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CIVIL ENGINEERING REPORT FOR STATE SIGNIFICANT DEVELOPMENT APPLICATION SSD 7155

PRESTONS INDUSTRIAL ESTATE: LOTS 33-35 & 43 DP 2359 AND LOT 20 DP 1173483 YARRUNGA STREET PRESTONS NSW

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1 INTRODUCTION

Costin Roe Consulting Pty Ltd has been commissioned by Logos Property to prepare this Engineering Report in support of a proposed development application to be lodged over the site.

The site is located on the western side of Bernera Road between Kurrajong and Yarrunga Roads, Prestons, NSW. The proposed development is for an industrial estate with several warehouses, office space, provision for truck loading, unloading and circulation, and for passenger vehicle parking.

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

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

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

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

The consent authority is The NSW Department of Planning & Environment as the proposal considered a State Significant Development (SSD). However as the subject site is located within Liverpool City Council (LCC) local government area, the engineering and policy requirements of LCC have also been considered in the design.

The NSW Department of Planning & Environment has provided Secretary's Environmental Assessment Requirements (SEAR's) dated 11 September 2015, Ref: SSD7155. In addition to providing a general summary of civil engineering aspects of the project, this report addresses the Soil and Water components of the SEAR's including flooding impacts, surface water management, on-site detention and treatment, details of erosion and sediment control, details of proposed cut and fill works and measures to minimise the extent of cut to fill and details of any fill to be imported to site.

2 SITE CHARACTERISTICS

2.1 Site Description

The site, being Lots 33, Part Lot 34, 35 and 43 in DP 2359 and Lot 2 in DP 615548, is approximately 19.3 Ha in area, roughly rectangular in shape and is zoned to General Industrial land under the Liverpool City Council LEP as shown in **Figure 2.1.**

The site is bounded on the north by Yarrunga Street, on the east by Bernera Road and the south by Kurrajong Road. Land to the west of the site is currently undeveloped.

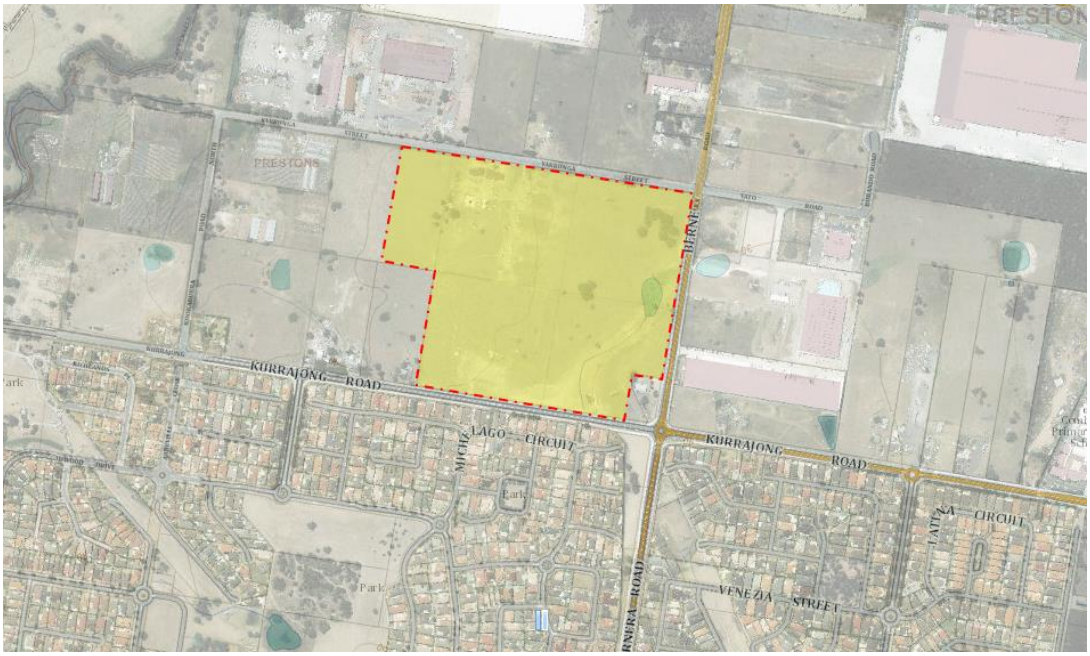

Figure 2.1 Locality Plan

A high voltage transmission line and associated 60m wide easement is located within the site. The transmission line extends through the site beginning at the south-eastern corner of the property, adjacent to the corner of Kurrajong Road and Bernera Road, and traversing in a north/ north-west direction to Yarrunga Street. Two (2) transmission towers are located within the site adjacent to the Yarrunga Street and Kurrajong Road property boundaries.

An overland flow path is present on the property consisting of an open earth drainage channel formed by a natural gully in the landform. The overland flow path extends through the site beginning at the Kurrajong Road frontage of Lot 2 in DP 615548. The overland flow path travels through the site in a north-eastern direction towards the Bernera Road frontage of Lot 33 in DP 2359 at grades of approximately 1.0% to 2.0%. The overland flow path is generally 2.0m deep with 1v in 1h batter slopes. Council has advised has the overland flow path will convey flows of up to 15m³/sec from the upstream residential catchment (33 Ha). At the downstream end of the overland flow path, where it intersects with Bernera Road, a series of box culverts are present. These culverts convey flow beneath Bernera Road to the east. It is understood that these culverts have a limited capacity of approximately $3m^3/s$, hence flows greater than $3m^3/s$ will be conveyed as overland within the Bernera Road reserve to the north.

Access to the site is currently available along Kurrajong Road 30m from the intersection with Bernera Road and along Yarrunga Street from the existing dwellings on Lot 34 in DP 2359.

The site is located within the bounds of Liverpool City Council (LCC), therefore the engineering requirements of the LCC apply.

2.2 Proposed Development

The proposed development is for earthworks and infrastructure construction for an industrial subdivision of the land. Future industrial warehouse and distribution facilities would be subject to future separate detailed building design and development applications.

An indicative layout of the development has been produced by Axis Architecture and can be seen in **Figure 2.2** below.

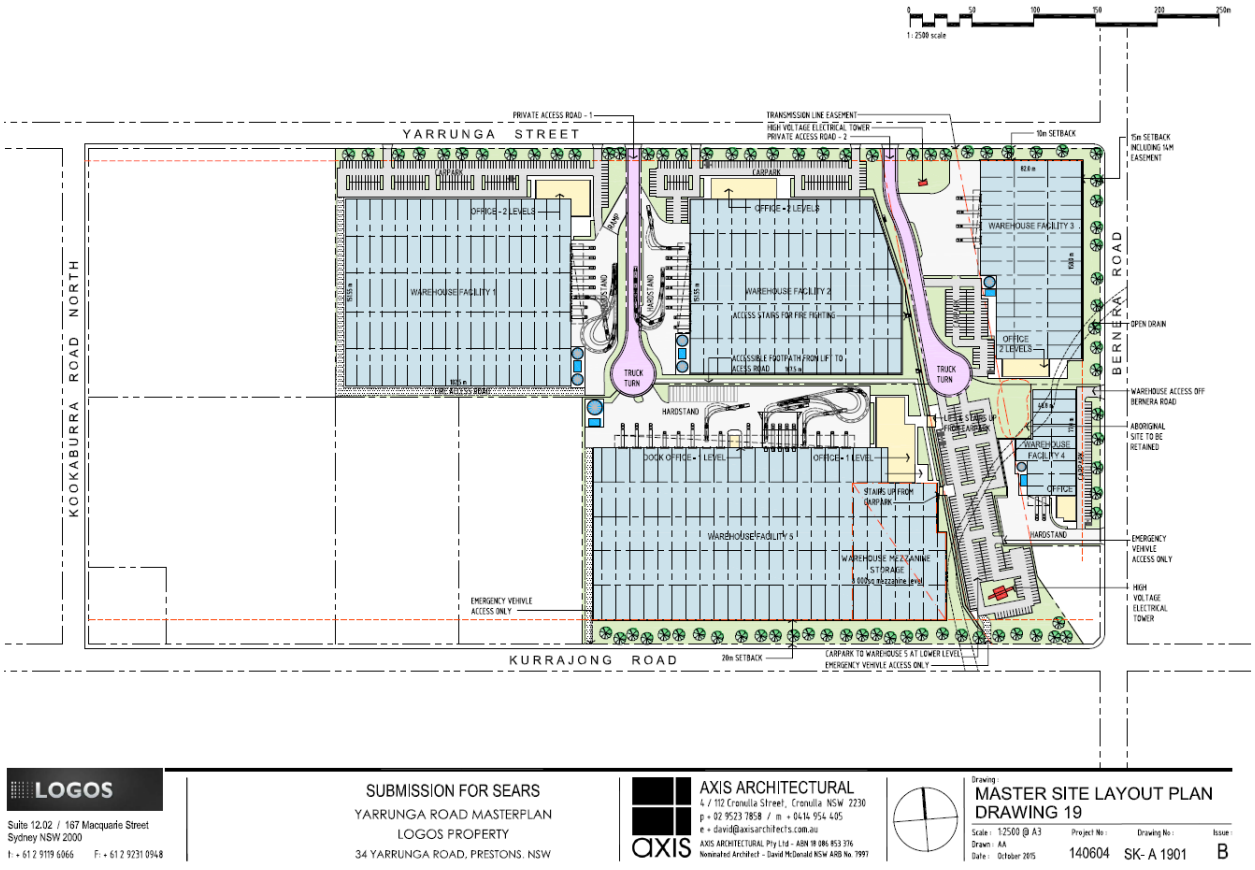

Figure 2.2. Development Layout

The development will include the following engineering components:

- Earthworks to create large flat pads to facilitate future industrial construction;
- Construction of two estate access driveways off Yarrunga Street;
- Conveyance and diversion of the existing waterway and overland flow path through the development site. This is proposed to be managed by a combination of piped culvert and overland flow;
- Stormwater drainage system based on a major/ minor design philosophy;
- Management of stormwater quality using a treatment train approach to pollutant loads on a developed catchment in accordance with councils load based pollutant reduction percentages; and
- Management of stormwater quantity by reducing post developed flow to pre-developed over the range of storms between the 1 in 2 year Average Recurrence Interval (ARI) to the 1 in 100 year ARI as per council policy.

