Wagga Wagga Base Hospital Stage 3

Structural Report

Revision: 4

Prepared By: Alex Cornelius

Project No.: 10578

Date: 12th June 2018

Issued For: DA

Bonacci Group (NSW) Pty Ltd
ABN 29 102 716 352
Level 6, 37 York Street
SYDNEY NSW 2000
Tel: +61 2 8247 8400
www.bonaccigroup.com

Report Amendment Register

Rev. No.	Issue/Amendment	Author	Reviewer	Date
1	DA	AC	JW	15/03/18
2	DA	AC	JW	20/03/18
3	DA	AC	JW	28/03/18
4	DA	AC	JW	12/06/2018

Table of Contents

1. EXECUTIVE SUMMARY

In accordance with the SEARs application requirements, a Structural and Geotechnical Report has been prepared. This report focuses on structural aspects of the new Ambulatory Care Building (ACB). The site specific geotechnical report can be found in Appendix A.

The Wagga Wagga Base Hospital Stage 3 consists of a six storey Ambulatory Care Building, including a rooftop Plant Room, all above an undercroft parking level. The Ambulatory Care Building will provide the following Units:

- 28 flexible Aged Care Beds, including 4 dedicated beds for Acute Delirium.
- 24 Rehabilitation beds, including inpatient therapy and ADL facilities shared with the Aged Care and Older Persons Health inpatient units.
- A 24 bed Older Person's Mental Health Inpatient Unit, including 8 T-BASIS beds.
- A 20 chair Renal Dialysis Unit plus 4 training chairs (2 x HD and 2 x peritoneal) collocated with other Extended Hours Services.
- Ambulatory Clinics, Rehabilitation and Allied Health, comprising 60 bookable (electronic patient flow management system) Interview / Consult rooms and Gym / Allied Health treatment spaces. Services accessing this area will include Primary and Community Health, Outpatients, Prosthetics and Orthotics, Mental Health, Drug and Alcohol, and Oral Health services (8 Dental Chairs).
- An education area including library, conference rooms (60 seats total) and a lecture theatre (100 seats).
- Extended Hours Services including Hospital in the Home, Integrated Care, Rapid Assessment Clinic, After Hours GP, and Infusions using 10 treatment spaces and 6 consultation rooms and shared support areas with renal dialysis.
- Workforce and office accommodation will be provided for staff associated with Stage 3, refined through New Ways of Working (NWW).

The NWW assessment will be also extended to Support Services staff, including Patient Flow, IT, Health Share, Health Information Services, Pastoral Care and Volunteer Services.

The ACB is to be a concrete framed structure. The foundations are to comprise CFA piles founded in the deep alluvium and similar to those utilised for Stage 2. This foundation system needs to be allowed for in the cost plan. The proposed basement is above the observed water table and will therefore be designed as a drained system.

It is expected that the structural grid is to be 8.4m where possible in accordance with the Health Infrastructure (HI) guidelines. Floors are to be post tensioned concrete banded slabs with a response factor of 2 for future flexibility. Lateral stability is to be (primarily) provided by lift and stair cores with the intention of minimising shear walls within the floor plate to allow future flexibility. The structure is to be designed as having an Importance Level of 4 with respect to wind and earthquake loading.

Provision has been made in the recently constructed Acute Services Building to receive a bridge link at Level 4. Structural works to this zone will likely include the construction of a corbel to support the southern end of the link structure. Some structural works will also be required at the interface with the existing Support Services Building (SSB), which is a reinforced concrete framed structure. It is not anticipated, at this stage, that any major works will be undertaken that would trigger an upgrade of the building to current standards.

The development at Yathong Lodge is likely to comprise a combination of refurbishment and new build. This is expected to be of low rise single or double storey construction (domestic style) supported on high level foundations.

2. EXISTING CONDITIONS

2.1. Location

The existing hospital site is located to the south of Sturt Highway (Edward St), and to the east of Docker St. The southern and eastern site boundaries consist of low rise domestic buildings. The site slopes from a high point on the south-east corner to a low point on the north-west corner.

Figure 2.1 – Aerial view of the existing Wagga Wagga Hospital site.

2.2. Geotechnical

2.2.1. Geology

A site specific geotechnical investigation has been undertaken by Douglas Partners. The results from this investigation are presented in report No 72320.09 prepared in August 2014 (Appendix A). Previous geotechnical reports and geotechnical advice notes have also been carried out for the existing buildings on the site, and these were considered in the development of the masterplan, concept design, and subsequently, schematic design.

As part of the stage two works, a series of test pits were dug in the vicinity adjacent to the proposed site for the (then) new CEP/Mortuary. Stiff clays were observed within all of the test pits and a thin layer of fill was observed in one pit above the natural clays.

2.2.2. Soil Contamination

The geotechnical reports indicate that soil conditions at the site are alkaline. Therefore, the site exposure classification is assessed to be non-aggressive in accordance with AS2159 – 2011.

2.2.3. Groundwater

No presence of ground water was found as noted in the updated geotechnical report (DP 72320.09 – Appendix A) and the highest previously recorded ground water level was +176.800 AHD. Ground water levels are subject to seasonal variations and as such higher ground water levels may be found on site.

The semi basement is to be a drained structure typically with water being pumped to ground level to subsequently drain to the existing stormwater system under gravity.

2.3. Acute Hospital Link Bridge

Allowances have been made in the existing Acute services building to support the load from the proposed link bridge to the south. Between grid B and C of the existing Acute building, the edge beam has been thickened with cast-in inserts exposed to enable a corbel to be constructed. Refer Figure 2.4a and 2.4b below. The location of this thickened edge beam is to be confirmed on site.

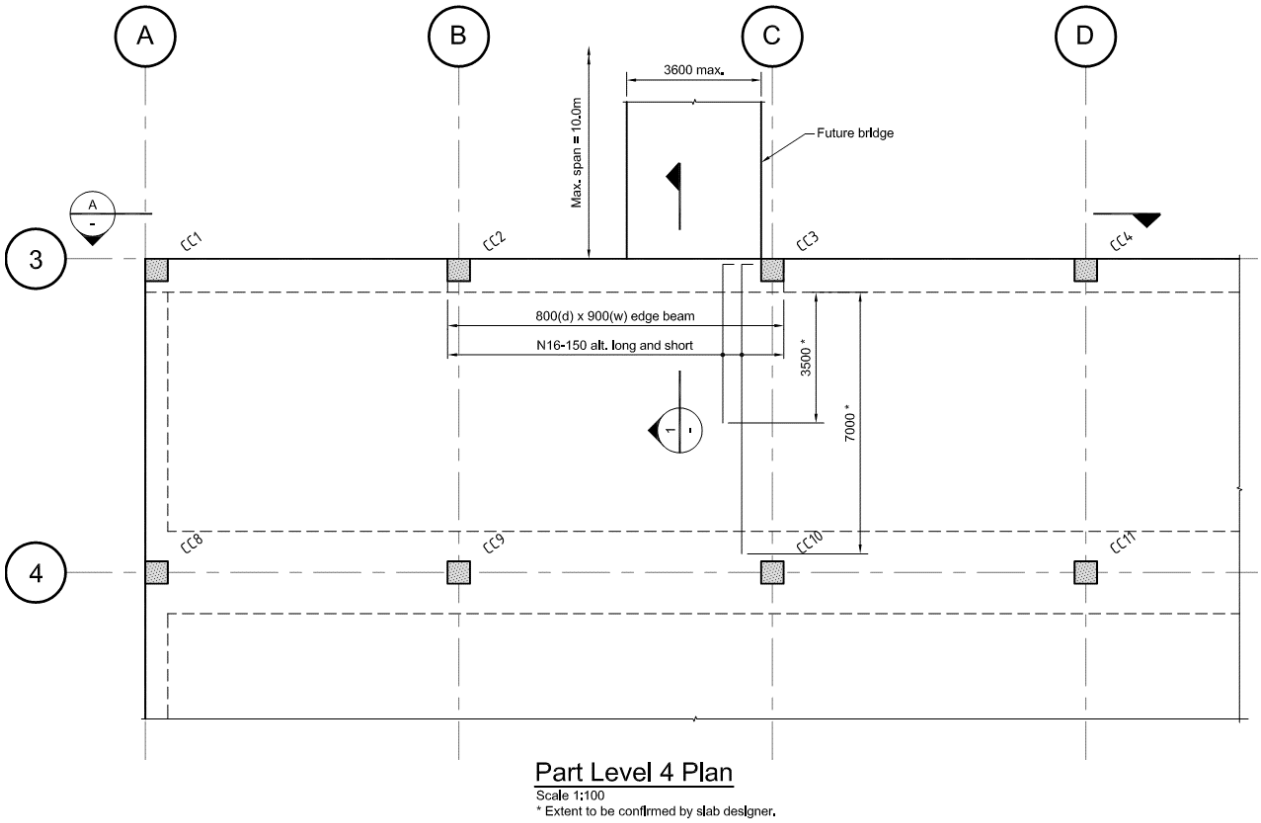


Figure 2.4a – Future link bridge support location.

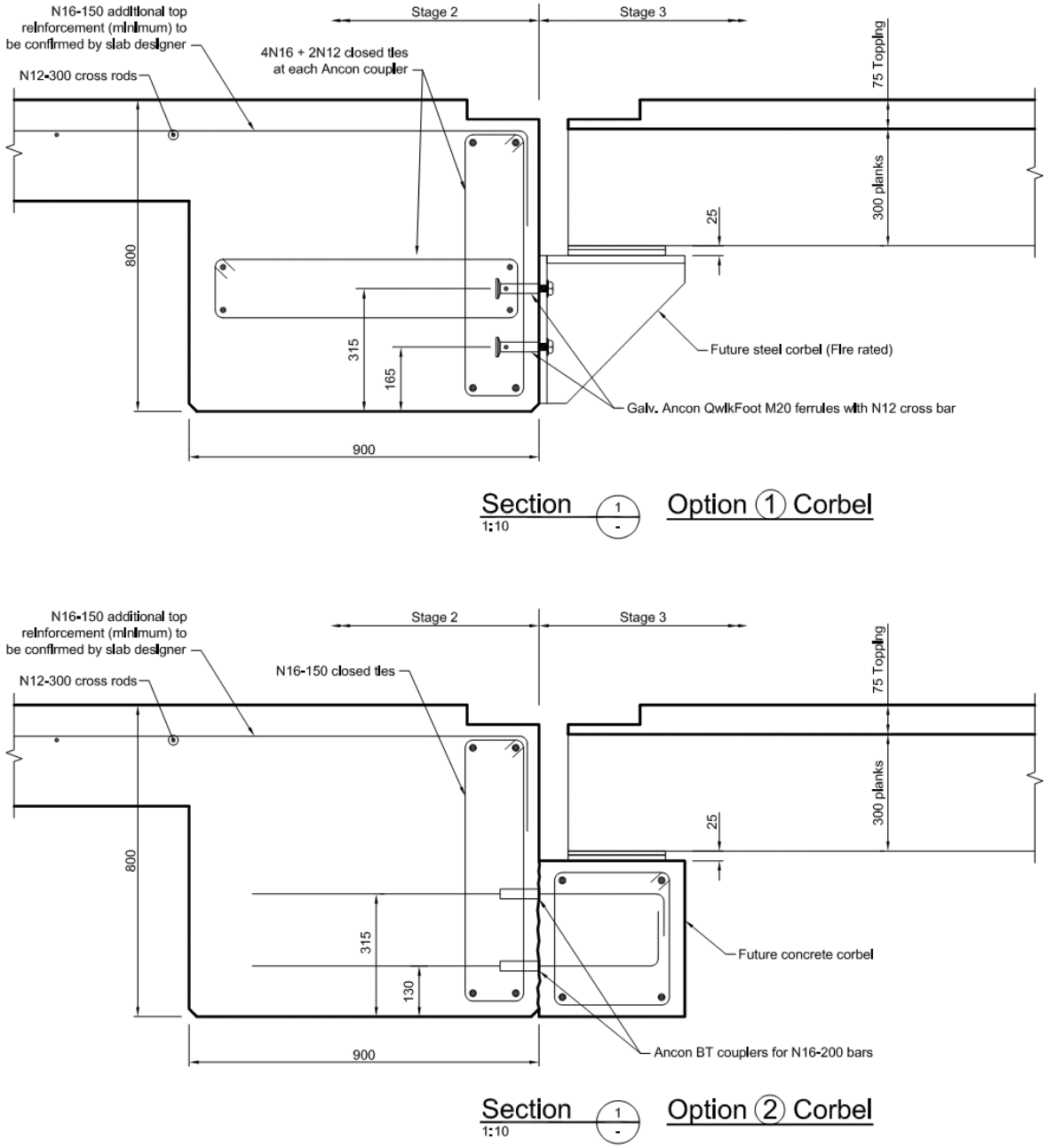


Figure 2.4b – Future link bridge support detail.

