted the required pollution reduction rates as follows:

Table 8.2. Individual Lot Pollution Reduction Targets

Gross Pollutants	90%
Total Suspended Solids	93%
Total Phosphorus	74%
Total Nitrogen	48%

8.2 Proposed Stormwater Treatment System

Developed impervious areas of the estate, including roof, hardstand, car parking, roads and other extensive impervious 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 the development. The STM's for the estate are based on a treatment train approach at the estate level to ensure that all the objectives above are met.

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

- All development lots will require on-lot treatment measures which meet the load-based percentage requirements noted in **Section 8.1** and **Section 6.1**.
- Lot systems will comprise proprietary filters and pit inserts, in combination with bio-retention basins; and
- A portion of the future building roofs will also provide a level of treatment via rainwater reuse and settlement within the rainwater tank.

The maintenance of the water quality measures (bio-retention and gross pollutant traps) will be made by each lot tenant at no cost or burden to council. Further discussion on maintenance are contained in **Section 8.6** of this document.

8.3 Stormwater Quality Modelling

8.3.1 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 included in **Section 6.1 & 8.1** of this report were used as a basis for assessing the effectiveness of the selected treatment trains.

The MUSIC model "*12990.05-REV 4.sqz*" was set up to examine the effectiveness of the water quality treatment train and to predict if council requirements have been achieved on an estate wide basis and on individual lots respectively. The layout of the MUSIC model is presented in **Appendix B**.

8.3.2 Rainfall Data

Six-minute pluviographic data 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

8.3.3 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

8.3.4 Pollutant Concentrations

Pollutant concentrations for source nodes are based on values nominated by Fairfield City Council for industrial land use as per the **Table 8.3**:

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 8.3. Pollutant Concentrations

The MUSIC model has been setup with a treatment train approach based on the pollutant concentrations in **Table 8.3** above.

8.3.5 Treatment Nodes

Bio-retention and Generic Treatment nodes have been used in the modelling of the development.

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

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

** Refer drawings for nominated filtration and storage area. Nominated area excludes all pits, scour protection and other structures which may be present in bio-retention basins.

8.3.6 Results

The Tables below show the results of the MUSIC analysis for each lot. The reduction rate is expressed as a percentage and compares the post-development pollutant loads without treatment versus post-development loads with treatment.

Table 8.4. Lot 201 MUSIC analysis results

	Source	Residual Load	% Reduction	Target Met
Total Suspended Solids (kg/yr)	11200	774	93.1	Y
Total Phosphorus (kg/yr)	22	5.6	74.5	Y
Total Nitrogen (kg/yr)	129	62.9	51.3	Y
Gross Pollutants (kg/yr)	1470	0	100	Y

Table 8.5. Lot 202 MUSIC analysis results

	Source	Residual Load	% Reduction	Target Met
Total Suspended Solids (kg/yr)	4230	288	93.2	Y
Total Phosphorus (kg/yr)	10	2.26	77.5	Y
Total Nitrogen (kg/yr)	82.2	39.4	52	Y
Gross Pollutants (kg/yr)	955	0	100	Y

Table 8.6. Lot 203 MUSIC analysis results

	Source	Residual Load	% Reduction	Target Met
Total Suspended Solids (kg/yr)	3770	265	93	Y
Total Phosphorus (kg/yr)	7.98	1.85	76.9	Y
Total Nitrogen (kg/yr)	56.2	26.6	52.6	Y
Gross Pollutants (kg/yr)	645	0	100	Y

Table 8.7. Lot 204 MUSIC analysis results

	Source	Residual Load	% Reduction	Target Met
Total Suspended Solids (kg/yr)	3310	228	93.1	Y
Total Phosphorus (kg/yr)	7.15	1.7	76.3	Y
Total Nitrogen (kg/yr)	51.6	24.4	52.7	Y
Gross Pollutants (kg/yr)	595	0	100	Y

These 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 load-based pollution reduction requirements.

8.3.7 Modelling Discussion

MUSIC modelling has been performed to assess the effectiveness of the selected treatment trains, at both an estate level and individual lot level, and to ensure that the pollutant retention requirements have been met.