3 ROADS AND ACCESS

3.1 Introduction

The proposed development proposes two internal private access roads off Yarrunga Street. The development also includes for half road construction of Yarrunga Street for the extent of the property frontage and upgrade of the intersection of Yarrunga Street with Bernera Road on the southern property frontage.

The traffic movements relating to the intersection are discussed in a report by the Traffic Engineer, Transport and Traffic Planning Association (TTPA).

A functional layout of the proposed intersection and road works has been produced for the development and is presented in drawing Co8753.00-SKR01 and SKR02 and these can be found **Appendix A**.

The internal road will be a privately owned road by the estate owners and designed in accordance with Australian and council requirements.

3.2 Road Widths

The proposed internal roads are to be constructed as a privately owned roads with a cross section as nominated in Table 3.1. The half road construction of Yarrunga Street is also included, with carriageway measured from the existing centreline of the road.

Road Type & Traffic Volume	**Carriageway**	**Verge (Footpath Pedestrian)**	**Total Road Reserve**	**Number of lanes**
Private	11.5m	3.0m west 5.5m east	20.0m	2 travel/ 1 parking lane
Yarrunga Street (Half Road)	11.5m Half road construction at 5.75m from CL.	4.3	20.1m	2 travel/ 1 parking

Table 3.1. Proposed Estate Road Cross Section

All roads will have concrete kerb and gutter and carriageway surface finished with asphaltic concrete. A typical road cross section is described in Table 3.1 above.

3.3 Road Alignments

The proposed alignment for the half road construction of Yarrunga Street will be designed to meet Council requirements. The layout and levels will remain consistent with the existing built form on Yarrunga Street with road widening to facilitate the required cross sectional dimensions and the construction of kerb and gutter and drainage system to collect run off from the road reserve and also provide in-ground drainage connections for a portion of the development site.

The Horizontal alignments will be designed to meet Council standards. Minimum horizontal radii in accordance with Council's engineering guidelines are to be provided.

In accordance with the Council standards, a minimum longitudinal grade of 1% and a maximum of 6% have been generally provided. Where change of grade is in excess of 0.6%, a vertical curve in accordance with the RMS Road Design Guide for a design speed of 60 km/h has been provided.

Internal access roads will be designed

3.4 Road Pavements

The design for the proposed pavement for internal roads is to be based on *Austroads Pavement Design – A Guide to the Structural Design of Road Pavements.*

The pavement makeup for will be subject to detail design. The Yarrunga Street pavement will be a flexible pavement with unbound granular base in accordance with Liverpool City Council construction specifications. The expected makeup of the pavement for the internal access roads will be for a flexible pavement with unbound granular base and bituminous wearing coarse layer.

3.5 Pedestrian Facilities and Transportation

A pedestrian path will be located on the southern side of Yarrunga Street and western side of Bernera Road in accordance with councils engineering requirements.

4 SITE WORKS

4.1 Bulk Earthworks

Bulk earthworks will be required to facilitate the development of the property for industrial use.

The objective for the site will be to provide large flat building pads, facilitate site access, to drain the site stormwater via gravity, keep building levels above the 1 in 100 year ARI flood level (with appropriate freeboards) and to perform a cut to fill balance of earthworks for the development.

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

High level earthworks and volume estimates have been completed and are shown on drawing **Co8753.11-DA30** of **Appendix A**. The earthworks volume estimates are based on a five (5) 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:

Cut	-242,000 m^3	
Fill	+227,500 m^3	
Balance	+14,500 m^3	*(Approx. cut and fill achieved.)*

Retaining walls are shown on drawing **Co8753.11-DA51 to DA54** of **Appendix A**. Retaining, based on a flat pad arrangement, are required on the western, southern and northern boundaries to a maximum height of 6.5m. Estimates of the retaining wall surface area are provided on the drawing.

There is opportunity to reduce the above retaining wall areas by the introduction of landscaped batters which can be located on street setbacks and between development lots. This would be looked at once specific building and site layouts are known as part of concept/ development application design stage of the development.

4.2 Erosion and Sediment Control

Soil Erosion and Sediment Control measures including sedimentation basins will also be provided for the development during the construction phase. All Soil and Sediment Control measures will be performed in accordance with Liverpool City Council requirements and Landcom Managing Urban Stormwater, Soils and Construction (1998) – The Blue Book.

Earthworks over the site will be relatively small when compared to large scale development or mining activity. The effect on groundwater is expected to be minor as a result of these works.

4.3 Embankment Stability

To assist in maintaining embankment stability, permanent batter slopes will be no steeper than 3 horizontal to 1 vertical while temporary batters will be no steeper than 2 horizontal to

1 vertical. This is in accordance with the recommended maximum batter slopes for residual clays and shale which are present in the area.

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

Stability of batters and reinstatement of vegetation shall be in accordance with the submitted drawings and the Soil and Water Management Plan in Section 7.

4.4 Supervision of Earthworks

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

4.5 Retaining Walls

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

Given the existing natural falls and nature of the industrial development, retaining walls will be required. Where possible, landscaped batters are proposed to limit and reduce retaining wall construction. Retaining will be provided as part of infrastructure works to at boundary locations. The proposed method of construction will be reinforced concrete masonry, masonry faced reinforced earth retaining, pile and shot-crete, or other concrete or masonry type construction.

Location and indicative heights of retaining walls are shown on drawing **Co8753.11-DA51-DA54**.

5 STORMWATER MANAGEMENT

5.1 Hydrologic Modelling and Analysis

5.1.1 General Design Principles

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

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

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

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

5.1.2 Minor/ Major System Design

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

5.1.3 Rainfall Data

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

5.1.4 Runoff Models

In accordance with the recommendations and standards of Liverpool City Council, the calculation of the runoff from storms of the design ARI has been calculated with the catchment modelling software DRAINS.

The design parameters for the DRAINS model are to be based on the recommendations as defined by council and parameters for the area and are as follows:

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

Table 4.1. DRAINS Parameters

5.2 Hydraulics

5.2.1 General Requirements

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

5.2.2 Freeboard

The calculated water surface level in open junctions of the piped stormwater system will not exceed a freeboard level of 150mm below the finished ground/ grate level, for the peak runoff from the Minor System runoff.

The calculated water surface for the peak runoff from the Major System runoff will not exceed a freeboard level of 300mm below the finished floor level of the building/ development pads.

5.2.3 Public Safety

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

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

5.2.4 Inlet Pit Spacing

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

5.2.5 Overland Flow

Dedicated flow paths have been designed to convey all storms up to and including the 100-year ARI. These flow paths will convey stormwater from the site to the estate road system and to Estate Detention Basins.

5.3 Site Drainage

5.3.1 Existing Site Drainage

The property is currently undeveloped with no formal drainage located on site. The site contains three sub-catchments which are defined by a natural hillside on the northern site boundary and gulley through the eastern and southern portion of the site. The existing and proposed catchments are shown on drawing Co8753.11-DA40.

As noted in earlier sections, a natural gully conveys stormwater through the southern and eastern portion of the site in a north-easterly direction. This gully drains an upstream residential catchment (33 Ha Approx.). The overland flow from this catchment is discussed further in Section 5.4 of this report.

5.3.2 Proposed Site Drainage

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

The minor system is to consist of a piped drainage system which has been designed to accommodate the 1 in 20-year ARI storm event (Q20). This results in the piped system being able to convey all stormwater runoff up to and including the Q20 event. This meets the requirements of BCC and is the minimum recommended capacity for an industrial development.

The major system will be designed to cater for storms up to and including the 1 in 100-year ARI storm event (Q100). The major system will employ the use of defined overland flow paths, such as roads and open channels, to safely convey excess run-off from the site.

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, the standards of BCC 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).

Stormwater Management is required to be provided for water quantity and quality in accordance with the requirements of LCC DCP and as per the items included in Liverpool City Council pre-development application minutes dated 30 October 2014 and further meeting with Liverpool City Council held between Liverpool Council, DBL Property and Costin Roe Consulting on 15 October 2015. Allowance for conveyance of the existing waterway and overland flow through the site will be required as discussed in **Section 5.4** of the report.

Further discussion on the Stormwater Management Strategy is provided in **Section 7** and **8** of this report. Reference to drawing **Co8753.11-DA41 to DA44** shows the proposed drainage layout.

5.3.3 Site Discharge

Discharge from the site is proposed at three main points on the property boundary, corresponding to the existing catchments over the property.

The first discharge point is made on the north-west corner of the property, draining a catchment of 4.33 Ha. Discharge of attenuated stormwater flows will be made to the existing table drain on Yarrunga Street.

The second discharge will be made at the existing culverts under Bernera Road. A catchment of 12.75 Ha will be directed to existing culverts which matches the current catchment draining to this location. This also corresponds with the alignment of flow from the residential catchment and overland flow which currently passes through the site.

The third and last discharge point will be made via new drainage infrastructure in Yarrunga Street. This system will allow for a 2.28 Ha to be drained from the development.

5.4 External Catchments and Flooding

5.4.1 Introduction

Stormwater flows from one external catchment need to be managed as part of the proposed development.

Liverpool City Council requires that flow from the upstream catchment be conveyed through the site, with no effect on upstream and downstream properties. This requirement was included in the pre-development application minutes dated 30 October 2014 and NSW DP&E SEAR's. The proposed strategy for conveyance of the stormwater flow was also discussed in detail in a meeting with Liverpool City Council held between Mr Charlie Caraballo, Mr Maruf Hossain and Mr Waliminipelli from Liverpool Council, Mr Jeffrey Lord of DBL Property and Mr Mark Wilson from Costin Roe Consulting on 15 October 2015. Following this meeting Council provided Costin

Roe Consulting access to their Prestons Trunk Drainage Flooding and Drainage Assessment Report (by JW Prince Consulting Engineers dated Aug. 2014) to assist in the assessment of the overland flow.