3. PROPOSED DEVELOPMENT

As presented in the Architectural Masterplan report, six options were considered for the Stage 3 development. The preferred option involves the demolition of the following buildings to make way for a new six (6) storey Ambulatory Care Building (ACB) and new future research and education zone to the north of the Support Services Building (SSB):

- Old Hospital Building;
- Robinson House;
- Hydrotherapy Pool;
- Physiotherapy & Occupational Therapy; and
- Demountable buildings housing Pathology and Rehabilitation services.

The Ambulatory Care Building will provide the following Units:

- 28 flexible Aged Care Beds, including 4 dedicated beds for Acute Delirium.
- 24 Rehabilitation beds, including inpatient therapy and ADL facilities shared with the Aged Care and Older Persons Health inpatient units.
- A 24 bed Older Person's Mental Health Inpatient Unit, including 8 T-BASIS beds.
- A 20 chair Renal Dialysis Unit plus 4 training chairs (2 x HD and 2 x peritoneal) collocated with other Extended Hours Services.
- Ambulatory Clinics, Rehabilitation and Allied Health, comprising 60 bookable (electronic patient flow management system) Interview / Consult rooms and Gym / Allied Health treatment spaces. Services accessing this area will include Primary and Community Health, Outpatients, Prosthetics and Orthotics, Mental Health, Drug and Alcohol, and Oral Health services (8 Dental Chairs).
- An education area including library, conference rooms (60 seats total) and a lecture theatre (100 seats).
- Extended Hours Services including Hospital in the Home, Integrated Care, Rapid Assessment Clinic, After Hours GP, and Infusions using 10 treatment spaces and 6 consultation rooms and shared support areas with renal dialysis.
- Workforce and office accommodation will be provided for staff associated with Stage 3, refined through New Ways of Working (NWW).

The NWW assessment will be also extended to Support Services staff, including Patient Flow, IT, Health Share, Health Information Services, Pastoral Care and Volunteer Services.

Figure 3 – Preferred site option.

3.1. Structural Works

3.1.1. Foundations

The foundations are to comprise Continuous Flight Auger (CFA) piles founded deeply in the deep alluvium and similar to those utilised for Stage 2. This foundation system needs to be allowed for in the cost plan. Pile capacities listed in the geotechnical report (Appendix A) are as per the below:

- Ultimate end bearing capacity = 2250kPa;
- Ultimate shaft friction (compression) = 30kPa; and
- Ultimate shaft friction (tension) = 20kPa

A geotechnical reduction factor of 0.67 has been assumed for the pile design in the schematic design stage. This value has been assumed based on the pile design being carried out as a D&C contract.

3.1.2. Superstructure

The superstructure is to be a braced frame with columns placed on a 8.4m x 8.4m grid in accordance with the HI Design Guidelines. Lateral resistance is to be provided by in situ shear walls as well as stair cores and lift cores. The proposed locations of the shear walls on the structural drawings are indicative only and an allowance should be made in the cost plan. Locations and extent of walls are to be confirmed in the design development stage.

The lift location and stair core locations have not yet been finalised and the position and size of these will heavily influence the location and extent of additional shear walls required.

3.1.3. Floor Systems

A number of suspended floor systems were developed in the concept design stage and are shown in Table 3.1.3 below. As noted in the table, flat plate, flat slab and banded slab floor options were developed to assist with preliminary costing. The thickness of these options vary based on the required vibration criteria set out in HI guidelines. Once clinical planning has been completed, the thicknesses can be rationalised.

DESIGN PARAMETERS	STRUCTURAL SYSTEM	
RF=2 (Future flexibility) 40mm sacrificial cover	**Option 1 - Flat Plate**	280mm thick slab 800W x 400D edge beams
	Option 2 - Flat Slab	280mm thick slab 800W x 400D edge beams
	Option 3 - Banded Slab	240mm thick slab (end bays) 240mm thick slab (int. bays) 2200W x 400D internal beams 1100W x 400D edge beams

Table 3.1.3 – Floor system summary

3.1.4. Spandrel Panels

It is anticipated that the building is to be sprinklered, therefore spandrel panels which comply with Clause C2.6 of the NCC will not be required in the façade.

3.1.5. Future Expansion

Future expansion was considered in the concept design stage, and was found to have the following structural implications:

- Columns sizes to increase by 50mm (length and width). Column reinforcement sizes and strength grade of concrete may also increase;
- Pile socket lengths to increase. The percentage socket length increase will be comparable to the building height percentage increase;
- Width of shear walls will increase by up to 50mm;
- Socket length and/or number of piles under shear walls and lift cores may increase; and
- Roof slab currently documented will increase in thickness to support 10kPa construction loading. This prevents having to prop within the hospital building when new floors are constructed.

It was agreed that vertical expansion was not to be allowed for.

3.1.6. Future Flexibility

The floor slabs are to be provided with a 40mm sacrificial cover zone as per the HI Design Guidelines. Structural details are shown below in Figure 3.1.6a-c. The reinforcement and post tensioning tendons are set down sufficiently so that they maintain the minimum cover when the 40mm sacrificial topping has been removed. This is in accordance with HI Design Guidelines.

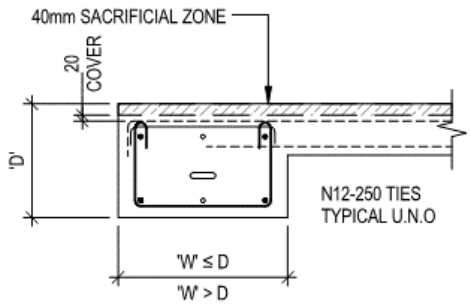


Figure 3.1.6a – Typical edge beam detail with sacrificial topping.

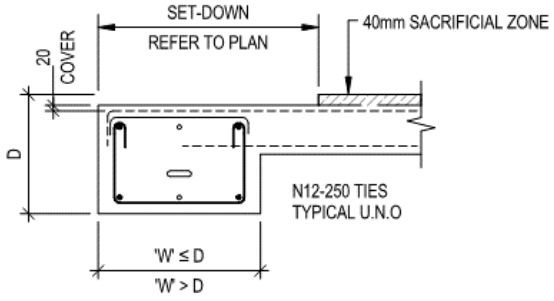


Figure 3.1.6b – Typical edge beam detail at set-down.

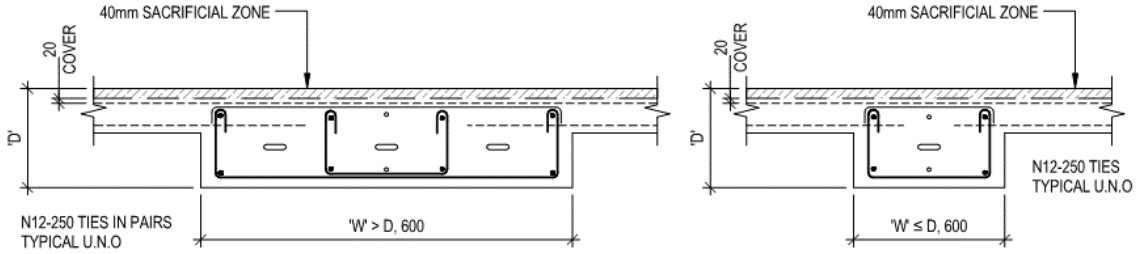


Figure 3.1.6c – Typical internal beam detail with sacrificial topping.

Allowance for additional service risers at each internal column is to be made in the design in accordance with HI Design Guidelines. This will require the reinforcement at the column lines to be displaced so that penetrations can be cut in the future and not require any associated strengthening works to the slab. Refer Figure 3.1.6d and Figure 3.1.6e.

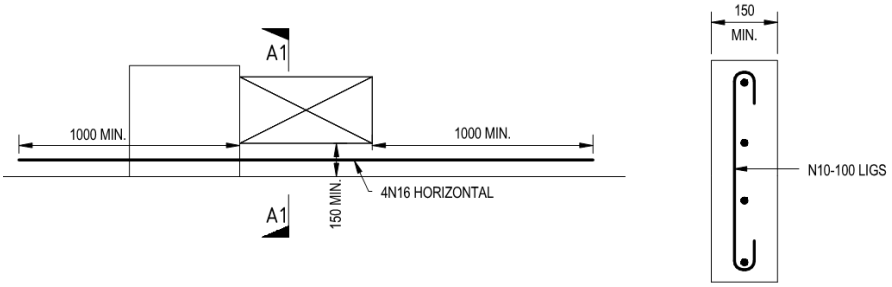


Figure 3.1.6d – Allowance for future service riser zone adjacent to column.

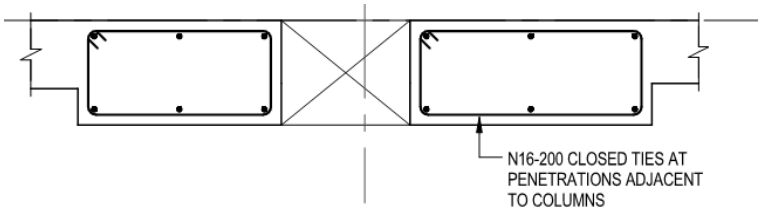


Figure 3.1.6e - Allowance for future service riser zone adjacent to column – Alternative detail.

3.1.7. Service Coordination

The structural scheme has been developed closely with the architect and service consultants to provide adequate space for ducting within the ceiling space. The band beam arrangements documented are one directional for each wing of the building, and allow for riser position flexibility along the length of each wing.

