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Report on
Geotechnical Investigation

Westfield Kotara, Stage 4 Redevelopment
Northcott Drive, Kotara

Prepared for
Scentre Group Ltd

Project 71995.07
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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

	Signature	Date
Author		6 July 2016
Reviewer		6 July 2016

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Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
15 Callistemon Close
Warabrook NSW 2304
PO Box 324
Hunter Region Mail Centre NSW 2310
Phone (02) 4960 9600
Fax (02) 4960 9601

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Report on Geotechnical Investigation
Westfield Kotara, Stage 4 Redevelopment
Northcott Drive, Kotara

1. Introduction

This report presents the results of a geotechnical investigation undertaken for Stage 4 of proposed redevelopment at the Westfield complex at Northcott Drive, Kotara. The investigation was commissioned in an email dated 15 April 2016 by Justin Cunningham of Scentre Group Ltd and was undertaken in accordance with Douglas Partners' proposals NCL160257 dated 6 April 2016 and NCL160182 (Rev 2) dated 31 March 2016. The work was undertaken in consultation with MPN Group Pty Ltd, the structural engineer for the project.

1.1 Project Appreciation

The project includes the re-development and refurbishment of parts of the existing Westfield shopping complex. The aspects of the development which are pertinent to this investigation have been divided into four items, as shown in Figure 1. These include the following:

- **Item 1 – South-Eastern Retaining Wall**

  Demolition of the existing building (Kmart Auto) and excavation into the slope behind the existing retaining wall
  to facilitate construction of a new retaining wall along the boundary of the site.

- **Item 2 – New Piles Under Existing Structure and Areas of New Development**

  Development is proposed for the area which is currently being used as under cover parking. This area has been designated the “Green Zone” for this project and is shown in Figure 1. The additional loads imposed by the new development will be carried by either the existing piles, understood to be enlarged base, bottom driven piles, or on new piles.

  Further development is proposed in the area to the east of the existing undercover carparking. This area is currently covered with open car parking and has been designated the “Red Zone” for this project.

- **Item 3 – Proposed IMM02 Tenancy Shear Walls and Hoist Base**

  A new IMM02 tenancy will be constructed within the central area of the shopping centre, which will require the construction of two new shear walls together with a new hoist. The hoist will require lowering of the existing floor slabs by up to 0.7 m.

- **Item 4 – New Block 15 Lift Pit**

  As part of the development a new lift pit will be constructed within the southern area of the shopping centre, in an area which is currently a lay-by area off the main vehicle accessway.

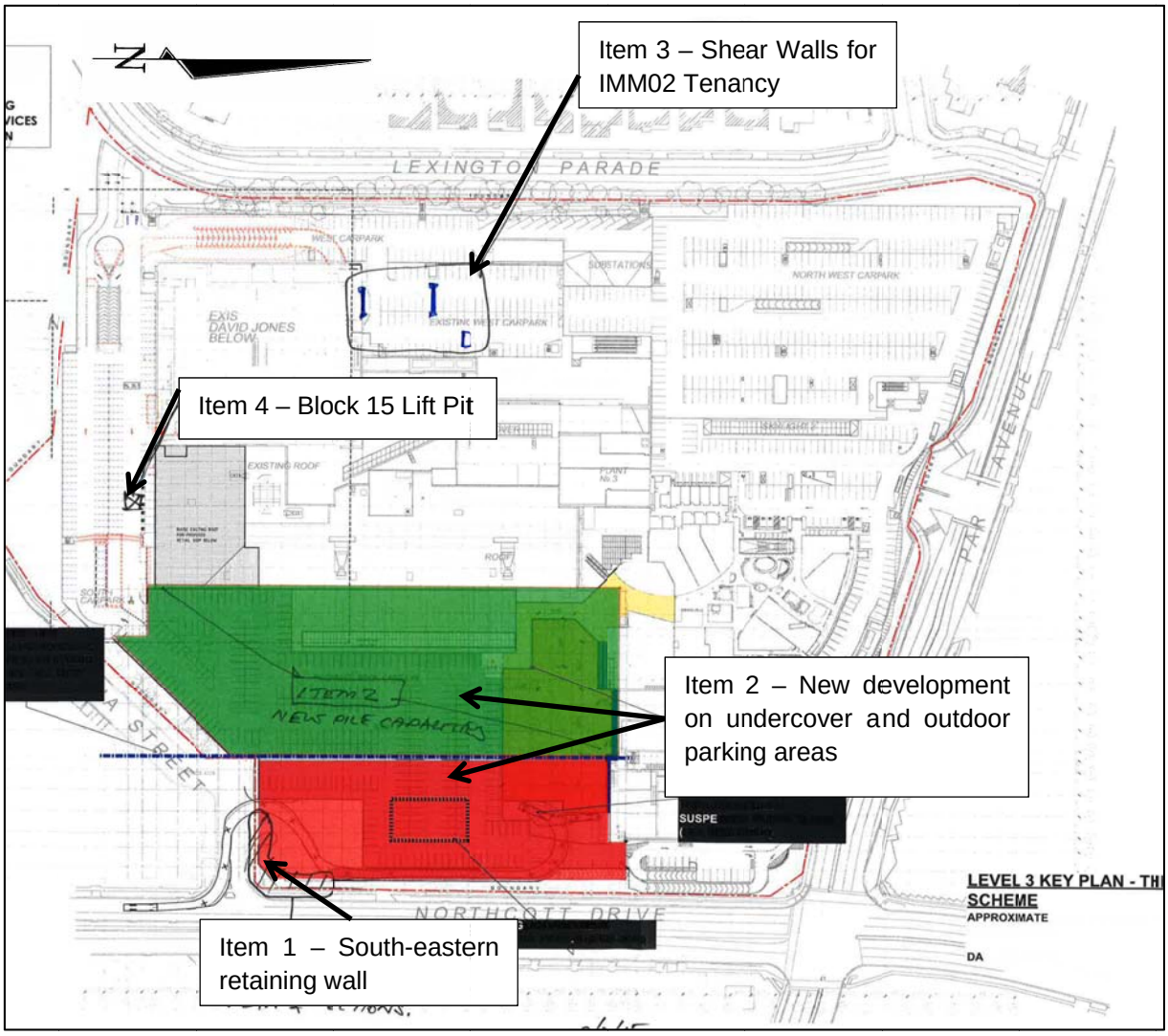


Figure 1: Key plan of areas of proposed development pertinent to geotechnical investigation

For the purposes of the investigation the client provided DP with a range of drawings either providing survey information for the site or proposed development schemes, as follows:

- Detail Survey, Plan 160413_A, dated 29 April 2016, prepared by Geosurv consulting surveyors, planners and engineers.
- Blocks 10 and 11 Alteration Plan, Drawing 10708, 10-10, Revision B#, prepared by MPN Group Pty Ltd;
- Blocks 10 and 11 Footing Layout, Drawing 10708, G4-3, Revision B, prepared by MPN Group Pty Ltd; and

- Blocks 10 and 11 Shear Wall Elevation and Details, Drawing 10708, 10-50, Revision A, prepared by MPN Group Pty Ltd.

1.2 Scope of Work

The aim of the investigation was to provide information on the subsurface conditions at the test locations together with comments on the following geotechnical issues specific to each of the four development items, as follows:

- **Item 1 – South-eastern retaining wall**
  - Safe temporary batter slopes for excavation in the area of the new retaining wall to avoid the crest of the excavation from crossing the site boundary; and
  - Parameters for design of the new retaining wall.
- **Item 2 – New piles under existing structure and areas of new development**
  - Geotechnical parameters for pile design.
  - Comment on the likely capacity of drilling rigs which would be able to operate in the limited access area ("Green Zone").
  - Comments on probable capacities of existing enlarged base piles;
- **Item 3 – Proposed IMM02 Tenancy Shear Walls and Hoist Base**
  - Earthquake class (z-factor);
  - Geotechnical design parameters for new piles; and
  - Piling equipment capable of working within the limited access available.
- **Item 4 – New Block 15 Lift Pit**
  - Allowable bearing pressures for the foundation of the pit (high level foundations);
  - Safe temporary batter slopes for the excavation;
  - Angle of influence of the excavation and the risk of impact on the nearby existing pile groups;
  - The need for temporary bracing of existing piles; and
  - Excavation support requirements.

1.3 Outline of Investigations

The field work for the investigations comprised the drilling of 10 bores, cone penetration testing at five locations, concrete coring at a number of existing footing locations as well as shallow subsurface investigation using hand tools at several locations. The results are presented in the report, together with comments on geotechnical aspects of design and construction.

2. Previous Relevant Investigations

Douglas Partners Pty Ltd (DP) has provided progressive advice during the investigation process, including a report on Item 3 titled "Report on Geotechnical Investigation, Stage 4 Redevelopment IMM02 Tenancy, Northcott Drive, Kotara", Project 71995.07, dated 24 May 2016 (Ref 1).

DP has also undertaken a number of previous investigations at the shopping centre site, both within and outside of the proposed redevelopment area. These include the following:

- Subsurface investigation in the area of the proposed cinema complex, titled "Report on Preliminary Geotechnical Assessment, Proposed Building Upgrade, Westfield Shopping Centre, Northcott Drive, Kotara", Project 71995, dated September 2010 (Ref 2). This investigation included five CPT tests to the north of the current site. The CPTs were taken to depths ranging from about 12 m to 16 m and encountered predominantly very stiff to hard clays';
- a review of the existing foundations for a previous building upgrade to the north of the current redevelopment area. The findings of this report were presented in a report titled "Report on Geotechnical Assessment of Existing Foundations, Proposed Building Upgrade, Northcott Drive, Kotara", prepared for Westfield Ltd, Project 71995-2 dated December 2010 (Ref 3).

Relevant information from these previous investigations has been used during the preparation of this report. It is also discussed in Section 5.

3. Site Description

The Westfield shopping centre is located to the south-west of the intersection of Northcott Drive and Park Avenue, Kotara. The site of Stage 4 Redevelopment investigation works is located mainly in the south eastern part of the Westfield complex, immediately adjacent to Northcote Drive, as shown on the attached Drawing 1.

The Stage 4 site (Items 1, 2 and 4) is bound by the existing multi-level Westfield development to the north and west, Northcott Drive to the east and Cynthia Avenue to the south.

At the time of investigation the Stage 4 site comprised both covered and uncovered, ground level car park, which was surfaced with asphalt. The surface sloped generally towards the middle of the site from the east and west site boundaries at approximately 1º to 3º. Surrounding slopes are generally to the north and west towards Park Avenue.

A brief site description of the area for each item of development is presented in Sections 3.1 to 3.4 below.

3.1 Item 1 – South-eastern retaining wall

The new retaining wall will be constructed in the south-eastern corner of the site, to the south of the existing K-Mart tyre centre. This building will be demolished to allow development within this area.

An existing concrete block retaining wall is visible within this area and is about 2 m in height with a further block wall of about 1.2 m in height located below and to the north (refer Figure 2).

Figure 2: Looking towards south east retaining wall

The area behind the retaining wall is generally covered with shrubs and several mature trees (landscaped garden) as shown in Figure 3 below.

As part of the re-development, further excavation beyond the line of the existing retaining wall will be required.

Figure 3: Area behind existing retaining wall

The area to the rear of the existing building is covered by a narrow garden with low shrubs and the adjacent footpath.

3.2 Item 2 – New piles under existing structure and areas of new development

At the time of investigation the “Red Zone” comprised an uncovered, ground level car park, which was surfaced with asphalt (refer Figure 4). Site slopes generally fall to the west at approximately 1º to 3º. Surrounding slopes are generally to the north and west towards Park Avenue.

Figure 4: Looking south-west from Bore 108 in “Red Zone”

The “Green Zone” comprises a covered car parking area. The area is characterised by traffic isles or lanes around several strips of double car parking spaces. Concrete columns are present throughout the area at regular spacing. The ground surface generally falls to the west at slopes of less than 5°. The head height to the overlying first floor slab ranges from about 3.7 m to greater than 6 m (refer Figure 5 and Figure 6).

Figure 5: Looking south at test location 104

Figure 6: Looking west at test location 101

Numerous existing services, such as sewer, water and parking indicators hang from the overlying floor slab.

3.3 Item 3 – Proposed IMM02 Tenancy Shear Walls and Hoist Base

The proposed shear walls will be located within the area currently being occupied by the David Jones loading dock (refer Figure 7).

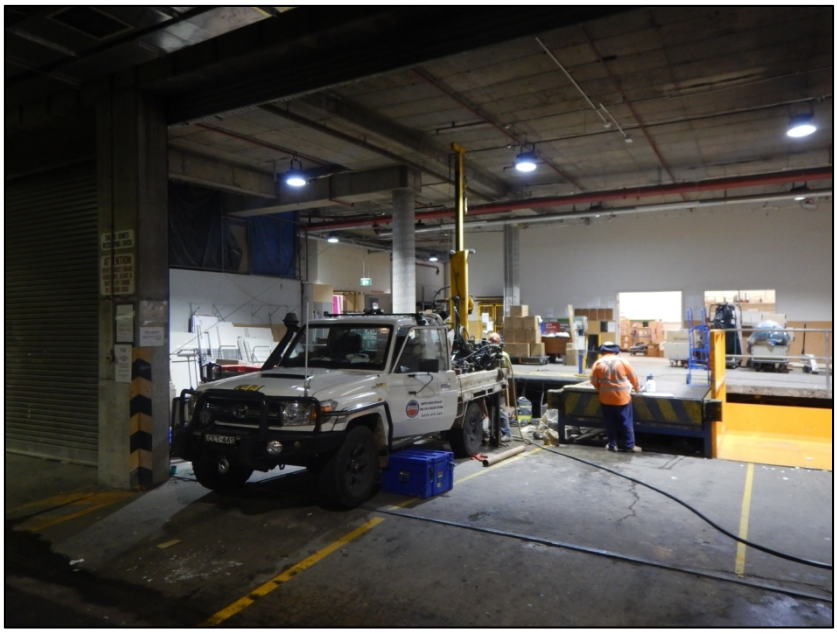


Figure 7: General area of David Jones loading dock (Drilling rig at Bore 302 location). New shear wall will be located to the rear of the raised area

The new hoist will be located in an area currently being used as a cleaners store room (refer Figure 8).

Figure 8: General view of cleaners storeroom where new hoist will be located

The head room within the area of proposed development is understood to vary from about 4 m to 5.2 m. A number of existing services (ducting, electrical and water) are located immediately below the concrete floor slab of the overlying floor level (refer Figure 7).

3.4 Item 4 – New Block 15 Lift Pit

The new Block 15 lift pit will be located in the southern area of the shopping centre site (refer Figure 1). It is within the undercover car parking area and positioned within a lay-by area off the main vehicle accessway (refer Figure 9). The head room in this area is in the order of 3.5 m.

Figure 9: Looking south west towards bore location 201

3.5 Local Grid Co-Ordinates

A local grid co-ordinate system is present at the site and is shown on Drawing 7 in Appendix D. This system is referred to in discussions regarding existing piles.

4. Regional Geology

The 1:250,000 Geological Series Sheet for Newcastle indicates that the Stage 4 Redevelopment part of the Westfield site is located near to the border between Quaternary alluvium, typically comprising gravel, sand, silt and clay (mapped as extending to the north and west of the site), and bedrock of the Permian aged Lambton Subgroup of the Newcastle Coal Measures (mapped as extending to the south and east of the site).

Based on the maps presented on the Mine Subsidence Board website (www.minesub.nsw.gov.au), the site lies near the boundary of the Newcastle Mine Subsidence District. Mine subsidence assessment was beyond the scope of this report. Reference should be made to the NSW Mine Subsidence Board regarding possible restrictions or conditions which may be imposed on the proposed development.

5. Previous Investigation and Background Data

5.1 Existing Foundation System

Based on information provided by the client, it is understood that the existing structure in the "Green Zone" is supported by either single piles or groups of two piles that are principally orientated in a north-south direction.

The foundations for the subject portion of the existing carpark were installed by Frankipile Australia Pty Ltd (Franki) during 1987. Construction records for the piles were obtained by DP from the archive records of Franki in 2010. The records are in the form of "Daily Reports" and include installation details for each individual pile. Based on these records it is apparent that the pile foundations were constructed as enlarged-base Frankipiles. An enlarged-base Frankipile is a driven, cast-in-situ, proprietary pile type.

A summary of the as-constructed details for a number of piles in the vicinity of the test locations undertaken during the present investigation is presented in Table C1, included within Appendix C. The summary includes the "Driving Tube Depth", which was taken to represent the length of pile from the working surface down to the mid-point of the enlarged base of the pile, based on comparison of the piling records and the pile load test reports. The enlarged base of the piles was assumed to be spherical, as is normal practice for this pile type. Also shown in Table C1 are the shaft diameter and method of construction (i.e. "hammered" or "wet") and the (bulk) volume of concrete used to form the enlarged base of each pile.

Hammered shaft construction refers to driving of successive charges of zero-slump concrete out of driving tube to progressively form the pile shaft, resulting in a full-displacement shaft with very rough sidewalls. The as-built shaft diameter is typically 50 – 150 mm greater than the driving tube diameter, depending on the stiffness of the soil profile. Wet shaft construction refers to conventional concrete placement methods involving pouring semi-fluid concrete from an agitator truck into the pile hole into which the steel reinforcement has previously been installed. The as-built shaft diameter for "wet shaft" construction is normally close to the tube diameter.

A review of the piling records indicated that the piles installed in the vicinity of the test locations are as outlined in Table 1.

Table 1: Summary of As-Built Pile Dimensions

Test Location	Founding Level[(1)] (m)	Shaft Type[(2)]	Shaft Diameter[(3)] (m)	Base Volume[(3)] (m^3)
CPT/Bore 101	11.5 to 12.5	Wet	0.5	0.56
CPT/Bore 102	6.5 to 7.5	Wet	0.4	0.4 – 0.5
CPT 103	9.5	Wet	0.5	0.7
CPT/Bore 104	6.5	Wet	0.4 to 0.5	0.4 – 0.5
CPT 105	6.5	Wet	0.4	0.4 – 0.5
Bore 106	6 to 6.5	Wet	0.5	0.28 – 0.6
Bore 107	11.5 – 12.5	Wet	0.5	0.5 – 0.6
Bore 108	9.5 – 10	Hammered Shaft	0.4	0.5 – 0.6

Notes to Table 1:

(1) Founding level taken as Driving Tube Depth from piling records, plus 0.5m, representing the radius of a theoretical spherical enlarged-base Frankipile.

(2) Hammered shaft construction refers to driving of successive charges of zero-slump concrete out of driving tube to progressively form the pile shaft, resulting in a full-displacement shaft with very rough sidewalls. Wet shaft construction refers to conventional concrete placement methods involving pouring semi-fluid concrete from an agitator truck into the pile hole into which the steel reinforcement has previously been installed.

(3) Shaft diameter for hammered shaft piles constructed with either a 400 mm or 500mm diameter driving tube.

5.2 Pile Load Tests

DP reviewed and analysed test reports (Ref 3) for three piles subjected to static (compression) load testing during previous investigations at the site. The test piles were located to the north of the area of proposed Stage 4 Redevelopment.

It was concluded that the columns supported by groups of Franki-type piles in the adjacent area of the site should be capable of supporting a 35% load increase with additional settlements of typically less than 5 mm.

It is noted, however, that the majority of the increased settlements, in the order of 10 – 15 mm, were expected for the single piles, particularly if load increases of greater than 15% were required. Some piles were found to be loaded close to their safe working limit.

It is further noted that some construction problems were identified within the area immediately to the north of the “Green Zone”, with “back pressures” being noted in the piling records. If there are any piles for which construction problems were encountered within the “Green Zone”, higher settlements could occur.

Further, more detailed analysis would be necessary to assess the feasibility of the existing piles taking additional load, including integrity testing of a number of the existing piles, in critical locations.

6. Field Work Methods

The field work for the current geotechnical investigation was undertaken during the period extending from 18 April 2016 to 12 May 2016. The test locations were set out by a geotechnical engineer from DP in consultation with the client. The engineer also logged the subsurface conditions encountered and collected samples for identification and laboratory testing purposes.

The field work included a number of investigation techniques, as follows

- Test Bores (truck mounted and track mounted drill rigs);
- Cone Penetration Testing (CPT);
- Hand Auger Test Bores;
- Hand excavated test pits;
- Coring through the existing concrete slab and footings;
- Dynamic penetrometer testing; and
- Inspection of development areas by a senior geotechnical engineer.

The locations of all tests are shown on the drawings in Appendix D. Sections through selected bores are also provided in Appendix D to assist with interpretation of the results of the investigation. The drawings are summarised below:

- Drawing 1 Test Location Plan (overall) – (Items 1, 2 and 4);
- Drawing 2 Test Location Plan (Item 1);
- Drawing 3 Test Location Plan (Item 3);
- Drawing 4 Section XX' (Item 1);
- Drawing 5 Section AA' (Item 2);
- Drawing 6 Section BB' (Item 2);
- Drawing 7 Local Grid Co-ordinate System.

The location of each bore was positioned by measurement from existing site features.

At the completion of drilling all bores were backfilled with cuttings and finished at the surface with cold-mix asphalt.

A summary of the field investigations is shown in Table 2.

Table 2: Summary of Field Investigations

Investigation Location	Development Area	Investigation Method	Investigation Depth (m)		
			CPT	Bore	Pit
101	Item 2 – Green Zone	CPT and Bore	14.42	20.56	-
102		CPT and Bore	17.70	24.10	-
103		CPT	2.62	-	-
104		CPT and Bore	10.26	16.71	-
105		CPT	16.18	-	-
106	Item 2 – Red Zone	Bore	-	18.00	-
107		Bore	-	17.8	-
108		Bore	-	17.59	-
201	Item 4 – Block 15 Lift Pit	Bore	-	7.95	-
301	Item 3 – IMM02 Tenancy	Bore	-	8.5	-
302		Bore	-	9.45	-
603		Bore (hand auger)	-	1.7	-
604		Bore (hand auger)	-	0.6	-
605		Bore (hand auger)	-	1.5	-
401	Item 1 – SE Retaining Wall	Bore	-	3.6	-
402/1		Pit	-	-	0.57
402/2		Pit	-	-	0.8
402/3		Pit	-	-	0.4
403		Bore	-	1.2	-
404		Bore (hand auger)	-	1.2	-
405		Bore (hand auger)	-	1.3	-

Notes to Table 2:
Investigation locations are shown on Drawings 1 to 3

These field activities for the present investigation are discussed in more detail below.

Item 1 – South-eastern retaining wall

The field work in this area included the following:

- Drilling of four bores (Bores 401, 403 to 405); and
- Excavation of three test pits (402/1 to 402/3) to depths ranging from 0.4 m to 0.8 m.

Bore 401 was drilled using a 4WD mounted drill rig and was taken to 3.6 m depth. NMLC coring of the bedrock was undertaken. Photos of the recovered core are attached on Plate 6 in Appendix B.

All remaining bores were drilled using a hand auger and were supplemented with dynamic cone penetration (DCP) testing. The DCPs were taken to depths ranging from 1.5 m to 2.7 m.

Pits 402/1 to 402/3 were excavated using hand tools and exposed bedrock to the rear of the lower retaining wall. The exposed conditions were logged by a geotechnical engineer. Photos of the test pits are attached on Plates 7 and 8 in Appendix B.

Item 2 – New Piles Under Existing Structure and Areas of New Development

The field work in this area included the following:

- Five cone penetration tests (CPT) (designated CPTs 101 to 105); and
- Six test bores (designed Bores 101, 102, 104 and 106 to 108).

The CPTs were conducted using a portable purpose built CPT rig. A 35 mm diameter instrumented cone and friction sleeve assembly was hydraulically thrust into the soil at a rate of 2 cm / sec using the overlying floor slab for resistance (refer Figure 10).

Figure 10: Typical set up of portable CPT equipment

Cone tip resistance and sleeve friction were recorded by a computer data acquisition system for subsequent plotting and analysis (refer Figure 11). The remnant CPT holes were dipped to measure the depth to water or hole collapse.

Figure 11: Capture of CPT investigation data

CPTs 101, 102, 104 and 105 were taken to refusal depths ranging from 10.26 m to 17.73 m. Refusal occurred owing to high cone resistance, most likely refusal on weathered bedrock or very dense gravel.

CPT 103 refused at 2.62 m owing to refusal on a buried object and unacceptable inclination of the CPT string.

Bores were drilled at CPT locations 101, 102 and 104 within the “Green Zone” and Bores 106 to 108, located within the “Red Zone”. The bores were drilled to depths ranging from 16.71 m to 24.1 using either a small 4WD mounted drilling rig (“Green Zone”) or truck mounted drilling rig (“Red Zone”) [refer Figure 12].

Figure 12: Truck mounted drilling rig at Bore 107

Standard penetration tests (SPTs) were performed at regular depth intervals in the soils. NMLC coring of the bedrock was undertaken at all test bore locations. Photos of the recovered core are attached on Plates 1 to 4 in Appendix B.

Item 3 – Proposed IMM02 Tenancy Shear Walls and Hoist Base

Two bores (Bores 301 and 302) were drilled to depths of 8.5 m and 9.45 m respectively. The bores were drilled using either a 4WD mounted drilling rig (refer Figure 13) or a buggy mounted low head height investigation rig.

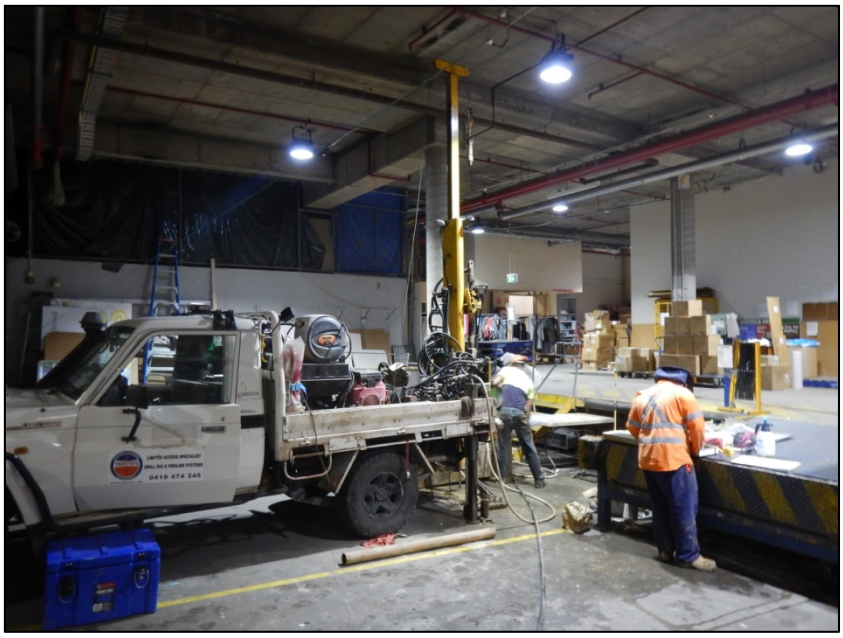


Figure 13: View of location of Bore 302

Standard penetration tests (SPTs) were performed at selected depths and locations. NMLC coring of the bedrock was undertaken in both of the bores. Photos of the recovered core are attached on Plate 5 in Appendix B.

These bores were located at the nearest accessible locations to the proposed new shear walls.

Item 3 - Coring through Floor Slab

Coring through the floor slab was undertaken at three accessible locations adjacent to existing columns to determine the depth to the top of existing footings (refer Drawing 3 in Appendix D). Two additional locations were investigated using a combination of concrete sawing and coring to assess the presence and depth of a reported concrete footing associated with a previous retaining wall. The investigation locations are shown on Drawing 3 and summarised below:

- Core 601 Column EE/34-35;
- Core 602 Column EE/31-33;
- Core/Saw 603 Grid CC-DD/29;
- Core 604 Grid CC-DD/30-31;
- Core 605 Column EE/35.

The coring was undertaken using a 100 mm diameter diatube and taken to the underside of the floor slab (refer Figures 14 to 16). Penetrometer testing and hand auger boreholes were then undertaken to refusal in an attempt to establish the depth to the top of existing footings under the columns (Cores 601 and 602) and the underside of the footings (Cores 603 to 605). Photos of the recovered concrete core in Bores 603 and 604 are provided in Plate 9, Appendix B.

Shallow hand auger bores were undertaken at Cores 601 to 604, with the subsurface conditions at these locations logged as Bores 601 to 604. These bores were taken to depths ranging from 0.34 m to 1.7 m.

Figure 14: Location of Core 601 (Darrell Lea Storeroom). Note column EE/34-35 in top right hand corner

Figure 15: Location of Core/Saw 603. Note apparent footing below initial thin slab

Figure 16: Location of Core 604

Item 4 – New Block 15 Lift Pit

A single bore (Bore 201) was drilled to a depth of 7.95 m using a buggy mounted low head height investigation rig fitted with solid flight augers (refer Figure 17).

Figure 17: Location of Bore 201

SPTs were performed at regular depth intervals and was supplemented by DCP testing from 0.45 m to 2.25 m depth.

The location of Bore 201 is shown on Drawing 1, Appendix D.

7. Field Work Results

The subsurface conditions encountered in the bores are presented in detail in the borehole logs, CPT logs and test pit logs in Appendix B. These should be read in conjunction with the accompanying notes in Appendix A which explain the descriptive terms and classification methods used in the logs. Photos of the recovered core are provided on Plates 1 to 9 in Appendix B.

The site stratigraphy can be divided into the following units, as summarised in Table 3 below.

Table 3: Summary of Site Stratigraphy for Items 2 to 4

Geotechnical Unit	Stratum	Description
1A	Filling - Pavement materials	Asphalt over sandy gravel (roadbase) or concrete.
1B	Filling	Generally comprising sandy clay with some gravel.
1C	Filling	Encountered for item 1 only, generally comprising silty sand with some gravel/ gravel
1D	Filling	Encountered for item 1 only, generally comprising silty clay/ sandy clay / clay with some gravel
2A	Silty Clay / Sandy Clay	Firm to stiff.
2B	Silty Clay / Sandy Clay / Gravelly Clay / Clay / Clayey Sand	Stiff to hard / Medium Dense to Dense
3	Bedrock	• Unit 3.1 – Class V Siltstone– ranging from extremely low to very low strength; • Unit 3.2 - Class IV Sandstone / Conglomerate, typically low strength with extremely low strength bands; • Unit 3.3 – Class III/IV Sandstone / Conglomerate, typically medium strength but included bands ranging from extremely low to high strength; • Unit 3.4 – Class IV/V Siltstone / Sandstone / Conglomerate, typically extremely low to low strength.

Table 4, below, provides a summary of the subsurface conditions encountered in the CPTs, pits and bores.

Table 4: Summary of Test Locations – Bores, Pits and CPTs

Test Location	Depth to Base of Each Unit (m)										Depth of Investigation (m)
	Unit 1 - Filling				Unit 2A Silty / Sandy Clay	Unit 2B Silty / Sandy / Gravelly Clay	Unit 3.1 Siltstone	Unit 3.2 Sandstone / Conglomerate	Unit 3.3 Sandstone / Conglomerate	Unit 3.4 Sandstone / Conglomerate / Siltstone	
	Unit 1A	Unit 1B	Unit 1C	Unit 1D							
Item 2 – New piles under existing structure and areas of new development											
101	-	-	-	-	2.94	14.42			-	>20.59	20.56
102	-	-	-	-	-	17.70	-		-	>24.10	24.10
103	2.62 [(a)]	-	-	-	-	-	-	-	-	-	-
104	-	-	-	-	2.83	10.26	-	-	-	>16.71	16.71
105	-	-	-	-	5.11	16.18	15.27	-	15.65	>16.71	16.18
106	0.2	0.6	-	-	-	8.0[(d)]	-	-	-	>18.0	18.0
107	1.2	-	-	-	6.5	11.0	-	11.36	12.35	16.5[(e)]	17.80
108	0.8	2.8	-	-	-	12.15	-	-	13.05	>17.59	17.59
1[(b)]	0.7	1.3	-	-	2.2	13.0	13.5	15.3	18.4	>20.44	20.44
2[(b)]	0.6	1.2	-	-	4.0	14.5	14.7	16.2	19.9	>21.55	21.55
Item 4 – New Block 15 Lift Pit											
201	1.6	-	-	-	3.3	7.95	-	-	-	-	7.95
Item 3 – Proposed IMM02 Tenancy Shear Walls and Hoist Base											
301	0.25[(c)]	-	-	-	-	4.1	7.45	8.5	-	-	8.5
302	0.2[(c)]	-	-	-	-	5.2	7.95	9.45	-	-	9.45
603	0.56[(c)]	-	-	-	-	1.7	-	-	-	-	1.7
604	0.45[(c)]	-	-	-	-	0.6	-	-	-	-	0.6
605	0.63[(c)]	-	-	-	>1.5						
Item 1 – South-eastern retaining wall											
401	0.35	-	-	-	-	-	-	-	2.46	1.45	3.6
402/1	-	-	0.2	-	-	-	-	-	>0.57	-	0.57
402/2	-	-	0.8	-	-	-	-	-	-	-	0.8
402/3	-	-	0.2	-	-	-	-	-	>0.4		0.4
403	-	-	0.4	1.2	-	-	-	-	-	-	1.2
404	-	-	0.6	1.2	-	-	-	-	-	-	1.2
405	-	-	>1.3	-	-	-	-	-	-	-	2.70

Notes to Table 4:

(a) No asphalt over fill at test location 103.

(b) Data from previous investigation Douglas Partners report (Ref 1)

(c) Concrete was encountered over the filling

(d) Core loss from 4.32 m to 8 m interpreted to be extremely low strength conglomerate with significant clay and should be treated as clay

(e) Medium strength from 16.5 m depth

Drawing 4 is included in Appendix D and shows a section through the bores and pits in the location of the proposed south-eastern retaining wall. Similarly, Drawings 5 and 6 show a section through the test locations in the "Green and Red Zones".

