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Our Ref: PSM1541-140R

6 June 2016

Goodman Property Services (Aust) Pty Ltd
Level 17, 60 Castlereagh Street
SYDNEY NSW 2000

ATTENTION: [redacted]

Dear [redacted]

RE: WESTERN NORTH SOUTH LINK ROAD
(OAKDALE WEST ESTATE – PART B)
GEOTECHNICAL INVESTIGATION

We are pleased to submit our geotechnical report for the proposed western north-south link road (WNSLR) of the Oakdale West Estate (Part B).

Please do not hesitate to contact the undersigned if you have any queries.

For and on behalf of
PELLS SULLIVAN MEYNINK

[redacted]

GARRY MOSTYN

Distribution: pdf copy emailed to [redacted]
Original held by PSM

Goodman Property Services

WESTERN NORTH-SOUTH LINK ROAD-OAKDALE WEST ESTATE (PART B)

GEOTECHNICAL INVESTIGATION

PSM1541-140R **JUNE 2016**

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1 INTRODUCTION

This report presents the results of the geotechnical investigation undertaken by Pells Sullivan Meynink (PSM) for the proposed western north-south link road (WNSLR) within the Oakdale West Estate (Part B).

The work was undertaken in accordance with the PSM proposal dated 15 January 2016 (Ref. PSM1541-128L).

Prior to the work, PSM was supplied with the following documents:

- Urban Advisory Services Consultant Briefing Note – Review of Environmental Factors including AT&L drawings of the road corridor plan; (ref. SKC073 to SKC 075).
- Northrop as built drawings for Lockwood Road Pavement (Ref. CL02, CL03 and CL10). These documents were forwarded by Jamie Steward of Fitzpatrick Investments Pty Ltd. This is presented in Appendix A.

We note that PSM have previously undertaken a site investigation for the Oakdale West Estate, east of the proposed WNSLR in October 2015. The results were reported in the following documents:

- PSM geotechnical report dated 18 November 2015 (Ref. PSM1541-123R).
- PSM soil salinity and aggressivity investigation dated 18 November 2015 (Ref. PSM1541-124L).

2 PROPOSED DEVELOPMENT

Based on the briefing note, PSM understand the following about the proposed development at the Western North-South Link Road:

- Provide the primary access for the Oakdale West Estate (OWE).
- Extend south from Erskine Park Link Road to the OWE.
- Include a bridge structure over the SCA pipeline located on the northern boundary.
- Connect to the existing pavement at the end of Lockwood Road.

An existing intersection has been constructed as part of the Erskine Park link road, with paved stub roads to the north and south. The WNSLR will join the southern stub road.

Appendix B presents the proposed WNSLR alignment.

3 GEOTECHNICAL INVESTIGATION

3.1 Fieldwork

The fieldwork was undertaken on 17 to 18 May 2016 under the fulltime supervision of PSM geotechnical engineers, who undertook the following tasks:

- Setting out test locations
- Preparing engineering logs
- Taking photos of the site and recovered rock cores
- Collection of samples for testing in geotechnical laboratory
- Collection of samples for testing in an environmental laboratory

The test locations were recorded with a hand-held GPS unit with a horizontal accuracy of about ±5 m. Approximate elevations were inferred from the site contour map provided to PSM. Figure 1 presents the test locations.

3.1.1 Cored Boreholes

A total of two (2) cored boreholes (BH-A and BH-B) were completed using a tracked drill rig. These boreholes were mainly for the proposed bridge over the SCA pipeline. A TC bit auger was used within soils and NMLC triple tube coring was used within rock for the cored boreholes.

Engineering logs were prepared for each cored borehole and are presented in Appendix C, along with explanation sheets and core photography.

Point load tests on the core were performed at approximately metre intervals. Results are tabulated in Appendix D.

3.1.2 Augered Boreholes (Pavement boreholes)

A total of seven (7) augered boreholes were drilled using a ute mounted drill rig. They were mainly for the pavement investigation and were shallow. Details of the augered boreholes are as follows.

- **Existing Pavement Boreholes**. Two augured boreholes (BH01 and BH02) were drilled within existing pavements on Erskine Park Link Road, and on Lockwood Road to a depth of up to 0.5 m into the subgrade. They are
  - BH01 – on Erskine Park Link Road (Southern Stub)
  - BH02 – in the cul-de-sac at the end of Lockwood Road
- **New Pavement Boreholes**. Five augured boreholes (BH03 to BH07) were drilled within the new pavement areas of the proposed road corridor to the north of the SCA pipeline to a maximum depth of 6.0 m.

At the locations of BH03 to BH07 a dynamic cone penetrometer (DCP) test was undertaken at the subgrade level. The DCP test results are included in Appendix E.

The materials encountered within the boreholes are summarised in Table 4.

4 LABORATORY TESTING

4.1 Geotechnical laboratory test results

Nine soil samples recovered on site were sent to a NATA accredited geotechnical laboratory The geotechnical laboratory testing undertaken is summarised in Table 1. The PSD Results are presented in Figure 2. The geotechnical laboratory test results are included in Appendix F.

TABLE 1
CBR TESTING RESULTS SUMMARY

SAMPLE ID	BOREHOLE	DEPTH (m)	UNIT[1]	TEST METHOD	SHRINK SWELL INDEX I_{ss} (%/pF)	CBR (%)	FMC (%)	MOISTURE RATIO (%)	COMPACTION RATIO (%)	SWELL (%)
L1	BH03	0.20-0.60	NATURAL SOIL	AS1289.7.1.1	2.5	N.A.				
L2	BH03	0.20-0.70	NATURAL SOIL	CBR (RMS T117 & RMS T112)	N.A.	2.0	13.1	102	99	4.5
L3	BH04	0.20-0.70	NATURAL SOIL	CBR (RMS T117 & RMS T112)	N.A.	2.5	10.1	98	100	3.5
L4	BH07	0.65-1.00	NATURAL SOIL	AS1289.7.1.1	2.7	N.A.				
L5	BH07	0.10-0.70	NATURAL SOIL	CBR (RMS T117 & RMS T112)	N.A.	1.5	16.3	96	101	7.0
L6	BH05	0.10-1.00	NATURAL SOIL	CBR (RMS T117 & RMS T112)	N.A.	1.5	14.9	99	100	4.0
L7	BH05	0.33-0.70	NATURAL SOIL	AS1289.7.1.1	2.5	N.A.				
L8	BH02	0.04-0.15	EXISTING PAVEMENT	PSD[2] (RMS T201 & RMS T203	N.A.	N.A.				
L9	BH01	0.35-0.70	EXISTING PAVEMENT	PSD[2] (RMS T201 & RMS T203	N.A.	N.A.				

Notes: [1] See Section 5.3 for more details
[2] See Figure 2 for PSD results

4.2 Environmental laboratory test results

Eight disturbed soil samples recovered on site were sent to a NATA accredited environmental laboratory for the following testing:

- Soil pH
- Salinity (total soluble salts)
- Chlorides
- Sulphates
- Cation exchange capacity of calcium (Ca), magnesium (Mg), potassium (K) and sodium (Na)
- Exchangeable sodium percentage

Table 2 presents a full list of the tested samples. The laboratory reports are provided in Appendix G.

TABLE 2
ENVIRONMENTAL LABORATORY TEST RESULTS

SAMPLE ID	BOREHOLE	DEPTH	SOIL PH	ELECTRICAL CONDUCTIVITY [µS/cm]	MOISTURE CONTENT [%]	SOLUBLE SULPHATE BY ICPAES [mg/kg]	CHLORIDE BY DISCRETE ANALYSER [mg/kg]	EXCHANGEABLE CATIONS [meq/100g]					ESP [%]
								Ca	Mg	K	Na	CEC	
ES1	BH-B	0.8-1.0	5.4	358	13.0	140	510	0.3	6.9	0.2	2.4	9.9	24.4
ES2	BH3	0.9-1.2	6.8	972	12.6	240	1670	<0.01	3.3	0.1	1.7	5.3	32.7
ES3	BH4	0.2-0.7	6.3	850	10.8	90	1410	0.1	5.0	0.2	1.6	6.9	23.3
ES4	BH7	0.2-0.4	5.7	191	13.3	140	240	0.4	11.8	0.2	4.2	16.6	25.4
ES5	BH6	0.5-0.7	5.2	458	18.3	300	560	0.4	11.5	0.2	2.8	15.0	18.7
ES6	BH5	0.1-0.5	5.4	304	17.3	120	460	0.2	9.9	0.2	2.2	12.6	17.0
ES7	BH2	0.7-1.0	11.1	894	9.5	100	280	8.2	0.5	<0.2	1.5	10.2	14.8
ES8	BH-A	0.3-0.5	5.6	213	15.9	150	1030	1.4	8.8	0.2	2.8	13.4	21.3

5 SITE CONDITIONS

5.1 Geological Setting

The 1:100,000 Penrith Geological map (1991) indicates the site is underlain by:

- The Wianamatta Group formation (Bringelly Shale) comprising shale, carbonaceous claystone, claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff.
- Alluvium (Qal) comprising fine-grained sand, silt and clay in the eastern portion near the boundary, eg. Ropes Creek.

5.2 Surface Conditions

During the fieldwork, numerous grassy paddocks separated by steel wire fencing were observed within the road alignment.

Immediately north of the Sydney Catchment Authority pipeline we observed a large stockpile of material. It is possible that this material is uncontrolled fill. This area has been highlighted on Figure 1. This area was not accessed or drilled during our site investigation because of difficult access and we did not have permission to access the land from Sydney Catchment Authority.

Appendix H presents some selected photos taken during the fieldwork.

5.3 Subsurface Conditions

The subsurface conditions encountered within the boreholes are summarised in Table 3. The encountered subsurface conditions were consistent with the published information in the geological map.

TABLE 3
SUMMARY OF INFERRED SUBSURFACE CONDITIONS ENCOUNTERED IN PSM BOREHOLES

INFERRED UNIT	ENCOUNTERED DEPTH TO TOP OF INFERRED UNIT (m)	DESCRIPTION
EXISTING PAVEMENT	0.0	Existing asphaltic concrete pavement with depth of 700 mm.
TOPSOIL	0.0 to 0.5	CLAY with trace gravel; low plasticity, brown and grey with inferred soft to stiff consistency.
NATURAL SOIL	0.1 to 0.5	CLAY; medium to high plasticity, light brown, red and grey with inferred stiff to very stiff consistency.
BEDROCK	5.2 to 5.7	SHALE; dark grey and brown, extremely weathered to slightly weathered, very low to low strength

Table 4 shows depths of the inferred geotechnical units encountered in PSM boreholes.

TABLE 4
APPROXIMATE REDUCED LEVELS OF TOP OF INFERRED GEOTECHNICAL UNITS ENCOUNTERED IN PSM BOREHOLES

BOREHOLE TYPE	BOREHOLE ID	APPROXIMATE LEVEL OF TOP OF INFERRED GEOTECHNICAL UNITS (m AHD)				
		EXISTING PAVEMENT*	TOP SOIL*	NATURAL SOIL	BEDROCK	EOH
Existing Pavement Boreholes	BH01	58.0 See Table 5	NE	57.3	NE	56.8
	BH02	60.0 See Table 5	NE	59.3	NE	59.0
New Pavement Boreholes	BH03	NE	58.0	57.8	NE	56.0
	BH04	NE	59.5	59.3	NE	57.5
	BH05	NE	64.0	63.9	58.3	58.0
	BH06	NE	65.2	65.1	NE	62.8
	BH07	NE	66.4	66.3	NE	63.4
Cored Boreholes (Bridge)	BH-A	NE	67.1	66.6	61.6	51.8
	BH-B	NE	66.5	66.0	61.3	54.6

Note: * Surface RL's from existing levels and contours on AT&L drawings (SKC073 to SKC 075)
EOH = End of hole
NE = Not encountered

5.3.1 Existing pavements

The existing pavement structure as observed in the two pavement boreholes (BH01 and BH02) are summarised within Table 5. .

TABLE 5
INFERRED EXISTING PAVEMENT STRUCTURE ENCOUNTERED IN BH01 AND BH02

LAYER		MATERIAL	DEPTH (mm)	
			ERSKINE PARK LINK ROAD BH01	CUL-DE-SAC LOCKWOOD ROAD BH02
WEARING COURSE		Asphaltic Concrete	0 - 350	0 - 40
ROADBASE	**BASE COURSE**	GRAVEL with sand, grey, rounded to sub-angular 20 mm gravels, sand medium to coarse grained.	350 - 700	40 - 150
	SUB-BASE COURSE	Clayey SAND with some gravels, red, brown and white, medium to coarse grained, sub-rounded to sub-angular gravels.	NE	150 - 700
SUBGRADE		NATURAL SOIL - CLAY; medium to high plasticity, light brown, red and grey with inferred stiff to very stiff consistency.	700	700
END OF HOLE			1200	1000

The pavement observed at the Lockwood Road cul-de-sac is consistent with the pavement noted on the Northrop as-built drawings; they are presented in Appendix A.

6 DISCUSSION AND RECOMMENDATIONS

6.1 Excavation and material reuse

The road works will involve excavation in TOPSOIL and NATURAL SOIL. We consider that the TOPSOIL unit is not suited for reuse as engineered fill for subgrade.

It is our opinion that most of the remaining cut material would be suitable for reuse on the site as engineered fill for subgrade.

Pavement materials, constructions / placement of the fill (subgrade, road base, etc.) and wearing course and testing should comply with the relevant specification, eg. Penrith City Council (PCC) Specification or RMS Specification.

It is not clear to PSM what specification would be used for the works. Goodman or its civil designer should clarify this with the relevant authority.

6.2 Temporary and Permanent Batters

The batter slope angles shown in Table 6 are recommended for the design of batters up to 4 m height subject to the following recommendations:

- The batters shall be protected from erosion.
- Permanent batters shall be drained.
- Temporary batters shall not be left unsupported for more than 2 months without further advice, and inspection by a geotechnical engineer should be undertaken following significant rain events.
- No buildings, loads or services should be located within 1 batter height of the crest.

If the conditions above cannot be met, further advice should be sought.

Where Fill is not engineered / controlled fill, batter slope angles will have to be assessed by a geotechnical engineer.

Exposed rock faces should be inspected by a geotechnical engineer or engineering geologist to assess the need for localised rock bolting to control adverse jointing in the BEDROCK unit and shotcreting for overall face support.

TABLE 6
BATTER SLOPE ANGLES

UNIT	TEMPORARY	PERMANENT
ENGINEERED FILL[1]	1.5H : 1V	2H : 1V
NATURAL SOIL	1.5H : 1V	2H : 1V
BEDROCK[2]	0.5 H : 1V	1 H : 1V

Note: 1. We assume road and associated fill to be constructed in accordance with Council/ RMS specification
2. See above requirements regarding inspections

Proper and suitable safe work method statements and OHS documents need to be developed for works to be undertaken in the vicinity of the crest and toe of batters.

Steeper batters may be possible subject to further advice, probably including inspection during construction and possibly shotcreting, spot bolting, etc.

6.3 Foundations (Bridge and Signal Posts)

6.3.1 Shallow Footings

Pad footings can be proportioned on the basis of an allowable bearing pressure (ABP) for centric vertical loads provided in Table 7. Higher ABPs may be available, but these depend on the size, depth, loads, etc and would be subject to specific advice.

6.3.2 Piles

Piles should be designed in accordance with the requirements in AS 2159-2009, *Piling - Design and Installation*. The parameters provided in Table 7 may assist in the design of piles.

TABLE 7
ENGINEERING PARAMETERS OF INFERRED GEOTECHNICAL UNITS

INFERRED UNIT	BULK UNIT WEIGHT (kN/m^3)	SOIL EFFECTIVE STRENGTH PARAMETERS		ULTIMATE BEARING PRESSURE UNDER VERTICAL CENTRIC LOADING (kPa)	ALLOWABLE BEARING PRESSURE (ABP) UNDER VERTICAL CENTRIC LOADING (kPa)	ULTIMATE SHAFT ADHESION (kPa)	ELASTIC PARAMETERS	
		c' (kPa)	*ϕ'* (deg)				LONG TERM YOUNG MODULUS (MPa)	POISSON'S RATIO
NATURAL SOIL and ENGINEERED FILL	18	0	30	420[1]	150[1]	NA	10	0.3
BEDROCK	22	N.A.	N.A.	3000[2]	1000[3]	150	100	0.25

Note: 1. Pad footings (for ABP of 150 kPa) should have a minimum horizontal dimension of 1 m and a minimum embedment depth of 0.5 m.
2. Ultimate values occur at large settlement (>5% of minimum footing dimensions)
3. End bearing pressure to cause settlement of <1% of minimum footing dimensions

Settlements in soil units can be estimated using the elastic parameters provided in Table 7.

The designer should note the following with regards to the pile design:

- The ABP needs to be confirmed by a geotechnical engineer during a pile inspection.
- Under permanent load, the contribution of side adhesion for soils including ENGINEERED FILL and NATURAL SOIL should be ignored.
- Short term uplift loading on piers in soil units should be designed for:
  - No resistance in the top 1 m.

- Below the upper metre, the lesser of:
  - Side adhesion = 20 kPa, or
  - Cohesion, *c*', = 0 kPa, and friction angle, ϕ', = 30 deg.
- Deflection needs to be checked using the recommended elastic parameters in Table 7.

The bearing capacities provided are contingent on piles or footings being vertically and centrally loaded. Further advice should be sought if the footings are not vertically centrically loaded, eg. When the base of footings are located less than 2H from excavations or trenches

Inspections will be required during construction to confirm base cleanliness and rock conditions at the base of piles or footings and to confirm the advice provided in this letter.

6.4 Durability

6.4.1 Salinity

Site Investigations for Urban Salinity (DLWC 2002) classify soil salinity based on electrical conductivity (EC_e) as per Richards (1954). The method of conversion from $EC_{1:5}$ to EC_e (electrical conductivity of saturated extract) is based on DLWC (2002) and given by $EC_e = EC_{1:5} \times M$, where M is the multiplication factor based on "Soil Texture Group".

The "Soil Texture Group" of the samples tested has been assessed as "Heavy clay" with a corresponding M of 6. The salinity classification for the soil samples that were tested is presented in Table 8.

TABLE 8
SALINITY CLASSIFICATION

SAMPLE ID	$EC_{1:5}$ (dS/m)	SOIL TYPE	M	EC_e (dS/m)	SALINITY CLASS
ES1	0.358	Heavy Clay	6	2.148	Slightly saline
ES2	0.972	Heavy Clay	6	5.832	Moderately saline
ES3	0.850	Heavy Clay	6	5.1	Moderately saline
ES4	0.191	Heavy Clay	6	1.146	Non-saline
ES5	0.458	Heavy Clay	6	2.748	Slightly saline
ES6	0.304	Heavy Clay	6	1.824	Non-saline
ES7	0.894	Heavy Clay	6	5.364	Moderately Saline
ES8	0.213	Heavy Clay	6	1.278	Non-saline

It is assessed that the soils on the site range from "non-saline" to "moderately saline".

Table 4.8.2 of Australian Standard AS3600-2009 “Concrete Structures” provides an exposure classification for concrete structures in saline soils based on soil electrical conductivity (EC_e). We assess the exposure classification for this site is “A2”. This was consistent with previous investigation undertaken by PSM for Oakdale West estate.

6.4.2 Exposure classification

Table 6.4.2(C) of Australian Standard AS2159:2009, Piling – Design and Installation provides criteria for exposure classification for concrete piles in soil, and here the exposure classification for concrete piles in soil is mild.

Table 6.5.2(C) of Australian Standard AS2159:2009, Piling – Design and Installation provides criteria for exposure classification for steel piles based on resistivity, soil and groundwater pH, and chlorides in soil and groundwater. On the basis of the resistivity, pH and chloride testing completed we assess the exposure classification for steel piles in the soil to be mild.

6.4.3 Acid Sulphate Soils (Desktop study)

We have undertaken a desktop study on acid sulphate soils based on the available acid sulphate soil risk map data and our previous investigation for the Oakdale West Estate, eg. east of the proposed WNSRL.

We note the following:

- The site is not located within the areas covered by the Acid Sulfate Soil Risk Map Data (2013), and the risk of acid sulphate soils is considered low within this site.
- Some samples undertaken during the previous investigation at the Oakdale West Estate, eg. east of the proposed WNSRL indicates higher acidity trail (TPA or TSA) than the action criteria in Table 4.4 of the “*Acid Sulfate Soils Assessment Guidelines*” (1998). We note that the samples were located in proposed fill areas of the estate.
- For the proposed WNSRL, we expect some surficial earthworks will need to be undertaken for the construction of the pavement, eg. minimum earthworks. Thus, we expect minimum disturbance of the existing ground.

Based on the above, we consider that the development will not disturb acid sulphate soils and that no further action is required to address this issue.