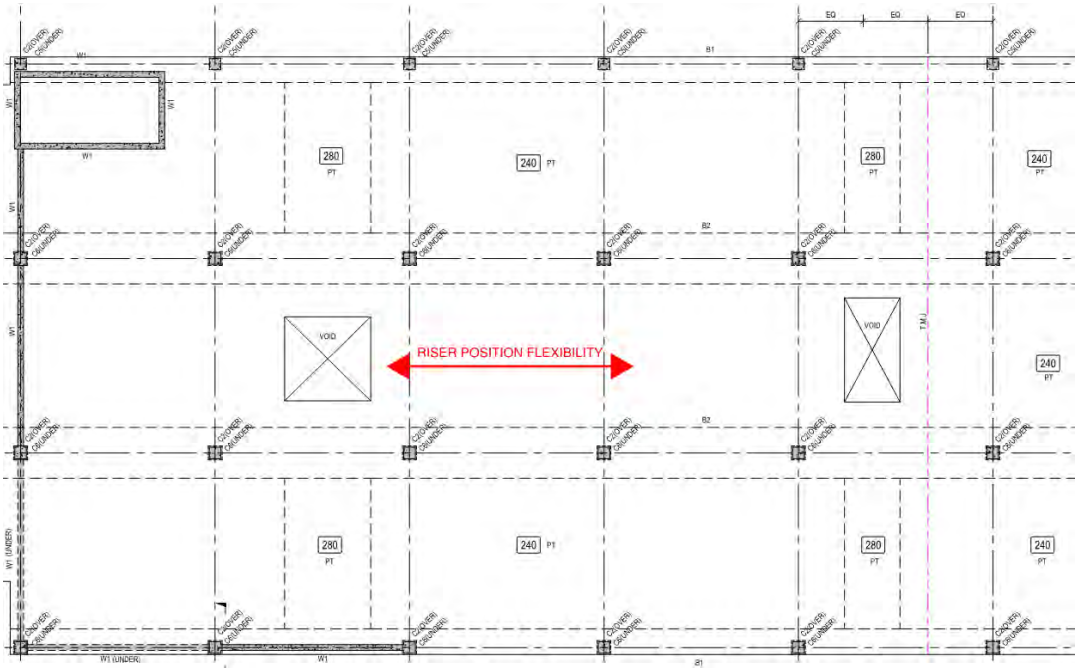


Figure 3.1.7 – Post tensioned band beam orientation and riser flexibility

4. PERFORMANCE PARAMETERS

4.1. Importance Factor

As the building is to accommodate medical emergency and surgical facilities, it has Importance Level 4 and will be designed to fulfil a post disaster function.

4.2. Design Loads

Table 4.2a: Floor & Roof Loads

Floor Type	Uniform Imposed Load (kPa)	Imposed Point Load (kN)	Superimposed Dead Load (kPa)	40mm Sacrificial Topping (kPa)
Stairs, ramps	4.0	4.5	0.0	0.0
Corridors, circulation areas and foyer spaces	5.0	4.5	1.3	1.0
Wards typically	2.0	1.8	1.8	1.0
Clinical areas	3.0	4.5	1.8	1.0
Plant rooms	7.5	4.5	2.4	0.0
Roof typically	0.25	1.4	0.75	0.0
Shell space future expansion	4.0	4.5	3.0	0.0

Table 4.2b: Wind Load Parameters

Item	Value
Location	Region A1
Importance Level	4
V_u	48m/s
V_s	37m/s
M_s	1.0
M_t	1.0
M_d	1.0
Terrain Category	3

Table 4.2c: Earthquake Load Parameters

Item	Value
Importance Level	4
Probability Factor, K_p	1.8
Hazard Factor, Z	0.09
Sub-Soil Class	D_e
Earthquake Design Category	III
Structural Ductility Factor, μ	2
Structural Performance Factor, S_p	0.67

.

4.3. Floor Vibration

Footfall response will be calculated using the Concrete Centre Design Guide. The response will also be checked against the recommendations made within and Murray, Allen and Ungar in the AISC, 2003. The footfall frequencies and corresponding response factors defined within the NSW Health Design Guidance Note No. 1 (refer Table 4.3) will be checked for compliance with the Concrete Centre Design Guide.

Once clinical planning has been completed, thicknesses of beams and slabs can be rationalised to meet the required vibration criteria. The current response factors are shown in Table 4.3 below. As stipulated in the HI Design Guidelines, the response factor for a particular slab zone is required for the slab directly above and below.

Table 4.3: Footfall Response Factor Design Parameters – Concrete Centre Method

Facility/Equipment/Use	Design Response Factor	Footfall Frequency (Hz)
Generally procedure rooms, laboratories and general surgery	2	2.2
Corridors, circulation spaces, offices and other non-vibration sensitive areas	4	2.2
Imaging Suite and operating theatres	1	1.8
Plant areas	N/A	N/A
Roof areas	N/A	N/A

4.4. Fire Rating

Building Element	FRL (Type 9a)
External Walls (Load Bearing)	120/60/30
External Columns	120/-/-
Load Bearing Fire Walls	120/120/120
Shafts (Non-load Bearing)	-/-/-
Other Load Bearing Walls, Beams, Trusses, Columns	120/-/-
Floors	120/120/120
Steel Framed and Metal Sheeted Roofs Not Providing Fire Separating Function	No FRL*
Steel Columns Supporting Steel Framed and Metal Sheeted Roofs Not Providing Fire Separating Function	120/-/- (TBC)

**This concession is gained as the building is to be fully sprinklered*

4.5. Durability

For concrete elements, durability will be achieved by specifying all elements in accordance with Section 4 of AS 3600, which sets out requirements for reinforced and post tensioned concrete structures with a design life of 40 to 60 years. Exposure classifications are as follows:
Piles – A2
Columns – A2
Suspended slabs – A2
Plant level slab – B1

Protective coatings to structural steel elements shall comply with AS/NZS 2312 and ISO 2063 for the long-term protection category.

4.6. Health Infrastructure Design Guidelines

A list of the Health Infrastructure Design Guidelines is shown in Table 4.6 below. The guidelines that are relevant to the civil and structural disciplines of this project have been assigned a 'Y'. All other HI Design Guidelines that are not relevant to the civil and structural disciplines have been noted as 'N/A'.

Table 4.6: Health Infrastructure Design Guidelines

DGN No	Rev	Name	Consultant
1	A	Structural Design Criteria Guidelines	**Y**
5	A	Engineering Services Scope Definition	N/A
6	B	General Design Principles	**Y**
7	B	Mobile Wireless Devices & Radio Reception in Healthcare Facilities: In Building Coverage	N/A
8	A	Reduction of Interference in Neurophysiology Departments	N/A
9	A	AusHFG Clarification	N/A
10	A	Use of Curtains in Clinical Environments	N/A
12	A	Certification of HI Projects	N/A
13	A	Project Team Guidance Relating to Coordination with ERG	N/A
15	C	Asbestos Management	N/A
16	A	Legionella Risk - Delayed/Staged Occupation	N/A
17	A	Construction Works under SEPP (Infrastructure) 2007	**Y**
18	C	Training and Aboriginal Participation	N/A
19	B	Helipad Landing Sites Design Guideline	N/A
20	A	Design Deliverables for Tender	N/A
21	B	Medical Gas System	N/A
22	A	Planning and Delivery Workshop Plan	N/A
23	A	Black Start Test Guidance Process	N/A
24	A	Building Importance Levels for NSW Health Projects	**Y**
25	A	Commissioning Validation Period & Support Process	N/A
26	A	Mock-Ups Prototypes Sample Rooms and Spares	N/A
27	A	Switchable Glass in ICU	N/A
28	A	AUS HFG Isolation Room	N/A
29	A	Overhead Protective Structures	N/A
30	A	Site Investigations - Project Opportunities	**Y**
31	A	Water Testing and Compliance	N/A
32	A	External Wall Construction and Facade Compliance	N/A
33	A	Acoustic ESG	N/A
34	A	Overview of Eearly Contractor Involvement (ECI) Procurement Process	N/A
35	A	USB Charges in-built into GPOs in a Healthcare Facility	N/A
36	A	IPU Reference Design	**Y**
37	A	Variation to Australian Health Facility Guidelines	**Y**
38	A	Installation, Commissioning and Validation of Sterilising Equipment	N/A
39	A	Safe Assessment Room Design Requirements	N/A
40	A	Compliance with Planning Approval Conditions	**Y**

APPENDIX A. GEOTECHNICAL REPORT

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Wagga Wagga Base Hospital – Stage 3
Edward Street, Wagga Wagga

Prepared for
Health Infrastructure

Project 72320.09
August 2014

Douglas Partners
Geotechnics / Environment / Groundwater

Document History

Document details

Project No.	72320.09	Document No.	1
Document title	Report on Geotechnical Investigation Wagga Wagga Base Hospital – Stage 3		
Site address	Edward Street, Wagga Wagga		
Report prepared for	Health Infrastructure		
File name	P:\72320.09 WAGGA WAGGA, Base Hospital Stage 3 PMO\Docs\72320.09 WWBH Geotechnical Report.docx		

Document status and review

Revision	Prepared by	Reviewed by	Date issued
DRAFT	P Oitmaa	M J Thom	26 August 2014

Distribution of copies

Revision	Electronic	Paper	Issued to
DRAFT	1	0	AECOM

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		
Reviewer		

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde NSW 2114
PO Box 472
West Ryde NSW 1685
Phone (02) 9809 0666
Fax (02) 9809 4095

Douglas Partners
Geotechnics | Environment | Groundwater

Table of Contents

Page

Report on Geotechnical Investigation
Wagga Wagga Base Hospital – Stage 3
Edward Street, Wagga Wagga

1. Introduction

This report presents the results of a geotechnical investigation undertaken for Stage 3 of the Wagga Wagga Base Hospital redevelopment project at Edward Street, Wagga Wagga. The investigation work was commissioned by Health Infrastructure and was carried out in accordance with DP's proposal SYD140556 dated 19 May 2014.

It is understood that the Stage 3 redevelopment project will involve the demolition of existing hospital buildings in the north-western area of the campus and the construction of a new two to three-storey facility. A new on-grade carpark is also proposed in the south-western area of the hospital.

Geotechnical investigation was undertaken to provide information on the subsurface conditions on the site and included the drilling of boreholes, the installation of a groundwater monitoring well, laboratory testing and engineering analysis. Details of the current field work and comments relevant to design and construction are given in this report.

A contamination assessment was undertaken at the same time as the geotechnical investigation and is reported separately.

2. Previous Investigations

Douglas Partners has undertaken several investigations at Wagga Wagga Base Hospital since 2011 as outlined in the various reports for the 72320 project series. Borehole logs from investigations undertaken in 2011 (Projects 72320.00 and 72320.03) and 2012 (Project 72320.06) have been used to develop the geotechnical model for the Stage 3 area and are included in Appendix D.

3. Site Description and Geology

Wagga Wagga Base Hospital is located at the south-eastern corner of the intersection between Edward Street (Sturt Highway) and Docker Street. The Stage 3 development areas are located in the north-western and south-western portions of the campus. The ground surface levels generally fall at gentle grades to the north; the difference in levels is approximately 2 m over a distance of 200 m.

At the time of the current investigation the north-western portion of the site was occupied by several adjoining hospital buildings constructed at or close to the ground surface levels. The south-western area contained several smaller buildings, an on-grade carpark and a storage area for the Stage 2 development works which were underway.

The *Wagga Wagga 1:250 000 Geological Series Sheet* (SI 55-15) indicates that the site is underlain by unconsolidated sand, silt, clay and gravel (floodplain sediments) and includes high-level Tertiary aged terrace sediments of the Murray Valley comprising gravel, sand, silt and clay. The Wagga Marginal Base Formation comprising shale, slate, quartzite, sandstone and sub-greywacke is shown to the south.

Regional groundwater and surface water is expected to flow in a north-easterly direction towards the Murrumbidgee River.

4. Current Field Work Methods

The field work for the current geotechnical investigation included the drilling of nine boreholes (BH401 to BH409) at the locations shown on Drawing 1 in Appendix B. The bores in the area of the proposed building were drilled to depths of 10.3 m to 15.0 m using a DT250 drilling rig. They were commenced using solid flight augers then continued using rotary wash-boring equipment inside top casing. Standard penetration tests were undertaken at regular depth intervals.

