APPENDIX I

Geotechnical Investigation

Douglas Partners
Geotechnics / Environment / Groundwater

Integrated Practical Solutions

Report on
Geotechnical Investigation

Proposed Redevelopment
Wagga Wagga Base Hospital
Edward Street, Wagga Wagga

Prepared for
Health Infrastructure

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Douglas Partners
Geotechnics / Environment / Groundwater

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

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Executive Summary

A geotechnical investigation was carried out on the site of the Wagga Wagga Base Hospital for the proposed new development comprising new hospital buildings ranging in height from between one and eight storeys. The investigation included the drilling and sampling of nine (9) geotechnical boreholes across the site varying in depth from between 2.4 m to 28 m. Two standpipes were also installed for the purpose of groundwater level measurements and sampling.

The sub soil conditions typically comprised minor amounts of surface filling underlain by stiff to hard clay. Some sand and gravel bands were intersected in the boreholes located towards the northern part of the site, however, bedrock was not encountered in any of the boreholes drilled to the maximum test depth of 28 m. Groundwater was measured at between 6 m and 7 m depth below existing surface levels. The site has been classified as “M-D – Moderately reactive deep drying” in accordance with the Australian Standard AS 2870 – 2010, providing that ‘normal’ moisture conditions prevail for the site soils.

It is understood that proposed working column loads are between 4000 kN and 8000 kN. Based on the results of the geotechnical investigation, it is anticipated that the building foundation design will comprise pile groups or a piled raft design.

It is recommended that additional settlement analyses as well as further geotechnical investigation be carried out in order to refine the design.

Table of Contents

Report on Geotechnical Investigation
Proposed Wagga Wagga Base Hospital Redevelopment
Edward Street, Wagga Wagga

1. Introduction

This report presents the results of a geotechnical investigation carried out by Douglas Partners Pty Ltd (DP) for a proposed redevelopment of the Wagga Wagga Base Hospital at Edward Street (Sturt Highway), Wagga Wagga. The work was commissioned by Capital Insight Pty Ltd in an email dated 2 March 2011.

It is understood that the current redevelopment plans include the demolition of a number of existing buildings and the construction of a new main building with sections of the building varying in height from one to eight storeys. The current investigation was carried out to provide information on subsurface conditions for the planning and design of excavations, retaining walls and foundations.

The fieldwork for the investigation included the drilling of nine (9) geotechnical boreholes with in-situ testing and sampling of the subsurface strata together with the installation of two (2) standpipes for groundwater sampling and monitoring. Laboratory testing of selected soil and groundwater samples was undertaken, followed by engineering analysis and reporting. Details of the field and laboratory work are given in this report together with comments relating to design and construction practice.

Architectural Drawing No. DA11 by Rice Daubney, showing indicative building heights together with a site survey plan (untitled) were supplied by Capital Insight Pty Ltd for use in the investigation. A geotechnical brief by Sinclair Knight Mertz (SKM) dated 21 December 2010 was also provided by Capital Insight Pty Ltd.

Douglas Partners Pty Ltd (DP) carried out a Preliminary Contamination Assessment in conjunction with the present geotechnical investigation. The Preliminary Contamination Assessment is reported separately, dated May 2011.

2. Site Description and Geology

The site for the proposed redevelopment is located at the existing hospital, Edward Street (Sturt Highway) in Wagga Wagga. The site is approximately rectangular in shape and has an area totalling approximately 55 000 m^2. It has an approximate 220 m northern frontage to Edward Street and a length of approximately 270 m along Docker Street on the western boundary. The eastern boundary is irregular and typically fronts neighbouring residential boundaries and hospital support buildings. Rawson Avenue is along the southern site boundary. The ground surface falls gently to the north of the site with a cross fall of approximately 2 m over a total distance of 270 m.

The site is currently occupied by a number of separate buildings, some of which date back to the early 1900's. The main hospital building (refer to Figure 1) located within the central part of the site is eight

storeys in height and is understood to have been constructed around the 1960's. The original three storey hospital building located adjacent to the main building (adjacent to the lawn area that fronts Edward Street) is still operational. A number of smaller brick buildings ranging in height from between one and three storeys are located throughout the site and are currently used as university buildings (Harvey House circa 1936), hospital nursing quarters, engineering/ maintenance buildings and hospital specialist buildings. A relatively newly constructed theatre building (CSB building) is located to the south-west of the main building and is between two and three storeys in height. Open asphalt and gravel car parks are located along the eastern side of the site.

Figure 1: Main Hospital Building and the Original Hospital Building (looking south-east)

Reference to the Wagga Wagga 1:250 000 Geological Series Sheet (SI 55-15) indicates that the northern half of 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 southern half of the site is shown to be underlain by the Wagga Marginal Base Formation comprising shale, slate, quartzite, sandstone and subgreywacke.

The field work confirmed the presence of alluvial clays, sands and gravelly sand extending to over 25 m depth.

3. Field Work

3.1 Methods

The field work comprised ten boreholes (BH101, BH102, BH103, BH104, BH105, BH106, BH107, BH107A, BH108 and BH109). The locations are shown on Drawing 1, in Appendix B.

The boreholes were drilled to depths of 2.4 m to 26.95 m with a truck-mounted Scout drilling rig using spiral auger and rotary washboring techniques within the soil.

Bore BH107 was discontinued and relocated (BH107A) approximately 1 m to the west after premature refusal at a depth of 2.4 m.

Standard Penetration Tests (SPTs) were carried below depths of 1.0 m to sample the soil and assess the in-situ strength of the materials. Disturbed soil samples were taken from the cuttings returned by the auger blade and used for identification and classification purposes. Soil samples were logged on site by a senior engineering geologist.

Slotted PVC standpipes were installed in bores BH101 and BH106 to allow for sampling of the groundwater and measurement of the groundwater level during the investigation period.

The bores were set out relative to existing surface features (e.g. buildings and boundaries) by tape measurement and the reduced surface levels (RLs) at each test location (to AHD) were interpolated from the site survey plan (untitled) provided.

3.2 Results

Details of the conditions encountered in each borehole are given in the borehole logs in Appendix C, together with notes defining classification methods and descriptive terms.