5.4.2 Catchment Description and Hydrology

An upstream catchment (approximately 29 Ha) to the south of the site currently drains through the property. The location of the overland flow path and upstream catchment has been shown in **Figure 5.1** below. The upstream catchment comprises residential development and piped flow from the catchment discharge onto the site via twin 900mm steel stormwater pipes. The existing twin 900mm pipes align with the low point in Kurrajong Road and overland flows from the residential catchment are directed to this point. In a flood situation, overland flow would overtop the kerb and join the flow piped flow, before being directed toward Bernera Road in a natural gully. Once reaching Bernera Road, three 1150mm wide by 600mm deep box culverts convey stormwater across Bernera Road to the east of the development. We understand this system has limited capacity and a large proportion overtops the culvert system and continues north along Bernera Road as overland flow.

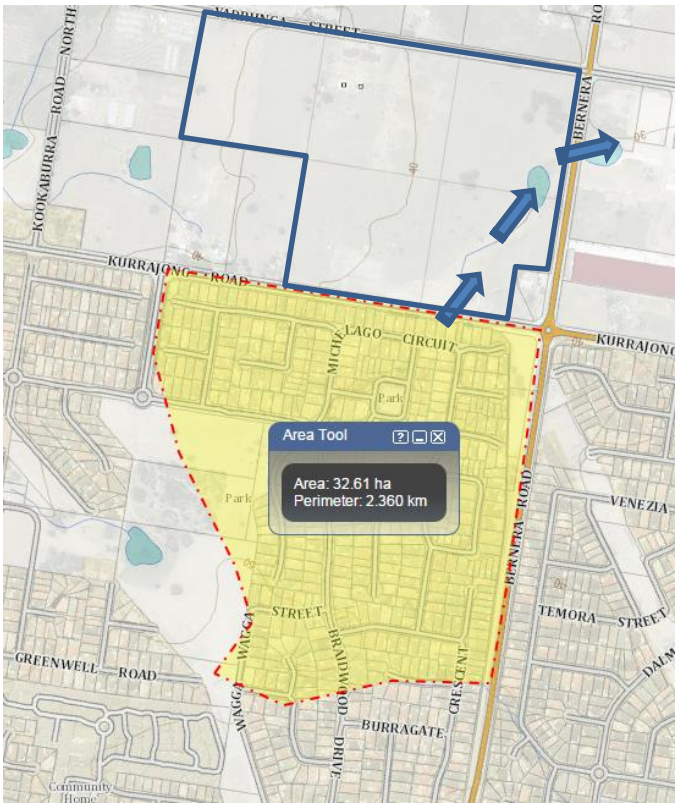

Figure 3.1. Upstream Catchment and Overland Flow Path

The Q100 Average Recurrence Interval (ARI) design flow, provided by Liverpool City Council in their Prestons Trunk Drainage Flooding and Drainage Assessment Report (by JW Prince Consulting Engineers dated Aug. 2014) is estimated to be 12.3m^3/s at the upstream end and 13.3m^3/s at the downstream end of the gully. The flow at the downstream end of the gully, following development, is based on based on attenuation

of flows from the proposed development site. The flow regime in the Prestons Trunk Drainage Report has been reviewed and adopted by Costin Roe Consulting Pty Ltd for use in this analysis.

5.4.3 Hydraulics

A new trunk drainage line and overland flow channel is proposed to convey the 1% AEP flow of 12.3m3/s to 13.3m^3/s flow through the site. It is proposed to allow for conveyance of up to 1.5m3/s as overland flow through the car-parking area with the remaining 11.8m^3/s of flow being provided in a box culvert system. Once downstream of the car parking area, the full flow will be conveyed as an open channel between Building 3 and 4 to the Bernera Road boundary. The channel will then run adjacent to Bernera Road, within a 14m setback zone within the property, to the existing Bernera Road culvert system where it will terminate.

The trunk drainage system is shown on drawings **Co8753.11-DA41** to **DA44**. The box culvert system will comprise two cells of 1800mm wide by 1500mm deep to convey the expected flow. The new trunk drainage system has been designed to bypass all site specific detention (OSD) measures and water quality devices.

A HEC-RAS analysis of the proposed system was completed to ensure the safe conveyance of overland flows through the development site. The results of the assessment can be found in **Appendix E**. The assessment shows the following:

- The proposed 14m wide cross section is able to convey stormwater flow of 1.5m3/s through the parking area with a depth of 150mm, velocity of 1m/s and corresponding depth by velocity (DV) factor 0.15;
- The DV factor of 0.15 is below the maximum council limit of 0.4 for safe pedestrian movements;
- The open channel downstream of the culvert outlet is able to convey the 13.3m3/s at a depth of 750mm, velocity of 2.4m/s and corresponding depth by velocity (DV) factor 1.8;
- The DV factor is above safe limits for pedestrians and this area will require fencing from Bernera Road and the site;
- The Flood Planning Levels (FPL) for Buildings 3 and 4 are based on the 1 in 100 year ARI water level of 34.2m at the upstream end of the channel, adjacent to the buildings. The FPL for Building 3 and 4 is RL 34.7m, which allows for 500mm freeboard to the building floor level from the 1 in 100 year water level.
- The existing levels and arrangement at the downstream end of the overland flow path around the culvert beneath Bernera Road will be maintained as per the current arrangement. The flows being directed to the existing culverts in Bernera Road will also match existing (following site attenuation). This will ensure a no worsening effect relating to overland flow and flooding issues of adjacent and downstream properties.

The HEC-RAS assessment shows that the overland flow which emanates from Kurrajong Road and the residential catchment to the south of the site can be conveyed through the property in a safe and effective manner.

5.5 Cabramatta Creek

Cabramatta Creek is located some 450m to the west of the development and is subject to flash flooding and overland flow. Review of the *Cabramatta Creek Floodplain Management Study and Plan, October 2004*, produced by Bewsher Consulting Pty Ltd for Liverpool City Council & Fairfield City Council, shows that the Q100 ARI flood extent extends along Yarrunga Road some 250m to its intersection with Kookaburra Road North.

The Cabramatta Creek flood extent can be seen to be at least 200m from the closest boundary of the development site. The site is not affected by, nor will it effect, flood events within Cabramatta Creek. The development is above the flood planning levels related to Cabramatta Creek and no additional design measures are required to be introduced as a result of flooding in Cabramatta Creek.

The *Cabramatta Creek Floodplain Management Study and Plan, October 2004* is a publically available document available for download from the Liverpool City Council website.

6 WATER QUANTITY MANAGEMENT

Liverpool City Council requires water quantity management, or stormwater detention, to be provided to limit the runoff discharged from private property into the underground piped drainage system to pre-developed flow and to assist in mitigating the increased stormwater runoff generated by development.

Attenuation of stormwater runoff from the development is proposed to be managed via a number of detention tanks provided in strategic locations for each of the development lots. As discussed with Liverpool Council the objective is to attenuate stormwater flow from the development to pre-developed flows.

Sizing of the basin systems has been completed using DRAINS modelling software in accordance with the Liverpool City Council Policy for the 1 in 2 year ARI to 1 in 100 year ARI storms for various durations. The modelling accounts for

Table 7.1 provides details for the pre and post development flows and storage for the total detention system. The critical storm duration for the 1in 2 year, 1in 20 year and 1 in 100 year ARI storms is 2 hours and flows and storage information are provided for this storm.

ARI	Pre-developed Flow (m^3/s)	Post Developed Flow (m^3/s)	
		Un-attenuated	Attenuated
2	2.31	4.49	2.29
20	5.28	7.423	3.45
100	6.64	9.209	5.55

Table 7.1. Site and Detention Hydrology

Indicative locations of the eight (8) detention systems can be found on drawings **Co8753.11-DA41 to DA44**. These have been shown as detention tanks on the planning application drawings. The final arrangement of tanks would be confirmed in detail design stage, ensuring the flow arrangements of **Table 7.1** are achieved. Indicative hydrological and storage arrangements are shown below.

ARI	Post Developed Flow (m^3/s)				Storage (m^3)
	Un-attenuated	Attenuated			
		Low Flow	High Flow	Total	
2	0.99	0.523	0	0.523	650
20	1.48	0.820	0	0.820	975
100	2.04	0.914	0.401	1.31	1100

Table 7.2. Detention Tank A

ARI	Post Developed Flow (m^3/s)				Storage (m^3)
	Un-attenuated	Attenuated			
		Low Flow	High Flow	Total	
2	0.9	0.499	0	0.499	355
20	1.35	0.739	0	0.739	670
100	1.65	0.803	0.487	1.29	750

Table 7.3. Detention Tank B

ARI	Post Developed Flow (m^3/s)				Storage (m^3)
	Un-attenuated	Attenuated			
		Low Flow	High Flow	Total	
2	0.394	0.251	0	0.251	125
20	0.592	0.378	0	0.378	220
100	0.713	0.423	0.132	0.553	260

Table 7.4. Detention Tank C

ARI	Post Developed Flow (m^3/s)				Storage (m^3)
	Un-attenuated	Attenuated			
		Low Flow	High Flow	Total	
2	0.16	0.086	0	0.086	65
20	0.241	0.127	0	0.127	115
100	0.291	0.137	0.089	0.226	130

Table 7.5. Detention Tank D

ARI	Post Developed Flow (m^3/s)				Storage (m^3)
	Un-attenuated	Attenuated			
		Low Flow	High Flow	Total	
2	0.187	0.073	0	0.073	105
20	0.280	0.105	0	0.105	190
100	0.338	0.113	0.114	0.227	220

Table 7.6. Detention Tank E

ARI	Post Developed Flow (m^3/s)				Storage (m^3)
	Un-attenuated	Attenuated			
		Low Flow	High Flow	Total	
2	0.316	0.182	0	0.182	110
20	0.474	0.270	0	0.270	210
100	0.573	0296	0.154	0.448	240

Table 7.7. Detention Tank F

ARI	Post Developed Flow (m^3/s)				Storage (m^3)
	Un-attenuated	Attenuated			
		Low Flow	High Flow	Total	
2	0.272	0.129	0	0.129	130
20	0.406	0.185	0	0.185	250
100	0.493	0.194	0.208	0.402	275

Table 7.8. Detention Tank G

ARI	Post Developed Flow (m^3/s)				Storage (m^3)
	Un-attenuated	Attenuated			
		Low Flow	High Flow	Total	
2	1.04	0.425	0	0.425	620
20	1.55	0.615	0	0.615	1100
100	1.88	0.676	0.438	1.11	1300

Table 7.9. Detention Tank H

The modelling has shown that, with the provision of a total storage volume of 4275m^3 contained in eight modelled systems, stormwater flows from the development will be attenuated to predevelopment flows. Detention storage will fully active and will be provided as a series of underground tanks, and where available as above ground basins

in open space and conservation areas. The proposed detention system meets the policy requirements of Liverpool City Council. The modelling allows for 1.0 Ha (5%) of the site to be un-attenuated and includes the eastern access road and landscaped batters. We also confirm that the flow from the site ($2.33m^3/s$) being directed to the existing Bernera Road culvert system are approximately 20% less than the pre-developed flow of $3.0m^3/s$.