Table 5, below, provides a summary of the conditions encountered in the concrete coring and sawing undertaken for Item 3 (see also Drawing 3 in Appendix B).

Table 5: Summary of Concrete Cores

Investigation Location	Thickness of Floor Slab (m)	Profile Below Floor Slab	Depth to Top of Footing (m)	Depth to Base of Footing (m)
601	0.15	Silty sandy clay	0.3	ND
602	0.19	Sand filling	0.39	ND
603	0.11	Footing at base of slab	0.11	0.56
604	0.11	Footing at base of slab	0.11	0.50
605	0.63	Sandy Clay	NE	NE

Notes to Table 5:
ND – Not determined
NE – Not encountered

Groundwater Observations

Free groundwater was observed at depths ranging 2.3 m to 7.0 m across the site. Reference should be made to specific logs. It should be noted that groundwater levels are affected by factors such as climatic conditions and soil permeability and will therefore vary with time.

Photographs of the rock core together with the concrete cores are presented in Appendix B.

8. Proposed Development

The details of the proposed development are discussed in Section 1. Information on design loads has been provided by the structural engineers for the project, MPN Group Pty Ltd, for Items 2 and 3 as follows:

Item 2 – New piles under existing structure and areas of new development

No design loads have been provided at this stage, although it is understood that pile capacities in the order of 1000 kN are anticipated.

Item 3 – Proposed IMM02 Tenancy Shear Walls and Hoist Base

The proposed development includes the construction of two new shear walls, which will be supported on piles. Two pile types (P1 and P2) have been nominated by the structural engineer which will be subject to the following loadings as outlined in Table 6 below.

Table 6: Design Loads for Item 3

Pile	Ultimate Load (kN)	Serviceability Load (kN)	Earthquake Load (kN)
P1	1540 (compressive)	1235 (compressive)	1360 (compressive) 1000 (tensile)
P2	390 (compressive)	300 (compressive)	133 (tensile)

Lateral loads on the P1 pile type under ultimate vertical loading and earthquake loading cases are 285 kN and 625 kN respectively.

9. Comments

9.1 Excavation

It is understood that excavation into the existing slope may be required for Item 1 in order to construct the new retaining wall in the south-eastern corner of the site. The excavation would be taken to a similar level to the existing car park downslope and adjacent to the existing wall. Similarly, excavation of up to 1 m may be required for the lowering of the floor slab associated with the new hoist for Item 3 (IMM02 Tenancy).

Based on the results of the bores undertaken during the present investigation, subsurface conditions in these areas are anticipated to include the following:

Item 1 – South-Eastern Retaining Wall
Topsoil and sandy gravel filling is anticipated within the existing garden areas to depths ranging from 0.2 m to 1.3 m depth and is anticipated to be generally underlain by conglomerate bedrock, as exposed in Pits 402/1 to 402/3 and Bore 401. While the recovered core in Bore 401 was initially very low strength, it is noted that an approximately 1 m thick layer of medium strength sandstone was encountered from 1.45 m depth. Similarly, low strength conglomerate bedrock was exposed within Pits 402/1 to 402/3. Drawing 4, in Appendix D, shows a section through the area of investigation and shows that the inferred rock level increases to the east at about 30° above the horizontal. It appears that this area of the site has been formed by excavation into the bedrock during initial development. Excavation for the proposed retaining wall is likely to encounter the conglomerate and sandstone bedrock.

Item 3 – Proposed IMM02 Tenancy Shear Walls and Hoist Base
Excavation for the new hoist associated with the IMM02 tenancy is likely to encountered some gravelly filling underlain by stiff or stronger clay soils. Based on the concrete coring undertaken in this area, concrete footings associated with a former retaining wall (Cores 603 and 604) and supporting existing columns (Cores 601 and 602) may be intersected.

The majority of the filling and clays, together with the extremely low to very low strength rock, are expected to be readily excavated using conventional equipment such as hydraulic excavators with light ripping to aid pick-up although with a lower rate of production in the stronger materials at depth.

Excavation of the medium strength bedrock, as encountered/exposed within the south-eastern retaining wall area, is expected to require medium to heavy earthmoving equipment, particularly for detailed excavation and trimming.

9.2 Excavation Batters

The suitability of excavation batters without positive support will be dependent upon the proposed position of the toe of the batter in relation to the boundary. Ongoing inspection of the excavation face during construction will be necessary to assess the continuity and degree of fracturing of the bedrock, although the batter slopes outlined in Table 7 below are suggested for preliminary design purposes.

Table 7: Suggested Preliminary Safe Batter Slopes

Material	Safe Batter Slope (H:V)	
	Short Term (temporary)	Long Term
Filling and clay	1.5:1	2:1
Extremely low and very low strength rock	0.75:1	1:1
Low strength or stronger rock	0.25:1*	0.5:1*

Notes to Table 7:

* - subject to further investigation and detailed inspection by an engineering geologist during construction / excavation

Previous experience with the rocks of the Newcastle Coal Measures suggests that the discontinuities are generally strata bound (i.e. not vertically continuous). However, adoption of the batter slopes for strength low or stronger rock shown in Table 7 must be accompanied by geological inspection to assess any adverse jointing which could give rise to localised instability such as block fallout or wedge failure. The support of these locally unstable blocks and wedges, or extremely low and very low strength bands, can then be provided by in-situ stabilisation techniques utilising dowelled mesh, rock bolts and sprayed concrete.

If excavation faces are protected from weathering by overhead construction and sprayed concrete facing, the short term temporary safe batter slopes shown in Table 7 may be incorporated into the permanent excavation construction, as long as unstable blocks are pinned or anchored to the slope and provision for drainage is made.

9.3 Excavation Support

Where support is to be provided to adjoining structures, services or existing retaining walls, which may be the case along the south-eastern boundary of the site (Item 1) and also within the area of the IMM02 Tenancy (Item 3), the use of retaining systems is suggested to increase the stability of the upper soil and weathered rock profile at these locations during construction.

It is suggested that design of retaining structures be based on an average bulk unit weight for the retained material of 22 kN/m^3. Cantilevered support should be designed on a triangular earth pressure distribution and anchored or propped support should be designed on a trapezoidal earth pressure distribution (increasing linearly from zero pressure to full pressure over the upper 0.25H, then decreasing linearly to zero pressure over the lowest 0.25H – where H is the retained height in metres). The earth pressure coefficients to be adopted for design will be dependent upon the nature and strength of the retained materials, as shown in Table 8 below.

Table 8: Preliminary Active Earth Pressure Coefficients for Retaining Wall Design

Retained Material	Long Term Earth Pressure Coefficient
Filling and clays	0.35
Extremely low and very low strength sandstone	0.25
Low and medium strength sandstone	0.1*

Note to Table 8:
* - subject to further investigation

Additional pressures should be allowed for where surcharging of the wall system results from the proximity of the proposed structure itself near changes in excavation level, to reduce the risk of damage occurring to these structures.

To increase the wall stiffness and thereby reduce lateral (inward) wall deflection, the active earth pressure coefficients shown in Table 8 should be increased by 50% to represent the “at rest” condition. Further, allowance should be made in the wall design for estimated footing loads.

The parameters given above are based on the provision of full drainage behind the retaining walls.

The calculation of the ultimate lateral capacity of piles embedded below the bulk excavation should be based on ultimate lateral resistance pressures given in Table 9 below. Design should incorporate an appropriate factor of safety, and the capacity developed within the first or upper 0.5 m below bulk excavation level should be disregarded in the calculation of lateral capacity.

Table 9: Ultimate Lateral Resistance Pressure for Retaining Wall Design

Material	Ultimate Lateral Resistance (kPa)
Extremely low strength sandstone	600
Low strength sandstone	2500
Medium strength sandstone	4500

9.4 Excavation Vibration

It would be prudent to allow for dilapidation surveys to be carried out on any nearby buildings and existing services to document their condition prior to the commencement of all work in order to respond to any spurious claims for damage arising from construction activities.

It is expected that the very low strength rock encountered in the bores should break readily along natural partings such as clay filled joints and bedding planes observed at 0.05 m – 0.30 m spacings. However, the presence of medium strength bedrock may require the use of heavy equipment, rock breaking tools and pneumatic equipment which has the potential to affect structures and services adjoining the proposed excavation.

As a guide, the damage threshold due to vibration is dependent on the quality of the building foundations and construction of the building as well as the wavelength of the vibration and the source distance. The longer the wavelength, the more likely a building is to resonate and suffer damage. For construction equipment (generally in the high frequency or short wavelength range), the damage threshold is 40 mm/sec to 50 mm/sec for buildings founded on rock. Most vibration codes set safe limits for building vibrations at lower levels.

The Standards Australia explosives code recommends the maximum peak particle velocities for various structures subjected to blasting vibration (generally a low frequency vibration) as set out in Table 10 below.

Table 10: Recommended Maximum Peak Particle Velocity (from AS 2187.2 – 1993)

Type of Building or Structure	Peak Particle Velocity (v_p) (mm/sec)
Houses and low-rise residential buildings: commercial buildings not included below	10
Commercial and industrial buildings or structures of reinforced concrete or steel construction	25

Notes to Table 10:

1. In a specific instance, where substantiated by careful investigation, a value of peak particle velocity other than that recommended in the Table 10 may be used.
2. The peak particle velocities in the Table 10 have been selected taking into consideration both human discomfort and structural integrity together with the effect on sensitive equipment located within buildings.

It should be noted that humans are very sensitive to vibration and consequently may be disturbed by vibration levels which are considered relatively insignificant for buildings. It may therefore be beneficial to carry out vibration monitoring to confirm vibration levels during site works.

9.5 Footing Options

Given the conditions encountered at the site and the anticipated working loads, it is suggested that the new structural loads are carried by piled foundations. In the area of Item 2, the existing structure is understood to be supported by enlarged base bottom driven piles (Franki piles) founded at depths ranging from 6 m to 12 m below existing ground surface levels. The new loads in this area are likely to be carried by groups of piles either founded within the bedrock where access for suitable equipment is available, or within the clays soils in area of limited access, such as the "Green Zone".

9.6 Piling Equipment

It is recommended that a detailed survey of the area of development along with access and egress pathways is undertaken and provided to prospective piling contractors so that appropriate equipment is chosen for the project.

Based on preliminary measurements undertaken by DP during the investigation, access restrictions are present for Items 2, 3 and 4, with head room measured in these areas as follows:

Item 2 – New piles Under Existing Structure and Areas of New Development
Head room in the "Green Zone" was measured by DP to range from about 3.5 m to greater than 6 m, but varies considerably throughout the site. An uneven surface to the underside of the first floor slab together with numerous hanging services results in a highly variable free head space for drilling equipment. Similarly, the presence of columns at regular spacing can present difficulties for manoeuvring piling equipment around in this area.

Item 3 – Proposed IMM02 Tenancy Shear Walls and Hoist Base
Since completion of field work the location of the shear walls has been altered and hence the specific head height within the footprint has not been determined. However, based on the measurements undertaken within the area of investigation, the available head room is likely to range from 3.5 m to 5 m.

Item 4 – Block 15 Lift Well
Head room in this area was measured to range from about 3.5 m to 5 m.

DP has undertaken preliminary consultation with piling contractors in relation to capabilities of rigs to work within the limited access available at this site. Several companies have equipment which can work within limited access as follows:

- Mait Baby Drill (MGI Piling), reported to be able to work in 3.75 m height for a maximum penetration of 12 m;
- Limited access piling rig (Wagstaff), reported to be able to work in 5 m height for a maximum penetration of about 14 m.

9.7 Piles

9.7.1 Geotechnical Strength Reduction Factor

In the current Piling Code (Ref 4), the design geotechnical strength of a pile ($R_{d,g}$) is the ultimate geotechnical strength ($R_{d,ug}$) multiplied by the geotechnical strength reduction factor (ϕ_g), such that:

- $R_{d,g} = \phi_g . R_{d,ug}$

The calculated value $R_{d,g}$ must equal or exceed the structural design action effect E_d.

Selection of the geotechnical strength reduction factor (ϕ_g) is based on a series of individual risk ratings (IRR) which are weighted and lead to an average risk rating (ARR). The individual risk ratings and final value of ϕ_g depend on the following factors:

- Site: the type, quantity and quality of testing;
- Design: design methods and parameter selection;
- Installation: construction control and monitoring;
- Pile testing regime; testing benefit factor based on percentage of piles tested and the type of testing; and
- Redundancy: whether other piles can take up load if a given pile settles or fails.

Using the methodology outlined in the piling code and the supplementary site data retrieved during the present investigation, average risk ratings have been assessed for future foundations. It is noted that the confidence in the geological conditions is somewhat dependent on the design foundation strata. For instance, the results of the CPTs indicate the presence of very stiff to hard clays throughout the site. The depth to, and quality of bedrock, however, is highly variable across the site. Hence, differing geotechnical strength reduction factors would apply for foundations designed to found within the very stiff to hard clay as opposed to the underlying bedrock. An increase in the geotechnical strength reduction factor from the basic geotechnical strength reduction factor has been applied for the pile founded in clay owing to the pile load testing undertaken previously at the site.

The recommended geotechnical strength reduction factors (ϕ_g) for the two foundation scenarios are as follows in Table 11.

Table 11: Recommended Geotechnical Strength Reduction Factor

Foundation Strata	Geotechnical Strength Reduction Factor (ϕ_g)	
	Low Redundancy in design of piles	High Redundancy in design of piles
Piles in very stiff to hard clay	0.62	0.67
Piles founded in underlying bedrock	0.55	0.60

These strength reduction factors are based on inspections to be completed by a qualified geotechnical engineer during piling operations, and on dynamic or static load testing in accordance with the requirements of AS2159 (Ref 4) during piling operations. It is however pointed out that the final ϕ_g will depend on the piling contractor chosen and the experience of the pile designers. The strength reduction factors should be checked when this information is available. Piles should be installed by experienced operators, using suitably sized piling rigs, monitoring equipment and supervision.

9.7.2 Pile Design Parameters

Item 2 – New Piles Under Existing Structure and Areas of New Development

Green Zone
The head room in the "Green Zone" appears to vary from about 3.5 m to over 6 m, with access restrictions of about 2.2 m at the entrances. As discussed in Section 9.6, small piling rigs are likely to be required in this area which have a limited depth reach.

Based on the results of the CPT data, an in-house pile analysis programme, "ConePile" has been used to estimate pile capacities for continuous flight auger piles (CFA). The analysis is based on the assumption that all piles will be located at least 2.5 centres from each other and from any existing piles, to avoid group effects. If more closely spaced piles are required, consideration should be given to such group effects.

The estimated ultimate geotechnical strength ($R_{d,ug}$) and design geotechnical strength ($R_{d,g}$) for a range of pile diameters and depths at each CPT location are presented in Table 12 below. Pile Capacity Estimate Charts are also provided in Appendix C.

Table 12: Estimated Pile Capacities for CFA Piles supported in the soil profile

CPT	Depth to Toe of Pile (mBGL)	Pile Diameter (m)	Estimated Compressive Capacity (kN)		
			Ultimate Geotechnical Strength ($R_{d,ug}$)	Design Geotechnical Strength ($R_{d,g}$)	Serviceability Geotechnical Strength
101	11	0.75	1200	750	Not calculated
		0.9	1550	1000	1400
		1.05	2050	1300	1800
102	14	0.75	1330	830	Not calculated
		0.9	1700	1050	1500
		1.05	2100	1300	1900
104	9	0.75	1200	700	Not calculated
		0.9	1350	850	1200
		1.05	1750	1100	1600
105	14	0.75	1750	1090	Not calculated
		0.9	2100	1300	1800
		1.05	2500	1550	2100

Notes to Table 12:
mBGL – metres below ground level

For calculation of serviceability geotechnical strength, an elastic axisymmetric Plaxis analysis was undertaken using the parameters estimated from the CPT and the assumption of 32MPa concrete. The serviceability strengths are based on limiting pile deflections to about 2% of the pile diameter. It is recommended that predicted deflection under load is checked by settlement analyses and compared to serviceability deflection limits. The serviceability geotechnical strength for the 750 mm diameter piles have not been calculated but are anticipated to be at least 120% of the design geotechnical strength.

It is noted that bedrock was encountered in Bores 101 and 104 at depths of 14.1 m and 11.05 m respectively. Depending on the capabilities of the piling equipment used, the construction of piles founded within the bedrock may be possible in these areas. The design of such end bearing piles in rock should be undertaken using the parameters presented in Table 15.

It is noted, however, that in the event that piles are to be designed for end-bearing in rock, the presence of rock at each pile location should be confirmed via additional investigation.

Piles should be installed by experienced operators, using suitably sized piling rigs, monitoring equipment and supervision.

It is noted that the existing structure is supported on Franki piles. Review of the piling records during installation of these piles is discussed in Section 5. The depth of installed piles in the vicinity of the current investigation locations were compared with the conditions inferred in the CPTs in Table 13 below.

Table 13: Inferred Conditions at Existing Pile Toe Levels

CPT	Reported Depth to Toe of Existing Pile (mBGL)	Conditions Inferred/Encountered at Pile Toe Level
101	11.5 – 12.5	Very stiff to hard CLAY
102	6.5	Very stiff SILTY CLAY with some medium dense sand layers
104	6.5	Very stiff to hard SILTY CLAY
105	6.5	Very stiff to hard SILTY CLAY
106	6.0 – 6.5	Very stiff to hard SILTY CLAY
107	11.5 – 12.5	Extremely low strength CONGLOMERATE
108	9.5 – 10.0	Very stiff GRAVELLY CLAY

The estimated ultimate geotechnical strength (Rd,ug) and design geotechnical strength (Rd.g) for a 0.5 m diameter Franki Pile with enlarged base diameters calculated from the reported base volumes in the Franki-pile drilling records (summarised in Table C1 of Appendix C) and the reported pile toe depth outlined in Table 13 above at each CPT location is presented in Table 14 below.

Table 14: Estimated Pile Capacities for Frankipiles supported in the soil profile

CPT	Depth to Toe of Pile (mBGL)	Pile Diameter(1) (m)	Enlarged Bulb Diameter (m)	Estimated Compressive Design Geotechnical Strength ($R_{d.g}$) (kN)
101	11	0.5	1.0	1200 – 1600
102	6.5	0.5	0.96	1000 – 1300
104	6.5	0.5	0.96	1500 – 1900
105	6.5	0.5	0.96	900 – 1000

Notes to Table 14:
mBGL – metres below ground level
(1) - Shaft diameter taken as tube diameter owing to wet construction

Red Zone

The structural loads within the "Red Zone" could be supported on cased bored piles formed under a bentonite slurry, or continuous flight auger (CFA) piles, with the piles founded in bedrock. The design of the piles should be based on the parameters presented in Table 15 below.

Table 15: Pile Design Parameters in Rock

Unit	Description	Ultimate Strength ($R_{d,ug}$)*		Serviceability/Max Allowable End - Bearing (kPa)	Elastic Modulus (E_{field}) (MPa)
		Design End - Bearing (kPa)	Design Shaft Adhesion (kPa)		
3.1	Siltstone	2000	50	700	50
3.2	Sandstone	4000	250	1500	100
3.3	Conglomerate / Sandstone	8000	700	2500	350
3.4	Sandstone / Siltstone	2500	100	1000	75

Notes to Table 15:

Ultimate Values occur at large settlements (> 5% of minimum footing diameter).

Shaft adhesion values based on a shaft roughness of R2 or better.

Serviceability / Max Allowable end bearing to cause settlement of < 1% of minimum footing dimension or pile diameter.

AS 2159 – 2009 requires that the contribution of the shaft from finished surface to 1.5 times pile diameter or 1 m (whichever is greater) shall be ignored.

For piles in tension, the shaft adhesion parameters should be reduced to 75% of the values in Table 15.

For vertical loading, it is suggested that piles should be spaced at 2.5 pile diameters or greater such that the overall capacity of the pile group can be equivalent to the sum of the individual piles (i.e. group efficiency factor of unity).

It should be noted that the parameters given in Table 15 are for clean rock sockets (with an R2 roughness rating) and bases. Specific cleaning buckets and grooving tools should be used in pile construction, together with suitable inspection or verification methods.

Item 3 – Proposed IMM02 Tenancy Shear Walls and Hoist Base

For vertical loading, it is suggested that piles should be spaced at 2.5 pile diameters or greater such that the overall capacity of the pile group can be equivalent to the sum of the individual piles (i.e. group efficiency factor of unity). It is understood, however, that a pile spacing of 2 pile diameters may apply for the proposed pile arrangement. With this spacing it is recommended that the capacity of each pile in the group is reduced to 75% of the design geotechnical strength of the pile.

For calculation of serviceability geotechnical strength, the capacity can be calculated using the serviceability end bearing values and ultimate shaft adhesion values within the rock units. In the serviceability case, these values do not need to be factored. It is recommended that deflection under load is checked and compared to serviceability deflection limits.

Table 16, below presents that estimated pile capacities for a 750mm diameter bored pile, founded at 12 m depth within low strength bedrock. It is noted that this is based on the presence of low strength bedrock at depths greater than the depth of drilling during the present investigation. There is a risk that higher strength bedrock, which may restrict piling equipment penetration may be present below the investigation depths.

Table 16: Estimated Pile Capacities for 0.75 m diameter pile founded in low strength rock (using g = ϕ_g = 0.55)

Pile Diameter (m)	Depth to Toe of Pile(m)	Design Geotechnical Strength ($R_{d.g}$)*		Serviceability Strength (kN)
		Design Geotechnical Strength (Compressive) (kN)	Design Geotechnical Strength (Uplift) (kN)	
0.75	12	2460	1190	3680

It is noted that these capacities are based on embedment of the pile within low strength or stronger bedrock. It is important that the presence of such foundation conditions is confirmed at each pile location. This will require inspection of all pile excavations by a geotechnical engineer together with additional drilling investigation in the exact locations of the piles once access is made available.

It is understood that a maximum horizontal load of 240 kN will be applied to the head of the piles, based on the short term earthquake loading. A laterally loaded piling program, “Pygmy” was used to analyse a 0.75 m diameter pile founded at 12 m depth in low strength bedrock. Based on the analysis the estimated deflection at the head of the pile for a free head condition was in the order of 9 mm under the design ultimate lateral loading (corresponding with ultimate vertical loading case) and 22 mm under the design ultimate earthquake loading case. Depending on the fixity of the head, a lower displacement may be applicable. Graphical results of deflection, rotation, shear force and bending moment along the pile are attached in Plates C1, C2, C3 and C4 in Appendix C.

9.7.3 Pile Testing and Geotechnical Inspections

Section 8 of AS2159 – 2009 (Ref 4) outlines the pile load testing requirements. Clause 8.2.4 of AS2159 states that where the basic geotechnical strength reduction factor is greater than 0.4 m, testing shall be performed to verify the integrity of pile shafts. Assessment of pile shaft integrity may be by high-strain dynamic pile testing or other methods of integrity testing. Seismic integrity testing may be suitable in this instance. It is recommended that a percentage of piles are tested as outlined in AS2159 (Ref 4).

It is also recommended that comprehensive inspections and monitoring be undertaken during the installation of piles, including but not necessarily limited to geotechnical inspection during installation to record the depth of pile, the conditions encountered at the toe of the pile and review of any pile installation data acquired during drilling.

9.8 Lift Well

9.8.1 Excavation and Support

It is understood that excavation to the base of the proposed lift well will be approximately 1.6 m below existing surface levels.

Based on the conditions encountered in Bore 201, excavation conditions are likely to include predominantly sandy gravel or clayey sandy gravel to about 1.6 m depth underlain by sandy clay. These materials should be readily removed by conventional earthmoving equipment assuming groundwater inflows are satisfactorily controlled and adequate lateral support is provided. In this regard, some moisture was encountered at the base of the filling during drilling. It is noted, however, that free groundwater was measured at 4 m depth at the completion of the drilling and hence the moisture encountered at the base of the filling may be as a result of seepage accumulating above the less permeable clay soils and not the permanent groundwater table.

Given the proximity of existing services and structural columns, sufficient room may not be available for the requisite safe batters and hence positive lateral support may be required for the excavation.

Planning of excavation methodology and design of lateral support should be undertaken with consideration to the highest possible water table. Although groundwater was measured in Bore 201 at 4 m depth, groundwater measurements during the drilling process in cohesive soils can be inaccurate by several metres, due to low soil permeability. It is therefore suggested that design should take into account a possible groundwater level of about 2 m depth unless further long term groundwater monitoring proves otherwise. Furthermore, the possible infiltration of surface water into the annulus around the lift pit should be considered unless sufficient measures are provided to avoid such infiltration.

Conventional shoring boxes may be suitable for support of the excavation provided they are capable of withstanding the resulting lateral loads associated with the retained soils of this depth. The excavation support systems should be specifically designed to withstand additional lateral loads applied, such as construction traffic and any other surcharge loads, such as that imposed by footings supporting the nearby columns which are within the zone of influence of the excavation. The zone of influence is defined as a plane extending from the base of the excavation at 33° above the horizontal. It is recommended that further assessment of the footing depths of adjacent columns is undertaken.

Notwithstanding the above comments on excavation stability, the contractor should comply with all statutory requirements for excavation support and worker safety in below ground level construction.

To assist with design of excavation support for the lift well, any non-propped or laterally unrestrained walls away from existing structures/services may be designed based upon “active” (K_a) lateral earth pressure coefficients. Under these circumstances movements of the order of 0.01 to 0.02 times the overall wall height can be tolerated with the soil “relaxing” from an “at rest” to “active” condition. Where lateral movements are to be minimised or the excavation support is relatively unyielding, design should be based on “at-rest” (K_o) earth pressure coefficients.

Recommended lateral earth pressure design parameters are as follows:

- Bulk density (above water table) 18 kN/m^3
- Submerged density (below water table) 8 kN/m^3
- Active earth pressure coefficient (K_a) 0.35
- At-rest earth pressure coefficient (K_o) 0.5

These earth pressure coefficients are for well drained level backfill. Separate account should be taken account in the design of any additional surcharge loads, during or after construction.

If appropriate drainage cannot be provided the lift well and excavation support should be designed for full hydrostatic pressure.

For passive restraint of any temporary excavation support that extends below the base of the excavation should be designed for an allowable passive earth pressures of 200 kPa in the very stiff or stronger sandy clay anticipated below excavation level.

9.8.2 Foundations

It is understood that the lift well will not support any structural members other than its own self weight. Spread footings for the support of the well should be founded within the very stiff or stronger sandy clay as encountered in Bore 201 at 1.7 m depth and designed for a maximum allowable bearing pressure of 200 kPa.

9.9 Earthquake Classification (Seismic Site Sub-Soil Class)

Using the results of the geotechnical investigation and the procedures described in AS1170.4 – 2007 (Ref 5) an earthquake hazard factor of 0.11 was estimated for the site. Ref 5 indicates a site sub-soil Class C_e (shallow soil site) for earthquake design.

9.10 Off Site Disposal of Excavated Material

In accordance with NSW EPA guidelines, all material that will be removed from site should be subjected to a Waste Classification Assessment or appropriate chemical assessment for it potential for off site reuse as either Virgin Excavated Natural Material or Excavated Natural Material.

10. Recommended Additional Investigation

The following additional investigation is recommended during the design phase, prior to and during construction:

- Subsurface investigation in the specific location of the shear walls for Item 3 (IMM02 Tenancy) once this is known and access is available. The investigation should be aimed at proving the depth to bedrock and that the strength of the bedrock is similar to, or stronger than, assumed in Section 9.7.1;

- Given the variability of bedrock levels and strength encountered in the investigation, if piles are to be founded in bedrock for the support of the new loads in the Green Zone, further investigation should be undertaken to confirm the depth and strength of bedrock at a closer spacing throughout this area;
- Detailed survey of the areas of development, including overhead structures (head height) should be undertaken and made available to prospective contractors to ensure that suitable equipment is made available, which is capable of working within the access restrictions and able to penetrate to the design foundation strata. In this regard, it is recommended that the contractors are shown the development areas by a representative of Westfields during the tender process;
- Geotechnical inspections should be undertaken during piling operations (Items 2 to 4) and also excavation work (particularly for Item 1) to ensure that the foundation strata is being reached and that conditions exposed within the excavation are appropriately assessed and stabilised if necessary. The inspections should include but not necessarily be limited to geotechnical inspections during installation to record the depth of pile, the conditions encountered at the toe of the pile and review of any pile installation data acquired during drilling;
- Pile shaft integrity testing, such as seismic integrity testing, should be undertaken to a suitable percentage of piles as outlined in AS2159 (Ref 4).
- All material to be removed from site should be classified in accordance with the NSW Waste Classification Guidelines (Ref 6) prior to disposal to an appropriately licensed landfill or alternatively assessed for beneficial reuse against the appropriate resource recovery order (e.g. Ref 7).

11. References

1. Douglas Partners Pty Ltd, “Report on Geotechnical Investigation, Stage 4 Redevelopment IMM02 Tenancy, Northcott Drive, Kotara”, Project 71995.07, dated 24 May 2016.
2. Douglas Partners Pty Ltd, “Report on Geotechnical Assessment of Existing Foundations, Proposed Building Upgrade, Northcott Drive, Kotara”, prepared for Westfield Ltd, Project 71995.02 dated September 2010.
3. Douglas Partners Pty Ltd, “Report on Geotechnical Assessment of Existing Foundations, Proposed Building Upgrade, Northcott Drive, Kotara”, prepared for Westfield Ltd, Project 71995-2 dated December 2010.
4. Australian Standard AS2159-2009, "Piling - Design and Installation".
5. Australian Standards AS 1170.4-2007, Structural design actions, Part 4: Earthquake actions in Australia, October 2007, Standards Australia
6. NSW EPA, “Waste Classification Guidelines – Part 1: Classifying Waste, November 2014”.
7. NSW EPA, “Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014, The Excavated Natural Material Order 2014”, November 2014.

12. Limitations

Douglas Partners (DP) has prepared this report (or services) for this project at Westfield Kotara Shopping Centre in accordance with DP's proposals NCL160257 dated 6 April 2016 and NCL160182(Rev2) dated 31 March 2016 and acceptance received from Justin Cunningham of Scentre Design Group dated 15 April 2016. The work was carried out under a Consultant Service Contract (No 10707). This report is provided for the exclusive use of Scentre Design Group for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life. This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to

DP. Any such risk assessment would, however, be necessarily restricted to the (geotechnical / environmental / groundwater) components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About this Report
Sampling Methods
Soil Descriptions
Rock Descriptions
Symbols and Abbreviations
Cone Penetration Testing

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Soil Descriptions

Douglas Partners

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Rock Strength

Rock strength is defined by the Point Load Strength Index ($Is_{(50)}$) and refers to the strength of the rock substance and not the strength of the overall rock mass, which may be considerably weaker due to defects. The test procedure is described by Australian Standard 4133.4.1 - 1993. The terms used to describe rock strength are as follows:

Term	Abbreviation	Point Load Index $Is_{(50)}$ MPa	Approx Unconfined Compressive Strength MPa*
Extremely low	EL	<0.03	<0.6
Very low	VL	0.03 - 0.1	0.6 - 2
Low	L	0.1 - 0.3	2 - 6
Medium	M	0.3 - 1.0	6 - 20
High	H	1 - 3	20 - 60
Very high	VH	3 - 10	60 - 200
Extremely high	EH	>10	>200

* Assumes a ratio of 20:1 for UCS to $Is_{(50)}$

Degree of Weathering

The degree of weathering of rock is classified as follows:

Term	Abbreviation	Description
Extremely weathered	EW	Rock substance has soil properties, i.e. it can be remoulded and classified as a soil but the texture of the original rock is still evident.
Highly weathered	HW	Limonite staining or bleaching affects whole of rock substance and other signs of decomposition are evident. Porosity and strength may be altered as a result of iron leaching or deposition. Colour and strength of original fresh rock is not recognisable
Moderately weathered	MW	Staining and discolouration of rock substance has taken place
Slightly weathered	SW	Rock substance is slightly discoloured but shows little or no change of strength from fresh rock
Fresh stained	Fs	Rock substance unaffected by weathering but staining visible along defects
Fresh	Fr	No signs of decomposition or staining

Degree of Fracturing

The following classification applies to the spacing of natural fractures in diamond drill cores. It includes bedding plane partings, joints and other defects, but excludes drilling breaks.

Term	Description
Fragmented	Fragments of <20 mm
Highly Fractured	Core lengths of 20-40 mm with some fragments
Fractured	Core lengths of 40-200 mm with some shorter and longer sections
Slightly Fractured	Core lengths of 200-1000 mm with some shorter and loner sections
Unbroken	Core lengths mostly > 1000 mm

Rock Descriptions

Rock Quality Designation

The quality of the cored rock can be measured using the Rock Quality Designation (RQD) index, defined as:

$$\text{RQD \%} = \frac{\text{cumulative length of 'sound' core sections} \geq \text{100 mm long}}{\text{total drilled length of section being assessed}}$$

where 'sound' rock is assessed to be rock of low strength or better. The RQD applies only to natural fractures. If the core is broken by drilling or handling (i.e. drilling breaks) then the broken pieces are fitted back together and are not included in the calculation of RQD.

Stratification Spacing

For sedimentary rocks the following terms may be used to describe the spacing of bedding partings:

Term	Separation of Stratification Planes
Thinly laminated	< 6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	> 2 m

Symbols & Abbreviations

Douglas Partners

Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

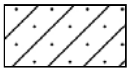
Soils


Topsoil

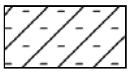

Peat


Clay

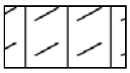

Silty clay

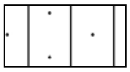

Sandy clay

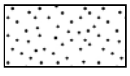

Gravelly clay

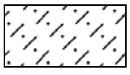

Shaly clay

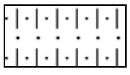

Silt


Clayey silt


Sandy silt

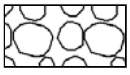

Sand

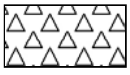

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

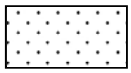

Talus

Sedimentary Rocks

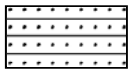

Boulder conglomerate

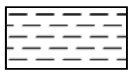

Conglomerate


Conglomeratic sandstone

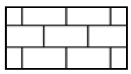

Sandstone


Siltstone


Laminite

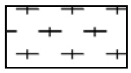

Mudstone, claystone, shale

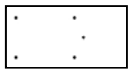

Coal


Limestone

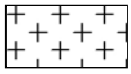
Metamorphic Rocks

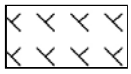

Slate, phyllite, schist

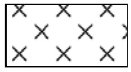

Gneiss

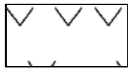

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Cone Penetration Tests

Douglas Partners

Introduction

The Cone Penetration Test (CPT) is a sophisticated soil profiling test carried out in-situ. A special cone shaped probe is used which is connected to a digital data acquisition system. The cone and adjoining sleeve section contain a series of strain gauges and other transducers which continuously monitor and record various soil parameters as the cone penetrates the soils.