The boreholes generally encountered filling over alluvial clay and sand. The subsurface conditions may be generally summarised as follows:

- **PAVEMENTS:** encountered in boreholes BH102 (road base only), BH103, BH104, BH107 and BH107A comprised asphaltic concrete (AC), also referred to as bituminous concrete, over road base with a combined pavement thickness of between 0.1 and 0.2 m, overlying

- **TOPSOIL:** encountered in bores BH101, BH105, BH106, BH108 and BH109 to depths of between 0.1 m and 0.7 m. The topsoil generally comprised sandy silt and silty clay overlying, where present;

- **FILLING**: encountered to depths of 1.2 m to 2.4 m in boreholes BH105 and BH107, respectively, and generally comprised poorly compacted, silty clay filling with some building rubble (tiles and concrete fragments) overlying;

- **SILTY CLAY AND GRAVELLY SILTY CLAY:** silty clay encountered in all bores to depths of 7.0 m to 26.95 m, gravelly silty clay encountered in bore BH101 from between 7.0 to 8.0 m and

between 16.0 to 19.0 m and sandy clay encountered in borehole BH104 from between 13.00 to 13.20 m. The silty clay was of a typically very stiff to hard consistency in all bores (BH101 to BH109) however some stiff zones were logged in BH106 to BH109 generally between depths of 2 to 4 m. Gravelly silty clay was logged in bore BH101 between 7 to 8 m depth and 16 to 19 m depth and was of a typically hard consistency and found to overly where present;

- **SAND AND CLAYEY SAND**: encountered towards the northern end of the site in boreholes BH104, BH105 and BH106 to depths of 10.0 m to 15.5 m. The sand was typically medium dense to dense, medium to coarse grained and appeared to be well graded.

Free groundwater was observed during augering (or after leaving the boreholes open for a 12-hour period) in boreholes BH104 at a depth of 14.95 m, BH106 at a depth of 13.10 m and BH107A at a depth of 13.10 m. The use of water during washbore drilling prevented the measurement of groundwater below depths of 8.50 m in bores BH101, BH102 and BH103 and also below a depth of 14.5 m in the remaining bores (BH104 to BH109).

Water levels within the standpipes in boreholes BH101 and BH106 were recorded after completion of the drilling and "bailing out" the standpipes to lower the water level on the 29 March 2011 and 5 April 2011, respectively. The water level measurements are given in Table 1.

Table 1: Standing Water Levels in Standpipes

Borehole No.	Surface RL	Water Level Measurements		
	(m AHD)	Date	Depth (m)	RL (m AHD)
BH101	183.0	31.3.11	6.6	176.4
		5.4.11	6.7	176.3
		7.4.11	6.7	176.3
BH106	182.6	6.4.11	6.3	169.5

4. Laboratory Testing

4.1 Soil and Groundwater

Selected samples of soil were tested in the DP laboratory for Atterberg Limits, Linear Shrinkage, Standard compaction values and four-day soaked Californian Bearing Ratio (CBR) values. Selected samples of soil were tested at an external laboratory to assess aggressivity (electrical conductivity, pH, chloride ion and sulphate content). The results of the laboratory testing are included in Appendix D and summarised in Tables 2 and 3.

Table 2: Summary of Laboratory Test Results

Bore	Depth (m)	Material	W (%)	Atterberg Limits			LS (%)	OMC (%)	MDD (t/m^3)	Swell (%)	4-day soaked CBR (%)
				LL (%)	PL (%)	PI (%)					
BH101	0.3	Silty Clay – red orange	9.7					13.5	1.8	0.8	6
BH103	0.5	Clay – red orange	12.4					13.5	1.89	0.3	9
BH106	0.3	Silty Clay – brown silty clay	12.9					14.0	1.82	0.6	8
BH109	0.4	Clay – brown clay	15.7					15.0	1.71	1.3	10
BH101	4.0-4.45	Silty Clay – orange brown		35	18	17	11.0				
BH106	2.5-2.95	Silty Clay – orange brown		33	18	15	10.0				
BH108	1.4-1.85	Silty Clay – red brown		28	15	13	8.5				
BH109	4.0-4.45	Silty Clay – orange brown		34	17	17	10.5				

W = Field Moisture Content LL = Liquid Limit PL = Plastic Limit
PI = Plasticity Index LS = Linear Shrinkage OMC =Optimum Moisture Content
MDD = Maximum Dry Density CBR = Californian Bearing Ratio

The results of the Atterberg Limits and Linear Shrinkage tests indicate the clay is of medium plasticity and moderately reactive with changes in moisture content.

Table 3: Summary of Laboratory Chemical Analysis

Bore No.	Depth (m)	Sample Type	Electrical Conductivity (µS/cm)	pH	Chloride, Cl^- (ppm)	Sulphate, SO_4^{2-} (ppm)
BH101	5.5-5.95	soil	150	8.5	24	<20
BH106	4.0-4.45	soil	140	8.1	21	<20
BH108	2.5-2.95	soil	100	7.8	<20	64
BH107A	11.5-11.95	soil	100	8.0	31	<20

The results of the chemical analysis indicate the soil samples are generally alkaline and constitute a non-aggressive exposure classification in accordance with AS2159 - 2011.

5. Geotechnical Model

A geotechnical model of the site is presented in the form of two interpreted geotechnical cross-sections in Drawings 2 (Sections A – A') and in Drawing 3 (Section B - B'), in Appendix B. The sections show the depth of filling and soil overburden logged in the test bore locations.

The natural sub-surface profile at the site comprises alluvial clays and sands. The sediments consist of interbedded layers of silty clay, gravelly silty clay, sandy clay and sand. Due to their 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.

6. Proposed Development

It is understood that the proposed redevelopment of the site comprises three stages of construction activities including the demolition of all buildings except the CSB building (the newly constructed theatre building), Harvey House (UNSW medical building) and the Hydrotherapy Pool building. The proposed new main building will vary between two and eight storeys in height and will spread out across the site (refer to Drawing 1, in Appendix B).

The design also includes a service tunnel under the new building constructed to a depth equivalent to approximately one basement level. Open spaced car parking will be located on ground level only towards the north-eastern corner and south-western corners of the site.