The bores in the area of the proposed pavement were drilled to depths of 1.0 m to 1.5 m using either a DT250 drilling rig or a hand-auger. Dynamic penetrometer tests were undertaken at these locations.

Bore BH405 was converted into groundwater monitoring well at the completion of drilling. This involved placing Class 18 uPVC screen and solid casing in the borehole. A gravel pack was placed around the screen and a bentonite plug was placed above the gravel. The remainder of the void was backfilled with drill cuttings and the top of the well was finished with a steel cover mounted flush with the surface.

The ground surface levels at the bores were measured to AHD using an automatic level relative to known benchmarks on the site.

5. Field Work Results

The subsurface conditions encountered in the boreholes are presented in the borehole logs in Appendix C (current investigation) and Appendix D (previous investigations). Notes defining descriptive terms and classification methods are included in Appendix A.

The subsurface conditions encountered in the area of the proposed building can be described as follows:

- FILLING – silty sand, gravelly clay, silty clay and clayey sand filling with gravel, rootlets, coal, concrete and tile to depths of 0.2 m to 1.2 m;
- NATURAL SOIL – stiff, very stiff and hard silty clay with gravel and sand to depths of 10.0 m to 10.4 m, underlain by dense gravelly sand, sandy gravel, sand and clayey sand to the base of the deeper bores at 10.0 m to 15.5 m depth.

The subsurface conditions encountered in the area of the proposed carpark included silty clay and silty sand filling to depths of 0.2 m to 0.5 m, underlain by stiff silty clay.

Table 1 summarises the levels at which different materials were encountered in the deeper boreholes.

Table 1: Summary of Material Strata Levels

Stratum	RL of Top of Stratum (m, AHD)							
	BH401	BH402	BH403	BH404	BH405	BH105	BH106	BH108
Ground Surface/ Filling	181.0	181.5	181.6	181.7	181.6	181.5	182.6	181.8
Natural Clay[1]	180.7	181.3	181.3	180.9	181.1	180.3	182.4	181.4
Natural Sand or Gravel[2]	170.8	171.1	171.4	171.7	171.3	171.5	172.2	NE
Base of Borehole	170.7	171.1	166.6	167.2	171.1	171.0	167.1	171.3

Notes: [1]Stiff, very stiff or hard; [2]Dense; NE = not encountered

Free groundwater was not observed during augering and the use of drilling fluid prevented groundwater observations during rotary wash-boring. The monitoring well installed in BH405 was purged following installation and remained dry during the remainder of the field work.

The water levels measured during the previous investigations are provided in Table 2.

Table 2: Previous Groundwater Observations in Monitoring Wells (m, AHD)

Date	BH101	BH106
31 March 2011	176.4	NM
6 April 2011	NM	176.3
7 April 2011	176.3	NM
20 September 2011	175.7	176.8

Notes: NM = not measured

6. Laboratory Testing

Four soil samples obtained from the bores in the area of the proposed carpark were tested to determine the California bearing ratio (CBR) of the soil. The samples were compacted to a dry density ratio of 100% relative to Standard compaction, subjected to a 4.5 kg surcharge and were soaked in a water bath for 4 days prior to testing. The results of the analysis are summarised in Table 3.

Table 3: Laboratory Test Results for California Bearing Ratio

Sample/Depth (m)	Material Description	Maximum Dry Density (t/m^3)	California Bearing Ratio (%)	Swell (%)
BH406/0.5-0.8	Silty clay	1.78	9	0.4
BH407/0.5-0.8	Silty clay	1.83	19	0.8
BH408/0.3-1.0	Silty clay	1.70	8	0.2
BH409/0.5-0.9	Silty clay	1.85	13	0.3

7. Geotechnical Model

The development areas are underlain by a minor depth of filling over stiff, very stiff and hard alluvial silty clays to depths of about 10 m. Previous laboratory test results suggest that the clayey soils are of moderate plasticity. The clays are underlain by sands and gravels to the base of the deeper bores at depths of up to 15.5 m. Due to their alluvial origin these soil materials are expected to be variable across the site, varying in depth, thickness and extent, depending on the alignment and size of ancient river channels.

Groundwater was not observed during the current investigation but has previously been encountered between RL 175.7 m and RL 176.8 m AHD.

8. Proposed Development

It is understood that the Stage 3 redevelopment project will involve the demolition of existing hospital buildings in the north-western area of the campus and the construction of a new two to three-storey facility. A new on-grade carpark is also proposed in the south-western area of the hospital.

The geotechnical issues considered relevant to the proposed development include site preparation, excavation, excavation support, groundwater, foundations and pavements.

9. Comments

9.1 Site Preparation

The existing filling is considered to be uncontrolled as there is no evidence to suggest that it has been placed and compacted to an engineering specification. If the existing filling is required to support new pavements and building slabs then it will need to be reworked. The following process could be undertaken:

- Excavate the existing filling to expose natural clay soils;

- Prepare the subgrade by rolling with a large roller (e.g. 12 tonne deadweight) and ensure there are no areas that exhibit heaving under the roller;
- Place suitable filling in 250 mm thick layers (loose) and compact to achieve a dry density ratio of at least 98% relative to Standard compaction. This should be increased to 100% relative to Standard compaction for the top 300 mm of pavement subgrade;
- If the filling exhibits clay-like properties then the moisture content should be within 2% of optimum.

It is noted that the existing filling should be suitable for re-use provided that any deleterious materials (e.g. particles larger than 100 mm, waste, organic material etc.) are removed prior to or during placement.

Any new filling could also be placed in accordance with the procedure outlined above.

It is suggested that a working platform comprising a layer of crushed rock or recycled crushed concrete be placed over areas of the site where machinery and personnel traffic is expected, due to the risk of poor trafficability over the clays when wet.

9.2 Excavation

Excavation works for the new building and carpark may be required within filling and clayey soils which should be readily achievable using conventional earthmoving equipment such as a hydraulic excavator with bucket attachment. Bulk excavation in bedrock will not be required.

It should be noted that any off-site disposal of spoil will generally require assessment for re-use or classification in accordance with current *Waste Classification Guidelines* (NSW Department of Environment, Climate Change and Water, 2009).

9.3 Excavation Support

Vertical excavations in filling and soil are not expected to be stable for an extended period of time. Temporary batters of 1(H):1(V) could be used to support the sides of the excavations in these materials for cuts up to 2 m deep. The silty clay will be susceptible to significant slaking and erosion from exposure to air and water flows from run-off. Any permanent or semi-permanent batter slopes will need to be covered with either shotcrete pinned to the face, or preferably battered to 3(H):1(V) or flatter, to allow the establishment of topsoil and vegetation (e.g. grass).

Excavations or embankments retained either temporarily or permanently will be subjected to earth pressures down to the base of the excavation. Table 4 outlines material and strength parameters that could be used for the design of retaining structures.

Table 4: Material and Strength Parameters for Retaining Structures

Material	Bulk Density (kN/m^3)	Coefficient of Active Earth Pressure (K_a)	Coefficient of Earth Pressure at Rest (K_o)	Ultimate Passive Earth Pressure (kPa)
Filling	20	0.4	0.6	-
Alluvial Clays	20	0.3	0.45	200[1]

Notes: [1]Only below excavation/ground level

The lateral earth pressure distribution for cantilevered walls and for walls with a single row of support could be assumed to be triangular (i.e. increase with depth). Lateral pressures due to surcharge loads from adjacent buildings, road corridors and construction machinery should be included where relevant. Hydrostatic pressure acting on retaining walls should also be included in the design where adequate drainage is not provided behind the full height of the walls.

9.4 Groundwater

Groundwater appears to be at least 6 m below the ground surface, and possibly deeper, and is therefore not expected to be an issue for the proposed structures. However, seepage into bored pile holes (if applicable) may be an issue and will need to be removed prior to pouring concrete unless a tremie is used.

9.5 Foundations

9.5.1 Spread Footings

Depending on the design column loads, spread footings (e.g. pad footings and strip footings) may be suitable for supporting the proposed structure and could be designed using the parameters shown in Table 5.

Table 5: Design Parameters for Spread Footings

Material	Allowable Bearing Pressure (kPa)	Modulus of Elasticity (MPa)
Engineered Filling	150	15
Stiff Clays	200	20
Very Stiff/Hard Clays	400	50

Settlements can be determined using the moduli of elasticity provided in Table 5. All spread footings should be inspected by a geotechnical engineer to confirm the strength of the foundation material.

9.5.2 Raft Slabs

A raft slab could be used to support the proposed building. The modulus of subgrade reaction (k_s) associated with a raft slab is dependent upon the column loads and the area over which the raft transfers the loads. Previous analysis on earlier stages of the hospital redevelopment project suggested that k_s values of between 1.5 kPa/mm and 3 kPa/mm were appropriate and it is suggested that these values are used in the first instance. Further refinement should be made once column loads and slab efficiencies have been determined.

9.5.3 Piles

Buildings constructed during previous stages of the development project are supported by continuous flight auger (CFA) piles. Presumably similar piles would be used to support the Stage 3 building, if piles are required, and would be founded in the stiff to hard clays and dense sands and gravels.

Preliminary pile design could be undertaken using the following parameters:

- Ultimate end-bearing pressure: 2250 kPa
- Average ultimate shaft adhesion (compression): 30 kPa (ignore top 3 m of pile shaft)
- Average ultimate shaft adhesion (tension): 20 kPa (ignore top 3 m of pile shaft)

These parameters were derived from the interpretation of cone penetration test (CPT) data from previous investigations and do include a degree of conservatism as some CFA piling contractors are more experienced than others. Higher parameters may be able to be justified by some contractors on the basis of previous experience, load test results etc.

An appropriate geotechnical strength reduction factor will need to be calculated by the pile designer in accordance with the procedure outlined in Australian Standard AS 2159 – 2009 *Piling – Design and installation*. The serviceability limit state will also require consideration to ensure settlements are within an acceptable range.

9.6 Pavements

The current boreholes drilled in the proposed carpark area indicate minor depths of filling over stiff silty clay. The laboratory testing on the clay samples indicated four-day soaked CBR values of between 8% and 19%. Previous testing provided CBR results of between 4% and 10%. The current CBR test results are higher than would generally be expected for medium to high plasticity clays. Subject to the subgrade preparation outlined below, it is recommended that the design of a pavement on a clayey subgrade be based on a CBR value of 3%.

Site preparation for pavement areas should be undertaken in accordance with Section 9.1 of this report. Appropriate cross-fall and subsurface drainage should be installed to reduce the risk of the clayey subgrade becoming saturated during periods of wet weather.

10. Limitations

Douglas Partners (DP) has prepared this report for the Stage 3 redevelopment project at Wagga Wagga Base Hospital, NSW in accordance with DPs proposal dated 19 May 2014. The report is provided for the use of Health Infrastructure for this project only and for the purpose(s) described in the report. It should not be used for other projects or by a third party.

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

DPs 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 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 notes 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 given 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 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.

Douglas Partners Pty Ltd

Appendix A

About this Report

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 Methods

Douglas Partners

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.

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.