The soil parameters measured depend on the type of cone being used, however they always include the following basic measurements

- Cone tip resistance q_c
- Sleeve friction f_s
- Inclination (from vertical) i
- Depth below ground z

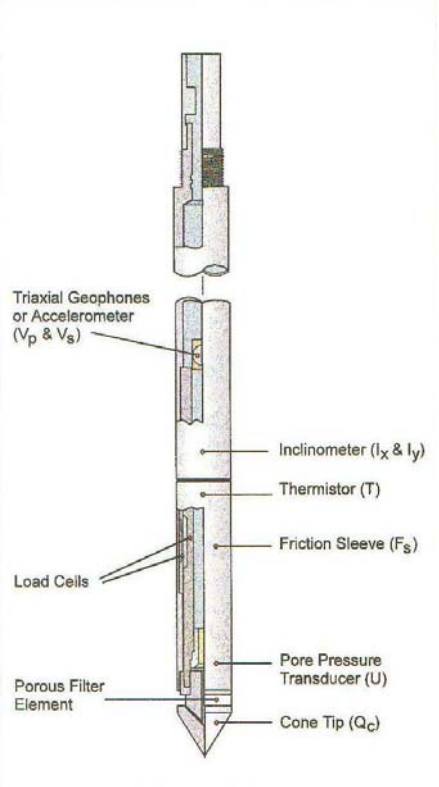


Figure 1: Cone Diagram

The inclinometer in the cone enables the verticality of the test to be confirmed and, if required, the vertical depth can be corrected.

The cone is thrust into the ground at a steady rate of about 20 mm/sec, usually using the hydraulic rams of a purpose built CPT rig, or a drilling rig. The testing is carried out in accordance with the Australian Standard AS1289 Test 6.5.1.

Figure 2: Purpose built CPT rig

The CPT can penetrate most soil types and is particularly suited to alluvial soils, being able to detect fine layering and strength variations. With sufficient thrust the cone can often penetrate a short distance into weathered rock. The cone will usually reach refusal in coarse filling, medium to coarse gravel and on very low strength or better rock. Tests have been successfully completed to more than 60 m.

Types of CPTs

Douglas Partners (and its subsidiary GroundTest) owns and operates the following types of CPT cones:

Type	Measures
Standard	Basic parameters (q_c, f_s, i & z)
Piezocone	Dynamic pore pressure (u) plus basic parameters. Dissipation tests estimate consolidation parameters
Conductivity	Bulk soil electrical conductivity (σ) plus basic parameters
Seismic	Shear wave velocity (V_s), compression wave velocity (V_p), plus basic parameters

Strata Interpretation

The CPT parameters can be used to infer the Soil Behaviour Type (SBT), based on normalised values of cone resistance (Qt) and friction ratio (Fr). These are used in conjunction with soil classification charts, such as the one below (after Robertson 1990)

Cone Penetration Tests

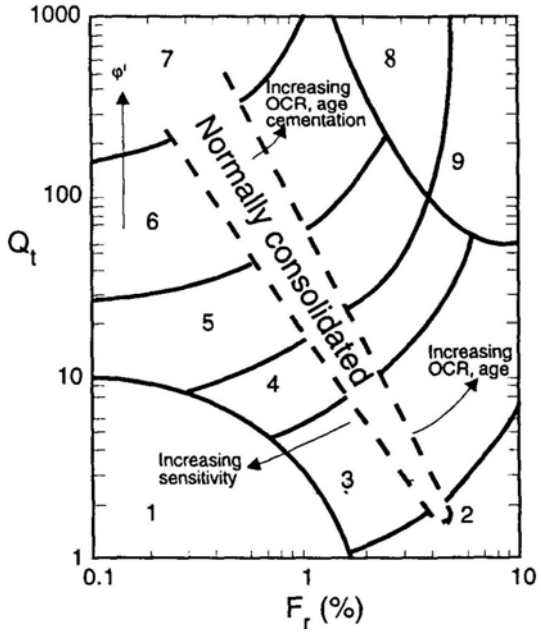


Figure 3: Soil Classification Chart

DP's in-house CPT software provides computer aided interpretation of soil strata, generating soil descriptions and strengths for each layer. The software can also produce plots of estimated soil parameters, including modulus, friction angle, relative density, shear strength and over consolidation ratio.

DP's CPT software helps our engineers quickly evaluate the critical soil layers and then focus on developing practical solutions for the client's project.

Engineering Applications

There are many uses for CPT data. The main applications are briefly introduced below:

Settlement

CPT provides a continuous profile of soil type and strength, providing an excellent basis for settlement analysis. Soil compressibility can be estimated from cone derived moduli, or known consolidation parameters for the critical layers (eg. from laboratory testing). Further, if pore pressure dissipation tests are undertaken using a piezocone, in-situ consolidation coefficients can be estimated to aid analysis.

Pile Capacity

The cone is, in effect, a small scale pile and, therefore, ideal for direct estimation of pile capacity. DP's in-house program ConePile can analyse most pile types and produces pile capacity versus depth plots. The analysis methods are based on proven static theory and empirical studies, taking account of scale effects, pile materials and method of installation. The results are expressed in limit state format, consistent with the Piling Code AS2159.

Dynamic or Earthquake Analysis

CPT and, in particular, Seismic CPT are suitable for dynamic foundation studies and earthquake response analyses, by profiling the low strain shear modulus G_0. Techniques have also been developed relating CPT results to the risk of soil liquefaction.

Other Applications

Other applications of CPT include ground improvement monitoring (testing before and after works), salinity and contaminant plume mapping (conductivity cone), preloading studies and verification of strength gain.

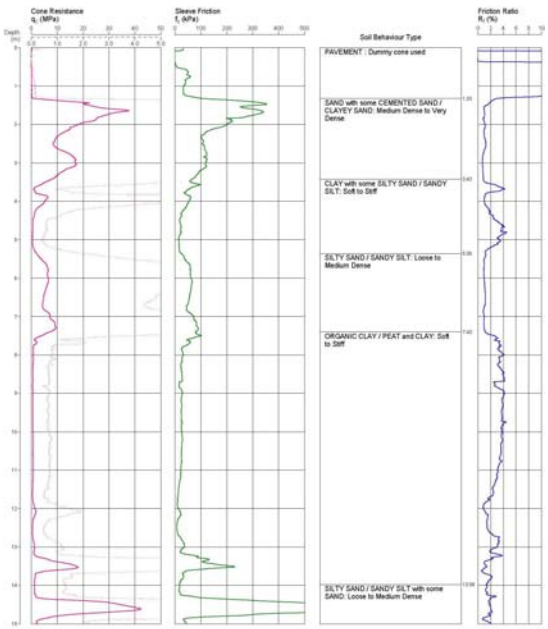


Figure 4: Sample Cone Plot

Appendix B

Borehole Logs 101, 102, 104, 106 to 108, 201, 301, 302, 401, 403, 404 and 405, 602 to 605
CPTs 101 to 105
Photo Plates 1 to 6
Test Pit Logs 402/1, 402/2, 402/3
Photo Plates 7 to 9
Borehole Logs 101 and 102 (Previous Investigation)

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 23.3m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 71995.07
DATE: 6/5/2016
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	11	For description of upper material see CPT 101										
	12											
	13											
	14	SILTSTONE - Extremely low strength, extremely weathered, grey siltstone							C	100	0	

RIG: 4WD Scout **DRILLER:** Tightsite **LOGGED:** Goodall **CASING:** HQ to 14.1m

TYPE OF BORING: NMLC from 14.1m

WATER OBSERVATIONS: No free groundwater observed whilst auger drilling

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 23.3m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 71995.07
DATE: 6/5/2016
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SILTSTONE - Extremely low strength, extremely weathered, grey siltstone *(continued)*							C	100	0	
	15.48	CONGLOMERATE - Extremely low strength, highly weathered, grey conglomerate with subangular to subrounded pebbles up to 5mm in size						15.48m: J, 50°, pl, ro				
	15.69	CORE LOSS - 0.31m						15.69m: CORE LOSS: 310mm				
	16 16.0	CONGLOMERATE - Extremely low strength, highly weathered, grey conglomerate with subangular to subrounded pebbles up to 20mm in size						16.72m: J, 10°, pl, ro, fe	C	73	0	
	16.87	SILTSTONE - Extremely low to low strength, moderately weathered, grey siltstone						16.9m: J, 70°, pl, ro, fe 16.93m: P, ro, fe	C	100	68	PL(D) = 0.03
	17	From 17.28m, low strength						17.08m: P, ro, 10mm clay infill 17.17m: P, pl, ro, 10mm clay infill From 17.21m to 17.25, fg 17.27m: P, pl, ro, 10mm clay infill				PL(A) = 0.22 PL(A) = 0.14 PL(A) = 0.01 PL(D) = 0.08
	17.5	SANDSTONE - Very low to low strength, moderately weathered, grey fine grained sandstone										
	17.64	SILTSTONE - Extremely low to low strength, slightly weathered, grey siltstone						17.74m: J, 80°, pl, ro, fe 17.76m: P, pl, ro, 3mm clay infill 17.93m: J, 50°, pl, ro, fe	C	100	98	
	18	From 17.83m, moderately weathered From 18.21m, slightly weathered						18.46m: J, 50°, pl, ro, fe 18.53m: J, 50°, pl, ro	C	100	99	PL(A) = 0.11 PL(D) = 0.09
		From 18.63m, very low to low strength						18.79m: J, 60°, pl, ro				
	19											PL(A) = 0.07 PL(D) = 0.09
	19.46	From 19.36m, low strength CORE LOSS - 0.74m						19.27m: J, 70°, pl, sm 19.46m: CORE LOSS: 1100mm	C	67	100	PL(A) = 0.11 PL(D) = 0.25

RIG: 4WD Scout **DRILLER:** Tightsite **LOGGED:** Goodall **CASING:** HQ to 14.1m

TYPE OF BORING: NMLC from 14.1m

WATER OBSERVATIONS: No free groundwater observed whilst auger drilling

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 23.3m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 71995.07
DATE: 6/5/2016
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		CORE LOSS - 0.74m *(continued)*							C	67	100	
	20.56	Bore discontinued at 20.56m , limit of investigation										
	21											
	22											
	23											
	24											

RIG: 4WD Scout **DRILLER:** Tightsite **LOGGED:** Goodall **CASING:** HQ to 14.1m

TYPE OF BORING: NMLC from 14.1m

WATER OBSERVATIONS: No free groundwater observed whilst auger drilling

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: SCENTRE GROUP LTD

PROJECT: KOTARA SHOPPING CENTRE - STAGE 4 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

REDUCED LEVEL: 23.3m AHD*

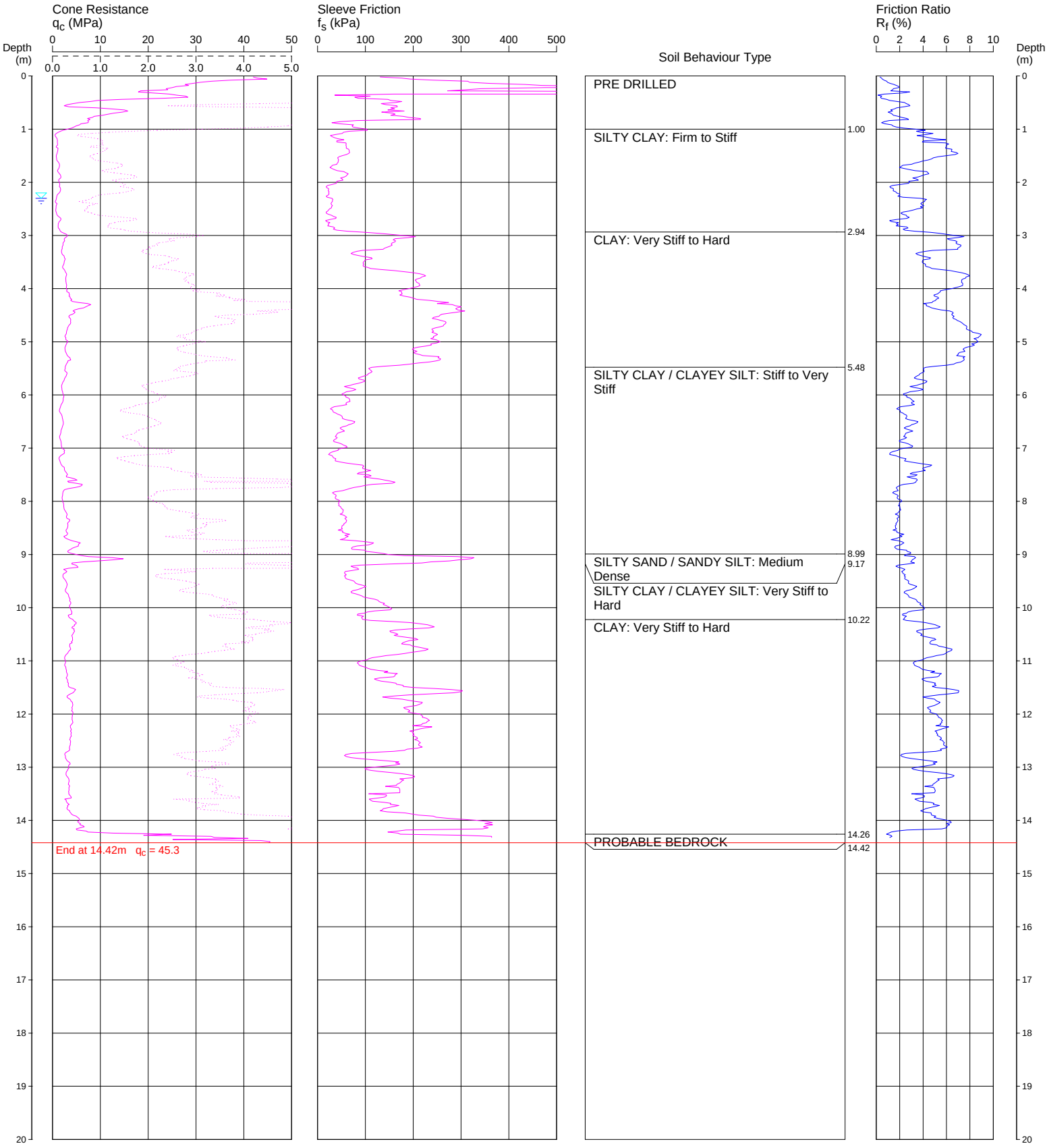
COORDINATES:

CPT101

Page 1 of 1

DATE 18/4/2016

PROJECT No: 71995.07



REMARKS: TEST DISCONTINUED DUE TO LIMIT OF THRUST. TEST LOCATION PARTIALLY PRE-DRILLED TO 1m DEPTH PRIOR TO TESTING.
GROUNDWATER MEASURED AT 2.3m DEPTH AFTER WITHDRAWAL OF RODS.
*SURFACE LEVEL INTERPOLATED FROM SURVEY PLAN PROVIDED BY CLIENT

Water depth after test: 2.30m depth (measured)

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT101.CP5

Cone ID: 120618 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

BORE 101 PROJECT 71995.07 21.04.2016

14.1 m – 20.56 m

DOUGLAS PARTNERS PTY LTD

BORE 102 PROJECT 71995.07 21.04.2016

18.6 m – 24.1 m

Douglas Partners Geotechnics / Environment / Groundwater	**Core Photoplate** **Westfield Kotara Stage 4** **Northcott Drive, Kotara**	PROJECT: 71995.07 PLATE No: 1 REV: 0
	CLIENT: Scentre Group Ltd	DATE: 18.05.16

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 24.0m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 71995.07
DATE: 3/5/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	16	For description of upper material see CPT 102										
	17											
	18											
	19	CORE LOSS - 0.4m						18.6m: CORE LOSS: 400mm				
	19.0	GRAVEL - (Dense to very dense) grey brown gravel, subangular to subrounded gravel up to 60mm in size										
	19.49											
	19.52	CLAYEY GRAVEL - Stiff, brown clayey gravel, subangular to subrounded gravel up to 15mm in size, wet, (possibly completely weathered conglomerate)										pp = 150-200
	19.6							19.6m: CORE LOSS: 270mm				
	19.87	SANDY CLAY - Stiff to very stiff,										pp = 50-150
	20.0											

RIG: 4WD Scout **DRILLER:** Tightsite **LOGGED:** Goodall **CASING:** HQ to 20.0m, changed to 20m 3/5/16

TYPE OF BORING: NMLC from 18.6m

WATER OBSERVATIONS: No free groundwater observed whilst auger drilling

REMARKS: *Surface levels assumed

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 24.0m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 71995.07
DATE: 3/5/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
		brown sandy clay, fine grained sand, some silt, M≥Wp						20m: CORE LOSS: 750mm	C	63	0	
		CORE LOSS - 0.27m										
		SANDY CLAY - Firm to stiff, brown sandy clay, fine to coarse grained sand, some silt, M≥Wp										
		CORE LOSS - 0.75m										
	20.75											
	20.8	SILTSTONE - (Very low strength), highly weathered, grey with orange/brown staining siltstone, with extremely low strength clay seams						20.77m: J, 45°, pl, ro, 10mm gravelly clay infill				
	21							20.8m: CORE LOSS: 1200mm	C	0	0	
		CORE LOSS - 1.2m										
	22	22.0										
		CORE LOSS - 0.52m						22m: CORE LOSS: 520mm	C	12	0	
	22.52											
	22.59	SANDSTONE - Low strength, highly weathered, grey fine grained sandstone						22.52m: J, 40°, pl, ro, fe				
	22.63							22.59m: J, 70°, pl, ro	C	100	0	
	22.7							22.63m: P, ir				
		SILTSTONE - Extremely low strength, highly weathered, orange siltstone						22.7m: CORE LOSS: 220mm	C	41	0	
	22.92											
	23	23.0						22.93m: J, 85°, pl, ro				
		CONGLOMERATE - Extremely low strength, highly weathered, orange grey conglomerate, with subangular/subrounded pebbles up to 40mm in size							C	92	0	PL(A) = 0.03 PL(D) = 0.01
		CORE LOSS - 0.22m										
	23.45							23.38m: J, 5°, pl, ro, fe				
	23.5	SANDSTONE - Very low strength, highly weathered, grey, fine grained sandstone						23.39m: J, 90°, pl, ro, fe				
		SILTSTONE - Extremely to low strength, highly weathered, grey siltstone						23.45m: CORE LOSS: 50mm				
								From 23.50m to 23.60m, fg				
	23.9							23.62m: J, 5°, pl, ro, fe	C	67	0	
		CORE LOSS - 0.05m						23.65m: J, 5°, pl, ro, fe				
	24							23.67m: J, 50°, pl, ro, fe				
	24.1	SILTSTONE - Extremely low strength, extremely weathered, grey siltstone						From 23.80m to 23.90m, fg				
		CORE LOSS - 0.2m						23.9m: CORE LOSS: 200mm				
		Bore discontinued at 24.1m , limit of investigation										

RIG: 4WD Scout **DRILLER:** Tightsite **LOGGED:** Goodall **CASING:** HQ to 20.0m, changed to 20m 3/5/16

TYPE OF BORING: NMLC from 18.6m

WATER OBSERVATIONS: No free groundwater observed whilst auger drilling

REMARKS: *Surface levels assumed

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: SCENTRE GROUP LTD

PROJECT: KOTARA SHOPPING CENTRE - STAGE 4 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

REDUCED LEVEL: 24.0 m AHD*

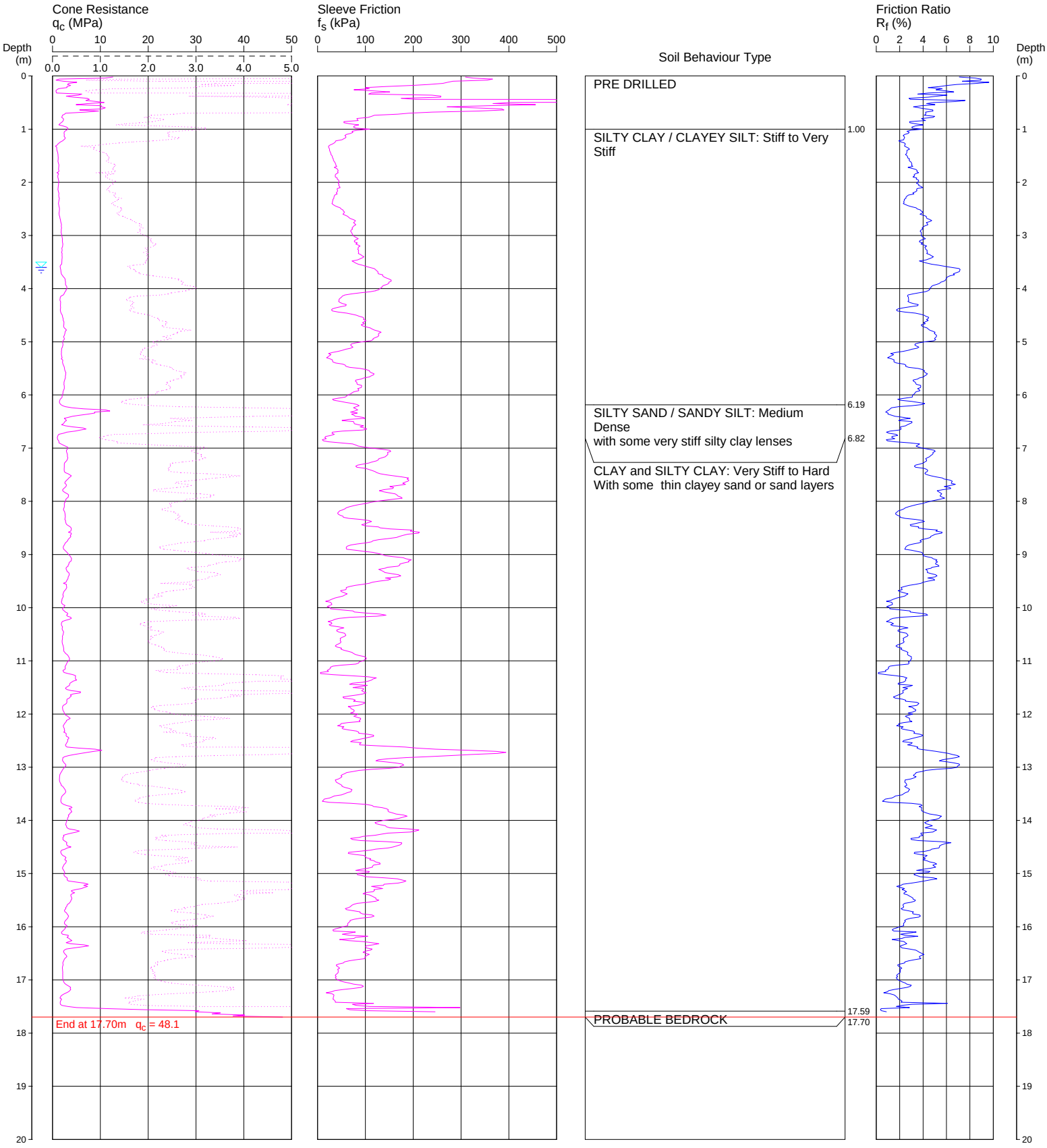
COORDINATES:

CPT102

Page 1 of 1

DATE 21/4/2016

PROJECT No: 71995.07



REMARKS: TEST DISCONTINUED DUE TO LIMIT OF THRUST. TEST LOCATION PARTIALLY PRE-DRILLED TO 1m DEPTH PRIOR TO TESTING.
GROUNDWATER MEASURED AT 3.6m DEPTH AFTER WITHDRAWAL OF RODS.
* SURFACE LEVEL INTERPOLATED FROM SURVEY PLAN PROVIDED BY CLIENT

Water depth after test: 3.60m depth (measured)

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT102.CP5

Cone ID: 120618 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: SCENTRE GROUP LTD

PROJECT: KOTARA SHOPPING CENTRE - STAGE 4 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

REDUCED LEVEL: 23.5 m AHD*

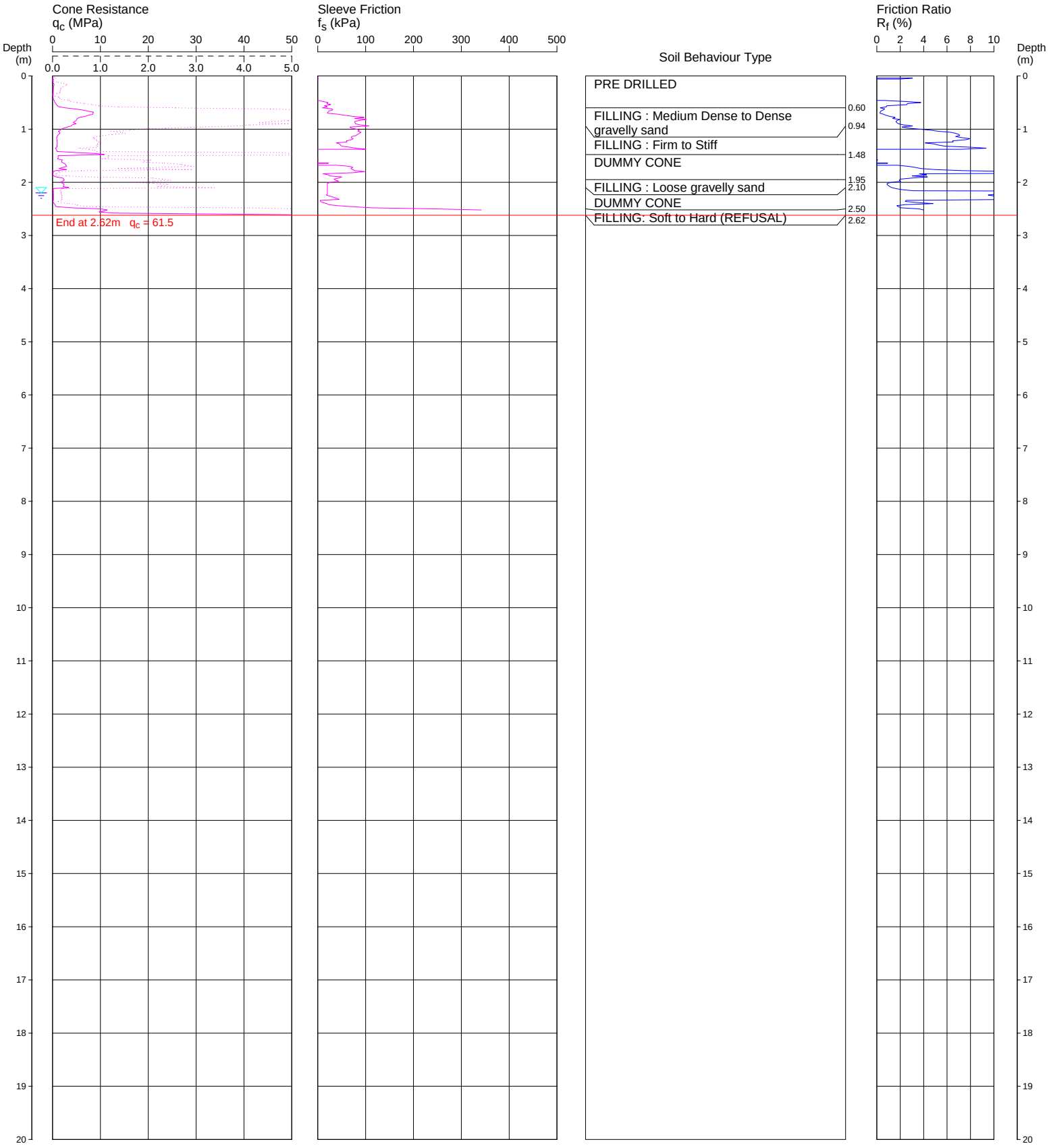
COORDINATES:

CPT103

Page 1 of 1

DATE 22/4/2016

PROJECT No: 71995.07



REMARKS: TEST DISCONTINUED DUE TO SUDDEN BENDING. CONCRETE SLAB DIACORED TO 0.1m DEPTH AND TEST LOCATION PRE-DRILLED TO 0.6m DEPTH PRIOR TO TESTING. DUMMY CONE UTILISED FROM 1.48m TO 1.95m DEPTH AND FROM 2.1m TO 2.5m DEPTH DUE TO BENDING. GROUNDWATER MEASURED AT 2.2m DEPTH AFTER WITHDRAWAL OF RODS. *SURFACE LEVEL INTERPOLATED FROM SURVEY PLAN PROVIDED BY CLIENT

Water depth after test: 2.20m depth (measured)

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT103.CP5

Cone ID: 120618 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 24.0m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 71995.07
DATE: 4/5/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		For description of upper material see CPT 104										
	11											
	11.045	CORE LOSS - 0.045m						11m: CORE LOSS: 45mm				
		CONGLOMERATE - Extremely low to low strength, highly weathered, orange grey conglomerate with subangular to subrounded pebbles up to10mm in size						11.2m: P, pl, ro, 10mm sandy clay infill				PL(A) = 0.01 PL(D) = 0.02
									C	96	91	PL(A) = 0.05
		From 11.84m, low strength										PL(A) = 0.24 PL(D) = 0.12
	12											
	12.11	SANDSTONE - Extremely low strength, extremely weathered, orange fine to medium grained sandstone (soil-like properties)							C	63	0	
	12.25							12.25m: CORE LOSS: 150mm				
	12.4	CORE LOSS - 0.15m										PL(A) = 0.03
	12.63	CONGLOMERATE - Extremely low strength, highly weathered, orange grey conglomerate, with subangular to subrounded pebbles up to 10mm in size										PL(D) = 0.01 PL(A) = 0.02 PL(A) = 0.17 PL(D) = 0.13
	12.83	SANDSTONE - Low strength, highly weathered, yellow fine grained sandstone, 2% interbedded siltstone						12.74m: P, pl, ro 12.93m: J, 30°, pl, ro				
	13											
	13.14	SILTSTONE - Very low strength, highly weathered, orange grey siltstone, with extremely low strength clay seams						13.07m: J, 60°, pl, ro 13.26m: J, 60°, pl, ro	C	100	56	PL(A) = 0.07 PL(D) = 0.07
	13.42	SANDSTONE - Very low strength, highly weathered, yellow fine grained sandstone						13.44m: J, 70°, pl, ro From 13.57m to 14.0m , fg				
		SILTSTONE - Very low to low strength, moderately weathered, orange siltstone From 13.57m to 14.0m, fragmented										
	14 14.0	SILTSTONE - Very low to low strength, moderately weathered, grey siltstone with 20% interbedded fine grained sandstone						14.11m: J, 5°, pl, ro, fe 14.21m: J, 5°, pl, ro, fe 14.27m: J, 5°, pl, ro 14.33m: P, pl, ro 14.43m: J, 50°, pl, ro, fe 14.45m: J, 5°, pl, ro, fe 14.5m: J, 40°, pl, ro, 3mm clay infill 14.53m: J, 20°, pl, 3mm clay infill	C	100	78	PL(A) = 0.03 PL(D) = 0.03
	14.9							14.87m: P, pl, 3mm clay infill				PL(A) = 0.07 PL(D) = 0.15 PL(A) = 0.17

RIG: 4WD Scout **DRILLER:** Tightsite **LOGGED:** Goodall **CASING:** HQ to 11.0m

TYPE OF BORING: Solid flight auger to 11.05m, NMLC coring to 16.71m

WATER OBSERVATIONS: No free groundwater observed whilst auger drilling

REMARKS: *Surface levels assumed

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 24.0m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 104
PROJECT No: 71995.07
DATE: 4/5/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
	15.1	SANDSTONE - Low to medium strength, slightly weathered, grey fine grained sandstone *(continued)*						15.04m: J, 5°, pl, ro 15.18m: J, 90°, 10mm clay infill	C	100	78	PL(D) = 0.36 PL(A) = 0.39
	15.27	SILTSTONE - Extremely low to low strength, slightly weathered, grey siltstone with 30% thinly laminated fine grained sandstone										
	15.65	SANDSTONE - Medium strength, moderately weathered, grey fine grained sandstone						15.45m: P, pl, ro, 3mm clay infill				
16		SILTSTONE - Extremely low strength, slightly weathered, grey siltstone with 20% interbedded, fine grained sandstone						15.87m: P, pl, ro	C	100	63	PL(A) = 0.02
	16.1	COAL - Low strength, moderately weathered, black coal										PL(A) = 0.24 PL(D) = 0.27
		From 16.54m, extremely low strength, extremely weathered						16.38m: J, 5°, pl, ro 16.4m: J, 40°, pl, ro				
	16.7											
	16.71	SILTSTONE - Extremely low strength, extremely weathered, grey siltstone (soil-like properties)										
17		Bore discontinued at 16.71m , limit of investigation										
18												
19												

RIG: 4WD Scout **DRILLER:** Tightsite **LOGGED:** Goodall **CASING:** HQ to 11.0m

TYPE OF BORING: Solid flight auger to 11.05m, NMLC coring to 16.71m

WATER OBSERVATIONS: No free groundwater observed whilst auger drilling

REMARKS: *Surface levels assumed

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

CONE PENETRATION TEST

CLIENT: SCENTRE GROUP LTD

PROJECT: KOTARA SHOPPING CENTRE - STAGE 4 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