Based on the brief provided estimated maximum working column loads were assumed to be around 8,000 kN (internal) and 4,000 kN (external).

7. Comments

7.1 Site Classification

For Wagga Wagga an Hs of 3 m and Δu of either 1.2 (AS2870 value) or 1.5 pF (maximum value from Barnett and Kingsford, 1999) are considered applicable. Shrink swell indices of the clays (Iss) at the site have not been measured as part of this investigation and may vary with depth however based on previous experience in the same subsoil conditions an average value for the profile is probably between 1.5 and 2.0 % per pF.

Characteristic soil surface movements, ys for the combination of parameters given above were calculated using an in-house spreadsheet and the assumed parameters and results are presented in Table 4.

Table 4: Site Classifications for Wagga Wagga Base Hospital

Δu (pF)	Iss (% per pF)	ys mm (no fill)	Site Classification
1.2	1.5	30	M-D
1.2	2.0	40	M-D
1.5	1.5	40	M-D
1.5	2.0	50	H-D

Based on the above table, the site is classified as “M-D – Moderately reactive deep drying” in accordance with the Australian Standard AS 2870 – 2010, providing that ‘normal’ moisture conditions prevail for the site soils. Where ‘abnormal’ moisture conditions occur (as defined in AS 2870) due to factors such as nearby trees, the range of soil moisture and suction variation can exceed that implicit in the design. In these circumstances, a more severe site classification (eg. “H-D”) may apply.

7.2 Site Preparation and Earthworks

7.2.1 Excavation Conditions

The proposed redevelopment will involve excavation depths of approximately 3 m for the proposed service tunnel, lift-wells and on-site detention (OSD) tanks. The majority of the excavated material is expected to comprise very stiff to hard silty clay with some filling material.

It is considered that excavation in the filling and silty clay should be readily carried out using conventional earthmoving equipment (e.g. bulldozers and hydraulic excavators).

It is suggested that a working platform comprising a layer of crushed rock or 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.

7.2.2 Disposal of Excavated Material

The materials that will be derived from the excavation works include filling and natural soil overburden.

The new Waste Classification Guidelines – Part 1: Classifying Waste (DECC, 2008) states that a waste/fill receiving site must be satisfied that materials received meet the environmental criteria for proposed land use. This includes filling and natural materials, such as may be removed from this site.

The scope of this investigation included a preliminary or "Phase 1" contamination investigation (refer DP Preliminary Contamination Assessment Report, May 2011) but did not include sampling and testing for waste classification assessment purposes.

It will be necessary to test any material required to be taken off site. The type and extent of testing undertaken will depend on the final use or destination of the spoil, and requirements of the receiving site.

7.2.3 Vibration with Excavation

It is anticipated that most of the excavation work within filling and residual soils will result in relatively minor vibrations. Some vibrations may however occur from the operation of heavy machinery and compaction plant (i.e. rollers).

Available information indicates that the types of structures adjacent to the site could probably withstand vibration levels higher than those required to maintain the comfort of their occupants. It is suggested that a provisional maximum peak particle velocity of 5 mm/sec (in any component direction) be adopted at the foundation level of adjacent structures for both structural and human comfort considerations. However, this limit should be reviewed prior to the commencement of site work with regards to the effects noise and vibration may have on a working hospital. It is anticipated that a working hospital will have specific requirements/limits with regard to noise and vibration.

As the magnitude of vibration transmission is site specific, it is recommended that a vibration trial be undertaken at the commencement of any work that may result in vibration of the surrounding ground and structures. The trial may indicate that smaller or different types of equipment should be used for earthworks at the site.

Dilapidation surveys should be carried out on neighbouring buildings prior to commencement of all excavation work so as to allow an appropriate and informed response to any claims for damages arising from construction activities.

7.2.4 Groundwater Seepage

Water levels were measured at 6.7 m depth (RL 176.3) and 6.3 m depth (RL 169.5) in the standpipes installed in BH101 and BH106, respectively. Groundwater levels do vary overtime, however, due to seasonal, climatic and other factors.

Due to the relatively low permeability of the clayey soils above a depth of approximately 6 m, it is anticipated that inflow rates would be relatively low and consequently, should be readily controlled by pumping from suitably located sumps within the floor of the excavation. As part of a permanent

drainage system, it may be prudent to provide under-floor drainage to protect the subgrade (and footing bases) from softening. This layer could comprise a 100 mm thick durable, open-graded crushed rock with subsurface drains and sumps.

7.3 Excavation Batters

The excavated faces may stand vertically where the excavation depth is less than 1.5 m. Some minor slumping may occur and site personnel should be made aware of the risks. Faces should either be battered or shored where the excavation depth exceeds 1.5 m. The suggested batter angles for temporary and permanent excavations are given in Table 5.

Table 5: Suggested Excavation Batter Angles

Material	Height	Batter Slope (H:V)	
		Short term Temporary	Long term Permanent
Existing filling and stiff clay	<2 m 2-3 m	1:1 1.5:1	1.5:1 2:1
Very stiff/hard clay	<2 m 2-4	0.75:1 1:1	1.5:1 2:1

All batters should be subject to geotechnical inspection for every 1.5 m of vertical excavation to confirm the adequacy of the slopes indicated above and to assess whether a flatter slope or localised dowelling is required to control any local instability within the face.

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 3H:1V or flatter, to allow the establishment of topsoil and vegetation (e.g. grass).

7.4 Excavation Support

Where battering cannot be incorporated due to space limitations and/or softening of the wall bases is likely, the provision of temporary and permanent retaining measures will be required. It is suggested that the design of the retaining system is based on an average bulk unit weight of 20 kN/m^3 for soil, with a triangular earth pressure distribution calculated as follows with suggested lateral earth pressure coefficients given in Table 6.

$$h_z = K z \gamma$$

where h_z = horizontal pressure at depth z
γ = unit weight of soil or rock
K = earth pressure coefficient

The earth pressure coefficient to be adopted for design will vary dependent upon the nature and strength of the retained material. Suggested active lateral earth pressure coefficients (horizontal backfill conditions) are given in Table 6 as a guide for design purposes.