7 NEW PAVEMENTS

7.1.1 Design CBR for pavement design

Subgrade CBR for pavement design depends on the material at the finished subgrade levels. Based on the CBR tests undertaken by PSM, we recommend a design subgrade CBR of 1.5% to be adopted.

Higher values may be available subject to testing of the subgrade material in place, or after subgrade treatment, eg. lime or cement stabilisation if available.

7.2 Pavement thickness design

The design of the pavement has been based on the following design inputs:

1. PSM has adopted a design traffic of 10^7 ESAs for a Heavy Industry road as defined in Penrith City Council "*Design guidelines for engineering works for subdivisions and developments"* (2003 – Table 2). The design traffic should be confirmed by Goodman with the relevant authorities.
2. A design subgrade CBR of 1.5% has been adopted for CLAY subgrade on the basis of the CBR tests results on the CLAY subgrade, ie. NATURAL SOIL unit.

We have referred to Austroad Pavement Design (2012). We recommend two options of the new pavements:

- Flexible asphalt pavement – Table 9
- Sealed granular pavement – Table 10

TABLE 9
MINIMUM PAVEMENT THICKNESS (CLAY SUBGRADE) – FLEXIBLE ASPHALT PAVEMENT

LAYER	MATERIAL	MINIMUM THICKNESS (mm)
Wearing course	Asphaltic Concrete (E=3000 MPa, mix = 11%)	180
Base course	Unbound granular material eg. DGB20	300
Sub-base course	Unbound granular material eg. DGB40	300

TABLE 10
MINIMUM PAVEMENT THICKNESS (CLAY SUBGRADE) – SEALED GRANULAR PAVEMENT

LAYER	MATERIAL	MINIMUM THICKNESS (mm)
Wearing course	Asphaltic Concrete	75**
Base course	Unbound granular material eg. DGB20	400
Sub-base course	Unbound granular material eg. DGS40	400

Note: **: Meets minimum asphalt thickness for industrial roads of 50 mm per Section 5.2.3 of Penrith City Council Engineering Construction Specification for Civil Works.

If required the subgrade can be improved by chemical stabilisation which would result in a thinner pavement. Such advice should be sought from PSM.

8 GENERAL

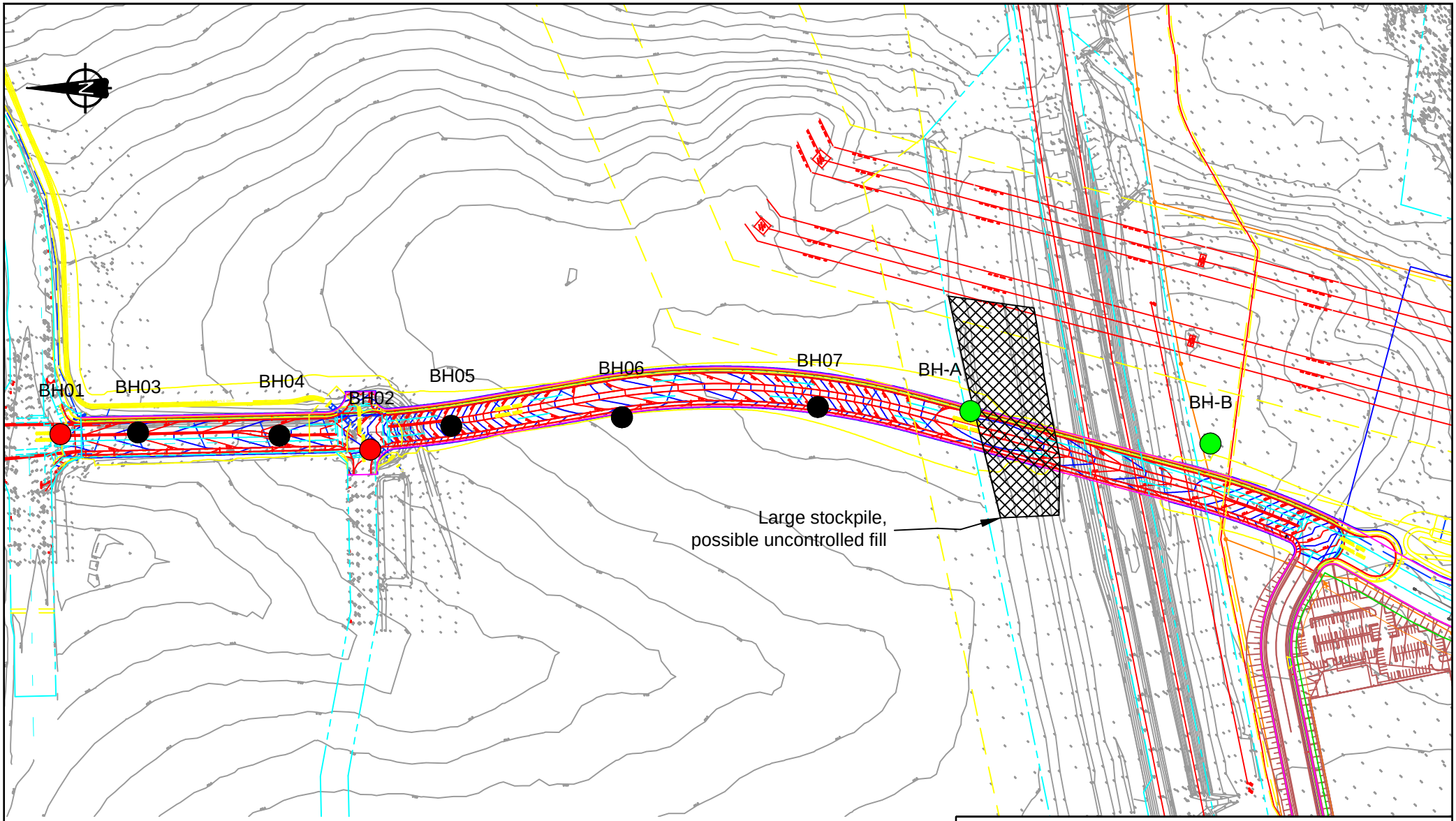
If at any time, the conditions are found to vary from those described in this report, further advice should be sought.

For and on behalf of
PELLS SULLIVAN MEYNINK

GARRY MOSTYN
Principal

REFERENCES

1. Austroad Pavement Design – *A Guide to the Structural Design of Road Pavements*, dated 2012
2. AS2159:2009, Piling – Design and Installation, Standards Australia
3. AS3600:2009, Concrete Structures, Standards Australia
4. Department of Land and Water Conservation (DLWC) 2002, *Site Investigations for Urban Salinity*
5. Penrith City Council 2003, *Design guidelines for engineering works for subdivisions and developments*
6. Penrith City Council 2015, *Engineering Construction Specification for Civil Works*



LEGEND

- PSM existing pavement borehole
- PSM new pavement borehole
- PSM cored corehole

0 50 100 150 200

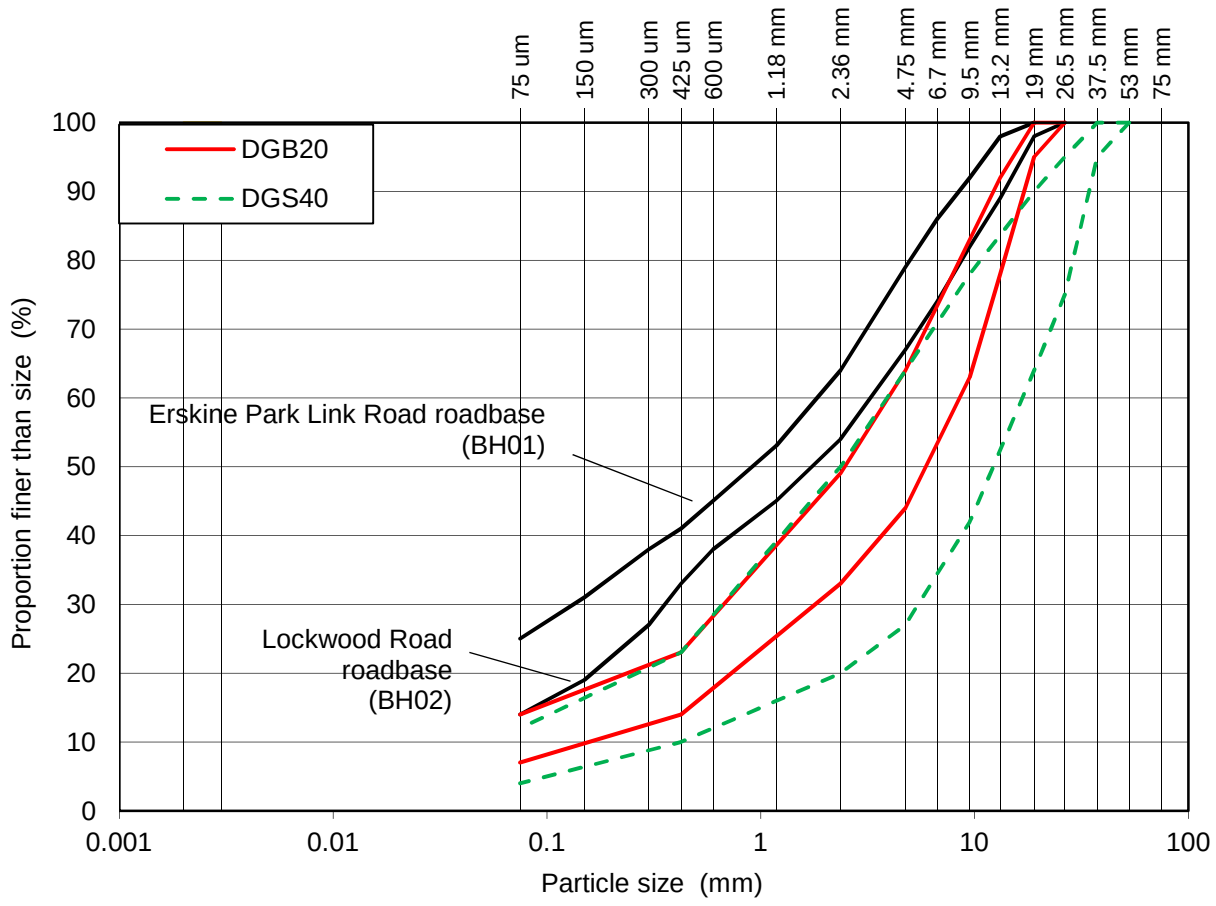
Scale (m)

Pells Sullivan Meynink

Goodman Property Services (Aust) Pty Ltd
Western North South Link Road
Erskine Park, NSW

LOCALITY PLAN

Figure 1	PSM1541-140R



Notes:

1. Testing performed by Ground Technologies
2. DGB20 and DGS40 grading taken from RMS QA Specification 3051 (Table 3051.1)

Pells Sullivan Meynink

Goodman Property Services (Aust) Pty Ltd
Western North South Link Road
Erskine Park, NSW
SUMMARY OF LABORATORY TESTING
Particle Size Distribution Results

PSM1541-140R	**FIGURE 2**

S:\PSM1541\Engineering\PSM1541.50 West North-South Link Road\PSD\[PSM1541.50 PSD.xlsx]Figure 2

APPENDIX A

NORTHROP AS-BUILT DRAWINGS FOR LOCKWOOD ROAD PAVEMENT

RONDO WAREHOUSE FFL 61.80

MODIFY/ADJUST EXISTING TELSTRA PIT & LID TO SUIT NEW LEVELS. PROVIDE HEAVY DUTY LID IN ACCORDANCE WITH AUTHORITIES REQUIREMENTS.

CONSTRUCT HEAVY DUTY CROSSING IN ACCORDANCE WITH COUNCIL'S REQUIREMENTS

CONSTRUCT NEW KERB INLET PIT WITH 1.8m WIDE LINTEL AT CH32.612 IN ACCORDANCE WITH COUNCIL'S STANDARDS.

REMOVE EXISTING CUL-DE-SAC TO CONSTRUCT LOCKWOOD ROAD EXTENSION

CONSTRUCT 2m WIDE CONCRETE CYCLEWAY TO COUNCIL'S REQUIREMENTS - PROVIDE SAWN JOINTS AT 2m CTS & EXPANSION JOINTS AT 6m CTS. (TYP)

CONSTRUCT HEAVY DUTY CROSSING IN ACCORDANCE WITH COUNCIL'S REQUIREMENTS

FOR CONTINUATION REFER DWG No.CL01

EXISTING LOCKWOOD ROAD

LOCKWOOD ROAD

BOUNDARY

3750 RCP

RL60.75
IL59.75

3/1

3/2

K&G

K&G

61.0

61.5

62.0

62.5

63.5

64.0

60.5

1/8

1/7

1/5

1/4

CL61.546
IL60.360

CL61.444
IL60.468

CL61.089
IL60.170

CL60.856
IL59.7

3750 RCP

450ø RCP

BOUNDARY

BOUNDARY

21m ROAD RESERVE

CH0.0
CH15.0
CH30.0
CH45.0
CH52.0
CH60.0
CH75.0
CH90.0
CH105.0
CH120.0
CH135.0
CH150.0
CH165.0
CH180.0
CH195.0
CH210.0
CH225.0
CH240.0
CH255.0
CH270.0
CH285.0
CH300.0
CH315.0
CH330.0

MODIFY EXISTING KERB INLET PIT TO A BLIND JUNCTION PIT (WITH CONCRETE LID UNDERGROUND). BACKFILL WITH CEMENT STABILISED SAND.

CONNECT NEW 375Ø RCP TO BIND PIT IN DRIVEWAY. IL59.60. RECONSTRUCT ROAD PAVEMENT, K&G, VEHICLE CROSSING TO MATCH EXISTING.

RECONSTRUCT (RE_SEAL) ASPHALTIC CONCRETE TO MATCH EXISTING TO COUNCIL"S REQUIREMENTS

COMMENCEMENT OF LOCKWOOD ROAD EXTENSION WORKS - (CH 75.0) SAWCUT & MATCH NEATLY TO EXISTING KERBS & PAVEMENT LEVELS.

RECONSTRUCT EXISTING KERB INLET PIT TO SUIT NEW KERB LEVELS. MAINTAIN EXISTING STORMWATER PIPES & INVERT LEVELS,

MODIFY EXISTING DRIVEWAY TO SUIT NEW ROAD EXTENSION. APPROX LOCATION.

CONSTRUCT NEW PAVEMENT & KERB & GUTTER IN ACCORDANCE WITH COUNCIL'S REQUIREMENTS.

CONSTRUCT 5m WIDE GRASS SWALE TO CONVEY UPSTREAM RUNOFF AROUND NEW ROAD. REFER CROSS SECTIONS.

REFER DWG CL04 FOR EXTENT OF RE-GRADING

FOR CONTINUATION REFER DWG No.CL02

LEGEND

- GRASS SWALE
- STORMWATER PIPE (CLASS 2)
- COUNCIL'S KERB INLET PIT
- CONCRETE PAVEMENT
- NEW FLEXIBLE PAVEMENT
- RE-SEAL ASPHALTIC CONCRETE
- K&G — KERB & GUTTER
- PROPOSED CONTOURS (0.1m INTERVAL)
- EXISTING CONTOURS

NOTES:-

1. CONTRACTOR TO CONTACT RELEVANT AUTHORITIES PRIOR TO COMMENCEMENT OF WORKS.
2. CONTRACTOR TO UNDERTAKE A DIAL BEFORE YOU DIG INVESTIGATION PRIOR TO COMMENCEMENT OF WORKS.
3. NEW VEHICLE CROSSING TO BE LOCATED TO SUIT NEW DEVELOPMENTS.

DRAWN L MILLS ..... DESIGNED N SUTHERLAND ..... JOB MANAGER N SUTHERLAND ..... VERIFIER M RICHARDS

ISSUE	AMENDMENT	VERIFIED	APPROVED	DATE
1	ISSUED FOR SEC 96 DA MODIFICATION		N.S.	16.09.08
2	AMENDED EXISTING STORMWATER		N.S.	20.10.08
3	ADDED STORMWATER LONG SECTION - CLOUDED		N.S.	22.10.08
4	ISSUED FOR COUNCIL'S APPROVAL		N.S.	11.11.08
5	AMENDED CREST IN ROAD		N.S.	09.01.09
6	ISSUED FOR CONSTRUCTION CERTIFICATE		N.S.	16.01.09

Client
FITZPATRICK INVESTMENTS

Contractor

22-24 Junction Street, Forest Lodge NSW 2037
PH: (02) 9566 2822 FAX: (02) 9566 2900
ACN 055 267 788

ALL DIMENSIONS TO BE VERIFIED ON SITE BEFORE MAKING ANY SHOP DRAWINGS OR COMMENCING ANY WORK.

0 5 10 15 20 25m SCALE 1:500 @ A1

0 5 10 15 20 25m SCALE 1:1000 @ A3

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Ph (02) 9241 4188 Fax (02) 9241 4324 Email sydney@northrop.com.au
P.O. Box H171 Australia Square, N.S.W. 1215 ABN 81 094 433 100

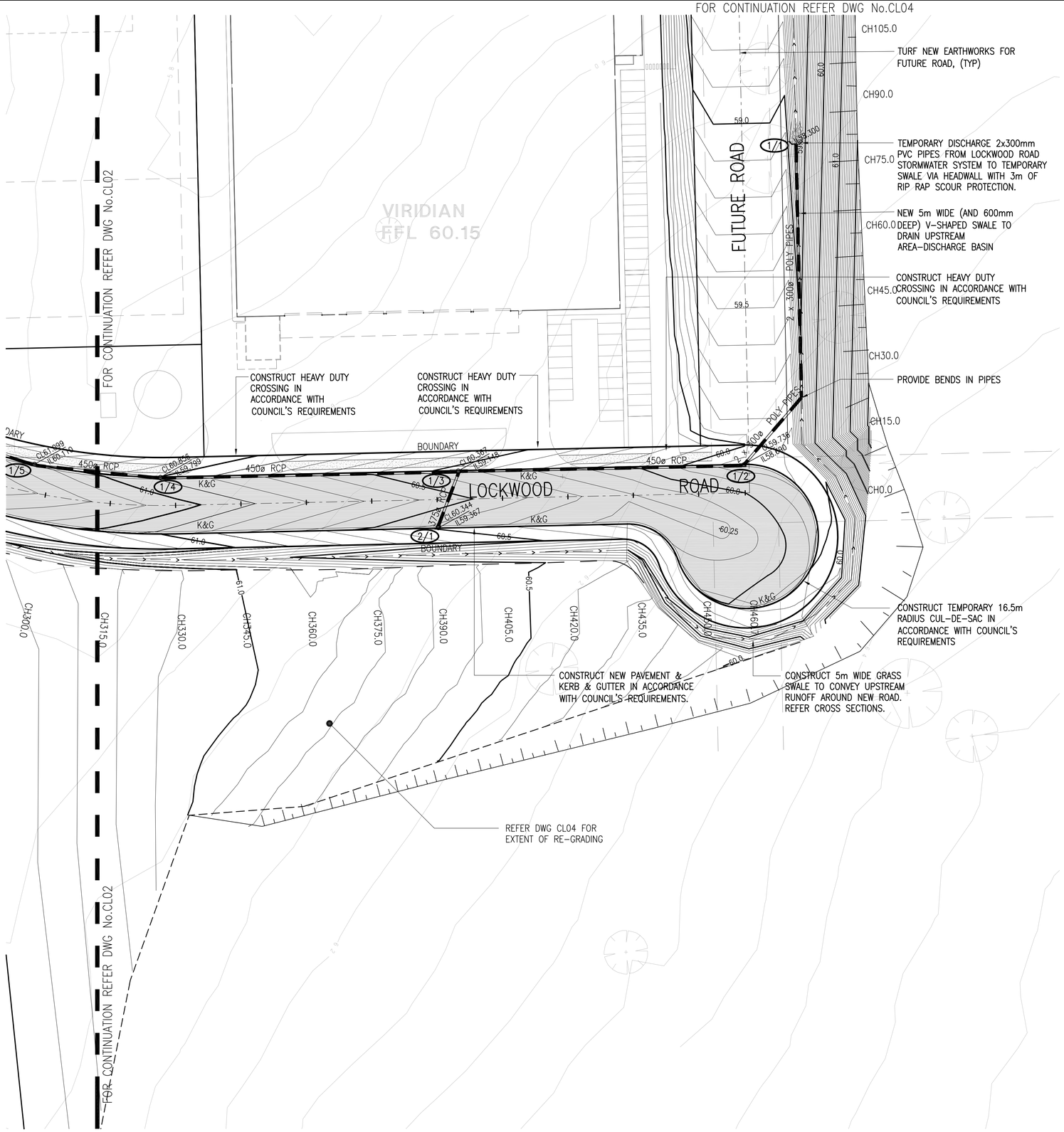
PROJECT
LOCKWOOD ROAD EXTENSION ERSKINE PARK

DRAWING TITLE
LOCKWOOD ROAD PLAN SHEET 1 OF 2

JOB NUMBER **08610**

DRAWING NUMBER **CL02** REVISION **6**

DRAWING SHEET SIZE = A1



LEGEND

- GRASS SWALE
- STORMWATER PIPE (CLASS 2)
- COUNCIL'S KERB INLET PIT
- CONCRETE PAVEMENT
- NEW FLEXIBLE PAVEMENT
- RE-SEAL ASPHALTIC CONCRETE
- K&G — KERB & GUTTER
- PROPOSED CONTOURS (0.1m INTERVAL)
- EXISTING CONTOURS

NOTES:-

1. CONTRACTOR TO CONTACT RELEVANT AUTHORITIES PRIOR TO COMMENCEMENT OF WORKS.
2. CONTRACTOR TO UNDERTAKE A DIAL BEFORE YOU DIG INVESTIGATION PRIOR TO COMMENCEMENT OF WORKS.
3. NEW VEHICLE CROSSING TO BE LOCATED TO SUIT NEW DEVELOPMENTS.

