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CIVIL ENGINEERING REPORT INCORPORATING WATER CYCLE MANAGEMENT STRATEGY

PROSPECT LOGISTIC ESTATE

SSD 10399

CLUNIES ROSS STREET GREYSTANES NSW

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1 INTRODUCTION & SCOPE

Costin Roe Consulting Pty Ltd has been commissioned by Aliro Group to prepare a *Civil Engineering Report & Water Cycle Management Strategy* (WCMS) to accompany a State Significant Development Application (SSDA) to the NSW Department of Planning, Industry and Environment (DPIE) for industrial development of the land.

This report presents a civil engineering assessment of a number of properties bounded by The M4 Motorway to the north, Clunies Ross Street and residential properties to the east, existing industrial development to the south and south-west and Girraween Creek and a regional detention basin and wetland on the west and north-west in the suburb of Pemulwuy, NSW. The development will be referred to "*The Prospect Logistics Estate*" (PLE) 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;
- Services
- 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 PLE development on the surrounding environment and neighbouring properties including the adjacent Girraween Creek and associated corridor. 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 development for industrial warehouse and logistic facilities consistent with industrial estates in the surrounding area and s and indicative Masterplan provided for Aliro by SBA Architects.

A request for SEAR's has been completed by the proponent. Reference to **Appendix C** should be made for SSD-10399 SEAR's dated 16 December 2019. **Section 10** of this report provides specific responses to civil engineering and water management related items included in the SEAR's.

The site is located within the bounds of two local government areas (LGA's), Blacktown City Council and the recently formed Cumberland Council (within the bounds of the previous LGA of Holroyd City Council). Consideration to the policy of both these councils has been made as part of the proposed development. Further it is noted that at the time of writing, the codes and policies of the previous LGA, Holroyd City Council are still adopted for sites within Cumberland Council and former Holroyd

City Council LGA. Further a precinct specific Development Control Plan (DCP) is relevant for the majority of this site and surrounding developments per *Part Q – Pemulwuy Industrial Controls - Holroyd Development Control Plan 2013*. The stormwater management and engineering requirements as set out in this document have also been considered in the engineering concept and impact assessments included in this report and concept design package.

2 SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 Site Description

The development is located on several parcels of land on the west of Clunies Ross Street in the suburb of Pemulway as shown in **Figure 2.1** and aerial image from Nearmap (dated 22 January 2020) in **Figure 2.2**.

The land comprises a combined area of approximately 18.4 Ha.

The current land-use is predominately industrial and commercial with the majority of the site being the current utilised by Austral Masonry Sales and Factory Outlet facility and southern part of the property being previous Boral head office. An aboriginal heritage area is also located on the far south-west of the site and will be excluded from the proposed redevelopment of the property.

The highest elevation on the site is RL 107m AHD at the south-eastern boundary of the site, within the aboriginal heritage area. The lowest level is approximately RL 51m on the north of the site.

Access to the site can be made via Foundation Place on the western side of the site (approx. RL 73.4m AHD), and from Clunies Ross Street to the east.

An existing regional detention basin is present on the north-west of the site. The basin is noted to be a prescribed dam, hence subject to NSW Dam Safety Committee requirements. The basin is owned and managed by Blacktown City Council. The basin storage is noted to currently encroach on the subject land.

A precinct water quality basin/ wetland is also present on the west/ north-west of the property, constructed as part of the precinct Stormwater Management Strategy set out in the *Part Q – Pemulwuy Industrial Controls - Holroyd Development Control Plan 2013*. This system also encroaches the subject land and is managed by Cumberland City Council.

A major WaterNSW Supply Pipeline is located within the north of the property which services Sydney areas from the nearby Prospect Dam.

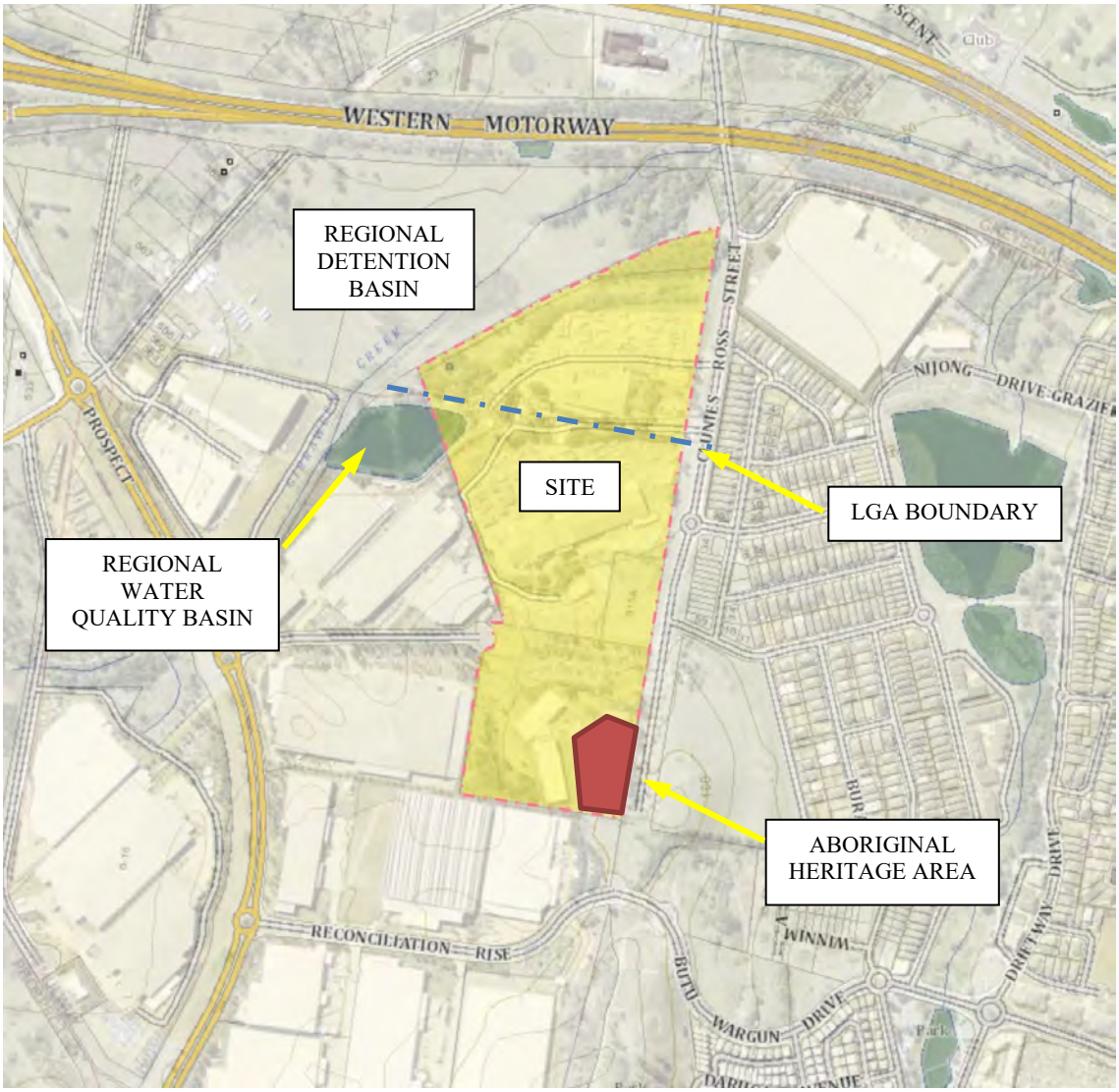

Figure 2.1. Locality Plan

Figure 2.2. Nearmap Image 22 January 2020

2.2 Proposed Development

The proposed development is for an industrial estate, earthworks and infrastructure for future industrial development. The Masterplan Layout has been prepared by SBA Architects and included as **Figures 2.3**.

The proposed development involves construction of seven (7) warehouse buildings with associated office space, car parking, tuck circulation areas and truck loading and unloading areas. Access is proposed from Foundation Place and Clunies Ross Street. Consideration to fire access has been made in the design.

Infrastructure works to facilitate the development will include bulk earthworks, provision of services, internal access driveways, stormwater drainage and stormwater management.

Adjustments to the regional detention basin and wetland systems (which currently encroach on the subject property) are also proposed to remove the encroaching storages from the land. These modifications are proposed to maintain the existing water quality and quantity outcomes of both systems and detailed assessments have been included in this report which set out the proposed modification concepts. Further it is noted that consultation with Blacktown City Council has been made as part of the preparation of the SSDA submission in relation to the intended basin modifications. Refer **Section 5.4**, **Section 6** and **Appendix E**.

The preliminary masterplan layout provided shows development buildings approximately 7,000m^2 and 25,000m^2 in size. Siting of the buildings and development pads will require consideration to the existing topography of the land, access and flood planning requirements.

As noted, the aboriginal heritage area (located on the south-west of the site) will be excluded from the redevelopment of the property and maintained its current form.

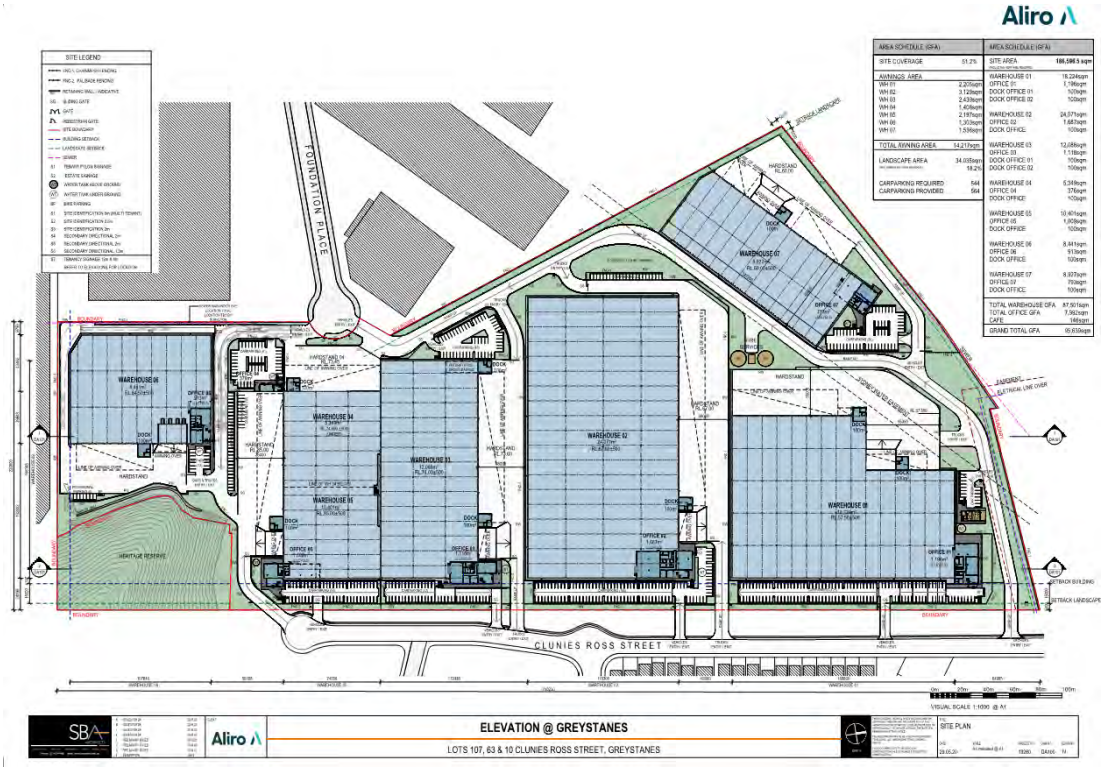

Figure 2.3. Indicative Development Masterplan

3 EARTHWORKS & FOUNDATIONS

3.1 Soil Profile and Geotechnical Considerations

A geotechnical report has been completed by Pells Sullivan Meynink (PSM) dated 11 February 2020. Refer to PSM report for detailed geotechnical information pertaining to the site.

The PSM Geotechnical investigation reference the Penrith 1:100,000 Geological Series Sheet and shows the site to be close to the boundary of the following rock units:

- Prospect Picrite (*Jp*) which typically comprises picrite, dolerite, minor basalt;
- Bringelly Shale of the Wianamatta Group formation (*Rwb*). This group typically comprises shale, carbonaceous claystone, laminate, fine to medium grained lithic sandstone, rare coal and tuff; and
- Qal which typically comprises fine-grained sand, silt and clay.

Engineering properties of the residual clay soils are that they will be moderately reactive, highly plastic subsoils with poor drainage.

Figure 3.1 presents the geological map of the site as included in the PSM report noted above. As noted by PSM, the Dolerite unit (*Jp*) is an intrusion and it is possible for sills and dykes of this material to be located beyond the boundaries depicted in the figure.