Table 6: Suggested Active Lateral Earth Pressure Coefficients

Retained Material	Earth Pressure Coefficient		
	Active (short-term)	Active (long-term)	Passive
Clays - stiff / very stiff	0.3	0.35	2.5

Additional lateral pressures should be included where surcharging occurs either from footings due to adjacent construction or from traffic or other loads. Unless positive drainage measures can be incorporated to prevent water pressure build up behind the walls, full hydrostatic head should be allowed for in design while, at the same time, allowing for the soil density to reduce due to the buoyant condition.

7.5 Foundations

7.5.1 General

Given the magnitude of the column loads and taking into consideration that the depth to rock on the site is in excess of approximately 25 m, it is unlikely to be economically feasible to construct piles founded on rock. Alternative foundation systems include the use of friction piles (bored and cast-in place pile footing systems) or the construction of a stiffened raft slab with or without a pile foundation system.

When detailed information on loads and proposed foundation systems are available, detailed analyses will be required for raft design and estimates of settlements and possibly pile design to reduce settlement. Further investigation may also be required to confirm the continuity and variability of the subsurface conditions in heavily loaded areas.

7.5.2 Shallow Foundations

Based on the results of the boreholes the clay below the site within approximately 10 m depth from the surface is generally very stiff to hard consistency.

Therefore, consideration may be given to the use of a raft slab foundation. Based on an assumed floor (Working) load of 10 kPa per floor it is anticipated that a distributed slab load in the order of 20 kPa to 80 kPa may be applicable for a building varying in height between two and eight storeys. As a guide, for raft slab foundations, preliminary settlement analyses has been carried out assuming a uniform distributed slab pressure of 20 kPa to 80 kPa over a loaded area of 20 m by 20 m. Based on the results of the analyses, the preliminary design of raft slabs to support column and floor loadings may be based on a modulus of subgrade reaction in the order of 2 to 8 kPa/mm for the broad loaded area (i.e. 20 m by 20 m). Settlements in the order of 5 mm to 30 mm could therefore be expected under the assumed loads. The modulus of subgrade reaction value will vary with the load and the size of the loaded higher area and for detailed design of a raft foundation, modelling the soil profile as an elastic solid is preferred.

The design of raft slabs should consider potential differential settlements between different building heights due to the varying loadings on the raft slab and separate raft slabs may be required. A piled raft foundation may be considered to minimise differential settlements, particularly for the eight-storey section of the building, if required. Further geotechnical investigation and advice will be required in relation to the design of both raft slabs and possibly piled raft slabs once the column layout and loadings are confirmed.

7.5.3 Piled Foundations

The alternative to shallow foundations is to support the structural loads on piles founded within at least very stiff clay typically observed within 2 to 10 m depth (RL 183 to RL 171). Relatively large diameter piles or pile groups may be required to accommodate the heavier column loads of up to 8000 kN.

It is expected that noise and vibration constraints at this site will preclude the use of driven pile types. The adoption of uncased bored piles is possible within the clay but is not recommended below depths of about 10 m due to the presence of sand (in the northern part of the site) and the potential for soil collapse and major groundwater inflows. Even so, groundwater seepage may occur below 5 m depth but should be handled by pumping to remove the water immediately prior to concrete placement. It may be necessary to drill the piles and pour each one directly after cleaning and installing steel reinforcement. Steel screw piles are unlikely to be feasible for the high column loads and may have difficulty penetrating through the hard clays.

Suitable pile types would include bored piers and continuous flight auger (CFA) piles. These types of piles are all associated with relatively low levels of noise and vibration.

It is recommended that the bored piles be subject to regular geotechnical inspections of the founding condition in order to assess whether ground conditions are consistent with the bearing capacity requirements of the piles. In contrast, CFA piling is a ‘blind’ piling technique, and the piling contractor would need to be responsible for assessment or whether suitable materials were encountered and whether available bearing capacities meet the design requirements. Further investigation may be required.

It is recommended that piles founded within the very stiff to hard clay, be designed on the basis of the following Ultimate parameters:

- Ultimate End Bearing Pressure (compression) 600 kPa
- Ultimate Shaft Adhesion (compression) 50 kPa

Table 7 provides a comparison of the possible Working loads capable of being supported on different pile types (bored and CFA) and pile diameters (900 mm and 1500 mm). It is noted that Table 7 assumes the piles are installed in hard clay.

Table 7: Pile Type Working Loads

Pile Diameter (mm)	CFA and Bored Piles		
	Shaft Load [(1)] (kN)	End Bearing Load (kN)	Total Load (kN)
900	490	189	679
1500	826	531	1357

1. Assuming a pile depth of 10 m below surface level, but only taking into account the lower 7 m in hard clay.

Based on the total working loads for the different pile types and sizes shown in Table 7, an approximate pile quantity required for different design loads can be estimated. For example, a working column load of 8000 kN will require a group of twelve (12) 900 mm diameter bored piles taken to a depth of 10 m to support the column load.

Alternatively the same working column load of 8000 kN will require a group of six (6) 1500 mm diameter bored piles taken to a depth of 10 m to support the column load.

Settlements for pile groups, if adopted, will be larger than settlements for individual piles due to the increased zone of influence below the base of the pile group. A detailed settlement analysis will be required to assess total and differential settlements between individual piles and pile groups.

A Geotechnical Strength Reduction Factor (ϕ_g) that is appropriate for the level of pile testing and site investigation should be applied to R_{ug}, in accordance with AS 2159-2009.

7.5.4 Pavements and Floor Slabs

Proof rolling of the exposed subgrade should be carried out under the supervision of a geotechnical engineer to detect any soft or heaving areas. Any soft spots detected during proof rolling would need to be stripped to a stiff base and replaced with engineered filling. Engineered filling should be placed in maximum 200 mm thick loose layers and compacted to a minimum Dry Density Ratio (DDR) of 98% Standard compaction with moisture contents within 2% of optimum moisture content (OMC). The compaction should be increased to a DDR of 100% Standard compaction within 0.3 m of the subgrade surface.