Appendix B

Drawings

APPROXIMATE OUTLINE OF PROPOSED STAGE 3 HOSPITAL BUILDING

APPROXIMATE OUTLINE OF PROPOSED CARPARK

EDWARD STREET

DOCKER STREET

HARDY AVENUE

RAWSON AVENUE

BROOKONG AVENUE

MURRAY STREET

BH106 BH401 BH201 BH202 BH203 BH204 BH402 BH105 BH403 BH205 BH404 BH405 BH108 BH104 BH103 306 BH107 BH107A BH209 BH109 CPT1 CPT3 307 BH207 BH210 BH101 CPT4 303 BH206 CPT2 305 BH208 BH102 BH407 BH406 BH408 BH409 302 304 BH211 301 CPT5

Locality Plan

0 5 10 20 30 40 50 75 100 150m

1:1500 @ A3

LEGEND

- Current Borehole Location
- Previous Test Location (CPT & Shallow borehole)
- Previous Borehole Location (April 2011)
- Previous CPT Location (September 2011)
- Previous Borehole Location (September 2011)
- Approximate Hospital Boundary

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Health Infrastructure		TITLE: Test Location Plan Wagga Wagga Base Hospital - Stage 3 Edward Street, Wagga Wagga	PROJECT No: 72320.09
OFFICE: Sydney	DRAWN BY: PSCH		DRAWING No: 1
SCALE: As shown	DATE: 18.8.2014		REVISION: 0

P:\72320.09 WAGGA WAGGA Base Hospital Stage 3 PMO\Drawings\72320.09-1.dwg, 26/08/2014 8:28:21 AM, DWG To PDF.pc3

Appendix C

Results of Current Field Work

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital - Stage 3
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH401
PROJECT No: 72320.09
DATE: 23/7/2014
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
181	0.0			A/E*	0.1				
	0.3	SILTY CLAY - firm to stiff, dark brown, silty clay with some fine grained sand, damp (with some rootlets in top 100mm)			0.2				
		SILTY CLAY - stiff to very stiff, red-brown, silty clay, humid		A/E	0.5				
					0.6				
180	1			A/E	0.9				1
					1.0				
				S			5,6,12 N = 18		
					1.45				
179	2								2
	2.0	SILTY CLAY - hard, brown to red-brown, silty clay with some quartz/ironstone gravel and fine grained sand, humid			2.5				
				S			18,23,26 N = 49		
178	3				2.95				3
		- very stiff below 3.5m							
177	4				4.0				4
				S			5,7,10 N = 17		
					4.45				
176	5	- brown and grey mottled below 5.0m							5
					5.5				
				S			6,8,13 N = 21		
175	6				5.95				6
		6.3-6.8m: hard band							
174	7				7.0				7
		- orange-brown and grey mottled below 7.0m		S			7,8,13 N = 21		
					7.45				
173	8								8
		- hard below 8.0m							
					8.5				
		- slightly sandy below 8.5m		S			10,21,26 N = 47		
172	9				8.95				9

RIG: DT250 **DRILLER:** SY **LOGGED:** AG **CASING:** HW to 2.5m

TYPE OF BORING: Hand auger to 0.7m; Solid flight auger to 2.5m; Rotary to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering, drilling fluid prevented the observation of groundwater below 2.5m

REMARKS: *TSA/230714, TSB/230714 are triplicate samples of 0.1-0.2m

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital - Stage 3
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH401
PROJECT No: 72320.09
DATE: 23/7/2014
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	10.2			S	10.0		18,29/150mm refusal		
	10.3	GRAVELLY SAND - dense, orange-brown, medium to coarse grained, gravelly (quartz) sand			10.3				
		Bore discontinued at 10.3m - target depth reached							

RIG: DT250 **DRILLER:** SY **LOGGED:** AG **CASING:** HW to 2.5m

TYPE OF BORING: Hand auger to 0.7m; Solid flight auger to 2.5m; Rotary to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering, drilling fluid prevented the observation of groundwater below 2.5m

REMARKS: *TSA/230714, TSB/230714 are triplicate samples of 0.1-0.2m

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital - Stage 3
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH402
PROJECT No: 72320.09
DATE: 23/7/2014
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
181	0.2	FILLING - brown, fine to medium grained, silty sand filling with some quartz gravel, moist (with some rootlets in top 100mm)		A/E	0.0 - 0.1				
	0.6	SILTY CLAY - firm, orange-brown, silty clay, moist (possible filling)		A/E	0.4 - 0.5				
				A/E	0.6 - 0.7				
	1	SILTY CLAY - stiff, red-brown, silty clay, humid		A/E	0.9 - 1.0				1
				S	1.0 - 1.45		5,6,9 N = 15		
180		- very stiff below 1.5m							
	2								2
	2.0	SILTY CLAY - hard, brown to red-brown, silty clay with some quartz/ironstone gravel and fine grained sand, humid		S	2.5 - 2.95		13,22,28 N = 50		
179									
	3	- very stiff below 3.0m							3
178									
	4	- brown and grey mottled below 4.0m		S	4.0 - 4.45		6,9,12 N = 21		4
177									
	5								5
176				S	5.5 - 5.95		6,8,9 N = 17		
	6								6
175									
	7	- grey-brown and orange-brown below 7.0m		S	7.0 - 7.45		6,10,12 N = 22		7
174									
	8								8
173				S	8.5 - 8.95		9,10,9 N = 19		
	9								9
172									

RIG: DT250 **DRILLER:** SY **LOGGED:** AG **CASING:** HW to 2.5m

TYPE OF BORING: Hand auger to 0.7m; Solid flight auger to 2.5m; Rotary to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering, drilling fluid prevented the observation of groundwater below 2.5m

REMARKS:

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital - Stage 3
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH402
PROJECT No: 72320.09
DATE: 23/7/2014
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		- hard below 10.0m		S	10.0		6,11,22 N = 33		
171	10.4 10.45	GRAVELLY SAND - dense, orange-brown, gravelly (quartz) sand			10.45				
		Bore discontinued at 10.45m - target depth reached							
	11								11
170									
	12								12
169									
	13								13
168									
	14								14
167									
	15								15
166									
	16								16
165									
	17								17
164									
	18								18
163									
	19								19
162									

RIG: DT250 **DRILLER:** SY **LOGGED:** AG **CASING:** HW to 2.5m

TYPE OF BORING: Hand auger to 0.7m; Solid flight auger to 2.5m; Rotary to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering, drilling fluid prevented the observation of groundwater below 2.5m

REMARKS:

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital - Stage 3
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.6 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH403
PROJECT No: 72320.09
DATE: 23/7/2014
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	0.3	FILLING - dark brown, fine to medium grained, silty sand filling with some quartz gravel, damp (with some rootlets in top 100mm)		A/E	0.1 0.2				
181		SILTY CLAY - stiff, red-brown, silty clay, humid		A/E	0.5 0.6				
	1			A/E	0.9 1.0				1
		- with some quartz gravel below 1.0m		S	1.45		3,4,10 N = 14		
180	2								2
		- very stiff below 2.5m		S	2.5 2.95		11,12,16 N = 28		
179	3								3
	4	- brown and grey mottled below 4.0m		S	4.0 4.45		8,12,18 N = 30		4
178									
	5								5
177				S	5.5 5.95		7,12,14 N = 26		
	6								6
176									
	7	- slightly sandy below 7.0m		S	7.0 7.45		8,10,13 N = 23		7
175									
	8								8
174									
		- orange-brown and grey mottled below 8.5m		S	8.5 8.95		7,11,12 N = 23		
173	9								9
172									

RIG: DT250 **DRILLER:** SY **LOGGED:** AG **CASING:** HW to 2.5m; HQ to 14.0m

TYPE OF BORING: Hand auger to 0.7m; Solid flight auger to 2.5m; Rotary to 14.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering, drilling fluid prevented the observation of groundwater below 2.5m

REMARKS:

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital - Stage 3
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.6 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH403
PROJECT No: 72320.09
DATE: 23/7/2014
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
171	10.2	SILTY CLAY - stiff, red-brown, silty clay, humid *(continued)*		S	10.0		22,33 refusal		
					10.3				
		GRAVELLY SAND - dense, orange-brown, medium to coarse grained, gravelly (quartz) sand							
	11 11.0								11
		SANDY GRAVEL - dense and very dense, brown, orange-brown and light grey, medium to coarse grained, sandy gravel (quartz)							
170				S	11.5		16,23,25/80mm refusal No sample return		
	12				11.88				12
169									
	13			S	13.0		25/90mm refusal No sample return		13
168					13.09				
	14								14
167					14.5				
				S			13,17,27 N = 44		
	15 14.95	Bore discontinued at 14.95m - refusal due to borehole collapsing in gravels			14.95				15
166	16								16
165	17								17
164	18								18
163	19								19
162									

RIG: DT250 **DRILLER:** SY **LOGGED:** AG **CASING:** HW to 2.5m; HQ to 14.0m

TYPE OF BORING: Hand auger to 0.7m; Solid flight auger to 2.5m; Rotary to 14.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering, drilling fluid prevented the observation of groundwater below 2.5m

REMARKS:

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital - Stage 3
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.7 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH404
PROJECT No: 72320.09
DATE: 25/7/2014
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
181	0.1	ASPHALT		A/E	0.1				
		FILLING - light brown, gravelly clay filling, humid			0.2				
	0.5	FILLING - dark brown, gravelly clay filling with a trace of coal fragments, humid		A/E	0.5				
	0.8	SILTY CLAY - very stiff, red-brown, silty clay with some ironstone gravel, humid			0.6				
	1			A/E	0.9				1
					1.0				
				S			7,11,14 N = 25		
					1.45				
180	1.8	SILTY CLAY - hard, brown, silty clay with some ironstone gravel, humid							
	2			A/E	1.9				2
					2.0				
					2.5				
179				S			23,15/70mm refusal		
					2.72				
	3								3
178									
	4	- brown and grey mottled below 4.0m			4.0				4
				S			10,15,28 N = 43		
					4.45				
177									
	5	- very stiff below 5.0m							5
					5.5				
176				S			8,9,14 N = 23		
	6				5.95				6
175									
	7	- orange-brown and grey mottled below 7.0m							7
174									
	8								8
					8.5				
173		- stiff below 8.5m		S			4,5,7 N = 12		
	9				8.95				9
172									
	10.0								

RIG: DT250 **DRILLER:** SY **LOGGED:** AG **CASING:** HW to 2.5m; HQ to 14.0m

TYPE OF BORING: Hand tools to 0.6m; Solid flight auger to 2.5m; Rotary to 14.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering, drilling fluid prevented the observation of groundwater below 2.5m

REMARKS:

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital - Stage 3
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.7 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH404
PROJECT No: 72320.09
DATE: 25/7/2014
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
171	11	SAND - dense, orange-brown, medium to coarse grained, slightly clayey sand		S	10.0 - 10.45		14,18,16 N = 34		
170	12	SANDY GRAVEL - dense, brown, orange-brown and light grey, medium to coarse grained, sandy gravel (quartz)		S	11.5 - 11.95		15,19,27 N = 46		
169	13			S	13.0 - 13.45		15,18,25 N = 43		
168	14								
167	15	Bore discontinued at 14.5m - refusal due to borehole collapsing in gravels							
166	16								
165	17								
164	18								
163	19								
162									

11.0
14.5

RIG: DT250 **DRILLER:** SY **LOGGED:** AG **CASING:** HW to 2.5m; HQ to 14.0m

TYPE OF BORING: Hand tools to 0.6m; Solid flight auger to 2.5m; Rotary to 14.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering, drilling fluid prevented the observation of groundwater below 2.5m

REMARKS:

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital - Stage 3
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.6 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH405
PROJECT No: 72320.09
DATE: 25/7/2014
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
181	0.05	FILLING - light grey, orange-brown and dark grey, medium to coarse gravel (quartz) filling, humid		A/E	0.1 0.2				Gatic cover Backfill Blank 0.0-1.0m
	0.5	FILLING - orange-brown, gravelly clay filling, humid		A/E	0.5 0.6				
		SILTY CLAY - very stiff, orange-brown, silty clay with some ironstone and quartz gravel, humid		A/E	0.9				Bentonite
	1	- red-brown below 1.0m		A/E S	1.0 1.45		4,9,20 N = 29		
180	2								
179		- hard below 2.5m		S	2.5 2.95		16,22,29 N = 51		
	3								Backfilled with gravel
178	4	- brown and grey mottled below 4.0m		S	4.0 4.45		8,14,19 N = 33		
177	5	- very stiff below 5.0m							
176				S	5.5 5.95		9,14,17 N = 31		Machine slotted PVC screen
	6								
175	7			S	7.0 7.45		9,11,14 N = 25		
174	8								
173		- stiff below 8.5m		S	8.5 8.95		5,6,8 N = 14		
	9								
172									End cap

RIG: DT250 **DRILLER:** SY **LOGGED:** AG **CASING:** HW to 2.5m

TYPE OF BORING: Hand tools to 0.6m; Solid flight auger to 2.5m; Rotary to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering, drilling fluid prevented the observation of groundwater below 2.5m

REMARKS: Standpipe pumped dry, no recharge prior to leaving site

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital - Stage 3
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.6 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH405
PROJECT No: 72320.09
DATE: 25/7/2014
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		- very stiff and slightly sandy below 10.0m		S	10.0		6,10,20 N = 30		
	10.3								
	10.45	CLAYEY SAND - dense, orange-brown, fine to medium grained, clayey sand			10.45				
		Bore discontinued at 10.45m - target depth reached							

RIG: DT250 **DRILLER:** SY **LOGGED:** AG **CASING:** HW to 2.5m

TYPE OF BORING: Hand tools to 0.6m; Solid flight auger to 2.5m; Rotary to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering, drilling fluid prevented the observation of groundwater below 2.5m

REMARKS: Standpipe pumped dry, no recharge prior to leaving site

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital - Stage 3
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 182.6 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH406
PROJECT No: 72320.09
DATE: 26/7/2014
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)
182	0.2	FILLING - brown, silty clay (topsoil) filling with some fine grained sand and rootlets, damp		A/E	0.0 - 0.1				
		SILTY CLAY - stiff, light brown, silty clay, humid - orange-brown below 0.4m		A/E	0.4 - 0.5		0.5-0.8m: Bulk sample		
181	1.0	Bore discontinued at 1.0m - virtual hand auger refusal		A/E	0.9 - 1.0				

RIG: Hand tools **DRILLER:** AG **LOGGED:** AG **CASING:** Uncased

TYPE OF BORING: Hand auger to 1.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital - Stage 3
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 182.8 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH407
PROJECT No: 72320.09
DATE: 26/7/2014
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)
182	0.2	FILLING - brown, silty clay filling with some steel fragments, fine grained sand and rootlets, damp		A/E	0.1 0.2				
		SILTY CLAY - stiff, brown, silty clay, humid - light brown to orange-brown below 0.5m		A/E	0.4 0.5		Bulk sample collected from 0.5m-0.8m		
				B					
	1.0			A/E	0.8 0.9				
		Bore discontinued at 1.0m - virtual hand auger refusal							

RIG: Hand tools **DRILLER:** AG **LOGGED:** AG **CASING:** Uncased

TYPE OF BORING: Hand auger to 1.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital - Stage 3
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 183.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH408
PROJECT No: 72320.09
DATE: 25/7/2014
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)
183	0.3	FILLING - dark brown, silty sand filling with a trace of clay, damp (with some rootlets in top 200mm)		A/E*	0.1 0.2		0.3-1.0m: Bulk sample collected		
		SILTY CLAY - stiff, brown and grey, silty clay, humid - red-brown below 0.5m		A/E	0.3 0.4 0.5				
182	1			A/E	1.0 1.1				1
	1.5	Bore discontinued at 1.5m - target depth reached							
181	2								2
180	3								3
179	4								4
178	5								5
177	6								6
176	7								7
175	8								8
174	9								9

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

RIG: DT250 **DRILLER:** SY **LOGGED:** AG **CASING:** Uncased

TYPE OF BORING: Hand auger to 0.5m; Solid flight auger to 1.5m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *TSA/250714, TSB/250714 are triplicate samples of 0.1-0.2m

☐ 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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital - Stage 3
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 183.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: BH409
PROJECT No: 72320.09
DATE: 26/7/2014
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)
183	0.2	MULCH		A/E*	0.2 0.3				
	0.5	FILLING - orange-brown, silty clay/gravelly clay filling with some fine grained sand, rootlets and organics, humid		A/E	0.4 0.5				
		SILTY CLAY - stiff, light brown to orange-brown, silty clay, humid		B			Bulk sample collected		
182	1.0	Bore discontinued at 1.0m - virtual hand auger refusal		A/E	0.9 1.0				
181	2								
180	3								
179	4								
178	5								
177	6								
176	7								
175	8								
174	9								

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

RIG: Hand tools **DRILLER:** AG **LOGGED:** AG **CASING:** Uncased

TYPE OF BORING: Hand auger to 1.0m

WATER OBSERVATIONS: No free groundwater observed whilst augering

REMARKS: *TSA/260714, TSB/260714 are triplicate samples of 0.2m-0.3m

☐ 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

Appendix D

Results of Previous Field Work

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital Redevelopment
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 72320.00
DATE: 31/3/2011
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
181	0.15	FILLING (TOPSOIL) - poorly compacted, brown, sandy silt filling with some grass rootlets, dry		E	0.2				
		FILLING - poorly compacted, orange brown, silty clay filling with some building rubble (concrete, tile) and quartz gravel, dry			0.3				
				E	0.8				
	1				0.9				1
	1.2	SILTY CLAY - very stiff, orange brown, silty clay with a trace of ironstone gravel, dry		S	1.2		2,11,18 N = 29		
180					1.65				
	2			E	2.0				2
					2.2				
179	2.5	SILTY CLAY - hard, orange brown silty clay, dry		S	2.5		13,18,22 N = 40		
	3				2.95				3
178									
	4								4
	4.0	SILTY CLAY - very stiff to hard, orange brown silty clay		S	4.0		9,12,20 N = 32		
177					4.45				
	5								5
176	5.5	SILTY CLAY - very stiff, brown silty clay, dry		S	5.5		7,9,12 N = 21		
	6	6.0m: becoming moist			5.95				6
175									
	7			S	7.0		6,8,12 N = 20		7
174					7.45				
	8								8
173				S	8.5		7,10,14 N = 24		
	9				8.95				9
172									
	10.0				10.0				

RIG: Scout **DRILLER:** JS **LOGGED:** PGH **CASING:** Uncased

TYPE OF BORING: Solid flight auger (TC-bit) to 10.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital Redevelopment
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 105
PROJECT No: 72320.00
DATE: 31/3/2011
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
171	10.45	SAND - medium dense, orange brown, medium to coarse grained sand with a trace of clay, moist		S	10.45		8,9,11 N = 20 (no sample recovered)		
		Bore discontinued at 10.45m - target depth achieved							
170	11								
169	12								
168	13								
167	14								
166	15								
165	16								
164	17								
163	18								
162	19								

RIG: Scout **DRILLER:** JS **LOGGED:** PGH **CASING:** Uncased
TYPE OF BORING: Solid flight auger (TC-bit) to 10.0m
WATER OBSERVATIONS: No free groundwater observed
REMARKS:

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital Redevelopment
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 182.6 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 72320.00
DATE: 5/4/2011
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
182	0.2	FILLING (TOPSOIL) - poorly compacted, brown, silty clay filling with some sand		E*	0.1				Gatic cover
	0.4	SILTY CLAY - hard, orange brown silty clay, dry		B	0.2 0.3				Concrete
		SILTY CLAY - hard, orange brown, silty clay with a trace of ironstone gravel, dry							Bentonite
181	1			S	1.3		7,22,20 N = 42		1
				E	1.75				
180	2	2.0m: very stiff			2.0				2
				S	2.5		16,29,25 N = 54		
179	3				2.95				3
	4.0	SILTY CLAY - stiff, mottled orange brown and grey, silty clay with a trace of ironstone gravel and sand, moist		S	4.0		4,4,5 N = 9		4
178	5				4.45				5
	5.5	SILTY CLAY - very stiff, brown silty clay, moist		S	5.5		5,8,12 N = 20		
177	6				5.95				6
	7.0	SILTY CLAY - hard, brown, silty clay with a trace of sand, dry		S	7.0		10,13,21 N = 34		7
176	7				7.45				
175	8								8
174				S	8.5		8,16,19 N = 35		Backfilled with gravel
	9				8.95				9
173					10.0				

RIG: Scout **DRILLER:** JS **LOGGED:** PGH **CASING:** HQ to 15.0m

TYPE OF BORING: Pot holing to 1.2m; Solid flight auger to 14.50m; Rotary (water) to 15.50m

WATER OBSERVATIONS: Free groundwater observed at 13.10m

REMARKS: *Denotes field replicate sample BD2/5.4.11 collected. Standpipe piezometer installed: solid 0.0-6.0m; Slotted 6.0-15.5m; Bentonite plug 0.3-1.0m; Quick-set concrete 0.0-0.3m with gatic cover

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 I Environment I Groundwater

BOREHOLE LOG

CLIENT: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital Redevelopment
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 182.6 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 106
PROJECT No: 72320.00
DATE: 5/4/2011
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
172	10.35	SILTY CLAY - hard, brown, silty clay with a trace of sand, dry *(continued)*		S	10.45		14,23,25 N = 48		
		SAND - dense, medium to coarse grained sand, dry							Machine slotted PVC screen
11		10.95m: rounded quartz gravel							11
171				S	11.5 11.95		16,25,25 N = 50		
12									12
170				A	12.5				
13	13.1				13.0			▼	13
		SAND - dense, medium to coarse grained, brown sand with some clay and rounded quartz gravel (to 50mm diameter), saturated		S	13.45		12,12,19 N = 31		
169									
14									14
	14.4			A	14.4				
168		CLAYEY SAND - dense, medium to coarse grained, clayey sand with some rounded quartz gravel, wet		S	14.5 14.95		10,15,25 N = 40 (no sample recovered)		
15									15
	15.5	Bore discontinued at 15.5m - target depth achieved							End cap
167									
16									16
166									
17									17
165									
18									18
164									
19									19
163									

RIG: Scout **DRILLER:** JS **LOGGED:** PGH **CASING:** HQ to 15.0m

TYPE OF BORING: Pot holing to 1.2m; Solid flight auger to 14.50m; Rotary (water) to 15.50m

WATER OBSERVATIONS: Free groundwater observed at 13.10m

REMARKS: *Denotes field replicate sample BD2/5.4.11 collected. Standpipe piezometer installed: solid 0.0-6.0m; Slotted 6.0-15.5m; Bentonite plug 0.3-1.0m; Quick-set concrete 0.0-0.3m with gatic cover

