Appendix X

Civil Engineering Design Report

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Civil Design Report

Cudgegong Road Station Precinct South

Cudgegong Road Station Precinct South

Civil Engineering Design Report - State Environmental Planning Policy (SEPP) Submission

Client: Landcom

ABN: 79 268 260 688

Prepared by

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28-Mar-2018

Job No.: 60558549

AECOM in Australia and New Zealand is certified to ISO9001, ISO14001 AS/NZS4801 and OHSAS18001.

Quality Information

Document Cudgegong Road Station Precinct South

Ref 60558549

Date 28-Mar-2018

Prepared by Jeffrey Chan

Reviewed by Daniel Fettell

Revision History

Rev	Revision Date	Details	Authorised	
			Name/Position	Signature
01	09-Mar-2018	For Review	Daniel Fettell Principal Engineer	
02	15-Mar-2018	For Issue	Daniel Fettell Principal Engineer	
03	28-Mar-2018	For Review	Daniel Fettell Principal Engineer	

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Executive Summary

The NSW Government is currently building the Sydney Metro Northwest (SMNW) that is due to start operations in 2019. The SMNW is Stage 1 of the overall Sydney Metro project and involves the construction of eight new metro stations supporting infrastructure between Cudgegong Road and Epping and converting five existing stations between Epping and Chatswood. Stage 2 will deliver a new metro rail line from Chatswood through Sydney's CBD to Sydenham (Sydney Metro City and Southwest).

Landcom and the Sydney Metro Delivery Office (SMDO), part of Transport for NSW (TfNSW), are working in collaboration to develop walkable, attractive, mixed use places around the SMNW stations. This includes using the surplus government owned land located around the Cudgegong Road Station.

The subject site, the Cudgegong Road Station Precinct South, is located between Cudgegong Road, Tallawong Road, Schofields Road and the Metro corridor and comprises around 7.8ha of government owned land. It is within the southern part of the broader Cudgegong Road Station Precinct (Area 20) of the North West Priority Growth Area, a substantial land release area for homes and jobs in Sydney's northwest.

AECOM has been engaged to carry out the Civil Engineering Design to support the State Significant Development Application (SSDA) for the Station Precinct South concept proposal. The concept proposal allows for approximately 1,100 dwellings and 9,000 sqm of retail, commercial and community uses. It also includes a central park, new streets and supporting public domain.

This civil engineering design report provides advice on the design for roads, earthworks and levels, intersections and basement, pavements, lighting, stormwater and utilities. These have been prepared with consideration for the requirements set out in technical studies and standards already existing which include but are not limited to:

- Blacktown City Council – Civil Works Specification (BCC, 2005); and
- Blacktown City Council Growth Centre Precincts – Development Control Plan (DCP) (BCC, 2016).

1.0 Introduction

This document summarises the design approach, key assumptions, relevant references and standards applied to the development of the civil design documentation for the Cudgegong Road Station Precinct South development.

This report is to be read in conjunction with the following reports:

- Cudgegong Road Station Precinct South - Utilities Report; and
- Cudgegong Road Station Precinct South - Integrated Water Cycle Management Report

1.1 Extent of Work

The extent of work involved in the Cudgegong Road Station Precinct South development is illustrated in Figure 1.

Figure 1 Concept Proposal

Scope of works of the design includes:

- Pedestrian paths – up to the kerb line at Conferta Avenue and Themeda Avenue;
- Proposed internal roads;
- Cycling network and associated landscaping; and
- Residential, retail, commercial and community buildings up to 8 stories in height.

Further indicative dedications can be found in the *SSDA Civil Engineering Drawing Package* accompanying this report.

1.2 Design Overview

The key considerations incorporated throughout the design of the urban areas of the development include the following principles:

- A connected town centre;
- Street network hierarchy;
- Pedestrian and cycle network;
- Open space network;
- Urban block structure;
- Variations in height and scale;
- A range of housing typologies; and
- Mixed-uses and activation.

A summary of the design parameters considered for the concept proposal is outlined below in Table 1.

Table 1 Key Design Considerations

Area	Key Design Considerations
Proposed Roads	• Pedestrian crossing at the intersection with Conferta Avenue. • Trees and planting to improve the outdoor aesthetic and provide water quality treatment. • Utility services underneath footpath to service development lots • Road design to support vehicular access to development lots • Loading zone parking • Lighting • Integration with the landscape design
Local Park and Urban Plaza	• Flexible seating / event space adjacent • Retaining walls allow a view of the park and surrounds • Integration with the landscape design to form an interconnected open space
Pedestrian and Cycle Network	• Create a series of through site links that extend the pedestrian and cycle network connecting key elements such as the Metro station with landscaped spaces, major intersections and residential areas. • Seating along the walkway • Trees and planting to improve the outdoor aesthetic and provide water quality treatment • Coordination with the landscape of the existing traverse roads • Crime prevention through environmental design (CPTED) • Integration with the landscape design

1.3 Design Documentation

The Design Documentation comprises of the following drawing list:

Table 2 Design Documentation

Drawing Number	Drawing Name	Other
GENERAL PLANS		
60558549-SHT-CI-0001	COVER SHEET	
60558549-SHT-CI-0003	GENERAL NOTES	