The existing filling and topsoil is not considered suitable for use as subgrade and therefore needs to be removed. The underlying natural clay should generally be suitable for reuse as engineered filling provided it has a maximum particle size of 70 mm and moisture content within 2% of OMC (where possible, preference should be given to the use of granular material).

Subject to the subgrade preparation outlined above, the design of pavements on clay subgrade may be based on a California Bearing Ratio (CBR) value of 3%. The laboratory testing on the clay samples from boreholes BH101, BH103, BH106 and BH109 indicated a four-day soaked CBR value of 6%, 9%, 8% and 10% respectively, which is higher than would generally be expected for medium to high plasticity clays.

Alternatively, the design of floor slabs for wheel loadings may be based on a modulus of subgrade reaction in the range 20 – 30 kPa/mm. A lower value will be applicable for design of slabs to support column and floor slab loadings, probably of the order of 5 – 8 kPa/mm, but dependent on the area of the floor slab subject to loading.

It is recommended that a layer of crushed rock or concrete be placed over the exposed subgrade surface within 12 hours of exposure. This layer could be incorporated into the final floor slab or pavement design thereby reducing the thickness of the slab (or base course) required and providing a means of sub-floor drainage, which would involve contouring of the subgrade to achieve adequate cross-falls.

7.5.5 Soil Aggressivity

The pH values on the clay were recorded above 7.8 and the Electrical Conductivity (EC) ranging from 100 to 150 µS/cm. The sulphate content ranged from <20 to 64 ppm and the chloride from between <20 and 31 ppm.

Based on the results from the chemical laboratory testing of soil samples collected on site and with reference to Table 6.1 in AS 2159 – 2011, the Exposure Classification for concrete piles (and other concrete elements such as pad footings) for the site soils are likely to be non-aggressive to buried structural elements.

7.5.6 Seismic

In accordance with the Earthquake Loading Standard, AS1170.4-2007, the site has a hazard factor (z) of 0.08 and a site sub-soil class of deep or soft soil (D_e).

8. Limitations

Douglas Partners (DP) has prepared this report for a project at Wagga Wagga Base Hospital, NSW in accordance with DP's proposal dated 16 February 2011, and acceptance received from Mr Frank Tong of Capital Insight on 2 March 2011. The report is provided for the exclusive use of Capital Insight and for the purpose(s) described in the report. It should not be used for other projects or by a third party. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

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

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be limited by undetected variations in ground conditions between sampling 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.

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

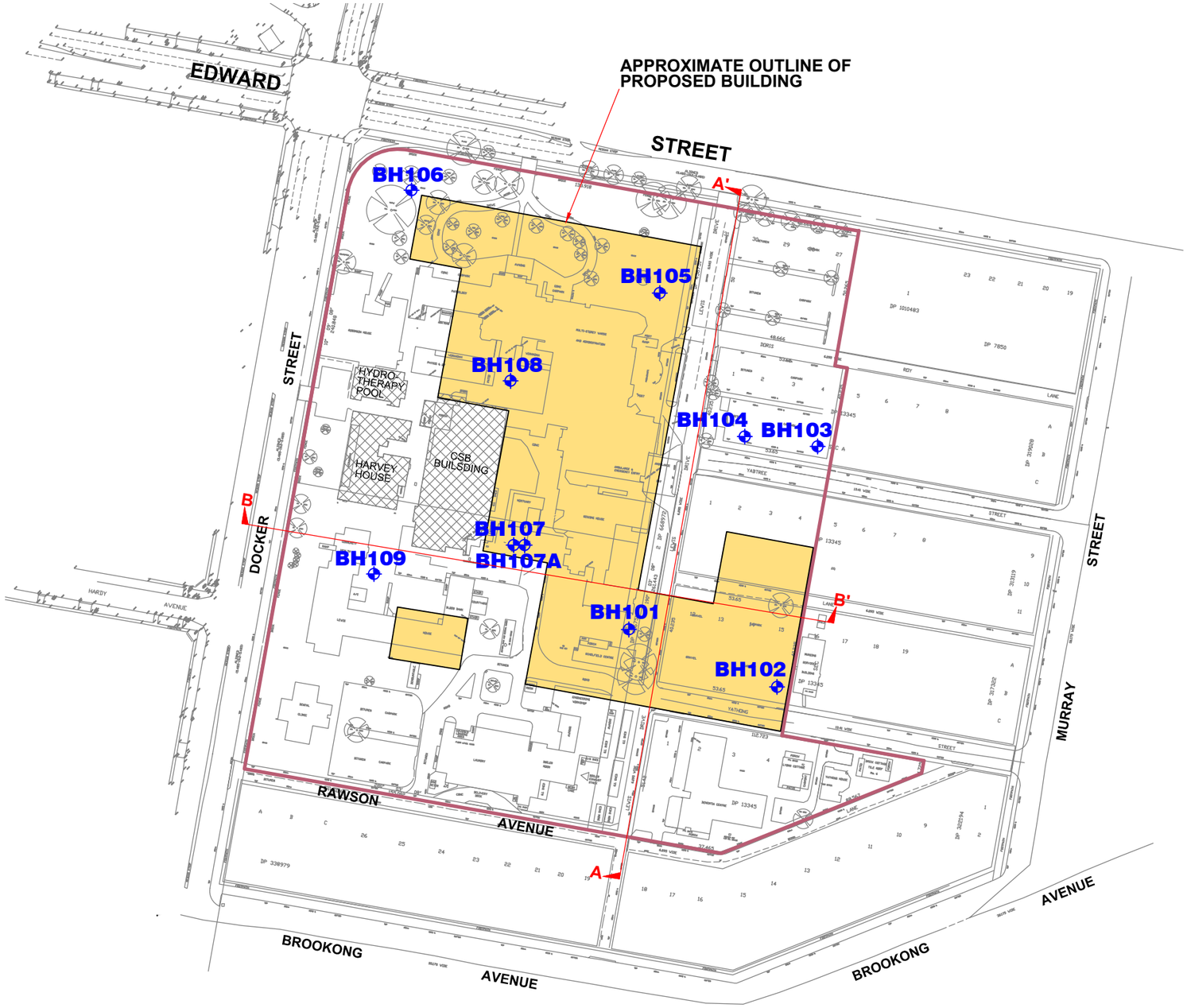
Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate 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.