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital Redevelopment
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.8 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 108
PROJECT No: 72320.00
DATE: 6/4/2011
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
181	0.0	FILLING - poorly compacted, medium grained clayey sand filling, moist		A	0.1				
					0.2				
	0.4	SILTY CLAY - apparently hard, red brown silty clay, dry							
	1								1
	1.4	SILTY CLAY - hard, red brown silty clay, dry			1.4				
180				S			5,17,22 N = 39		
					1.85				
	2				2.0				2
				A	2.2				
		2.5m: with a trace of ironstone gravel			2.5				
179				S			10,13,25 N = 38		
	3				2.95				3
178									
	4								4
	4.0	SILTY CLAY - very stiff, brown silty clay, moist			4.0				
				S			5,9,13 N = 22		
					4.45				
177	5								5
					5.5				
				S			5,7,13 N = 20		
176	6				5.95				6
175									
	7				7.0				7
		7.0m: becoming grey brown		S			4,8,12 N = 20		
					7.45				
174	8								8
	8.5	SILTY CLAY - stiff, brown silty clay, moist			8.5				
173				S			5,6,8 N = 14		
	9				8.95				9
172	10.0				10.0				

RIG: Scout **DRILLER:** JS **LOGGED:** PGH **CASING:** Uncased

TYPE OF BORING: Pot holing to 1.2m; Solid flight auger (TC-bit) to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst auger drilling

REMARKS:

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital Redevelopment
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.8 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 108
PROJECT No: 72320.00
DATE: 6/4/2011
SHEET 2 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
		SILTY CLAY - stiff, brown silty clay, mois*(continued)*		S			3,5,6 N = 11		
	10.45	Bore discontinued at 10.45m - target depth achieved			10.45				

RIG: Scout **DRILLER:** JS **LOGGED:** PGH **CASING:** Uncased

TYPE OF BORING: Pot holing to 1.2m; Solid flight auger (TC-bit) to 10.0m

WATER OBSERVATIONS: No free groundwater observed whilst auger drilling

REMARKS:

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital Redevelopment
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.4 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 201
PROJECT No: 72320.03
DATE: 21/9/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
181	0.0	FILLING (TOPSOIL) - poorly compacted, brown, sandy silt filling with some rootlets, dry		E	0.1–0.2		PID<1	
	0.3	FILLING - poorly compacted, brown, silty clay filling with some sand, moist		E	0.3–0.4		PID<1	
	0.8	SILTY CLAY - very stiff, orange brown silty clay, dry		A	0.8–0.9		0.8-1.1m: Bulk sample	
180	1	- hard from 1.2m						
				A	1.5–1.6			
179	2							
				A	2.9			
	3.0	Bore discontinued at 3.0m - target depth achieved			3.0			
178	4							
177								

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

RIG: 5 tonne Excavator **DRILLER:** John Rapley **LOGGED:** PGH **CASING:** Uncased

TYPE OF BORING: 200mm diameter 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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital Redevelopment
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 202
PROJECT No: 72320.03
DATE: 21/9/2011
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water
181	0.0	FILLING (TOPSOIL) - poorly compacted, brown, sandy silt filling with rootlets, dry		E*	0.1 – 0.2		PID<1	
	0.3	FILLING - poorly compacted, brown clay filling with some silt, moist		E	0.3		PID<1	
				D	0.4			
	0.6	FILLING - poorly compacted, red brown, silty clay filling with some silt and sand, moist		D	0.6			
				E	0.7 – 0.8		PID<1	
	0.8	SILTY CLAY - very stiff then hard, orange brown, silty clay, moist		B	1.1			
180	1							
				D	1.9 – 2.0			
179	2							
	3.0	Bore discontinued at 3.0m - target depth achieved						
178	3							
	4							
177								

Dynamic Penetrometer Test (blows per 150mm)
5 10 15 20
1 2 3 4

RIG: 5 tonne Excavator **DRILLER:** John Rapley **LOGGED:** PGH **CASING:** Uncased

TYPE OF BORING: 200mm diameter auger

WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Denotes field replicate sample BD1/21911 collected

☐ 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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital Redevelopment
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 181.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 203
PROJECT No: 72320.03
DATE: 21/9/2011
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)
181	0.25	FILLING (TOPSOIL) - poorly compacted, brown, sandy silt filling with some rootlets, dry		E	0.1 0.2		PID<1		
		SILTY CLAY - very stiff, orange brown silty clay, dry		A	0.3 0.4		0.3-0.4m: Bulk sample		
		- hard from 0.6m							
180	1			A	1.0 1.1				
				A	1.8 1.9				
179	2	2.5-2.6m: ironstone gravel		A	2.6 2.7				
	3	3.0 Bore discontinued at 3.0m - target depth achieved							
178	4								
177									

RIG: 5 tonne Excavator **DRILLER:** John Rapley **LOGGED:** PGH **CASING:** Uncased

TYPE OF BORING: 200mm diameter 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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital Redevelopment
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 182.9 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 301
PROJECT No: 72320.06
DATE: 7/11/2012
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
	0.03	ASPHALTIC CONCRETE							
		ROADBASE - sandy gravel roadbase		E/A	0.1				
	0.2	SILTY CLAY - orange brown silty clay			0.2				
182	1			E/A*	1.0				1
	1.2	Bore discontinued at 1.2m - target depth			1.2				
181									

RIG: Sucker Truck **DRILLER:** WWDD **LOGGED:** TS **CASING:** Uncased
TYPE OF BORING: Hand tool and water blast/ vacuum truck
WATER OBSERVATIONS: No free ground water observed
REMARKS: *BD2/ 071112

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: Health Infrastructure
PROJECT: Wagga Wagga Base Hospital Redevelopment
LOCATION: Edward Street, Wagga Wagga

SURFACE LEVEL: 182.5 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 302
PROJECT No: 72320.06
DATE: 7/11/2012
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
182	0.05	ASPHALTIC CONCRETE							
	0.1	ROADBASE - sandy gravel roadbase							
		SILTY CLAY - orange brown silty clay		E/A	0.1 0.2				
	1								1
	1.2	Bore discontinued at 1.2m - target depth							
181									

RIG: Sucker Truck **DRILLER:** WWDD **LOGGED:** TS **CASING:** Uncased
TYPE OF BORING: Hand tool and water blast/ vacuum truck
WATER OBSERVATIONS: No free ground water observed
REMARKS:

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

Appendix E

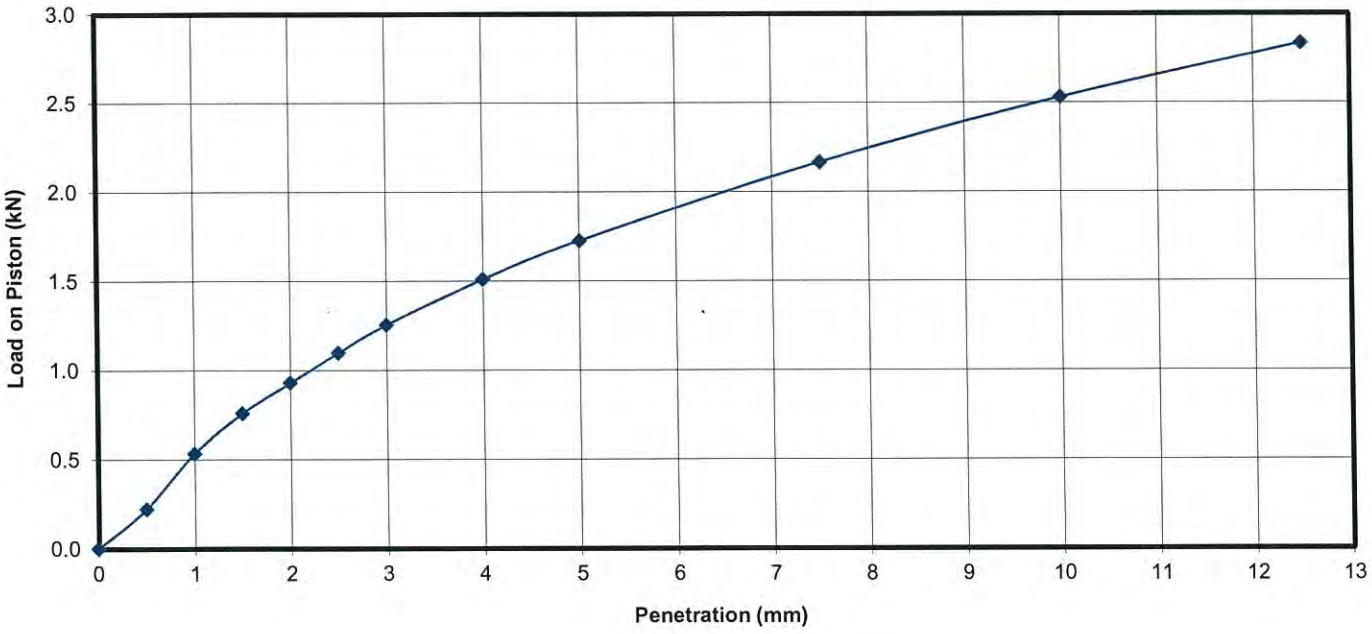
Laboratory Test Results

Douglas Partners
Geotechnics / Environment / Groundwater

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde
NSW 2114Phone (02) 9809 0666
Fax (02) 9809 4095

Results of California Bearing Ratio Test

Client :	Health Infrastructure (ABN 89600377397)	**Project No. :**	72320.09
		Report No. :	1
Project :	WAGGA WAGGA Base Hospital Stage 3	**Report Date :**	7/08/2014
		Date Sampled :	25/07/2014
Location :	Edward Street, WAGGA WAGGA	**Date of Test:**	4/08/2014
Test Location :	BH406		
Depth / Layer :	0.5 - 0.8m	**Page:**	1 of 1



Description: Orange brown silty clay

Test Method(s): AS1289 6.1.1, AS1289 5.1.1, AS1289 2.1.1

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 0% Excluded

LEVEL OF COMPACTION: 100% of STD MDD
MOISTURE RATIO: 98% of STD OMC
SURCHARGE: 4.5 kg
SOAKING PERIOD: 4 days
SWELL: 0.4%

CONDITION		MOISTURE CONTENT %	DRY DENSITY t/m^3
At compaction		16.6	1.78
After soaking		18.5	1.78
After test	Top 30mm of sample	19.3	-
	Remainder of sample	17.2	-
Field values		20.3	-
Standard Compaction		16.9	1.78

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**5.0 mm**	**9**

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory No 828
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025