60558549-SHT-CI-0010	DEDICATION PLAN	
60558549-SHT-CI-0011	KEY PLAN	
60558549-SHT-CI-0021	GENERAL ARRANGEMENT	
PUBLIC DOMAIN PLANS		
60558549-SHT-CI-0101	PUBLIC DOMAIN - PLAN	SHEET 01
60558549-SHT-CI-0102	PUBLIC DOMAIN - PLAN	SHEET 02
60558549-SHT-CI-0103	PUBLIC DOMAIN - PLAN	SHEET 03
60558549-SHT-CI-0104	PUBLIC DOMAIN - PLAN	SHEET 04
TYPICAL SITE SECTIONS		
60558549-SHT-CI-0121	TYPICAL SITE ELEVATIONS	SHEET 01
60558549-SHT-CI-0122	TYPICAL SITE ELEVATIONS	SHEET 02
60558549-SHT-CI-0123	TYPICAL SITE ELEVATIONS	SHEET 03
60558549-SHT-CI-0124	TYPICAL SITE ELEVATIONS	SHEET 04
60558549-SHT-CI-0125	TYPICAL SITE ELEVATIONS	SHEET 05
LONGITUDINAL SECTIONS		
60558549-SHT-CI-0161	PUBLIC DOMAIN LONGITUDINAL SECTIONS MC01	SHEET 01
60558549-SHT-CI-0162	PUBLIC DOMAIN LONGITUDINAL SECTIONS MC01	SHEET 02
60558549-SHT-CI-0163	PUBLIC DOMAIN LONGITUDINAL SECTIONS MC02	SHEET 01
60558549-SHT-CI-0164	PUBLIC DOMAIN LONGITUDINAL SECTIONS MC02	SHEET 02
EROSION AND SEDIMENTATION CONTROL PLANS		
60558549-SHT-CI-0201	EROSION AND SEDIMENT CONTROL PLAN	
60558549-SHT-CI-0201	EROSION AND SEIDMENT CONTROL DETAIL	
DRAINAGE PLANS		
60558549-SHT-CI-0301	DRAINAGE – PLAN	SHEET 01
60558549-SHT-CI-0302	DRAINAGE – PLAN	SHEET 02
60558549-SHT-CI-0303	DRAINAGE – PLAN	SHEET 03
60558549-SHT-CI-0304	DRAINAGE – PLAN	SHEET 04
CATCHMENT PLANS		
60558549-SHT-CI-0321	DRAINAGE CATCHMENT – PLAN	
DRAIANGE LONGITUDINAL SECTIONS		
60558549-SHT-CI-0401	DRAINAGE LONGITUDINAL SECTION	SHEET 01

60558549-SHT-CI-0402	DRAINAGE LONGITUDINAL SECTION	SHEET 02
60558549-SHT-CI-0403	DRAINAGE LONGITUDINAL SECTION	SHEET 03
SERVICE PLANS		
60558549-SHT-CI-0501	COMIBINED SERVICES – PLAN	SHEET 01
60558549-SHT-CI-0502	COMIBINED SERVICES – PLAN	SHEET 02
60558549-SHT-CI-0503	COMIBINED SERVICES – PLAN	SHEET 03
60558549-SHT-CI-0504	COMIBINED SERVICES – PLAN	SHEET 04
60558549-SHT-CI-0505	COMIBINED SERVICES – PLAN	SHEET 05
60558549-SHT-CI-0511	SEWER CONNECTION – PLAN	
VEHICLE TRACKING PLAN		
60558549-SHT-CI-0801	VEHICLE TRACKING – PLAN	SHEET 01
60558549-SHT-CI-0802	VEHICLE TRACKING – PLAN	SHEET 02
60558549-SHT-CI-0803	VEHICLE TRACKING – PLAN	SHEET 03
60558549-SHT-CI-0804	VEHICLE TRACKING – PLAN	SHEET 04

1.4 Consultation

The design documentation integrates comments and feedback received on preliminary documentation from the following authorities:

- Sydney Water;
- Endeavour Energy;
- Jemena Gas;
- Roads and Maritime Services;
- Sydney Metro;
- Telstra NSW;
- NBN Co; and
- Blacktown City Council.

Utility consultation with utility authorities is detailed further in the Cudgegong Road Utilities Report submitted as a part of the SSDA documentation.

1.5 Support Technical Studies

The following technical studies have been used to provide technical background information to assist in design:

- Northwest Rapid Transit (NRT) Project Integrated Management System, Construction Soil and Water Management Plan (NRT,2015);
- Water Cycle Management Strategy and Flood Study – Area 20 Precinct (JWP, 2010);
- Rouse Hill Stage 1b Area Trunk Drainage Study (GHD, 1998);
- Blacktown City Council – Civil Works Specification (BCC, 2005); and
- Blacktown City Council Growth Centre Precincts – Development Control Plan (DCP) (BCC, 2016).

2.0 Roadworks, Earthworks, Levels Design

2.1 Design Criteria

Design criteria applied to the road and levels design are summarised in Table 3 below.

Table 3 Road Design Criteria

Item	Standard	Adopted	Comment
Horizontal Road Alignment			
Vehicle Design Speed	BCC DCP	50 km/h	Based on operational speed of 50 km/h
Turning Paths	BCC/TfNSW AS 2890.2 – 2002	Design Vehicle: BCC Refuse vehicle: • Overall length = 11m • Width = 2.5m • Wall to wall turn radius = 10.5m Medium Rigid Vehicle (MRV) • Overall Length = 8.8m • Overall Width = 2.5m • Kerb to kerb turn radius = 10m	Access for BCC Garbage Truck and single Medium Rigid Vehicle (MRV) to proposed roads required.
	Austroads 2008	Emergency response vehicles and service vehicles	L = 19.0m
Road Reserve Width			
Lane Width	BCC Engineering Guideline	Proposed Roads • Local Road = 16m • Collector Road = 18m • Pathways = 4.0 – 10m (depending of function)	
Parking Lane	AS 2890.5 – 1993 On Street Car Parking	Min Width = 2.1 m Length 1 space = 6.3m	Allows for kerbs and/or obstructions at either end of the parking spaces.
Footpath/Cycleway	BCC Engineering Guideline	Min Width = 4.0m Max Width = 10.0m	Depending on function (access/drainage/servicing)
Kerb Types			
Collector Road (Major and Minor)	BCC Engineering Guideline	150mm kerb & gutter	
Local Road/Street	BCC Engineering Guideline	Roll top kerb & gutter	
Vertical Road Alignment			
Maximum Longitudinal Grade	BCC Engineering Guideline	Residential Roads Desirable = 12% Acceptable = 16%	
Maximum Longitudinal Grade at intersections	BCC Engineering Guideline	5 %	
Minimum Longitudinal Grade	BCC Engineering Guideline	Desirable = 1% Acceptable = 0.7%	
% change in grade requiring a Vertical Curve	BCC Engineering Guideline	1%	
Min VC lengths	BCC Engineering Guideline	Cul-de-sac, Access and Local Streets Desirable = 25m	Lengths of VC given are for straight alignments; longer curves may be necessary where roads also have horizontal curvature.