STORMWATER PIT SCHEDULE

PIT No.	PIT SIZE
1/7	COUNCIL'S KERB INLET PIT WITH 2.4m LONG LINTEL
1/6	COUNCIL'S KERB INLET PIT WITH 2.4m LONG LINTEL
1/5	COUNCIL'S KERB INLET PIT WITH 1.8m LONG LINTEL
1/4	COUNCIL'S KERB INLET PIT WITH 1.8m LONG LINTEL
1/3	COUNCIL'S KERB INLET PIT WITH 1.8m LONG LINTEL
1/2	COUNCIL'S KERB INLET PIT WITH 2.4m LONG LINTEL
1/1	ø450 HEADWALL
2/1	COUNCIL'S KERB INLET PIT WITH 2.4m LONG LINTEL

DRAWN L. MILLS ..... DESIGNED N. SUTHERLAND ..... JOB MANAGER N. SUTHERLAND ..... VERIFIER M. RICHARDS

ISSUE	AMENDMENT	VERIFIED	APPROVED	DATE
1	ISSUED FOR SEC 96 DA MODIFICATION		N.S.	16.09.08
2	ISSUED FOR COUNCIL'S APPROVAL		N.S.	11.11.08
3	AMENDED CREST IN ROAD		N.S.	09.01.09
4	ISSUED FOR CONSTRUCTION CERTIFICATE		N.S.	16.01.09
5	ADDITIONAL FUTURE ROAD DESIGN	K.M	N.S.	25.02.09

Client: FITZPATRICK INVESTMENTS

DRAWING NOT TO BE USED FOR CONSTRUCTION UNLESS VERIFICATION SIGNATURE HAS BEEN ADDED

Contractor: FDC

22-24 Junction Street, Forest Lodge NSW 2037
PH: (02) 9566 2822 FAX: (02) 9566 2900
ACN 055 267 788

ALL DIMENSIONS TO BE VERIFIED ON SITE BEFORE MAKING ANY SHOP DRAWINGS OR COMMENCING ANY WORK

0 5 10 15 20 25m SCALE 1:500 @ A1
0 5 10 15 20 25m SCALE 1:1000 @ A3

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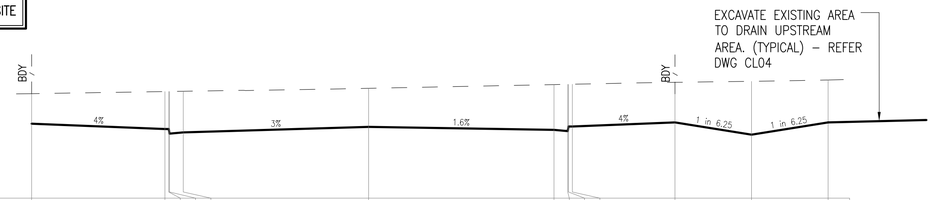
P.O. Box H171 Australia Square, N.S.W. 1215 ABN 81 094 433 100

PROJECT: LOCKWOOD ROAD EXTENSION ERSKINE PARK

DRAWING TITLE: LOCKWOOD ROAD PLAN SHEET 2 OF 2

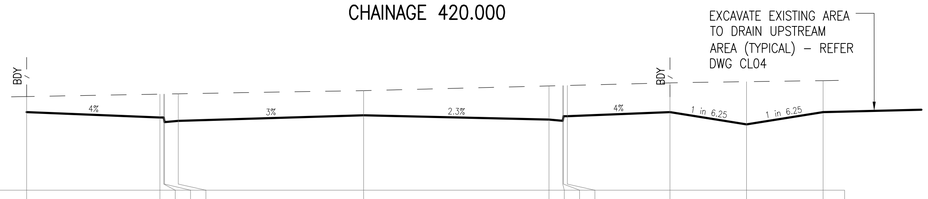
JOB NUMBER 08610
DRAWING NUMBER CL03
REVISION 5
DRAWING SHEET SIZE = A1

REFER CIVIL ENGINEERING DRAWINGS TO COORDINATE LEVELS BEYOND THE BOUNDARY – WITHIN THE SITE



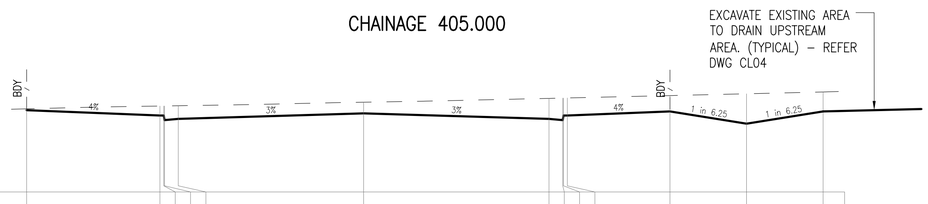
DATUM R.L.58										
FINISHED SURFACE LEVELS	60.428	60.254	60.254	60.104	60.144	60.326	60.228	60.188	60.338	60.338	60.472	60.072	60.472
EXISTING SURFACE LEVELS	61.409	61.478	61.480	61.480	61.487	61.583	61.705	61.714	61.714	61.717	61.778	61.812	61.856
OFFSET	-11.000	-6.650	-6.525	-6.500	-6.050	-0.000	6.050	6.500	6.525	6.650	10.000	12.500	15.000

CHAINAGE 420.000



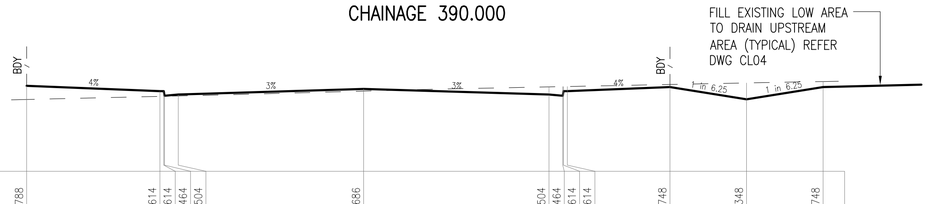
DATUM R.L.58										
FINISHED SURFACE LEVELS	60.548	60.374	60.374	60.224	60.264	60.446	60.306	60.266	60.416	60.416	60.550	60.150	60.550
EXISTING SURFACE LEVELS	61.057	61.136	61.138	61.138	61.147	61.251	61.403	61.415	61.415	61.419	61.503	61.542	61.577
OFFSET	-11.000	-6.650	-6.525	-6.500	-6.050	-0.000	6.050	6.500	6.525	6.650	10.000	12.500	15.000

CHAINAGE 405.000



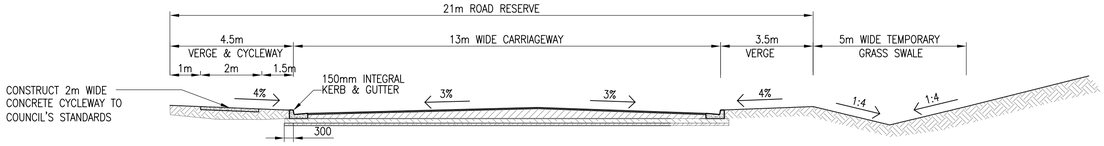
DATUM R.L.58										
FINISHED SURFACE LEVELS	60.668	60.494	60.494	60.344	60.384	60.566	60.384	60.344	60.494	60.494	60.628	60.228	60.628
EXISTING SURFACE LEVELS	60.712	60.804	60.806	60.807	60.814	60.930	61.054	61.065	61.065	61.068	61.146	61.204	61.264
OFFSET	-11.000	-6.650	-6.525	-6.500	-6.050	-0.000	6.050	6.500	6.525	6.650	10.000	12.500	15.000

CHAINAGE 390.000



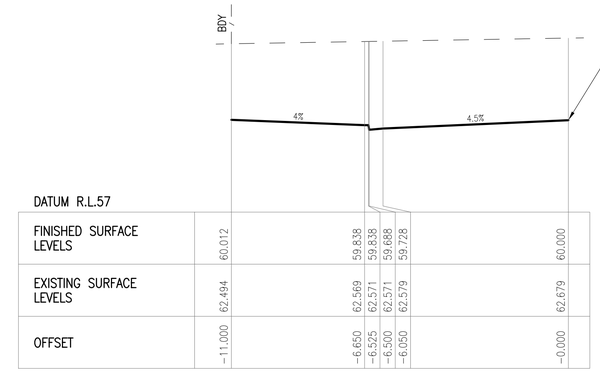
DATUM R.L.58										
FINISHED SURFACE LEVELS	60.788	60.614	60.614	60.464	60.504	60.686	60.504	60.464	60.614	60.614	60.748	60.348	60.748
EXISTING SURFACE LEVELS	60.343	60.444	60.447	60.447	60.458	60.616	60.754	60.763	60.764	60.766	60.833	60.883	60.929
OFFSET	-11.000	-6.650	-6.525	-6.500	-6.050	-0.000	6.050	6.500	6.525	6.650	10.000	12.500	15.000

CHAINAGE 375.000



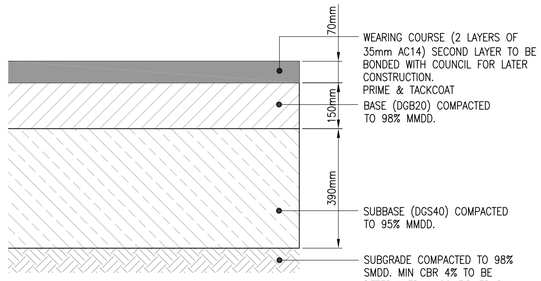
TYPICAL ROAD SECTION

SCALE 1:100



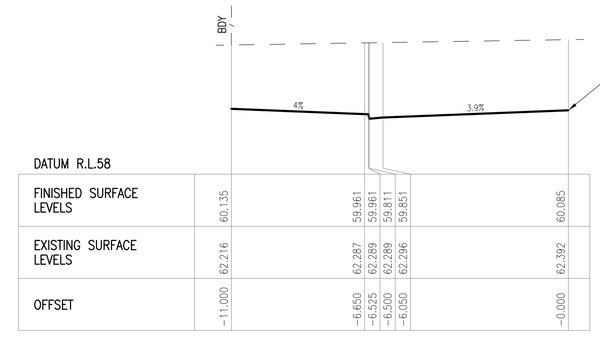
DATUM R.L.57						
FINISHED SURFACE LEVELS	60.012	59.838	59.838	59.688	59.728	60.000
EXISTING SURFACE LEVELS	62.494	62.569	62.571	62.571	62.579	62.679
OFFSET	-11.000	-6.650	-6.525	-6.500	-6.050	-0.000

CHAINAGE 460.674



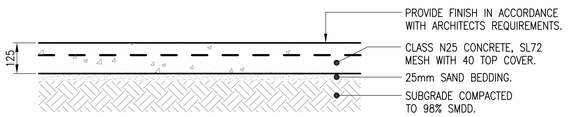
LOCKWOOD ROAD PAVEMENT

DESIGN LOADING = $1x10^6$ ESAs
DESIGN CBR = 4%



DATUM R.L.58						
FINISHED SURFACE LEVELS	60.135	59.961	59.961	59.811	59.851	60.085
EXISTING SURFACE LEVELS	62.216	62.287	62.289	62.289	62.296	62.392
OFFSET	-11.000	-6.650	-6.525	-6.500	-6.050	-0.000

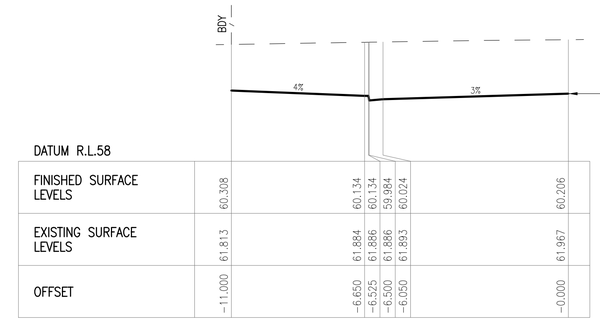
CHAINAGE 450.000



CYCLEWAY PAVEMENT

SCALE 1:10

NOTE:–
PROVIDE SAWN JOINTS AT 2m CTS & EXPANSION JOINTS AT 6m CTS TO COUNCIL'S STANDARDS.



DATUM R.L.58						
FINISHED SURFACE LEVELS	60.308	60.134	60.134	59.984	60.024	60.206
EXISTING SURFACE LEVELS	61.813	61.884	61.886	61.886	61.893	61.967
OFFSET	-11.000	-6.650	-6.525	-6.500	-6.050	-0.000

CHAINAGE 435.000

DRAWN L. MILLS ..... DESIGNED N. SUTHERLAND ..... JOB MANAGER N. SUTHERLAND ..... VERIFIER K.MELDRUM

ISSUE	AMENDMENT	VERIFIED	APPROVED	DATE
1	ISSUED FOR SEC 96 DA MODIFICATION		N.S.	16.09.08
2	ISSUED FOR COUNCIL'S APPROVAL		N.S.	11.11.08
3	ISSUED FOR CONSTRUCTION CERTIFICATE	K.M	N.S.	16.01.09

Client
FITZPATRICK INVESTMENTS

DRAWING NOT TO BE USED FOR CONSTRUCTION UNLESS VERIFICATION SIGNATURE HAS BEEN ADDED

Contractor

22–24 Junction Street, Forest Lodge NSW 2037
PH: (02) 9566 2822 FAX: (02) 9566 2900
ACN 055 267 788

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0 1 2 3 4 5m SCALE 1:100 @ A1
0 1 2 3 4 5m SCALE 1:200 @ A3

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P.O. Box H171 Australia Square, N.S.W. 1215 ABN 81 094 433 100

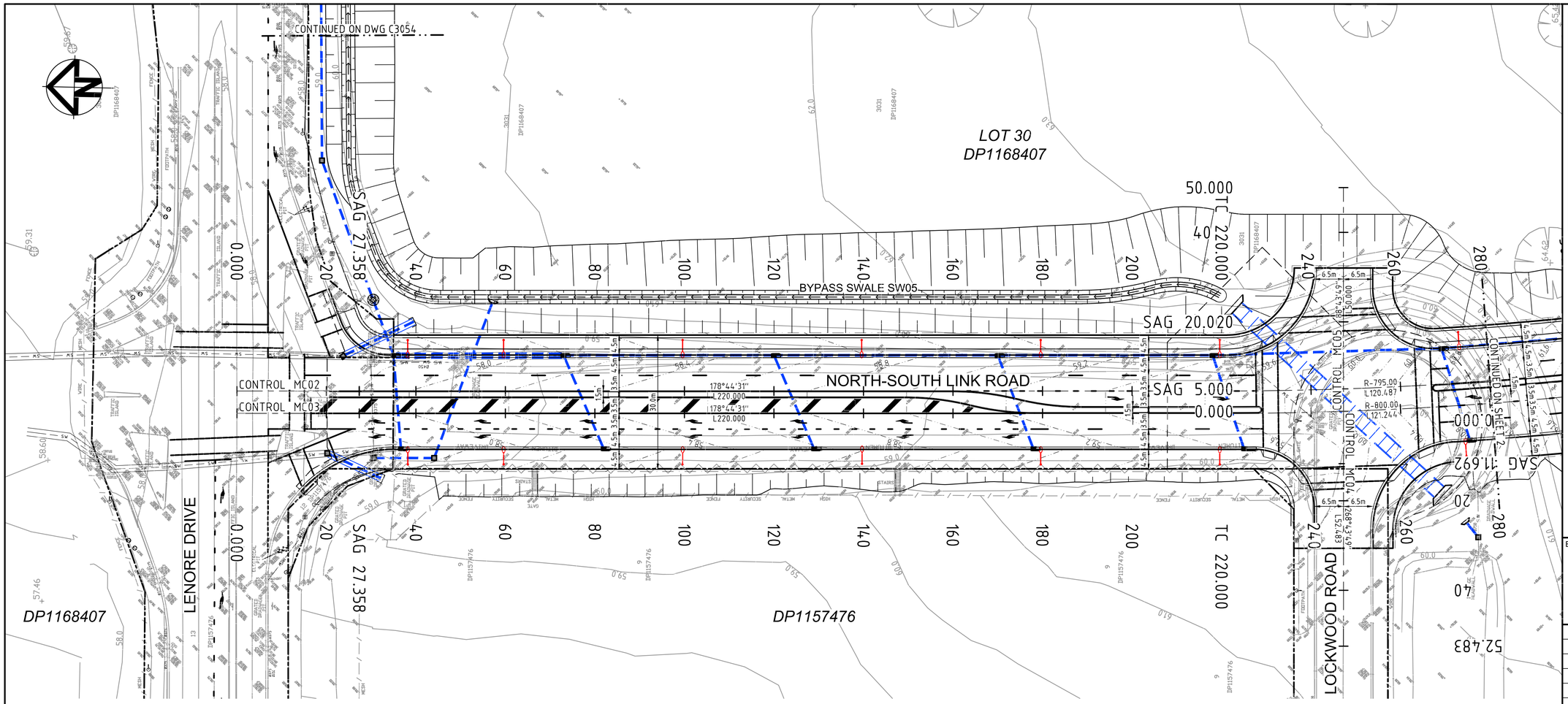
PROJECT
LOCKWOOD ROAD EXTENSION ERSKINE PARK

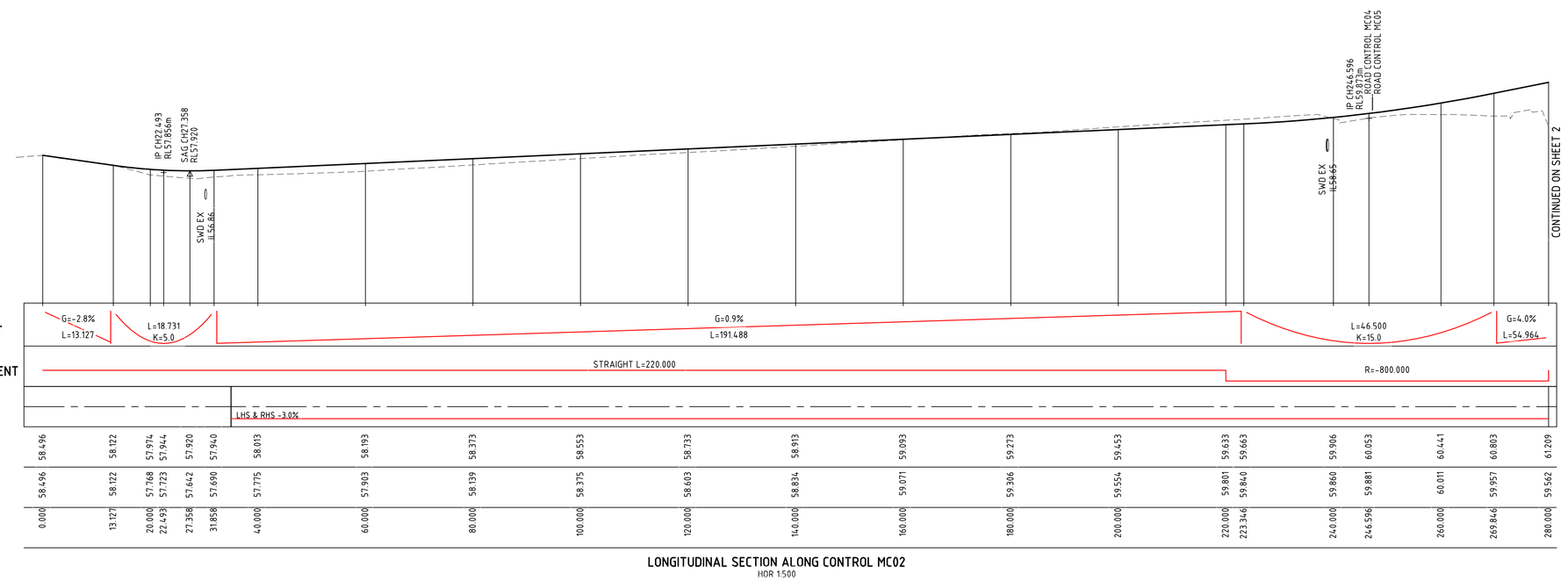
DRAWING TITLE
LOCKWOOD ROAD CROSS SECTIONS & DETAILS SHEET 4

JOB NUMBER **08610**
DRAWING NUMBER **CL10**
REVISION **3**
DRAWING SHEET SIZE = A1

APPENDIX B

PROPOSED WNSLR ALIGNMENT





LONGITUDINAL SECTION ALONG CONTROL MC02
HOR 1:500
VER 1:100

LEGEND

- EXISTING BOUNDARY
- EXISTING EASEMENT
- 60.0 EXISTING CONTOUR
- PROPOSED BOUNDARY
- 65.0 PROPOSED CONTOUR
- PROPOSED KERB AND GUTTER
- PROPOSED STORMWATER PIPE
- PROPOSED KERB INLET PIT
- PROPOSED HEADWALL
- PROPOSED BRIDGE DECK REFER DWG C304.0 FOR DETAILS