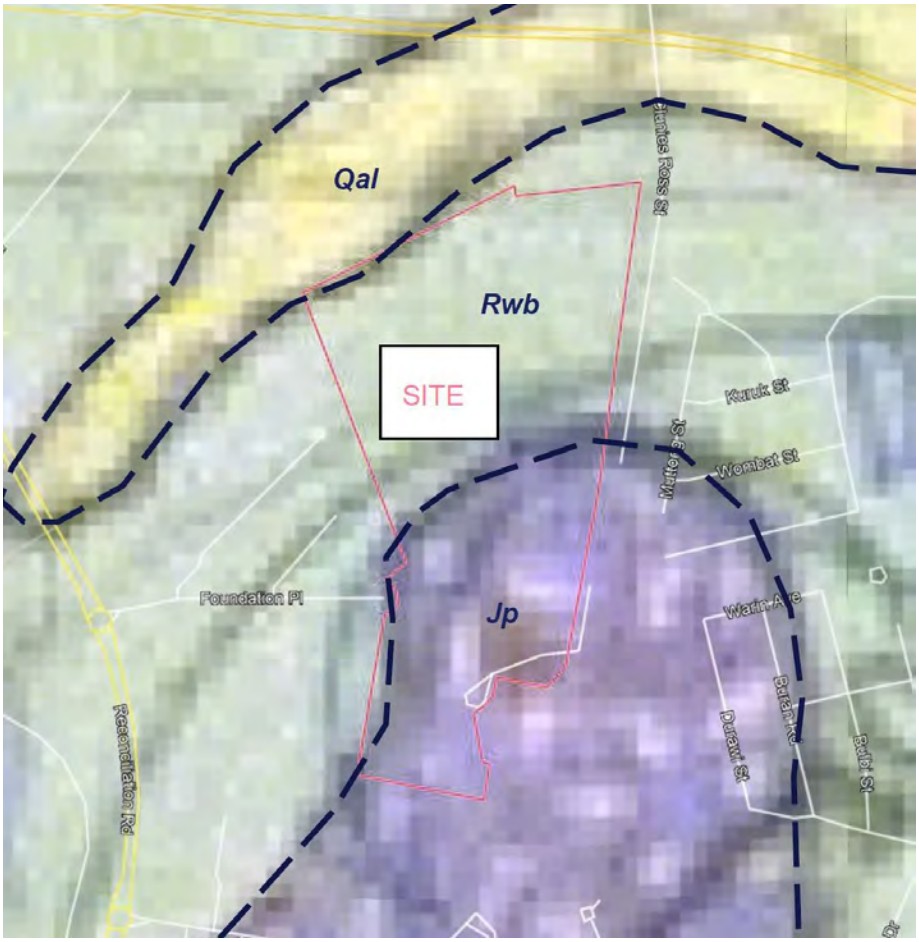

Figure 3.1. Geological Map

3.2 Earthworks

Bulk earthworks will be required to facilitate the development of the estate for industrial use. The earthworks will be undertaken to provide large flat building pads, facilitate site access, to drain the site stormwater via gravity, to minimise off-site export and retaining walls, and to keep building levels above the 1 in 100-year ARI flood level with a minimum freeboard of 500mm.

High level earthworks and volume estimates have been completed and are shown on drawing **Co13251.06-DA30** of **Appendix A**. The earthworks volume estimates are based on a lot layout with flat building pads. The earthworks analysis has been completed to a level of detail to enable general pad levels to be set and to obtain an order of magnitude cut and fill volume estimate.

The earthworks volume estimates are as follows:

Total Cut	- 139, 100 m^3	
Total Fill	+ 263, 000 m^3	
Basin Regrading	- 13, 900 m^3	
RE Wall Backfill	- 75, 800 m^3	
Detailed Excavation (1,500m^3/Ha)	- 26, 400 m^3	
Balance	+ 7, 800 m^3	*(import required.)*

The volume estimate is based on a 36,400m^3 topsoil/ deleterious strip (200mm over the site area) to be either removed from the site, blended or placed and used within non-developable vegetation zones. Given the large volume and associated cost this would impose to dispose the topsoil, geotechnical advice is recommended to confirm options for borrow pit arrangement or blending non-organic topsoil component with site won fill material, so disposal of topsoil is not required. Consideration to the short- and long-term performance of the blended fill, including effect on settlement, soil modulus, CBR and bearing capacity should be made in any geotechnical advice. If high-bay or other settlement sensitive uses are proposed on the site, then topsoil blending should not be adopted.

Consideration to bulking of cut materials including rock and clay materials should be allowed for in detailed engineering cut to fill designs. Bulking of clay would normally be expected to be 4% of the removed volume and rock bulking can be expected in the range of 8-12%.

Given the variance and detailed assessments required to ensure cut to fill balance is achieved and to minimise offsite export, the final levels of buildings will be subject to a variance of plus/ minus 0.5m from those nominated on engineering and architectural submission drawings.

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 10** of this report. All Soil and Sediment Control measures will be performed in accordance with the Landcom document *Managing Urban Stormwater, Soils and Construction (1998) – The Blue Book.*

3.3 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.

Steeper slopes may be adopted for dolerite if encountered subject to geotechnical assessments during works.

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**.

3.4 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.

3.5 Groundwater

The geotechnical investigations undertaken by PSM Geotechnical did encounter groundwater in two of the twelve boreholes undertaken on the site. Groundwater has been described as seepage water and noted at depths of 5.5m and 4.0m below ground level in BH09 and BH10 respectively. It could be expected that groundwater may have some seasonal variation and variation associated with periods of high rainfall.

We confirm that the development does not propose to utilise surface or groundwater water sources. An assessment of the impact on these items is not relevant for the warehouse distribution center construction.

Surface water management, including conveyance of surface runoff, management of water quantity (through on-site detention) and water quantity (through on-site and estate wide management systems using WSUD principles and best practice pollution reduction objectives) has been proposed in the design.

In relation to groundwater affectation, this is expected to be minor and would be managed via proposed on-site stormwater systems. The geotechnical investigations undertaken by PSM noted seepage in only two of the twelve boreholes undertaken hence any interaction with existing groundwater or groundwater flow paths would negligible and hence not be impacted.

3.6 Soil Salinity and Aggressivity

An assessment of the potential for salinity and aggressive soils has been requested as part of the SEAR's requirements.

Reference to the *NSW Land & Water Conservation Acid Sulphate Soils Map* shows the subject land clear of any known occurrence of acid sulphate soils.

The PSM Geotechnical report Section 6) confirms that the majority of soils on the site would be considered to be classified as "non-saline" to "slightly saline", with the exception of one sample which would be classified as "moderately saline".

The information in the PSM report showed that the risk of highly saline or aggressive soils would be considered to be low, and that soil salinity could be managed through typical design and normal best practice engineering completed to industry standards.

4 INFRASTRUCTURE SERVICES

An overview of the existing and proposed infrastructure network layouts is outlined in the following sections. The assessment considers the supply and management of the following services and considerations for the development of the site:

- Potable Water (drinking water);
- Wastewater (sewer);
- Power;
- Natural Gas; and
- Telecommunications.

The information provided in this Report is intended to inform the Master Planners of the opportunities and constraints associated with the provision of infrastructure services to the site. Specifically the report provides the following information:

- Layout and capacity of existing service networks;
- Indicative utility demands for the current development proposals where available;
- Current service infrastructure delivery programs from the primary utility suppliers where available; and
- Service infrastructure assets required onsite.

Location and description of services included in this section are based on review of Dial Before You Dig (DBYD) services diagrams obtained via a DBYD search conducted in March 2020. Refer **Appendix F** for authority provided layout drawings and following descriptions of existing services and requirements for servicing.

4.1 Potable Water (drinking water)

Sydney Water is the servicing authority for potable water.

A 150mm uPVC water main is present in Foundation Place. This main traverses along the southern side of Foundation Place and terminates in the cul-de-sac adjacent to the Lot 107 (former Boral House) street frontage.

A 150mm uPVC and DICL main is located on the eastern side of Clunies Ross Street, north of the intersection with Burraga Way.

There are extensive water mains servicing the residential areas east of Clunies Ross Street, however expect these have limited capacity to service further or additional developments.

It is also noted that Sydney Water has a critical 1200mm SCL IBL trunk watermain (Prospect WP159 Main) with associated elements located within the northern portion of the site. Refer Sydney Water DBYD map in **Appendix F** and Landpartners Pipeline Survey (A2-74855SWAPR dated 17 January 2020) in **Appendix D**. It is noted that this pipeline would not be utilised to service the property however consideration to construction will be required to ensure the continued utilisation of the water main

throughout construction and maintaining structural integrity of the watermain following construction.

It is noted that a meeting has been held between Sydney Water, the developer Aliro, Civil Engineers Costin Roe Consulting and Landpartners, the Sydney Water Service Coordinator on 11 March 2020 to begin consultation in regard to the development over and around the asset. This consultation is noted to be ongoing and works (and approval for the works) will be subject to a separate out of scope built over sewer application.

Potable Water Demand

Typical water demand rates for different land uses are provided in **Table 4.1** below.

Land Use	Design Criteria	Units	Potable Water Demand
Single Dwelling Residential (14 - 17 dwelling/net ha)	Max Day Demand	kL/dwelling/day	2.2
Town House (<30 units/net ha)	Max Day Demand	kL/unit/day	1.6
Multi/ high Rise Units	Max Day Demand	kL/N Floor Ha/day	33.5
Light Industrial	Max Day Demand	kL/N Ha/day	40
Medium Industrial	Max Day Demand	kL/N Ha/day	66
Suburban Commercial	Max Day Demand	kL/N Ha/day	40
City Rise Commercial/ shopping Centre	Max Daily Demand	kL/floor Ha/day	63

Table 4.1 Water Demand Unit Rates

Utilising the light industrial rate of 40kL/ N Ha/day over approximately 94,000m^2 GFA of industrial development, a demand for the estate in the order of 376 kL/day is expected. Studies undertaken by Landpartners indicate that areas such as Glendenning, Arndell Park, Huntingwood and Eastern Creek (all developed as warehouse/ logistic centres) utilise a much lower rate of approximately 15 kL/ N Ha/day. Utilising this rate would result in a demand of 141 kL/day for the estate.

Potable Water Strategy

A feasibility application with Sydney Water would provide a definitive answer as they would be able to assess their current water model to determine the capacity available to service the development. Confirmation of the capacity of the existing system will need to be confirmed initially via a feasibility application and ultimately via a Section 73 Application to Sydney Water performed by a Sydney Water qualified Quickcheck agent.

The strategy and design for the required extension of the system will need to be performed by a Sydney Water Service Coordinator. We provide a high-level discussion relating to the extension of the water main in Clunies Ross Street for the purpose of addressing the SEAR's and SSDA assessments.

The following considerations have been made in the strategy:

- Extending the 150mm main in Clunies Ross Street to provide better frontage of the main to the site;
- Connection to the site from the extended main, subject to final site layout and internal site requirements;
- Potentially connecting the 150mm main to the 250mm main in Reconciliation Rise or to the existing 150mm main in Foundation Place. This would provide bi-directional flow in the case of a main break/ shutdown to the 150mm main. This would be subject to Sydney Water requirements, noting potential difficulty in providing construction between Clunies Ross Street and Reconciliation Rise in relation to Aboriginal Heritage; and
- Potentially a need for cross-connection from the extended 150mm main to the 100mm mains in the Pemulwuy residential estate

A qualified Hydraulic Engineer shall design internal water and fire system water supply to service the proposed development sites. This will be investigated as part of the detailed design and assessed as part of future separate building development applications.

Notwithstanding the further investigations and applications required with Sydney Water, it is considered that water supply will be able to be provided to the development site in the required timeframe.

4.2 Wastewater (sewer)

Sydney Water is the servicing authority for sewage disposal in the suburbs of Greystanes and Pemulway.

There are three wastewater mains in the immediate vicinity of the development site as follows:

- a 225mm VC gravity main is located on the western boundary of Lot 107 at a depth of around 2.0-2.5m below natural levels. The main is shown to run parallel to the western boundary in a north-south direction. At the junction of Foundation Place the main traverses in a westerly direction along the southern side of Foundation Place. An existing site connection to Lot 107 is shown adjacent to the Foundation Place cul-de-sac;
- a 375mm VC gravity main is located on the northern site boundary within Lot 216 at a depth of around 3.7m below natural levels. The main is shown to run parallel to the northern boundary in a south-west to north-east direction.
- A 225mm VC gravity main is located on the north-east boundary of Lot 44 adjacent to Clunies Ross Street. This main then joins the 375mm VC described above just north of the development site before traversing east away from the development area.

Wastewater Service Demand

The design criteria used to forecast future sewer loadings are generally taken from the Sydney Water Area Planning Design Criteria Guide and are expressed as an Equivalent Population for a particular land use. The Average Dry Weather Flow (ADWF) per Equivalent Population (EP) is taken as 180 L/day or 0.0021 L/s (ADWF (L/s) = 0.0021 x EP). Alternatively an estimate of the ADWF can be made based on 80% of the expected potable water demand.

Values for typical development types are summarised in **Table 4.3**.