REDUCED LEVEL: 24.0 m AHD*

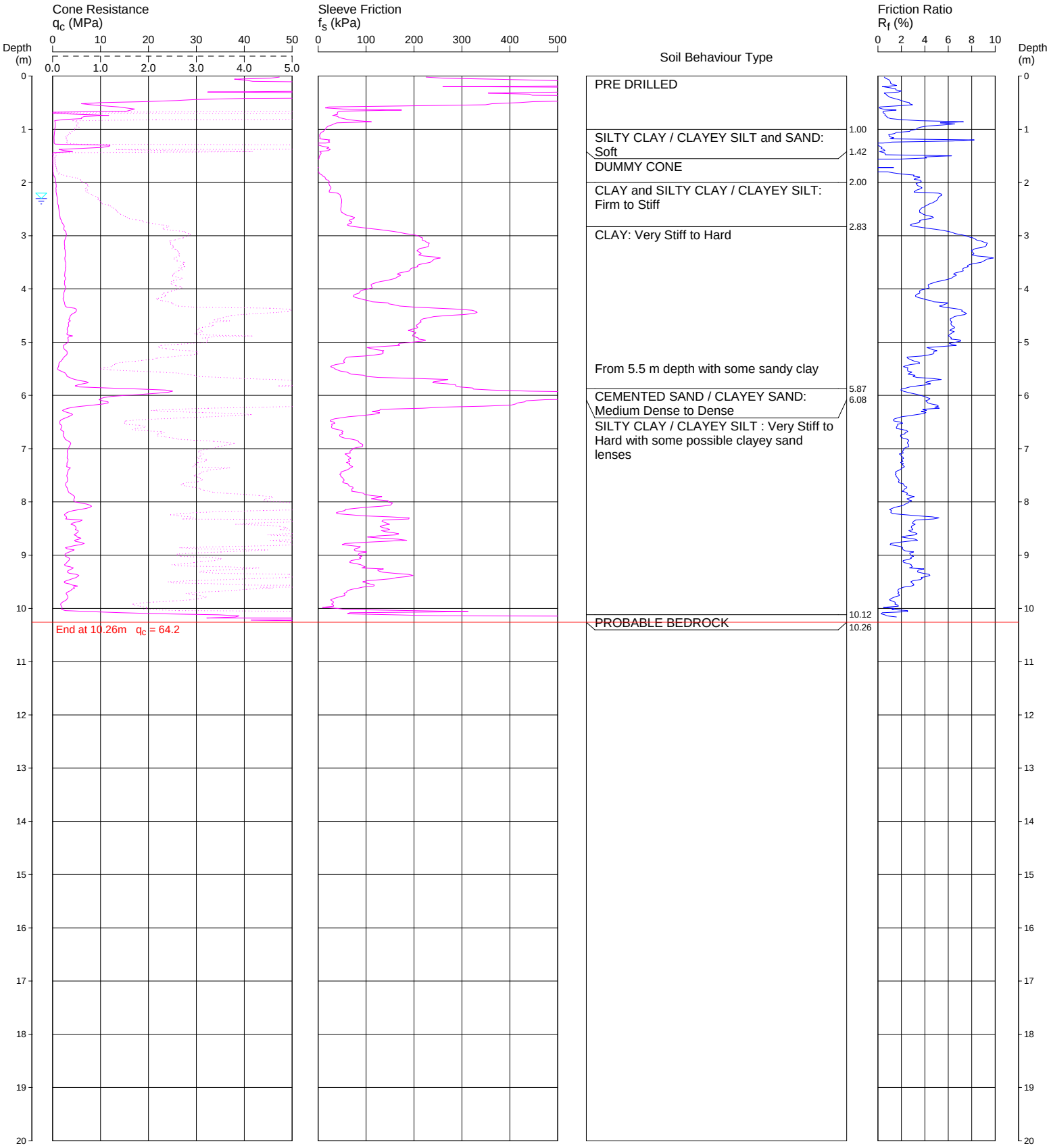
COORDINATES:

CPT104

Page 1 of 1

DATE 19/4/2016

PROJECT No: 71995.07



REMARKS: TEST DISCONTINUED DUE TO LIMIT OF THRUST. TEST LOCATION PARTIALLY PRE-DRILLED TO 1m DEPTH PRIOR TO TESTING.
DUMMY CONE UTILISED FROM 1.42m TO 2.00m DEPTH DUE TO BENDING. GROUNDWATER MEASURED AT 2.3m DEPTH AFTER WITHDRAWAL OF RODS.
*SURFACE LEVEL INTERPOLATED FROM SURVEY PLAN PROVIDED BY CLIENT

Water depth after test: 2.30m depth (measured)

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT104.CP5

Cone ID: 120618 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

BORE 104 PROJECT 71995.07 21.04.2016

11.0 m – 16.71 m

Douglas Partners Geotechnics / Environment / Groundwater	**Core Photoplate** **Westfield Kotara Stage 4** **Northcott Drive, Kotara**	PROJECT: 71995.07 PLATE No: 2 REV: 0
	CLIENT: Scentre Group Ltd	DATE: 18.05.16

CONE PENETRATION TEST

CLIENT: SCENTRE GROUP LTD

PROJECT: KOTARA SHOPPING CENTRE - STAGE 4 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

REDUCED LEVEL: RL 25.2 m AHD*

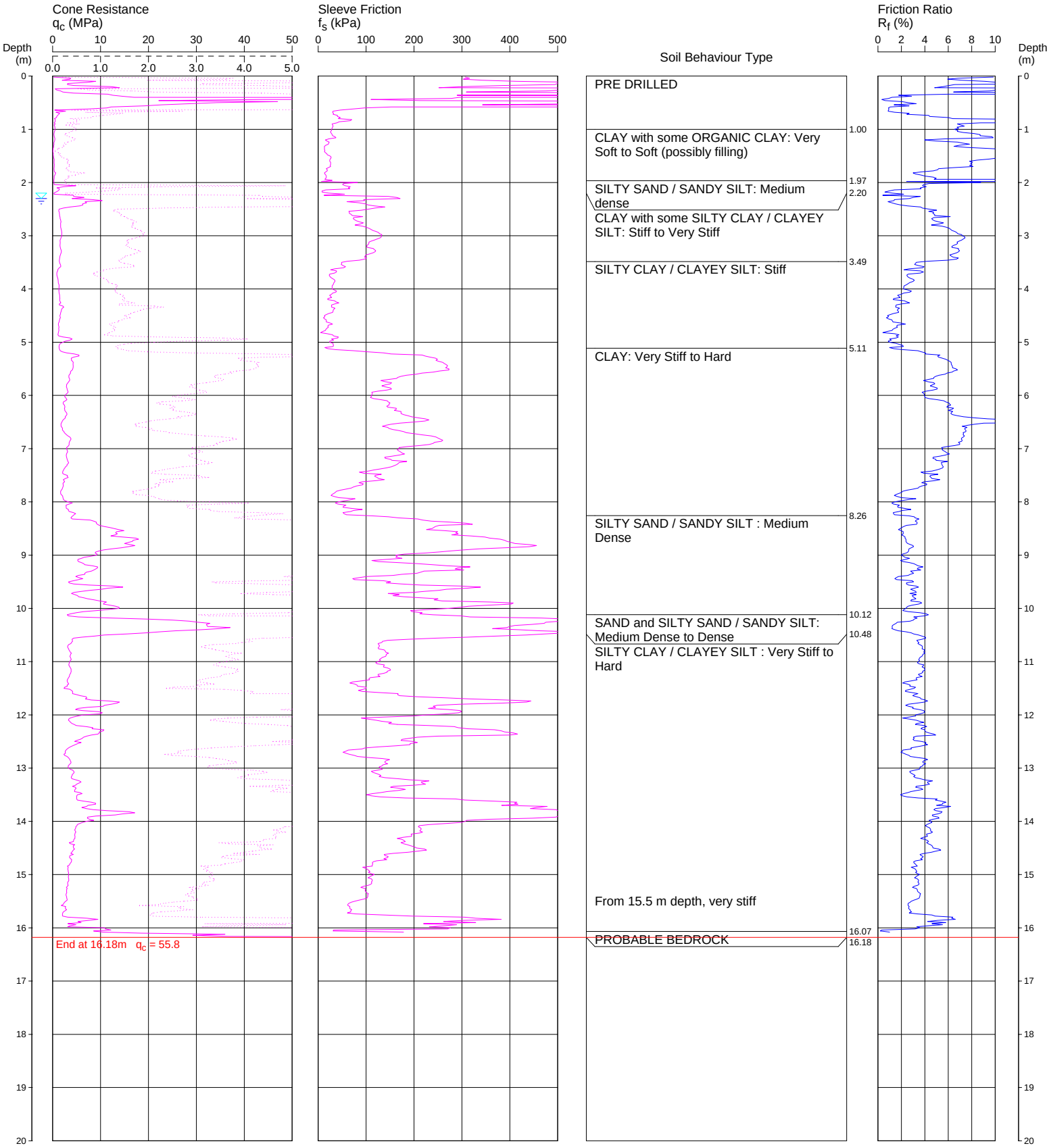
COORDINATES:

CPT105

Page 1 of 1

DATE 20/4/2016

PROJECT No: 71995.07



REMARKS: TEST DISCONTINUED DUE TO LIMIT OF THRUST. TEST LOCATION PARTIALLY PRE-DRILLED TO 1m DEPTH PRIOR TO TESTING.
GROUNDWATER MEASURED AT 2.3m DEPTH AFTER WITHDRAWAL OF RODS.
*SURFACE LEVEL INTERPOLATED FROM SURVEY PLAN PROVIDE BY CLIENT

Water depth after test: 2.30m depth (measured)

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT105.CP5

Cone ID: 120618 **Type:** I-CFXY-10

ConePlot Version 5.9.2

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 26.0m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 71995.07
DATE: 12/5/2016
SHEET 1 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.05	ASPHALT										
	0.2	FILLING - Generally comprising dark brown silty sand / sandy silt filling, fine to medium grained sand with some subangular gravel up to 15mm in size, humid							A			
	0.6	FILLING - Generally comprising brown clayey sandy gravel filling, fine to medium grained sand, subangular to subrounded gravel up to 20mm in size, M>Wp							A			
1		CLAY - Very stiff to hard, brown mottled red clay with some fine grained sand, trace subangular to subrounded gravel up to 5mm in size, M=Wp							A			
									S			pp = 500-600 5,9,12 N = 21
		From 1.5m, grey mottled red										
2		From 2.0m, gravelly, subangular to subrounded gravel up to 15mm in size										
									S			pp = 400-500 4,9,10 N = 19
3		From 3.5m, grey							A			
4	4.0	CONGLOMERATE - Extremely low strength, extremely weathered, grey conglomerate with subangular to subrounded pebbles up to 15mm in size							S			26,6/120,- refusal
	4.32	CORE LOSS - 1.09m (probably extremely low strength conglomerate)						4.32m: CORE LOSS: 1090mm	C	12	0	

RIG: Truck **DRILLER:** Total Drilling **LOGGED:** Goodall **CASING:** HW to 10.5m

TYPE OF BORING: Solid flight to 4.0m, NMLC 5.4m, wash 8.0m, NMLC to 11.4m, wash to 12.6m, NMLC to 18.0m

WATER OBSERVATIONS: No free groundwater observed whilst auger drilling

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 26.0m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 71995.07
DATE: 12/5/2016
SHEET 2 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		CORE LOSS - 1.09m (probably extremely low strength conglomerate) *(continued)*							C	12	0	
	5.41	CONGLOMERATE - Extremely low strength, extremely weathered, grey conglomerate with subangular to subrounded pebbles up to 15mm in size							C S	38	0	4,24,10/40 refusal
	5.54	CORE LOSS - 2.46m, (wash bore)						5.54m: CORE LOSS: 2460mm				
	6											
	7											
	8											
	8.0	CORE LOSS - 1.96m (probably completely weathered conglomerate)						8m: CORE LOSS: 1960mm				
	9								C	16	0	
	9.96											

RIG: Truck **DRILLER:** Total Drilling **LOGGED:** Goodall **CASING:** HW to 10.5m

TYPE OF BORING: Solid flight to 4.0m, NMLC 5.4m, wash 8.0m, NMLC to 11.4m, wash to 12.6m, NMLC to 18.0m

WATER OBSERVATIONS: No free groundwater observed whilst auger drilling

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 26.0m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 71995.07
DATE: 12/5/2016
SHEET 3 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SANDSTONE - Very low strength, slightly weathered, grey fine grained sandstone *(continued)*						10.07m: J, 50°, st, ro, 1mm clay infill	C	16	0	PL(A) = 0.06 PL(D) = 0.04 PL(A) = 0.03 PL(D) = 0.05
		From 10.19m, moderately weathered										
	10.4	From 10.3m, extremely low strength, extremely weathered, trace subangular to subrounded pebbles up to 10mm in size						10.4m: CORE LOSS: 780mm				
		CORE LOSS - 0.78m							C	19	0	
	11											
	11.18	SANDSTONE - Extremely low strength, extremely weathered, grey fine grained sandstone, trace subangular to subrounded pebbles up to 10mm in size										
	11.4	CORE LOSS - 0.79m (wash bore)						11.4m: CORE LOSS: 1200mm				
	12											
	12.6	SANDSTONE - Very low strength, fresh, grey fine grained sandstone with 15% thinly laminated siltstone										PL(A) = 0.06 PL(D) = 0.03 PL(A) = 0.17
		From 12.81m, moderately weathered, extremely low strength						12.84m: P, pl, ro, fe 12.87m: P, pl, ro, 10mm clay infill 12.93m: P, pl,ro, 10mm clay infill 13.02m: J, 50°, pl, ro, fe	C	70	0	
	13	From 13.07m, very low strength, fresh										
	13.3	CORE LOSS - 0.3m						13.3m: CORE LOSS: 300mm				
	13.6	SILTSTONE - Very low to low strength, fresh, grey siltstone										PL(A) = 0.17 PL(D) = 0.08 PL(A) = 0.17 PL(D) = 0.15
	13.65	SANDSTONE - Low strength, fresh, grey, fine grained sandstone with 30% laminated siltstone						13.88m: P, pl, ro, 10mm clay infill	C	100	50	
	14 14.0	SILTSTONE - Extremely low strength, highly weathered, grey siltstone with 30% to 40% interbedded fine grained sandstone										PL(D) = 0.03 PL(D) = 0.1 PL(A) = 0.31
		From 14.3m, very low strength										
		From 14.39m, medium strength						14.4m: J, 90°, pl, ro				PL(A) = 0.15
		From 14.52m, low strength							C	100	84	
												PL(D) = 0.07

RIG: Truck **DRILLER:** Total Drilling **LOGGED:** Goodall **CASING:** HW to 10.5m

TYPE OF BORING: Solid flight to 4.0m, NMLC 5.4m, wash 8.0m, NMLC to 11.4m, wash to 12.6m, NMLC to 18.0m

WATER OBSERVATIONS: No free groundwater observed whilst auger drilling

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 26.0m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 71995.07
DATE: 12/5/2016
SHEET 4 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		From 14.95m, very low strength						15.03m: J, 40°, pl, ro 15.16m: J, 60°, pl, ro				
	15.27	SANDSTONE - Very low strength, fresh, grey fine grained sandstone with 15% thinly laminated siltstone										PL(A) = 0.07 PL(D) = 0.1 PL(D) = 0.32 PL(A) = 0.35 PL(D) = 0.1
	16								C	100	84	
	16.2	SILTSTONE - Low strength, fresh, grey siltstone										PL(A) = 0.14 PL(A) = 0.19 PL(D) = 0.16 PL(D) = 0.13 PL(D) = 0.18
	16.68	COAL - Extremely low strength, moderately weathered, black coal						From 16.68m to 17.1m, fg				
	17											
	17.1	SILTSTONE - Low strength, moderately weathered, grey siltstone with occasional coal lenses										
	17.37	COAL - Extremely low strength, extremely weathered black coal (soil like properties) From 17.72m to 17.36m, clay like properties						17.32m: J, 5°, pl, sm From 17.37m to 17.45m, fg 17.49m: P, pl, ro, 3mm clay infill 17.51m: P, pl, ro, 1mm clay infill From 17.58m to 17.72m, fg From 17.76m to 18.0m, fg	C	100	24	
	18 18.0	Bore discontinued at 18.0m , limit of investigation										
	19											

RIG: Truck **DRILLER:** Total Drilling **LOGGED:** Goodall **CASING:** HW to 10.5m

TYPE OF BORING: Solid flight to 4.0m, NMLC 5.4m, wash 8.0m, NMLC to 11.4m, wash to 12.6m, NMLC to 18.0m

WATER OBSERVATIONS: No free groundwater observed whilst auger drilling

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

BORE 106 PROJECT 71995.07 21.04.2016

8.0 m – 18.0 m

Douglas Partners Geotechnics / Environment / Groundwater	**Core Photoplate** **Westfield Kotara Stage 4** **Northcott Drive, Kotara**	PROJECT: 71995.07 PLATE No: 3 REV: 0
	CLIENT: Scentre Group Ltd	DATE: 18.05.16

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 24.7m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 107
PROJECT No: 71995.07
DATE: 9/5/2016
SHEET 1 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.05	ASPHALT										
		FILLING - Generally comprising dark brown sandy gravel filling with fine to medium grained sand and subangular to subrounded gravel up to 10mm in size, humid							A			
		From 0.9m, brown							A			
1	1.0	FILLING - Generally comprising grey silty sand with fine to medium grained sand, trace subangular to subrounded gravel up to 10mm in size, humid							A			
	1.2											
	1.3	SILTY CLAY - (Stiff), dark brown silty clay, with some subangular to subrounded gravel up to 10mm in size, M>Wp							A			
		SILTY CLAY - Firm, dark brown silty clay, M⩾Wp										
2									S			1,1,2 N = 3 pp = 50
3		From 3.0m, stiff and some fine to medium grained sand							S			3,6,8 N = 14
4		At 4.0m, wet										
	4.5	SANDY CLAY - Stiff, brown sandy clay, fine to medium grained sand, with some silt, M⩾Wp										

RIG: Scout **DRILLER:** Total Drilling **LOGGED:** Goodall **CASING:** HWT at 8.5m, then HQ at 10.0m

TYPE OF BORING: Hand auger to 2.0m, solid flight auger from 2.0m to 8.0m, wash bore from 8.0m to 9.5m, NMLC from 9.5m to 17.8m

WATER OBSERVATIONS: Free groundwater observed at 7.0m whilst augering

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 24.7m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 107
PROJECT No: 71995.07
DATE: 9/5/2016
SHEET 2 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SANDY CLAY - Stiff, brown sandy clay, fine to medium grained sand, with some silt, M⩾Wp *(continued)*							S			4,4,7 N = 11 pp = 150-200
	6											
		From 6.5m, very stiff							S			9,11,14 N = 25 pp = 350-400
	7					09-05-16						
	8											
	9											
	9.5	SANDY GRAVEL - Loose to medium dense, grey sandy gravel, fine to medium grained sand with subangular to subrounded gravel up to 10mm size, wet							S			5,8,13 N = 21 pp = 300-350
	9.85											

RIG: Scout **DRILLER:** Total Drilling **LOGGED:** Goodall **CASING:** HWT at 8.5m, then HQ at 10.0m

TYPE OF BORING: Hand auger to 2.0m, solid flight auger from 2.0m to 8.0m, wash bore from 8.0m to 9.5m, NMLC from 9.5m to 17.8m

WATER OBSERVATIONS: Free groundwater observed at 7.0m whilst augering

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 24.7m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 107
PROJECT No: 71995.07
DATE: 9/5/2016
SHEET 3 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SANDY CLAY - Very stiff, orange sandy clay, fine to medium grained sand, some subangular to subrounded gravel up to 5mm in size, M~Wp *(continued)*										8,27/90 refusal (double bouncing)
	11 11.0	CONGLOMERATE - Extremely low strength, extremely weathered, grey conglomerate with subangular/subrounded pebbles up to 10mm in size							S			
		From 11.36m, high to very high strength and moderately weathered							C	100	0	PL(A) = 1.98 PL(D) = 3.46
	12							12.04m: J, 60°, pl, ro, 15mm clay infill				
	12.15	SANDSTONE - High strength, moderately weathered, orange fine to medium grained sandstone						12.12m: J, 20°, pl, ro, fe				PL(A) = 1.62 PL(D) = 1.26
	12.35	From 12.31m, extremely low strength and extremely weathered						12.28m: J, 50°, pl, ro, fe	C	60	9	
		CORE LOSS - 0.74m						12.35m: CORE LOSS: 750mm				
	13											
	13.1	SANDSTONE - Extremely low strength, extremely weathered, orange fine to medium grained sandstone										
	13.17							13.48m: P, pl, ro, fe				
	13.2	COAL - Extremely low strength, extremely weathered black coal (soil-like properties)						13.53m: P, pl, ro				
		SILTSTONE - Extremely low strength, moderately weathered, grey siltstone						13.64m: P, pl, ro				PL(A) = 0.01 PL(D) = 0.01
	13.74							13.74m: CORE LOSS: 140mm				
	13.88	At 13.73m depth, coal seam 10mm thick							C	91	54	
	14	CORE LOSS - 0.14m										PL(D) = 0.03 PL(A) = 0.06
		SILTSTONE - Extremely low strength, extremely weathered, grey siltstone (soil-like properties)						14.04m: P, pl, ro, 3mm clay infill				
		From 13.92m depth, very low strength with coal lenses up to 5mm thick						14.08m: P, pl, ro				
		From 14.08m depth, extremely low to very low strength, highly weathered						14.14m: P, pl, ro, 10mm clay infill				PL(A) = 0.01 PL(D) = 0.03
								14.37m: P, pl, ro				
								14.43m: J, 20°, pl, ro, 10mm clay infill				
								14.92m: P, pl, ro, 10mm				

RIG: Scout **DRILLER:** Total Drilling **LOGGED:** Goodall **CASING:** HWT at 8.5m, then HQ at 10.0m

TYPE OF BORING: Hand auger to 2.0m, solid flight auger from 2.0m to 8.0m, wash bore from 8.0m to 9.5m, NMLC from 9.5m to 17.8m

WATER OBSERVATIONS: Free groundwater observed at 7.0m whilst augering

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 24.7m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 107
PROJECT No: 71995.07
DATE: 9/5/2016
SHEET 4 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SILTSTONE - Extremely low strength, extremely weathered, grey siltstone (soil-like properties) *(continued)*						clay infill				PL(A) = 0.04 PL(D) = 0.01
	15.32	SANDSTONE - Low strength, slightly weathered, grey fine grained sandstone with 30% interbedded siltstone										PL(A) = 0.2 PL(D) = 0.23
												PL(A) = 0.35 PL(A) = 0.21 PL(D) = 0.11
	16							15.96m: J, 5°, pl, ro				PL(A) = 0.26
								16.32m: J, 10°, pl, ro				PL(A) = 0.2 PL(D) = 0.31
		From 16.5m, medium strength										
	17											PL(A) = 0.33
												PL(A) = 0.39 PL(D) = 0.31
	17.7	SILTSTONE - Extremely low strength, slightly weathered, grey siltstone						17.74m: J, 10°, pl, sm				
	17.8	Bore discontinued at 17.8m, limit of investigation										
	18											
	19											

RIG: Scout **DRILLER:** Total Drilling **LOGGED:** Goodall **CASING:** HWT at 8.5m, then HQ at 10.0m

TYPE OF BORING: Hand auger to 2.0m, solid flight auger from 2.0m to 8.0m, wash bore from 8.0m to 9.5m, NMLC from 9.5m to 17.8m

WATER OBSERVATIONS: Free groundwater observed at 7.0m whilst augering

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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BORE 107 PROJECT 71995.07 21.04.2016

11.0 m – 17.8 m

DOUGLAS PARTNERS PTY LTD

BORE 108 PROJECT 71995.07 21.04.2016

Douglas Partners Geotechnics / Environment / Groundwater	**Core Photoplate** **Westfield Kotara Stage 4** **Northcott Drive, Kotara**	PROJECT: 71995.07 PLATE No: 4 REV: 0
	CLIENT: Scentre Group Ltd	DATE: 18.05.16

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 24.0m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 108
PROJECT No: 71995.07
DATE: 11/5/2016
SHEET 1 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.05	ASPHALT										
		FILLING - Generally comprising brown silty sandy gravel filling with fine to medium grained sand and subangular to subrounded gravel up to 10mm in size, humid							A			
		From 0.5m depth, grey sandy gravel; gravel fraction up to 20mm maximum dimension, with trace silt							A			
	0.8	FILLING - Generally comprising brown gravelly clay filling, with some fine to medium grained sand, with subangular gravel up to 15mm in size, M<Wp							A			
1	1.0	FILLING - Generally comprising brown clay, with some fine to medium grained sand, trace silt, M<Wp							A			
		From 1.2m, silty, M<<Wp										
2		From 2.0m depth, brown-red clay with trace sand, silt and rootlets, M<Wp										
	2.8	CLAY - Hard, grey mottled orange and red clay, trace subrounded gravel up to 6mm in size, M<<Wp							A			
3												pp = 400-450
4		From 4.1m depth, stiff to very stiff, grey clay, with some subangular to subrounded gravel up to 20mm in size, trace rootlets, M=Wp							S			4,6,8 N = 14 pp = 300-350

RIG: Scout **DRILLER:** Total Drilling **LOGGED:** Goodall **CASING:** HQ at 11.5m

TYPE OF BORING: Hand auger to 2.0m, solid flight auger from 2.0m to 11.0m, washbore from 11.0m to 12.15m, NMLC from 12.15m to 17.59m

WATER OBSERVATIONS: Free groundwater observed at 8.8m whilst augering

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 24.0m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 108
PROJECT No: 71995.07
DATE: 11/5/2016
SHEET 2 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		CLAY - Hard, grey mottled orange and red clay, trace subrounded gravel up to 6mm in size, M<<Wp *(continued)*										
		From 5.5m, mottled red orange (Fe staining?)							S			pp = 300-350 4,6,9 N = 15
	6											
		From 6.7m depth, brown							A			pp = 100-150
	7	From 7m depth, very stiff to hard, grey							S			pp >600 5,10,14 N = 24
	8											
	8.8	GRAVELLY CLAY - Very stiff, brown gravelly clay, with subangular to subrounded gravel up to 15mm in size, with some fine to medium grained sand, M=Wp				11-05-16			A			
	9	From 9.1m, grey							S			pp = 300-400 5,8,11 N = 19
		From 9.3m to 9.4m, grey mottled orange/red (Fe staining?)										
		From 9.4m, grey										
		From 9.5m, wet										

RIG: Scout **DRILLER:** Total Drilling **LOGGED:** Goodall **CASING:** HQ at 11.5m

TYPE OF BORING: Hand auger to 2.0m, solid flight auger from 2.0m to 11.0m, washbore from 11.0m to 12.15m, NMLC from 12.15m to 17.59m

WATER OBSERVATIONS: Free groundwater observed at 8.8m whilst augering

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 24.0m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 108
PROJECT No: 71995.07
DATE: 11/5/2016
SHEET 3 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
		GRAVELLY CLAY - Very stiff, brown gravelly clay, with subangular to subrounded gravel up to 15mm in size, with some fine to medium grained sand, M=Wp *(continued)*							S			pp = 300-400 4,7,11 N = 18
	11											
	12								S			16,7/40 refusal (double bounce) pp = 250-350
	12.15											
	12.19	SANDSTONE - Extremely low strength, extremely weathered, yellow fine to medium grained sandstone						12.19m: CORE LOSS: 340mm				
		CORE LOSS - 0.34m										
	12.53	CONGLOMERATE - Medium strength, moderately weathered, orange conglomerate, with pebbles up to 15mm in size										PL(A) = 0.97
	13							12.87m: P, pl, ro, 1mm clay infill 12.95m: P, pl, ro	C	64	70	PL(D) = 0.81
	13.05	SILTSTONE - Extremely low strength, extremely weathered, grey siltstone										PL(A) = 0.02 PL(D) = 0.02
	13.14	SANDSTONE - Extremely low strength, moderately weathered, grey fine grained sandstone						13.44m: J, 50°, pl, ro, 5mm clay infill				
	13.7	SILTSTONE - Extremely low strength, highly weathered, grey siltstone						From 13.84m to 13.88m, fg From 13.97m to 14.15m, fg From 14.24m to 14.34m, fg	C	100	68	
	14							14.48m: P, pl, ro 14.5m: J, 70°, pl, ro, fe				
									C	100	71	PL(A) = 0.01

RIG: Scout **DRILLER:** Total Drilling **LOGGED:** Goodall **CASING:** HQ at 11.5m

TYPE OF BORING: Hand auger to 2.0m, solid flight auger from 2.0m to 11.0m, washbore from 11.0m to 12.15m, NMLC from 12.15m to 17.59m

WATER OBSERVATIONS: Free groundwater observed at 8.8m whilst augering

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 24.0m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 108
PROJECT No: 71995.07
DATE: 11/5/2016
SHEET 4 OF 4

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
												PL(D) = 0.03
	15.18	SANDSTONE - Very low to low strength, moderately weathered, brown, fine grained sandstone						15.18m: P, pl, ro, 10mm clay infill				PL(A) = 0.12 PL(D) = 0.07
	15.65	SILTSTONE - Extremely low to very low strength, moderately weathered, grey siltstone with 20% interbedded fine grained sandstone						15.54m: J, 20°, I, ro, fe				
	16											PL(A) = 0.09 PL(D) = 0.02
								16.13m: J, 50°, pl, ro, fe	C	100	71	
		From 16.49m to 16.56m, extremely low strength, extremely weathered						From 16.56m to 16.63m, fg 16.64m: P, pl, ro, fe 16.74m: P, pl, ro, fe				PL(A) = 0.06 PL(A) = 0.1
	16.68	SANDSTONE - Low strength, moderately weathered, grey fine grained sandstone										
	16.84	SILTSTONE - Low strength, moderately weathered, grey siltstone						16.89m: J, 85°, ro, fe				PL(D) = 0.12
	17							17.1m: J, 70°, pl, sm				
												PL(A) = 0.11 PL(D) = 0.1
	17.59	Bore discontinued at 17.59m , limit of investigation										
	18											
	19											

RIG: Scout **DRILLER:** Total Drilling **LOGGED:** Goodall **CASING:** HQ at 11.5m

TYPE OF BORING: Hand auger to 2.0m, solid flight auger from 2.0m to 11.0m, washbore from 11.0m to 12.15m, NMLC from 12.15m to 17.59m

WATER OBSERVATIONS: Free groundwater observed at 8.8m whilst augering

REMARKS: *Surface levels interpolated from survey plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Kotara Shopping Centre, Stage 4
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: NR
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 71995.07
DATE: 10/5/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.07	ASPHALT - 70mm thick		D	0.1				
	0.15	FILLING - Generally comprising dark grey-brown sandy fine to coarse grained sand, subangular gravel up to 30mm in size, humid		D	0.2				
		FILLING - Generally comprising brown clayey sandy gravel filling, fine to coarse grained sand, subrounded gravel up to 30mm in size, moist							
	1.2	FILLING - Generally comprising brown gravel filling, subangular gravel up to 30mm in size, trace silt and trace fine to coarse grained sand, moist From 1.4m, moist to wet		D	1.3				
	1.6	SANDY CLAY - Firm, grey-brown sandy clay, fine to coarse grained sand with trace subrounded gravel up to 5mm in size, M>Wp (wet) From 1.7m, very stiff to hard, M>Wp, (moist)			1.7				
				A S	1.9		pp = 220-410 6,9,9 N = 18		
					2.15				
					3.0				
				S			5,7,8 N = 15 (0.15m recovery)		
	3.3	SILTY CLAY - Stiff to very stiff, red-brown to grey silty clay with trace fine to medium grained sand and trace subangular to subrounded gravel up to 30mm in size, M~Wp			3.4 3.45		pp = 150-250		
								▼	
	4.5	SANDY CLAY - Very stiff, grey, fine to coarse grained sandy clay with trace, fine to medium sized subrounded gravel, M≯Wp			4.5				
				S			pp = 310-360 7,12,12 N = 24 (0.3m recovery)		
					4.95				

RIG: Dando **DRILLER:** Tightsite (Drever) **LOGGED:** Semmler/Ballinger **CASING:** Uncased

TYPE OF BORING: Hand Auger to 1.7m, 100mm diameter solid flight auger to 7.95m

WATER OBSERVATIONS: Free groundwater observed at 4.0m (during drilling)

REMARKS: NR - Not recorded

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Kotara Shopping Centre, Stage 4
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: NR
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 71995.07
DATE: 10/5/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		SANDY CLAY - Very stiff, grey, fine to coarse grained sandy clay with trace, fine to medium sized subrounded gravel, M≥Wp *(continued)*							
6	6.0	CLAYEY SAND - Dense, fine to medium grained clayey sand, wet		S	6.0		8,11,20 N = 31		
					6.45				
7		From 7.5m, medium dense		S	7.5		5,8,7 N = 15		
8	7.95	Bore discontinued at 7.95m , limit of investigation			7.95				
9									

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Dando **DRILLER:** Tightsite (Drever) **LOGGED:** Semmler/Ballinger **CASING:** Uncased

TYPE OF BORING: Hand Auger to 1.7m, 100mm diameter solid flight auger to 7.95m

WATER OBSERVATIONS: Free groundwater observed at 4.0m (during drilling)