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

Hydrocarbon removal cannot easily be modelled with MUSIC software. The proposed distribution/ storage facility would be expected to produce 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 FCC and the DCP have been met.

8.4 Stormwater Harvesting

Refer to **Section 6.6** for details on the stormwater harvesting system.

8.5 Maintenance and Monitoring

It is important that each component of the water quality treatment train is properly operated and maintained. To achieve the design treatment objectives, an indicative maintenance schedule has been prepared (refer to **Table 8.5** 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 8.5. 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 topsoil in eroded area and cover and secure with biodegradable fabric. Cut hole in fabric and revegetate.
BIO-RETENTION BASIN			
Check all items nominated for SWALES/ LANDSCAPED AREAS above	Refer to SWALES/ LANDSCAPED AREAS section above	Refer to SWALES/ LANDSCAPED AREAS section above	Refer to SWALES/ LANDSCAPED AREAS section above
Check for sediment accumulation at inflow points	Six monthly/ After Major Storm	Maintenance Contractor	Remove sediment and dispose in accordance with local authorities' requirements.
Check for erosion at inlet or other key structures.	Six monthly/ After Major Storm	Maintenance Contractor	Reinstate eroded areas so that original, designed profile is maintained

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
Check for evidence of dumping (litter, building waste or other).	Six monthly	Maintenance Contractor	Remove waste and litter and dispose in accordance with local authorities' requirements.
Check condition of vegetation is satisfactory (density, weeds, watering, replating, mowing/ slashing etc)	Six monthly	Maintenance Contractor	Replant and/or fertilise, weed and water in accordance with landscape consultant specifications
Check for evidence of prolonged ponding, surface clogging or clogging of drainage structures	Six monthly/ After Major Storm 10-15 years	Maintenance Contractor	Remove sediment and dispose in accordance with local authorities' requirements. Replace filter media & planting – refer to appropriately qualified engineer or stormwater specialist
Check stormwater pipes and pits	Six monthly/ After Major Storm	Maintenance Contractor	Refer to INLET/ JUNCTION PIT section below.
OSD/ BIO-RETENTION BASIN			
Check all items nominated for SWALES/ LANDSCAPED AREAS above	Refer to SWALES/ LANDSCAPED AREAS section above	Refer to SWALES/ LANDSCAPED AREAS section above	Refer to SWALES/ LANDSCAPED AREAS section above
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.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
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 are 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.
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.
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

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
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 hydraulic consultant
INLET & JUNCTION PITS			
Inside of pits	Six Monthly	Maintenance Contractor	Remove grate and inspect internal walls and base, repair where required. Remove any collected sediment, debris, litter.
Outside of pits	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 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 are 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.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
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.
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.

9 FLOODING

Consideration to flooding has been made as part of the project assessment.

The South Creek Flood Study, *The Updated South Creek Flood Study*, by Worley Parsons, 8th May 2014 has been utilised to confirm the relationship between known flooding areas and overland flow paths with the development site.

The South Creek Study is a regional study commissioned by Penrith Council in-conjunction with Blacktown, Liverpool and Fairfield Councils. The study includes South Creek and associated tributaries, defining flood planning levels and hydraulic hazard zones along the creek, creek floodplain areas and tributaries.

The site is located within the Ropes Creek Catchment to the east of Ropes Creek as shown below if **Figure 9.1** below.