Item	Units	Adopted Value	Source
Single Dwelling Residential	EP/dwelling	3.5	SWC Area Planning Design Criteria Guide
Medium Density Residential (townhouses up to 4 storeys)	EP/dwelling	3.0	SWC Area Planning Design Criteria Guide
High Density Unit Development (up to 200-400 Bedrooms/ Ha)	EP/Bedroom	0.275	SWC Area Planning Design Criteria Guide
Light Industrial	EP/ha	75	SWC Area Planning Design Criteria Guide
Heavy Industrial	EP/ha	150	SWC Area Planning Design Criteria Guide
Commercial	EP/ha	75	SWC Area Planning Design Criteria Guide
High Density Commercial	EP/ha	300 - 800	WSA 02-2002-2.2
Reserves	EP/ha	20	SWC Area Planning Design Criteria Guide

Table 4.3. Sewer Equiv Population Loading Criteria

An equivalent population (EP) of 685 has been estimated and the discharge per EP rate of 180kL/day results in discharge of 123kL/day. The Average Dry Weather Flow (ADWF) for the project has been calculated based on 90% of the expected 123kL demand. An ADWF of 111 kL/day or 1.3 L/s has been estimated for the development.

Note that the design of sewer mains will apply a peaking factor to the ADWF to get the Peak Daily Dry Weather Flow (PDWF), and include the peak (rainfall dependent) inflow and infiltration and the groundwater (non-rainfall) dependent infiltration. The peaking factor will vary depending on the size of the upstream catchment and would normally be within a range of 2 to 5.

Wastewater Capacity

The existing sewer connections at Foundation Place and the north-east corner of the site adjacent to Clunies Ross Street can be used for connecting development wastewater. The receiving 375mm carrier for the area is expected to be able to cater for the expected discharge rate shown above.

Confirmation of the proposed strategy will need to be performed in conjunction with Sydney Water via a Sydney Water qualified Water Service Coordinator during project application stage.

Notwithstanding the further investigations and applications required with Sydney Water, it is considered that wastewater reticulation will be able to be provided to the development site through connection to the existing infrastructure in Greystanes and Pemulway.

4.3 Power

Endeavour Energy is the servicing authority for energy adjacent to the site.

Existing low voltage supply run overhead along Clunies Ross Street past the subject site and servicing the current Austral Masonry operations on the land. DBYD also shows inground conduits and cable on the eastern side of Clunies Ross Street.

Inground conduits and cable are also present on within Foundation Place. Refer **Appendix F**.

An initial enquiry to the service provider regarding the ability of these cables to service the site, suggests that additional infrastructure will be required to service the site. Endeavour Energy advise that the engagement of a Level 3 Service Provider will be required to further assess the capacity of the existing system and the requirements for the infrastructure to service the proposed development.

Notwithstanding the further investigations and applications required with Endeavour Energy, it is considered that power supply will be able to be provided to the development site from surrounding infrastructure for normal light industrial or logistic type facility development.

4.4 Natural Gas

Jemena is the servicing authority for gas supply adjacent to the site.

Existing underground natural gas reticulation exists on Clunies Ross Street. Low pressure gas mains (110mm PE low pressure) mains service residential areas east of the development area.

100mm ST 1050kPa mains are also present on Clunies Ross Street with site connection which is understood to service existing Austral Masonry operations.

It is expected that demand for gas would only be necessary for a user/ tenant with specific uses for gas, and that generally gas would not be required for the development.

Notwithstanding the further investigations and applications required with Jemena, it is considered that gas supply will be able to be provided to the development site if required for a future specific user. We would expect this to be on an as needs basis for individual lots.

4.5 Telecommunications

Existing local telecommunications services are present on site which service the previous Boral House, and current Austral Masonry operations.

NBN conduits are shown to be located in Foundation Place and Clunies Ross Street.

We expect that the existing local cable network would not have the capacity to service the proposed development and that new underground cabling would be required to suit the project requirements. Normally this would be completed on a project by project basis.

Demand and capacity calculations have not been provided for telecommunications as these are not readily quantifiable like the other services provided. The requirements for telecommunications would need to be formalised via a Telstra Smart Community (or similar) registration.

Notwithstanding the further investigations and applications required with Telstra, it is considered that telecommunication infrastructure will be able to be provided to the estate.

5 WATER CYCLE MANAGEMENT STRATEGY & DRAINAGE METHODOLOGY

5.1 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 SSD 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 assists urban rezoning and estate infrastructure planning for the industrial development proposed on the land.

This WCMS has been prepared to inform the DPIE and Penrith Council 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.

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 5.1** following.

It is noted that the land to the north of the LGA boundary, that is within Blacktown City Council LGA, does not form part of the *Northern Employment Land Precinct* whose controls are governed by the *Part Q – Pemulwuy Industrial Controls - Holroyd Development Control Plan 2013* (refer **Section 5.2**). WCM measures for the land north of the LGA boundary will adopt Blacktown City Council LGA requirements for water quality and quantity as set out in the Blacktown City Council DCP Part J.

Element	Target	Reference
Water Quantity	Ensure that additional stormwater runoff generated by the development does not adversely affect peak flows, velocities and water levels downstream of the site in the full range of flood up to 1 in 100year storm event.	Pemulway Industrial Controls Holroyd DCP Part Q
Water Quality	*Cumberland Council LGA/ Northern Employment Lands* Load-based pollution reduction targets based on an untreated urbanised catchment: Gross Pollutants >5mm 70% Coarse Sediment 80% Fine Sediments 0 % Total Phosphorus 0 % Total Nitrogen 0 % Total Hydrocarbons 90% *Blacktown Council LGA Land* Load-based pollution reduction targets based on an untreated urbanised catchment: Gross Pollutants 90% Total Suspended Solids 85% Total Phosphorus 65% Total Nitrogen 45% Total Hydrocarbons 90%	Source Controls - Section 7.3 and Table 1 of *Pemulway Industrial Controls Holroyd DCP Part Q* Blacktown City Council DCP Part J
Flooding	Buildings and road set 500mm above 1% AEP. No affectation to upstream downstream or adjoining properties as a result of development	Pemulway Industrial Controls Holroyd DCP Part Q Blacktown City Council NSW Floodplain Development Manual. Pemulway Industrial Controls Holroyd DCP Part Q Blacktown City Council DCP Part J
Water Supply	Ensure reduced demand for imported mains water by water conservation measures and re-use of stormwater in accordance with the principles of Water Sensitive Urban Design Reduce non-potable water supply demands by 80%.	Pemulway Industrial Controls Holroyd DCP Part Q Blacktown City Council

Erosion and Sediment Control	Appropriate erosion and sedimentation control measures must be described in the environmental assessment for all stages of construction to mitigate potential impacts downstream waters in accordance with Landcom Blue Book.	Landcom Blue Book Penrith City Council DPI
Waterway and Stream Health	Maintain pre and post development flows within Girraween (Greystanes) Creek.	Pemulway Industrial Controls Holroyd DCP Part Q

Table 5.1. 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 6)***

  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.

  As discussed in earlier sections of the report, an existing regional basin is located to the north of the site, managed by Blacktown City Council. The existing basin has an active storage of approximately 100,000m^3 during the 1% AEP storm and attenuates a catchment with an area of approximately 167Ha including the 84 Ha associated with the Northern Employment Land precinct.

  Attenuation of stormwater runoff from the development will be managed via the regional detention basin. Modification of the existing detention basin is proposed to relocate existing storage which encroaches the site, and to increase the capacity of the basin to include discharge attenuation from the portion of the site which sits within the Blacktown Council LGA and does not form part of the current Northern Employment Lands. The proposed modification to the regional system was discussed with Blacktown City Council in a meeting held on 17 September 2019. During the meeting it was noted that council would accept the adjustment subject to key criteria and technical items being assessed and confirmed. Refer meeting minutes included in **Appendix E**.

  Reference to drawing **Co13251.06-DA47** shows the configuration for the proposed modification to the basin. It is proposed to provide additional storage on the northern side of the basin to provide compensation for lost storage and provide additional storage for the northern portion of the PLE land within Blacktown Council LGA.

  No on-lot detention systems are required or proposed for the PLE.

  Refer to **Section 6** of the document for assessment of the detention system modification.

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

  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 5.1** of this document and MUSIC modelling has been completed to confirm the reduction objectives can be met for the development and precinct overall.

  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 within the Northern Employment Land Precinct (Holroyd DCP Part Q) will require primary treatment via gross pollutant trap (GPT's) prior to discharge. Development sites within DCP Part Q precinct require primary treatment of litter, gross pollutants, course sediment and hydrocarbons. Tertiary treatment will be made within the wetland area.
  - The development area within Blacktown City Council LGA will require full on lot treatment which meets councils DCP Part J pollution reduction targets (refer **Table 5.1**).

  Refer to stormwater management drawings in **Appendix A** should be made, in particular drawing **Co13251.06-DA40** which provides and overall summary of stormwater management provisions for the development.

  Reference to **Section 7** of this document should be made for detailed Stormwater Quality modelling and confirmation of measures proposed.

- *Flood Management (refer **Section 8**)*

  The proposed development considered flooding and large rainfall events from the adjacent regional basin and Girraween Creek.

  The following measures have been incorporated in the design:

  - All buildings are sited 500mm above the 1% AEP design flood level of the regional detention basin.
  - Development is clear of the 1% AEP flood extents;
  - Requirements of Council DCP have been met regarding works in and around flooding areas;
  - Stormwater detention measures (via regional basin) have been included to manage pre and post development runoff as discussed above and in **Section 6**; and
  - Overland flow paths to manage runoff in large storm events have been made including achieving at least 500mm freeboard to building levels from the flow paths.

- *Water Demand Reduction/ Rainwater Reuse*

  Rainwater reuse measures will be provided as part of future building development designs. Rainwater reuse is proposed to reduce demand on non-potable uses by at least 50%, with a target of 80%. The reduction in demand will target non-potable uses such as toilet flushing and irrigation. **Refer Section 7.4**.

- *Waterway Health*

  The receiving waterway is noted to be Girraween Creek, previously referred to as Greystanes Creek. As required of Pemulway Industrial Controls Holroyd DCP Part Q stream health would be maintained through confirmation of post development peak flows and duration of flow being consistent with pre-development conditions. Refer Section 6 for confirmation of pre and post development flows in and around the regional detention system and Girraween Creek.

5.2 Existing Precinct and Regional Drainage Systems

An existing regional detention basin and water quality system services the Greystanes Northern Employment Lands in which the majority of the proposed development site is located. The regional measures are generally described in *Part Q – Pemulwuy Industrial Controls - Holroyd Development Control Plan 2013.*

The *Part Q DCP* confirms the measures provided for the *Northern Employment Land Precinct*, with the general arrangement as shown in **Figure 5.1** below, and current as constructed systems shown in **Figures 5.2** & **5.3**. *Appendix A* of the *Part Q DCP* describes the measures required for individual development sites and the measures provided at a regional level.

In terms of stormwater quantity management, a regional basin is located to the north of the site in Girraween Creek as shown in **Figure 5.4 & 5.5**. This basin comprises an active storage volume in the range of 100,000m^3 during the 1% AEP event and attenuates stormwater flows from a 167 Ha catchment including the 84 Ha Northern Employment Lands Estate and includes the subject development. No additional on-site measures are necessary to achieve compliance with water quantity or on-site detention requirements. Refer to **Appendix G** which includes work as constructed drawings of the basin as provided by Blacktown City Council. The basin is shown to include a downstream control consisting of a weir at RL 56.2m, spillway at RL 55.2m AHD a 1050mm Class 2 RCP outlet culvert, and 4m wide basin drain through the base of the excavated earth detention area.

In terms of water quality, the constructed wetland (refer **Figure 5.1, 5.2** and **5.3**) provides tertiary water quality treatment for the Northern Employment Lands Estate. The wetland targets fine sediments and nutrients which are not treated by lot treatment measures. Individual lots require gross pollutant trap (GPT) which targets coarse sediments, hydrocarbons, oil and grease, and litter.