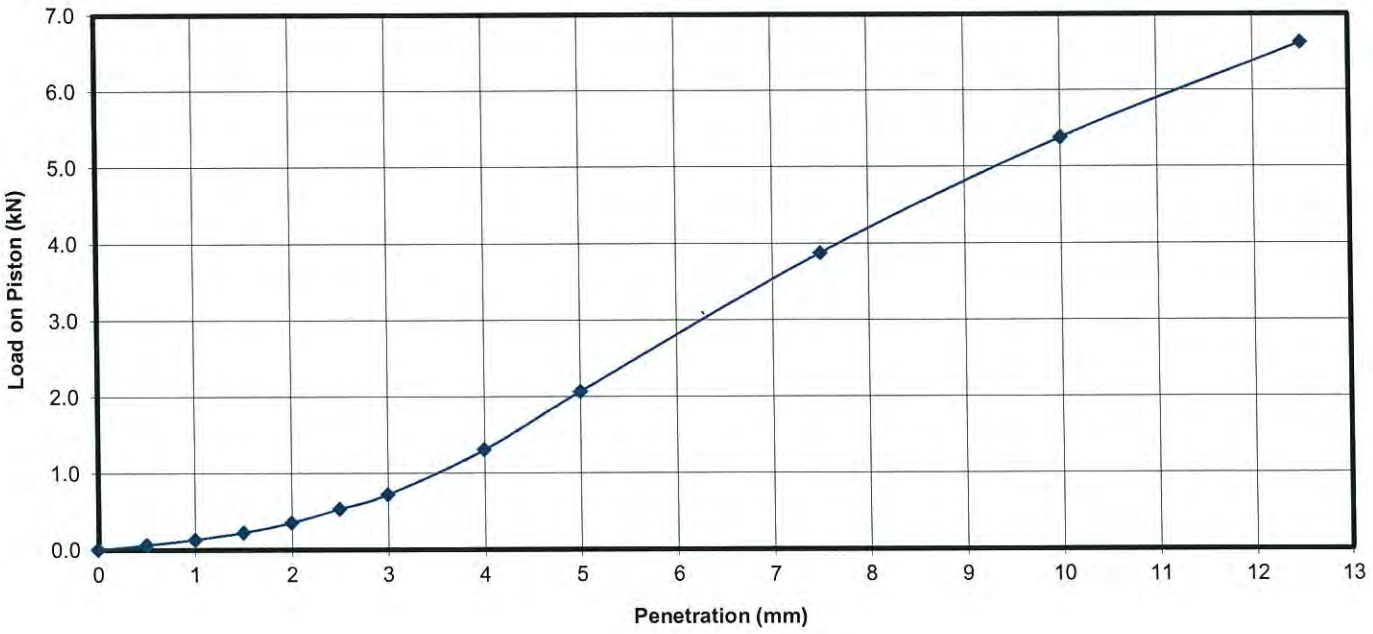
Mark Matthews
Laboratory Manager

Douglas Partners
Geotechnics I Environment I Groundwater

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde
NSW 2114Phone (02) 9809 0666
Fax (02) 9809 4095

Results of California Bearing Ratio Test

Client :	Health Infrastructure (ABN 89600377397)	**Project No. :**	72320.09
		Report No. :	2
Project :	WAGGA WAGGA Base Hospital Stage 3	**Report Date :**	7/08/2014
		Date Sampled :	25/07/2014
Location :	Edward Street, WAGGA WAGGA	**Date of Test:**	5/08/2014
Test Location :	BH407		
Depth / Layer :	0.5 - 0.8m	**Page:**	1 of 1



Description: Orange brown silty clay

Test Method(s): AS1289 6.1.1, AS1289 5.1.1, AS1289 2.1.1

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 0%

LEVEL OF COMPACTION: 100% of STD MDD
MOISTURE RATIO: 98% of STD OMC
SURCHARGE: 4.5 kg
SOAKING PERIOD: 4 days
SWELL: 0.8%

CONDITION		MOISTURE CONTENT %	DRY DENSITY t/m^3
At compaction		14.0	1.83
After soaking		16.4	1.83
After test	Top 30mm of sample	17.1	-
	Remainder of sample	15.8	-
Field values		20.5	-
Standard Compaction		14.2	1.83

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**5.0 mm**	**19**

NATA Accredited Laboratory No 828
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025

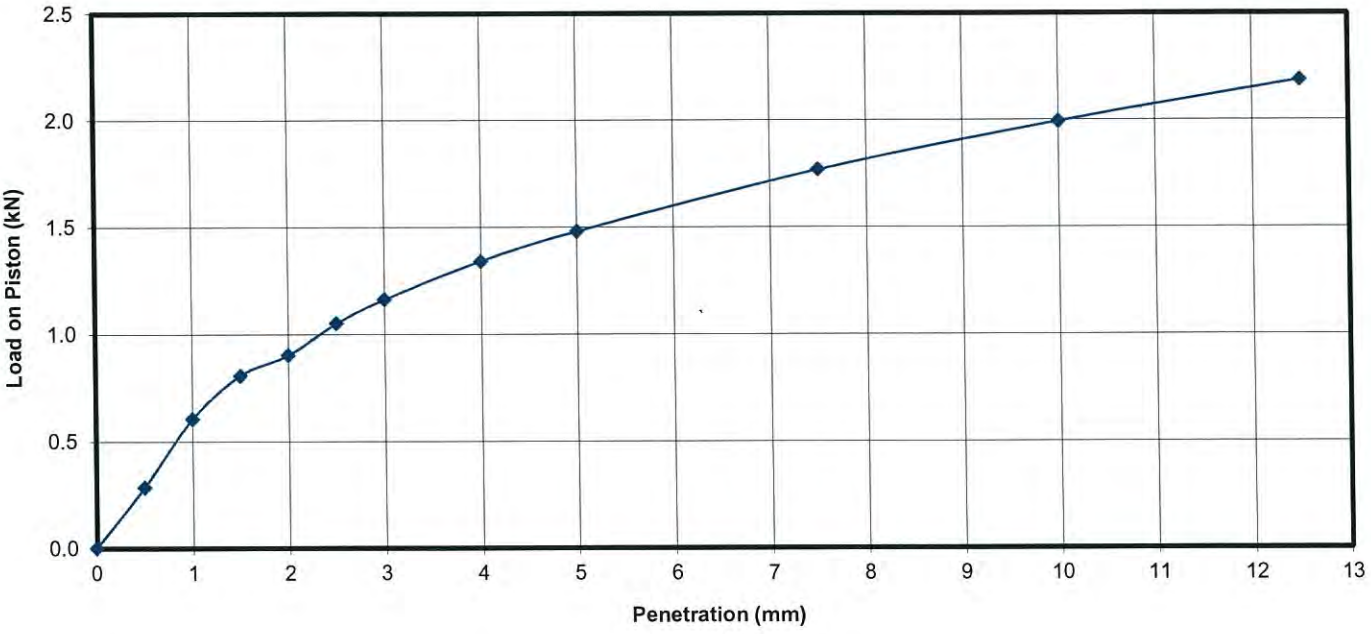
Mark Matthews
Laboratory Manager

Douglas Partners
Geotechnics / Environment / Groundwater

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde
NSW 2114Phone (02) 9809 0666
Fax (02) 9809 4095

Results of California Bearing Ratio Test

Client :	Health Infrastructure (ABN 89600377397)	**Project No. :**	72320.09
		Report No. :	3
Project :	WAGGA WAGGA Base Hospital Stage 3	**Report Date :**	5/08/2014
		Date Sampled :	25/07/2014
Location :	Edward Street, WAGGA WAGGA	**Date of Test:**	4/08/2014
Test Location :	BH408		
Depth / Layer :	0.3 - 1.0m	**Page:**	1 of 1



Description: Red brown silty clay

Test Method(s): AS1289 6.1.1, AS1289 5.1.1, AS1289 2.1.1

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 0%

LEVEL OF COMPACTION: 100% of STD MDD
MOISTURE RATIO: 97% of STD OMC
SURCHARGE: 4.5 kg
SOAKING PERIOD: 4 days
SWELL: 0.2%

CONDITION		MOISTURE CONTENT %	DRY DENSITY t/m^3
At compaction		19.3	1.70
After soaking		21.6	1.70
After test	Top 30mm of sample	21.3	-
	Remainder of sample	20.8	-
Field values		22.5	-
Standard Compaction		20.0	1.70

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**5.0 mm**	**8**

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory No 828
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025

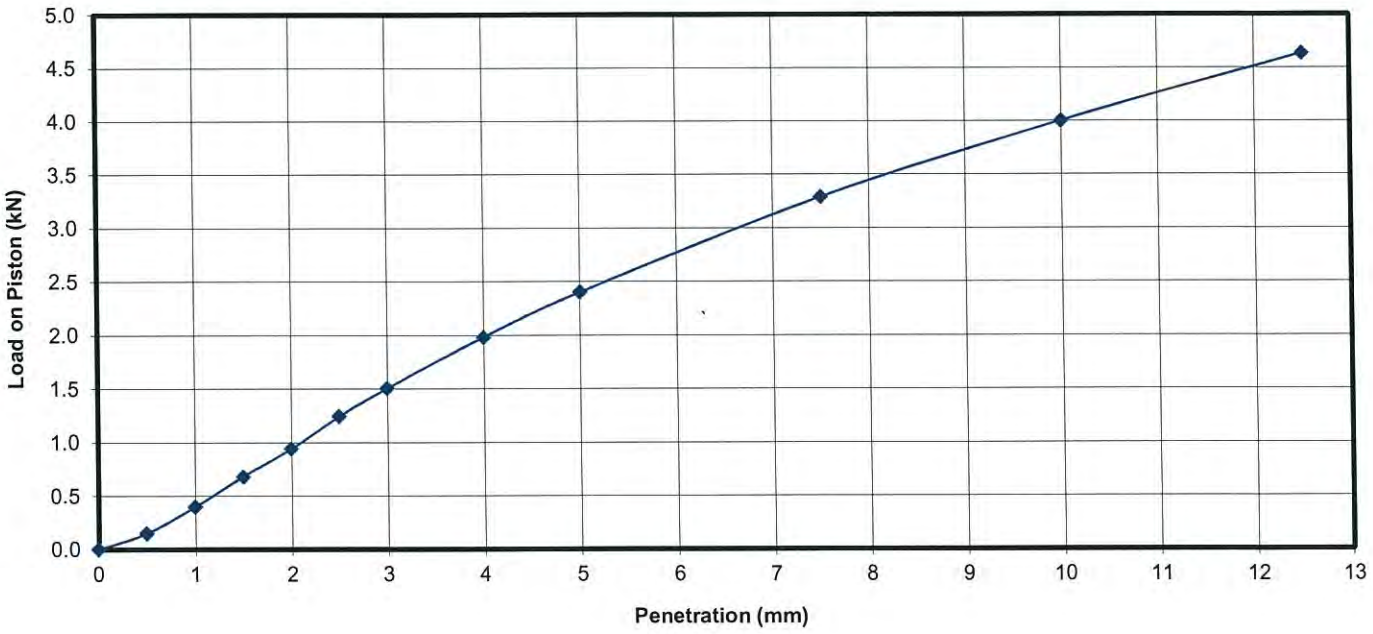
Mark Matthews
Laboratory Manager

Douglas Partners
Geotechnics I Environment I Groundwater

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
96 Hermitage Road
West Ryde
NSW 2114Phone (02) 9809 0666
Fax (02) 9809 4095

Results of California Bearing Ratio Test

Client :	Health Infrastructure (ABN 89600377397)	**Project No. :**	72320.09
		Report No. :	4
Project :	WAGGA WAGGA Base Hospital Stage 3	**Report Date :**	5/08/2014
		Date Sampled :	25/07/2014
Location :	Edward Street, WAGGA WAGGA	**Date of Test:**	4/08/2014
Test Location :	BH409		
Depth / Layer :	0.5 - 0.9m	**Page:**	1 of 1



Description: Light brown to orange brown silty clay

Test Method(s): AS1289 6.1.1, AS1289 5.1.1, AS1289 2.1.1

Sampling Method(s): Sampled by Engineering Department

Percentage > 19mm: 0%

LEVEL OF COMPACTION: 100% of STD MDD
MOISTURE RATIO: 98% of STD OMC
SURCHARGE: 4.5 kg
SOAKING PERIOD: 4 days
SWELL: 0.3%

CONDITION		MOISTURE CONTENT %	DRY DENSITY t/m^3
At compaction		14.5	1.85
After soaking		16.3	1.85
After test	Top 30mm of sample	16.6	-
	Remainder of sample	15.3	-
Field values		16.8	-
Standard Compaction		14.7	1.85

RESULTS		
TYPE	**PENETRATION**	**CBR (%)**
TOP	**5.0 mm**	**13**

NATA Accredited Laboratory No 828
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Accredited for compliance with ISO/IEC 17025

Mark Matthews
Laboratory Manager