Appendix B

Drawings



Locality Plan

0 10 20 30 40 60 80 100 150 200m

1:2000 @ A3

LEGEND

- Borehole Location
- Approximate Site Boundary
- Existing Building to Remain

Douglas Partners
Geotechnics | Environment | Groundwater

CLIENT: Health Infrastructure		TITLE: **Borehole Test Location Plan**	PROJECT No: 72320
OFFICE: Sydney	DRAWN BY: PSCH	**Proposed Wagga Wagga Base Hospital Redevelopment**	DRAWING No: 1
SCALE: As shown	DATE: 12.4.2011	**Edward Street, Wagga Wagga**	REVISION: A

MGA

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A

A'

SOUTHERN SITE BOUNDARY

NORTHERN SITE BOUNDARY

RAWSON AVENUE

EDWARD STREET

ELEVATION (AHD)

200
195
190
185
180
175
170
165
160
155
150

0
2
4
6
8
10
12
14
16
18
20
22
24
26

101
Offset 10m W

st-vst
20,22,20
N = 42

vst-h
10,13,17
N = 30

vst
16,22,20/100mm
refusal

h
13,24,20/100mm
refusal

GRAVELLY SILTY CLAY

h
26,28,20/100mm
refusal

h
10,16,17
N = 33

SILTY CLAY

h
10,10,12
N = 22

vst
12,24
refusal

13,21,23
N = 44

h
7,9,13
N = 22

vst
9,15,23
N = 38

GRAVELLY SILTY CLAY

h
17,25/130mm
refusal

7,10,14
N = 24

vst
7,10,14
N = 24

vst
7,10,18
N = 28

10,12,20
N = 32

Bottom Depth 26.95 m

104
Offset 20m E

9,17,20
N = 37

h
10,10,22
N = 32

6,8,15
N = 23

vst
6,6,12
N = 18

7,9,11
N = 20

vst
5,7,9
N = 16

SILTY CLAY

st-vst
3,8,10
N = 18

vst
6,15,17
N = 32

d
11,13,14
N = 27

vst
md
4,8,13
N = 21

Bottom Depth 14.95 m

SAND

105
Offset 25m W

2,11,18
N = 29

vst
13,18,22
N = 40

h
9,12,20
N = 32

vst-h
7,9,12
N = 21

SILTY CLAY

6,8,12
N = 20

vst
7,10,14
N = 24

md
8,9,11
N = 20

Bottom Depth 10.45 m

CROSS-SECTION A-A'

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

DISTANCE ALONG PROFILE (m)

LEGEND

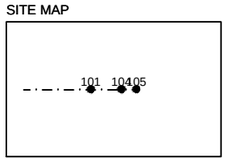
- Filling
- Silty Clay
- Gravelly Silty Clay
- Asphaltic Concrete
- Roadbase
- Sand
- Sandy Clay

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard
vl - very loose
l - loose
md - medium dense
d - dense
vd - very dense

TESTS / OTHER
N - Standard penetration test value
- Water level

SITE MAP



Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Health Infrastructure		TITLE: **INTERPRETED GEOTECHNICAL CROSS-SECTION A-A'**	PROJECT No: 72320.00
OFFICE: Sydney	DRAWN BY: PGH/LD	**Wagga Wagga Base Hospital Redevelopment**	DRAWING No: 2
SCALE: 1:75 (H) 1:250 (V) @ A3	DATE: 14.04.2011	**Edward Street, Wagga Wagga**	REVISION: 0

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B

B'

ELEVATION (AHD)

200
195
190
185
180
175
170
165
160
155
150

WESTERN SITE BOUNDARY

EASTERN SITE BOUNDARY

DOCKER STREET

SILTY CLAY

SILTY CLAY

GRAVELLY SILTY CLAY

GRAVELLY SILTY CLAY

109
Offset 10m S

st 4,4,9 N = 13
st 4,5,7 N = 12
7,11,14 N = 25
vst 7,10,12 N = 22
4,7,8 N = 15
st 10,12,21 N = 33
h 20 refusal
Bottom Depth 10.15 m

107A
Offset 10m N

vst 7,9,18 N = 27
vst 6,6,8 N = 14
st 5,8,14 N = 22
6,9,14 N = 23
vst 4,6,11 N = 17
6,7,9 N = 16
st-vst 9,14,30 N = 44
h 5,6,7 N = 13
st 8,15,19 N = 34
Bottom Depth 13.45 m

101
Offset 16m S

st-vst 20,22,20 N = 42
vst-h 10,13,17 N = 30
vst 16,22,20/100mm refusal
13,24,20/100mm refusal
h 26,28,20/100mm refusal
10,16,17 N = 33
h 10,10,12 N = 22
vst 12,24 refusal
13,21,23 N = 44
h 7,9,13 N = 22
vst 9,15,23 N = 38
h 17,25/130mm refusal
7,10,14 N = 24
vst 7,10,14 N = 24
vst 7,10,18 N = 28
10,12,20 N = 32
Bottom Depth 26.95 m

102
Offset 30m S

vst 5,8,18 N = 26
10,15,25 N = 40
h 15,25/130mm refusal
18,22,20 N = 42
h 9,13,16 N = 29
h 9,19,16 N = 35
h 8,23,25 N = 48
vst 6,8,12 N = 20
8,16,26 N = 42
h 10,20,28 N = 48
9,18,23 N = 41
Bottom Depth 16.45 m

CROSS-SECTION B-B'

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

0 2 4 6 8 10 12 14 16 18 20 22 24 26

DISTANCE ALONG PROFILE (m)

LEGEND

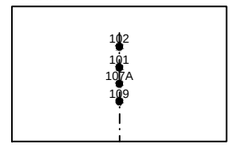
- Filling
- Silty Clay
- Gravelly Silty Clay
- Asphaltic Concrete

ROCK STRENGTH
EL - Extremely Low
VL - Very Low
L - Low
M - Medium
H - High
VH - Very High

SOIL CONSISTENCY
vs - very soft
s - soft
f - firm
st - stiff
vst - very stiff
h - hard
vl - very loose
l - loose
md - medium dense
d - dense
vd - very dense

TESTS / OTHER
N - Standard penetration test value
- Water level

SITE MAP



Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Health Infrastructure		TITLE: **INTERPRETED GEOTECHNICAL CROSS SECTION B-B'**	PROJECT No: 72320.00
OFFICE: Sydney	DRAWN BY: PGH/LD	**Wagga Wagga Base Hospital Redevelopment**	DRAWING No: 3
SCALE: 1:75 (H) 1:250 (V) @ A3	DATE: 14.04.2011	**Edward Street, Wagga Wagga**	REVISION: 0

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Appendix C

Results of Field Work

Soil Descriptions

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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.