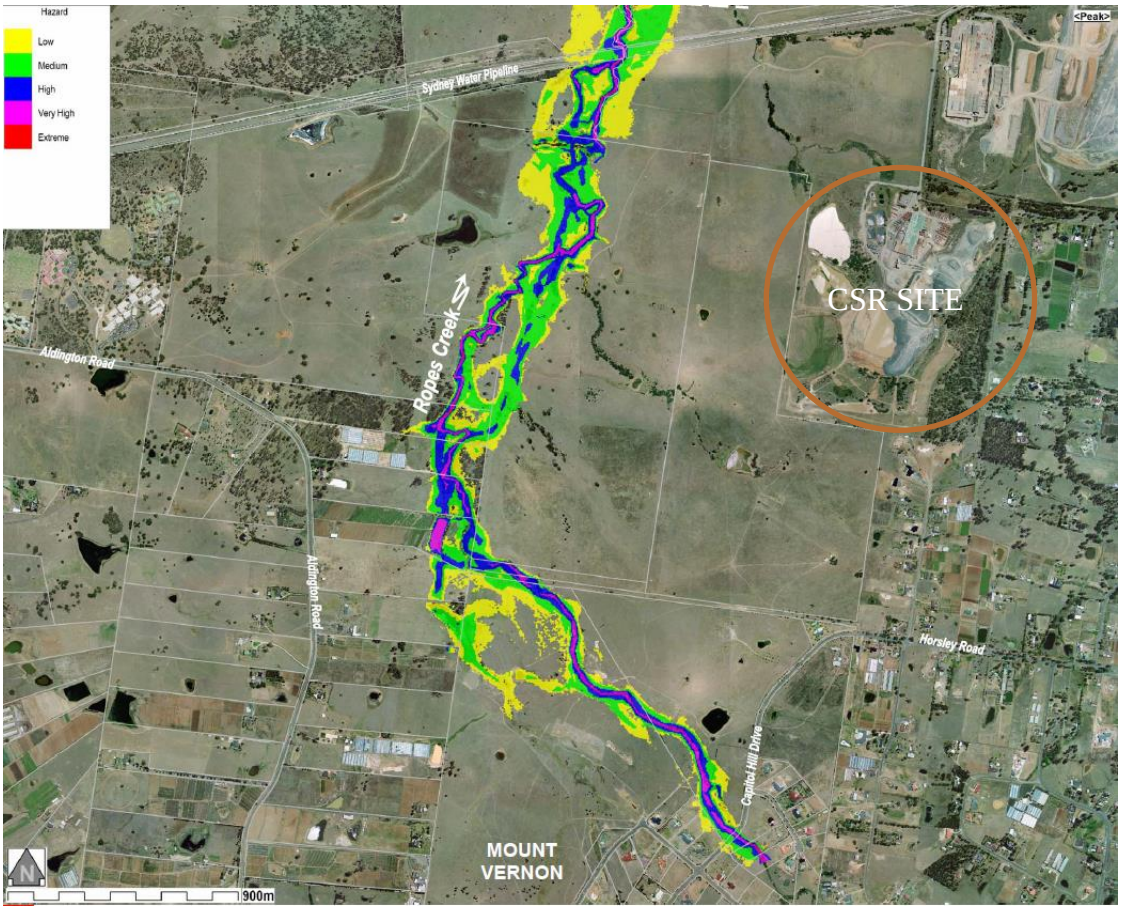


Figure 9.1-Provisional flood hazard mapping for the 1 in 100-year ARI flood. (Source: Worley Parsons)

Using the Fairfield City Council flood planning maps in conjunction with the Worley Parson's South Creek Flood Study, as depicted above it **Figure 9.1**, it can be concluded that the site has a very low risk of flooding affectation from Ropes Creek or other regional flooding. Further that there is no risk that the new development will affect known

overland flow paths or other flood affected areas, given local drainage systems for the development are constructed per the recommendations included in this document.

The survey levels also show that the estate is not affected by any external catchments so flooding from local overland flow is also not considered to be a risk for the estate.

10 EROSION & SEDIMENT CONTROL PLAN

An erosion and sediment control plan (ESCP) is included in drawings **Co12990.00-SSDA20** and **SSDA25**. 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.

It is noted that all measures constructed by CSR as part of the estate works would remain operational until ESR take possession of the land, and commence construction. Any modifications to existing ESCP measures would be undertaken to suit the intended construction layout and program, completed per the Landcom document *Managing Urban Stormwater, Soils and Construction (1998).*

10.1 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 FCC specifications.
3. All subcontractors will be informed by the site manager of their responsibilities in minimising the potential for sedimentation and soil erosion.

10.2 Land Disturbance

1. Where practicable, the soil erosion hazard on the site will be kept as low as possible and as recommended in **Table 10.1**.