REMARKS: NR - Not recorded

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: NR
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 301
PROJECT No: 71995.07
DATE: 21/4/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		CONCRETE -										
	0.16											
	0.25	FILLING - Generally comprising brown, fine to coarse grained sandy gravel filling with subangular to subrounded gravel up to 40mm in size, trace clay, humid										
		CLAY - (Stiff), grey mottled yellow clay, trace fine to medium grained sand, M≫Wp										
	1	From 1.0m, hard							S			pp >600 8,14,14 N = 28
									D			pp >600
	2											
	2.1	CLAY - Hard, orange-brown clay, M≪Wp										
									D S			pp = 550 12,14,22 N = 36
	3					▼						pp >600
		From 3.7m to 4.2m, stiff										
	4											
	4.1	CLAYSTONE / SILTSTONE - Extremely low strength, extremely weathered, brown mottled red-grey claystone / siltstone, soil like properties							D S			pp = 100-150 14,15,17 N = 32
		At 4.2m, extremely low strength, extremely weathered siltstone lense, 50mm thick										pp >600
	5.0											

RIG: Dando Terrier **DRILLER:** Tightsite (Drever) **LOGGED:** Benson / Parkinson **CASING:** HQ to 7m

TYPE OF BORING: Solid flight auger to 7.1m, then NMLC coring to 8.5m

WATER OBSERVATIONS: Free groundwater observed at 3.5m, whilst drilling

REMARKS: NR - Not recorded

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: NR
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 301
PROJECT No: 71995.07
DATE: 21/4/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
			EW HW MW SW FS FR		Ex Low Very Low Low Medium High Very High Ex High		0.01 0.05 0.10 0.50 1.00	B - Bedding J - Joint S - Shear F - Fault				
	5.2	CLAYEY SILT - Dark brown clayey silt, M⩽Wp										
		COAL - Extremely low strength, dark brown-black, weathered coal, M<Wp							D			
	5.5								D			
		SILTY CLAY - Hard, grey mottled yellow silty clay, (completely weathered claystone), M<Wp							D S			pp = 400-500 10,21,25/130mm refusal
	6.8	CARBONACEOUS SILTSTONE - Extremely low strength, extremely weathered, grey carbonaceous siltstone (soil like properties)							D S			37/100mm refusal
	7.1	SILTSTONE - Very low to low strength, fresh, grey, slightly fractured siltstone with some fine grained sand, trace carbonaceous inclusions From 7.45m, low strength						7.23m: J, 10°, ir, sm, cbs 7.33m-7.40m, Cz, sh, ir, sm, cbs 7.61m: PT, sh, pl, sm 7.7m: J, 30°, pl, sm	C	100	68	pp >550 PL(A) = 0.1 PL(D) = 0.08 PL(A) = 0.21 PL(D) = 0.15 PL(A) = 0.21 PL(D) = 0.15
	8.5	Bore discontinued at 8.5m , limit of investigation										

RIG: Dando Terrier **DRILLER:** Tightsite (Drever) **LOGGED:** Benson / Parkinson **CASING:** HQ to 7m
TYPE OF BORING: Solid flight auger to 7.1m, then NMLC coring to 8.5m
WATER OBSERVATIONS: Free groundwater observed at 3.5m, whilst drilling
REMARKS: NR - Not recorded

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

BORE 301 PROJECT 71995.07 21.04.2016

7.0 m – 8.5 m

DOUGLAS PARTNERS PTY LTD

BORE 302 PROJECT 71995.07 21.04.2016

5.4 m – 9.45 m

Douglas Partners Geotechnics / Environment / Groundwater	**Core Photoplate** **Westfield Kotara Stage 4** **Northcott Drive, Kotara**	PROJECT: 71995.07 PLATE No: 5 REV: 0
	CLIENT: Scentre Group Ltd	DATE: 9.05.16

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: NR
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 302
PROJECT No: 71995.07
DATE: 21/4/2016
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		CONCRETE -										
	0.15											
	0.2	FILLING - Generally comprising fine to coarse grained sandy gravel filling with subangular to subrounded gravel up to 40mm in size										
		SILTY CLAY - Stiff to very stiff, grey mottled orange silty clay, M<Wp										
	1								S			pp = 300-350 7,9,13 N = 22
									D			pp >550
	2											pp >550
	2.2	SILT - Very stiff to hard, grey silt with trace clay, M<Wp										
									S			13,28,25/100mm refusal
									D			pp >600
	3											
	3.4	CLAY - Very stiff to hard, grey mottled orange clay, trace silt, M<Wp										
	4								S			pp >550 21,17/79mm refusal

RIG: Dando Terrier **DRILLER:** Tightsite (Drever) **LOGGED:** Benson / Parkinson **CASING:** HQ to 5.4m
TYPE OF BORING: Solid flight auger to 5.4m, then NMLC coring to 9.45m
WATER OBSERVATIONS: Groundwater obscured by drilling fluids
REMARKS: NR - Not recorded

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U$_x$	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: NR
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 302
PROJECT No: 71995.07
DATE: 21/4/2016
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding J - Joint S - Shear F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	5.2	SILTSTONE - Extremely low strength, extremely weathered, grey mottled orange siltstone, soil like properties										
	5.4	SILTSTONE - Extremely low strength, extremely weathered, light grey stained orange-brown siltstone, some fine grained sand, with some very low strength bands, bedded 80° in parts (soil like properties)						5.52m: J, 60°, pl, ro				pp = 450
									S			13,25/110mm refusal pp >550
	6							5.93m: J, 80°, pl, sm				
									C	100	0	pp = 450
								6.17m: J, 40°, pl, sm				
								6.51m: J, 60°, pl, sm				
								6.7m: J, 60°, ir, inf, 5mm clay				pp = 400
	7											
		From 7.15m to 7.30m, clay seam						From 7.15m to 7.30m, Cs, sh, pl, inf clay				pp = 250
	7.3	COAL - Extremely low to very low strength, highly weathered, black coal							C	100	0	
		From 7.55m to 7.75m, clay seam						7.43m: J, 40°, ir, ro				pp = 300
		From 7.78m to 7.85m, clay seam										
	7.95	COAL - Low strength, fresh, black coal						8.01m: Pl, sh, pl, sm				
	8							From 8.04m to 8.40m, J, sv, pl, sm				
	8.4	SILTSTONE - Low strength, fresh, grey, fractured to slightly fractured siltstone, trace carbonaceous inclusions						8.58m: Pt, sh, pl, sm, cbs	C	100	60	PL(A) = 0.06 PL(D) = 0.16
								From 8.75m to 9.30m, J, sv, pl, sm				
	9							8.83m: Pt, sh, pl, sm				PL(A) = 0.22
	9.35	COAL - Low strength, fresh, black coal						9.35m: Pt, sh, pl, sm, cbs				
	9.4							9.38m: Pt, sh, pl, sm, cbs				
	9.45	SANDSTONE - Low strength, moderately weathered, brown, fine grained sandstone, trace carbonaceous inclusions										
		Bore discontinued at 9.45m, limit of investigation										

RIG: Dando Terrier **DRILLER:** Tightsite (Drever) **LOGGED:** Benson / Parkinson **CASING:** HQ to 5.4m
TYPE OF BORING: Solid flight auger to 5.4m, then NMLC coring to 9.45m
WATER OBSERVATIONS: Groundwater obscured by drilling fluids
REMARKS: NR - Not recorded

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

DOUGLAS PARTNERS PTY LTD

BORE 401 PROJECT 71995.07 21.04.2016

1.0 m – 3.6 m

Douglas Partners Geotechnics / Environment / Groundwater	**Core Photoplate** **Westfield Kotara Stage 4** **Northcott Drive, Kotara**	PROJECT: 71995.07 PLATE No: 6 REV: 0
	CLIENT: Scentre Group Ltd	DATE: 18.05.16

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 31.2m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 403
PROJECT No: 71995.07
DATE: 3/5/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.0	TOPSOIL - Generally comprising brown silty sand topsoil, fine graind sand with rootlets, humid							
	0.4	FILLING - Generally comprising brown silty sandy clay filling, fine grained sand, M<<Wp From 0.5m to 0.6m, gravelly band with subrounded gravel up to 15mm in size							
	0.8	FILLING - Generally comprising brown/grey clay filling, trace rootlets, M<<Wp		D	0.8				
	1								1
	1.2	Bore discontinued at 1.2m , refusal							
	2								2

RIG: Hand Auger **DRILLER:** Goodall **LOGGED:** Goodall **CASING:**

TYPE OF BORING: Hand Auger

WATER OBSERVATIONS: No free groundwater observed while augering

REMARKS: DCP approximately 0.2m to 0.3m higher surface level than bore. *Surface level interpolated from plan provided by client

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: RL 29.7m AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 404
PROJECT No: 71995.07
DATE: 3/5/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		TOPSOIL - Generally comprising brown silty sand filling, fine to medium grained sand with some rootlets and trace subangular to subrounded gravel up to 10mm in size, humid From 0.2m to 0.4m, some cobble and crushed concrete up to 70mm in size		D	0.4				
	0.6	FILLING - Generally comprising orange brown silty clay filling, trace fine grained sand, M<<Wp From 0.8m, trace gravel up to 25mm in size							
	1.2	Bore discontinued at 1.2m , refusal on possible rock							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20; 1; 2

RIG: Hand Auger **DRILLER:** Goodall **LOGGED:** Goodall **CASING:** Uncased
TYPE OF BORING: Hand Auger
WATER OBSERVATIONS: No free groundwater observed while augering
REMARKS: *Surface level interpolated from plan provided by client

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: RL28.9m AHD*
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 405
PROJECT No: 71995.07
DATE: 4/5/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
	0.0	TOPSOIL - Generally comprising brown silty sand, fine to medium grained sand, some rootlets to 0.1m depth, trace gravel up to 10mm in size							
		From 0.3m, with gravel up to 10mm in size							
		From 0.4m, some crushed concrete up to 40mm in size							
	0.5	FILLING - Generally comprising brown silty clay filling, trace fine grained sand, M<<Wp							
	0.6	FILLING - Generally comprising brown gravelly sand/sandy gravel filling, with some clay, trace silt, fine to medium grained sand with subangular to subrounded gravel up to 20mm in size, humid		D	0.7				
	1.0	FILLING - Generally comprising grey crushed gravel, subangular gravel up to 10mm in size, trace clay with some fine grained sand, humid							
		From 1.2m, moist		D	1.2				
	1.3	Bore discontinued at 1.3m , practical refusal - hole collapse							

RIG: Hand Auger **DRILLER:** Goodall **LOGGED:** Goodall **CASING:** Uncased
TYPE OF BORING: Hand Auger
WATER OBSERVATIONS: No free groundwater observed while augering
REMARKS: *Surface level interpolated from plan provided by client

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Kotara Shopping Centre, Stage 4
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 602
PROJECT No: 71995.07
DATE: 11/5/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 50mm)
		CONCRETE SLAB							
	0.185 0.186	PLASTIC LINER							
	0.39	FILLING - Generally comprising yellow, fine to medium grained sand filling, moist From 0.365m, clayey Bore discontinued at 0.39m , refusal on concrete footing, limit of investigation							

RIG: Hand Auger **DRILLER:** Fuller / Goodall **LOGGED:** Fuller / Goodall **CASING:** Uncased

TYPE OF BORING: Concrete core to 0.19m then hand auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Kotara Shopping Centre, Stage 4
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: NR
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 603
PROJECT No: 71995.07
DATE: 31/5/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.11	CONCRETE - Un-reinforced, depth varies 0.05m to 0.11m							
		CONCRETE - (Footing), depth varies 0.42m to 0.45m From 0.31m to 0.34m, reinforcement			0.5		pp = 200-300		
	0.56	CLAY - Very stiff, brown clay with some fine to medium grained sand, trace silt, trace subangular gravel up to 5mm in size, M=Wp		A	0.57 0.59				
1		From 0.86m, sandy, grey brown, M⩽Wp From 1.1m, gravelly subangular to subrounded gravel up to 10mm in size From 1.2m, orange grey, M<Wp (becoming very stiff to hard)							1
	1.7	Bore discontinued at 1.7m , limit of investigation, auger refusal							
2									2
3									3
4									4

RIG: Hand Tools **DRILLER:** Robert Guy & Sons **LOGGED:** Goodall **CASING:** Uncased
TYPE OF BORING: Concrete saw and core to 0.56m, hand auger at 0.56m
WATER OBSERVATIONS: No free groundwater observed
REMARKS: NR - Not recorded

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▽	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Kotara Shopping Centre, Stage 4
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: NR
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 604
PROJECT No: 71995.07
DATE: 31/5/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		CONCRETE - (Footing), 0.45m depth From 0.0m to 0.11m, aggregate subangular up to 5mm in size From 0.11m to 0.45m, aggregate subangular 10mm to 20mm in size From 0.3m to 0.33m, reinforcement							
	0.5								
	0.6	CLAY - Hard, brown clay, with some fine grained sand, trace silt, trace subangular gravel up to 5mm in size, M=Wp			0.59		pp >600		
		Bore discontinued at 0.6m , limit of investigation							
	1								1
	2								2
	3								3
	4								4

RIG: Hand Tools **DRILLER:** Robert Guy & Sons **LOGGED:** Goodall **CASING:** Uncased

TYPE OF BORING: Concrete core to 0.45m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: NR - Not recorded

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Kotara Shopping Centre, Stage 4
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: --
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 605
PROJECT No: 71995.07
DATE: 14/6/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 150mm)
		CONCRETE							
		At 0.53m, 16mm diameter steel reinforcement							
	0.63	SANDY CLAY - Very stiff, grey mottled orange brown, fine to coarse grained sand clay, with subrounded to subangular gravel up to 20mm in size, M>Wp		D	1.0				
	1.5	Bore discontinued at 1.5m , limit of investigation							

Dynamic Penetrometer Test (blows per 150mm): 5, 10, 15, 20

RIG: Hand Tools **DRILLER:** Fuller / West **LOGGED:** West **CASING:** Uncased

TYPE OF BORING: 75mm diameter hand auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: RL 29.5m AHD
EASTING:
NORTHING:

PIT No: 402-1
PROJECT No: 71995.07
DATE: 3/5/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		TOPSOIL - Grey silty sand topsil, with rootlets and roots, humid							
	0.2	CONCRETE - 70mm depth							
	0.27	SANDSTONE/PEBBLY SANDSTONE - Medium strength, moderately weathered, yellow, fine to medium grained sandstone, with subangular to subrounded pebbles up to 25mm in size, dry							
	0.57	Pit discontinued at 0.57m, refusal on rock							
	1								1
	2								2

RIG: Hand tools
LOGGED: Goodall
SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed while augering

REMARKS: Descriptions of materials based on exposed conditions at bore location. *Surface level interpolated from plan provided by client

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: RL 29.5m AHD*
EASTING:
NORTHING:

PIT No: 402-2
PROJECT No: 71995.07
DATE: 3/5/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
		TOPSOIL - Generally comprising brown silty sand topsoil, with roots and rootlets, humid							
	0.3	FILLING - Generally comprising brown filling, sandy gravel with some clay, fine grained sand and subangular to subrounded gravel up to 10mm in size, dry							
	0.8	Pit discontinued at 0.8m, refusal on probable rock							
	1								1
	2								2

RIG: Hand tools

LOGGED: Goodall

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed while augering

REMARKS: Descriptions of materials based on exposed conditions at bore location. *Surface level interpolated from plan provided by client

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

TEST PIT LOG

CLIENT: Scentre Group Ltd
PROJECT: Stage 4 Redevelopment
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: RL 29.5m AHD*
EASTING:
NORTHING:

PIT No: 402-3
PROJECT No: 71995.07
DATE: 3/5/2016
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per mm) 5 10 15 20
	0.2	TOPSOIL - Generally comprising brown silty sand, fine grained sand, with rootlets, humid							
	0.4	CONGLOMERATE - Medium strength, moderately weathered, orange-grey conglomerate, with subangular to subrounded pebbles up to 25mm in size							
	1	Pit discontinued at 0.4m, refusal on probable rock							
	2								

RIG: Hand tools

LOGGED: Goodall

SURVEY DATUM: MGA94

WATER OBSERVATIONS: No free groundwater observed while augering

REMARKS: Descriptions of materials based on exposed conditions at bore location. *Surface level interpolated from plan provided by client

☐ Sand Penetrometer AS1289.6.3.3
☐ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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Photo 1: Pit 402/1

Photo 2: Pit 402/2

Douglas Partners Geotechnics / Environment / Groundwater	**Photo Plate – Pit 402** **Westfield Kotara Stage 4** **Northcott Drive, Kotara**	PROJECT: 71995.07 PLATE No: 7 REV: 0
	CLIENT: Scentre Group Ltd	DATE: 9.05.16

Photo 3: Pit 402/3

Douglas Partners Geotechnics / Environment / Groundwater	**Photo Plate – Pit 402** **Westfield Kotara Stage 4** **Northcott Drive, Kotara**	PROJECT: 71995.07 PLATE No: 8 REV: 0
	CLIENT: Scentre Group Ltd	DATE: 9.05.16

Photo 1: Concrete core from Bore 603

Photo 2: Concrete core from Bore 604

Douglas Partners Geotechnics / Environment / Groundwater	**Photo Plate – Concrete Cores** **Westfield Kotara Stage 4** **Northcott Drive, Kotara**	PROJECT: 71995.07 PLATE No: 9 REV: 0
	CLIENT: Scentre Group Ltd	DATE: 6.06.16

Photo 3: Concrete core from Bore 605

Douglas Partners Geotechnics / Environment / Groundwater	**Photo Plate – Concrete Cores** **Westfield Kotara Stage 4** **Northcott Drive, Kotara**	PROJECT: 71995.07 PLATE No: 10 REV: 0
	CLIENT: Scentre Group Ltd	DATE: 6.06.16

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Westfield Kotara Proposed Extensions, Stage 1
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 25.2 AHD*
EASTING: 379643
NORTHING: 6354431
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 71995.06
DATE: 10/2/2016
SHEET 1 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.05	ASPHALT										
		FILLING - Generally comprising dark brown sandy gravel filling, with fine to coarse grained sand and subrounded to subangular gravel up to 20mm in size, humid From 0.40m, medium grained										
	0.7	FILLING - Generally comprising grey / brown slightly sandy to sandy clay filling, with some subrounded to subangular gravel up to 10mm in size From 1.05m to 1.30m, sandstone boulders							S			22/140,-,- refusal (bouncing)
	1.3	SILTY CLAY - Firm to stiff, dark brown silty clay, with trace fine grained sand, M>Wp							U_{50}			
	2.2	CLAY - Stiff, grey clay, trace fine to coarse grained sand, trace gravel up to 10mm in size, M>Wp							U_{50}			
									S			2,3,4 N = 7 pp = 110-140
		From 4.0m, very stiff							S			pp = 400-440 5,9,12 N = 21

RIG: Truck Mounted Scout **DRILLER:** Total Drilling **LOGGED:** Benson / West **CASING:** HQ at 13.20m

TYPE OF BORING: Solid flight augering to 13.2m, then NMLC coring

WATER OBSERVATIONS: Seepage observed at 6.5m, free groundwater observed at 9.50m, whilst augering

REMARKS: Coordinates obtained using hand held GPS typical accuracy 5m ± 1.5m, 100% water loss from 16.0m *Surface level interpolated from Lidar topographic imagery and is approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Westfield Kotara Proposed Extensions, Stage 1
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 25.2 AHD*
EASTING: 379643
NORTHING: 6354431
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 71995.06
DATE: 10/2/2016
SHEET 2 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low / Very Low / Low / Medium / High / Very High / Ex High)	Water	Fracture Spacing (m) (0.01 / 0.05 / 0.10 / 0.50 / 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		CLAY - Stiff, grey clay, trace fine to coarse grained sand, trace gravel up to 10mm in size, M>Wp *(continued)*										
									S			4,8,10 N = 18 pp = 300-400
	6											
		From 6.50m, slightly sandy to sandy, with fine to coarse grained sand, some gravel up to 15mm in size				▷						
	7	At 7m, wet							S			pp = 200 6,7,10 N = 17
	8											
									S			6,8,13 N = 21 pp = 350-400
	9											
	9.5	CLAY - Very stiff, grey clay, trace silt, M>Wp				▼ 10-02-16						

RIG: Truck Mounted Scout **DRILLER:** Total Drilling **LOGGED:** Benson / West **CASING:** HQ at 13.20m

TYPE OF BORING: Solid flight augering to 13.2m, then NMLC coring

WATER OBSERVATIONS: Seepage observed at 6.5m, free groundwater observed at 9.50m, whilst augering

REMARKS: Coordinates obtained using hand held GPS typical accuracy 5m ± 1.5m, 100% water loss from 16.0m *Surface level interpolated from Lidar topographic imagery and is approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Westfield Kotara Proposed Extensions, Stage 1
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 25.2 AHD*
EASTING: 379643
NORTHING: 6354431
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 71995.06
DATE: 10/2/2016
SHEET 3 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Type	Core Rec. %	RQD %	Test Results & Comments
		CLAY - Very stiff, grey clay, trace silt, M>Wp *(continued)*							S			5,8,13 N = 21 pp = 350-450
		From 10.40m, mottled orange brown										
	11											
		From 11.50m, brown, with carbonaceous lenses up to about 5mm thickness										8,16,20 N = 36 pp = 350
	12											
	13 13.0	SILTSTONE - Extremely low strength, extremely weathered, grey siltstone (soil like properties)							S			31,-,- refusal
	13.2	SILTSTONE - Very low strength, moderately weathered, grey with orange/brown staining siltstone, with 20% interbedded, fine grained sandstone, with extremely low strength clay seams						13.25m: P, 5°, sh, planer, 5m 13.31m: P, sh, planer smooth 13.36m: P, 5°, pl, sm 13.41m: J, 35°, pl, sm, fr	C	100	47	PL(A) = 0.06 PL(A) = 0.1
	13.54	CONGLOMERATE - Medium strength, moderately weathered, grey and orange brown conglomerate, with subrounded / subangular pebbles up to 30mm in size, some extremely low to very low strength bands						13.49m: P, sh, pl, sm 13.51m: P, sh, pl, sm 13.71m: J, 15°, pl, ro, fe 13.74m: P, sh, pl, sm 13.79m: P, sh, pl, sm 13.82m: P, sh, pl, sm From 13.84m to 13.85m, fg 13.9m: J, 10°, pl, ro 14.38m: J, 80°, pl, partically healed, fe				PL(A) = 0.1
	14							14.7m: J, sv, pl, sm, fe	C	87		

RIG: Truck Mounted Scout **DRILLER:** Total Drilling **LOGGED:** Benson / West **CASING:** HQ at 13.20m

TYPE OF BORING: Solid flight augering to 13.2m, then NMLC coring

WATER OBSERVATIONS: Seepage observed at 6.5m, free groundwater observed at 9.50m, whilst augering

REMARKS: Coordinates obtained using hand held GPS typical accuracy 5m ± 1.5m, 100% water loss from 16.0m *Surface level interpolated from Lidar topographic imagery and is approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Westfield Kotara Proposed Extensions, Stage 1
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 25.2 AHD*
EASTING: 379643
NORTHING: 6354431
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 71995.06
DATE: 10/2/2016
SHEET 4 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering	Graphic Log	Rock Strength	Water	Fracture Spacing (m)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		CONGLOMERATE - Medium strength, moderately weathered, grey and orange brown conglomerate, with subrounded / subangular pebbles up to 30mm in size, some extremely low to very low strength bands *(continued)*						From 15.05m to 15.17m, fg				
		From 15.17m, fine to coarse grained, with some pebbles up to 10mm in size						15.28m: J, 35°, pl, ro 15.32m: P, sh, pl, ro 15.45m: J, 45°, pl, ro, fe	C	87		PL(D) = 0.31
16	16.0	From 15.88m, very low strength (friable)										
		CORE LOSS						16m: CORE LOSS: 700mm				
	16.7	CONGLOMERATE - Medium strength, moderately weathered, grey/brown congolmerate, with subangular to subrounded up to 20mm in size						16.78m: P, sh, pl, ro, fe 16.81m: P, sh, pl, ro, fe				PL(A) = 1.6
17		From 16.86m, high strength						17.26m: J, 30°, pl, ro, fe 17.34m: J, 70°, pl, ro, fe	C	77	1.27	PL(D) = 1.16
								17.58m: J, 70°, pl, ro, fe				
		From 17.82m, low strength						17.91m: J, 70°, pl, ro, fe				
18		From 17.97m, high strength, grey										
		From 18.13m, medium strength						18.16m: J, 70°, pl, ro, fe 18.2m: J, 80°, pl, ro, fe 18.28m: J, 10°, pl, healed				
	18.4	From 18.38m to 18.40m, extremely low strength, extremely weathered						18.33m: J, 5°, pl, ro, 5mm clay infill	C	100	0	
		SILTSTONE - Extremely low strength, extremely weathered, grey siltstone						18.7m: J, 40°, pl, sm				
	18.77	SILTSTONE - Low strength, slightly weathered, grey siltstone							C	10	100	PL(A) = 0.18
19		From 19.09m to 19.53m, low strength						19.15m: J, 80°, pl, 5mm clay infill 19.29m: P, sh, pl, sm				
		From 19.14m, 20% interbedded fine grained sandstone						19.52m: P, sh, pl, sm	C	100	92	PL(A) = 0.13
	19.84											

RIG: Truck Mounted Scout **DRILLER:** Total Drilling **LOGGED:** Benson / West **CASING:** HQ at 13.20m

TYPE OF BORING: Solid flight augering to 13.2m, then NMLC coring

WATER OBSERVATIONS: Seepage observed at 6.5m, free groundwater observed at 9.50m, whilst augering

REMARKS: Coordinates obtained using hand held GPS typical accuracy 5m ± 1.5m, 100% water loss from 16.0m *Surface level interpolated from Lidar topographic imagery and is approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	⊻	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Westfield Kotara Proposed Extensions, Stage 1
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 25.2 AHD*
EASTING: 379643
NORTHING: 6354431
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 71995.06
DATE: 10/2/2016
SHEET 5 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SANDSTONE - Extremely low strength, extremely weathered, grey fine grained sandstone *(continued)*						From 20m - 20.05m, fg	C	100	92	
	20.36	From 20.05m, low strength, slightly weathered										PL(D) = 0.26
	20.44	SILTSTONE - Low strength, slightly weathered, dark grey siltstone, with 10% interbedded fine grained sandstone										PL(A) = 0.29
		Bore discontinued at 20.44m, limit of investigation										
	21											
	22											
	23											
	24											

RIG: Truck Mounted Scout **DRILLER:** Total Drilling **LOGGED:** Benson / West **CASING:** HQ at 13.20m

TYPE OF BORING: Solid flight augering to 13.2m, then NMLC coring

WATER OBSERVATIONS: Seepage observed at 6.5m, free groundwater observed at 9.50m, whilst augering

REMARKS: Coordinates obtained using hand held GPS typical accuracy 5m ± 1.5m, 100% water loss from 16.0m *Surface level interpolated from Lidar topographic imagery and is approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Westfield Kotara Proposed Extensions, Stage 1
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 25.2 AHD*
EASTING: 379638
NORTHING: 6354418
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 71995.06
DATE: 11/2/2016
SHEET 1 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
	0.05	ASPHALT										
		FILLING - Generally comprising grey/brown sandy gravel filling, with fine to coarse grained sand and subrounded to subangular up to 10mm in size, trace clay, humid										
	0.6	FILLING - Generally comprising grey brown clay filling, trace subangular / subrounded gravel up to 10mm in size, M>Wp										
1		From 0.90m to 1.20m, boulder										
	1.2	SILTY CLAY - Firm to stiff, dark brown silty clay, trace fine grained sand, M>Wp							S			3,2,3 N = 5
2									U_{50}			pp = 100-140
												pp = 100-140
		From 2.50m, trace subangular / subrounded gravel up to 15mm							S			2,2,2 N = 4 pp = 60-80
3												
4	4.0	CLAY - Stiff to very stiff grey clay, trace fine to coarse grained sand, M>Wp							S			pp = 200-300 4,5,9 N = 14

RIG: Truck Mounted Scout **DRILLER:** Total Drilling **LOGGED:** Benson / West **CASING:** HQ at 9.0m

TYPE OF BORING: Solid flight augering to 9m, wash bore to 14.50, then NMLC coring to 21.55m

WATER OBSERVATIONS: Free groundwater observed at 3.70m, whilst augering

REMARKS: Coordinates obtained using hand held GPS typical accuracy 5m ± 1.5m, 100% water loss from 16.0m *Surface level interpolated from Lidar topographic imagery and is approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Westfield Kotara Proposed Extensions, Stage 1
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 25.2 AHD*
EASTING: 379638
NORTHING: 6354418
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 71995.06
DATE: 11/2/2016
SHEET 2 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		CLAY - Stiff to very stiff grey clay, trace fine to coarse grained sand, M>Wp *(continued)*										
	5.5	SANDY CLAY - Stiff to very stiff, grey fine to coarse grained sandy clay, trace subrounded to subangular gravel up to 20mm in size, M>Wp							S			pp = 200-250 6,10,17 N = 27
6												
7	7.0	GRAVELLY CLAY - Very stiff, grey/brown gravelly clay, subrounded to subangular gravel up to 15mm in size, M>Wp							S			6,9,13 N = 22 pp = 300-350
8												
	8.5	CLAY - Very stiff, green/grey, slightly gravelly clay, subrounded to subangular gravel up to 20mm in size, M>Wp							S			pp = 450-500 4,8,12 N = 20
9												

RIG: Truck Mounted Scout **DRILLER:** Total Drilling **LOGGED:** Benson / West **CASING:** HQ at 9.0m

TYPE OF BORING: Solid flight augering to 9m, wash bore to 14.50, then NMLC coring to 21.55m

WATER OBSERVATIONS: Free groundwater observed at 3.70m, whilst augering

REMARKS: Coordinates obtained using hand held GPS typical accuracy 5m ± 1.5m, 100% water loss from 16.0m *Surface level interpolated from Lidar topographic imagery and is approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Westfield Kotara Proposed Extensions, Stage 1
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 25.2 AHD*
EASTING: 379638
NORTHING: 6354418
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 71995.06
DATE: 11/2/2016
SHEET 3 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		CLAY - Very stiff, green/grey, slightly gravelly clay, subrounded to subangular gravel up to 20mm in size, M>Wp *(continued)*							S			pp = 400-450 10,12,15 N = 27
	11	From 10m, grey mottled orange, trace gravel										
		From 11.50m, very stiff to hard										
		From 11.50m, very stiff to hard carbonaceous in parts, with occasional coal lenses up to 30mm thick							S			pp = 450-500 9,13,15 N = 28
	12											
	13								S			pp >600 9,15,29 N = 44
	14											
	14.5	SILTSTONE - Extremely low strength, extremely weathered, grey brown stained siltstone						From 14.50m to 14.59m, fg	C	100	93	PL(D) = 0.05 PL(A) = 0.09
	14.67	From 14.60m, very low strength, slightly weathered										PL(A) = 0.13

RIG: Truck Mounted Scout **DRILLER:** Total Drilling **LOGGED:** Benson / West **CASING:** HQ at 9.0m

TYPE OF BORING: Solid flight augering to 9m, wash bore to 14.50, then NMLC coring to 21.55m

WATER OBSERVATIONS: Free groundwater observed at 3.70m, whilst augering

REMARKS: Coordinates obtained using hand held GPS typical accuracy 5m ± 1.5m, 100% water loss from 16.0m *Surface level interpolated from Lidar topographic imagery and is approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
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BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Westfield Kotara Proposed Extensions, Stage 1
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 25.2 AHD*
EASTING: 379638
NORTHING: 6354418
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 71995.06
DATE: 11/2/2016
SHEET 4 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SANDSTONE - Low strength, slightly weathered, light grey, fine grained sandstone, 20% interbedded siltstone *(continued)*										
		From 15.30m, very low strength										PL(D) = 0.08 PL(A) = 0.07
								15.72m: J, 30°, pl, ro				
								15.82m: J, 30°, pl, ro				
	16							15.95m: J, 80°, pl, ro				
	16.23	SANDSTONE - Medium strength, highly weathered, grey stained orange/brown, fine to coarse grained sandstone							C	100	93	PL(A) = 0.45
								16.26m: J, 5°, pl, ro, fe				
								16.36m: P, sh, pl, ro, fe				
								16.4m: J, 15°, pl, ro, fe				PL(A) = 0.34
		From 16.50m, some pebbly bands										
	16.6	CONGLOMERATE - Medium strength, highly weathered, orange/grey conglomerate, with subrounded to subangular pebbles up to 30mm in size										
								16.75m: J, 30°, pl, ro, fe				
	17	From 17m to 17.10m, very low strength, friable						16.95m: J, 60°, pl, ro				PL(D) = 0.38
								17.21m: J, 30°, pl, ro, fe				
		From 17.81m grey, slightly weathered						17.86m: P, 10°, pl, ro, fe				
	18											
								18.54m: J, 15°, pl, ro	C	100	78	PL(A) = 0.86
												PL(A) = 0.55
	19											
								19.3m: P, sh, pl, ro, fe				
								19.37m: J, 20°, pl, ro, fe				
	19.5	SANDSTONE - High strength, slightly weathered, light grey, fine to coarse grained sandstone						19.42m: J, 20°, un, ro, fe				PL(A) = 1.11
								19.84m: J, 50°, pl, ro				
	19.92							19.86m: J, 50°, pl, ro, fe				

RIG: Truck Mounted Scout **DRILLER:** Total Drilling **LOGGED:** Benson / West **CASING:** HQ at 9.0m

TYPE OF BORING: Solid flight augering to 9m, wash bore to 14.50, then NMLC coring to 21.55m

WATER OBSERVATIONS: Free groundwater observed at 3.70m, whilst augering

REMARKS: Coordinates obtained using hand held GPS typical accuracy 5m ± 1.5m, 100% water loss from 16.0m *Surface level interpolated from Lidar topographic imagery and is approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Scentre Group Ltd
PROJECT: Westfield Kotara Proposed Extensions, Stage 1
LOCATION: Northcott Drive, Kotara

SURFACE LEVEL: 25.2 AHD*
EASTING: 379638
NORTHING: 6354418
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 71995.06
DATE: 11/2/2016
SHEET 5 OF 5