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 so as to minimise the adverse impact these pollutants could have on receiving waters and to also meet the requirements specified by Liverpool City Council.

Liverpool City Council have nominated, in *Section 6.4* of *Part 1* of their *DCP 2008*, the requirements for stormwater quality to be performed on a catchment wide basis. These are presented in terms of annual percentage pollutant reductions on a developed catchment and are as follows:

Gross Pollutants	90%
Total Suspended Solids	80%
Total Phosphorus	45%
Total Nitrogen	45%
Total Hydrocarbons	90%

7.2 Proposed Stormwater Treatment System

Developed impervious areas 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 development shall be based on a treatment train approach to ensure that all of the objectives above are met.

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

- Treatment of stormwater on the development is to be performed via the provision of a treatment train of proprietary systems;
- Primary treatment will be completed via Gross Pollutant Trap (GPT). The proposed GPT is the Humegard;
- Tertiary treatment is to be performed via Humeceptor Hydrodynamic separation system;
- It is noted that stormwater from the upstream catchments will bypass treatment systems and undeveloped areas are not included in the modelling; and
- A portion of the future building roof wills also provide a level of treatment via rainwater reuse and settlement within rainwater tanks. Indicative locations and sizes of rainwater tanks has been included in the modelling of the development and shown on drainage layout plans.

7.3 Stormwater Quality Modelling

7.3.1 Introduction

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

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

The pollutant retention criteria set out in Councils DCP and nominated in **Section 7.1** of this report were used as a basis for assessing the effectiveness of the selected treatment trains.

The MUSIC model "8487.11_*Rev1.sqz*"was set up to examine the effectiveness of the water quality treatment train and to predict if council requirements have been achieved. The layout of the MUSIC model is presented in **Appendix B**.

7.3.2 Rainfall Data

Six minute pluviographic data 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
Evapotanspiration	Sydney Monthly Areal PET
Model Timestep	6 minutes

7.3.3 Rainfall Runoff Parameters

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

7.3.4 Pollutant Concentrations& Source Nodes

Pollutant concentrations for source nodes are not available from Liverpool City Council. The source nodes used are based on the land use parameters defined by the nearby Blacktown City Council and are shown as per the **Table 8.1**:

Flow Type	Surface Type	TSS (log_{10} values)		TP (log_{10} values)		TN (log_{10} values)	
		Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Baseflow	Roof	1.20	0.17	-0.85	0.19	0.11	0.12
	Roads	1.20	0.17	-0.85	0.19	0.11	0.12
	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

Table 8.1. 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 **Co8487.11-DA40** in **Appendix A**.

7.3.5 Treatment Nodes

Gross Pollutant Trap and Hydrodynamic Separation device treatment nodes have been used in the modelling of the development as provided by the suppliers of the products based on testing completed by the product manufacturers. Detention basin and swale nodes were also introduced to the model using typical parameters contained in MUSIC modelling guidelines.

Gross Pollutant Trap (Humegard)

Parameter	**Value**
Treatable Flow	1.2m3/s (6 month ARI flow)
Pollutant Reductions	
TSS	46 %
TP	20 %
TN	20 %
GP's	85 %

Hydrodynamic Seperator (Humeceptor)

Parameter	**Value**
Treatable Flow	1.2m3/s (6 month ARI flow)
Pollutant Reductions	
TSS	80 %
TP	30 %
TN	30 %
GP's	98 %

7.3.6 Results

Table 7.3 shows the results of the MUSIC analysis. The reduction rate is expressed as a percentage and compares the post-development pollutant loads without treatment versus post-development loads with treatment.

	Source	Residual Load	% Reduction	Target Met
Total Suspended Solids (kg/yr)	28,700	975	96.6	Y
Total Phosphorus (kg/yr)	52.5	14.6	72.1	Y
Total Nitrogen (kg/yr)	278	152	45.4	Y
Gross Pollutants (kg/yr)	3140	0	100	Y

Table 7.3. MUSIC analysis results

The model results indicate that, through the use of the STM's in the treatment train, pollutant load reductions for Total Suspended Solids, Total Phosphorous, Total Nitrogen and Gross Pollutants will meet the requirements of Part 1 of Liverpool City Councils DCP 2008 on an overall catchment basis.

7.3.7 Modelling Discussion

MUSIC modelling has been performed to assess the effectiveness of the selected treatment trains and to ensure that the pollutant retention requirements of Part 1 of Councils DCP 2008 have been met.

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

Hydrocarbon removal cannot easily be modelled with MUSIC software. The proposed distribution/ storage facility would be expected to produce low source loadings of hydrocarbons. Potential sources of hydrocarbons would be limited to leaking engine sumps or for accidental fuel spills/leaks and leaching of bituminous pavements (car parking only). The potential for hydrocarbon pollution is low and published data from the CSIRO indicates that average concentrations from Industrial sites are in the order of 10mg/L and we would expect source loading from this site to be near to or below this concentration. Hydrocarbon pollution will be treated by the treatment train of propriety devices described above and based on the manufacturers testing would 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 Liverpool City Council have been met.

7.4 Stormwater Harvesting

Stormwater harvesting refers to the collection of stormwater from the developments internal stormwater drainage system for re-use in non-potable applications. Stormwater

from the stormwater drainage system can be classified as either rainwater where the flow is from roof areas only, or stormwater where the flow is from all areas of the development.

Rainwater harvesting will be required for the development in order to meet Liverpool Council Policy and NSW Department of Planning and The Environment requirements with the aim being to reduce overall demand by providing re-use for non-potable applications. Internal uses include such applications as toilet flushing while external applications will be used for irrigation.

Indicative locations for rainwater tanks have been made on the master plan layout for the development. As individual building uses have not yet been defined as part of this application, sizing of rainwater tanks has not been undertaken. These would be defined in future detail design and development applications based on a water balance assessment as outlined in Council Policy and the document Managing Urban Stormwater: Harvesting and Reuse – 2006 (NSW DEC).

In general terms the rainwater harvesting systems are expected to comprise 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. This however would be, as noted, subject to future detail design.

7.5 Maintenance And Monitoring

It is important that each component of the water quality treatment train is properly operated and maintained. In order to achieve the design treatment objectives, an indicative maintenance schedule has been prepared (refer to **Table 8.5** below) to assist in the effective operation and maintenance of the various water quality components.

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

Table 8.5. Indicative Maintenance Schedule

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
SWALES/ LANDSCAPED AREAS			
Check density of vegetation and ensure minimum height of 150mm is maintained. Check for any evidence of weed infestation	Six monthly	Maintenance Contractor	Replant and/or fertilise, weed and water in accordance with landscape consultant specifications
Inspect swale for excessive litter and sediment build up	Six monthly	Maintenance Contractor	Remove sediment and litter and dispose in accordance with local authorities' requirements.
Check for any evidence of channelisation and erosion	Six monthly/ After Major Storm	Maintenance Contractor	Reinstate eroded areas so that original, designed swale profile is maintained
Weed Infestation	Three Monthly	Maintenance Contractor	Remove any weed infestation ensuring all root ball of weed is removed. Replace with vegetation where required.
Inspect swale surface for erosion	Six Monthly	Maintenance Contractor	Replace top soil in eroded area and cover and secure with biodegradable fabric. Cut hole in fabric and revegetate.
OSD SYSTEM			
Check all items nominated for SWALES/ LANDSCAPED AREAS above	Refer to SWALES/ LANDSCAPED AREAS section above	Refer to SWALES/ LANDSCAPED AREAS section above	Refer to SWALES/ LANDSCAPED AREAS section above
Inspect and remove any blockage from orifice	Six Monthly	Maintenance Contractor/ Owner	Remove grate and screen to inspect orifice.
Inspect trash screen and clean	Six Monthly	Maintenance Contractor/ Owner	Remove grate and screen if required to clean it.
Inspect flap valve and remove any blockage.	Six Monthly	Maintenance Contractor/ Owner	Remove grate. Ensure flap valve moves freely