Item	Standard	Adopted	Comment
		Acceptable = 6m <u>Collector Streets</u> Desirable = 35m Acceptable = 12m	
Cross fall	BCC Engineering Guideline	Concrete = 2.0-3.0% Asphaltic Concrete = 3.0% Sprayed Seal = 3.0-4.0%	
Vertical Footpath Alignment			
Maximum Longitudinal Fall	BCC Engineering Guideline	8.3%	Grading of pathways shall not be steeper than 1 in 12
Minimum Footpath Cross Fall	BCC Engineering Guideline	2%	To accommodate existing vehicular crossing and other facilities.
Maximum Footpath Cross Fall	BCC Engineering Guideline	6%	With prior approval from Council
Cross fall	BCC Engineering Guideline	Roads 2.0 to 3.0% Footpaths 2.0 to 6.0%	For concrete road pavement

Vehicle tracking was undertaken at three intersections namely at:

- Themeda Avenue and Proposed Road (MC02);
- Conferta Avenue and Proposed Road (MC02); and
- Conferta Avenue and Proposed Road (MC01).

The results of these are shown in drawings 60558549-SHT-CI-0801 to 60558549-SHT-CI-0804. A basement entry and intersection design speed of 10km/hr was used.

2.2 General Description

The following are the main features of the road and earthworks design for the project:

- Design of roads with 2-way cross-fall to suit stormwater management requirements;
- Kerb radii to suit the turn path of the design vehicle;
- Footpath cross fall designed to meet BCC standards; and
- Landscaping and earthworks to suit a public park.

2.3 Cut and Fill

2.3.1 Pre-development and Post-development Conditions

These were obtained from a combination of aerial mapping and field surveys taken in 2011. Based on these plans, it can be identified that the site had previously comprised of undulating hills with a semi-rural landscape. Comparing the pre and post-development conditions show substantial changes to the site, undertaken as part of the Northwest Rapid Transit (NRT) precinct works.

The main changes to the site's levels involve the removal of sediment basins located downstream of most property lots and grading of the site to allow for suitable construction of new roads, carparks and stormwater infrastructure. Following NRT precinct works, the overall site currently grades towards the South East with an average slope of approximately 3%. Additionally, there has been a substantial increase in overall surface levels as a result of the NRT works of approximately 2m.

2.3.2 Cut and Fill Volumes

The cut / fill volumes for the works are presented in Table 4 below and include Site 1 and Site 2 construction.

- Site 1: Construction site, includes fill of approximately 36,500m3 (up to 5m); and
- Site 2: Construction site, includes cut of approximately 1,600m3 (up to 1.3m) and fill of approximately 32,200m3 (up to 4m).

Table 4 Cut / Fill Volume (Site 1 and 2 only)

Type	Volume (m^3)
Total Cut	1,600
Total Fill	68,700
Balance	**67,100**

This cut/fill volume has been based on the following assumptions:

- No bulking or spill factors have been applied;
- The finalised cut/fill balance is pending in-fill survey requirements (not this will only have a minor impact); and
- Cut to fill quantities are from existing surface to top of finished surface. No allowance for pavement boxing, footings, services, stormwater or topsoil removal has been made.

Refer to Figure 2 and Figure 3 below for the NRT and Cudgegong Town Centre earthworks cut (red) and fill (green) plans below.

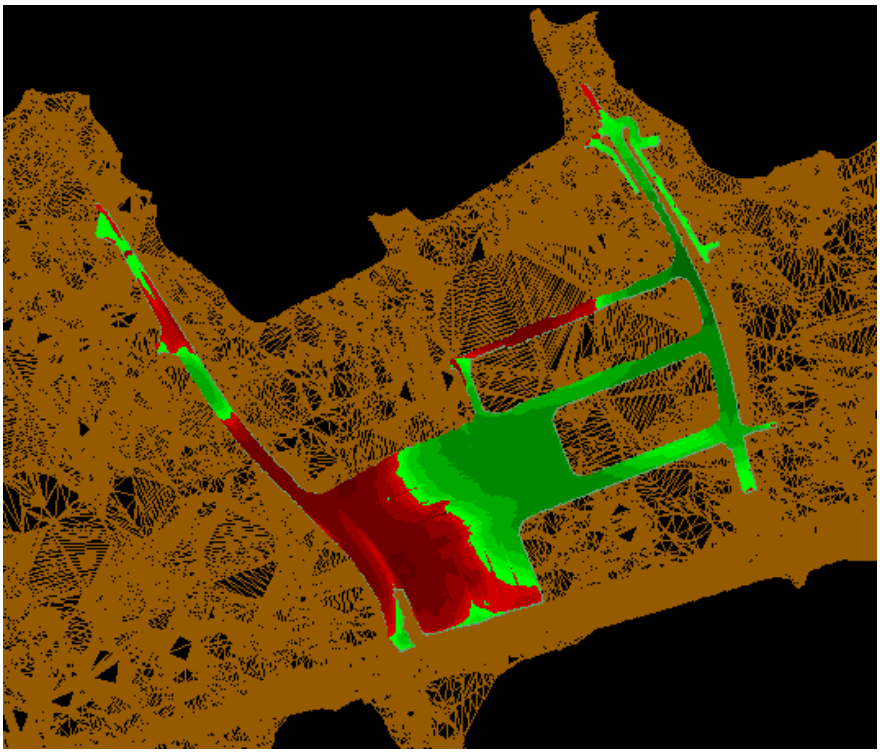

Figure 2 NRT Earthworks Plan

There are a number of different materials that will be required, these are summarised below in Table 5.