BOREHOLE LOG

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

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

BORE No: 101
PROJECT No: 72320.00
DATE: 28/3/2011
SHEET 1 OF 3

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
183	0.2	FILLING (TOPSOIL) - dark brown, sandy silt filling with rootlets, dry		E	0.1				Gatic cover
				D	0.2				Quick-set concrete
	0.5	SILTY CLAY - stiff to very stiff, brown silty clay with a trace of sand			0.3				
				E	0.5				
		SILTY CLAY - hard, red brown silty clay, dry			0.6				Bentonite
182	1				1.0				
				S			20,22,20 N = 42		
					1.45				
181	2	2.0 SILTY CLAY - very stiff, orange brown silty clay, dry		E	2.0				
					2.2				
					2.5				
				S			10,13,17 N = 30		
180	3				2.95				
179	4	4.0 SILTY CLAY - hard, orange brown silty clay with some sub-rounded ironstone gravel, dry		S	4.0		16,22,20/100mm refusal		
					4.4				
		4.5-4.7m: rounded quartz gravel							
178	5								
				S	5.5		13,24,20/100mm refusal		
177	6				5.9				
								31-03-11	
176	7	7.0 GRAVELLY SILTY CLAY - hard, orange brown, gravelly (sub-rounded ironstone and quartz gravel) silty clay, dry		S	7.0		26,28,20/100mm refusal		
					7.4				
175	8	8.0 SILTY CLAY - hard, orange brown, silty clay with a trace of ironstone gravel, moist							
				S	8.5		10,16,17 N = 33		
174	9				8.95				
	10.0				10.0				

RIG: Scout **DRILLER:** JS **LOGGED:** PGH **CASING:** HQ to 8.8m

TYPE OF BORING: Solid flight auger (TC-bit) to 8.50m; Rotary (water) to 26.95m

WATER OBSERVATIONS: No free groundwater observed.Standpipe pumped dry on 30/3/11&4/4/11.Water level at 6.6m on 31/3/11& 6.7m on 5&7/4/11

REMARKS: Standpipe piezometer installed: Solid 0.0-6.0m; Slotted 6.0-26.95m; 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: 183.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 72320.00
DATE: 28/3/2011
SHEET 2 OF 3

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
173		SILTY CLAY - very stiff, orange brown, silty clay with some schist gravel, moist		S	10.45		10,10,12 N = 22		
172	11								11
				S	11.5 11.8		12,24 refusal (bouncing)		
171	12	11.7m: ironstone gravel band (~100mm thick)							12
170	13 13.0	SILTY CLAY - hard, grey silty clay, moist		S	13.0 13.45		13,21,23 N = 44		13
169	14								14 Backfilled with gravel
	14.54	SILTY CLAY - very stiff, red brown, silty clay with some ironstone gravel, moist		S	14.5 14.95		7,9,13 N = 22		
168	15								15
167	16 16.0	GRAVELLY SILTY CLAY - hard, red brown, gravelly (rounded quartz, schist and ironstone gravels) silty clay, moist		S	16.0 16.45		9,15,23 N = 38		16 Machine slotted PVC screen
166	17								17
				S	17.5 17.95		17,25/130mm refusal		
165	18								18
164	19 19.0	SILTY CLAY - very stiff, red brown silty clay, moist		S	19.0 19.45		7,10,14 N = 24		19

RIG: Scout **DRILLER:** JS **LOGGED:** PGH **CASING:** HQ to 8.8m

TYPE OF BORING: Solid flight auger (TC-bit) to 8.50m; Rotary (water) to 26.95m

WATER OBSERVATIONS: No free groundwater observed.Standpipe pumped dry on 30/3/11&4/4/11.Water level at 6.6m on 31/3/11& 6.7m on 5&7/4/11

REMARKS: Standpipe piezometer installed: Solid 0.0-6.0m; Slotted 6.0-26.95m; 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: 183.0 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 101
PROJECT No: 72320.00
DATE: 28/3/2011
SHEET 3 OF 3

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Well Construction Details
	20.3	SILTY CLAY - very stiff, red brown silty clay, moist *(continued)*							
		SILTY CLAY - very stiff, red brown silty clay with some ironstone gravel, moist		S	20.5		7,10,14 N = 24		
					20.95				
				S	23.5		7,10,18 N = 28		
					23.95				
				S	26.5		10,12,20 N = 32		
	26.95				26.95				End cap
		Bore discontinued at 26.95m - target depth achieved							

RIG: Scout **DRILLER:** JS **LOGGED:** PGH **CASING:** HQ to 8.8m

TYPE OF BORING: Solid flight auger (TC-bit) to 8.50m; Rotary (water) to 26.95m

WATER OBSERVATIONS: No free groundwater observed.Standpipe pumped dry on 30/3/11&4/4/11.Water level at 6.6m on 31/3/11& 6.7m on 5&7/4/11

REMARKS: Standpipe piezometer installed: Solid 0.0-6.0m; Slotted 6.0-26.95m; 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)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