Figure 8: The constructed wetlands- Pemulwuy North Employment Lands

Figure 5.2. Excerpt: Figure 8 from Part Q DCP2013 – Wetland Location

gure 9: The constructed wetland and riparian corridor Pemulwuy North Employment lands

Figure 5.3. Excerpt: Figure 9 from Part Q DCP2013 – General Arrangement

Figure 5.4. As Constructed Stormwater Management Systems

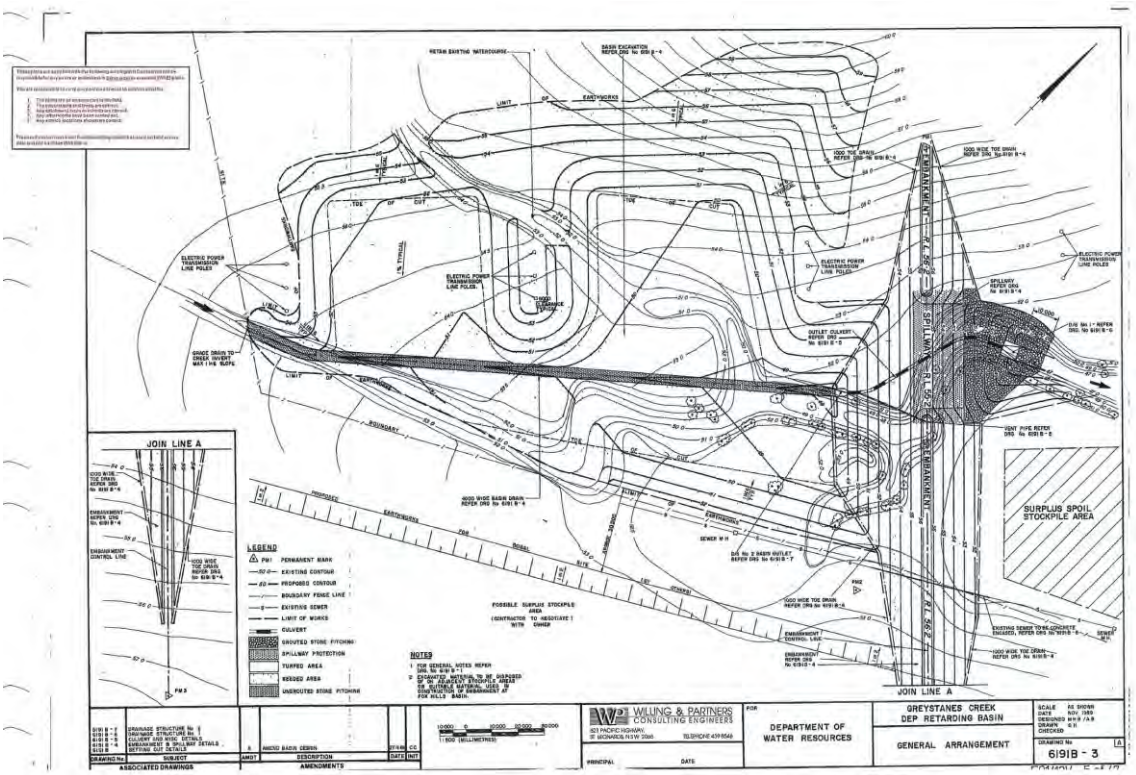

Figure 5.5. Work As Constructed General Layout of Regional Basin

5.3 Proposed Estate Drainage System

As per general engineering practice and relevant council and state guidelines, 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 points of discharge.

The minor system will consist of a piped drainage system which is designed to convey runoff from a 1 in 20-year ARI design storm event (Q20). 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 to the regional detention basin.

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, the Holroyd Council Part Q DCP for areas within the Pemulway Northern Employment Lands and the standards of Blacktown City Council for areas within Blacktown City Council LGA, 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 to ensure that any increase in the detrimental effects of pollution are mitigated, Water Quality Objectives are met and that the demand on potable water resources is reduced.

The legal point of discharge is a point specified by Council 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, or regional detention system.

Legal discharge for the entire development is via:

- Existing trunk drainage in Foundation Place, or to the wetland on the west/ north-west of the site for areas within the Pemulway Northern Employment Lands: or
- Directly to the regional detention system (for areas within Blacktown City Council LGA).

The design and construction of any new outlet structures will be assessed in accordance with the NSW Office of Water document *Controlled Activities: Guidelines for Outlet Structures.*
The stormwater outlets to the regional basin will need to consist of a reinforced concrete pipe and 'natural' energy dissipater. The outlet is to be aligned with the creek to remove the potential for bank scour and shall include rip rap energy dissipaters constructed in accordance with the Outlet Structures Guidelines as published by the Department of Water & Energy and The Blue Book. The arrangement is shown figuratively below in **Figure 5.4** below.

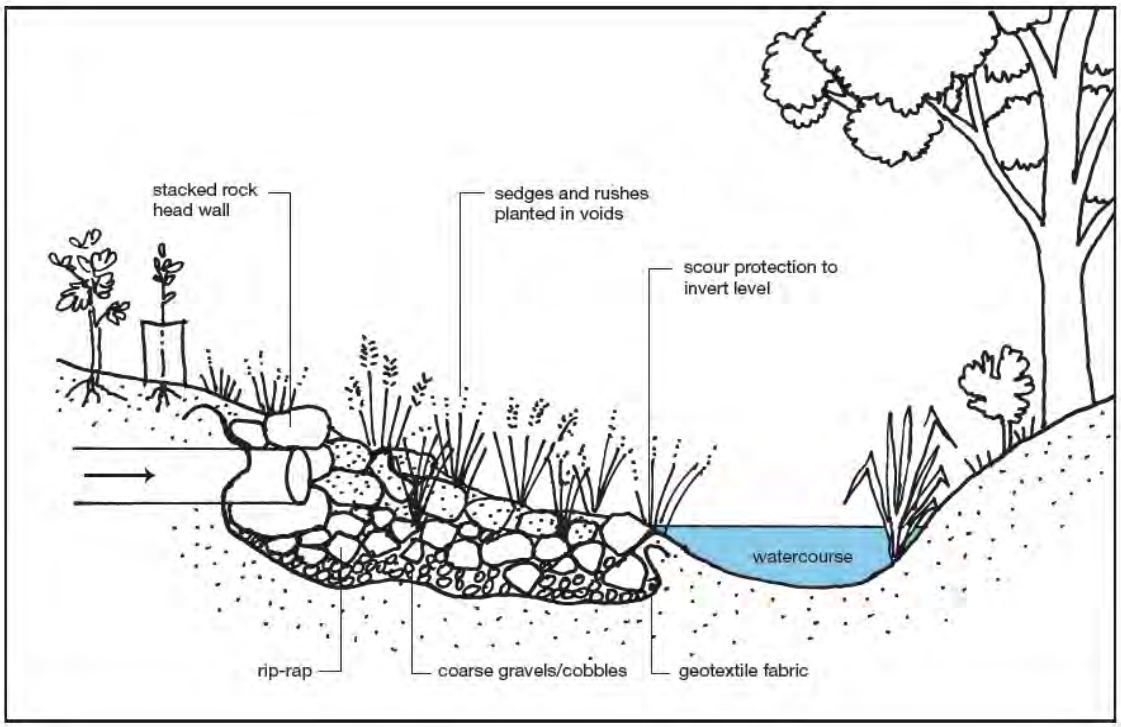

Figure 5.4. Typical Natural Outlet Structure Components

5.4 Proposed Modifications to Precinct Wetland and Regional Detention Systems

As discussed in this report, it is proposed that modifications be undertaken to the existing precinct wetland and regional detention systems described in **Section 5.2** and shown in **Figure 5.2**.

The modifications are proposed to remove the areas of the existing systems which currently encroach on the subject land. The proposed modifications have been shown on drawings **Co13251.06-DA40** and **DA47** as included in **Appendix A**.

The modifications proposed to the existing wetland will maintain the existing wetland pond treatment efficiency. This would be achieved through maintaining the existing surface area and volume by filling a portion of the eastern end of the pond and providing compensatory storage and area on the northern side of the pond. Consideration to maintaining existing discharge and inlet structures, and also maintaining maintenance access points has been made in the proposed concepts included in the drawings noted above. It is noted the existing area of the pond is approximately 9500m^2, with a permanent volume of approximately 11,400m^3 based on a nominal 1.2m depth. The effectiveness of the existing regional system has not been assessed as part of this SSDA.

The modifications to the existing detention system involved filling of the site on the northern boundary of the property and providing compensatory storage to an area on the northern side of the detention system. Additional storage is also proposed to be introduced to the system to enable discharge of the portion of the site within Blacktown City Council LGA to discharge directly to the basin. This additional storage would be provided at a rate of 455m^3/Ha as required of Blacktown City Council LGA.

Detailed assessment of the storage/ discharge for the existing detention system and proposed modified system has been made and included in **Section 6** of this report. The proposed modification to the regional system was discussed with Blacktown City Council in a meeting held on 17 September 2019 at Blacktown City Council offices. During the meeting it was noted that council would support the adjustment subject to key criteria and technical items being assessed and confirmed. Refer meeting minutes included in **Appendix E**.

5.5 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 during a 1% AEP event. 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 modification) 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.

In relation to impact on the development from the adjacent regional detention system. A conservative estimate of the effect from an increase in rainfall intensity of 10% and a consistent flow rate increase would result in the 1% AEP flows increasing by a similar 10% amount. With reference to Table 6.9, this increased flow rate can be seen to be generally consistent with a 0.5% AEP event and less than the 0.2% AEP. As requested in the SEAR's an assessment of the 0.2% AEP and 0.5% AEP was to be included as a proxy for the effect of climate change. Reference to **Section 6** of the report should be made for an assessment of the detention basin for the noted AEP events. Based on the modelling completed for the 0.5% AEP, the effect from climate change (and considering the proposed modification to the basin) would result in an overall increase of 0.2m from the current 1% AEP. That is an increase in water level from RL 55.1m to 55.3m AHD.

Overall, flood immunity of the extreme western development sites would not be compromised given a large available freeboard amount much larger than minimum 0.5m values generally adopted.

The site is 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.

An assessment on the regional 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 WATER QUANTITY MANAGEMENT

6.1 General Design Principles & Methodology

Water quantity management, also known as "On-site Detention (OSD)", is required to be considered for this development to ensure the cumulative effect of development and urbanisation does not have a detrimental effect on the existing stormwater infrastructure and watercourses located downstream of the site.

With reference to **Sections 5.2** and **5.4** of this report and drawings in **Appendix A**, the existing regional detention system located to the north of the subject property is proposed to be utilised for the management of water quantity for the future development, and that a modification to the basin will be made to relocate detention storage which currently encroaches the subject property, and increase the storage to account for the portion of the development which falls within Blacktown City Council LGA.

A hydrological analysis of the regional detention system has been undertaken to confirm the effectiveness of the existing and the proposed modified detention system. The existing basin configuration is noted to be based on Work As Executed drawings (refer **Appendix G**) provided by Blacktown City Council, detail survey and lidar survey information.

In order to assess the existing and operational phase peak discharges from the development precinct, a RAFTS model hydrological model was used to estimate peak flows from catchments on the site for various storm durations as follows:

- 5% AEP (1 in 20yr ARI)
- 1% AEP (1 in 100yr ARI)
- 0.5% AEP (1 in 200yr ARI)
- 0.2% AEP (1 in 500yr ARI)
- PMF

RAFTS modelling has been undertaken using the following initial and continual losses in **Table 6.1**, consistent with Blacktown City Council recommended modelling parameters.

Catchment Type	Initial Loss (mm)	Continued Loss (mm/hr)
Pervious	15	2.5
Impervious	5	0

Table 6.1. Initial and Continued Loss for RAFTS Model

The detention system was then modelled in DRAINS to confirm water levels, storage and discharge relationships as noted above.

Further, the assessment has been utilised to confirm flood levels and flood conditions for the development which are further discussed in **Section 8**.

6.2 Catchment & Hydrological Assessment

A review of the existing catchment which drains to the regional detention system has been made. With reference to **Figure 6.1** below, it is estimated that 83.77 Ha from the Pemulway Employment lands, 76.47 Ha upstream of the Pemulway Employment Lands, 6.8 Ha from surrounding landform of the basin and the basin itself, and an area of 7.41 Ha from the Austral land within Blacktown Council LGA area. It is noted that the Austral land bypasses the Pemulway Employment Land wetland, however currently discharges directly to the regional basin.

The total area managed by the detention system is noted to be 173.55 Ha in the pre-development and post development conditions.

Figure 6.1. Regional Detention System Catchment Layout

6.3 Assessment of Existing Detention System

Table 6.1 shows the existing stage storage arrangement for the existing basin used in the assessment. Values have been assessed at 1.0m increments based on existing topography and basin WAE plans in **Appendix G**.

R.L. (m AHD)	Depth (m)	S.A. (m^2)	Volume (m^3)	Cum. Volume (m^3)
47.4	0	0	0	0
48	0.6	80	48	48
49	1.6	160	160	208
50	2.6	3285	3285	3493
51	3.6	9898	9898	13391
52	4.6	17307	17307	30698
53	5.6	22282	22282	52980
54	6.6	29506	29506	82486
55	7.6	43135	43135	125621
56	8.6	71080	71080	196701
56.5	9.1	81501	40751	237452
57	9.6	97169	48585	286036

Table 6.1. Existing Stage Storage Values

Table 6.2 to **6.4** shows the overall hydrology, storage and water levels for the detention systems for the regional basin. Output for the 5% AEP (1 in 20yr ARI), 1% AEP (1 in 100yr ARI), 0.5% AEP (1 in 200yr ARI), 0.2% AEP (1 in 500yr ARI) and PMF events have been included in the table. Flows and storages are provided for the critical peak inflow storm duration of 2 hours and the critical active storage storm which has a duration of 9 hours.