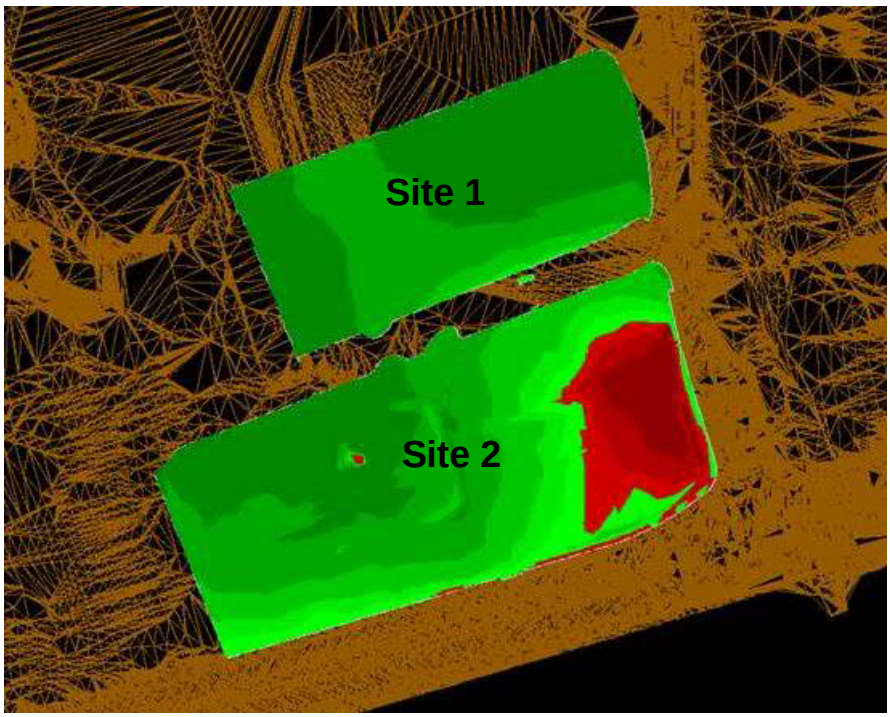

Figure 3 Cudgegong Town Centre Earthworks Plan

Pre-development survey (including pre-NRT works) levels are shown in Figure 4 and Figure 5 below.

Table 5 Materials

Material Type	Source
Topsoil	Potentially reused from Site
Engineered Fill	Potentially reused from Site
Select Material (SMZ)	Imported
Dense Graded Base (DGB 20)	Imported
Concrete	Imported
Reinstatement of existing decking	Imported
Heel guard Stainless Steel	Imported
Sand	Imported
Turf	Imported

The location for the importation of concrete and pavement materials will be determined based on the testing requirements of each material. There are a number of quarries and concrete batch plants within the area surrounding the Cudgegong Road Station Precinct that will be able to service the material requirements of the project. The identification of the appropriate quarries, batch plants and material providers will be made by the building contractor prior to construction. All material is to be tested at its source to ensure compliance with the projects specification prior to importation to site.

Stockpiles will be created within the site to store onsite and imported material as identified in the Erosion and Sediment Control plans.

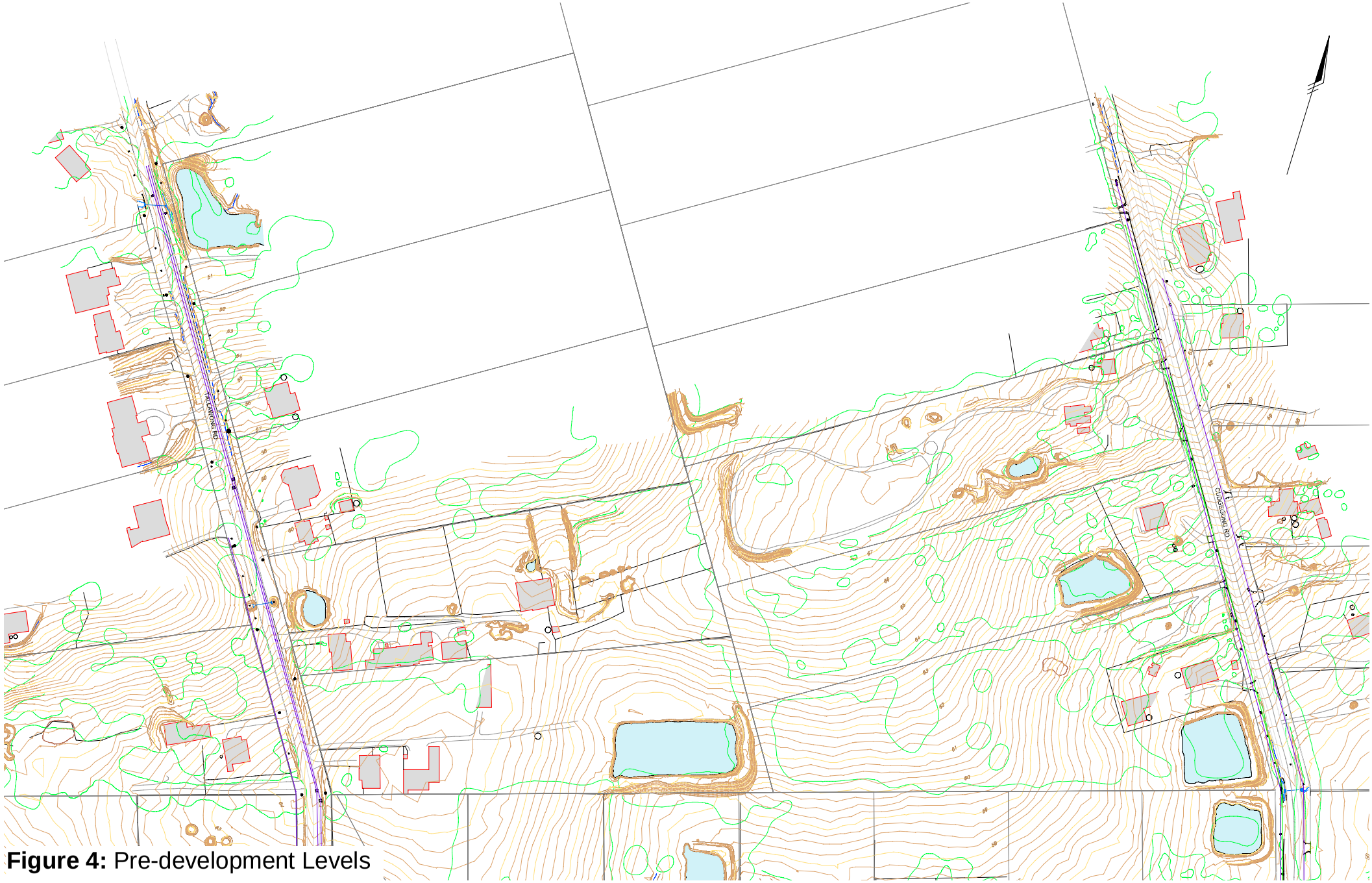

Figure 4: Pre-development Levels

No.	DATE	REVISION DETAILS	DRAWN	CHK	APP
V0.2	28.11.11	INTERIM TOPO MAPPING	N.E.C.	D.W.F.	