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 10.1. Limitations to access

10.3 Erosion & Sediment Control Conditions

1. Clearly visible barrier fencing shall be installed as shown on drawing **Co12990.05-SSDA20** 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 the period of time from starting land disturbance to stabilisation is minimised.
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 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
8. 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 10-year ARI (Q10).
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 enough 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.

10.4 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.

10.5 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.

10.6 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; 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 might 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.

11 SEAR's & AGENCY RESPONSE ITEMS

11.1 SEAR's Response Items

This section of the report covers items relating to the Planning SEAR's, dated 26 March 2020, and associated agency responses for SSD 10436.

We provide specific responses to SEAR's Key Issues *Soil and Water.*

It is noted that the majority of items raised in the SEARs will be managed and addressed via works and approved assessments already undertaken as part of the approved CSR Estate and development infrastructure works already completed. Our response to each SEAR's item considers this.

Further reference to the EIS should be made for confirmation of how the SEAR's have been addressed for non-civil engineering related items.

No.	***Item & Response***
SEARS Soils and Water	
a	*Justification of the need for any earthworks, detailing the resulting finished ground levels* Response With reference to **Sections 2** and **3** of this report, and estate infrastructure design drawings included in **Appendix D**, bulk earthworks are to be undertaken by CRS for the estate based on approvals from FCC. The current development proposes relatively minor earthworks to trim the pads constructed by CSR to suit the proposed building layout, loading and unloading zones, parking areas and other site layout considerations. Proposed finished levels have been shown on design drawings in **Appendix A**.
b	*A detailed and consolidated site water balance;* Response Refer to **Sections 6** to **8** of this Engineering Report for site water requirements and management of water quality and quantity, including reuse and water balance considerations.
c	*Details of proposed erosion and sediment controls during construction*; Response An Erosion and Sediment Control Plan has been prepared in accordance with Fairfield Council requirements and *Managing Urban Stormwater, Soils and Construction "The Blue Book"* (Landcom 1998).

No.	*Item & Response*
	The proposed erosion sediment controls are consistent with the overall CSR estate approved by FCC. Refer to **Section 10** of this *Engineering Report* for *Soil and Water Management* requirements and associated Erosion and Sediment Control drawings included in **Appendix A**.
d	*Assessment description of potential impacts on surface and groundwater sources (quality and quantity), soil, related infrastructure and watercourse(s);* Response Detailed drawings, **Co12990.05-SSDA40** to **SSDA44**, showing the proposed surface and stormwater management systems for the development have been included in **Appendix A**. Requirements for water quantity management, and water quality management have been discussed in **Sections 6** to **8** of this Engineering Report respectively. Proposed stormwater management systems are consistent with the overall CSR DCP. Each site is proposed to provide their own water quantity and quality management system. Reuse of roofwater is also proposed to reduce the demand on non-potable water including toilet flushing and irrigation. It has been confirmed that no watercourses are impacted by the development. It is noted that bulk earthworks are to be undertaken by CRS for the estate based on approvals from FCC. There are no measurable impacts on soils as a result of the proposed development.
e	*A description of surface and stormwater management measures designed in accordance with relevant policies and guidelines, including drainage design, on- site detention, measures to treat and/or reuse water, and proposed use of potable and non-potable water;* Response Detailed drawings, **Co12990.05-SSDA40** to **SSDA44**, showing the proposed surface and stormwater management systems for the development have been included in **Appendix A**. Requirements for water quantity management, and water quality management have been discussed in **Sections 6** to **8** of this Engineering Report respectively. Proposed stormwater management systems are consistent with the overall CSR DCP. Each site is proposed to provide their own water quantity and quality management system.