RL	Depth (m)	Description of Strata	Degree of Weathering (EW HW MW SW FS FR)	Graphic Log	Rock Strength (Ex Low, Very Low, Low, Medium, High, Very High, Ex High)	Water	Fracture Spacing (m) (0.01, 0.05, 0.10, 0.50, 1.00)	Discontinuities (B - Bedding, J - Joint, S - Shear, F - Fault)	Sampling & In Situ Testing: Type	Core Rec. %	RQD %	Test Results & Comments
		SILTSTONE - Extremely low strength, extremely weathered, grey siltstone *(continued)*						From 19.92m to 20.12m, fg				
		From 20.05m to 20.08m, low strength						20.22m: P, sh, pl, ro				PL(A) = 0.12
		From 20.12m to 20.80m, low strength						20.68m: P, 5°, pl, ro	C	100	19	
	21							21.06m: P, sh, pl, ro				
	21.26	SANDSTONE - Low strength, slightly weathered, light grey, fine to coarse grained sandstone										PL(A) = 0.25
	21.55	Bore discontinued at 21.55m, limit of investigation										
	22											
	23											
	24											

RIG: Truck Mounted Scout **DRILLER:** Total Drilling **LOGGED:** Benson / West **CASING:** HQ at 9.0m

TYPE OF BORING: Solid flight augering to 9m, wash bore to 14.50, then NMLC coring to 21.55m

WATER OBSERVATIONS: Free groundwater observed at 3.70m, whilst augering

REMARKS: Coordinates obtained using hand held GPS typical accuracy 5m ± 1.5m, 100% water loss from 16.0m *Surface level interpolated from Lidar topographic imagery and is approximate only

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Appendix C

Pile Capacity Estimate Charts
Table C1 – Summary of Franki-pile Installation Record in Vicinity of Test Locations
Plates C1 to C4 – Lateral Pile Calculation Charts

PILE CAPACITY ESTIMATE

PILE TYPE: Grout-Injected
PILE SHAPE: Round
PILE SIZE: Diameter = 0.75
STRENGTH REDUCTION FACTOR $Ø_g$: 0.62
CALCULATION METHOD: Douglas Method

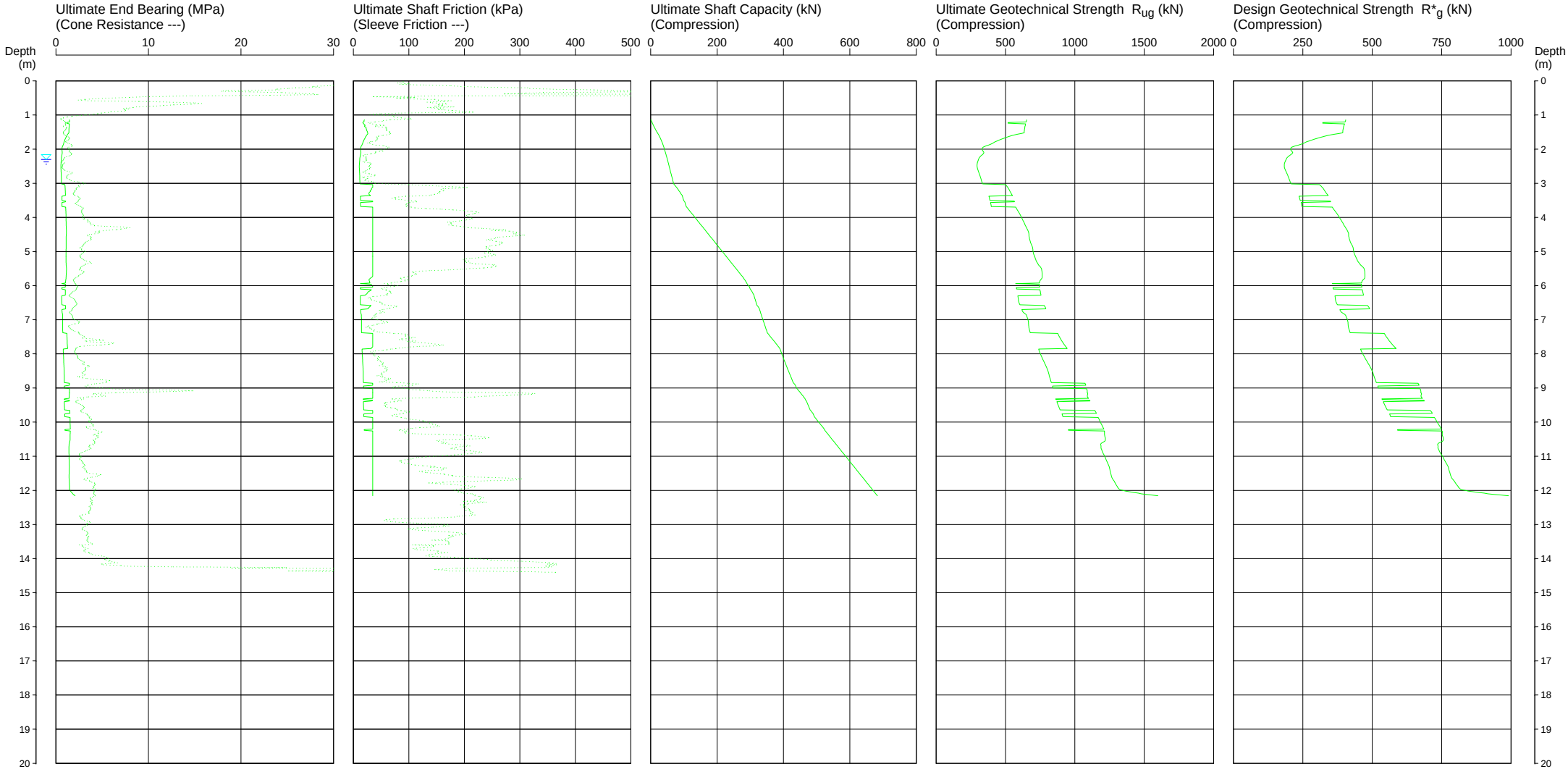
PROJECT: KOTARA SHOPPING CENTRE - STAGE 4 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

CLIENT: SCENTRE GROUP LTD

CPT101

DATE 18/04/2016
PROJECT No: 71995.07
SURFACE RL: 23.3m AHD*



DISCLAIMER:
These capacities have been estimated using accepted static theory, and are a guide only. Suitable verification procedures should be adopted (refer to AS2159), and piling contractors should confirm pile suitability and capacities. Structural capacity should be checked, and due allowance made for inclined or eccentric loads, and possible corrosion effects.

Water depth after test: 2.30m depth

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT101.CP5
Cone ID: 120618 **Type:** I-CFXY-10

ConePile Version 5.9.1

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PILE CAPACITY ESTIMATE

PILE TYPE: Grout-Injected
PILE SHAPE: Round
PILE SIZE: Diameter = 0.90
STRENGTH REDUCTION FACTOR $Ø_g$: 0.62
CALCULATION METHOD: Douglas Method

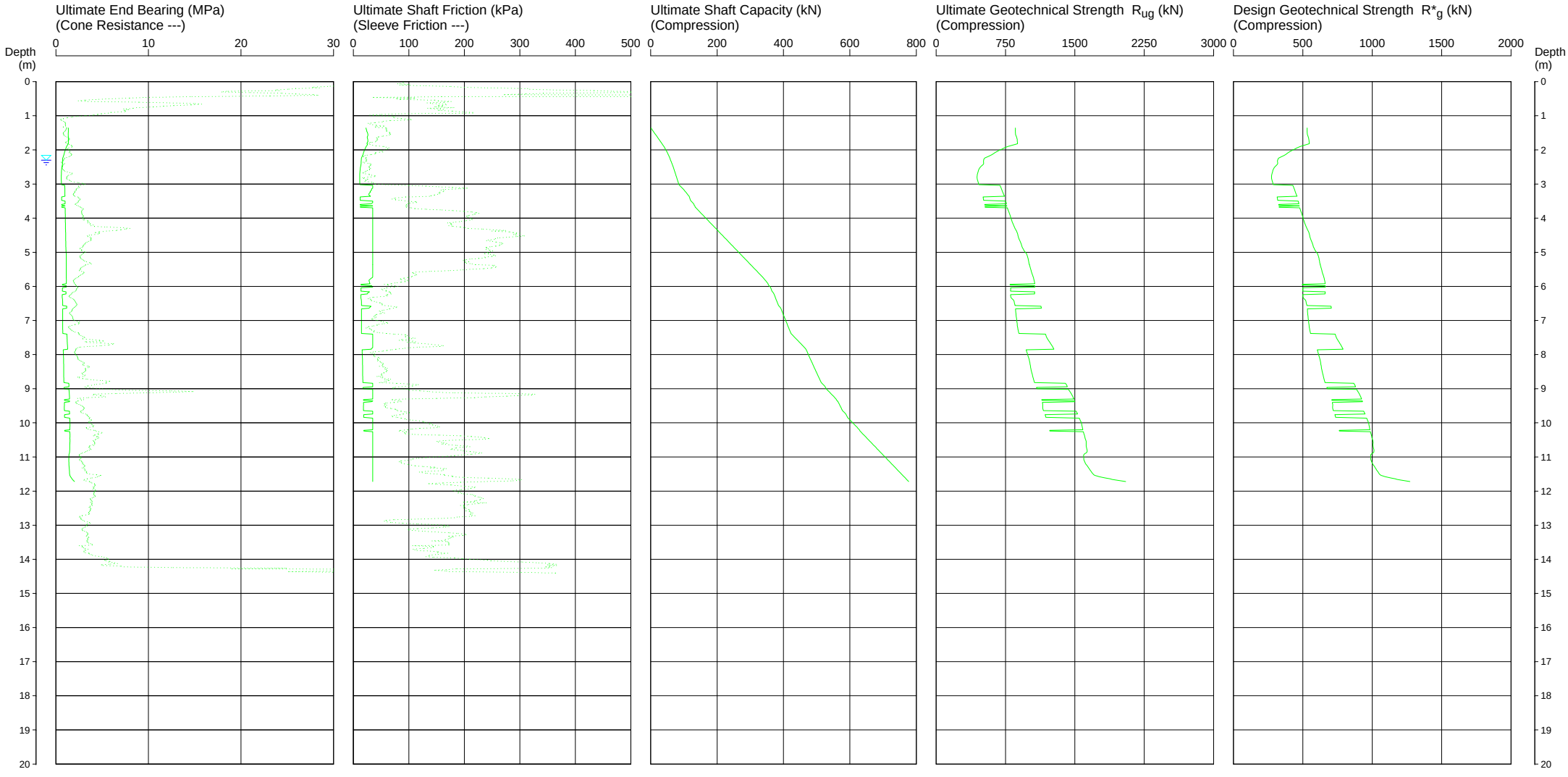
PROJECT: KOTARA SHOPPING CENTRE - STAGE 3 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

CLIENT: SCENTRE GROUP LTD

CPT101

DATE 18/04/2016
PROJECT No: 71995.07
SURFACE RL:



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Water depth after test: 2.30m depth

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT101.CP5
Cone ID: 120618 **Type:** I-CFXY-10

ConePile Version 5.9.1

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PILE CAPACITY ESTIMATE

PILE TYPE: Grout-Injected
PILE SHAPE: Round
PILE SIZE: Diameter = 1.05
STRENGTH REDUCTION FACTOR $Ø_g$: 0.62
CALCULATION METHOD: Douglas Method

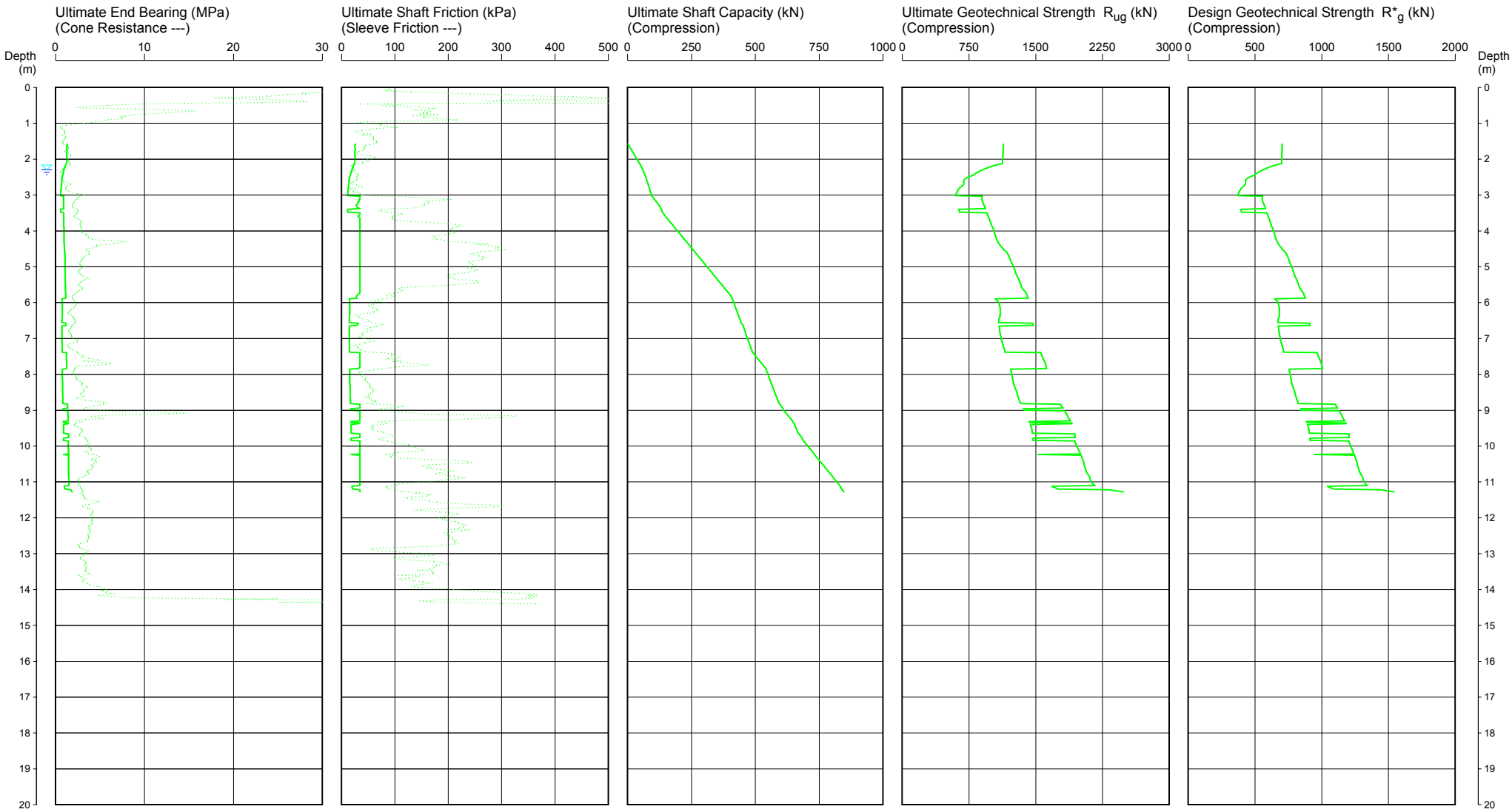
PROJECT: KOTARA SHOPPING CENTRE - STAGE 3 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

CLIENT: SCENTRE GROUP LTD

CPT101

DATE 4/18/2016
PROJECT No: 71995.07
SURFACE RL:



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Water depth after test: 2.30m depth

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT101.CP5
Cone ID: 120618 **Type:** I-CFXY-10

ConePile Version 5.9.1

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PILE CAPACITY ESTIMATE

PILE TYPE: Grout-Injected
PILE SHAPE: Round
PILE SIZE: Diameter = 0.75
STRENGTH REDUCTION FACTOR $Ø_g$: 0.62
CALCULATION METHOD: Douglas Method

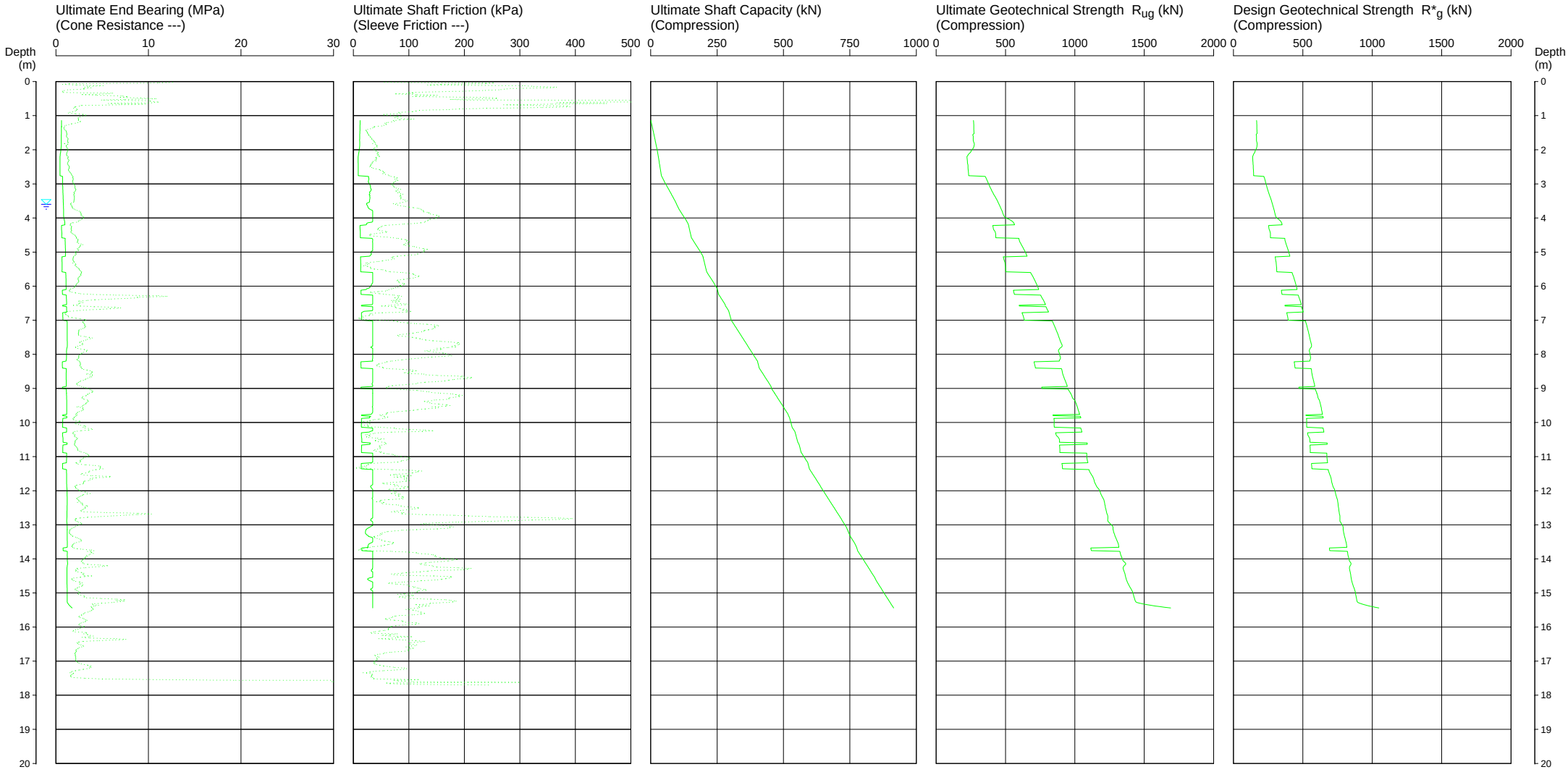
PROJECT: KOTARA SHOPPING CENTRE - STAGE 4 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

CLIENT: SCENTRE GROUP LTD

CPT102

DATE 21/04/2016
PROJECT No: 71995.07
SURFACE RL: 24.0 m AHD*



DISCLAIMER:
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Water depth after test: 3.60m depth

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT102.CP5
Cone ID: 120618 **Type:** I-CFXY-10

ConePile Version 5.9.1

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PILE CAPACITY ESTIMATE

PILE TYPE: Grout-Injected
PILE SHAPE: Round
PILE SIZE: Diameter = 0.90
STRENGTH REDUCTION FACTOR $Ø_g$: 0.62
CALCULATION METHOD: Douglas Method

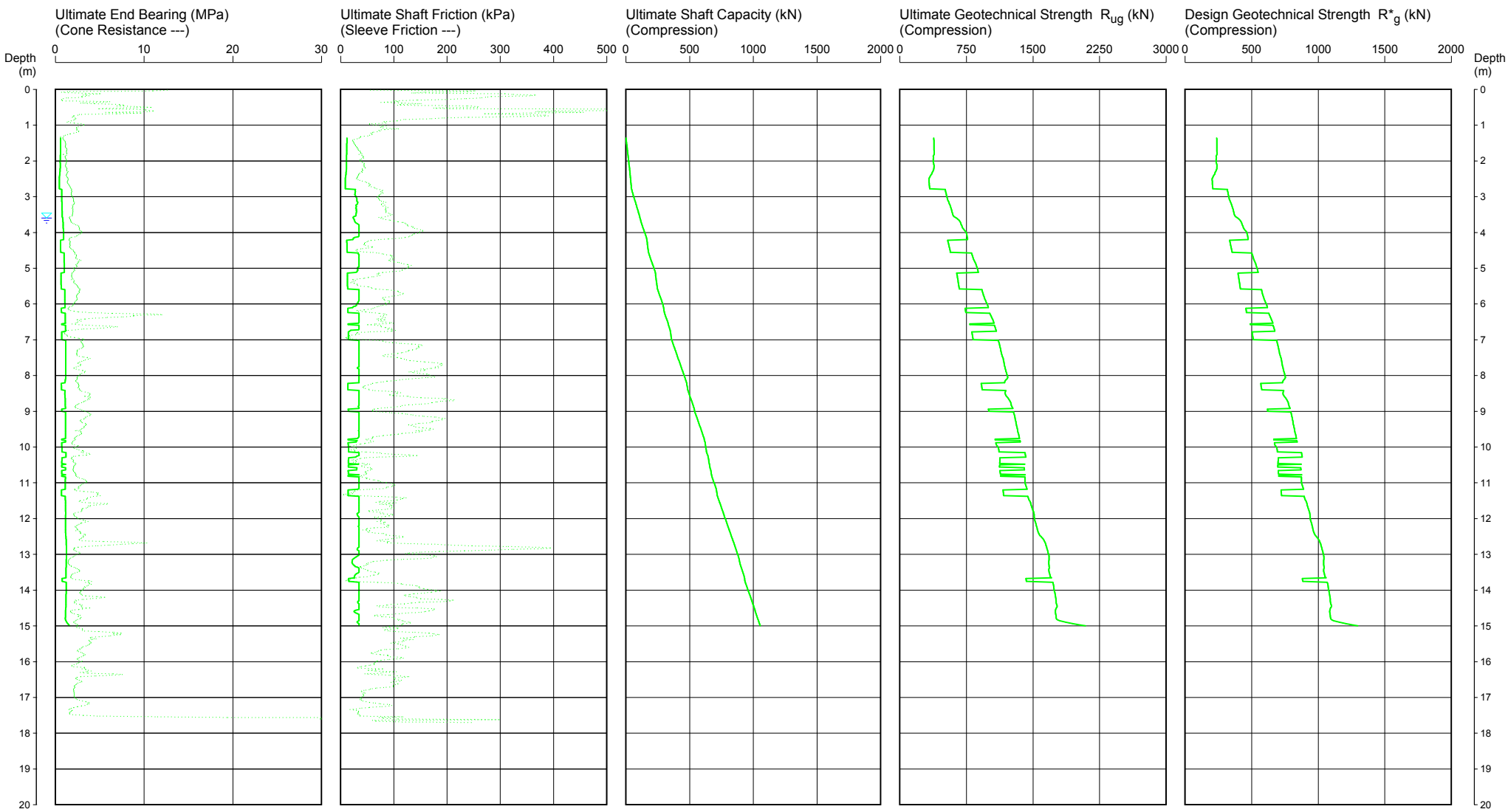
PROJECT: KOTARA SHOPPING CENTRE - STAGE 3 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

CLIENT: SCENTRE GROUP LTD

CPT102

DATE 4/21/2016
PROJECT No: 71995.07
SURFACE RL:



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Water depth after test: 3.60m depth

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT102.CP5
Cone ID: 120618 **Type:** I-CFXY-10

ConePile Version 5.9.1

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PILE CAPACITY ESTIMATE

PILE TYPE: Grout-Injected
PILE SHAPE: Round
PILE SIZE: Diameter = 1.05
STRENGTH REDUCTION FACTOR $Ø_g$: 0.62
CALCULATION METHOD: Douglas Method

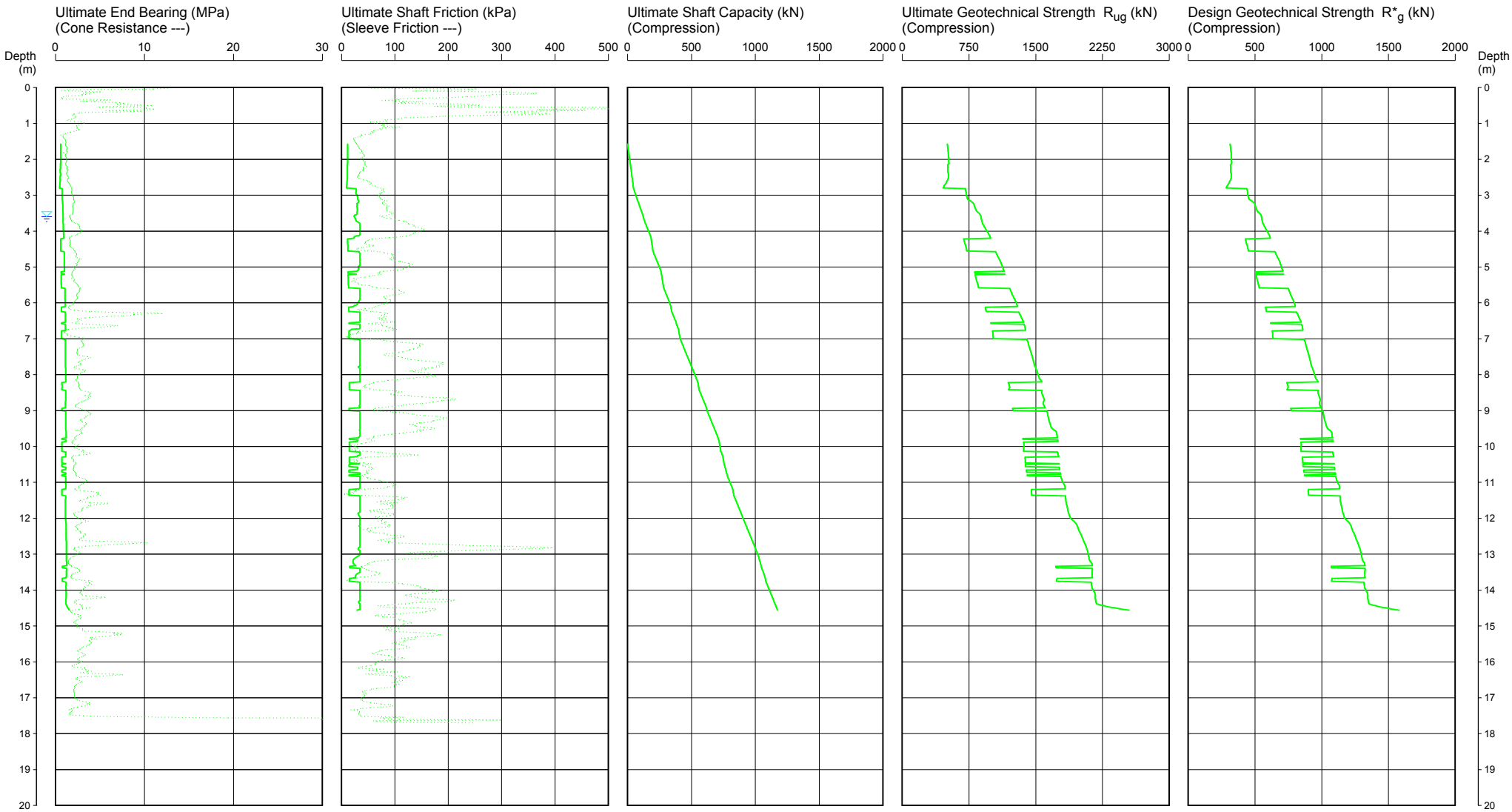
PROJECT: KOTARA SHOPPING CENTRE - STAGE 3 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

CLIENT: SCENTRE GROUP LTD

CPT102

DATE 4/21/2016
PROJECT No: 71995.07
SURFACE RL:



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Water depth after test: 3.60m depth

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT102.CP5
Cone ID: 120618 **Type:** I-CFXY-10

ConePile Version 5.9.1

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PILE CAPACITY ESTIMATE

PILE TYPE: Grout-Injected
PILE SHAPE: Round
PILE SIZE: Diameter = 0.75
STRENGTH REDUCTION FACTOR $Ø_g$: 0.62
CALCULATION METHOD: LCPC Method

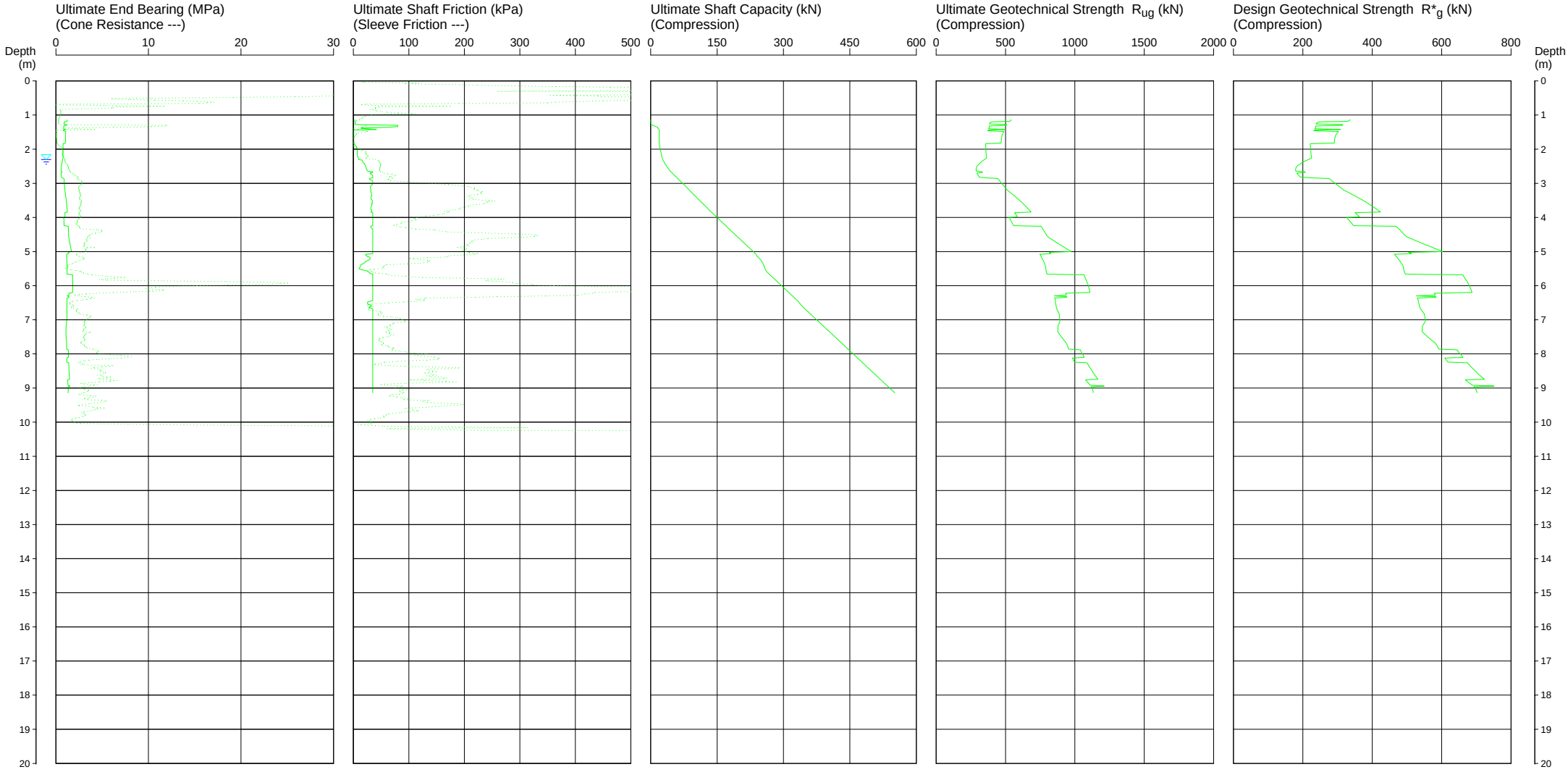
PROJECT: KOTARA SHOPPING CENTRE - STAGE 4 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

CLIENT: SCENTRE GROUP LTD

CPT104

DATE 19/04/2016
PROJECT No: 71995.07
SURFACE RL: 24.0 m AHD*



DISCLAIMER:
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Water depth after test: 2.30m depth

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT104.CP5
Cone ID: 120618 **Type:** I-CFXY-10

ConePile Version 5.9.1

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PILE CAPACITY ESTIMATE

PILE TYPE: Grout-Injected
PILE SHAPE: Round
PILE SIZE: Diameter = 0.90
STRENGTH REDUCTION FACTOR $Ø_g$: 0.62
CALCULATION METHOD: Douglas Method