NOTES: [Notes]

HORIZ. SCALE: 1:1000 @ A1 | VERTICAL SCALE: N/A @ A1
COORDINATES: MGA | DATUM: AHD
20 10 0 20 40 60
SCALE IN METRES AT ORIGINAL REDUCTION RATIO

PREPARED BY
WHELANS INSITES
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ACN: 088 148 743
Level 12, 80 Clarence Street
Sydney, NSW 2000
DX 369 Sydney
t. 02 8234 8300
f. 02 9262 6511

CLIENT: NSW Transport

SURVEY:	C.K.B.	DATE OF SURVEY:	NOV. 2011
DRAWN:	N.E.C.	DATE OF PLAN:	28.11.2011
CHECKED:	D.W.F.	DATE LAST SAVED:	30.11.11
APPROVED:		DATE APPROVED:	XX.XX.20XX

TITLE: INTERIM TOPOGRAPHIC MAPPING INCORPORATING AERIAL MAPPING AND FIELD SURVEY - TALLAWONG TO ROUSE HILL

DRAWING No: NWRL-10045-10-SWD-DWG-LS-60021-A.dwg

JOB No: H453NW 17&18 | ISSUE: A

SHEET 2 OF 7 SHEETS | SIZE A1

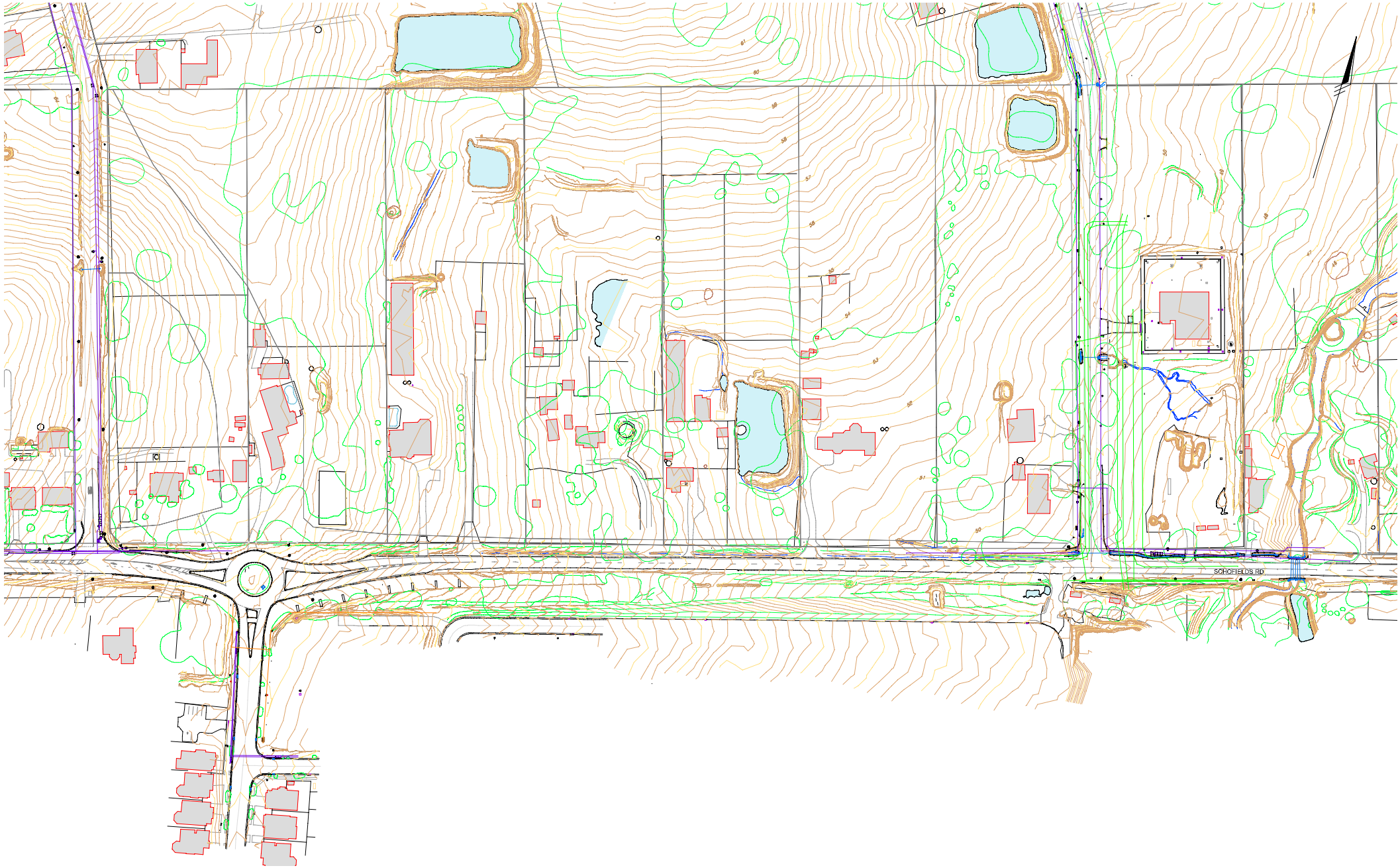

Figure 5: Pre-development Levels

REVISIONS					
No.	DATE	REVISION DETAILS	DRAWN	CHK	APP
V0.2	28.11.11	INTERIM TOPO MAPPING	N.E.C.	D.W.F.	