AEP	Flow In (m^3/s)	Flow Out (m^3/s)			Storage Volume (m^3)	Water Level (m AHD)
		Low Flow	High Flow	Total		
5	43.524	5.45	0	5.45	64824	54
1	55.639	5.853	0	5.853	91364	54.8
0.5	63.021	6.016	0	6.016	105276	55
0.2	71.755	6.177	0	6.177	121867	55.4

Table 6.2. Existing Precinct Hydrology, Basin Storage Volume and Water Level (2-Hour)

AEP	Flow In (m^3/s)	Flow Out (m^3/s)			Storage Volume (m^3)	Water Level (m AHD)
		Low Flow	High Flow	Total		
5	21.472	5.633	0	5.633	75662	54.3
1	25.16	6.093	0	6.093	112710	55.2
0.5	27.412	6.287	0	6.287	135232	55.7
0.2	29.859	6.451	0	6.451	158724	56

Table 6.3. Existing Precinct Hydrology, Basin Storage Volume and Water Level (9-Hour)

Duration	Flow In (m^3/s)	Flow Out (m^3/s)			Storage Volume (m^3)	Water Level (m AHD)
		Low Flow	High Flow	Total		
2hr	117.935	6.957	72.973	79.930	258203	57.15
6hr	65.175	6.88	54.879	61.759	239953	57

Table 6.4. Existing Precinct Hydrology, Basin Storage Volume and Water Level for PMF

Low flow values represent flows within the 1050mm RCP culvert and high flow represents flow over the basin spillway. Refer **Appendix G** and **Section 5.2** relating to existing basin configuration.

The modelling has shown that the existing detention system attenuates stormwater from the precinct and surrounding catchments to pre-development values, an active storage of m3 is achieved in the 1% AEP and that a water level in the 1% AEP is RL 55.01m AHD and in the PMF is 56.43m AHD. It is noted that in the 1% AEP the overflow weir is not activated with the water level being approximately 0.2m below the weir level of RL 55.2m.

Detention storage is noted to be fully active. It is also noted that, based on the 1% AEP volume of 101,920m^3 and contributing catchment of approximately 173 Ha, that a storage rate of 610m^3/Ha is achieved. This is noted to exceed council's current minimum storage rate of 455m^3/Ha by more than 30% for new detention systems within Blacktown City Council LGA.

During a PMF event the basin weir (in addition to the spillway) is predicted to overflow a depth of 0.25m and a duration of 2 hours.

6.4 Assessment of Modified Detention System

Table 6.5 shows the modified stage storage arrangement for the proposed basin arrangement used in the assessment. Values have been assessed at 1.0m increments based on proposed geometry in **Appendix A**. Review of the differences in volumes shows that the modified basin is generally consistent with the existing basin storage construction.

R.L. (m AHD)	Depth (m)	S.A. (m^2)	Volume (m^3)	Cum. Volume (m^3)
47.4	0	0	0	0
48	0.6	80	48	48
49	1.6	160	160	208
50	2.6	3285	3285	3493
51	3.6	9898	9898	13391
52	4.6	19595	19595	32986
53	5.6	25020	25020	58006
54	6.6	29506	29506	87512
55	7.6	37533	37533	125045
56	8.6	61355	61355	186400
56.5	9.1	68181	34091	220491
57	9.6	98373	49187	269677

Table 6.5. Modified Stage Storage Values

Table 6.5 shows the overall hydrology, storage and water levels for the proposed modification of the regional detention system. Output for the 5% AEP, 5% AEP (1 in 20yr ARI), 1% AEP (1 in 100yr ARI), 0.5% AEP (1 in 200yr ARI), 0.2% AEP (1 in 500yr ARI) and PMF events have been included in the table. Flows and storages are provided for the critical storm duration of 2 hours.

AEP	Flow In (m^3/s)	Flow Out (m^3/s)			Storage Volume (m^3)	Water Level (m AHD)
		Low Flow	High Flow	Total		
5	43.525	5.372	0	5.372	65599	53.8
1	55.658	5.814	0	5.814	92281	54.7
0.5	63.05	6	0	6	105968	55
0.2	71.853	6.182	0	6.182	122107	55.3

Table 6.6. Proposed Precinct Hydrology, Basin Storage Volume and Water Level (2hr duration)

AEP	Flow In (m^3/s)	Flow Out (m^3/s)			Storage Volume (m^3)	Water Level (m AHD)
		Low Flow	High Flow	Total		
5	21.52	5.573	0	5.573	76810	54.1
1	25.374	6.091	0	6.091	113568	55.2
0.5	27.476	6.307	0	6.307	135554	55.7
0.2	29.712	6.485	0	6.485	158222	56

Table 6.7. Proposed Precinct Hydrology, Basin Storage Volume and Water Level (9hr duration)

Duration	Flow In (m^3/s)	Flow Out (m^3/s)			Storage Volume (m^3)	Water Level (m AHD)
		Low Flow	High Flow	Total		
2hr	118.653	6.958	73.279	80.237	244949	57.16
6hr	65.477	9.884	55.72	65.604	226593	57

Table 6.8. Post Development Precinct Hydrology, Basin Storage Volume and Water Level for PMF

Low flow values represent flows within the 1050mm RCP culvert and high flow represents flow over the basin spillway.

The modelling has shown that the modified detention system attenuates stormwater from the precinct and surround catchments to the pre-development values. An active storage of 108,654m^3 and 108,654m^3 is achieved in the 1% AEP 2-hour and 9-hour storm events with a corresponding water level of RL 54.75m and 55.00m AHD respectively.

In the PMF storm, an active storage of 185,593m^3 and 173,383m^3 is achieved in 2-hour and 6-hour storm events with corresponding water levels of RL 56.45m and 56.30m AHD respectively.

6.5 Comparison of Pre and Post Development Detention System

A comparison of pre and post development storages, discharge rates and water levels for the various AEP events, and PMF event has been completed as shown in **Table 6.9**.

It is noted that comparison of the 1% AEP is most relevant for impact assessments, however the 0.5% and 0.2% being considered in the SEAR's as being proxy for climate change have also been included.

Review of differences in PMF have been made with respect to safety and Dam Safety Committee requirements.

AEP	Time	Peak Discharge (m^3/s)			Storage Volume (m^3)			Water Level (m)		
	(hrs)	Pre	Post	Diff.	Pre	Post	Diff.	Pre	Post	Diff.
5	2	5.45	5.372	-0.078	64824	65599	775	54	53.8	-0.20
5	9	5.633	5.573	-0.060	75662	76810	1148	54.3	54.1	-0.20
1	2	5.853	5.814	-0.039	91364	92281	917	54.8	54.7	-0.10
1	9	6.093	6.091	-0.002	112710	113568	858	55.2	55.2	0.00
0.5	2	6.016	6	-0.016	105276	105968	692	55	55	0.00
0.5	9	6.287	6.307	0.020	135232	135554	322	55.7	55.7	0.00
0.2	2	6.178	6.182	0.004	121867	122107	240	55.4	55.3	-0.10
0.2	9	6.451	6.485	0.034	158724	158222	-502	56	56	0.00
PMF	2	101.444	102.351	0.907	258203	244949	-13254	57.15	57.16	0.01
PMF	6	61.759	62.604	0.845	239953	226593	-13360	57	57	0.00

Table 6.9. Pre and Post Development Output and Differences (2hr duration)

Review of **Table 6.9** shows that pre and post development discharge, storage volumes and water levels are generally consistent, or a reduction in flow and water level is achieved, between the pre and post development conditions, allowing for the proposed modification to the existing detention basin for all AEP events assessed.

Water levels can be seen to be reduced by 0.1m for the 1% to 0.2% AEP events, and by 0.2m in the 5% AEP. Peak flows are also noted to be slightly lower in all AEP events, however extent of duration of flow for all events is shown to be generally consistent.

Review of change during the PMF event has been made. Although this criteria is not normally required for impact from development, given the basin is a prescribed dam, consideration to operation of the basin for dam break and downstream safety during larger than normally assessed events to the PMF events is necessary to be made. Review of **Table 6.9** shows a minor increase in total flow is noted in the PMF event.

The duration and velocity associated with the minor increase in total flow over the weir during the PMF event has been made. This review of the pre and post development duration of flow over the basin weir shows that a post-development duration of approximately 181 minutes in the 2hr event and 344 minutes in the 9 hour event and a reduction of flow time over the weir of 6.6 minutes and 4.5 minutes respectively (refer **Table 6.10)**. Further the pre and post development velocities of the flow are equal, hence. Given the reduction in overall duration of flow over the weir, and no increased velocity, the minor increase in flow is considered to result in negligible impact due to development and consistent pre and post development operation of the basin during the PMF event.

AEP	Time (hrs)	Velocity (m/s)			Flow Time (mins)		
		Pre	Post	Diff.	Pre	Post	Diff.
PMF	2	1.737	1.728	-0.009	188	181	-6.6
PMF	6	1.559	1.565	0.006	348	344	-4.5

Table 6.10. Pre and Post Development Output and Differences, Spillway Velocity and Flow Time

Table 6.11 shows the velocity and flow time difference over the embankment due to a 2hr PMF storm event.

AEP	Time (hrs)	Velocity (m/s)			Flow Time (mins)		
		Pre	Post	Diff.	Pre	Post	Diff.
PMF	2	0.087	0.090	0.002	73	75	2.7

Table 6.11. Pre and Post Development Output and Differences, Embankment Velocity and Flow Time

Based on the modelling and assessment completed, it can be confirmed that the proposed modification of the basin results in consistent operation of the basin for inflow, outflow, water levels and storage. Thus, the proposed modification is considered to be acceptable and meets councils recommended criteria for the basin modification.

It is further noted that duration of flow within Girraween Creek is also noted to be consistent or less than predevelopment. Stream health and other associated ecological considerations as such would remain consistent, hence not impacted, following the development.

For further discussion relating to flooding and flood planning refer to **Section 8** of this report.

7 STORMWATER QUALITY CONTROLS

7.1 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 to minimise the adverse impact these pollutants could have on receiving waters and to also meet the requirements specified by Cumberland (Holroyd) Council and Blacktown City Council.

Reference to **Section 5.1**, **Table 5.1** should be made for water quality criteria achieved for the development, noting differing requirements and strategy employed for areas within Cumberland City Council LGA (subject to Holroyd Council Part Q DCP) and those within Blacktown City Council LGA (subject Blacktown City Council DCP 2015 Part J).

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 in **Table 5.1** are met.

7.2 Proposed Stormwater Treatment System – Areas within Cumberland Council LGA

Provision for water quality for areas within Cumberland City Council LGA will be provided in accordance with the requirements for individual development lots set out as "*Source Controls" in* Section 7.3 and Table 1 of *Part Q – Pemulwuy Industrial Controls - Holroyd Development Control Plan 2013.* The pol

Components of the treatment train for areas within Cumberland Council LGA are as follows:

- Primary treatment of runoff from the development sites via a vortech style GPT (CDS or equivalent).
- A portion of the future building roofs will also provide a level of treatment via rainwater reuse and settlement within the rainwater tank. Given however that building layouts are subject to change during detail design, allowance for rainwater tank within the MUSIC model has not been made.

The maintenance of the water quality measures (gross pollutant traps) will be made by the estate at no cost or burden to council. Further discussion on maintenance are contained in **Section 7.7** of this document.

7.3 Proposed Stormwater Treatment System – Areas within Blacktown Council LGA

Provision for water quality for areas within Blacktown City Council LGA will be provided in accordance with the requirements for individual development lots set out as DCP 2015 Part J.

Components of the treatment train for areas within Blacktown City Council LGA are as follows:

- Primary treatment of runoff to be treated via pit inserts. These pit inserts will provide treatment for gross pollutants, course sediments, some fine sediments, some nutrients and some hydrocarbons.
- Tertiary treatment of runoff will be provided via proprietary filtration system produced by Ocean Protect. The syfon actuated filtration system will treat fine and course sediments, nutrients and hydrocarbons.
- 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 will be made by the estate at no cost or burden to council. Further discussion on maintenance are contained in **Section 7.7** of this document.

7.4 Stormwater Quality Modelling

7.4.1 Introduction

The MUSIC model was chosen to model water quality. The MUSIC 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 **Section 5.1** of this report were used as a basis for assessing the effectiveness of the selected treatment trains.

The MUSIC model "*13251.06 Prospect Logistic Rev 1.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**.

7.4.2 Rainfall Data

Six-minute pluviographic data was provided by BCC which has been 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
Evapotranspiration	Sydney Monthly Areal PET
Model Timestep	6 minutes

7.4.3 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

7.4.4 Pollutant Concentrations& Source Nodes

Pollutant concentrations for source nodes are based on the land use parameters defined by the nearby Blacktown City Council and are shown as per the **Table 7.1**:

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	*	*	*	*	*	*
	Roads	*	*	*	*	*	*
	Landscaping	1.2	0.17	-0.85	0.19	0.11	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
	Landscaping	2.15	0.32	-0.6	0.25	0.30	0.19

*Base flows are only generated from pervious areas; therefore these parameters are not relevant to impervious areas.

Table 7.1. Pollutant Concentrations

The MUSIC model has been setup with a treatment train approach based on the pollutant concentrations in **Table 7.1** above and the catchments shown on drawing **Co13251.06-DA40** in **Appendix A**.

7.4.5 Treatment Nodes

GPT, pit insert, filtration and rainwater tank treatment nodes have been used in the modelling of the development.

Modelling parameters as per Blacktown City Council WSUD technical requirements have been adopted for the modelling assessment.