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
			and remove any blockages or debris.
Inspect pit sump for damage or blockage.	Six Monthly	Maintenance Contractor/ Owner	Remove grate & screen. Remove sediment/ sludge build up and check orifice and flap valve is clear.
Inspect storage areas and remove debris/ mulch/ litter etc likely to block screens/ grates.	Six Monthly	Maintenance Contractor/ Owner	Remove debris and floatable materials.
Check attachment of orifice plate and screen to wall of pit	Annually	Maintenance Contractor	Remove grate and screen. Ensure plate or screen mounted securely, tighten fixings if required. Seal gaps if required.
Check orifice diameter is correct and retains sharp edge.	Five yearly	Maintenance Contractor	Compare diameter to design (see Work-as-Executed) and ensure edge is not pitted or damaged.
Check screen for corrosion	Annually	Maintenance Contractor	Remove grate and screen and examine for rust or corrosion, especially at corners or welds.
Inspect overflow weir and remove any blockage	Six monthly	Maintenance Contractor/ Owner	Ensure weir is free of blockage.
Inspect walls for cracks or spalling	Annually	Maintenance Contractor	Remove grate to inspect internal walls, repair as necessary.
Check step irons	Annually	Maintenance Contractor	Ensure fixings are secure and irons are free from corrosion.
RAINWATER TANK			
Check for any clogging and blockage of the first flush device	Monthly	Maintenance Contractor	First flush device to be cleaned out
Check for any clogging and blockage of the tank inlet -	Six monthly	Maintenance Contractor	Leaves and debris to be removed from the inlet leaf/litter screen

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
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.
PROPRIETARY TREATMENT DEVICES (GPT AND HYDRODYNAMIC)			
Refer to Manufacturers Operation and Maintenance Manuel	Annually	Maintenance Contractor	Refer to Manufacturers Operation and Maintenance Manuel
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 EROSION & SEDIMENT CONTROL PLAN

An erosion and sediment control plan (ESCP) is included in drawings **Co8753.11-DA20 and DA25**. These plans show the works can proceed without polluting receiving waters. A detailed plan will be prepared after development consent is granted and before works commence.

8.1 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 Liverpool 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.

8.2 Land Disturbance

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

Land Use	Limitation	Comments
Construction areas	Limited to 5 (preferably 2) metres from the edge of any essential construction activity as shown on the engineering plans.	All site workers will clearly recognise these areas that, where appropriate, are identified with barrier fencing (upslope) and sediment fencing (downslope), or similar materials.
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

8.3 Erosion & Sediment Control Conditions

1. Clearly visible barrier fencing shall be installed as shown on drawing **Co8753.11-DA20** and elsewhere at the discretion of the site superintendent to ensure traffic control and prohibit unnecessary site disturbance. Vehicular access to the site shall be limited to only those essential for construction work and they shall enter the site only through the stabilised access points.
2. Soil materials will be replaced in the same order they are removed from the ground. It is particularly important that all subsoils are buried and topsoils (landscaped areas only) remain on the surface at the completion of works.
3. The construction program should be scheduled so that period of time from starting land disturbance to stabilisation is minimised.
4. 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 2 year ARI (Q2).
9. During windy weather, large, unprotected areas will be kept moist (not wet) by sprinkling with water to keep dust under control. In the event water is not available in sufficient quantities, soil binders and/or dust retardants will be used or the surface will be left in a cloddy state that resists removal by wind.

8.4 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.

8.5 Waste Management Conditions

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

8.6 Site Inspection and Maintenance

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

The self audit will include:

- Recording the condition of every sediment control device;
- Recording maintenance requirements (if any) for each sediment control device;
- Recording the volumes of sediment removed from sediment retention systems, where applicable;
- Recording the site where sediment is disposed; and

- Forwarding a signed duplicate of the completed Check Sheet to the project manager/developer for their recording.

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

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

make ongoing changes to the plan where it proves inadequate in practice or is subjected to changes in conditions at the work site or elsewhere in the catchment.

11. Erosion and sediment control measures will be maintained in a functioning condition until all earthwork activities are completed and the site fully stabilised.
12. Litter, debris and sediment will be removed from the gross pollutant traps and trash racks as required.

9 CONCLUSION

This Civil Engineering Details Report has been prepared to support the application for a proposed warehouse and distribution development of at Yarrunga Street, Prestons.

A civil engineering strategy for the site has been developed which provides a best practice solution within the constraints of the existing landform and proposed development layout. Within this strategy a stormwater quantity and quality management strategy has been developed to reduce both peak flows and pollutant loads in stormwater leaving this site. The stormwater management for the development has been designed in accordance with Liverpool City Council's Part 1 of DCP2008.

The stormwater layout for the development maintains the existing catchment breakdown and three site discharge points are proposed. A hydrological assessment has been undertaken which confirms local post development flows from the site will be less than pre-development flows and demonstrates that the site discharge would not adversely affect any land, drainage system or watercourse as a result of the development. A stormwater detention system comprising active storage of 4275m^3 is proposed to attenuate developed stormwater flows to pre-developed flows. This will be provided by a number of detention tanks located strategically throughout the development site which align with the existing catchment breakdown and architectural layout over the site.

A trunk drainage system comprising conveyance of 13.3m^3/s via in-ground culverts and overland flow from the southern residential catchment has been made. This conveys stormwater through the site from the existing low point on Kurrajong Road, through the site to the existing Bernera Road culvert crossing. Existing levels and flow arrangement at the Bernera Road culverts remain consistent with the existing scenario ensuring a no-worsening effect on the existing flooding which has been identified by Liverpool Council in the area.

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

During the operational phase of the development, a treatment train incorporating the use Stormwater Treatment Measures (STM's) comprising a proprietary treatment train of gross pollutant trap, detention tanks and vortech style hydrodynamic separation unit have been proposed to mitigate the increase in stormwater pollutant loads generated by the development. MUSIC modelling results indicate that the proposed STM are effective in reducing pollutant loads from the stormwater discharging from the site and that the provided treatment meet the requirements of Council's pollution reduction targets. Best management practices have been applied to the development to ensure that the quality of stormwater runoff is not detrimental to the receiving environment.

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

10 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);
- Liverpool City Council – DCP 2008 (Part 1); and
- Water Sensitive Urban Design – "Technical Guidelines for Western Sydney" by URS Australia Pty Ltd, May 2004

Appendix A

DRAWINGS BY COSTIN ROE CONSULTING

PROPOSED DEVELOPMENT
YARRUNGA STREET
PRESTONS, NSW

DRAWING LIST:

DRAWING NO.	DRAWING TITLE
C08753.11-DA10	DRAWING LIST & GENERAL NOTES
C08753.11-DA15	TRANSMISSION LINE PLAN & LONGSECTION
C08753.11-DA20	EROSION & SEDIMENT CONTROL PLAN
C08753.11-DA25	EROSION & SEDIMENT CONTROL DETAILS-SHEET 1
C08753.11-DA26	EROSION & SEDIMENT CONTROL DETAILS-SHEET 2
C08753.11-DA30	INDICATIVE EARTHWORKS FLAT PAD & INDICATIVE VOLUMES
C08753.11-DA40	DRAINAGE MAJOR CATCHMENT PLAN
C08753.11-DA41	STORMWATER DRAINAGE PLAN-SHEET 1
C08753.11-DA42	STORMWATER DRAINAGE PLAN-SHEET 2
C08753.11-DA43	STORMWATER DRAINAGE PLAN-SHEET 3
C08753.11-DA44	STORMWATER DRAINAGE PLAN-SHEET 4
C08753.11-DA45	KURRAJONG ROAD CULVERT CONNECTION & PLAN
C08753.11-DA46	CONCEPT STORMWATER DRAINAGE DETAIL-SHEET 1
C08753.11-DA47	CONCEPT STORMWATER DRAINAGE DETAIL-SHEET 2
C08753.11-DA 50	FINISHED LEVELS PLAN-SHEET 1
C08753.11-DA 51	FINISHED LEVELS PLAN-SHEET 2
C08753.11-DA 52	FINISHED LEVELS PLAN-SHEET 3
C08753.11-DA 53	FINISHED LEVELS PLAN-SHEET 4
C08753.11-DA 55	TYPICAL SECTIONS
C08753.11-DA70	YARRUNGA STREET FUNCTIONAL LAYOUT-SHEET 1
C08753.11-DA71	YARRUNGA STREET FUNCTIONAL LAYOUT-SHEET 2
C08753.11-DA72	YARRUNGA STREET FUNCTIONAL LAYOUT-SHEET 3
C08753.11-DA73	YARRUNGA STREET-TYPICAL SECTIONS
C08753.11-DA74	YARRUNGA STREET-TYPICAL DETAILS

GENERAL NOTES:

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

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

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

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

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

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

ELECTRONIC INFORMATION NOTES:

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

SITE PREPARATION NOTES:

1. ALL EARTHWORKS SHALL BE COMPLETED GENERALLY IN ACCORDANCE WITH THE GUIDELINES SPECIFIED BY THE GEOTECHNICAL REPORT No. 115-17293 PROVIDED BY SOIL SURVEYS DATED MAY, 2015.
2. EXISTING LEVELS ARE BASED ON INFORMATION PROVIDED BY AAM TITLED 2444A_NOM_SCHWP_DTM_A DATED 12 FEBUARY 2015 & WOLTER CONSULTING GROUP TITLED SB3497-01 Issue A DATED 27 AUGUST 2015.
3. STRIP ANY TOP SOIL OR DELETERIOUS MATERIAL AND BLEND INTO BATTER TOPSOIL MATERIAL OR STORE AS DIRECTED.
4. COMPLETE CUT TO FILL EARTHWORKS TO ACHIEVE THE REQUIRED LEVELS AS INDICATED ON THE DRAWINGS WITHIN A TOLERANCE OF +0mm/-10mm THROUGH BUILDING PADS/PAVEMENTS AND +0mm/-20mm ELSEWHERE.
5. TOP 1000mm ROCK BELOW BULK EARTHWORKS LEVEL (BEL) IN AREAS OF CUT TO BE RIPPED AND RECOMPACTED IN ACCORDANCE WITH GEOTECHNICAL ADVICE AS 'SITE WON FILL'.
6. IN AREAS OF FILL, THE TOP 500mm IS TO COMPRISE OF SELECT CRUSHED ROCK, SITE WON FROM AREAS OF CUT IN ROCK.
7. PREPARE STEEP BATTERS TO RECEIVE FILL BY CONSTRUCTING BENCHING TO FACILITATE FILL PLACEMENT AND COMPACTION.
8. AREAS TO RECEIVE FILL (THAT ARE NOT ON BENCHED BATTERS) AND AREAS IN CUT SHALL BE PROOF ROLLED TO IDENTIFY ANY SOFT HEAVING MATERIAL. SOFT MATERIAL SHALL BE BOXED OUT AND REMOVED PRIOR TO FILL PLACEMENT.
9. SITE WON FILL TO BE PLACED IN MAXIMUM 300mm LOOSE LAYERS AND COMPACTED TO 100% STANDARD AND WITHIN 2% OF OPTIMUM MOISTURE CONTENT.
10. IMPORTED FILL SHALL BE PLACED IN MAXIMUM 300mm LOOSE LAYERS AND COMPACTED TO 100% STANDARD AND WITHIN 2% OF OPTIMUM MOISTURE CONTENT.
11. MAXIMUM PARTICLE SIZE TO BE THE SMALLER OF 150mm OR HALF THE (LOOSE) LAYER THICKNESS AND/OR TWO THIRDS THE LAYER THICKNESS AFTER COMPACTION.
12. ALL EARTHWORKS SHALL BE COMPLETED UNDER LEVEL 1 CONTROL IN ACCORDANCE WITH AS 3798-2007.
13. PRIOR TO ANY EARTHWORKS, EROSION CONTROL AS OUTLINED IN THE EROSION AND SEDIMENTATION CONTROL PLAN SHALL BE COMPLETED.
14. EXISTING ROCK, IF ANY, SHALL BE REMOVED BY HEAVY ROCK BREAKING OR RIPPING.
15. MATCH EXISTING LEVELS AT BATTER INTERFACE.
16. CONTRACTOR TO MATCH EXISTING LEVELS AT THE INTERFACE OF EARTHWORKS AND EXISTING SURFACE AT BATTER LOCATIONS OR WHERE NO RETAINING WALLS ARE PRESENT. ANY DISCREPANCY BETWEEN DESIGN AND EXISTING LEVELS TO BE REFERRED TO THE ENGINEER FOR DIRECTION OR ADJUSTMENTS TO DESIGN LEVELS.

LOCALITY PLAN
NOT TO SCALE

FOR DEVELOPMENT APPROVAL

AMENDMENTS	DATE	ISSUE
ISSUED FOR DEVELOPMENT APPROVAL	21.01.16	C
ISSUED FOR DEVELOPMENT APPROVAL	18.11.15	B
ISSUED FOR REVIEW	05.11.15	A

ARCHITECT

CLIENT
LOGOS PROPERTY
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167 MACQUARIE STREET
SYDNEY NSW

PROJECT
PROPOSED DEVELOPMENT
32 YARRUNGA STREET
PRESTONS NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	SD			A1		8753.11-DA10

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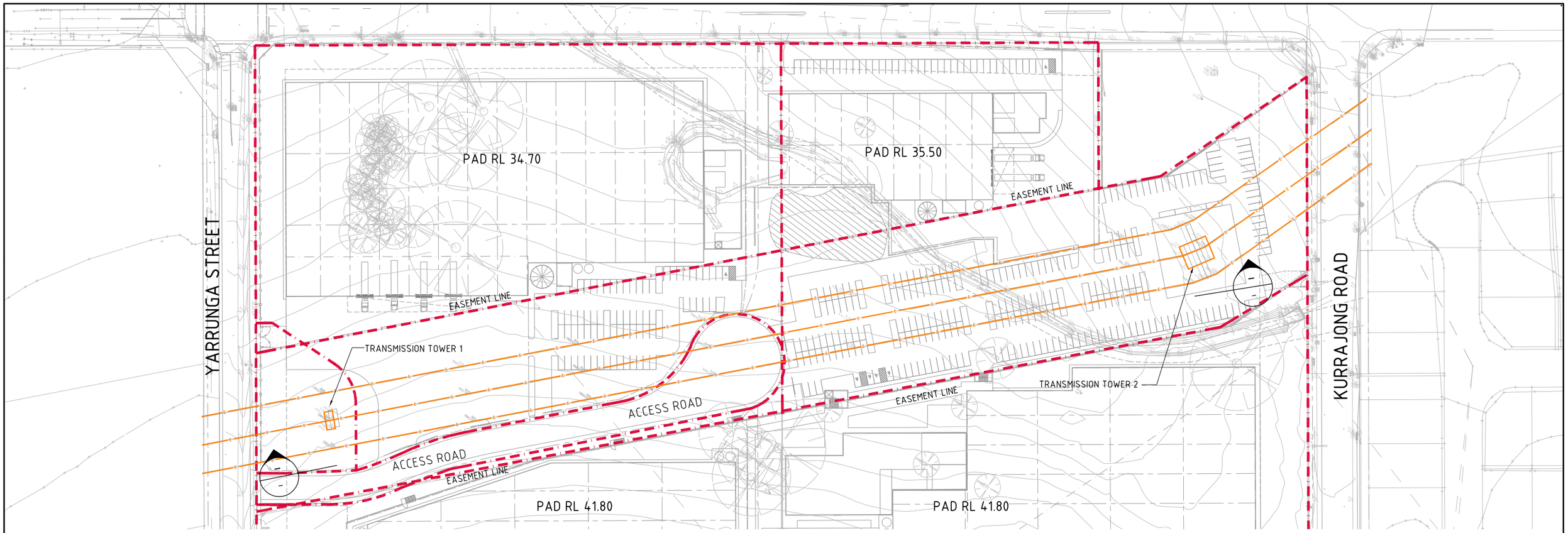
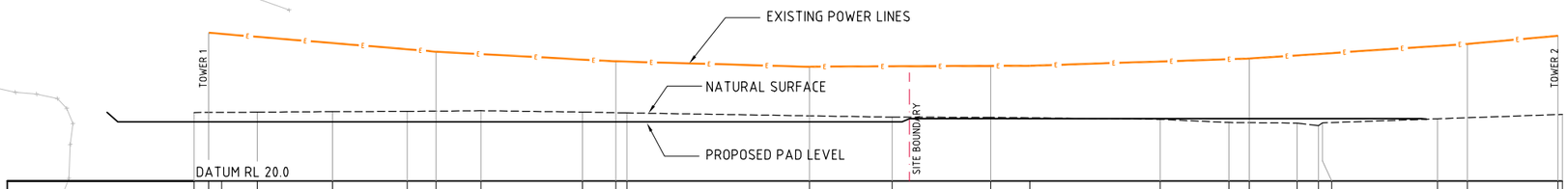
DRAWING TITLE
DRAWING LIST AND GENERAL NOTES

DRAWING No C08753.11-DA10

ISSUE C



TRANSMISSION LINE PLAN
SCALE 1:750



CHAINAGE (m)	0.000	3.650	6.870	15.374	34.511	53.121	60.259	71.459	96.782	105.180	107.800	153.310	173.896	198.491	208.228	240.681	257.820	262.889	276.820	281.110	281.110	309.810	317.210	339.799	340.875
NATURAL SURFACE (m)	37.046	37.064	37.080	37.124	37.260	37.328		37.488	37.160	36.936			35.894	35.832		35.353	34.554		34.395	33.798	34.446	35.480			36.580
PAD LEVEL (m)				34.700	34.700	34.700	34.700	34.700	34.700	34.700	34.700	34.700	34.700	35.500	35.500	35.500	35.500	35.500	35.500	35.500	35.500	35.500	35.500		
PRE-DEVELOPMENT CLEARANCE (m)		19.854					14.822			12.814		12.244		12.926	12.979			15.988					18.390		19.653
POST-DEVELOPMENT CLEARANCE (m)							17.512			15.105		13.763		13.158	13.200			14.994					18.632		
POWER LINES (m)		56.918					52.212			49.805		48.463		48.658	48.700			50.494					54.132		56.195

TRANSMISSION LINE LONGSECTION
SCALE 1:750

NOTES:
EXISTING LEVELS ARE BASED ON INFORMATION PROVIDED BY LAND PARTNERS TITLED SY073596.000_DETAIL SURVEY DATED 23/03/2015.

REFER TO ABOVE DRAWINGS FOR TEMPERATURE AND TIME OF SURVEY AT THE NOMINATED POWER LINES.

NOTE: ALL LEVELS ARE INDICATIVE & MAY BE SUBJECT TO MINOR VARIATION TO SUIT DETAILED DESIGN.

6m 0 15 30 45 60 75m
SCALE 1:750 AT A1 SIZE SHEET

FOR DEVELOPMENT APPROVAL

AMENDMENTS	DATE	ISSUE
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DRAWING TITLE
TRANSMISSION LINE PLAN AND LONGSECTION

DRAWING No C08753.11-DA15 ISSUE D

SEDIMENTATION BASIN NOTE:

FOR SEDIMENT & EROSION CONTROL DETAILS REFER TO DRAWING C08753.00-C25&C26.

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

APPROXIMATE AREA OF DISTURBED SITE = 19.5 Ha

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

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

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

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

SOIL TYPE ASSESSED FROM GEOTECHNICAL REPORT PROVIDED BY XXX TITLED XXX DATED XXX.