NOTES: [Notes]

HORIZ. SCALE: 1:1000 @ A1 | VERTICAL SCALE: N/A @ A1
COORDINATES: MGA | DATUM: AHD
20 10 0 20 40 60
SCALE IN METRES AT ORIGINAL REDUCTION RATIO

PREPARED BY: WHELANS INSITES insites.com.au
Whelans Insites Pty Ltd ACN: 088 148 743
Level 12, 80 Clarence Street Sydney, NSW 2000 DX 368 Sydney t: 02 8234 8300 f: 02 9262 6511

CLIENT: NSW Transport

SURVEY:	C.K.B.	DATE OF SURVEY:	NOV. 2011
DRAWN:	N.E.C.	DATE OF PLAN:	28.11.2011
CHECKED:	D.W.F.	DATE LAST SAVED:	30.11.11
APPROVED:		DATE APPROVED:	XX.XX.20XX

TITLE: INTERIM TOPOGRAPHIC MAPPING INCORPORATING AERIAL MAPPING AND FIELD SURVEY - TALLAWONG TO ROUSE HILL

DRAWING No: NWRL-10045-10-SWD-DWG-LS-60021-A.dwg

JOB No: H453NW 17&18 | ISSUE: A

SHEET 3 OF 7 SHEETS | SIZE A1

3.0 Intersection and Basement Design

The following traffic checks have been completed for the new roads and building access points within the Cudgegong Road Station Precinct South Development:

- Tracking for intersection turning circles and building carparks; and,
- Safe intersection Sight distance checks for the following intersections
  - Conferta Avenue and Proposed Road (Control String MC01);
  - Conferta Avenue and Proposed Road (Control String MC02); and
  - Aristida Street and Proposed Road (Control String MC02).

**For MC01 and MC02 refer to Concept Plan in Figure 1.*

3.1 Intersection turning circles and carparks

Swept path analysis of the new roads has been undertaken using AutoTrack vehicle swept path analysis software. The design vehicle used for intersection turning circles was the BCC Refuse vehicle, as outlined in Table 3. The swept path analysis was completed using the following assumptions.

- Waste collection will occur during times where there are minimal vehicles on the road. As such, it is acceptable that the waste vehicle crosses the centreline when entering and exiting driveways, as well as turning at intersections;
- Should waste collection occur during periods where there are higher traffic volumes on the road. Traffic control may need to be provided while vehicles are entering driveways; and
- Waste collection is expected to be infrequent and only occur once or twice per week.

The vehicle swept paths are included in the SSDA Civil Engineering Drawing package.

3.2 Safe Intersection Sight Distance (SISD)

Sight distance checks were undertaken to ensure that the proposed road conditions provide a safe environment. The SISD is the minimum distance which should be provided on the major road at any intersection. The SISD formula is illustrated in Figure 6.

$$SISD = \frac{D_T \times V}{3.6} + \frac{V^2}{254 \times (d + 0.01 \times a)} \qquad 2$$

where:

SISD	=	safe intersection sight distance (m)
DT	=	decision time (s) = observation time (3 s) + reaction time (s): refer to the Guide to Road Design – Part 3: Geometric Design (Austroads 2009a) for a guide to values
V	=	operating (85th percentile) speed (km/h)
d	=	coefficient of deceleration – refer to Table 3.2 and the Guide to Road Design – Part 3: Geometric Design (Austroads 2009a) for a guide to values
a	=	longitudinal grade in % (in direction of travel: positive for uphill grade, negative for downhill grade).

Figure 6:Safe Intersection Sight Distance – Austroads Guide to Road Design Part 4A.

Source: Austroads Guide to Road Design – Part 4A: Unsignalised and Signalised Intersections

To calculate the SISD the following values were applied:

DT = 3 seconds + 1.5 seconds reaction time (as specified by Roads and Maritime - Supplement to Austroads Guide to Road Design Part 3 – Geometric Design 2016).

V = 50km/hr

d = 0.36 from Table 3.2 Guide to Road Design Part 3: Geometric Design (Austroads 2009a)

a = 1% (minimum value specified in Table 3)

Applying the values above the SISD was calculated to be **90 metres**. The sight triangles were measured from 3 metres back from the lip of the intersection as outlined in the Austroads Guide to Road Design Part 4a. The sight triangles at the three intersections assessed have been illustrated in the Figure 7 **to** Figure 9**.**

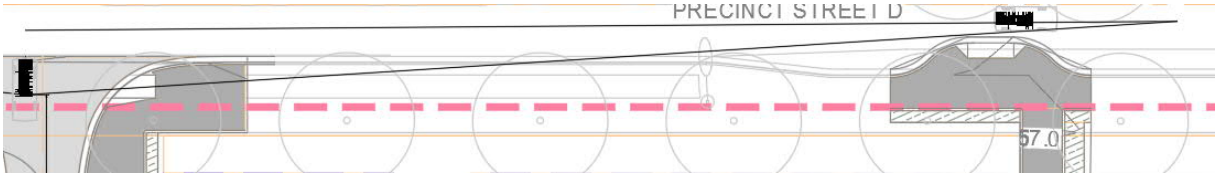

Figure 7 Sight triangle – Conferta Avenue and MC01

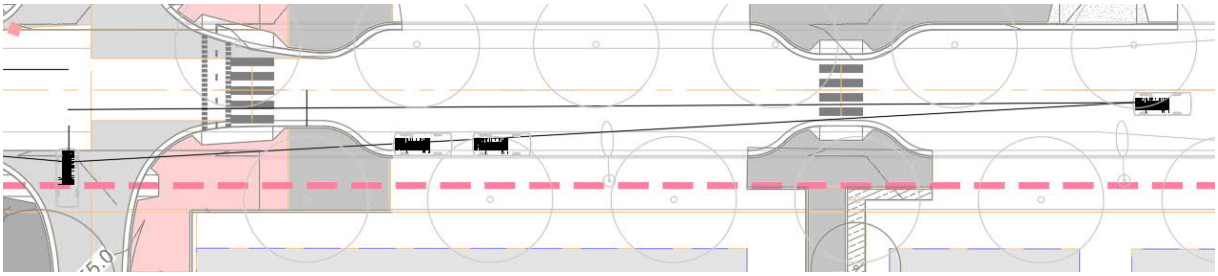

Figure 8 Sight triangle – Conferta Avenue and MC02

Note: The vehicle set back has been taken as three metres from the kerb extension the right of the vehicle on the minor road.