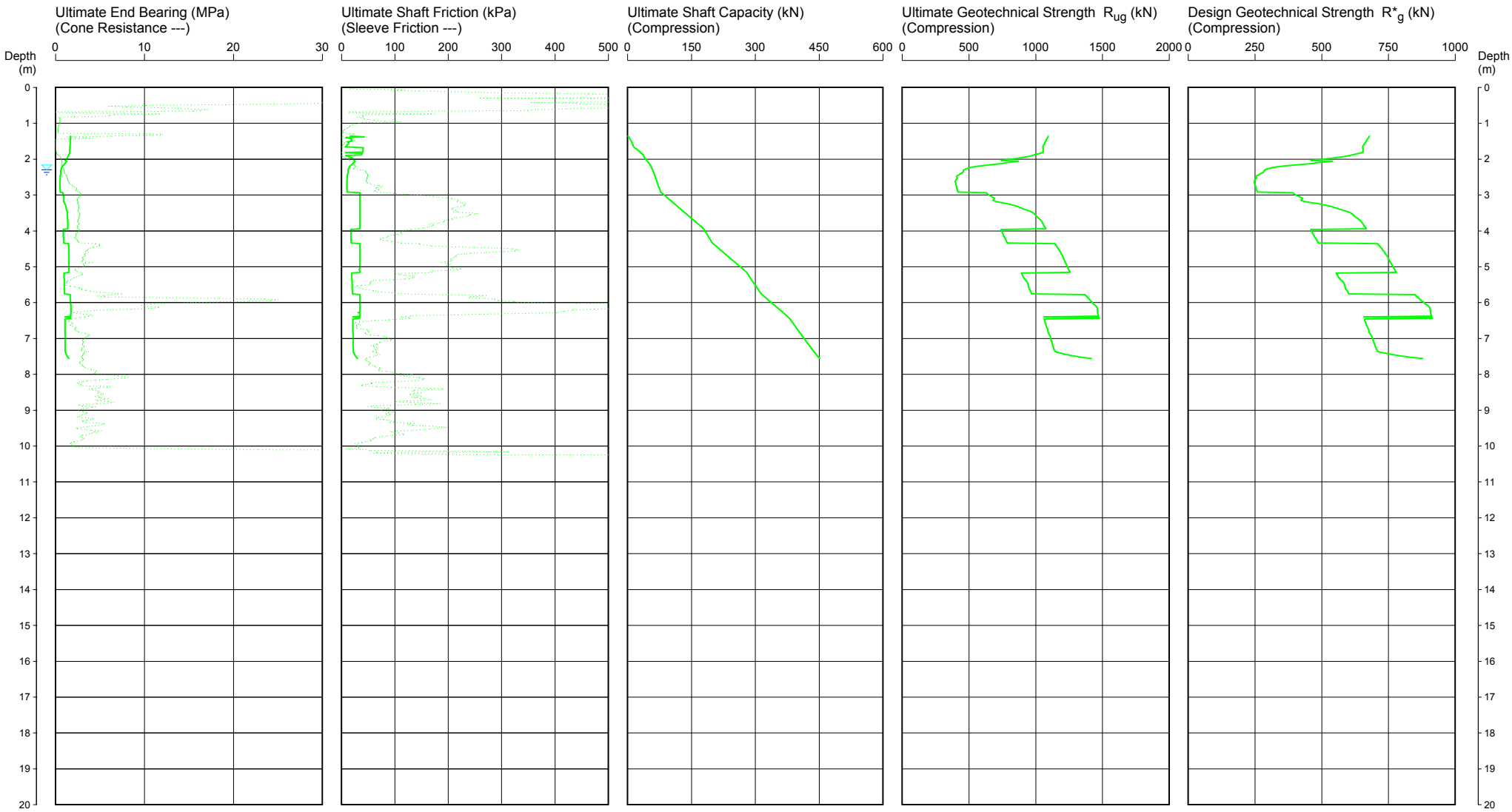
PROJECT: KOTARA SHOPPING CENTRE - STAGE 3 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

CLIENT: SCENTRE GROUP LTD

CPT104

DATE 4/19/2016
PROJECT No: 71995.07
SURFACE RL:



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Water depth after test: 2.30m depth

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT104.CP5
Cone ID: 120618 **Type:** I-CFXY-10

ConePile Version 5.9.1

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PILE CAPACITY ESTIMATE

PILE TYPE: Grout-Injected
PILE SHAPE: Round
PILE SIZE: Diameter = 1.05
STRENGTH REDUCTION FACTOR $Ø_g$: 0.62
CALCULATION METHOD: Douglas Method

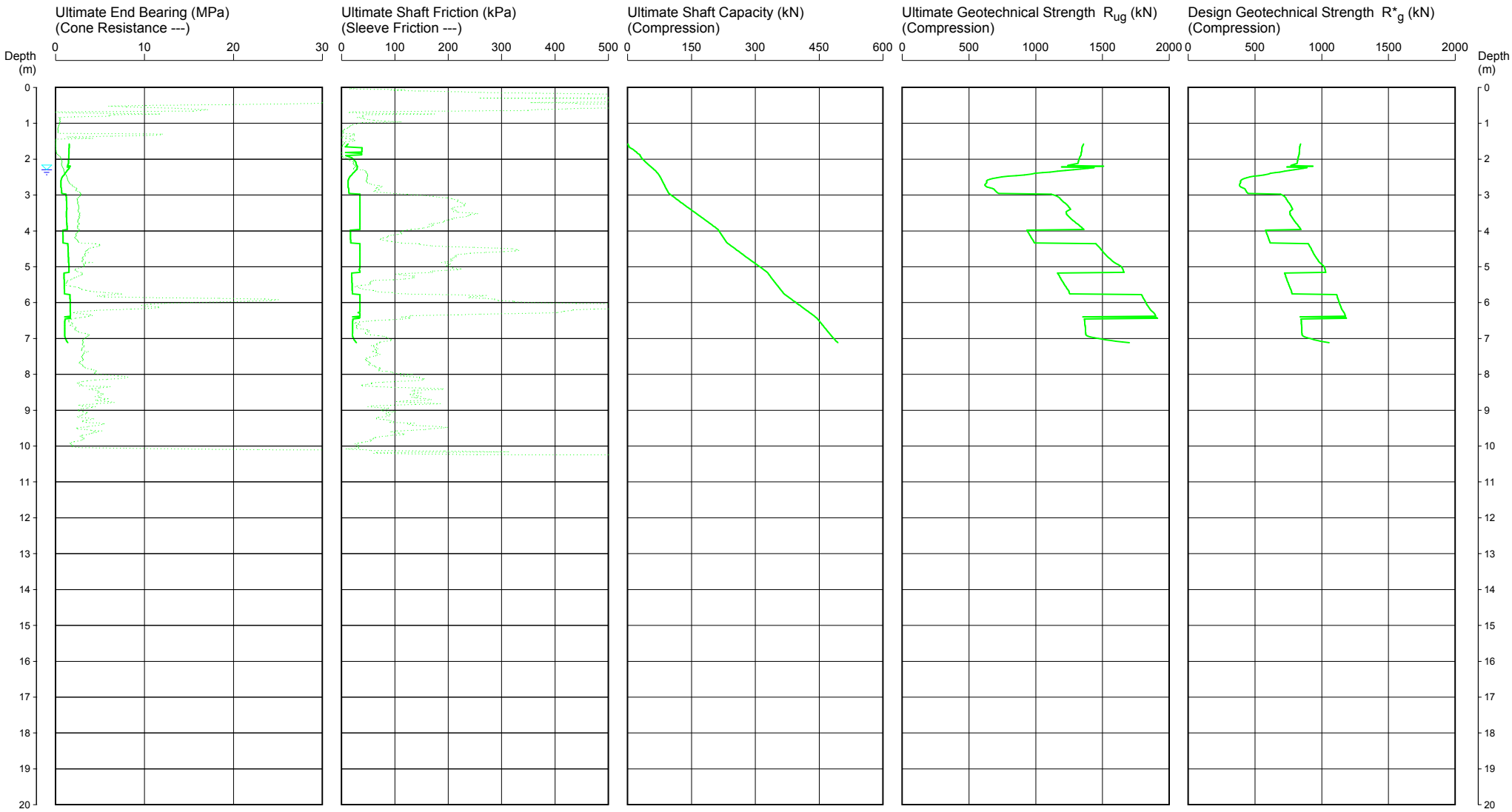
PROJECT: KOTARA SHOPPING CENTRE - STAGE 3 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

CLIENT: SCENTRE GROUP LTD

CPT104

DATE 4/19/2016
PROJECT No: 71995.07
SURFACE RL:



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These capacities have been estimated using accepted static theory, and are a guide only. Suitable verification procedures should be adopted (refer to AS2159), and piling contractors should confirm pile suitability and capacities. Structural capacity should be checked, and due allowance made for inclined or eccentric loads, and possible corrosion effects.

Water depth after test: 2.30m depth

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT104.CP5
Cone ID: 120618 **Type:** I-CFXY-10

ConePile Version 5.9.1

Douglas Partners
Geotechnics / Environment / Groundwater

PILE CAPACITY ESTIMATE

PILE TYPE: Grout-Injected
PILE SHAPE: Round
PILE SIZE: Diameter = 0.75
STRENGTH REDUCTION FACTOR $Ø_g$: 0.62
CALCULATION METHOD: LCPC Method

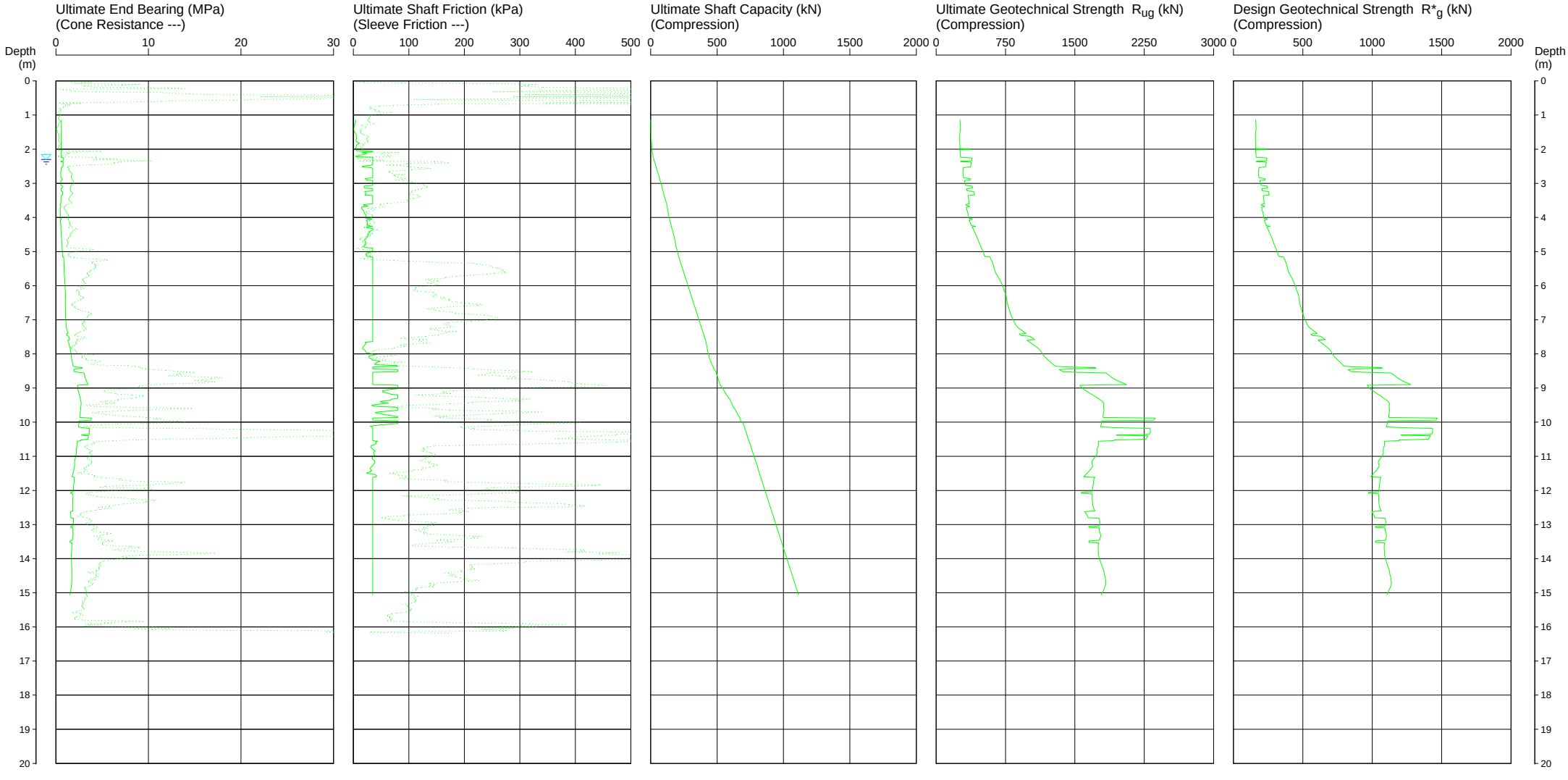
PROJECT: KOTARA SHOPPING CENTRE - STAGE 4 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

CLIENT: SCENTRE GROUP LTD

CPT105

DATE 20/04/2016
PROJECT No: 71995.07
SURFACE RL: RL 25.2 m AHD*



DISCLAIMER:
These capacities have been estimated using accepted static theory, and are a guide only. Suitable verification procedures should be adopted (refer to AS2159), and piling contractors should confirm pile suitability and capacities. Structural capacity should be checked, and due allowance made for inclined or eccentric loads, and possible corrosion effects.

Water depth after test: 2.30m depth

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT105.CP5
Cone ID: 120618 **Type:** I-CFXY-10

ConePile Version 5.9.1

Douglas Partners
Geotechnics | Environment | Groundwater

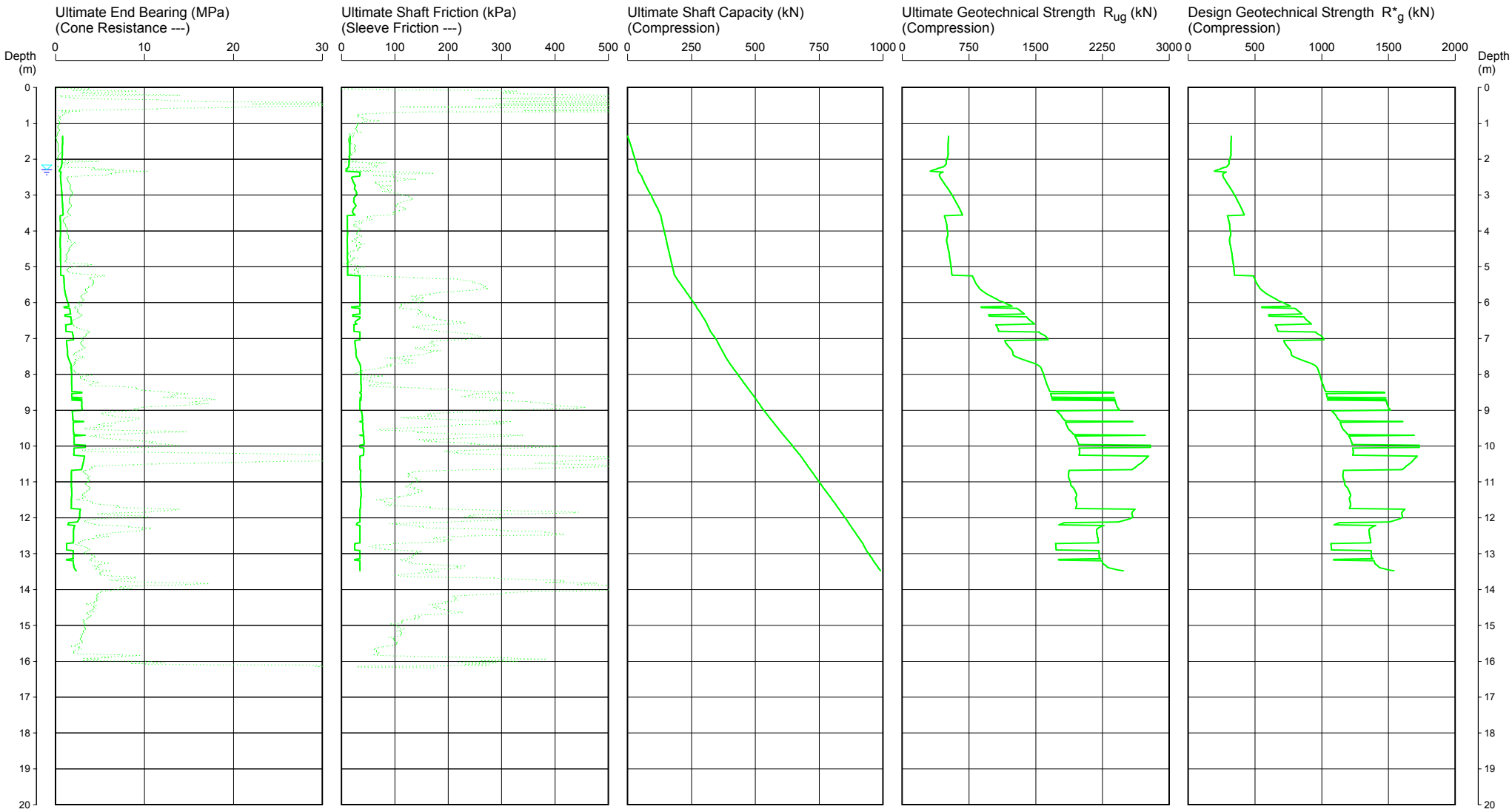
PILE CAPACITY ESTIMATE

PILE TYPE: Grout-Injected
PILE SHAPE: Round
PILE SIZE: Diameter = 0.90
STRENGTH REDUCTION FACTOR $Ø_g$: 0.62
CALCULATION METHOD: Douglas Method

PROJECT: KOTARA SHOPPING CENTRE - STAGE 3 EXPANSION
LOCATION: NORTHCOTT DRIVE, KOTARA
CLIENT: SCENTRE GROUP LTD

CPT105

DATE 4/20/2016
PROJECT No: 71995.07
SURFACE RL:



DISCLAIMER:
These capacities have been estimated using accepted static theory, and are a guide only. Suitable verification procedures should be adopted (refer to AS2159), and piling contractors should confirm pile suitability and capacities. Structural capacity should be checked, and due allowance made for inclined or eccentric loads, and possible corrosion effects.

Water depth after test: 2.30m depth

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT105.CP5
Cone ID: 120618 **Type:** I-CFXY-10

ConePile Version 5.9.1

Douglas Partners
Geotechnics / Environment / Groundwater

PILE CAPACITY ESTIMATE

PILE TYPE: Grout-Injected
PILE SHAPE: Round
PILE SIZE: Diameter = 1.05
STRENGTH REDUCTION FACTOR $Ø_g$: 0.62
CALCULATION METHOD: Douglas Method

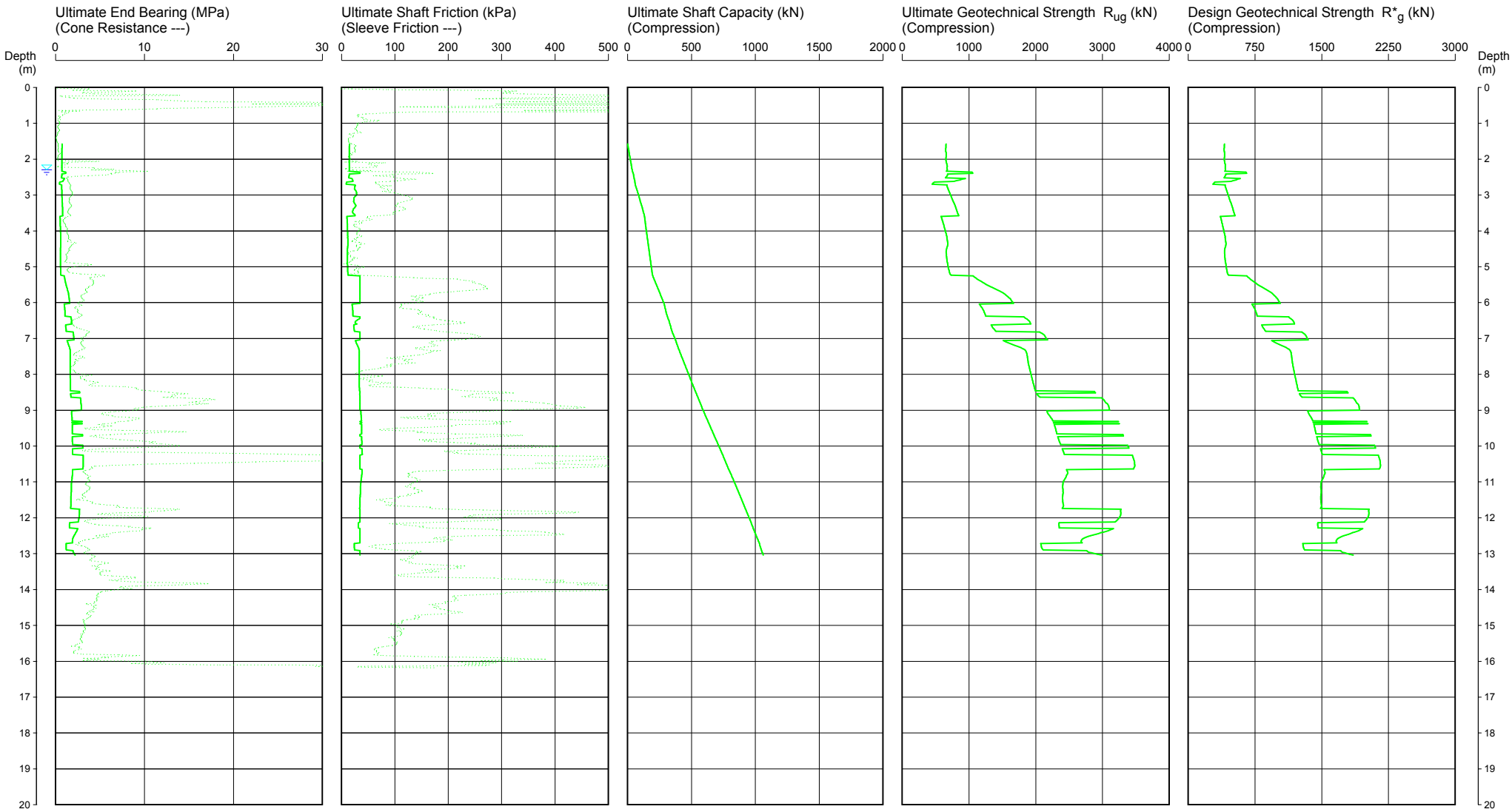
PROJECT: KOTARA SHOPPING CENTRE - STAGE 3 EXPANSION

LOCATION: NORTHCOTT DRIVE, KOTARA

CLIENT: SCENTRE GROUP LTD

CPT105

DATE 4/20/2016
PROJECT No: 71995.07
SURFACE RL:



DISCLAIMER:
These capacities have been estimated using accepted static theory, and are a guide only. Suitable verification procedures should be adopted (refer to AS2159), and piling contractors should confirm pile suitability and capacities. Structural capacity should be checked, and due allowance made for inclined or eccentric loads, and possible corrosion effects.

Water depth after test: 2.30m depth

File: P:\71995.07 - KOTARA, Westfield Kotara, Stage 4\4.0 Field Work\4.2 Testing\CPT105.CP5
Cone ID: 120618 **Type:** I-CFXY-10

ConePile Version 5.9.1

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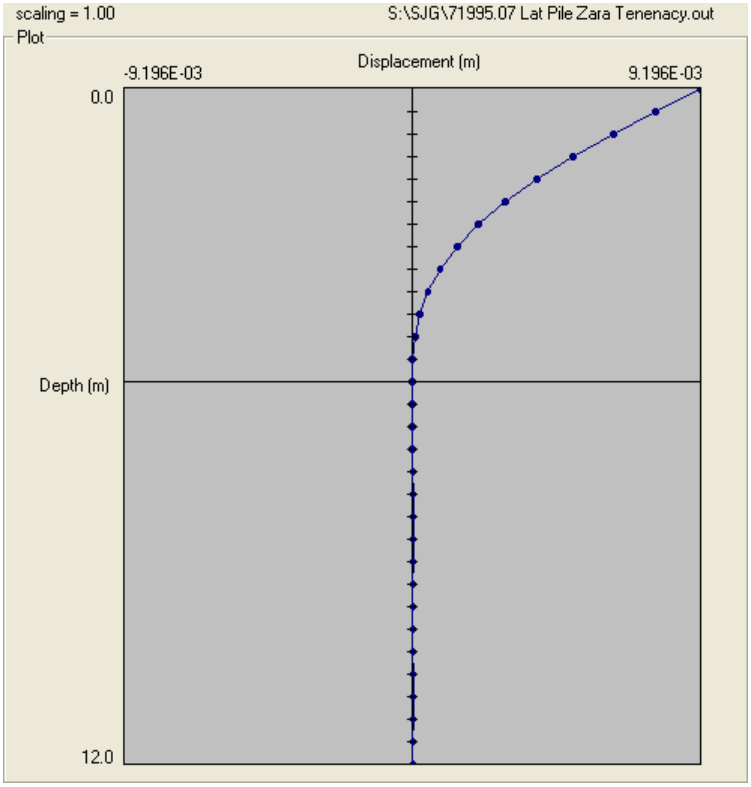
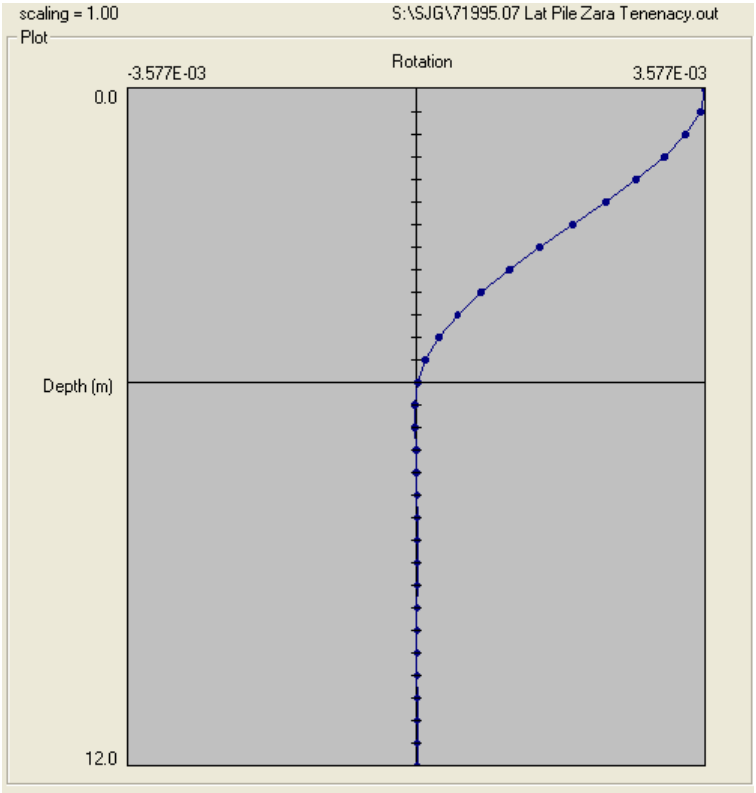
Geotechnics / Environment / Groundwater

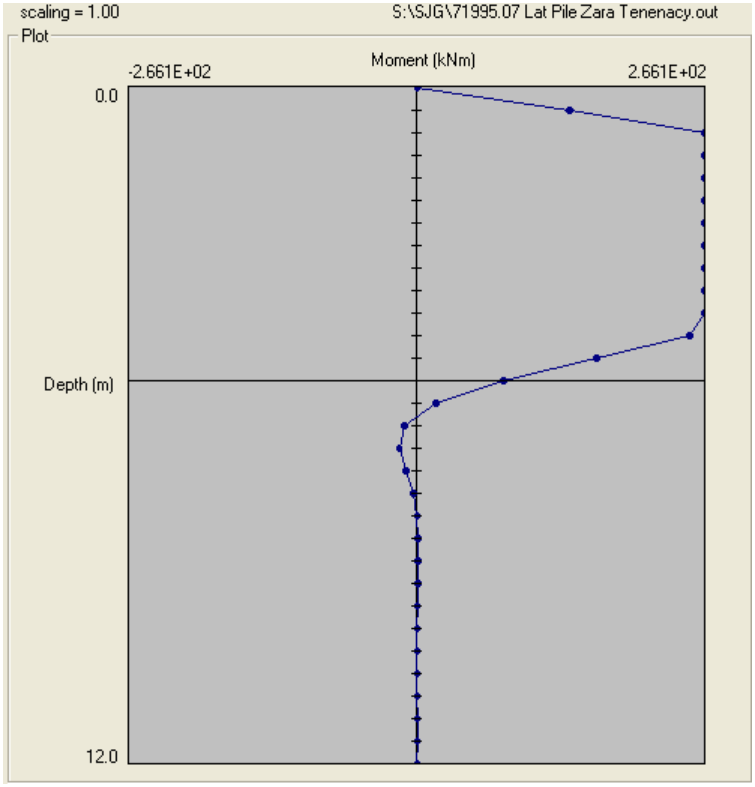


Displacement Plot

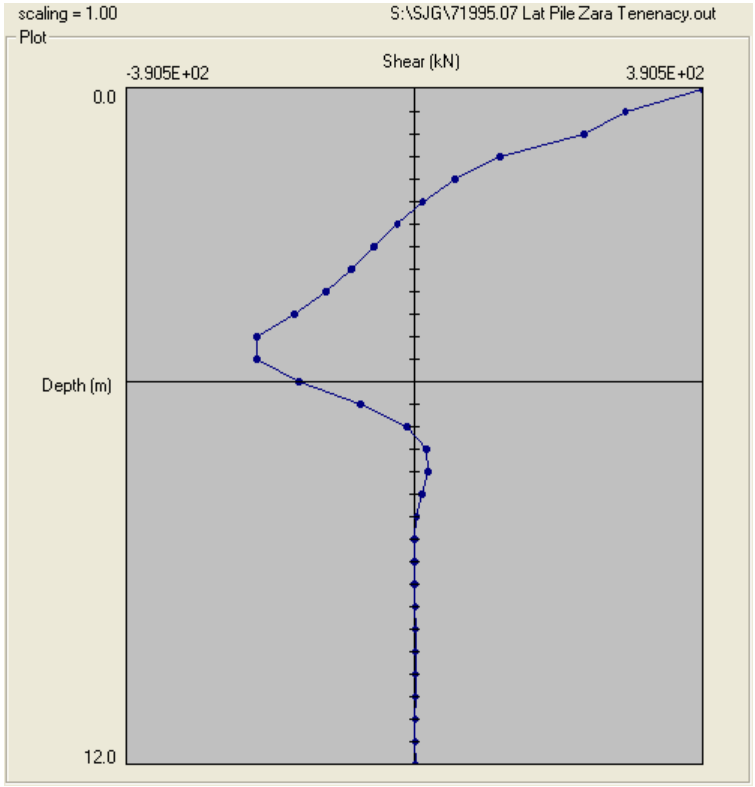


Rotation Plot

Douglas Partners Geotechnics / Environment / Groundwater	**Pygmy Output** **Westfield Kotara Stage 4 – Proposed IMM02 Tenancy** **Northcott Drive, Kotara**	PROJECT: 71995.07 PLATE No: C1 REV: 0
	CLIENT: Scentre Group Ltd	DATE: 24.05.16

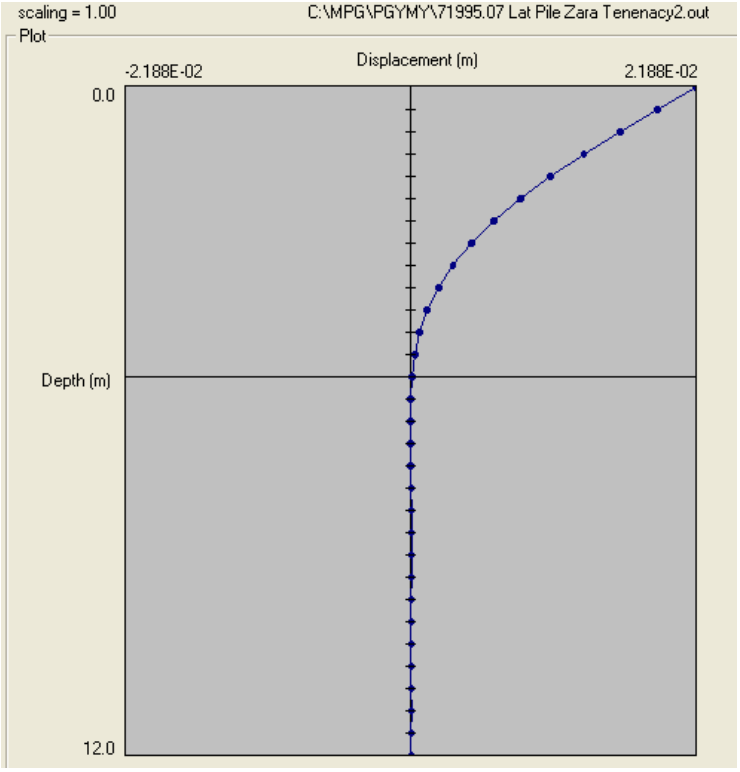


Bending Moment Plot

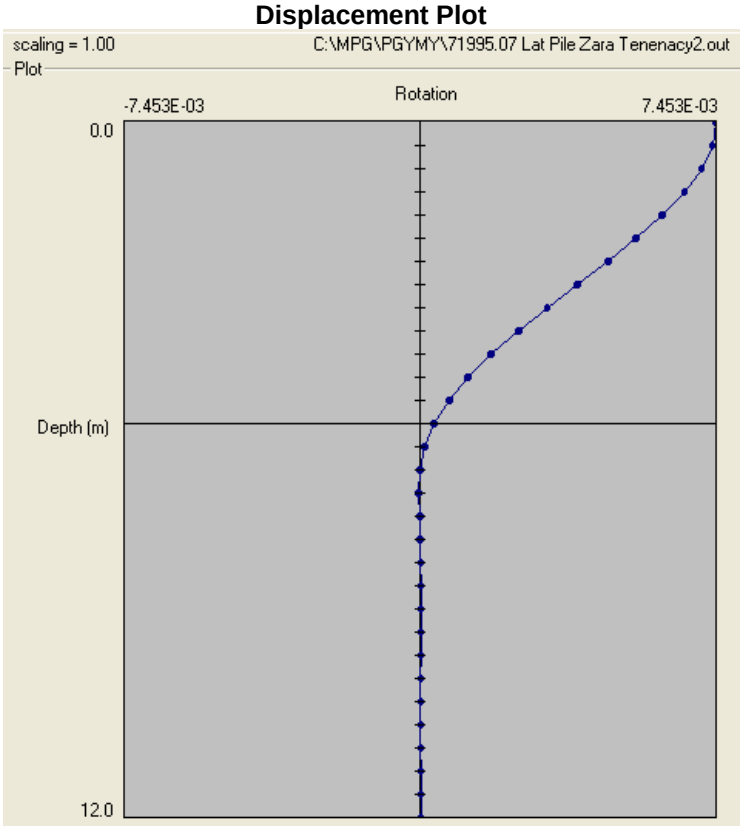


Shear Force Plot

Douglas Partners Geotechnics / Environment / Groundwater	**Pygmy Output** **Westfield Kotara Stage 4 – Proposed IMM02 Tenancy** **Northcott Drive, Kotara**	PROJECT: PLATE No: REV:	71995.07 C2 0
	CLIENT: Scentre Group Ltd	DATE:	24.05.16