Bar Scales

0 2 4 6 8
1 : 100 @ A1 1 : 200 @ A3
0 10 20 30 40
1 : 500 @ A1 1 : 1000 @ A3

Issue	Description	Date
P1	ISSUED FOR DRAFT REVIEW	8-4-16

Status: DRAFT ISSUE
NOT TO BE USED FOR CONSTRUCTION
A1

Scales	1 : 500	15-272-C3020.dwg	
		Drawn	MM
		Designed	MM
Height Datum	AHD	Checked	AM
Grid	MGA	Approved	

Client: Goodman

Civil Engineers and Project Managers
at&l
Level 7, 153 Walker Street
North Sydney NSW 2060
ABN 96 130 882 405
Tel: 02 9439 7777
Fax: 02 9923 1055
www.atl.net.au
info@atl.net.au

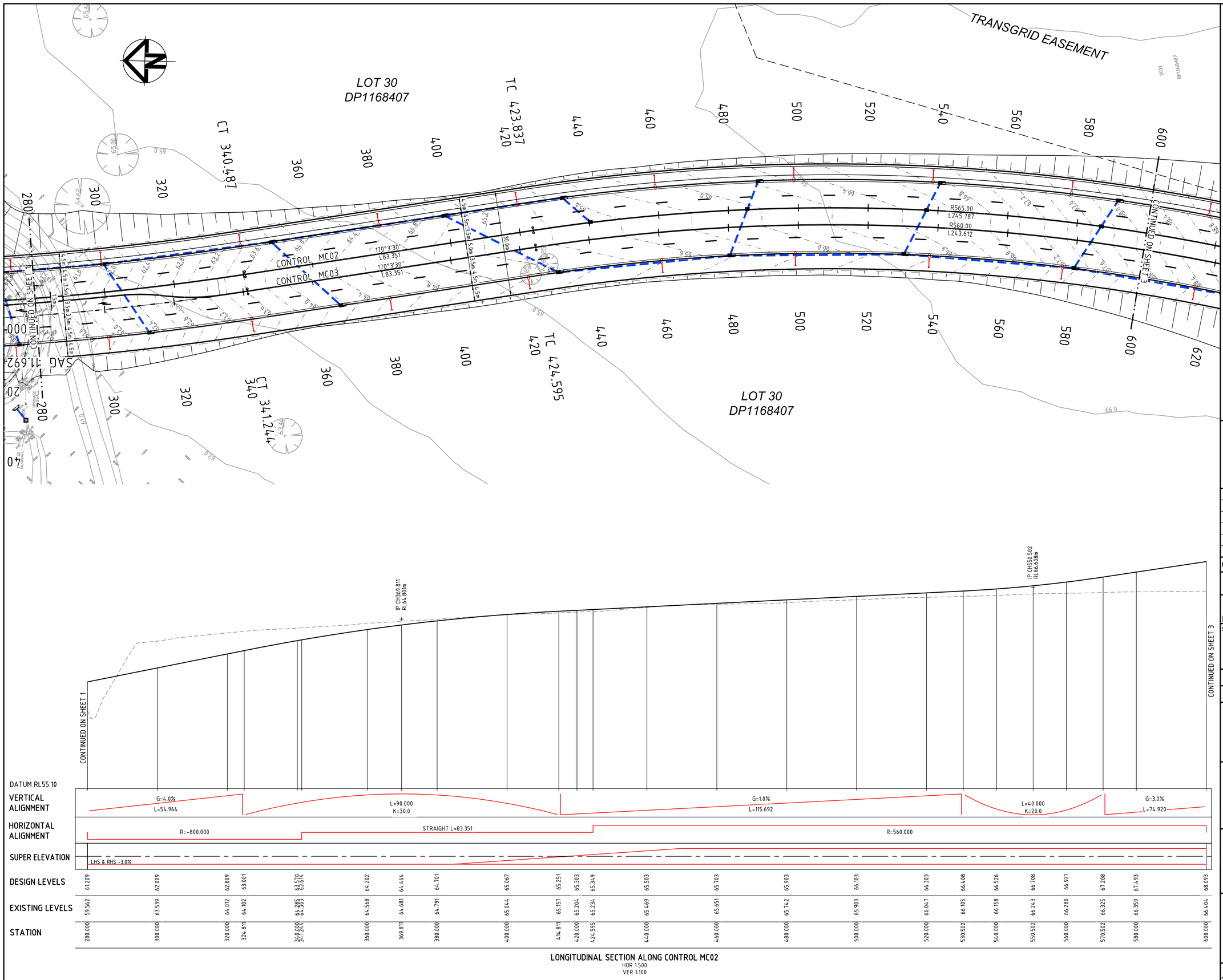
Project
PROPOSED INDUSTRIAL DEVELOPMENT
OAKDALE WEST

Title
ROADWORKS PLAN AND LONGITUDINAL SECTION
SHEET 1 OF 5

Drawing No.	Project No.	Issue
15-272-C3020	15-272	P1

100mm on Original

Date Plotted: 6 May 2016 - 10:04AM File Name: F:\15-272 Oakdale West\Drgs\Civil\Final\3000_WNSLR Package\15-272-C3020.dwg V1



DATUM RL55.10

VERTICAL ALIGNMENT	G=4.0% L=54.964	L=90.000 K=30.0	G=1.0% L=115.692	L=40.000 K=20.0	G=3.0% L=74.920	
HORIZONTAL ALIGNMENT	R=-800.000	STRAIGHT L=83.351	R=560.000			
SUPER ELEVATION	LHS & RHS -3.0%					
DESIGN LEVELS	61.209	62.009	62.809	63.001	63.370	63.516
EXISTING LEVELS	59.562	63.539	64.012	64.102	64.385	64.383
STATION	280.000	300.000	320.000	324.811	341.000	341.244

VERTICAL ALIGNMENT						
HORIZONTAL ALIGNMENT						
SUPER ELEVATION						
DESIGN LEVELS	64.202	64.464	64.701	65.067	65.251	65.303
EXISTING LEVELS	64.568	64.681	64.791	65.044	65.157	65.204
STATION	360.000	369.811	380.000	400.000	414.811	420.000

VERTICAL ALIGNMENT						
HORIZONTAL ALIGNMENT						
SUPER ELEVATION						
DESIGN LEVELS	65.349	65.503	65.703	65.903	66.103	66.303
EXISTING LEVELS	65.234	65.469	65.651	65.742	65.903	66.047
STATION	424.595	440.000	460.000	480.000	500.000	520.000

VERTICAL ALIGNMENT						
HORIZONTAL ALIGNMENT						
SUPER ELEVATION						
DESIGN LEVELS	66.408	66.526	66.708	66.921	67.208	67.493	68.093
EXISTING LEVELS	66.105	66.158	66.243	66.280	66.325	66.359	66.404
STATION	530.502	540.000	550.502	560.000	570.502	580.000	600.000

LONGITUDINAL SECTION ALONG CONTROL MC02
HOR 1:500
VER 1:100

LEGEND

- EXISTING BOUNDARY
- EXISTING EASEMENT
- 60.0 EXISTING CONTOUR
- PROPOSED BOUNDARY
- 65.0 PROPOSED CONTOUR
- PROPOSED KERB AND GUTTER
- PROPOSED STORMWATER PIPE
- PROPOSED KERB INLET PIT
- PROPOSED HEADWALL
- PROPOSED BRIDGE DECK REFER DWG C304.0 FOR DETAILS

Bar Scales

0 2 4 6 8
1 : 100 @ A1 1 : 200 @ A3

0 10 20 30 40
1 : 500 @ A1 1 : 1000 @ A3

Issue	Description	Date
P1	ISSUED FOR DRAFT REVIEW	8-4-16

Status: DRAFT ISSUE
NOT TO BE USED FOR CONSTRUCTION
A1

Scales	1 : 500	15-272-C3021.dwg	
		Drawn	MM
		Designed	MM
Height Datum	AHD	Checked	AM
Grid	MGA	Approved	

Client: Goodman

Civil Engineers and Project Managers
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Level 7, 153 Walker Street
North Sydney NSW 2060
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Fax: 02 9923 1055
www.atl.net.au
info@atl.net.au

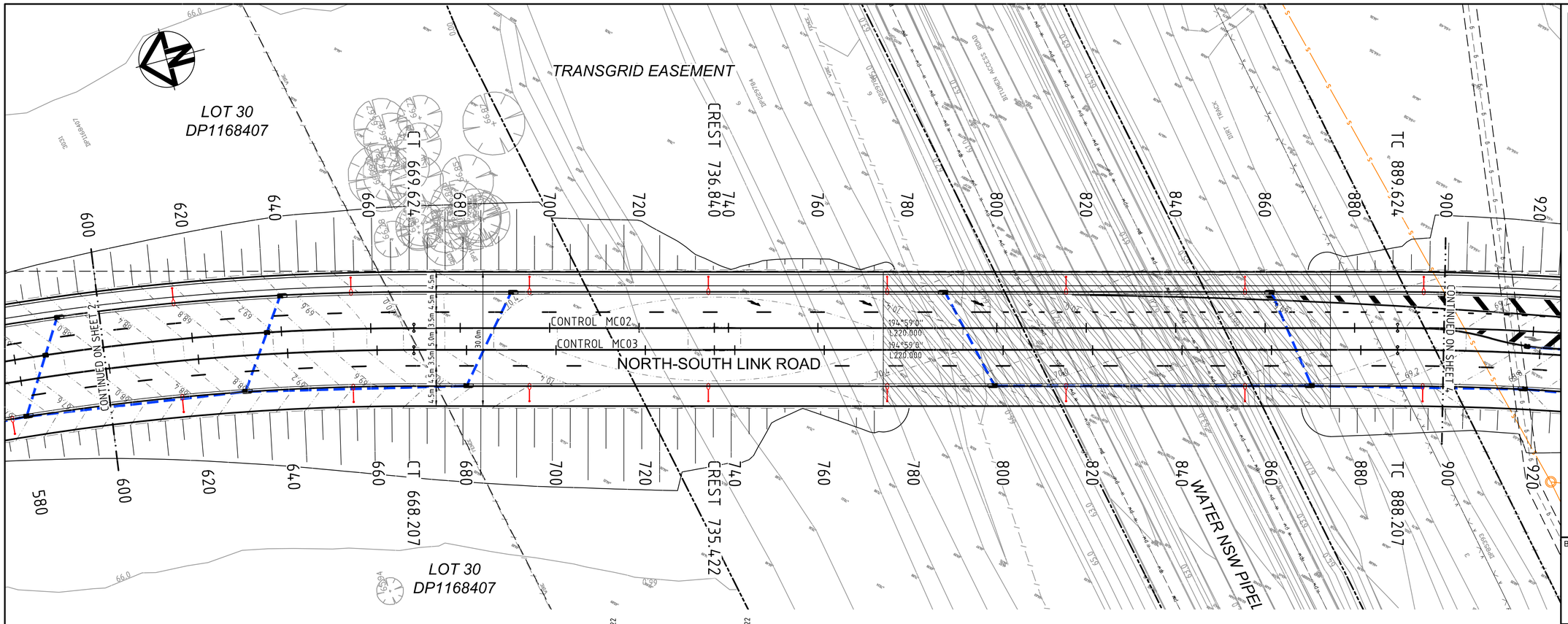
Project
PROPOSED INDUSTRIAL DEVELOPMENT
OAKDALE WEST

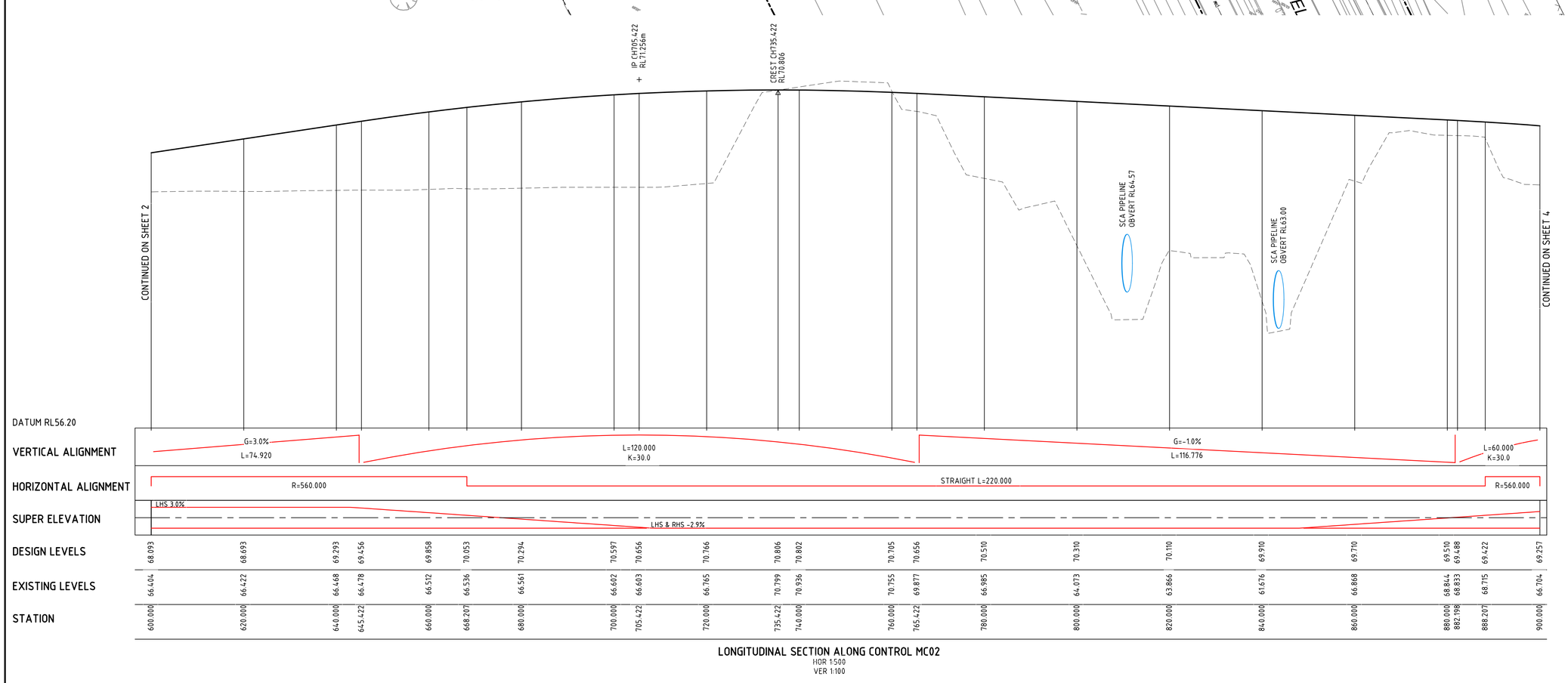
Title
ROADWORKS PLAN AND LONGITUDINAL SECTION
SHEET 2 OF 5

Drawing No.	Project No.	Issue
15-272-C3021	15-272	P1

100mm on Original

Date Plotted: 6 May 2016 - 10:04AM File Name: F:\15-272 Oakdale West\Drgs\Civil\Final\3000_WNSLR Package\15-272-C3021.dwg V1





LONGITUDINAL SECTION ALONG CONTROL MC02
HOR 1:500
VER 1:100

LEGEND

- EXISTING BOUNDARY
- EXISTING EASEMENT
- 60.0 EXISTING CONTOUR
- PROPOSED BOUNDARY
- 65.0 PROPOSED CONTOUR
- PROPOSED KERB AND GUTTER
- PROPOSED STORMWATER PIPE
- PROPOSED KERB INLET PIT
- PROPOSED HEADWALL
- PROPOSED BRIDGE DECK REFER DWG C3040 FOR DETAILS

Bar Scales

0 2 4 6 8
1 : 100 @ A1 1 : 200 @ A3
0 10 20 30 40
1 : 500 @ A1 1 : 1000 @ A3

Issue	Description	Date
P1	ISSUED FOR DRAFT REVIEW	8-4-16

Status: DRAFT ISSUE
NOT TO BE USED FOR CONSTRUCTION
A1

Scales	1 : 500	15-272-C3022.dwg	
		Drawn	MM
		Designed	MM
Height Datum	AHD	Checked	AM
Grid	MGA	Approved	

Client: Goodman

Civil Engineers and Project Managers
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Level 7, 153 Walker Street
North Sydney NSW 2060
ABN 96 130 882 405
Tel: 02 9439 1777
Fax: 02 9923 1055
www.atl.net.au
info@atl.net.au

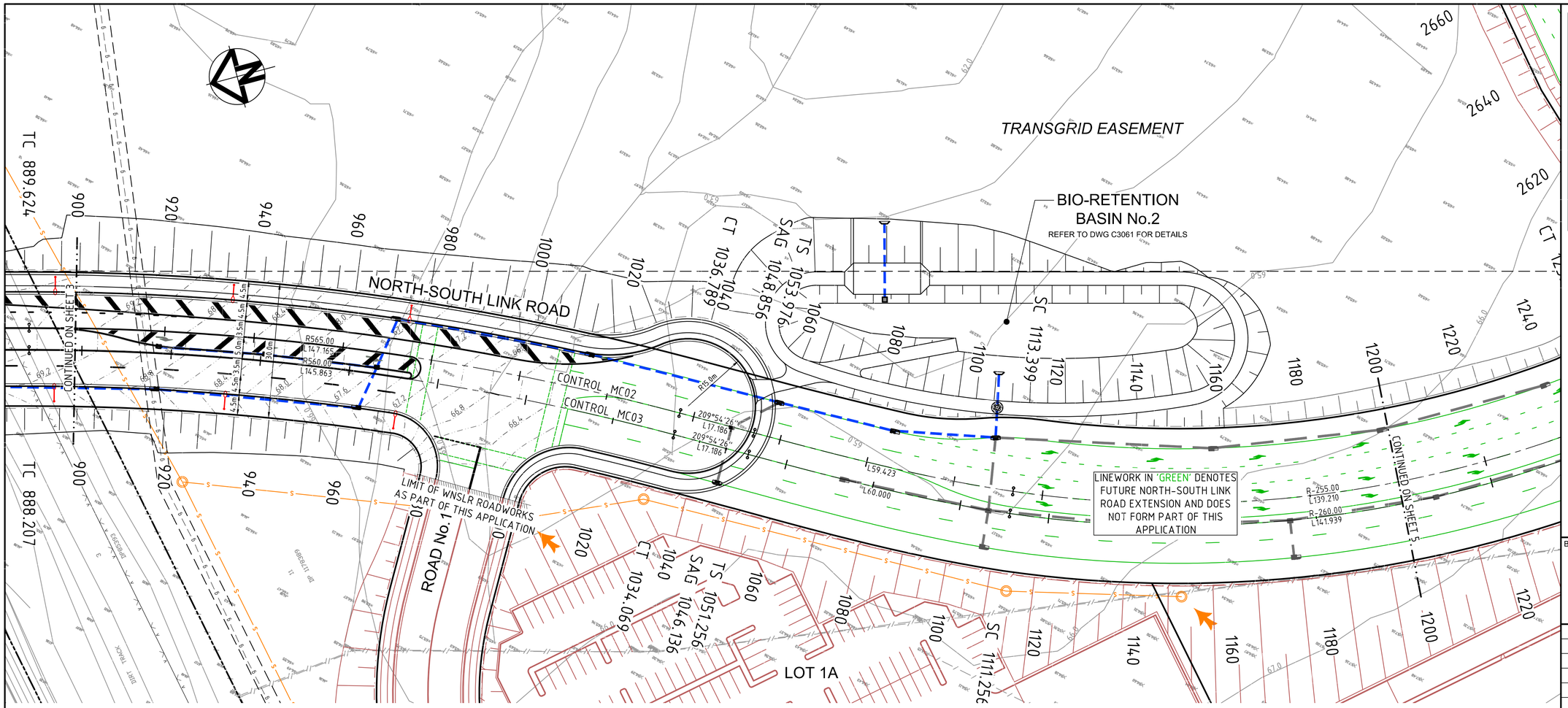
Project
PROPOSED INDUSTRIAL DEVELOPMENT
OAKDALE WEST