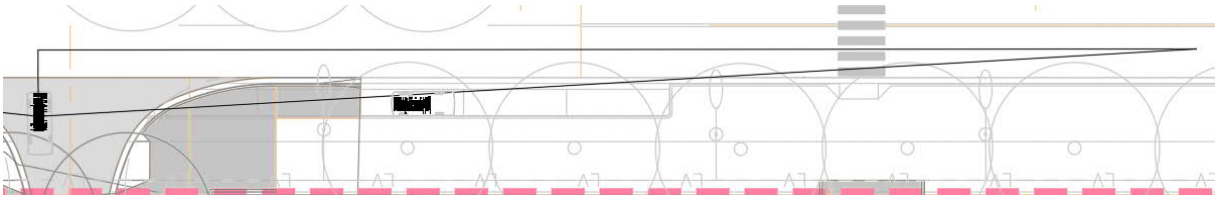

Figure 9 Sight triangle - Proposed Street A and MC02

The sight triangles illustrated in Figure 8 and Figure 9 show that minor obstructions occur for vehicles heading westbound along the major roads, Themeda Avenue and Conferta Avenue. The SISD has been calculated at an assumed speed limit of 50km/hr, however, in both cases the minor roads are located near future pedestrian crossings (Zebra crossings).

As such, it is anticipated that vehicles travelling along the major road would be travelling at a slower speed and more aware as they approach the crossing. Furthermore, at the intersection of Conferta Avenue and Proposed Road (MC02) (Figure 8), there are kerb extensions which narrow the road, at two points within the 90-metre SISD, with one being located just before the intersection. It is anticipated that vehicles travelling westbound on Conferta Avenue will be travelling at a lower speed than what is posted, as result of these traffic calming measures.

There are no obstructions for vehicles travelling eastbound at any of the three assessed intersections. Therefore the proposed design is considered acceptable.

3.3 Road Design Standards

The new internal streets proposed within the site were developed according to the following street sections illustrated in the Cudgegong Road (Area 20) Precinct DCP and with some guidance from the Blacktown City Council Growth Centre Precincts DCP:

- The double sided parking roads were based off DCP Figure 3-11 and have two travel lanes and a parking lane on each side hence a 11m carriageway(2.5m parking + 3m lane + 3m lane + 2.5m parking = 11m). Wider footpaths or a 3m wide shared path are proposed to cater for the expected high demand of pedestrian and cyclists in the town centre and along key desire lines to and from the Cudgegong Road Station.
- The single side parking roads were based off DCP Figure 3-12 and have two travel lanes and a parking lane on one side of the road hence a 8.5m carriageway (2.5m parking + 3m lane + 3m lane = 8.5m). Lane widths are kept the same as double sided parking roads.

While the road widths comply with the Blacktown City Council DCP requirements, they are narrower than typical Blacktown City roads within the town centre. This departure from the typical road width has been supported by the Council's City Architect. Indented parking was used to achieve a superior urban outcome and allow the establishment of larger trees further from the property boundaries. A swept path analysis was undertaken on the intersections with the BCC Garbage Truck parameters and used to inform the intersection designs as shown within the SSDA Civil Engineering Drawing Package.

4.0 Pavement Design

Paved areas throughout the Cudgegong Road Station Precinct South development include roads and footpaths along the Proposed Roads and along the pedestrian and cycle thoroughfares. This section summarises the structural design process for the pavements within the Cudgegong Road Station Precinct South development. Pavements included in the design are summarised as follows:

- Pavement Type PT-CUD-01C - Flexible Road Pavement; and
- Pavement Type PT-CUD-15 – Concrete Footpath.

These pavement designs will tie into the existing pavement for the precinct constructed as part of the Northwest Rapid Transit (NRT) works. BCC Engineering guidelines indicate that pavements should be designed using the general principles of Austroads (2012) "Guide to Pavement Technology – Part 2 Pavement Structural Design". These pavement designs are subject to further detailed analysis and may change during design development.

4.1 Pavement Designs

4.1.1 Type PT-CUD-01C – Unbound Granular

Flexible pavement is presented along the road surface of the Proposed Roads (MC01 and MC02). The previous pavement along the NRT design is shown below, adopting a Design Traffic Loading (ESA) 3.90×10^5.

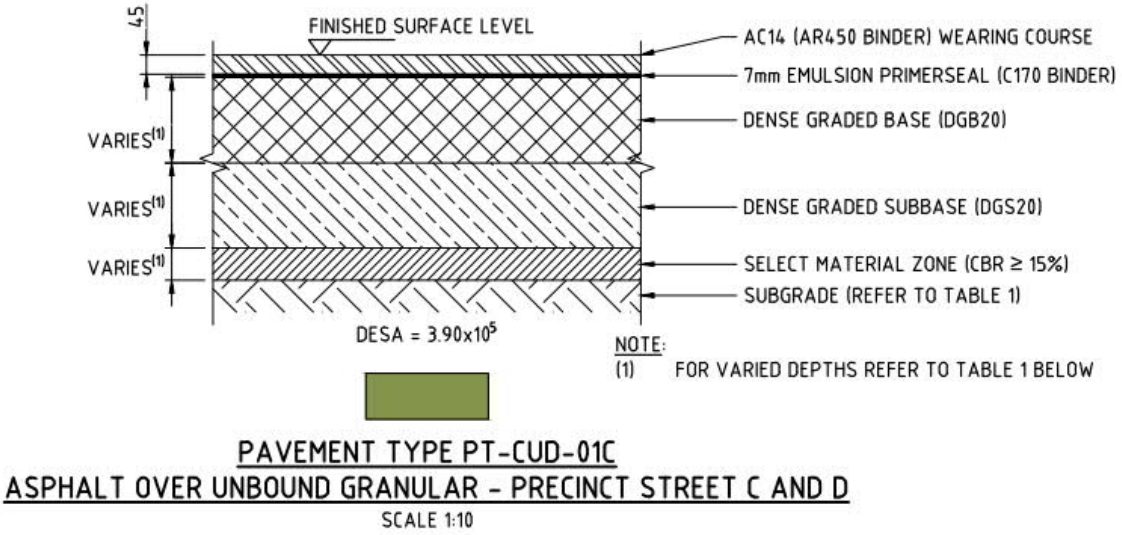

Figure 10 Type PT-CUD-01C Pavement (Proposed Roads MC01, MC02)