No.	*Item & Response*
	The site has no identified flooding or overland flow affecting the site, being located toward the top of the catchment. A desktop review is included in this report which confirms the nearest identified overland flow path is located a significant distance from the property. Refer **Section 9** of this report. Based on the above, a detailed site-specific flood assessment is not required or proposed to be undertaken for the development. Water use will be required for toilet flushing, hand washing, employee showers, van washing, tote washing and irrigation with supply being made from Sydney Water. Water demand will be supplemented by rainwater harvesting with proposed reduction in non-potable demands of 40%, Fairfield City Council and 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.
f	*A description of the proposed erosion and sediment controls during construction and operational phases of the development;* Response An Erosion and Sediment Control Plan has been prepared in accordance with Fairfield Council requirements and *Managing Urban Stormwater, Soils and Construction "The Blue Book"* (Landcom 1998). The proposed erosion sediment controls are consistent with the overall CSR estate approved by FCC. Refer to **Section 10** of this *Engineering Report* for *Soil and Water Management* requirements and associated Erosion and Sediment Control drawings included in **Appendix A**. During operational phase a water quality system has been proposed to manage pollutants including sediments. Refer to **Section 7** and drawings included in **Appendix A**
g	*Details of impact mitigation, management and monitoring measures.* Response Proposed mitigation and management measures relating to water quantity management, and water quality management have been included in **Sections 6** to **8** of this Engineering Report respectively, and drawings included in **Appendix A** **Section 10** of this *Engineering Report* for *Soil and Water Management* requirements and associated Erosion and Sediment Control drawings included in **Appendix A**.

12 CONCLUSION

This Civil Engineering Report has been prepared to accompany an SSDA to the NSW DPIE for the development of a 20.8Ha land parcel located within the Stage 2 of the CSR Estate in Horsley Park.

An overview of FCC and DCP requirements for stormwater management and access has been provided to assist in the SSDA submission. Specific mention has been made to on-site detention and water quality requirements as required as part of the *Water Cycle Management Plan* for each development lot.

A strategy for the management of stormwater for the estate has been provided based on the management measures to be provided at both individual lots and at an estate level. This option is in the form of a series of combined detention and water quality basins located at site discharge locations.

We recommend the strategies included in this report are adopted and integrated into future building developments.

13 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);

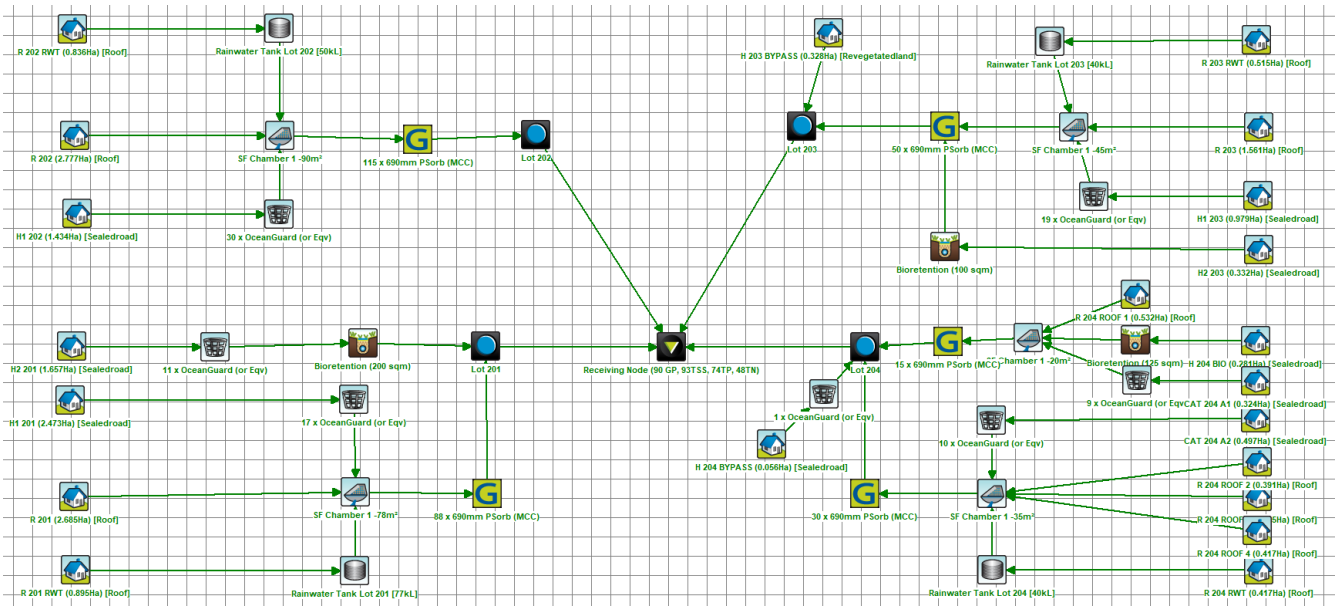
Managing Urban Stormwater: Soils & Construction – 2004(LANDCOM);