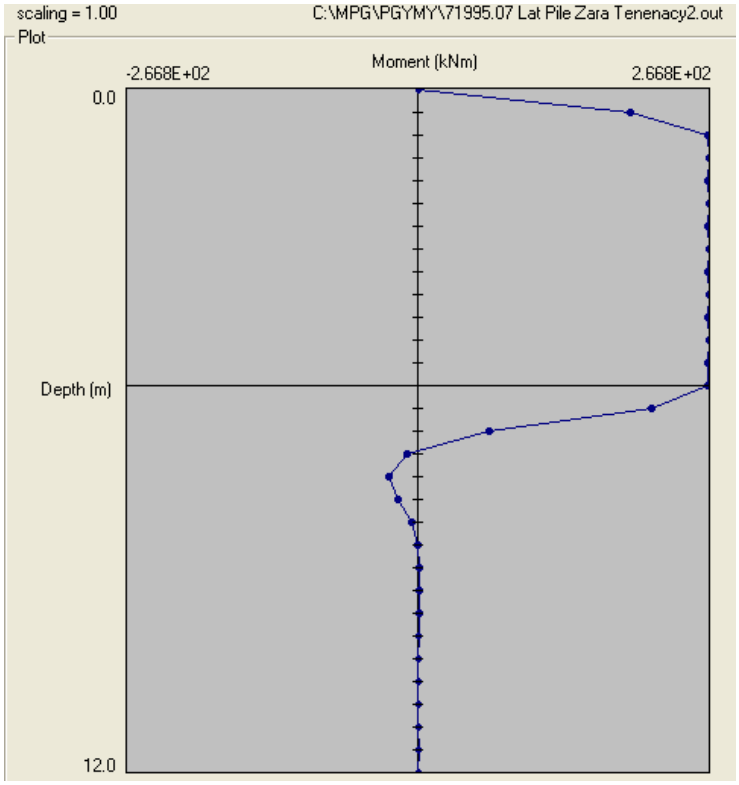


Displacement Plot

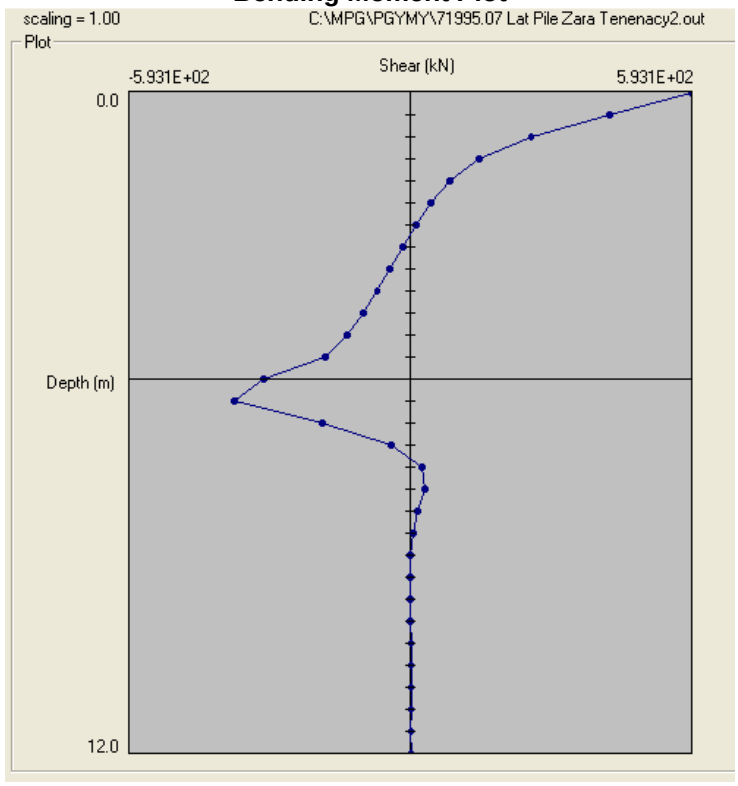


Rotation Plot

Douglas Partners Geotechnics / Environment / Groundwater	**Pygmy Output** **Westfield Kotara Stage 4 – Proposed IMM02 Tenancy** **Northcott Drive, Kotara**	PROJECT: 71995.07 PLATE No: C3 REV: 0
	CLIENT: Scentre Group Ltd	DATE: 21.06.16



Bending Moment Plot



Shear Force Plot

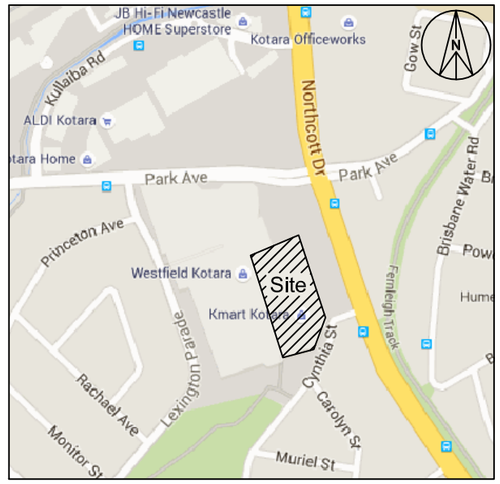
Douglas Partners Geotechnics / Environment / Groundwater	**Pygmy Output** **Westfield Kotara Stage 4 – Proposed IMM02 Tenancy** **Northcott Drive, Kotara**	PROJECT: 71995.07 PLATE No: C4 REV: 0
	CLIENT: Scentre Group Ltd	DATE: 21.06.16

Table C1: Summary of As-Constructed Pile Details (from Franki Pile Daily Report Sheets)

Test Location (Grid Reference)	Local Grid Reference	Driving Tube Depth (m)	Shaft Type	Shaft Length (m)	Shaft Volume (m^3)	Base Volume (m^3)
101 (M37)	M36	8.5	Wet	8.0	1.8	0.56
	M40	12.0	Wet	11.2	2.2	0.56
	N36	8.5	Wet	8.0	1.8	0.56
	N38	11.0	Wet	10.3	2.2	0.56
	N40-A	12.0	Wet	10.5	2.2	0.56
	N40-B	12.0	Wet	10.5	2.2	0.56
	P36	8.5	Wet	6.5	1.8	0.56
	R42	8.5	Wet	Unknown	1.8	0.56
102 (G38)	H35	6.0	Wet	5.0	0.8	0.42
	H37	6.0	Wet	5.0	0.8	0.42
	J37	6.0	Wet	5.0	1.0	0.42
	J39	6.0	Wet	5.0	0.8	0.42
104 (H5)	FG5/6	6.0	Wet	5.0	0.8	Unknown
	H5	6.0	Wet	Unknown	0.8	Unknown
	H8	6.0	Wet	5.0	0.8	0.42
	HG6/7	6.0	Wet	5.0	0.8	0.42
105 (D3)	D1	6.0	Wet	5.1	0.8	0.42
	D6	6.0	Wet	5.0	-	0.42
	E/F2	6.0	Wet	5.5	0.8	0.42
	E1/2	6.0	Wet	4.9	0.8	0.42
	E3	6.0	Wet	5.2	0.8	0.42
106 (P14)	N46-B	11.0	Wet	9.5	2.0	0.42
	P12	6.0	Wet	4.5	1.2	0.42
	P14	6.5	Wet	6.0	1.2	0.28
	P8	6.5	Wet	6.0	1.2	0.28
	R10	6.0	Wet	5.0	1.2	0.28
	R12	6.0	Wet	5.0	1.2	0.28
	W47	7.0	Wet	6.0	1.0	0.56
	XW47	7.0	Wet	6.0	1.0	0.56
107 (T30)	P28	8.5	Wet	6.3	1.4	0.56
	P30	8.5	Wet	6.3	1.4	0.56
	P32	8.0	Wet	6.3	1.4	0.56
	R32	8.2	Wet	6.2	1.6	0.56
108 (Z49)	W49	9.5	Hammered	8.5	2.2	0.6
	X48	9.0	Wet	8.0	2.0	0.6
	X49	9.0	Wet	8.0	2.0	0.6
	X50	9.5	Hammered	8.5	2.2	0.6

Appendix D

Drawing 1- Test Location Plan (overall site)
Drawing 2 – Test Location Plan (Item 1)
Drawing 3 – Test Location Plan (Item 3)
Drawing 4 – Section XX’ (Item 1)
Drawing 5 – Section AA’ (Item 2)
Drawing 6 – Section BB’ (Item 2)
Drawing 7 – Local Grid Co-ordinates



Locality Plan

LEGEND

- Borehole Location
- Cone Penetration Test Location
- Borehole and Cone Penetration Test Location
- Test Pit Location
- Borehole Location (previous investigation)

NOTES

1. Drawing adapted from plan by Geosurv, Ref 160413_A dated 30.4.2016.
2. Test locations are approximate only and were located using Tape measurement from existing site features.

0 5 10 15 20 30 40 60m

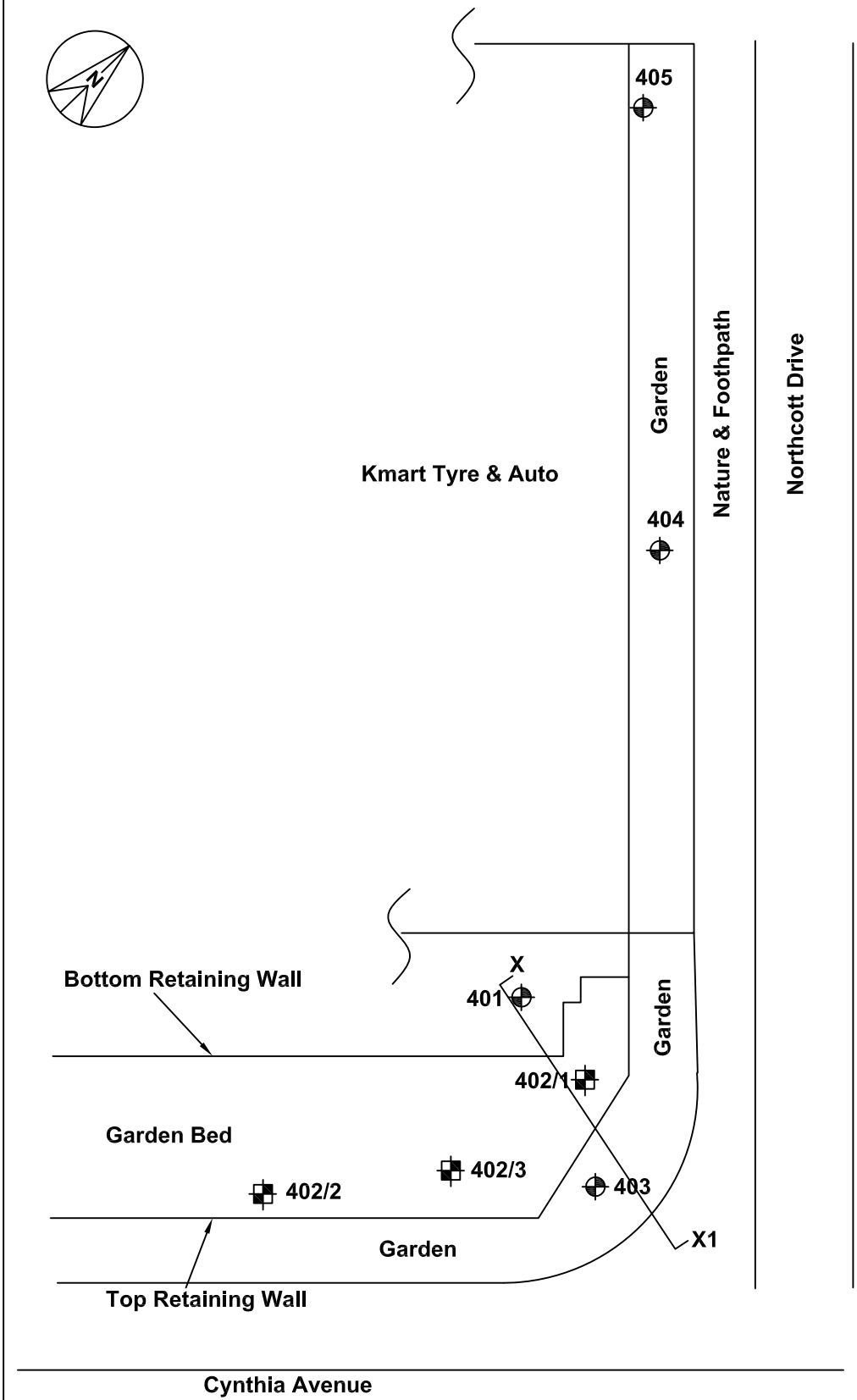
1:600 @ A3

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: Scentre Group Ltd		
OFFICE: Newcastle	DRAWN BY: PLH	
SCALE: 1:600@A3 Sheet	DATE: 09.06.2016	

TITLE: **Test Location Plan**
Westfield Kotara Stage 4
Northcott Drive, Kotara

PROJECT No:	71995.07
DRAWING No:	1
REVISION:	0



NOTE: Test locations are approximate only and were located using tape measurement from existing site features.

0 1 2 3 4 6 8 10 15 20m

1:200 @ A3

LEGEND

- Test Pit Location
- Test Borehole Location

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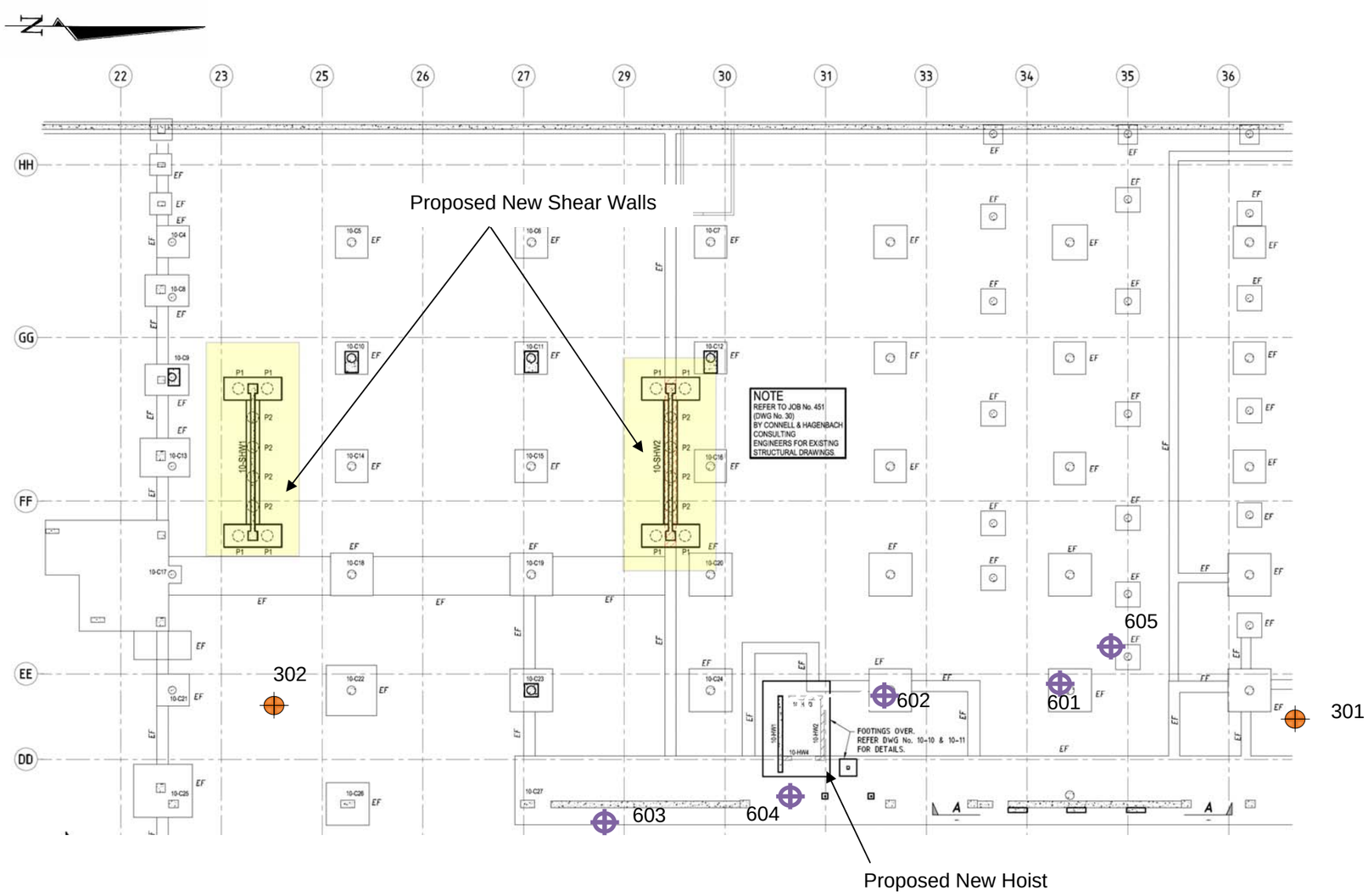
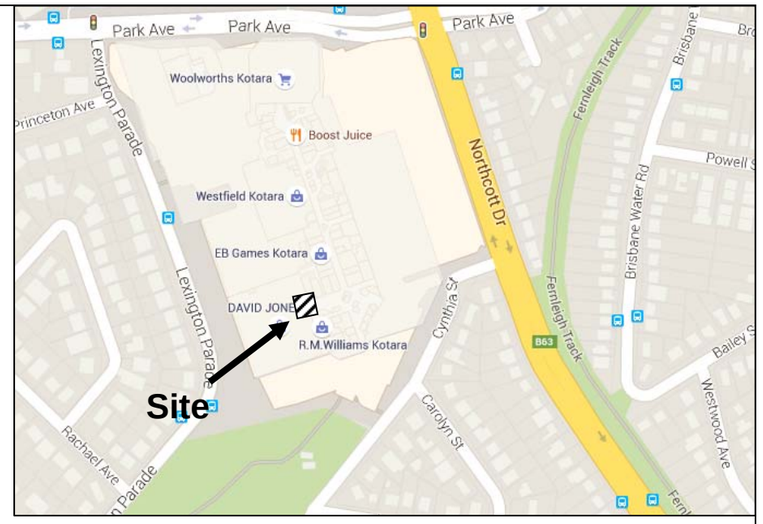
Geotechnics | Environment | Groundwater

Test Location Plan - Item 1
Westfield Kotara - Stage 4
Northcott Drive, Kotara

CLIENT: Scentre Group Ltd

PROJECT No:	71995.07
DRAWING No:	2
REVISION:	0
DATE:	09.06.2016





Site Locality

Legend:

Approximate Borehole Location

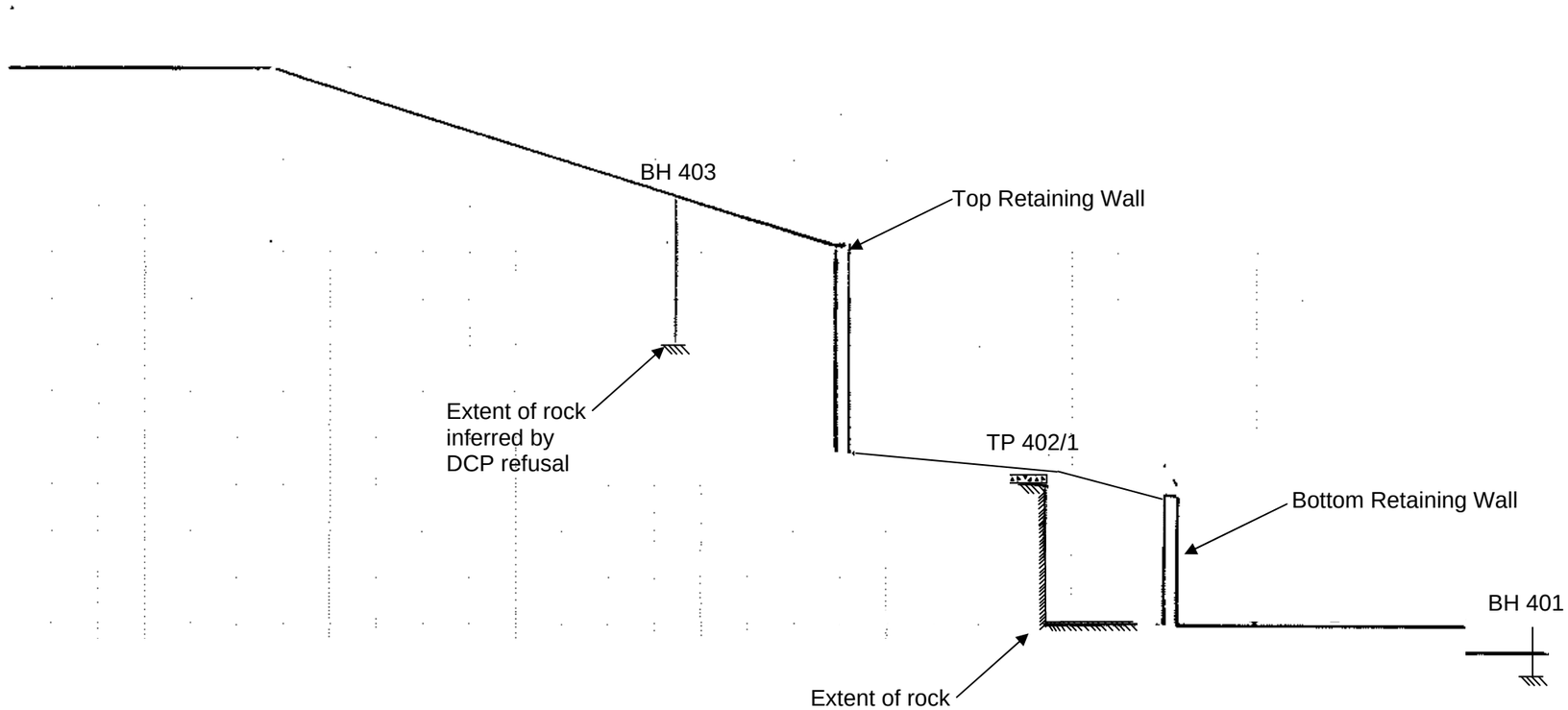
Approximate Concrete Core/Saw Location

Notes: Base drawing adapted from drawing provided by client

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Scentre Group Ltd	TITLE:	**Test Location Plan – Item 3**
OFFICE:	Newcastle	DRAWN BY:	MPG		**Westfield Kotara Proposed Redevelopment – Stage 4 IMM02 Tenancy**
SCALE:	NTS	DATE:	9.6.16		**Northcott Drive, Kotara**

PROJECT No:	71995.07
DRAWING No:	3
REVISION:	3



Legend:

- Rock
- Concrete

0 1 2

~ 1:50 @ A3

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Scentre Group Ltd		TITLE:	**Section X-X′ – Item 1**	PROJECT No: 71995.07
OFFICE:	Newcastle	DRAWN BY: SG		**Westfield Kotara Proposed Redevelopment – South-western Wall**	DRAWING No: 4
SCALE:	~ 1:50	DATE: 9.06.16		**Northcott Drive, Kotara**	REVISION: 0

A

A′

106
Offset ~ 1.7m
Rock Strength
N = 21
N = 19
refusal
refusal
Bottom Depth 18 m

107
Offset 4.9m
Rock Strength
N = 3
N = 14
N = 11
N = 25
refusal
Bottom Depth 17.8 m

2
Offset ~ 1.3m
Rock Strength
N = 5
N = 4
N = 14
N = 27
N = 22
N = 20
N = 27
N = 28
N = 44
Bottom Depth 21.55 m

1
Offset ~ 1.5m
Rock Strength
refusal
N = 7
N = 21
N = 18
N = 17
N = 21
N = 21
refusal
Bottom Depth 20.44 m

108
Offset ~ 0.4m
Rock Strength
N = 14
N = 15
N = 24
N = 19
N = 18
refusal
Bottom Depth 17.59 m

Inferred Rock Levels

ELEVATION (AHD)

25
20
15
10
5
0

0 10 20 30 40 50 60 70 80 90 100 110 120

DISTANCE ALONG PROFILE (m)

NOTE: Summary logs only. Should be read in conjunction with detailed logs.

LEGEND

- Core Loss
- Asphaltic Concrete
- Clay
- Coal
- Conglomerate
- Filling
- Gravelly Silty Clay
- Sandstone
- Sandy Clay
- Sandy Gravel
- Siltstone
- Silty Clay

TESTS / OTHER
N – Standard penetration test value
WL – Water level
PP – Pocket penetrometer test value

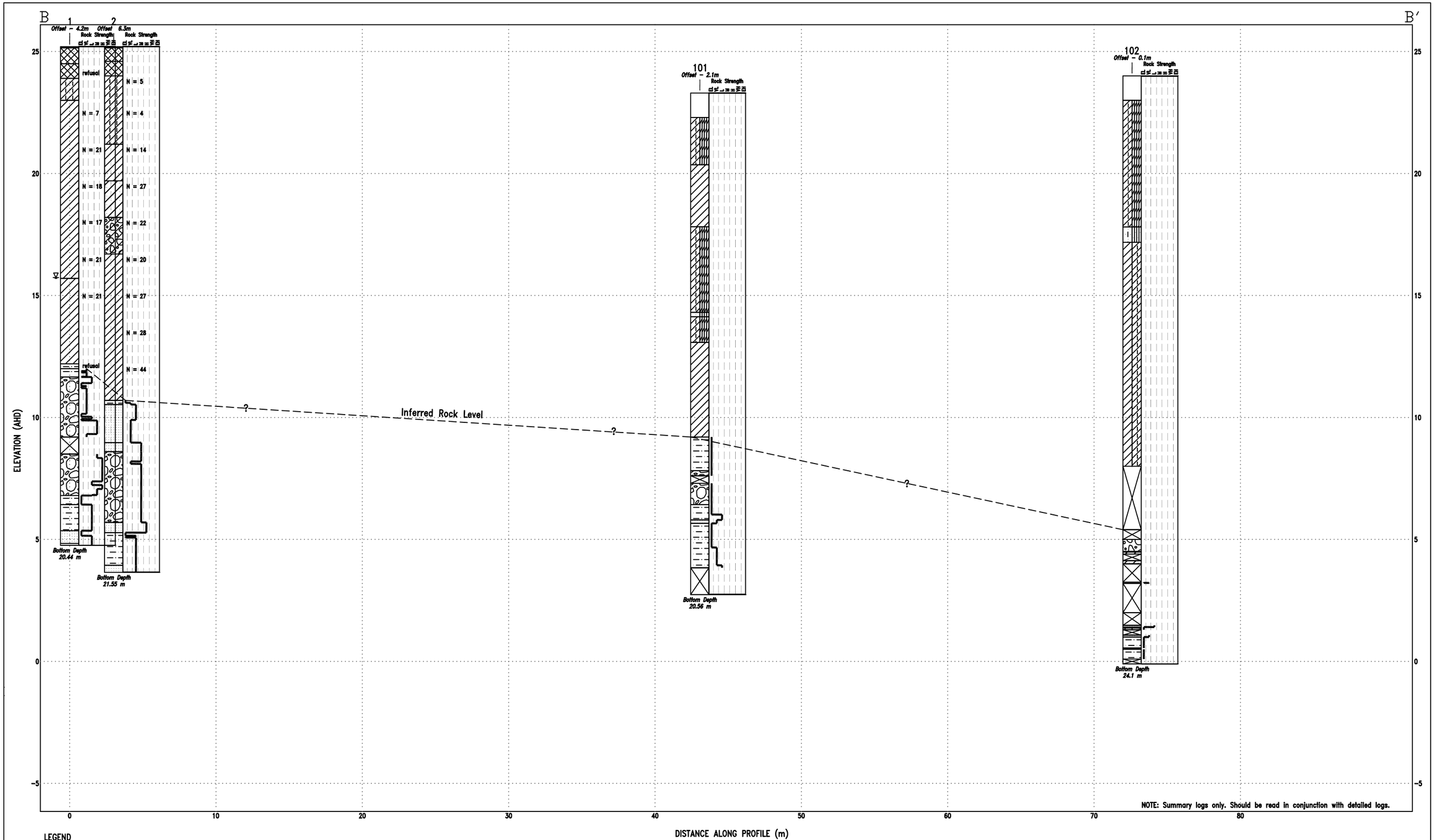
0 7
Horizontal Scale (metres)

Vertical Exaggeration = 2.3

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT:	Scentre Group Ltd	TITLE:	Cross–section A–A' – Item 2
OFFICE:	Newcastle	DRAWN BY:	PLH	Stage 4 Redevelopment
SCALE:	1:350 (H) 1:150 (V) @ A3	DATE:	09.06.2016	Northcott Drive, Kotara

PROJECT No:	71995.07
DRAWING No:	5
REVISION:	0



LEGEND

- Core Loss
- Asphaltic Concrete
- Blank Lithology (with no boundary)
- Clay
- Clayey Gravel
- Conglomerate
- Filling
- Gravel
- Gravelly Silty Clay
- Sandstone
- Sandy Clay
- Siltstone
- Silty Clay
- Silty Sand

TESTS / OTHER
N – Standard penetration test value
▽ – Water level
PP – Pocket penetrometer test value

0 5
Horizontal Scale (metres)

Vertical Exaggeration = 1.7

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: Scentre Group Ltd		TITLE: Cross-section B–B'	PROJECT No: 71995.07
OFFICE: Newcastle	DRAWN BY: PLH	Stage 4 Redevelopment	DRAWING No: 6
SCALE: 1:250 (H) 1:150 (V) @ A3	DATE: 17.05.2016	Northcott Drive, Kotara	REVISION: 0

PRELIMINARY DRAWING FOR DISCUSSION ONLY
ALL DIMENSIONS, EXISTING BUILDING STRUCTURE & SERVICES TO BE VERIFIED ON SITE.

LEXINGTON PARADE

HUDSON PARK

REVERT TO EXISTING CARPARK SCHEME

WEST CARPARK

SUBSTATIONS

NORTH WEST CARPARK

EXISTING DAVID JONES BELOW

EXISTING WEST CARPARK

NEW ROOF OVER

EXISTING ROOF

SKYLIGHT 2 OVER

SKYLIGHT 3

NORTH CARPARK

EXISTING ROOF

PLANT No.2

PLANT No.3

EXISTING ROOF

EXISTING ROOF

SOUTH CARPARK

PROPOSED ROOF CARPARK

ENTRY

A STREET

PARK AVENUE

NORTHCOTT DRIVE

BOUNDARY

BLUE DASHED LINE INDICATES APPROXIMATE DEMARCATION BETWEEN EXISTING AND ALL NEW STRUCTURES

GREEN ZONE INDICATES THE POTENTIAL EXTENT OF NEW LEVEL 3 POST-TENSIONED CARPARK ROOF SLAB OVER THE EXISTING STRUCTURE.

RED ZONE INDICATES THE EXTENT OF NEW LEVEL 2 & 3 POST-TENSIONED SUSPENDED FLOOR SLABS (ALL NEW BUILD)

DOUGLAS PARTNERS REPORT 71995.05 (FEB 2016)

LEGEND

EXISTING:
- EXISTING RETAIL

PROPOSED:
- PROPOSED MAJOR
- PROPOSED MINI MAJOR
- PROPOSED SPECIALITY
- PROPOSED FOOD SPECIALTY
- PROPOSED VERTICAL TRANSPORT
- PROPOSED AMENITIES
- PROPOSED COMMON MALL
- PROPOSED CAR PARK

- BOUNDARY LINE
- GLA INCREMENTAL AREA
- DEMOLISHED AREA
- DEMOLISHED CAR PARK BAY
- PROPOSED AREA

LEVEL 3 KEY PLAN - THIRD MALL SCHEME

APPROXIMATE AREA REQUIRING GEOTECHNICAL INVESTIGATION.

DATED 25/2/2016

LEXINGTON PARADE
PARK AVENUE
NORTHCOTT DR

ACTUAL NORTH
DRAWING NORTH

NOTES
- This document describes a Design Intent only.
- Written dimensions take precedence over scaling and are to be checked on site.
- Refer to all project documentation before commencing work.
- Refer any discrepancies to the Project Design Manager.
- Copyright is retained by Scentre Design and Construction.
- Written authority is required for any reproduction.

SCENTRE GROUP
Westfield
Scentre Design and Construction Pty Limited
85 Castlereagh Street Sydney NSW 2000
Phone (02) 8358 7000 Fax (02) 9028 8500
GPO Box 4004 Sydney NSW 2001
ACN 000 181 733

Title: LEVEL 3 PROPOSED PLAN

Centre: KOTARA
SCHEME 14

Project No. 10701 | Drawing No. 01.5205 | Revision C
Drawing Scale: 1:500@A0
Plot Date: 19/02/2016

Drawing 7: Local Grid Coordinates