Pavement Tag	Pavement Type	Thickness (mm)	Subgrade CBR%
PT-CUD-01C	Unbound Granular	180 (DGB20)	3
		180 (DGB20)	
		150 (SMZ)	
PT-CUD-01C	Unbound Granular	150 (DGB20)	7
		150 (DGS20)	
PT-CUD-01C	Unbound Granular	150 (DGB20)	12
		150 (DGS20)	

4.1.2 Type PT-CUD-15 - Footpath Pavement

Footpath pavement will be used along to link the site from North to South. All new footpaths within the Cudgegong Road Station Precinct South will implement the following footpath pavement design.

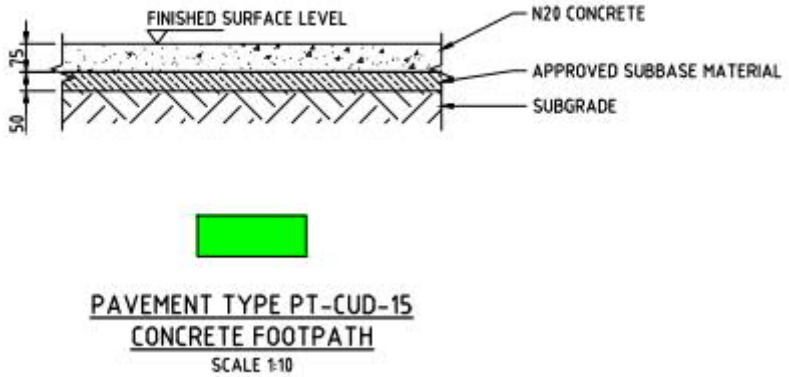

Figure 11 Footpath Pavement

New pavement calculations will be undertaken as part of detailed design but the intent would be to match the existing NRT design wherever possible with the exception of different finishes for the indented car bays and the proposed new plaza.

5.0 Lighting

Street lighting will be installed along all proposed Roads, pedestrian footpaths and cycle ways. These will be provided in accordance with Blacktown City Council and Endeavour Energy requirements. The key methodology and assumptions to be applied to the street lighting design are outlined below:

- Council requires all new lighting levels are to be in accordance with AS/NZ 1158 in its various parts and to comply with all the requirements of Endeavour Energy's document "*Public Lighting Equipment – Luminaires, Lamps & Ancillary Equipment, Technical Specification (2014)"*;
- The lighting of arterial and sub-arterial (Traffic Route Lighting) roads must comply with AS/NZS 1158. Part 1.1 – Vehicular Traffic (Category V) Lighting – Performance and Installation Design Requirements 1997, using the appropriate lighting categories;
- Lighting of residential roads and public places must comply with AS/NZS 1158 Residential Street Lighting Part 3.1: Pedestrian Area (category P) Lighting – Performance and Installation Design Requirements 1999, using the appropriate lighting categories;
- Luminaire Type (roads) = SHP250w ROADSTER;
- Column Height/Outreach = 8.5m / 3m (to be confirmed in lighting design); and
- Maintenance Factor = 0.7.

Luminaries to be supplied are to comply with AS/NZS 1158.6 specifications and Endeavour Energy's documents and shall be:

- With National Electrical manufacturers Association (NEMA) photoelectric cell base;
- With integral control gear;
- Designed for clear tubular lamp;
- Single insulated;
- With radio and television interference suppression capacitors; and
- With a Metal Oxide Varistor (MOV) – minimum 320 Joules.

Indicative lighting locations have been shown on the general arrangement and public domain plans, lighting calculations will be undertaken as a part of design development to confirm the location and wattage of all the required lighting.

6.0 Stormwater Management

Proposed stormwater infrastructure includes new pits and pipe networks, Water Sensitive Urban Design measures and a consideration for the regional stormwater strategy.

6.1 Proposed Infrastructure

The stormwater management approach and design standards are detailed in the Integrated Water Cycle Management strategy report.

The proposed stormwater drainage network will comprise of a pit and pipe drainage system designed to convey runoff from proposed roads, parks, footpaths and cycle ways. The Cudgegong Road Station Precinct South development site discharges from two outlets, Site 1 (north of Conferta Avenue) catchment discharges into a raingarden located immediately east of Cudgegong Road and Site 2 (south of Conferta Avenue) catchment into existing stormwater infrastructure underneath Schofields Road. Both catchment areas ultimately discharge into Second Ponds Creek approximately 80m east of the development site.

Water Sensitive Urban Design (WSUD) measures include implementation of bio-retention systems, rainwater harvesting, passive irrigation and Gross Pollutant Trap throughout the development to treat runoff.

Extensive areas of vegetation including planted and turfed areas for passive irrigation, allow treatment of stormwater runoff to meet water quality requirements.

For further details on stormwater management, including DRAINS and MUSIC modelling assumption and results, see Cudgegong Road Station Precinct South - Integrated Water Cycle Management (IWCM) Report.

7.0 Utilities Services

Utilities services have been designed to accommodate the development based on expected yields of the overall Cudgegong Road Station Precinct South and consider potential GFA and population scenarios.

A single connection point is proposed for each building at a location adjacent to future driveways. More broadly, the proposed services within the site will connect to existing infrastructure along Conferta Avenue and Cudgegong Road.

Detailed information regarding population scenarios, removal of services, proposed services and services coordination are outlined in the Cudgegong Road Station Precinct South – Utilities Report.

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