Fairfield City Council – Development Control Plan 2013,

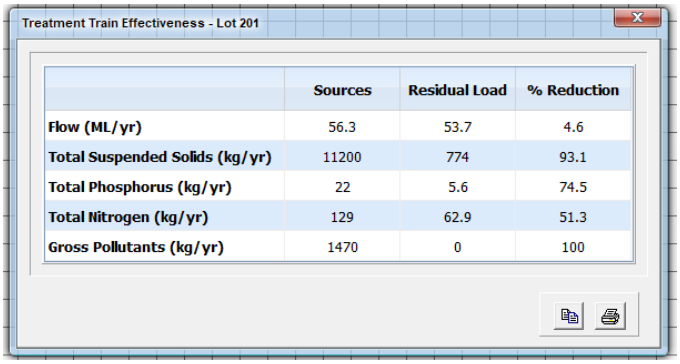
Water Sensitive Urban Design – "Technical Guidelines for Western Sydney" by URS Australia Pty Ltd, May 2004

Appendix A
Costin Roe Consulting Pty Ltd
SSDA Drawings

Appendix B
MUSIC Layout & Results

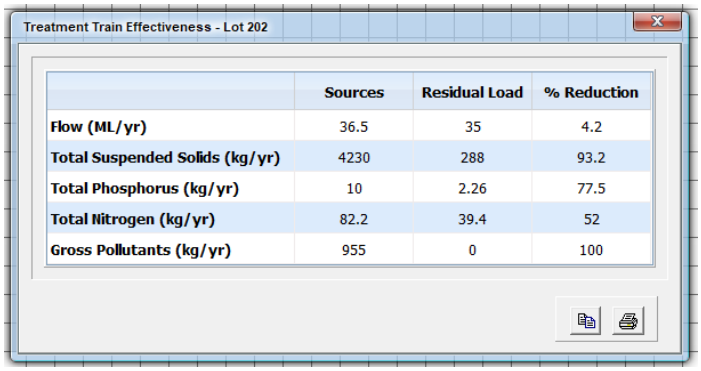


Lot 201 Results



	Sources	Residual Load	% Reduction
Flow (ML/yr)	56.3	53.7	4.6
Total Suspended Solids (kg/yr)	11200	774	93.1
Total Phosphorus (kg/yr)	22	5.6	74.5
Total Nitrogen (kg/yr)	129	62.9	51.3
Gross Pollutants (kg/yr)	1470	0	100

Lot 202 Results



	Sources	Residual Load	% Reduction
Flow (ML/yr)	36.5	35	4.2
Total Suspended Solids (kg/yr)	4230	288	93.2
Total Phosphorus (kg/yr)	10	2.26	77.5
Total Nitrogen (kg/yr)	82.2	39.4	52
Gross Pollutants (kg/yr)	955	0	100

Lot 203 Results

Treatment Train Effectiveness - Lot 203

	Sources	Residual Load	% Reduction
Flow (ML/yr)	24.8	23.4	5.5
Total Suspended Solids (kg/yr)	3770	265	93
Total Phosphorus (kg/yr)	7.98	1.85	76.9
Total Nitrogen (kg/yr)	56.2	26.6	52.6
Gross Pollutants (kg/yr)	645	0	100

Lot 204 Results

Treatment Train Effectiveness - Lot 204

	Sources	Residual Load	% Reduction
Flow (ML/yr)	22.8	21.4	6.2
Total Suspended Solids (kg/yr)	3310	228	93.1
Total Phosphorus (kg/yr)	7.15	1.7	76.3
Total Nitrogen (kg/yr)	51.6	24.4	52.7
Gross Pollutants (kg/yr)	595	0	100

Appendix C
SSD SEAR's

Appendix D

Calibre Consulting "*Stage 2A & 2B Subdivision Design*"

Reference Package 15-001115.13.