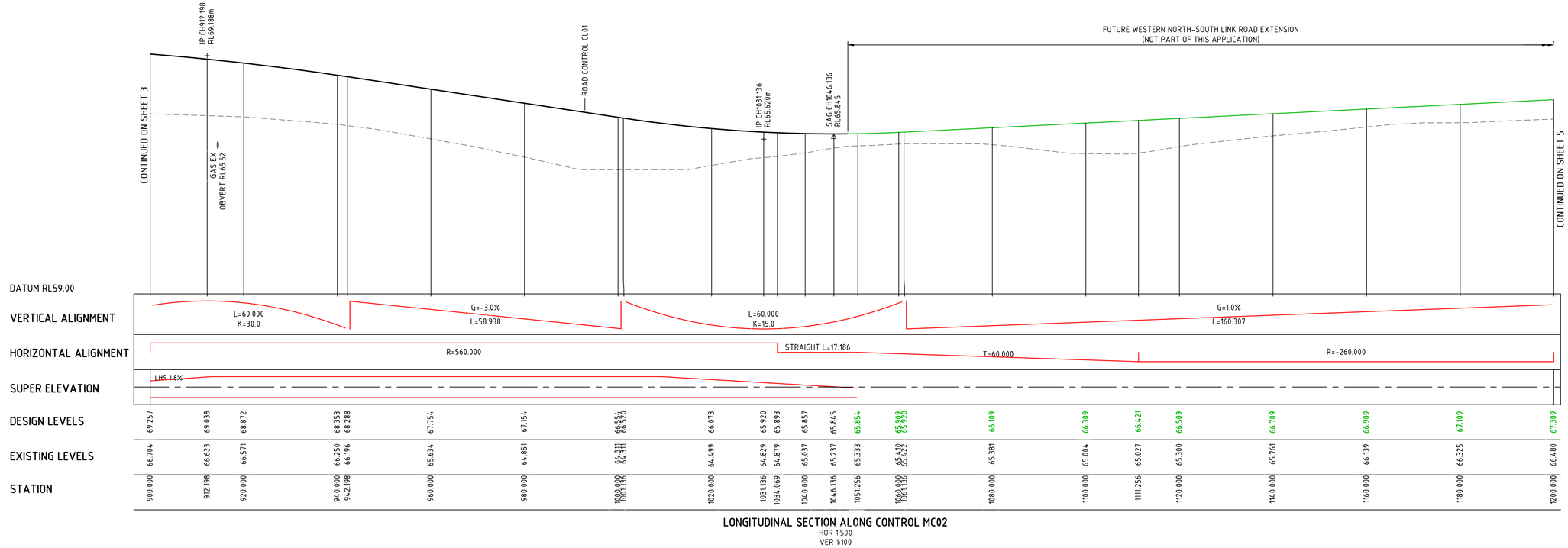
Title
ROADWORKS PLAN AND LONGITUDINAL SECTION
SHEET 3 OF 5

Drawing No.	Project No.	Issue
15-272-C3022	15-272	P1

100mm on Original

Date Plotted: 6 May 2016 - 10:04AM File Name: F:\15-272 Oakdale West\Drgs\Civil\Final\3000_WNSLR Package\15-272-C3022.dwg V1





LONGITUDINAL SECTION ALONG CONTROL MC02
HOR 1:500
VER 1:100

LEGEND

- EXISTING BOUNDARY
- EXISTING EASEMENT
- 60.0 EXISTING CONTOUR
- PROPOSED BOUNDARY
- 65.0 PROPOSED CONTOUR
- PROPOSED KERB AND GUTTER
- PROPOSED STORMWATER PIPE
- PROPOSED KERB INLET PIT
- PROPOSED HEADWALL
- PROPOSED BRIDGE DECK REFER DWG C304.0 FOR DETAILS

Bar Scales

0 2 4 6 8
1 : 100 @ A1 1 : 200 @ A3
0 10 20 30 40
1 : 500 @ A1 1 : 1000 @ A3

Issue	Description	Date
P1	ISSUED FOR DRAFT REVIEW	8-4-16

Status: DRAFT ISSUE — NOT TO BE USED FOR CONSTRUCTION — A1

Scales	1 : 500	15-272-C3023.dwg
		Drawn: MM
		Designed: MM
Height Datum	AHD	Checked: AM
Grid	MGA	Approved:

Client: Goodman

Civil Engineers and Project Managers
at&l
Level 7, 153 Walker Street
North Sydney NSW 2060
ABN 96 130 882 405
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Fax: 02 9923 1055
www.atl.net.au
info@atl.net.au

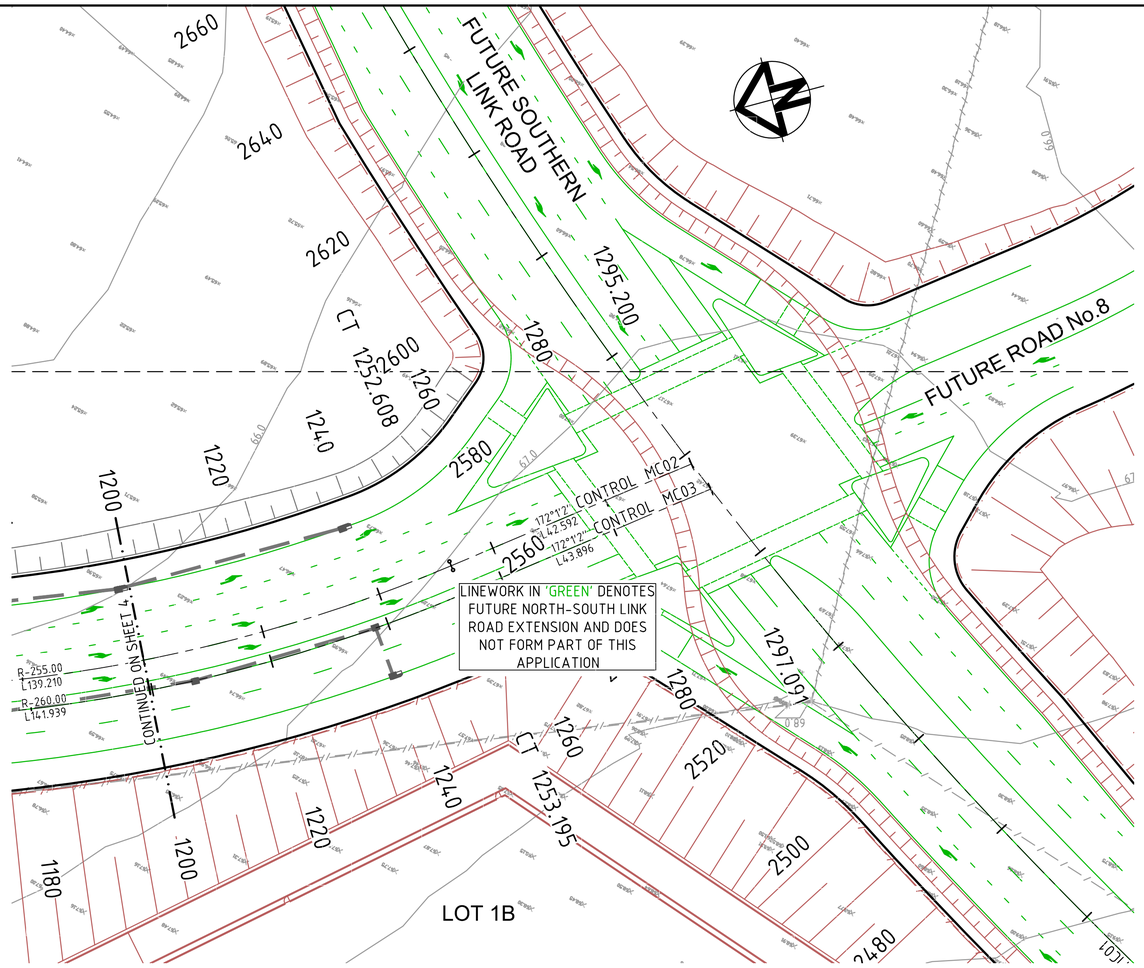
Project: PROPOSED INDUSTRIAL DEVELOPMENT OAKDALE WEST

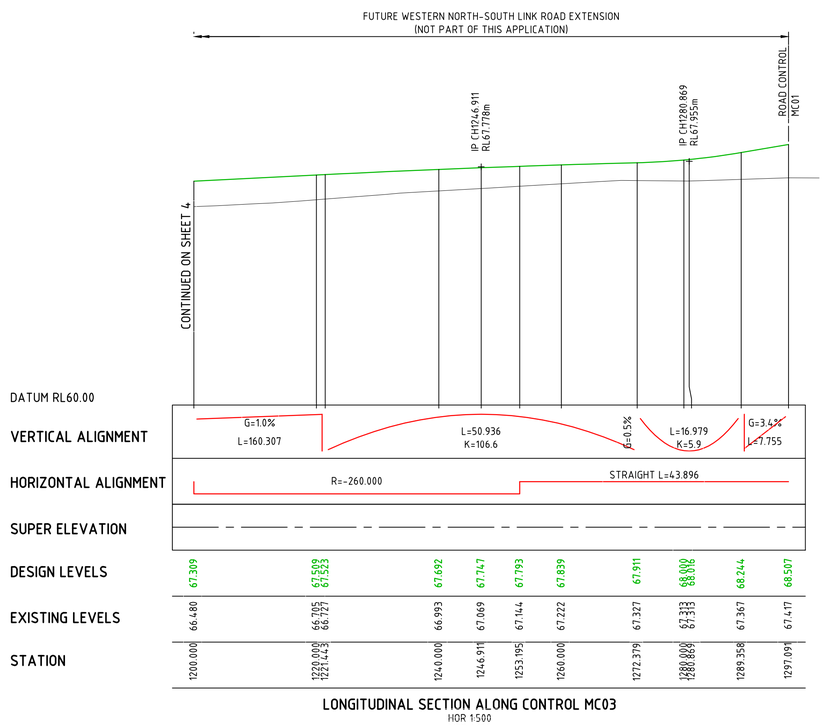
Title: ROADWORKS PLAN AND LONGITUDINAL SECTION SHEET 4 OF 5

Drawing No.	Project No.	Issue
15-272-C3023	15-272	P1

100mm on Original

Date Plotted: 6 May 2016 - 10:05AM File Name: F:\15-272 Oakdale West\Drgs\Civil\Final\3000_WNSLR Package\15-272-C3023.dwg V1





LONGITUDINAL SECTION ALONG CONTROL MC03
HOR 1:500
VER 1:100

LEGEND

- EXISTING BOUNDARY
- EXISTING EASEMENT
- 60.0 EXISTING CONTOUR
- PROPOSED BOUNDARY
- 65.0 PROPOSED CONTOUR
- PROPOSED KERB AND GUTTER
- PROPOSED STORMWATER PIPE
- PROPOSED KERB INLET PIT
- PROPOSED HEADWALL
- PROPOSED BRIDGE DECK REFER DWG C3040 FOR DETAILS

Bar Scales

0 2 4 6 8
1 : 100 @ A1 1 : 200 @ A3
0 10 20 30 40
1 : 500 @ A1 1 : 1000 @ A3

Issue	Description	Date
P1	ISSUED FOR DRAFT REVIEW	8-4-16

Status: DRAFT ISSUE
NOT TO BE USED FOR CONSTRUCTION
A1

Scales	1 : 500	15-272-C3024.dwg	
		Drawn	MM
		Designed	MM
Height Datum	AHD	Checked	AM
Grid	MGA	Approved	

Client: Goodman

Civil Engineers and Project Managers
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Level 7, 153 Walker Street
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info@atl.net.au

Project
PROPOSED INDUSTRIAL DEVELOPMENT
OAKDALE WEST

Title
ROADWORKS PLAN AND LONGITUDINAL SECTION
SHEET 5 OF 5

Drawing No.	Project No.	Issue
15-272-C3024	15-272	P1

100mm on Original

Document Set ID: 9193086
Version: 1, Version Date: 29/06/2020

APPENDIX C

CORED BOREHOLE LOGS

Borehole ID

BH-A

Engineering Log - Non Cored Borehole

Project No.: PSM1541.50

Client:	Goodman	Commenced:	18/05/2016
Project Name:	Western North-South Link Road	Completed:	18/05/2016
Hole Location:	North of Sydney water pipeline	Logged By:	LT
Hole Position:	297083.0 m E 6255411.0 m N MGA 56	Checked By:	CF

Drill Model and Mounting:	Commachio Geo305	Inclination:	-90°	RL Surface:	67.10 m		
Hole Diameter:	110 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T			Not Encountered	ES8 B 0.30-0.50 m					CL	CLAY: Grey and brown, low plasticity, with sub-rounded to sub-angular, up to 3mm gravel				
									CI-CH	CLAY: Pale grey, medium to high plasticity				
						66.1	1			Some ironstone bands				
						65.1	2					St		
									CI-CH	CLAY: Orange and brown, medium to high plasticity, trace sub-rounded, up to 2mm gravel	D			
						64.1	3							
									CI-CH	CLAY: Pale grey, medium to high plasticity				
						63.1	4					VSt		

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
VD - Very dense
Ce - Cemented
C - Compact

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

See Explanatory Notes for details of abbreviations and basis of descriptions.

Engineering Log - Non Cored Borehole

Project No.: PSM1541.50

Client:	Goodman	Commenced:	18/05/2016
Project Name:	Western North-South Link Road	Completed:	18/05/2016
Hole Location:	North of Sydney water pipeline	Logged By:	LT
Hole Position:	297083.0 m E 6255411.0 m N MGA 56	Checked By:	CF

Drill Model and Mounting:	Commachio Geo305	Inclination:	-90°	RL Surface:	67.10 m		
Hole Diameter:	110 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T			Not Encountered			61.1	6			CLAY; paley grey, medium to high plasticity	D	VSt		
						60.1	7			SHALE: dark grey, extremely low to very low strength				
						59.1	8							
						58.1	9							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
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Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

See Explanatory Notes for details of abbreviations and basis of descriptions.

Engineering Log - Non Cored Borehole

Project No.: PSM1541.50

Client:	Goodman	Commenced:	18/05/2016
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Hole Location:	North of Sydney water pipeline	Logged By:	LT
Hole Position:	297083.0 m E 6255411.0 m N MGA 56	Checked By:	CF

Drill Model and Mounting:	Commachio Geo305	Inclination:	-90°	RL Surface:	67.10 m		
Hole Diameter:	110 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
										Continued on cored borehole sheet				
						56.1	11							
						55.1	12							
						54.1	13							
						53.1	14							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
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Consistency/Relative Density
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Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

See Explanatory Notes for details of abbreviations and basis of descriptions.

Engineering Log - Cored Borehole

Project No.: PSM1541.50

Client:	Goodman	Commenced:	18/05/2016
Project Name:	Western North-South Link Road	Completed:	18/05/2016
Hole Location:	North of Sydney water pipeline	Logged By:	LT
Hole Position:	297083.0 m E 6255411.0 m N MGA 56	Checked By:	CF

Drill Model and Mounting:	Commachio Geo305	Inclination:	-90°	RL Surface:	67.10 m		
Barrel Type and Length:	NMLC 3.6 m	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information							Rock Substance																	Rock Mass Defects		
Method	Water	TCR (%)	RQD (%)	SAMPLES & FIELD TESTS	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable)	Weathering					Strength Is(50) ● - Axial ○ - Diametral								Defect Spacing (mm)				Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
									EW	HW	MW	SW	F	EL	VL	L	M	H	VH	EH	<20	60	200	600	1000	
								Continued from non-cored borehole sheet																		
NMLC	Not Encountered	100	99	10.95m Is(50) d=0.1 a=0.2 MPa	56.1	11		SHALE: dark grey, no distinct structure																		BP 10° CN ST S BP 5° CL VN IR S CZ RF 10 mm JT 60° CL VN IR S
				11.88m Is(50) d=0.2 a=0.2 MPa	55.1	12																				
				12.80m Is(50) d=0.3 a=0.2 MPa	54.1	13																				CZ RF 20 mm BP 5° CL VN IR S BP 5° CL VN IR S BP 0° CN IR S
		100	99	13.95m Is(50) d=0.2 a=0.1 MPa	53.1	14		Becoming distinctly laminated, laminations are sub-horizontal																		
				14.50m Is(50) d=0.3 a=0.3 MPa				No distinct structure																		CZ RF 20 mm IS 0° CL CO 10 mm BP 5° CL VN IR S

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
EW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
F - Fresh

Strength
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

PSM 3.00.2 LIB.GLB Log IS_AU_CORE_BH_PSM PSM1541.50 BH LOGS - CORED.GPJ <<DrawingFile>> 03/06/2016 18:53 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: PSM 3.00.2 2015-10-23 Prj: PSM 2.01 2015-04-07

Engineering Log - Cored Borehole

Project No.: PSM1541.50

Client:	Goodman	Commenced:	18/05/2016
Project Name:	Western North-South Link Road	Completed:	18/05/2016
Hole Location:	North of Sydney water pipeline	Logged By:	LT
Hole Position:	297083.0 m E 6255411.0 m N MGA 56	Checked By:	CF

Drill Model and Mounting:	Commachio Geo305	Inclination:	-90°	RL Surface:	67.10 m	
Barrel Type and Length:	NMLC 3.6 m	Bearing:		Datum:	AHD	Operator: Soilcheck

Drilling Information							Rock Substance																Rock Mass Defects		
Method	Water	TCR (%)	RQD (%)	SAMPLES & FIELD TESTS	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable)	Weathering EW	HW	MW	SW	F	Strength Is(50) ● - Axial ○ - Diametral EL <0.03	VL 0.1	L 0.3	M 1	H 3	VH 10	EH	Defect Spacing (mm) <20	60	200	600	1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
NMLC		100	99	15.20m Is(50) d=0.1 a=0.1 MPa				SHALE: dark grey, no distinct structure *(continued)*																		BP 0° CL VN IR S
					51.1	16		Hole Terminated at 15.26 m Target depth																		
					50.1	17																				
					49.1	18																				
					48.1	19																				

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

See Explanatory Notes for details of abbreviations and basis of descriptions.