7.4.6 Results

Tables 7.2 and **7.3** show 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	% Required
Total Suspended Solids (kg/yr)	24000	7670	68.1	0
Total Phosphorus (kg/yr)	42	29.2	30.3	0
Total Nitrogen (kg/yr)	186	176	5.4	0
Gross Pollutants (kg/yr)	2090	49.9	97.6	80

Table 7.2. MUSIC analysis results – Areas within Cumberland Council LGA

	Source	Residual Load	% Reduction	% Required
Total Suspended Solids (kg/yr)	13100	1680	87.2	85
Total Phosphorus (kg/yr)	22.9	8.01	65.1	65
Total Nitrogen (kg/yr)	97.4	53.4	45.2	45
Gross Pollutants (kg/yr)	1100	0	100	90

Table 7.3. MUSIC analysis results – Areas within Blacktown Council LGA

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 pollution reduction requirements on an overall catchment basis.

7.4.7 Modelling Discussion

MUSIC modelling has been performed to assess the effectiveness of the selected treatment trains.

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 Cumberland and Blacktown City Councils have been met.

7.5 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 will be provided for this development with re-use for non-potable applications as part of future individual building development 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 BCC DCP Part J.

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 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.

Rainwater tanks have been designed, using MUSIC software to balance the supply and demand, based on the below base water demands to provide a minimum 50% reduction in non-potable water demand with a target of 80% as set out in WCM's included in **Table 5.1**.

7.5.1 Internal Base Water Demand

Indoor water demand has been based on Section 7.11 of Blacktown Council DRAFT MUSIC Modelling Guideline 2013 for an industrial/ commercial development. Section 7.11 requires an allowance of 0.1kL/day/ toilet or urinal. No allowance is required for disable toilets.

The above rates result in the following internal non-potable demand:

Warehouse 1	23 Toilets	2.3 kL/day
Warehouse 2	30 Toilets	3.0 kL/day
Warehouse 3	21 Toilets	2.1 kL/day
Warehouse 4	14 Toilets	1.4 kL/day
Warehouse 5	15 Toilets	1.5 kL/day
Warehouse 6	18 Toilets	1.8 kL/day
Warehouse 7	18 Toilets	1.8 kL/day

7.5.2 External Base Water Demand

The external base water demand has also been based on Section 7.11 of Blacktown Council DRAFT MUSIC Modelling Guideline 2013 for an industrial/ commercial development. Section 7.11 requires an allowance of 0.3kL/year/m^2 as PET-Rain for subsurface irrigation.

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

Irrigated Area (0.3kL/year/m^2)	1.33m^2	0.4 kL/year
TOTAL		**0.4 kL/year**

7.5.3 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 MUSIC software to balance the supply and demand, based on the calculated base water demands and proposed roof catchment areas. Allowances in the MUSIC model have been made for high flow bypass which will be managed by a dual high flow (225mm downpipe) and low flow (100mm downpipe) roofwater collection configuration along a portion of the southern elevation of the warehouse. This has been shown on drawing **Co13251.06-DA40**.

Roof Catchment (m^2)	Highflow Bypass (l/s)	Tank Size in MUSIC (kL)	Predicted Demand Reduction (%)	Provided Tank (kL)
1	0	100	81.08	120
2	0	120	81.22	150
3	0	100	78.43	120
4	0	80	79.34	100
5	0	80	78.85	100
6	0	80	76.67	100
7	0	80	76.67	100

Table 7.4. Rainwater Reuse Requirements

The MUSIC model, results summarised in **Table 7.4**, predicts that the reductions in demand of 50% minimum with an 80% target can be met for the development with the provision of rainwater tanks noted.

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

7.6 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 7.5** 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 7.5. 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.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
GROSS POLLUTANT TRAPS			
Per manufacturers Operational & Maintenance Manuel requirements	Per manufacturers Operational & Maintenance Manuel requirements. Six to twelve monthly maximum or after major storm.	Maintenance Contractor	Per manufacturers Operational & Maintenance Manuel requirements
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 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.

8 FLOODING

8.1 Flooding Introduction

Consideration to flooding is required due to the proximity to the regional detention system and Girraween / Greystanes Creek located to the north of subject property.

As required by the SEAR's, a comprehensive flood assessment is required for the development. As described in previous parts of this report, the existing regional basin will be modified to address existing encroachment of basin storage on the northern boundary of the subject land.

8.2 Existing Flood Affectation

The approximate flood extent, as shown on Blacktown City Council online flood mapping per **Figure 8.1** below.

A formal application to council has been made to confirm council flood levels and to assist with model verification completed by Costin Roe Consulting in relation to the basin modifications. Blacktown Council Flood Advise Letter (325885 337658 dated 9 April 2020) is included in **Appendix H**.

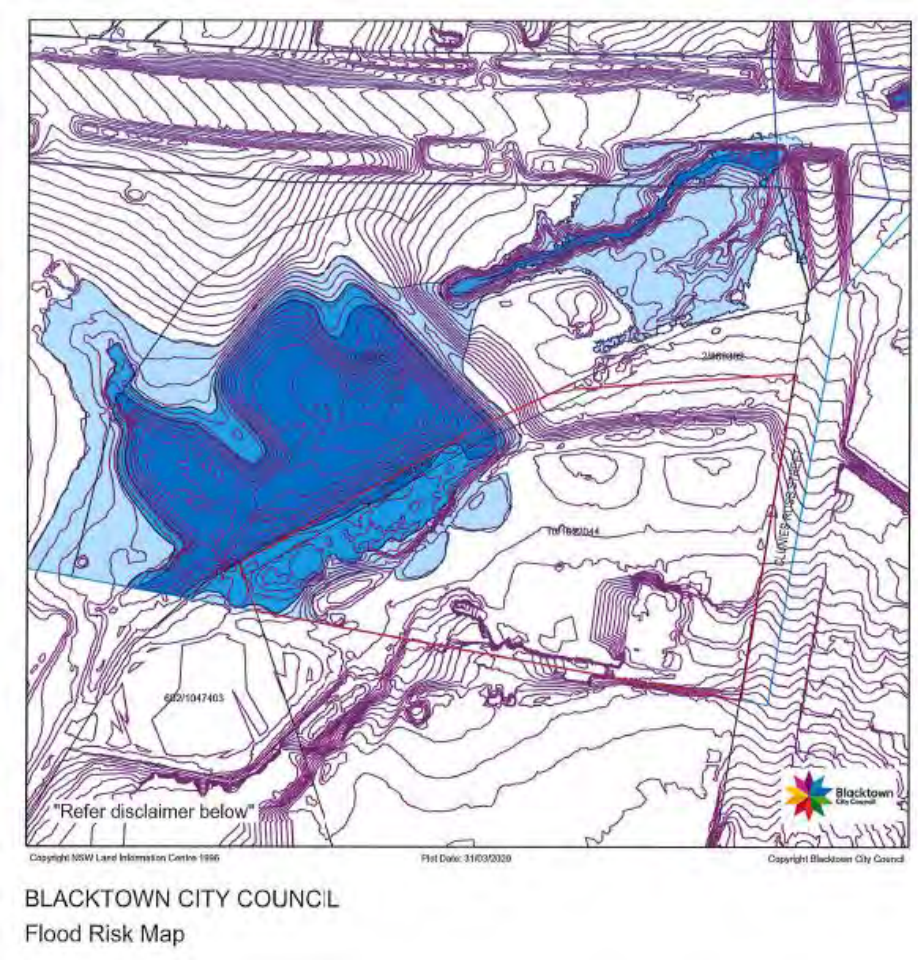

Figure 8.1. Existing Flood Extent vide Blacktown City Council.

Detention basin modelling completed and included in **Section 6** of this report confirms the following pre-development flood levels for the 100 year ARI and PMF events are generally consistent with the advice included in the council letter. Refer **Table 8.1** for comparison.

Event	BCC Flood Level (m)	Costin Roe Consulting Flood Level (m)	Difference (m)
100yr ARI	55.06	55.10	0.04
PMF	57.17	57.15	0.02

Table 8.1. Comparison of Costin Roe Consulting Model and Council Advise

Comparison of the Costin Roe Consulting Modelling output shows very good correlation with the council advise. The minor variance is considered consistent with modelling accuracy and tolerances. The modelling is considered suitable for completing pre and post development comparisons, impact assessments and confirming flood planning requirements.

8.3 Pre and post development Flood Extents

Modelling of the detention system (which defines the flood extent) has been completed for a range of events as included in **Section 6** of this report.

Pre and post development modelled extent are included in **Figure 8.2** and **8.3** below. Refer **Section 6** for further modelling.

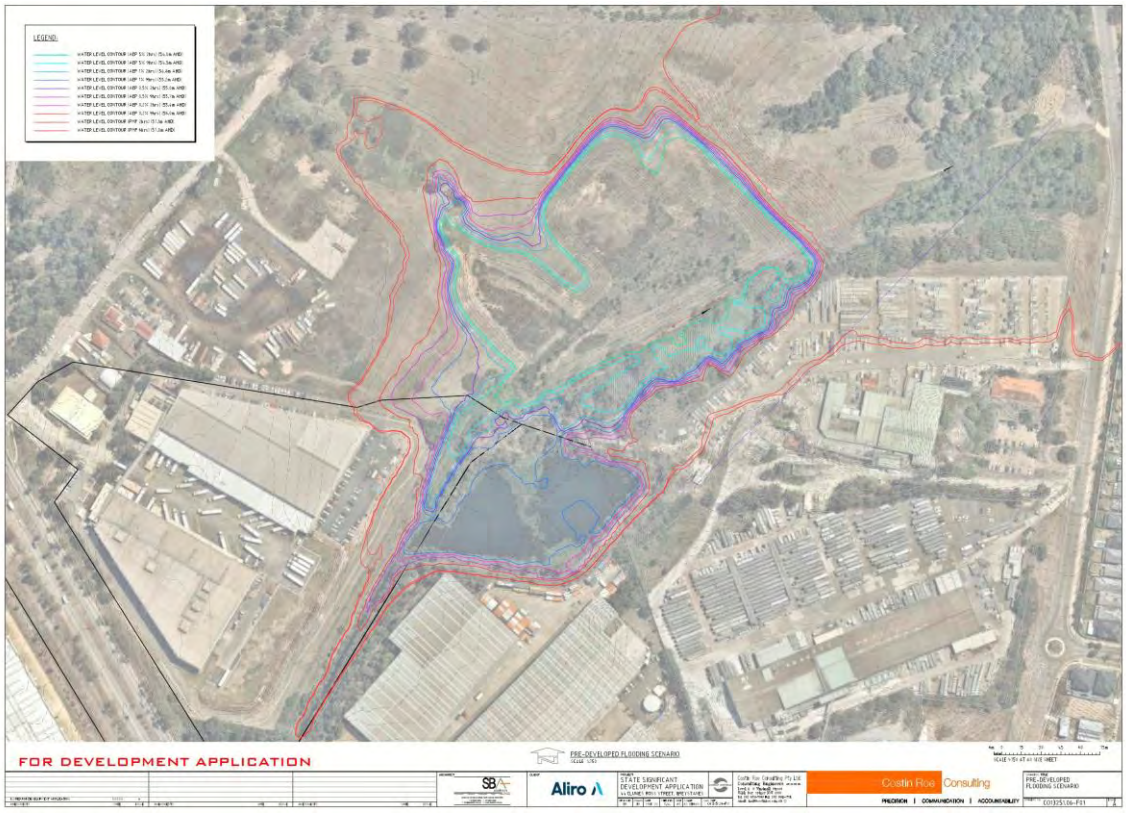

Figure 8.2. Existing/ pre-development Flood Extent

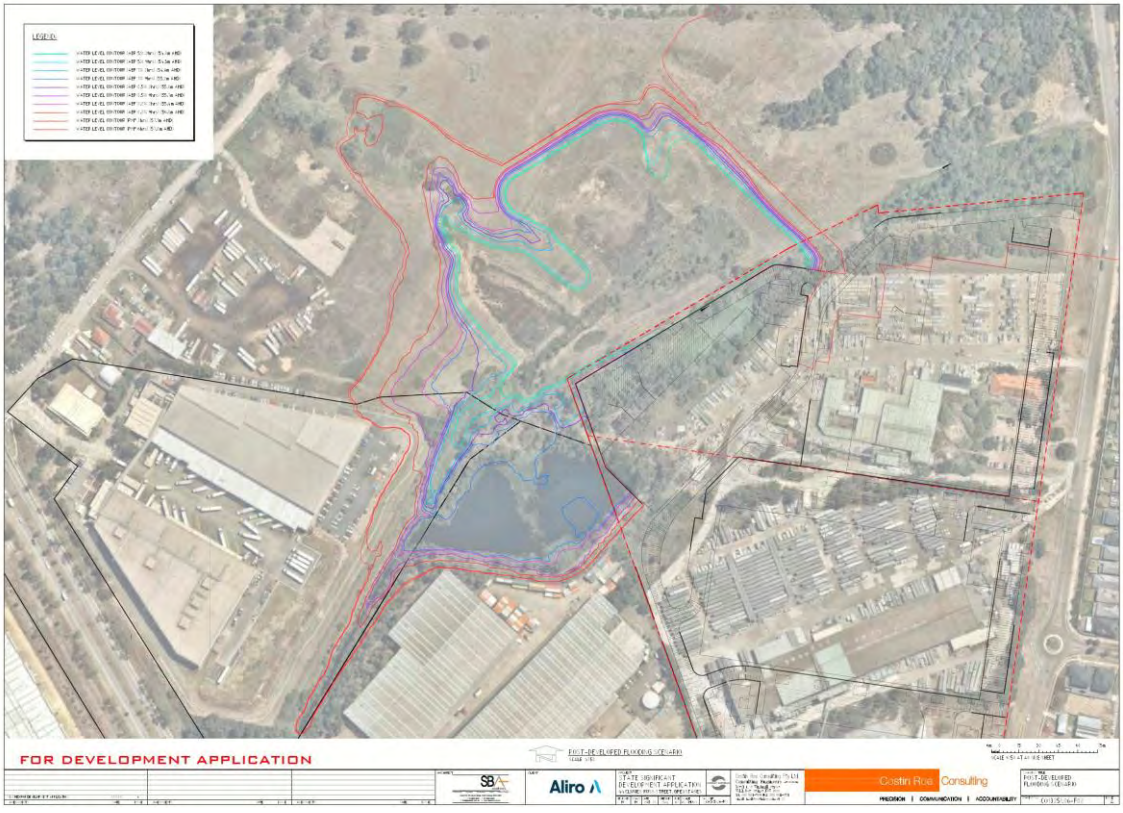

Figure 8.3. Post-development Flood Extent

8.4 Flood Planning Requirements

Allowing for the council required freeboard of 0.5m to the 1% AEP flood level, the corresponding flood planning level for the development is RL 55.6m AHD.