SEDIMENT BASIN 1:

CATCHMENT AREA	= 4.68ha
REQUIRED BASIN VOLUME	= 1130m^3
BASE DIMENSION (LxB)	= 12.0m x 41m
TOP DIMENSION (LxB)	= 21.0m x 50.0m
MAX SIDE SLOPE	= 1V:3H
DEPTH	= 1.5m
PROVIDED BASIN VOLUME	= 1199m^3

SEDIMENT BASIN 2:

CATCHMENT AREA	= 3.86ha
REQUIRED BASIN VOLUME	= 932m^3
BASE DIMENSION (LxB)	= 20.0m x 21.0m
TOP DIMENSION (LxB)	= 29.0m x 30.0m
MAX SIDE SLOPE	= 1V:3H
DEPTH	= 1.5m
PROVIDED BASIN VOLUME	= 947m^3

SEDIMENT BASIN 3:

CATCHMENT AREA	= 10.50ha
REQUIRED BASIN VOLUME	= 2536m^3
BASE DIMENSION (LxB)	= 30.0m x 45.0m
TOP DIMENSION (LxB)	= 39.0m x 54.0m
MAX SIDE SLOPE	= 1V:3H
DEPTH	= 1.5m
PROVIDED BASIN VOLUME	= 2571m^3

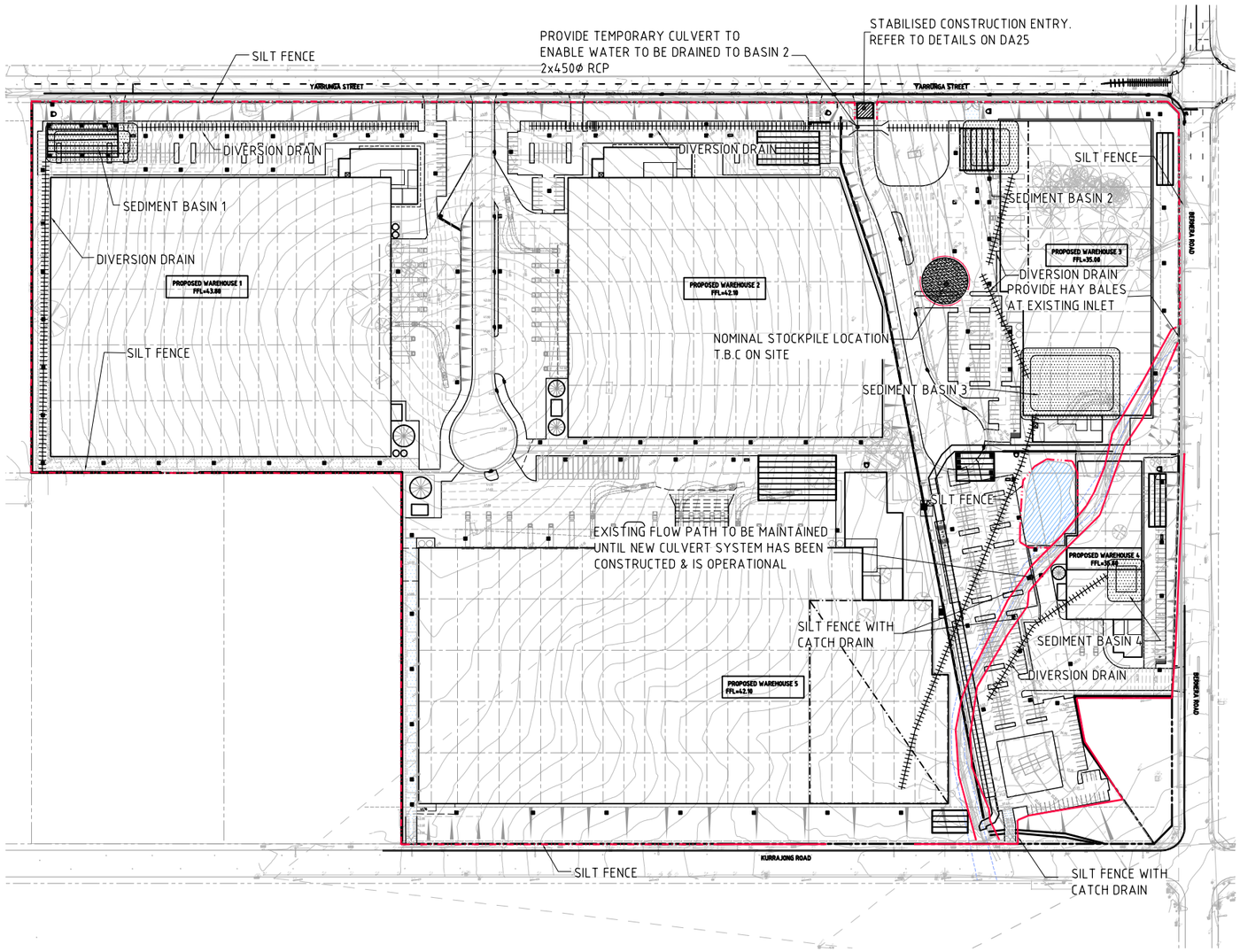
SEDIMENT BASIN 4:

CATCHMENT AREA	= 1.8ha
REQUIRED BASIN VOLUME	= 435m^3
BASE DIMENSION (LxB)	= 11.0m x 14.0m
TOP DIMENSION (LxB)	= 20.0m x 23.0m
MAX SIDE SLOPE	= 1V:3H
DEPTH	= 1.5m
PROVIDED BASIN VOLUME	= 440m^3

EROSION CONTROL NOTES

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

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



EROSION AND SEDIMENT CONTROL PLAN
SCALE 1:1500

FOR DEVELOPMENT APPROVAL

NOTE: ALL LEVELS ARE INDICATIVE & MAY BE SUBJECT TO MINOR VARIATION TO SUIT DETAILED DESIGN.

15m 0 15 30 45 60 75 90 105 120 135 150m

SCALE 1:1500 AT A1 SIZE SHEET

AMENDMENTS	DATE	ISSUE
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ISSUED FOR DEVELOPMENT APPROVAL	25.11.15	C
ISSUED FOR DEVELOPMENT APPROVAL	18.11.15	B
ISSUED FOR REVIEW	05.11.15	A

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PROJECT
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DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	SD			A1		8753.11-DA20

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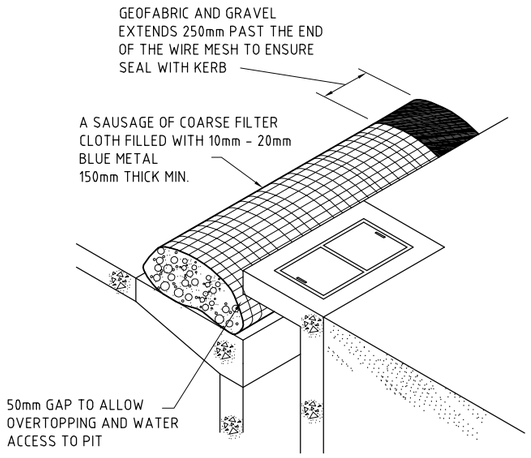
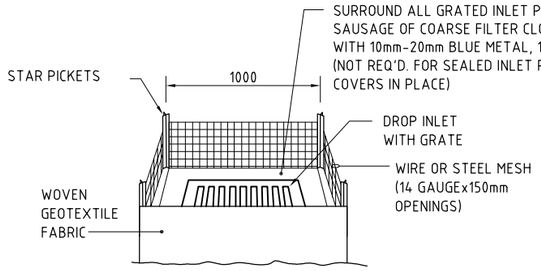
DRAWING TITLE
EROSION AND SEDIMENT CONTROL PLAN

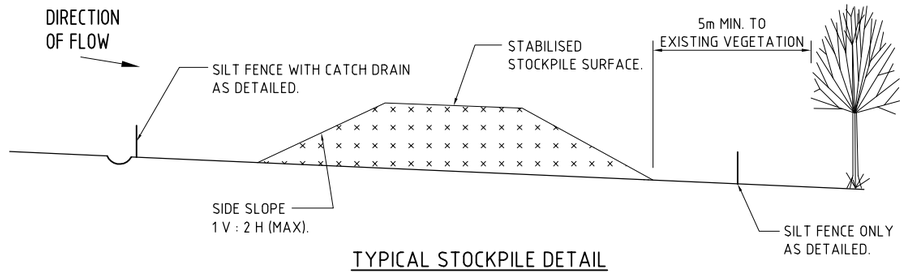
DRAWING No C08753.11-DA20 | ISSUE D



KERB INLET PIT CONTROL
N.T.S



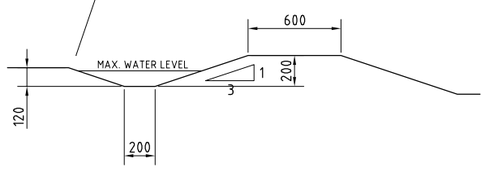
GRATED INLET PIT FILTER DETAIL
N.T.S



TYPICAL STOCKPILE DETAIL
N.T.S.

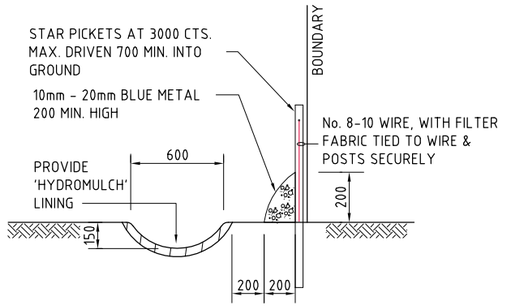
NOTE : ADOPT ABOVE DETAILS AROUND ALL PITS WITHIN AREA ENCOMPASSED BY SILT FENCE & TO PITS ON THE ROAD ADJACENT TO SITE BOUNDARY.