Weathering
EW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
F - Fresh

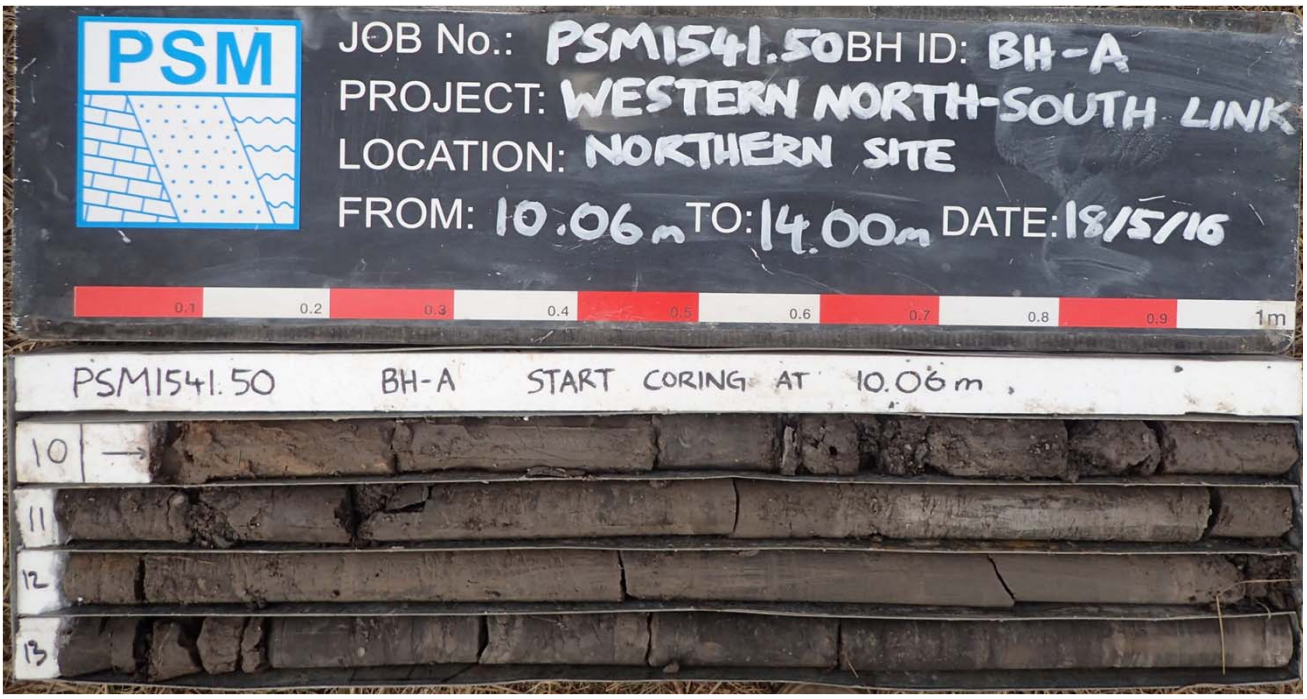
Strength
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

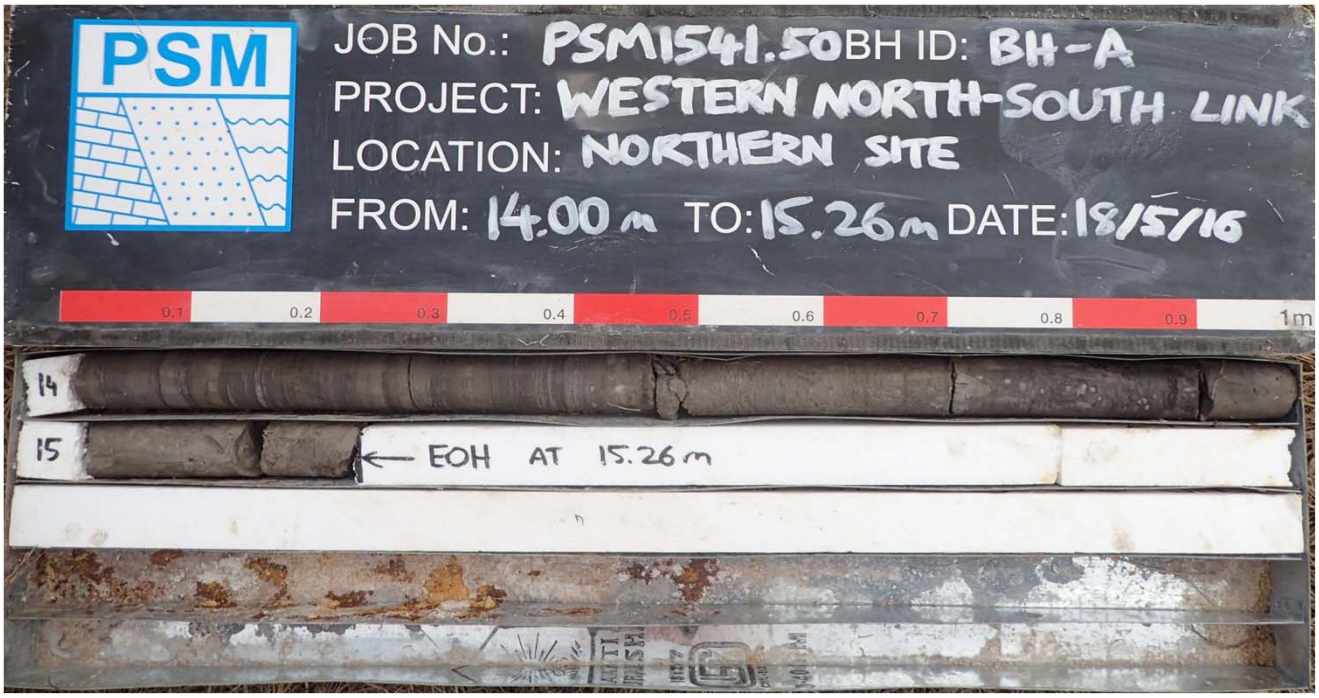
Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular





Goodman Property Services (Aust) Pty Ltd
Western North South Link Road
Erskine Park, NSW
CORE PHOTOGRAPHY - BH-A

Pells Sullivan Meynink

PSM1541-140R	Appendix C-1

S:\PSM1541\Engineering\PSM1541.50 West North-South Link Road\BH logs\GINT LOGS\[PSM1541-40R Core Photographs.xlsx]BH-B

Borehole ID

BH-B

Page 1 of 4

Engineering Log - Non Cored Borehole

Project No.: PSM1541.50

Client:	Goodman	Commenced:	17/05/2016
Project Name:	Western North-South Link Road	Completed:	17/05/2016
Hole Location:	South of Sydney water pipeline	Logged By:	LT
Hole Position:	297058.0 m E 6255229.0 m N MGA 56	Checked By:	CF

Drill Model and Mounting:	Commachio Geo305	Inclination:	-90°	RL Surface:	66.50 m		
Hole Diameter:	110 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T			Not Encountered	ES1 ES 0.80-1.00 m		65.5	1		ML	Sandy CLAY: brown, low plasticity, fine to coarse grained sand	D	S		
									CI	CLAY: light grey and mottled orange, medium plasticity				
										Becoming pale grey and mottled red				
						64.5	2			Some ironstone bands		St to VSt		
						63.5	3				M			
						62.5	4					H		

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
ES - Environmental Sample
TW - Thin Walled

Moisture Condition
D - Dry
M - Moist
W - Wet

Consistency/Relative Density
VS - Very soft
S - Soft
F - Firm
St - Stiff
VSt - Very stiff
H - Hard
VL - Very loose
L - Loose
MD - Medium dense
D - Dense
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Ce - Cemented
C - Compact

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

See Explanatory Notes for details of abbreviations and basis of descriptions.

Engineering Log - Non Cored Borehole

Project No.: PSM1541.50

Client:	Goodman	Commenced:	17/05/2016
Project Name:	Western North-South Link Road	Completed:	17/05/2016
Hole Location:	South of Sydney water pipeline	Logged By:	LT
Hole Position:	297058.0 m E 6255229.0 m N MGA 56	Checked By:	CF

Drill Model and Mounting:	Commachio Geo305	Inclination:	-90°	RL Surface:	66.50 m		
Hole Diameter:	110 mm	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information								Soil Description					Observations
Method	Penetration	Support	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description SOIL NAME: Colour, structure, plasticity, additional	Moisture Condition	Consistency / Relative Density	Hand Penetrometer UCS (kPa) 100 200 300 400 500	Structure and Additional Observations
AD/T			Not Encountered						CI	CLAY: pale grey and mottled red, medium plasticity	M	H		
										SHALE: grey, extremely low strength	D			
						60.5	6			Continued on cored borehole sheet				
						59.5	7							
						58.5	8							
						57.5	9							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
SPT - Standard penetration test
PT - Push tube

Penetration
No resistance through to refusal

Water
Inflow
Partial Loss
Complete Loss

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VD - Very dense
Ce - Cemented
C - Compact

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

See Explanatory Notes for details of abbreviations and basis of descriptions.

Borehole ID
BH-B

Engineering Log - Cored Borehole

Project No.: PSM1541.50

Client:	Goodman	Commenced:	17/05/2016
Project Name:	Western North-South Link Road	Completed:	17/05/2016
Hole Location:	South of Sydney water pipeline	Logged By:	LT
Hole Position:	297058.0 m E 6255229.0 m N MGA 56	Checked By:	CF

Drill Model and Mounting: Commachio Geo305 | Inclination: -90° | RL Surface: 66.50 m
Barrel Type and Length: NMLC 3.6 m | Bearing: | Datum: AHD | Operator: Soilcheck

Method	Water	TCR (%)	RQD (%)	Samples & Field Tests	RL (m)	Depth (m)	Material Description	Weathering	Strength Is(50)	Defect Spacing (mm)	Defect Descriptions / Comments
							Continued from non-cored borehole sheet				
NMLC	Not Encountered	100	60	5.95m Is(50) d=0.1 a=0.1 MPa	60.5	6	SHALE: brown and grey, no distinct structure	HW	EL–VL (axial ~0.1)	200–600	IS 0° CL CO 80 mm; BP 30° CL VN ST S; JT 85° CL VN CU S; BP 10° CL VN IR S
							CLAY: pale grey and brown				
				7.05m Is(50) d=0.2 a=0.3 MPa	59.5	7	SHALE: dark grey and brown, iron staining throughout, indistinct sub-horizontal laminations	MW	VL–L	600–1000	JT 30° CL VN IR S; JT 60° CN CU RF; IS 0° CL CO 10 mm
				8.40m Is(50) d=0.2 a=0.2 MPa	58.5	8					
		91	83	9.05m Is(50) d=0.2 a=0.2 MPa	57.5	9	Becoming grey	SW			BP 0° CN PR RF; IS 0° CL CO 50 mm
				9.95m Is(50) d=0.2 a=0.3 MPa							

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
EW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
F - Fresh

Strength
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
FZ - Fracture Zone
BSH - Bedding Shear
DB - Drilling Break

Infilling/Coating
CN - Clean
SN - Stain
VN - Veneer
CO - Coating
RF - Rock fragments
G - Gravel
S - Sand
Z - Silt
CA - Calcite
CL - Clay
FE - Iron
QZ - Quartz
X - Carbonaceous

Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

Engineering Log - Cored Borehole

Project No.: PSM1541.50

Client:	Goodman	Commenced:	17/05/2016
Project Name:	Western North-South Link Road	Completed:	17/05/2016
Hole Location:	South of Sydney water pipeline	Logged By:	LT
Hole Position:	297058.0 m E 6255229.0 m N MGA 56	Checked By:	CF

Drill Model and Mounting:	Commachio Geo305	Inclination:	-90°	RL Surface:	66.50 m		
Barrel Type and Length:	NMLC 3.6 m	Bearing:		Datum:	AHD	Operator:	Soilcheck

Drilling Information							Rock Substance																	Rock Mass Defects		
Method	Water	TCR (%)	RQD (%)	SAMPLES & FIELD TESTS	RL (m)	Depth (m)	Graphic Log	Material Description ROCK TYPE: Colour, grain size, structure (texture, fabric, mineral composition, hardness, alteration, cementation, etc as applicable)	Weathering EW	HW	MW	SW	F	Strength Is(50) ● - Axial ○ - Diametral EL <0.03	VL 0.1	L 0.3	M 1	H 3	VH 10	EH	Defect Spacing (mm) <20	60	200	600	1000	Defect Descriptions / Comments Description, alpha/beta, infilling or coating, shape, roughness, thickness, other
NMLC	Not Encountered	91	83	10.95m Is(50) d=0.1 a=0.1 MPa 11.50m Is(50) d=0.2 a=0.2 MPa	55.5	11		SHALE: grey, indistinct sub-horizontal laminations																		IS 0° CL CO 60 mm IS 0° CL CO 70 mm
								NO CORE																		
					54.5	12		Hole Terminated at 11.88 m Target depth																		
					53.5	13																				
					52.5	14																				

Method
AD/T - Auger drilling TC bit
AD/V - Auger drilling V bit
WB - Washbore
HQ3- Wireline core (63.5 mm)
PQ3- Wireline core (85.0 mm)
SPT- Standard penetration test
PT - Push tube

Water
Inflow
Partial Loss
Complete Loss

Graphic Log/Core Loss
Core recovered (hatching indicates material)
No core recovery

Weathering
EW - Extremely Weathered
HW - Highly Weathered
MW - Moderately Weathered
SW - Slightly Weathered
F - Fresh

Strength
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High
EH - Extremely High

Defect Type
FT - Fault
SS - Shear Surface
SZ - Shear Zone
BP - Bedding parting
SM - Seam
IS - Infilled Seam
JT - Joint
CO - Contact
CZ - Crushed Zone
VN - Vein
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CL - Clay
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Roughness
SL - Slickensided
POL - Polished
S - Smooth
RF - Rough
VR - Very Rough

Shape
PR - Planar
CU - Curved
UN - Undulating
ST - Stepped
IR - Irregular

See Explanatory Notes for details of abbreviations and basis of descriptions.

PSM 3.00.2 LIB.GLB Log IS_AU_CORE_BH_PSM PSM1541.50 BH LOGS - CORED.GPJ <<DrawingFile>> 03/06/2016 18:53 8.30.004 Datgel Lab and In Situ Tool - DGD | Lib: PSM 3.00.2 2015-10-23 Prj: PSM 2.01 2015-04-07

Goodman Property Services (Aust) Pty Ltd **Western North South Link Road** **Erskine Park, NSW** **CORE PHOTOGRAPHY - BH-B**	
Pells Sullivan Meynink	**PSM1541-140R** / **Appendix C-2**

S:\PSM1541\Engineering\PSM1541.50 West North-South Link Road\BH logs\GINT LOGS\[PSM1541-40R Core Photographs.xlsx]BH-B

EXPLANATION SHEET - SOIL DESCRIPTION

DEFINITIONS

Soil:
In engineering terms, soil includes every type of uncemented or partially cemented inorganic or organic material found in the ground. In practice, if the material can be remoulded or disintegrated by hand in its field condition or in water it is described as a soil. Other materials are described using rock description terms.

Classification symbol & soil name:
Soils are described in accordance with the Unified Soil Classification (UCS) as shown in the table on Sheet 2.

Support:
C - Casing
T - Timbering

See rock description on Sheet 3 for method and samples / field test definitions.

PARTICLE SIZE DESCRIPTIVE TERMS

NAME	SUBDIVISION	SIZE
Boulders		>200 mm
Cobbles		63 mm to 200 mm
Gravel	coarse	20 mm to 63 mm
	medium	6 mm to 20 mm
	fine	2.36 mm to 6 mm
Sand	coarse	600 µm to 2.36 mm
	medium	200 µm to 600 µm
	fine	75 µm to 200 µm

MOISTURE CONDITION

CONDITION	FIELD GUIDE
Dry	Looks and feels dry. Cohesive and cemented soils are hard, friable or powdery. Uncemented granular soils run freely through hands.
Moist	Soil feels cool and darkened in colour. Cohesive soils can be moulded. Granular soils tend to cohere
Wet	As for moist but with free water forming on hands when handles

CONSISTENCY OF COHESIVE SOILS

TERM	UNDRAINED STRENGTH SU (kPa)	FIELD GUIDE
Very Soft	<12	A finger can be pushed well into the soil with little effort
Soft	12 – 25	A finger can be pushed into the soil to about 25mm depth
Firm	25 – 50	The soil can be indented about 5mm with the thumb, but not penetrated
Stiff	50 – 100	The surface of the soil can be indented with the thumb, but not penetrated
Very Stiff	100 – 200	The surface of the soil can be marked, but not indented with thumb pressure
Hard	>200	The surface of the soil can be marked only with the thumbnail

DENSITY OF GRANULAR SOILS

TERM	DENSITY INDEX (%)
Very loose	<15
Loose	15 – 35
Medium Dense	35 – 65
Dense	65 – 85
Very Dense	>85

Where no SPT data, the following descriptions are used:

Loose: Can be removed from exposure by hand in a disaggregated form.

Compact (C) Only removed from exposure with an implement, material readily disaggregated by physical means.

Cemented (Ce) Only removed from exposure with an implement, material cannot be disintegrated / remoulded in air/ water.

MINOR COMPONENTS

TERM	ASSESSMENT GUIDE	PROPORTION OF MINOR COMPONENT
Trace of	Presence just detectable by feel or eye, but soil properties little or no different to general properties of primary component.	Coarse grained soils: <5% Fine grained soils: <15%
With some	Presence easily detected by feel or eye, soil properties little different to general properties of primary component.	Coarse grained soils: 5 - 12% Fine grained soils: 15 - 30%

SOIL STRUCTURE

ZONING		CEMENTING	
Layers	Continuous across exposure of sample	**Weakly Cemented**	Easily broken up by hand in air or water
Lenses	Discontinuous layers of lenticular shape	**Moderately Cemented**	Effort is required to break up the soil by hand in air or water
Pockets	Irregular inclusions of different material	**Cemented**	Only removed from exposure by implement, material does not disaggregate
		Compact	Only removed from exposure by implement, material readily disaggregated by physical means

GEOLOGICAL ORIGIN

Weathered in place soils:

Extremely weathered — Structure and fabric of parent rock visible

Residual Soil — Structure and fabric of parent rock not visible

Transported soil:

Aeolian — Deposited by wind

Alluvium — Deposited by streams and rivers

Colluvium — Deposited on slopes (transported downslope by gravity)

Lacustrine — Deposited by lakes

Marine — Deposited in ocean basins, bays, beached and estuaries

Man Made:

Fill — Fill may be significantly more variable between tested locations than naturally occurring soils

EXPLANATION SHEET - SOIL DESCRIPTION

SOIL CLASSIFICATION INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (EXCLUDING PARTICLES LARGER THAN 60 mm AND BASING FRACTIONS ON ESTIMATED MASS)*							USC	PRIMARY NAME
COARSE GRAINED SOILS More than 50% of materials less than 63 mm is larger than 0.075 mm	(About the smallest particle visible to the naked eye)	GRAVELS More than half of coarse fraction is larger than 2.0 mm	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.			GW	GRAVEL
				Predominantly one size or a range of sizes with more intermediate sizes missing.			GP	GRAVEL
			GRAVELS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)			GM	SILTY GRAVEL
				Plastic fines (for identification procedures see CL below)			GC	CLAYEY GRAVEL
		SANDS More than half of coarse fraction is smaller than 2.0 mm	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate sizes missing			SW	SAND
				Predominantly one size or a range of sizes with some intermediate sizes missing.			SP	SAND
			SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below).			SM	SILTY SAND
				Plastic fines (for identification procedures see CL below).			SC	CLAYEY SAND
FINE GRAINED SOILS More than 50% of material less than 63 mm is smaller than 0.075 mm			IDENTIFICATION PROCEDURES ON FRACTIONS <0.2 mm.					
		SILTS & CLAYS Liquid limit less than 50	**Dry strength**	**Dilatancy**	**Toughness**			
			None to Low	Quick to slow	None		ML	SILT
			Medium to High	None	Medium		CL	CLAY
			Low to medium	Slow to very slow	Low		OL	ORGANIC SILT
		SILTS & CLAYS Liquid limit greater than 50	Low to medium	Slow to very slow	Low to medium		MH	SILT
			High	None	High		CH	CLAY
			Medium to High	None	Low to medium		OH	ORGANIC CLAY
HIGHLY ORGANIC SOIL Readily identified by colour, odour, spongy feel and frequently by fibrous texture							Pt	PEAT
• Low plasticity – Liquid Limit W_L less than 35%. • Medium plasticity – W_L between 35% and 50%.								

*Taken from AS1726 (1993)

COMMON DEFECTS IN SOIL

TERM	DEFINITION
Parting	A surface or crack across which the soil has little or no tensile strength. Parallel or sub parallel to layering (e.g. bedding). May be open or closed.
Joint	A surface or crack across which the soil has little or no tensile strength but which is not parallel or sub parallel to layering. May be open or closed. The term 'fissure' may be used for irregular joints <0.2 m in length.
Sheared Zone	Zone in clayey soil with roughly parallel near planar, curved or undulating boundaries containing closely spaced, smooth or slickensided, curved intersecting joints which divide the mass into lenticular or wedge shaped blocks.
Sheared Surface	A near planar curved or undulating, smooth, polished or slickensided surface in clayey soil. The polished or slickensided surface indicates that movement (in many cases very little) has occurred along the defect.
Softened Zone	A zone in clayey soil, usually adjacent to a defect in which the soil has a higher moisture content than elsewhere.
Tube	Tubular cavity. May occur singly or as one of a large number of separate or inter-connected tubes. Walls often coated with clay or strengthened by denser packing of grains. May contain organic matter
Tube Cast	Roughly cylindrical elongated body of soil different from the soil mass in which it occurs. In some cases, the soil that makes up the tube cast is cemented.
Infilled Seam	Sheet or wall like body of soil substance or mass with roughly planar to irregular near parallel boundaries that cuts through a soil mass. Formed by infilling of open joints.

EXPLANATION SHEET - ROCK DESCRIPTION

DEFINITIONS

Rock Substance:
In engineering terms rock substance is any naturally occurring aggregate of minerals and organic material which cannot be disintegrated or remoulded by hand in air or water. Other material is described using soil descriptive terms. Effectively homogenous material may be isotropic or anisotropic.

Defect:
Discontinuity or break in the continuity of a substance or substances.

Mass:
A body of material that is not effectively homogeneous. It can consist of two or more substances without defects, or one or more substances with one or more defects.