The lowest proposed building level on the site is RL 60.0m AHD. The proposed minimum building level is noted to be at least 4.5m above the flood planning level, hence meets all flood planning requirements.

It is noted that flood levels and extent downstream of the basin weir within Girraween Creek are significantly lower than those within the basin and are not required to be considered from a flood or flood planning perspective.

8.5 Flood Safety and Egress

The PMF level is estimated to be RL 56.43m.

The site, having a minimum floor level of RL 60.0m is hence shown to be higher than and not affected by PMF Flooding. Detailed flood safety management report is not required or proposed for the development.

9 EROSION & SEDIMENT CONTROL PLAN

An erosion and sediment control plan (ESCP) is included in drawings **Co13251.06-DA20, DA21 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.

9.1 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 Penrith City Council's specifications.
3. All subcontractors will be informed by the site manager of their responsibilities in minimising the potential for sedimentation and soil erosion.

9.2 Land Disturbance

1. Where practicable, the soil erosion hazard on the site will be kept as low as possible and as recommended in **Table 9.1**.

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 9.1. Limitations to access

9.3 Erosion & Sediment Control Conditions

1. Clearly visible barrier fencing shall be installed as shown on drawing **Co13261.06-DA20 & DA25** 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.

9.4 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.

9.5 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.

9.6 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.

10 SEAR's & AGENCY RESPONSE ITEMS

10.1 SEAR's & Agency Response Items Introduction

The following sections of the report covers response to civil engineering and WCM items included in the NSW Department of Planning and Environment SEARS letter dated 16 December2019, reference SSD_10399 and associated agency response letters from Blacktown City Council (10 September 2018), NSW Department of Primary Industries (DPI) and NSW Office of Environment & Heritage (OEH).

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

SEAR's responses are included in **Section 10.2** and Agency responses in **Section 10.3**.

10.2 SEAR's Response Items

This section of the report covers items relating to the NSW Department of Planning and Environment SEARS letter dated 16 December 2019.

SEARS – Soil and Water	
Item 1.1	*A description of the water demands and a breakdown of water supplies, including a detailed site water balance* Response Refer to **Section 4.1 & 5.1** which sets out key components relating to water cycle management, water demand and supplies. Further discussion relating to water management, including rainwater reuse requirements are set out in **Section 6** and **7** of the report.
Item 1.2	*A description of the measures to minimise water use* Response Refer to **Section 5.1** which sets out key components relating to water cycle management. Further discussion, including rainwater reuse requirements are set out in **Section 6** and **7** of the report.
Item 1.3	*A description of all wastewater generated on site.* Response Refer **Section 4.2** for discussion on wastewater, noting that for this site this would be confined to sewer.
Item 1.4	*characterisation of the nature and extent of any contamination of the site and a description of proposed measures.*

	Response Refer EIS and report by environmental consultant for items relating to contamination.
Item 1.5	*A detailed description of any cut and fill works and/ or additional retaining walls required to facilitate the development.* Response A preliminary earthworks assessment has been undertaken for the development to confirm building pad levels and estimate of cut to fill for the development. The objective for the earthworks is to achieve cut to fill balance with minimal import or export from the site, to minimize retaining walls through landscape batter where possible, to provide suitable site access and to drain the site by gravity. Reference to earthworks drawings included in **Appendix A**, and written descriptions relating to earthworks and geotechnical considerations in **Section 3** of this report.
Item 1.6	*A description of the proposed erosion and sediment controls during construction and operational phases of the development.* Response A concept erosion and sediment control plan has been undertaken for the development to confirm minimum erosion and sediment control measures. The erosion and sediment controls have been provided in accordance with the Landcom document *Managing Urban Stormwater: Soils & Construction – 2004, "The Blue Book".* Reference to erosion and sediment control drawings included in **Appendix A**, and written description of the plan in **Section 9** of this report.
Item 1.7	*A description of the surface and stormwater management system, including on site detention, and measures to treat or re-use water* Response A comprehensive WCMP has been included in this report – refer **Section 5** for key objectives for the development. This includes description of proposed surface water management system, water quantity requirements and water quality included in **Section 7** and **8** respectively. Reference to stormwater management and layout drawings included in **Appendix A** should be made pertaining to site layout and confirmation of key management measures and proposals should also be made.
Item 1.8	*An assessment of potential surface and groundwater impacts associated with the development including impacts on bulk water supply infrastructure within the vicinity of the site*

	Response We confirm that the development does not propose to utilise surface or groundwater water sources. An assessment of the impact on these items is not relevant for the warehouse distribution center construction.
Item 1.9	*A description of the surface and stormwater management including drainage design, on site detention, and measures to treat or re-use water* Response Refer *Item 1.7* response.
Item 1.10	*A flooding assessment* Response An assessment of flooding relating to the regional detention system and Girraween Creek to the north of the development has been included in **Section 8** of this report, in conjunction with the water quantity assessment included in **Section 6**. The assessment has been completed in accordance with the SEAR's and agency response letter, especially the NSW Planning Industry & Environment letter dated 26 November 2020 (refer detailed responses to this letter in **Section 10.3**). The assessment shows that the development will be above and clear of the flood level within the regional basin (meeting flood planning controls), that the development will not impact existing flooding and discharge relationships in the detention basin or downstream of the development site, hence confirming no impact to upstream, downstream or adjacent properties has resulted.
Item 1.11	*A description of erosion and sediment controls* Response A concept erosion and sediment control plan has been undertaken for the development to confirm minimum erosion and sediment control measures. The erosion and sediment controls have been provided in accordance with the Landcom document *Managing Urban Stormwater: Soils & Construction – 2004, "The Blue Book".* Reference to erosion and sediment control drawings included in **Appendix A**, and written description of the plan in **Section 9** of this report.
Item 1.12	*Details of impact mitigation, management and monitoring measures.* Response Details of impact mitigation throughout construction phase are included in the concept erosion and sediment control plan, in accordance with the Landcom document *Managing Urban Stormwater: Soils & Construction –*

	2004, "The Blue Book". Refer to erosion and sediment control drawings included in **Appendix A**, and written description of the plan in **Section 9** of this report.

10.3 Agency Response Items

This section of the report provides response to civil engineering items included in the agency responses from the following agencies :

- Blacktown City Council SSD 10399 File no:F15/1234-02 Dated 4 December 2019;
- NSW Environment Protection Authority DOC19/1014381-2 Dated 25 November 2019;
- NSW Planning Industry and Environment letter DOC 19/1026978 Dated 26 November 2019; and
- Sydney Water letter Dated: 10 February 2020.

Authority Comments	***Response***
Blacktown City Council SSD 10399 File no:F15/1234-02 Dated 4 December 2019	
Planning Comments	
Submission of a cut and fill plan is to be submitted with the EIS.	An earthworks concept has been included in the submission documents. This includes cut to fill depth shading and estimate of earthworks volumes. The project intent is to maintain an overall cut to fill balance, enable access, minimise retaining walls, drain the site by gravity and to meet any flood planning requirements. Refer **Section 3** of this report and earthworks drawings included in **Appendix A**.

Authority Comments	***Response***
<u>*Engineering Matters*</u>	
Detail measures to minimise operational water quality impacts on surface waters and groundwater as per area controls (outlined in the documents listed below).	Refer below response.
Stormwater plans detailing the proposed methods of drainage without impacting on downstream properties (including Wamuli Reserve) and providing appropriate management of all anticipated flows. <u>*Relevant Policies and Guidelines:*</u> • *Guidelines for development adjoining land and water managed by DECCW (OEH, 2013)* • *Blacktown City Council Development Control Plan (Current Version) including Part J — Water Sensitive Urban Design and Integrated Water Cycle Management* • *Blacktown City Council's Water Sensitive Urban Design Standard Drawing A(BS)175M* • *Blacktown City Council's Engineering Guide for Development* • *Blacktown City Council's Works Specification — Civil land development.*	Reference to stormwater management and layout drawings included in **Appendix A** should be made pertaining to site layout and confirmation of key management measures and proposals should also be made. A comprehensive WCMP has also been included in this report – refer **Section 5** for key objectives for the development to which stormwater management measures specified in the drawings (**Appendix A)** have been made. The WCMP includes description of proposed surface water management system, water quantity requirements and water quality included in **Section 7** and **8** respectively. Consideration to the relevant policy guidelines noted has been made for areas within *Pemulway Industrial Controls Holroyd DCP Part Q* and Blacktown City Council LGA's.
NSW Environment Protection Authority DOC19/1014381-2 Dated 25 November 2019	
The requirements of State Environmental Planning Policy (SEPP) 55 will need to be satisfied and documented in the EIS. SEPP 55 states that as part of the development process, the following key considerations should be addressed: *o Whether the land is contaminated;* *o If the land is contaminated whether it is suitable in its contaminated state (or will be suitable, after remediation) for all the purposes*	Refer to EIS and relevant environmental consultant reports in regard to contamination investigations and requirements.

Authority Comments	*Response*
to which the land will be used; and *o If the land requires remediation; will be made suitable for any purpose for which the land will be used.*	
The EIS should consider the likelihood of the basements encountering groundwater. If groundwater is likely to be intersected by a basement, the EIS should detail measures to collect and manage any seepage groundwater from the basement/underground car parking areas to prevent pollution of waters, particularly as the site is situated in an area of moderate to high salinity potential. Consideration should be given to waterproofing or "Tanking" and basement levels likely to interfere with an aquifer to prevent the need for treatment and discharge of moderate to high salinity potential.	There are no basements proposed or expected as part of any developments. It is noted however that cut to fill earthworks will be completed over the site. The geotechnical investigations completed by PSM show that groundwater has not been observed in any of the historical investigations completed on the site. The expectation is that no significant groundwater will be experienced on site, however if any groundwater is encountered suitable subsoil and surface measures will be employed to control drainage of the groundwater. This most likely to be in the form of subsoil drainage to retaining structures, subsoil drainage around pavement edges or in areas of cut rather than basement tanking or other tanking arrangements.
***NSW Planning Industry and Environment DOC 19/1026978* Dated 26 November 2019**	
Water and Soils – Item 9	
The EIS must map the following features relevant to water and soils including: *a. Acid sulfate soils (Class 1, 2, 3 or 4 on the Acid Sulfate Soil Planning Map)* *b. Rivers, streams, wetlands, estuaries (as described in s4. 2 of the Biodiversity Assessment Method)* *c. Wetlands as described in s4. 2 of the Biodiversity Assessment Method* *d. Groundwater* *e. Groundwater dependent ecosystems* *f. Proposed intake and discharge locations.*	Refer geotechnical and ecological studies relating to Items a to c. In relation to Items d & e, as per the geotechnical investigations completed by PSM, groundwater has not been observed in any of the historical investigations completed on the site. The expectation is that no significant groundwater will be experienced on site and there will negligible impact to groundwater and/ or groundwater dependent ecosystems as a result of the development.