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

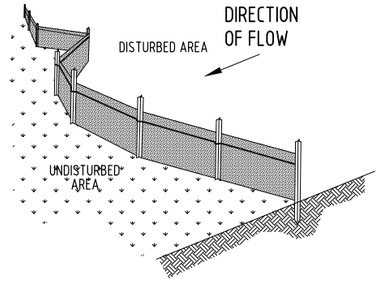


TYPICAL DIVERSION DRAIN SECTION
SCALE 1:20

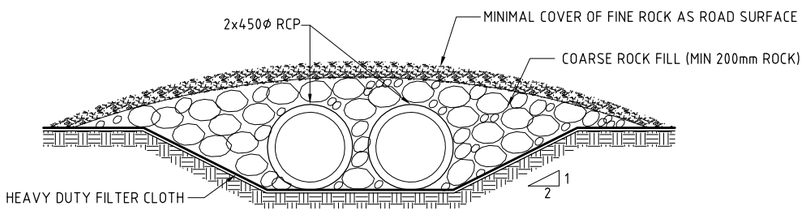
STOCKPILE NOTES
1. PLACE ALL STOCKPILES IN LOCATIONS MORE THAN 5m FROM EXISTING VEGETATION, ROADS & HAZARD AREAS.
2. CONSTRUCT ON THE CONTOUR AS LOW, FLAT ELONGATED MOUNDS. SIDE SLOPE TO BE 1 V: 2 H MAX.
3. WHERE THERE IS SUFFICIENT AREA, TOPSOIL STOCKPILES SHALL BE LESS THAN 2m IN HEIGHT.
4. WHERE STOCKPILES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



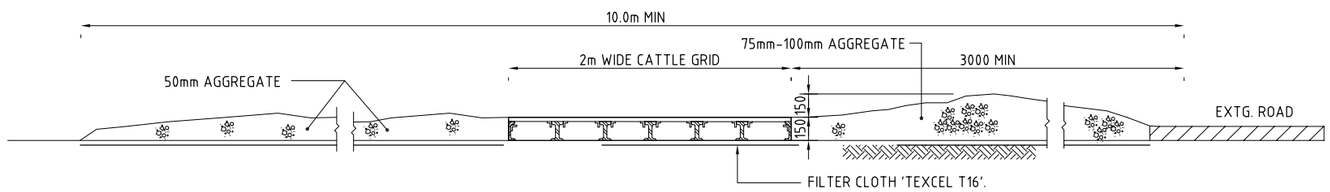
TYPICAL OPEN DRAIN & SILT FENCE
SCALE 1:20



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



TYPICAL CROSSING OVER DIVERSION CHANNEL
SCALE 1:20



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

FOR DEVELOPMENT APPROVAL

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

ISSUED FOR DEVELOPMENT APPROVAL	18.11.15	B
ISSUED FOR REVIEW	05.11.15	A
AMENDMENTS	DATE	ISSUE

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DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
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DRAWING TITLE
EROSION AND SEDIMENT CONTROL
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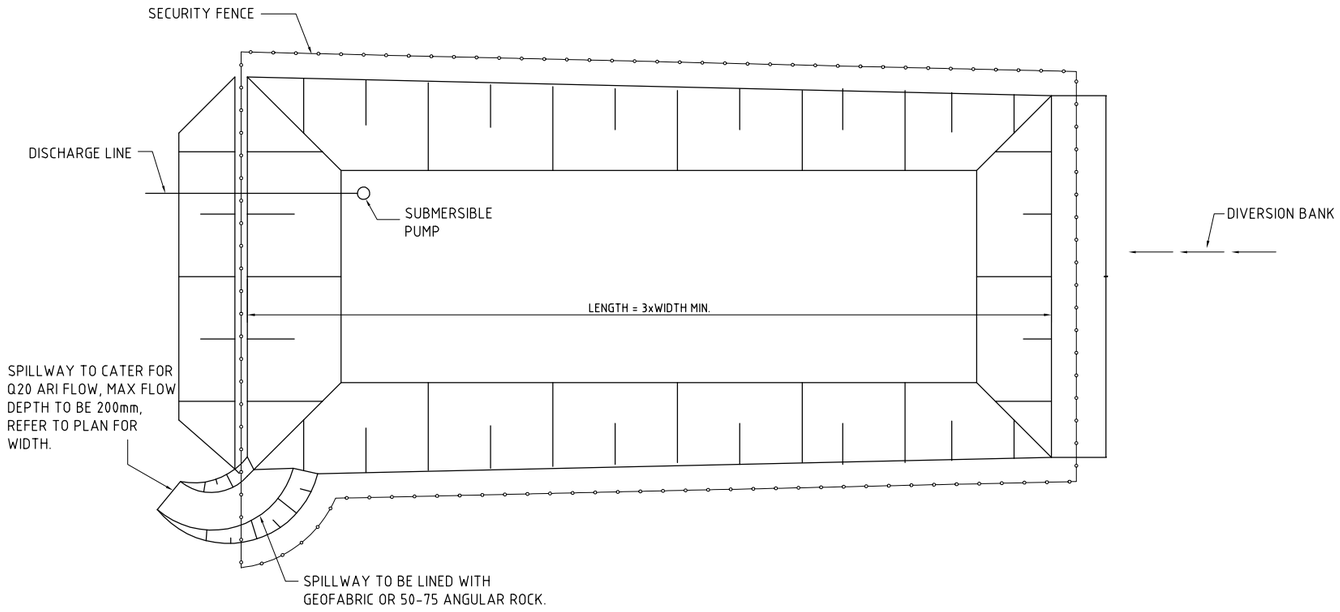
DRAWING No C08753.11-DA25 | ISSUE B

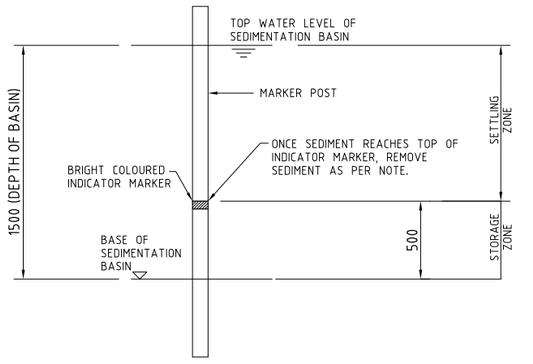


TYPICAL SEDIMENT CONTROL POND PLAN

SCALE 1:250

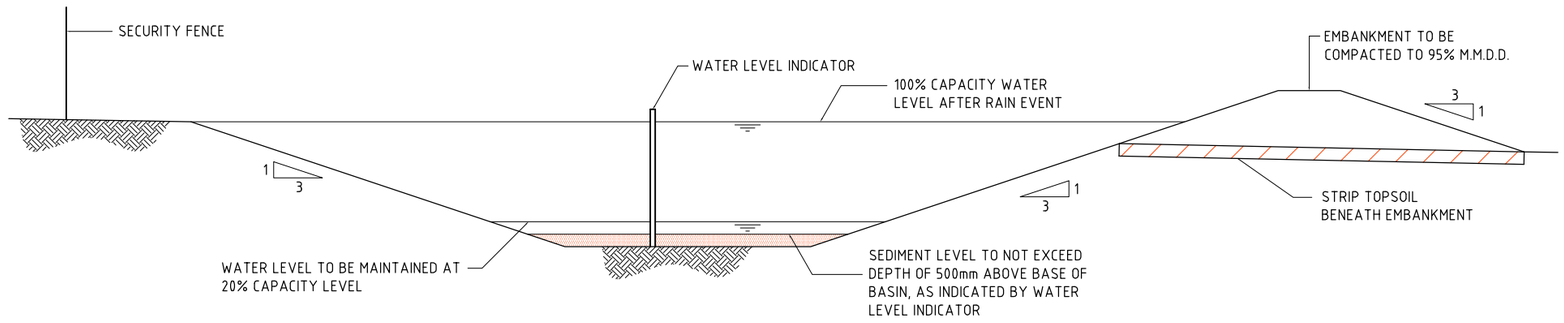
SEDIMENT CONTROL POND NOTES:

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



SEDIMENT STORAGE MARKER

SCALE 1:20



TYPICAL SEDIMENT CONTROL BASIN SECTION

SCALE 1:50

FOR DEVELOPMENT APPROVAL

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

AMENDMENTS	DATE	ISSUE
ISSUED FOR DEVELOPMENT APPROVAL	18.11.15	B
ISSUED FOR REVIEW	05.11.15	A

ARCHITECT

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

PROJECT
PROPOSED DEVELOPMENT
32 YARRUNGA STREET
PRESTONS NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	SD			A1		8753.11-DA26

CONSULT AUSTRALIA

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Value in Engineering and Management

DRAWING TITLE
EROSION AND SEDIMENT CONTROL DEATILS-SHEET 2

DRAWING No C08753.11-DA26

ISSUE B

YARRUNGA STREET

BERNERA ROAD

KURRAJONG ROAD

PAD 1
RL 43.50

PAD 2
RL 41.80

PAD 3
RL 34.70

PAD 4
RL 35.50

PAD 5
RL 41.80

EARTHWORKS SUMMARY NOTES

LEVELS DATUM IS AHD.

PRELIMINARY BULK EARTHWORKS VOLUMES BASED ON DIFFERENCE BETWEEN FLAT PAD OPTION AND EXISTING SURFACE CONTOURS.

VOLUMES:

CUT	= - 242,000m^3
FILL	= + 227,500m^3
BALANCE	= - 14,500m^3

NO ALLOWANCE HAS BEEN MADE FOR TOPSOIL STRIPPING, SITE GRADING, DETAILED EXCAVATION, BULKING OR COMPACTION OF FILLED SOILS.

INDICATIVE EARTHWORKS FLAT PAD AND INDICATIVE VOLUMES

SCALE 1:1000

FOR DEVELOPMENT APPROVAL

NOTE: ALL LEVELS ARE INDICATIVE & MAY BE SUBJECT TO MINOR VARIATION TO SUIT DETAILED DESIGN.

10m 0 10 20 30 40 50 60 70 80 90 100m

SCALE 1:1000 AT A1 SIZE SHEET

AMENDMENTS	DATE	ISSUE
ISSUED FOR DEVELOPMENT APPROVAL	28.01.16	E
ISSUED FOR DEVELOPMENT APPROVAL	21.01.16	D
ISSUED FOR DEVELOPMENT APPROVAL	25.11.15	C
ISSUED FOR DEVELOPMENT APPROVAL	18.11.15	B
ISSUED FOR REVIEW	05.11.15	A

ARCHITECT

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SUITE 02, LEVEL 12
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PROJECT
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PRESTONS NSW

DESIGNED	DRAWN	DATE	CHECKED	SIZE	SCALE	CAD REF:
MW	SD			A1		8753.11-DA30

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DRAWING TITLE
INDICATIVE EARTHWORKS FLAT PAD & INDICATIVE VOLUMES

DRAWING No C08753.11-DA30

ISSUE E