Method:

AD/T	Auger drilling with tcbit
AD/V	Auger drilling with vbit
AS	Auger screwing
AT	Air track
B	Dozer blade
BH	Backhoe bucket
CT	Cable tool
DB	Washbore drag bit
DT	Diatube
E	Excavator
EH	Excavator with hammer
HA	Hang auger
HMLC	HMLC core barrel
HQ3	Coring 63.5mm diameter, triple tube, wireline
MZ	Mazier
N	Natural exposure
NMLC	NMLC core barrel
NQ3	Coring 45.1mm diameter, triple tube, wireline
PQ3	Coring 83.1mm diameter, triple tube, wireline
Pushed SPT	Pushed SPT
PT	Push tube
R	Ripper
RR	Rock roller
SPT	Driven SPT
WB	Washbore
X	Existing excavation

Core Quality:

TCR	Total Core Recovered (%)
RQD	Rock Quality Designation (%)

Samples and Field Tests:

B	Bulk Disturbed Sample
BLK	Block sample
C	Core sample
CBR	CBR mould sample
D	Small disturbed sample
ES	Soil sample for environmental testing
EW	Water sample for environmental testing
G	Gas sample
LB	Large bulk disturbed sample
M	Mazier type sample
P	Piston sample
SPT	Standard Penetration Test
U	Undisturbed push in sample
W	Water sample

Rock Strength:

A	Axial point load test result (Is50)
D	Diametral point load test result (Is50)

Water:

▻ Inflow
◅ Partial Loss
◄ Complete Loss

SUBSTANCE DESCRIPTIVE TERMS

Rock name:
Simple rock names are used rather than precise geological classification

Particle size (for sandstone):
Coarse - Mainly 0.6mm to 2mm
Medium - Mainly 0.2mm to 0.6mm
Fine - Mainly 0.05mm (just visible) to 0.2mm

Fabric:
Massive - No layering or penetrative fabric
Indistinct - Layering or fabric visible. Little effect on properties
Distinct - Layering or fabric is easily visible. Rock breaks more easily parallel to layering of fabric

Bedding:
Thinly Laminated - <6mm
Laminated - 6 – 20mm
Very Thinly Bedded - 20 – 60mm
Thinly Bedded - 60 – 200mm
Medium Bedded - 200 – 600mm
Thickly Bedded - 600 – 2000mm
Very Thickly Bedded - >2000mm

ROCK SUBSTANCE STRENGTH

ABBR	TERM	POINT LOAD INDEX, IS50 (MPA)	FIELD GUIDE
EL	Extremely Low	≤0.03	Easily remoulded by hand to a material with soil properties
VL	Very Low	>0.03≤0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with a knife; pieces up to 30mm thick can be broken by finger pressure.
L	Low	>0.1≤0.3	Easily scored with a knife; indentations 1mm to 3mm show with firm bows of a pick point; has a dull sound under hammer. Pieces of core 150mm long by 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling.
M	Medium	>0.3≤1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty.
H	High	>1≤3	A piece of core 150mm long by 50mm cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer.
VH	Very High	>3≤10	Hand specimen breaks after more than one blow of a pick; rock rings under hammer.
EH	Extremely High	>10	Specimen requires many blows with geological pick to break; rock rings under hammer.

EXPLANATION SHEET - ROCK DESCRIPTION

CLASSIFICATION OF WEATHERING

ABBR	TERM	FIELD GUIDE
F	Fresh	Rock substance unaffected by weathering
SW	Slightly Weathered	Rock substance affected by weathering to the extent that partial staining or partial discolouration of the rock substance (usually by limonite) has taken place. The colour and texture of the fresh rock is recognisable; strength properties are essentially those of the fresh rock substance
MW	Moderately Weathered	The whole of the rock substance is discoloured, usually by iron staining or bleaching, to the extent that the colour of the fresh rock is no longer recognisable.
HW	Highly Weathered	Rock strength is changed by weathering. The whole of the rock substance is discoloured, usually by iron staining or bleaching to the extent that the colour of the original rock is not recognisable. Some minerals are decomposed to clay minerals. Porosity may be increased by leaching or may be decreased due to the deposition of minerals in pores.
EW	Extremely Weathered	Material is weathered to such an extent that it has soil properties, i.e.; it either disintegrates or can be remoulded in water. Original rock fabric still visible.

COMMON DEFECTS IN ROCK MASS

ABBR	TERM	FIELD GUIDE
FT	Fault	Fracture long which displacement is recognisable
SS	Shear Seam	A fracture along which movement has taken place but no displacement is recognisable. Evidence for movement may be slickensides, polishing and/or clay gouge
SZ	Sheared Zone	Zone of multiple closely spaced fracture planes with roughly parallel planar boundaries usually forming blocks of lenticular or wedge shaped intact material. Fractures are typically smooth, polished or slickensided; and curved
BP	Bedding Parting	Arrangement in layers of mineral grains or crystals parallel to surface of deposition along which a continuous observable parting occurs
SM	Seam	Seam of soil substance, often with gradational boundaries. Formed by weathering of the rock substance in place
IS	Infilled Seam	Seam of soil substance usually with distinct roughly parallel boundaries formed by the migration of soil into an open cavity or joint, infilled seams less than 1mm thick may be described as veneer or coating on joint surface
JT	Joint	A single fracture across which rock has little or no tensile strength and is not obviously related to rock fabric
CO	Contact	Surface between two lithologies
CZ	Crushed Zone	Zone with roughly parallel, planar boundaries (commonly slickensided) containing disoriented usually angular rock fragments of variable size often in a soil matrix.
VN	Vein	Fracture in which a tabular or sheet-like body of minerals have been intruded
FZ	Fractured Zone	A zone of closely spaced defects (mainly joints, bedding, cleavage and/or schistosity) comprised of core lengths in the order of 50mm or less.
BSH	Bedding Shear	A shear formed along a bedding plane
DB	Drilling Break	Drilling induced break

SHAPE TERMS

ABBR	TERM	FIELD GUIDE
PR	Planar	The defect does not vary in orientation
CU	Curved	The defect has a gradual change in orientation
UN	Undulating	The defect has a wavy surface
ST	Stepped	The defect has one or more well defined steps
IR	Irregular	The defect has many sharp changes of orientation

ROUGHNESS TERMS

ABBR	TERM	FIELD GUIDE
SL	Slickensided	Grooved or striated surface, usually polished
POL	Polished	Shiny smooth surface
S	Smooth	Smooth to touch. Few or no surface irregularities
RF	Rough	Many small surface irregularities (amplitude generally less than 1mm). Feels like fine to coarse sand paper.
VR	Very Rough	Many large surface irregularities (amplitude generally more than 1mm). Feels like, or coarser than very coarse sand paper.

COATING TERMS

ABBR	TERM	FIELD GUIDE
CN	Clean	No visible coating
SN	Stained	No visible coating but surfaces are discoloured
VN	Veneer	A visible coating of soil or mineral, too thin to measure; may be patchy
CO	Coating	A visible coating up to 1mm thick. Thicker soil material is usually described using appropriate defect terms (e.g., infilled seam). Thicker rock strength material is usually described as a vein

INFILLING MATERIAL

ABBR	TERM
CA	Calcite
CL	Clay
Fe	Iron Oxide
Fe Clay	Iron Oxide Clay
KT	Chlorite
MS	Secondary Mineral
MU	Unidentified Mineral
Qz	Quartz
X	Carbonaceous
RF	Rock fragments
G	Gravel
S	Sand
Z	Silt

APPENDIX D

POINT LOAD STRENGTH INDEX TESTING RESULTS

Pells Sullivan Meynink

POINT LOAD STRENGTH INDEX TEST RESULTS

Job No. ***PSM1541.50*** **Sheet 1 of 2**

Project ***Western North South Link***

Test Method	*AS 4133.4.1 - 1993 Methods of Testing Rocks for Engineering Purposes, Determination of Point Load Strength Index*	Sampling Technique		Sampling Date	*18/5/2016*
		Storage History	*North Ryde office indoor core storage area*	Testing Date	*18/05/2016*
Test Machine	*GSA 6500*	Moisture Condition		Tested By	*LT*
Calibration Date	*3/12/2012*	Loading Rate	*< 30 seconds*		

Rock Type	Location	Depth	Diametral Tests					Axial, Block, and Irregular Lump Tests							AS 1726 Strength Class
			D	L	P	$I_{s(50)}$	Failure Mode	W	D	L	P	I_s	$I_{s(50)}$	Failure Mode	
		(m)	(mm)	(mm)	(kN)	(MPa)		(mm)	(mm)	(mm)	(kN)	(MPa)	(MPa)		
Shale	***BH-A***	***10.95***	*50*	*110*	*0.3*	***0.1***	*Parallel to bedding*	*50*	*27*		*0.3*	*0.2*	***0.2***	*Through substance*	***L***
Shale	***BH-A***	***11.88***	*50*	*200*	*0.4*	***0.2***	*Parallel to bedding*	*50*	*22*		*0.3*	*0.2*	***0.2***	*Through substance*	***L***
Shale	***BH-A***	***12.80***	*50*	*200*	*0.7*	***0.3***	*Parallel to bedding*	*50*	*40*		*0.5*	*0.2*	***0.2***	*Through substance*	***L***
Shale	***BH-A***	***13.95***	*50*	*140*	*0.5*	***0.2***	*Parallel to bedding*	*50*	*30*		*0.3*	*0.1*	***0.1***	*Through substance*	***L***
Shale	***BH-A***	***14.50***	*50*	*130*	*0.7*	***0.3***	*Parallel to bedding*	*50*	*30*		*0.7*	*0.3*	***0.3***	*Through substance*	***L / M***
Shale	***BH-A***	***15.20***	*50*	*80*	*0.2*	***0.1***	*Parallel to bedding*	*50*	*30*		*0.2*	*0.1*	***0.1***	*Through substance*	***VL***

By: ***MH*** **Checked:** *CF* **Date:** ***24/5/2016***

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POINT LOAD STRENGTH INDEX TEST RESULTS

Job No. ***PSM1541.50*** **Sheet 2 of 2**

Project ***Western North South Link***

Test Method	*AS 4133.4.1 - 1993 Methods of Testing Rocks for Engineering Purposes, Determination of Point Load Strength Index*	Sampling Technique		Sampling Date	*17/5/2016*
		Storage History	*North Ryde office indoor core storage area*	Testing Date	*17/05/2016*
Test Machine	*GSA 6500*	Moisture Condition		Tested By	*LT*
Calibration Date	*3/12/2012*	Loading Rate	*< 30 seconds*		

Rock Type	Location	Depth	Diametral Tests					Axial, Block, and Irregular Lump Tests							AS 1726 Strength Class
			D	L	P	$I_{s(50)}$	Failure Mode	W	D	L	P	I_s	$I_{s(50)}$	Failure Mode	
		(m)	(mm)	(mm)	(kN)	(MPa)		(mm)	(mm)	(mm)	(kN)	(MPa)	(MPa)		
Shale	***BH-B***	***5.95***	*50*	*90*	*0.2*	***0.1***	*Parallel to bedding*	*50*	*30*		*0.2*	*0.1*	***0.1***	*Through substance*	***VL***
Shale	***BH-B***	***7.05***	*50*	*160*	*0.6*	***0.2***	*Parallel to bedding*	*50*	*23*		*0.5*	*0.3*	***0.3***	*Through substance*	***L***
Shale	***BH-B***	***8.40***	*50*	*160*	*0.6*	***0.2***	*Parallel to bedding*	*50*	*40*		*0.5*	*0.2*	***0.2***	*Through substance*	***L***
Shale	***BH-B***	***9.05***	*50*	*80*	*0.4*	***0.2***	*Parallel to bedding*	*50*	*30*		*0.4*	*0.2*	***0.2***	*Through substance*	***L***
Shale	***BH-B***	***9.95***	*50*	*120*	*0.5*	***0.2***	*Parallel to bedding*	*50*	*30*		*0.6*	*0.3*	***0.3***	*Through substance*	***L***
Shale	***BH-B***	***10.95***	*50*	*90*	*0.3*	***0.1***	*Parallel to bedding*	*50*	*30*		*0.3*	*0.2*	***0.1***	*Through substance*	***L***
Shale	***BH-B***	***11.50***	*50*	*60*	*0.5*	***0.2***	*Parallel to bedding*	*50*	*30*		*0.4*	*0.2*	***0.2***	*Through substance*	***L***

By: ***LT*** **Checked:** *CF* **Date:** ***17/5/2016***

S:\PSM1541\Engineering\PSM1541.50 West North-South Link Road\BH logs\[PSM1541.5 BH-B Point Load Tests.xlsx]Data Input

APPENDIX E

DCP TEST RESULTS

Pells Sullivan Meynink

DYNAMIC CONE PENETROMETER TEST RESULTS

Job No.	PSM1541.50	**Sheet**	1 **of** 1
Project	Western North South Link Road	**Date**	17-May-16

Test Method	*AS 1289.6.3.2. - 1997 Methods of Testing Soils for Engineering Purposes - 9 kg Dynamic Cone Penetrometer Test*	Drop Height	*510 mm*
		Hammer Mass	*9 kg*
Tested by	*CF*	Tip Type	*CONICAL*

Test Depth LOCATION	***BH03***	***BH04***	***BH05***	***BH06***	***BH07***	***BH-B***
0.10	10	11	9	7	8	6
0.20	8	9	17	10	9	8
0.30	9	11	11	10	11	9
0.40	5	20+	8	12	10	10
0.50	10	END	7	9	8	11
0.60	12		6	7	7	13
0.70	10		3	4	5	11
0.80	18		4	3	4	END
0.90	END		3	END	3	
1.00			END		4	
1.10					10	
1.20					17	
1.30					END	
1.40						
1.50						
1.60						
1.70						
1.80						
1.90						
2.00						
2.10						
2.20						
2.30						
2.40						
2.50						
2.60						
2.70						
2.80						
2.90						
3.00						
3.10						
3.20						
3.30						
3.40						
3.50						
3.60						
3.70						
3.80						
3.90						
4.00						

Comments: DCP tests undertaken adjacent to borehole locations

APPENDIX F

GEOTECHNICAL LABORATORY TEST RESULTS

GROUND TECHNOLOGIES
Geotechnical Testing Services

Ground Technologies Pty Ltd
ABN 25 089 213 294
55 Fifteenth Avenue, West Hoxton NSW 2171
PO Box 1121 Green Valley NSW 2168
Ph: (02) 8783 8200 Fax: (02) 8783 8210
Email: lab@groundtech.com.au

CALIFORNIAN BEARING RATIO

Client	Pells Sullivan Meynink	Job no :	**GTE844**
Project	Laboratory Testing (PSM 1541.5)	Test date :	**3-Jun-16**
Location	Erskine Park	Report No.	**GTER844-L2**

		L2	L3	L5	L6
Sample Number		L2	L3	L5	L6
Date Sampled		17-May-16	17-May-16	17-May-16	17-May-16
Depth		0-0.7m	0-0.7m	0-0.7m	0-0.7m
Location		BH3	BH4	BH7	BH5
Laboratory Compaction RMS T111 standard					
Oversize Material 19mm Sieve	%	1.0	1.0	1.0	0.0
Maximum Dry Density	t/m^3	1.76	1.81	1.71	1.89
Optimum Moisture Content	%	17.6	14.4	19.1	14.7
Field Moisture Content	%	13.1	10.1	16.3	14.9
Test Results RMS T117					
Before Soaking	Dry Density t/m^3	1.75	1.81	1.73	1.89
	Moisture Ratio %	102.0	98.0	96.0	99.0
	Density Ratio %	99.0	100.0	101.0	100.0
After Soaking	Dry Density t/m^3	1.67	1.75	1.61	1.81
	Moisture Content %	23.8	19.9	25.3	14.6
Moisture Content after test - remainder	%	21.8	18.7	25.1	18.5
Moisture Content after test - top 30mm	%	23.5	20.1	28.7	21.8
Number of days soaking	days	10	10	10	10
Mass of Surcharge	Kg	4.5	4.5	4.5	4.5
Swell after soaking	%	4.5	3.5	7.0	4.0
CBR penetration	mm	5.0	5.0	5.0	5.0
CBR VALUE	**%**	**2**	**2.5**	**1.5**	**1.5**

Material Description : L2: Brown Silty Clay, L3: Brown Silty Clay, L5:Red Brown Silty Clay, L6: Brown Silty Clay

Test Methods: RMS T117, T111, T120 Sampling : AS1289 1.2.1 (6.5.4)

NATA ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory No. 14343
Accredited for compliance with ISO/IEC 17025

Approved Signatory
Date 06-Jun-16

GROUND TECHNOLOGIES
Geotechnical Testing Services

Ground Technologies Pty Ltd
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PO Box 1121 Green Valley NSW 2168
55 Fifteenth Ave, West Hoxton NSW 2171
Ph: (02) 8783 8200 Fax: (02) 8783 8210
Email: lab@groundtech.com.au

Client:	Pells Sullivan Meynink	Job No.	GTE844
Project:	Laboratory Testing (PSM 1541.5)	Report No.	GTER844-L1
Location:	Erskine Park	Test date:	24-May-16

SHRINK / SWELL TEST RESULTS

Sample identification : **L1 (BH 3)** depth (m) **0.2-0.6m**

Sample description: **Orange/Pale Grey Silty Clay**

SHRINK TEST

bulk density of core specimen	
2.144	t/m^3
moisture content%	**17.5**

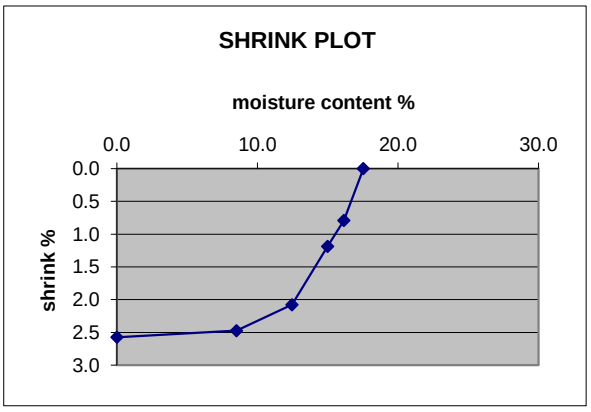
SWELL TEST

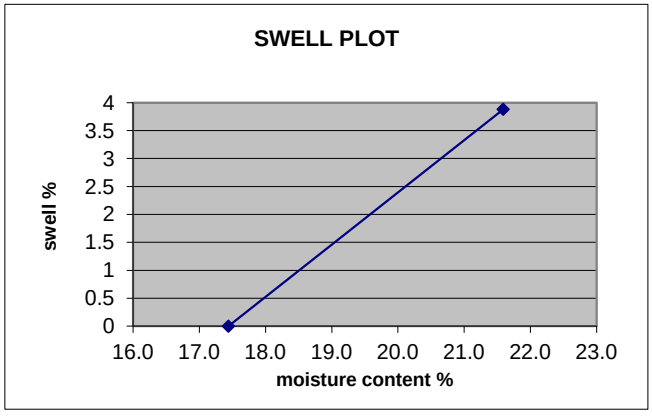
moisture content (%)		Pocket Penotrometer (Kpa)	
before test	after test	before test	after test
17.4	**21.6**	**>600**	**150**

shrink on drying (%)
2.6
amount of crumbling during shrinkage
0

estimated inert material (%)
0.0
amount of cracking during shrinkage
0

swell on saturation(%)	shrink / swell index: I_{ss} (%)
3.9	**2.5**





Notes: Sampled on 17/5/16 " Undisturbed U50 Sample"

Test Methods					
Shrink/Swell	AS1289 7.1.1	X	AS1289.5.1.1	Standard Compaction	
Moisture Content	AS1289.2.1.1	X	AS1289.5.2.1	Modified Compaction	
Sampling	AS1289 1.2.1				

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Email: lab@groundtech.com.au

Client:	**Pells Sullivan Meynink**	Job No.	**GTE844**
Project:	**Laboratory Testing (PSM 1541.5)**	Report No.	**GTER844-L3**
Location:	**Erskine Park**	Test date:	**24-May-16**

SHRINK / SWELL TEST RESULTS

Sample identification : **L4 (BH 7)** depth (m) **0-1.0m**

Sample description: **Red/Grey Gravelly Clay**

SHRINK TEST

bulk density of core specimen	
1.835	t/m^3
moisture content%	**16.3**

shrink on drying (%)
4.0
amount of crumbling during shrinkage
0

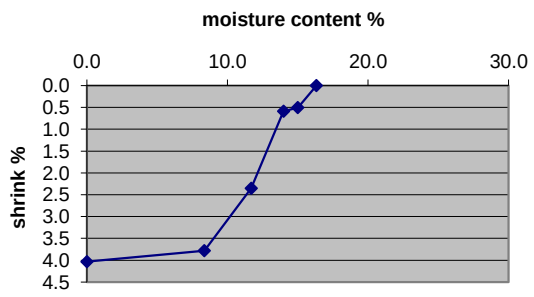
estimated inert material (%)
0.0
amount of cracking during shrinkage
0