Authority Comments	*Response*
	In relation to Item f, there are no proposed groundwater intake or discharge locations as part of this development.
Water and Soils – Item 10	
The EIS must describe background conditions for any water resource likely to be affected by the development, including: *a. Existing surface and groundwater.* *b. Hydrology, including volume, frequency and quality of discharges at proposed intake and discharge locations.* *c. Water Quality Objectives (as endorsed by the NSW Governmenthttp://www. environment.nsw. gov. au/ieo/index.htm) including groundwater as appropriate that represent the community's uses and values for the receiving waters* *d. Indicators and trigger values/criteria for the environmental values identified at (c) in accordance with the ANZECC (2000) Guidelines for Fresh and Marine Water Quality and/or local objectives, criteria or targets endorsed by the NSW Government* *e. Risk based Framework for Considering Waterway Health Outcomes in Strategic Land-use Planning Decisions http://www. environment. nsw.gov. au/research-and-publications/publications-search/risk-based-framework-for-considering-waterway- health-outcomes-in-strategic-land-use-and planning.*	Detailed drawings showing the proposed surface water 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** and 7 of this Engineering Report respectively which include volumes, discharge rates. Water quality objectives consistent with local planning requirements and NSW Government have been adopted for the development as set out in **Section 5.1** and confirmed as being met through MUSIC modelling in **Section 7**. The adopted water quality discharge values are consistent with *Pemulway Industrial Controls Holroyd DCP Part Q* and Blacktown City Council DCP 2015 Part J.
Water and Soils – Item 11	
The EIS must assess the impacts of the development on water quality, including *a. The nature and degree of impact on receiving waters for both surface and groundwater, demonstrating how the development protects the Water Quality*	a. Refer responses for *Item 9* relating to groundwater and *Item 10* relating to water quality.

Authority Comments	*Response*
Objectives where they are currently being achieved, and contributes towards achievement of the Water Quality Objectives over time where they are currently not being achieved. This should include an assessment of the mitigating effects of proposed stormwater and wastewater management during and after construction. b. *Identification of proposed monitoring of water quality* c. *Consistency with any relevant certified Coastal Management Program (or Coastal Zone Management Plan).*	b. There are no requirements for monitoring of water quality for industrial type developments and none are proposed for this site. c. The development is not located within any certified coastal management program or plan.
Water and Soils – Item 12	
The EIS must assess the impact of the development on hydrology, including: a. *Water balance including quantity, quality and source.* b. *Effects to downstream rivers, wetlands, estuaries, marine waters and floodplain areas.* c. *Effects to downstream water-dependent fauna and flora including groundwater dependent ecosystems* d. *Impacts to natural processes and functions within rivers, wetlands, estuaries and floodplains that affect river system and landscape health such as nutrient flow, aquatic connectivity and access to habitat for spawning and refuge (e.g. river benches).* e. *Changes to environmental water availability, both regulated/licensed and unregulated/rules-based sources of such water.* f. *Mitigating effects of proposed stormwater and wastewater management during and after*	a. We confirm that water usage is consistent with industrial developments typical of the area. Water use will be 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 as per the *Pemulway Industrial Controls Holroyd DCP Part Q* and Blacktown City Council DCP 2015 Part J 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. b. Discharge from the site is made directly to an existing precinct wetland and regional detention basin. Confirmation of achieving pre and post discharge rates downstream of the

Authority Comments	*Response*
construction on hydrological attributes such as volumes, flow rates; management methods and re-use options. g. *Identification of proposed monitoring of hydrological attributes.*	basin, maintaining active basin storage volumes and consistency in the system pre and post have been confirmed in **Section 6** of this report. Based on the assessment completed there will be no negative affect on downstream rivers, estuaries, marine waters and/ or floodplain areas. c. As per *Item b* above, as pre and post development conditions within the wetland and basin, and downstream of these systems, are confirmed to be consistent, there would be no negative effect on water dependant flora or fauna. d. As per *Item b* above, as pre and post development conditions within the wetland and basin, and downstream of these systems, are confirmed to be consistent there would be no impact to current natural processes within the receiving waters. e. No changes to environmental water availability are proposed as part of the project. f. During construction an Erosion and Sediment Control program is proposed to be implemented. An Erosion and Sediment Control Plan has been prepared in accordance with *Managing Urban Stormwater, Soils and Construction "The Blue Book"* (Landcom 1998). Post construction storm water quantity and quality will be managed as set out in **Sections 5** to **7** and per drawings in **Appendix A**.

Authority Comments	*Response*
Flooding and Coastal Hazards Item 13	
The EIS must map the following features relevant to flooding as described in the Floodplain Development Manual 2005 (NSW Government 2005) including *a. Flood prone land.* *b. Flood planning area, the area below the flood planning level* *c. Hydraulic categorization (floodways and flood storage areas)* *d. Flood hazard*	Flooding is noted to be related to the regional detention system and Girraween Creek (also known as Greystanes Creek) to the north of the development site. Refer to **Section 8** which confirms flooding considerations including flood extent, flood planning levels and flood hazard in relation to the development. It is noted that the development and all access points are flood free during major flooding events.
Flooding and Coastal Hazards Item 14	
The EIS must describe flood assessment and modelling undertaken in determining the design flood levels for events, including a minimum of the 5% Annual Exceedance Probability (AEP), 1% AEP, flood levels and the probable maximum flood, or an equivalent extreme event.	Refer **Section 6** which confirms hydrology and flow hydrographs for the noted storm events, and **Section 8** which confirms flood descriptions and items included in the requested item.
Flooding and Coastal Hazards Item 15	
The EIS must model the effect of the proposed development (including fill) on the flood behavior under the following scenarios: *a. Current flood behavior for a range of design events as identified in 14 above. This includes the 0.5% and 0.2% AEP year flood events as proxies for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.*	Refer **Section 6** which confirms hydrology and flow hydrographs for the noted storm events, and **Section 8** which confirms flood descriptions and items included in the requested item.
Flooding and Coastal Hazards Item 16	
Modelling in the EIS must consider and document: *a. Existing council flood studies in the area*	

Authority Comments	*Response*
and examine consistency to the flood behavior documented in these studies *b. The impact on existing flood behavior for a full range of flood events including up to the probable maximum flood, or an equivalent extreme flood* *c. Impacts of the development on flood behavior resulting in detrimental changes in potential flood affection of other developments or land. This may include redirection of flow, flow velocities, flood levels, hazard categories and hydraulic categories* *d. Relevant provisions of the NSW Floodplain Development Manual 2005.*	a. Existing flood information has been obtained from Blacktown City Council. The existing flood information has been utilised to confirm assessment of the detention basin is consistent with modelling completed by council and suitable to utilise in post development scenario assessments. Refer to **Appendix H** for council flood letter and flood levels for the 1% AEP flood event. b. The impact on behaviour for a range of flood events has been completed as per *Item 14* and *15* as included in **Section 6** and **8** of the report. c. Flood behaviour changes have been assessed and included in **Section 6** and **8** of the report. d. Relevant provisions of the NSW *Floodplain Development Manual 2005* have been made including confirmation of flood planning levels and impact from and on development in relation to flooding.
Flooding and Coastal Hazards Item 17	
The EIS must assess the impacts on the proposed development on flood behavior, including *a. Whether there will be detrimental increases in the potential flood affectation of other properties, assets and infrastructure.* *b. Consistency with Council floodplain risk management plans.* *c. Consistency with any Rural Floodplain Management Plans.* *d. Compatibility with the flood hazard of the land.* *e. Compatibility with the hydraulic functions of flow conveyance in floodways and*	a. The assessment included in **Section 6** and **8** of the report confirm consistency between existing and post development flood behaviour, hence no detrimental impact or potential affectation of other properties would be anticipated as a result of the development. b. As above, given there is negligible change to flood behaviour, consistency with any floodplain risk management plans is achieved. c. Refer Item 17(b) above.

Authority Comments	*Response*
storage in flood storage areas of the land. *f. Whether there will be adverse effect to beneficial inundation of the floodplain environment, on, adjacent to or downstream of the site.* *g. Whether there will be direct or indirect increase in erosion, siltation, destruction of riparian vegetation or a reduction in the stability of riverbanks or watercourses.* *h. Any impacts the development may have upon existing community emergency management arrangements for flooding. These matters are to be discussed with the NSW SES and Council.* *i. Whether the proposal incorporates specific measures to manage risk to life from flood. These matters are to be discussed with the NSW SES and Council.* *j. Emergency management, evacuation and access, and contingency measures for the development considering the full range or flood risk (based upon the probable maximum flood or an equivalent extreme flood event). These matters are to be discussed with and have the support of Council and the NSW SES.* *k. Any impacts the development may have on the social and economic costs to the community as consequence of flooding.*	d. All parts of the site are noted to be flood free hence compatible with flood hazard of the land. e. A modification to flood storage associated with the regional basin is proposed as set out in **Sections 6** and **8** of the report. The assessment shows no change to flood behaviour and that full storage compensation is achieved. f. Refer Item 17(a) response. g. Existing and proposed flow regime in downstream waters have been confirmed to be consistent. A detailed water quality management system has been employed for the development which would mitigate any potential sedimentation, it is anticipated that potential for any reduction in stability or banks or watercourses would be negligible. h. There would be no effect on any existing community emergency management arrangements for flooding as a result of the development. Refer **Section 8.4**. i. The development site is flood free up to the PMF flood event. There are no specific flood related management arrangements required for the development. Refer **Section 8.4**. j. Refer *Item 17(h) & 17(i)* responses. k. The assessment included in **Section 6** and **8** of the report confirm consistency between existing and post development flood behaviour, hence no detrimental impact or potential affectation relating to social or economic costs to the community are anticipated as a result of the development l.

Authority Comments	*Response*
Sydney Water Dated: 10 February 2020	
Water Related Infrastructure Requirements Item 1	
The proponent of the development should determine service demands following servicing investigations and demonstrate that satisfactory arrangements for drinking water, wastewater, and if required, recycled water services have been made	Refer to **Section 4.1** and **4.2** regarding anticipated service demands and service investigations relating to water and sewer. It is noted that reduction in demand for non-potable reuse is proposed as set out in **Section 7.4**. It is anticipated that existing services will have sufficient capacity, noting that a Section 73 application to Sydney Water will be required as part of ongoing designs to confirm requirements for water supply and wastewater.
Water Related Infrastructure Requirements Item 2	
The proponent must obtain endorsement and/or approval from Sydney Water to ensure that the proposed development does not adversely impact on any existing water, wastewater or stormwater main, or any other Sydney Water asset, including any easement or property. When determining landscaping options, the proponent should take into account that certain tree species can cause cracking or blockage of Sydney Water pipes and therefore should be avoided	The requirement for endorsement of development by Sydney Water is noted. Future detailed assessment and Build Over Sewer approvals are anticipated to be completed as part of Construction Certificate approval phases of the development. It is noted that consultation with Sydney Water has been completed in this regard with meetings held with the proponent (Aliro), civil engineers (Costin Roe Consulting) and Sydney Water Service Coordinators (Landpartners) held on 11 March 2020.
Water Related Infrastructure Requirements Item 3	
Strict requirements for Sydney Water's stormwater assets (for certain types of development) may apply to this site. The proponent should ensure that satisfactory steps/measures been taken to protect existing stormwater assets, such as avoiding building over and/or adjacent to stormwater assets and	Consideration to all Sydney Water assets in and around the development area have been considered as part of the development application concept designs. These include construction considerations for the 375mm wastewater carrier on the northern site boundary, the 225mm carrier on the south-

Authority Comments	***Response***
building bridges over stormwater assets. The proponent should consider taking measures to minimise or eliminate potential flooding, degradation of water quality, and avoid adverse impacts on any heritage items, and create pipeline easements where required	west of the site and the 1200mm SCL IBL trunk watermain (Prospect WP159 Main). It is noted that consultation with Sydney Water has been completed in this regard with meetings held with the proponent (Aliro), civil engineers (Costin Roe Consulting) and Sydney Water Service Coordinators (Landpartners) held on 11 March 2020.
Integrated Water Cycle Management Item 4	
The proponent should outline any sustainability initiatives that will minimise/ reduce the demand for drinking water, including any alternative water supply and end uses of drinking and non-drinking water that may be proposed, and demonstrate water sensitive urban design (principles are used), and any water conservation measures that are likely to be proposed. This will allow Sydney Water to determine the impact of the proposed development on our existing services and required system capacity to service the development.	Refer to **Section 4.1** and **4.2** regarding anticipated service demands and service investigations relating to water and sewer. It is noted that reduction in demand for non-potable reuse is proposed as set out in **Section 7.4**. It is anticipated that existing services will have sufficient capacity, noting that a Section 73 application to Sydney Water will be required as part of ongoing designs to confirm requirements for water supply and wastewater.

11 CONCLUSION

This Civil Engineering Report has been prepared to accompany and EIS for the development of the Prospect Logistic Park at Pemulway, NSW.

An overview of Cumberland City Council and Blacktown City Council requirements, in conjunction with DPIE, for earthworks, stormwater management and erosion and sediment controls has been provided as part of 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 the estate. These are provided for both specific on-lot requirements and broader regional and precinct systems including the existing precinct wetland and detention basin on the north and north-west of the property.

The development is located in the vicinity of, however clear of the predicted 1% AEP flood extent from the regional basin and Girraween Creek. The floor levels of proposed buildings will be set as a minimum to the 1% AEP flood level plus 500mm freeboard in accordance with the requirements of Council and the *NSW Floodplain Development Manual*.

We consider the civil engineering and stormwater management measures included in this report and associated drawings (**Appendix A**) address anticipated impacts and the requirements of the SSD 10399 SEAR's, and associated agency requirements.

We recommend the management measures referenced in this report are adopted as part the approval consent, and further in the detail design process and future development construction.

12 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) – "The Blue Book";

Engineering Guide for Development (2005), Blacktown City Council

Part J, Development Control Plan (2015), Blacktown City Council

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