SWELL TEST

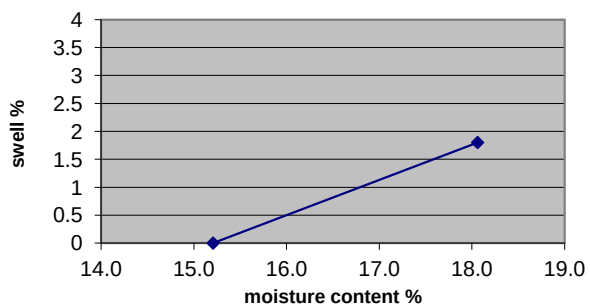
moisture content (%)		Pocket Penotrometer (Kpa)	
before test	after test	before test	after test
15.2	**18.1**	**>600**	**520**

swell on saturation(%)	shrink / swell index: I_{ss} (%)
1.8	**2.7**

SHRINK PLOT



SWELL PLOT



Notes: Sampled on 17/5/16 " Undisturbed U50 Sample"

Test Methods					
Shrink/Swell	AS1289 7.1.1	X	AS1289.5.1.1	Standard Compaction	
Moisture Content	AS1289.2.1.1	X	AS1289.5.2.1	Modified Compaction	
Sampling	AS1289 1.2.1				

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Client:	Pells Sullivan Meynink	Job No.	GTE844
Project:	Laboratory Testing (PSM 1541.5)	Report No.	GTER844-L5
Location:	Erskine Park	Test date:	24-May-16

SHRINK / SWELL TEST RESULTS

Sample identification : **L7 (BH 5)** depth (m) **0-0.7m**

Sample description: **Brown Silty Clay**

SHRINK TEST

bulk density of core specimen	
1.980	t/m^3
moisture content%	**18.3**

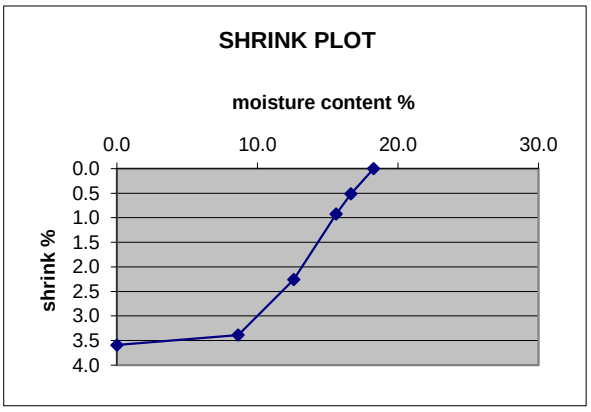
shrink on drying (%)
3.6
amount of crumbling during shrinkage
0

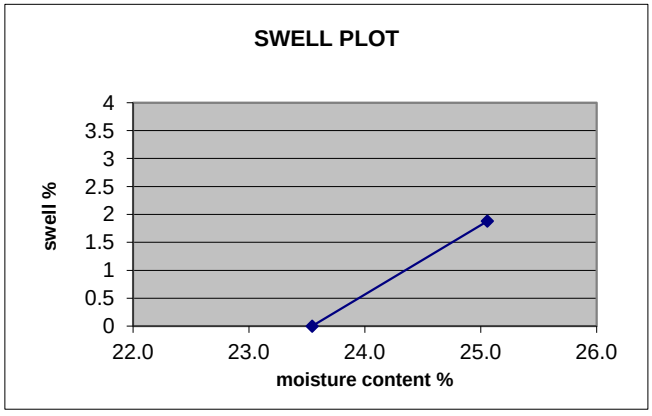
estimated inert material (%)
0.0
amount of cracking during shrinkage
0

SWELL TEST

moisture content (%)		Pocket Penotrometer (Kpa)	
before test	after test	before test	after test
23.5	**25.1**	**450**	**200**

swell on saturation(%)	shrink / swell index: I_{ss} (%)
1.9	**2.5**





Notes: Sampled on 17/5/16 " Undisturbed U50 Sample"

Test Methods					
Shrink/Swell	AS1289 7.1.1	X	AS1289.5.1.1	Standard Compaction	
Moisture Content	AS1289.2.1.1	X	AS1289.5.2.1	Modified Compaction	
Sampling	AS1289 1.2.1				

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Email: lab@groundtech.com.au

GROUND TECHNOLOGIES

Geotechnical Testing Services

Particle Size Distribution & Atterberg Limits Test Report

Client:	Pells Sullivan Meynink	Job No.	**GTE844**
Project:	Laboratory Testing (PSM 1541.5)	Test Date:	**24-May-16**
Location:	Erskine Park	Report No.	**GTER844-L6**

Lab Reference No.	**L8**	Sample Location:	**BH2 / 0- 0.3m**
Test Request No.	**-**	Lot No.:	**-**

Laboratory Specimen Classification: Brown Sandy Gravel with some Silt/Clay

Particle Size Distribution RMS T201

Sieve Size	% Passing	Specification
100 mm	**100**	
75 mm	**100**	
53 mm	**100**	
37.5 mm	**100**	
26.5 mm	**100**	
19.0 mm	**98**	
13.2 mm	**89**	
9.5 mm	**82**	
6.7 mm	**74**	
4.75 mm	**67**	
2.36 mm	**54**	
1.18 mm	**45**	
600 um	**38**	
425 um	**33**	
300 um	**27**	
150 um	**19**	
75 um	**14**	

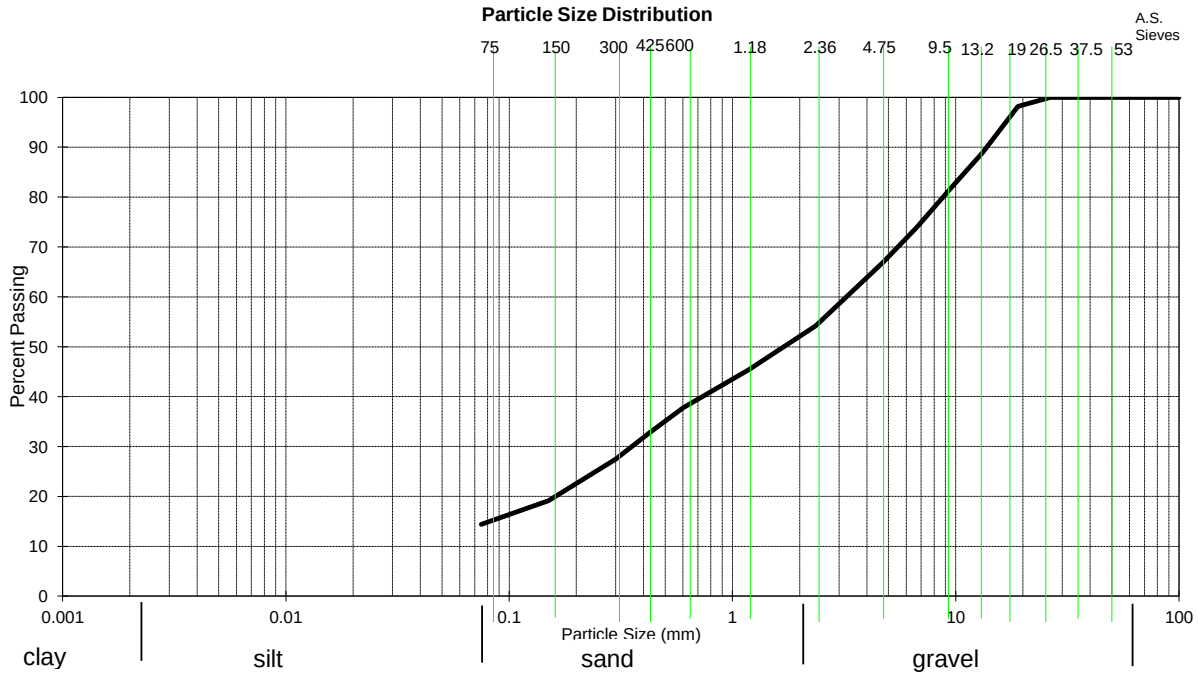
Consistency Limits and Moisture Content

Test		Method	Result	Spec.
Liquid Limit	%	RMS T108	**ND**	
Plastic Limit	%	RMS T109	**ND**	
Plasticity Index	%	RMS T109	**ND**	
Linear Shrinkage	%	RMS T113	**ND**	
Moisture Content	%	RMS T120	**8.2**	

Sample History: Oven Dried
Preparation Method: Dry sieved
Crumbling / Curling of linear shrinkage: NA
Linear shrinkage mould length: NA

ND = not determined NO = not obtainable NP = non plastic

Notes Sampling Method - AS1289.1.2.1- (6.5.3)
Date Sampled17/5/16



Date:

NATA Accredited Laboratory No. 14343
Accredited for compliance with ISO/IEC 17025
The results of the tests, calibrations and/or measurements in this document are traceable to Australian/National Standards

Approved Signatory

GROUND TECHNOLOGIES

Geotechnical Testing Services

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Ph: (02) 8783 8200 Fax: (02) 8783 8210
Email: lab@groundtech.com.au

Particle Size Distribution & Atterberg Limits Test Report

Client:	Pells Sullivan Meynink	Job No.	**GTE844**
Project:	Laboratory Testing (PSM 1541.5)	Test Date:	**24-May-16**
Location:	Erskine Park	Report No.	**GTER844-L7**

Lab Reference No.	**L9**	Sample Location:	**BH1 / 0.2-0.3m**
Test Request No.	**-**	Lot No.:	**-**

Laboratory Specimen Classification: **Brown Clayey Gravelly Sand**

Particle Size Distribution RMS T201

Sieve Size	% Passing	Specification
100 mm	100	
75 mm	100	
53 mm	100	
37.5 mm	100	
26.5 mm	100	
19.0 mm	100	
13.2 mm	98	
9.5 mm	92	
6.7 mm	86	
4.75 mm	79	
2.36 mm	64	
1.18 mm	53	
600 um	45	
425 um	41	
300 um	38	
150 um	31	
75 um	25	

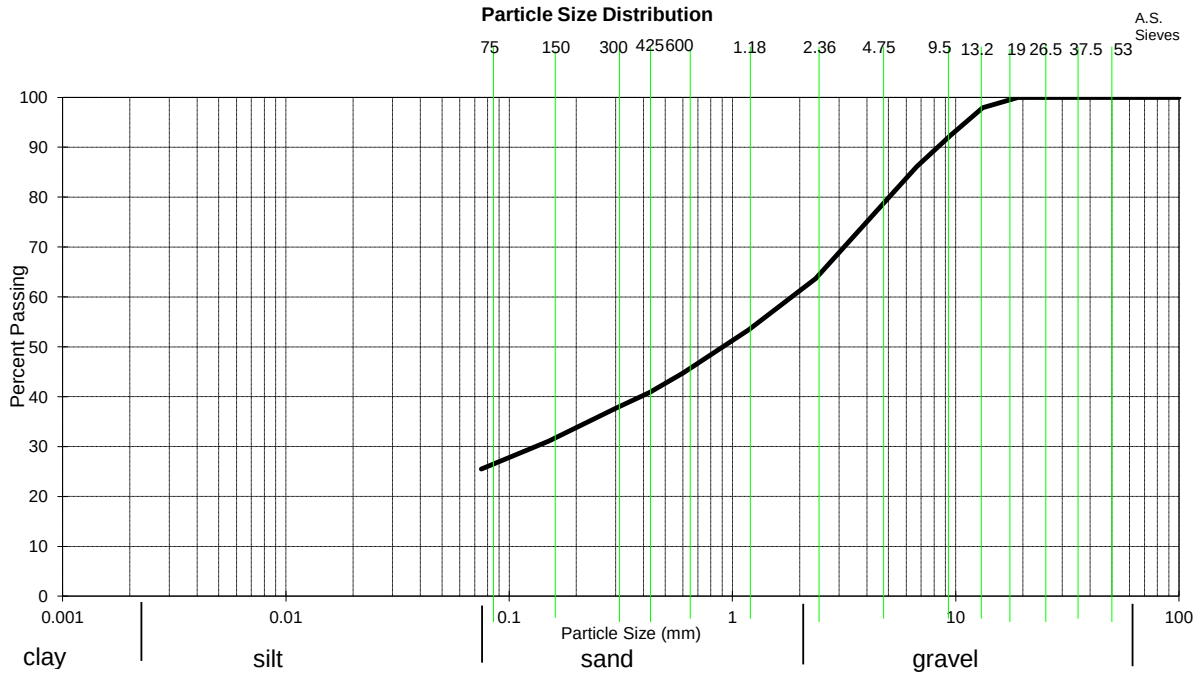
Consistency Limits and Moisture Content

Test		Method	Result	Spec.
Liquid Limit	%	RMS T108	ND	
Plastic Limit	%	RMS T109	ND	
Plasticity Index	%	RMS T109	ND	
Linear Shrinkage	%	RMS T113	ND	
Moisture Content	%	RMS T120	5.0	

Sample History:	Oven Dried
Preparation Method:	Dry sieved
Crumbling / Curling of linear shrinkage:	NA
Linear shrinkage mould length:	NA

ND = not determined NO = not obtainable NP = non plastic

Notes Sampling Method - AS189.1.2.1(6.5.3)
Date Sampled17/5/16



Date:

NATA Accredited Laboratory No. 14343
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The results of the tests, calibrations and/or measurements in this document are traceable to Australian/National Standards

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APPENDIX G

ENVIRONMENTAL LABORATORY TEST RESULTS

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **ES1610886**	Page	: 1 of 4
Client	: **PELLS SULLIVAN MEYNINK PTY LTD**	Laboratory	: Environmental Division Sydney
Contact	: CHRISTOPHER FERNANDEZ	Contact	:
Address	: G3, 56 DELHI ROAD NORTH RYDE NSW, AUSTRALIA 2113	Address	: 277-289 Woodpark Road Smithfield NSW Australia 2164
Telephone	: +61 02 9812 5000	Telephone	: +61-2-8784 8555
Project	: Oakdale WNSLR	Date Samples Received	: 19-May-2016 15:20
Order number	: ----	Date Analysis Commenced	: 20-May-2016
C-O-C number	: ----	Issue Date	: 26-May-2016 15:16
Sampler	: CHRISTOPHER FERNANDEZ		
Site	: ----		
Quote number	: ----		
No. of samples received	: 8		
No. of samples analysed	: 8		

NATA Accredited Laboratory 825
Accredited for compliance with
ISO/IEC 17025.

NATA
WORLD RECOGNISED ACCREDITATION

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Sydney Inorganics, Smithfield, NSW
Celine Conceicao	Senior Spectroscopist	Sydney Inorganics, Smithfield, NSW
Dian Dao		Sydney Inorganics, Smithfield, NSW

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	ES1 (BHB)	ES2 (BH03)	ES3 (BH04)	ES4 (BH07)	ES5 (BH06
			Client sampling date / time	17-May-2016 09:15	17-May-2016 10:46	17-May-2016 11:10	17-May-2016 11:45	17-May-2016 12:40
Compound	CAS Number	LOR	Unit	ES1610886-001	ES1610886-002	ES1610886-003	ES1610886-004	ES1610886-005
				Result	Result	Result	Result	Result
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	5.4	6.8	6.3	5.7	5.2
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	358	972	850	191	458
EA014 Total Soluble Salts								
Total Soluble Salts	----	5	mg/kg	1160	3160	2760	621	1490
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1	%	13.0	12.6	10.8	13.3	18.3
ED006: Exchangeable Cations on Alkaline Soils								
Exchangeable Calcium	----	0.2	meq/100g	----	----	----	----	----
Exchangeable Magnesium	----	0.2	meq/100g	----	----	----	----	----
Exchangeable Potassium	----	0.2	meq/100g	----	----	----	----	----
Exchangeable Sodium	----	0.2	meq/100g	----	----	----	----	----
Cation Exchange Capacity	----	0.2	meq/100g	----	----	----	----	----
Exchangeable Sodium Percent	----	0.2	%	----	----	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	----	0.4	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	----	11.8	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	----	0.2	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	----	4.2	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	----	16.6	----
Exchangeable Sodium Percent	----	0.1	%	----	----	----	25.4	----
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	0.3	<0.1	0.1	----	0.4
Exchangeable Magnesium	----	0.1	meq/100g	6.9	3.3	5.0	----	11.5
Exchangeable Potassium	----	0.1	meq/100g	0.2	0.1	0.2	----	0.2
Exchangeable Sodium	----	0.1	meq/100g	2.4	1.7	1.6	----	2.8
Cation Exchange Capacity	----	0.1	meq/100g	9.9	5.3	6.9	----	15.0
Exchangeable Sodium Percent	----	0.1	%	24.4	32.7	23.3	----	18.7
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	140	240	90	140	300
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	510	1670	1410	240	560

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	ES6 (BH05)	ES7 (BH02)	ES8 (BH-A)	----	----
			Client sampling date / time	17-May-2016 13:05	17-May-2016 14:40	18-May-2016 08:30	----	----
Compound	CAS Number	LOR	Unit	ES1610886-006	ES1610886-007	ES1610886-008	--------	--------
				Result	Result	Result	----	----
EA002 : pH (Soils)								
pH Value	----	0.1	pH Unit	**5.4**	**11.1**	**5.6**	----	----
EA010: Conductivity								
Electrical Conductivity @ 25°C	----	1	µS/cm	**304**	**894**	**213**	----	----
EA014 Total Soluble Salts								
Total Soluble Salts	----	5	mg/kg	**988**	**2900**	**692**	----	----
EA055: Moisture Content								
Moisture Content (dried @ 103°C)	----	1	%	**17.3**	**9.5**	**15.9**	----	----
ED006: Exchangeable Cations on Alkaline Soils								
Exchangeable Calcium	----	0.2	meq/100g	----	**8.2**	----	----	----
Exchangeable Magnesium	----	0.2	meq/100g	----	**0.5**	----	----	----
Exchangeable Potassium	----	0.2	meq/100g	----	<0.2	----	----	----
Exchangeable Sodium	----	0.2	meq/100g	----	**1.5**	----	----	----
Cation Exchange Capacity	----	0.2	meq/100g	----	**10.2**	----	----	----
Exchangeable Sodium Percent	----	0.2	%	----	**14.8**	----	----	----
ED007: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	----	----	**1.4**	----	----
Exchangeable Magnesium	----	0.1	meq/100g	----	----	**8.8**	----	----
Exchangeable Potassium	----	0.1	meq/100g	----	----	**0.2**	----	----
Exchangeable Sodium	----	0.1	meq/100g	----	----	**2.8**	----	----
Cation Exchange Capacity	----	0.1	meq/100g	----	----	**13.4**	----	----
Exchangeable Sodium Percent	----	0.1	%	----	----	**21.3**	----	----
ED008: Exchangeable Cations								
Exchangeable Calcium	----	0.1	meq/100g	**0.2**	----	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g	**9.9**	----	----	----	----
Exchangeable Potassium	----	0.1	meq/100g	**0.2**	----	----	----	----
Exchangeable Sodium	----	0.1	meq/100g	**2.2**	----	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g	**12.6**	----	----	----	----
Exchangeable Sodium Percent	----	0.1	%	**17.0**	----	----	----	----
ED040S : Soluble Sulfate by ICPAES								
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**120**	**100**	**150**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	10	mg/kg	**460**	**280**	**1030**	----	----

APPENDIX H

SELECTED SITE PHOTOS

Photo 1- BH01 Looking East

Photo 2 - BH01

Goodman Property Services (Aust) Pty Ltd
Western North South Link Road
Erskine Park, NSW

SELECTED PHOTOS (1 OF 4)

PSM1541-140R	**Appendix H - 1**

Pells Sullivan Meynink

S:\PSM1541\Engineering\PSM1541.50 West North-South Link Road\Photos and site notes\Selected Photos\[PSM2343-059L Figure 1&2&3.xls]Figure 3.2

Photo 2- BH03 Looking South

Photo 4 - BH07 Looking North

Goodman Property Services (Aust) Pty Ltd
Western North South Link Road
Erskine Park, NSW

SELECTED PHOTOS (2 OF 4)

Pells Sullivan Meynink

PSM1541-140R	Appendix H - 2

S:\PSM1541\Engineering\PSM1541.50 West North-South Link Road\Photos and site notes\Selected Photos\[PSM2343-059L Figure 1&2&3.xls]Figure 3.2

Photo 5 - BH07 Looking North

Photo 6 - BH07 Looking South

Goodman Property Services (Aust) Pty Ltd
Western North South Link Road
Erskine Park, NSW

SELECTED PHOTOS (3 OF 4)

Pells Sullivan Meynink

PSM1541-140R	**Appendix H - 3**

S:\PSM1541\Engineering\PSM1541.50 West North-South Link Road\Photos and site notes\Selected Photos\[PSM2343-059L Figure 1&2&3.xls]Figure 3.3

Photo 7 - BH-A

Photo 8 - BH-B Looking NW

Goodman Property Services (Aust) Pty Ltd
Western North South Link Road
Erskine Park, NSW

SELECTED PHOTOS (4 OF 4)

Pells Sullivan Meynink

PSM1541-140R	**Appendix H - 4**

S:\PSM1541\Engineering\PSM1541.50 West North-South Link Road\Photos and site notes\Selected Photos\[PSM2343-059L Figure 1&2&3.xls]Figure 3.4