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

SURFACE LEVEL: 183.8 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 72320.00
DATE: 29 - 30/3/2011
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
183	0.1	FILLING (ROADBASE) - grey, sandy gravel (blue metal), dry		A	0.1				
		SILTY CLAY - very stiff, orange brown, silty clay with some ironstone gravel and a trace of sand, dry		E*	0.4 0.5				
	1			S	1.0		5,8,18 N = 26		
					1.45				
182	2			E	2.0 2.2				
	2.5	SILTY CLAY - hard, orange brown silty clay, dry		S	2.5		10,15,25 N = 40		
181	3				2.95				
180	4			S	4.0		15,25/130mm refusal		
					4.45				
179	5								
				S	5.5		18,22,20 N = 42		
178	6				5.95				
				A	6.0 6.2				
177	7	7.0 SILTY CLAY - hard, orange brown, silty clay with some sub-rounded schist gravel and a trace of ironstone gravel, dry		S	7.0		9,13,16 N = 29		
176	8				7.45				
	8.5	SILTY CLAY - hard, orange brown, silty clay with a trace of ironstone gravel, dry		S	8.5		9,19,16 N = 35		
175	9				8.95				
174					10.0				

RIG: Scout **DRILLER:** JS **LOGGED:** PGH **CASING:** HQ to 3.0m

TYPE OF BORING: Solid flight auger (TC-bit) to 8.50m; Rotary (water) to 16.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Dry on completion of auger drilling. *Denotes field replicate sample BD1/29.3.11 collected

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: 183.8 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 102
PROJECT No: 72320.00
DATE: 29 - 30/3/2011
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
173	11	SILTY CLAY - hard, orange brown, silty clay with a trace of ironstone gravel, dry *(continued)*		S	10.45		8,23,25 N = 48		11
172	11.5 12	SILTY CLAY - very stiff, red brown, silty clay with a trace of quartz and ironstone gravel, moist		S	11.5 11.95		6,8,12 N = 20		11.5 12
171	13 13.0	SILTY CLAY - hard, red and grey, silty clay with some ironstone gravel, moist		S	13.0 13.45		8,16,26 N = 42		13
170	14								14
169	15			S	14.5 14.95		10,20,28 N = 48		15
168	16			S	16.0		9,18,23 N = 41		16
	16.45	Bore discontinued at 16.45m - target depth achieved			16.45				
167	17								17
166	18								18
165	19								19
164									

RIG: Scout **DRILLER:** JS **LOGGED:** PGH **CASING:** HQ to 3.0m

TYPE OF BORING: Solid flight auger (TC-bit) to 8.50m; Rotary (water) to 16.0m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Dry on completion of auger drilling. *Denotes field replicate sample BD1/29.3.11 collected

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: 103
PROJECT No: 72320.00
DATE: 30/3/2011
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	0.04	ASPHALT - 40mm thick		A	0.1				
	0.2	ROADBASE - grey, angular blue metal gravel, 160mm thick		B	0.2				
		SILTY CLAY - hard, orange brown, silty clay with a trace of ironstone gravel, dry		E	0.5				
	1				0.6				
				S	1.0		8,17,33 N = 50		
181					1.45				
	2			E	2.0				
		2.25m: grading to very stiff and moist			2.2				
	2.3	SILTY CLAY - very stiff, orange brown silty clay with some ironstone gravel, moist			2.5				
180				S			5,8,14 N = 22		
	3	2.85-3.0m: sub-rounded quartz gravel (to 10mm)		A	2.9				
					2.95				
					3.0				
179	3.5	SILTY CLAY - very stiff, orange brown, silty clay with a trace of ironstone gravel, moist							
	4			S	4.0		5,8,10 N = 18		
178					4.45				
	5								
177				S	5.5		7,11,16 N = 27		
	6				5.95				
176									
	7	7.0 SILTY CLAY - very stiff, orange brown, silty clay with a trace of sand, moist		S	7.0		5,10,10 N = 20		
175					7.45				
	8								
174	8.5	SILTY CLAY - stiff to very stiff, orange brown, silty clay with a trace of sand, moist		S	8.5		5,6,10 N = 16		
	9	8.95 Bore discontinued at 8.95m - target depth achieved			8.95				
173									

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

TYPE OF BORING: Solid flight auger (TC-bit) to 8.50m

WATER OBSERVATIONS: No free groundwater observed

REMARKS: Hole backfilled on 31/3/11. Dry on completion and the following day

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: 182.2 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 104
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
182	0.04	ASPHALT - 40mm thick							
	0.2	ROADBASE - blue grey, angular basalt gravel, dry		E	0.3				
		SILTY CLAY - hard, orange brown, silty clay with a trace of ironstone gravel, dry			0.4				
	1			S	1.0		9,17,20 N = 37		
					1.45				
				E	1.6 1.7				
	2	2.0m: grading to very stiff							
				S	2.5		10,10,22 N = 32		
	3				2.95				
179	4	4.0 SILTY CLAY - very stiff, orange brown silty clay, dry		S	4.0		6,8,15 N = 23		
		4.5m: becoming brown			4.45				
177	5								
				S	5.5		6,6,12 N = 18		
	6				5.95				
175	7	7.0 SILTY CLAY - very stiff, orange brown, silty clay with a trace of ironstone gravel, dry		S	7.0		7,9,11 N = 20		
					7.45				
174	8								
	8.5	SILTY CLAY - stiff to very stiff, orange brown silty clay, moist		S	8.5		5,7,9 N = 16		
173	9				8.95				
	10.0				10.0				

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

TYPE OF BORING: Solid flight auger (TC-bit) to 14.50m

WATER OBSERVATIONS: Free groundwater observed on hole completion at 14.95m on 31/3/11 and at 12.75m on 1/4/11

REMARKS: Hole backfilled on 1/4/11

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: 182.2 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 104
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
172		SILTY CLAY - very stiff, mottled grey and orange brown, silty clay with some sand, moist		S	10.45		3,8,10 N = 18		
171	11				11.5				11
	11.65	SAND - dense, orange brown, medium to coarse grained sand, moist		S	11.95		6,15,17 N = 32		
170	12								12
	13 13.0				13.0				13
169	13.2	SANDY CLAY - very stiff, brown, sandy (medium grained) sand, moist		S			11,13,14 N = 27		
		SAND - medium dense, orange brown, medium to coarse grained sand with a trace of clay, moist			13.45				
168	14								14
					14.5				
				S			4,8,13 N = 21	▼	
	15 14.95	Bore discontinued at 14.95m			14.95			31-03-11	15
167									
	16								16
166									
	17								17
165									
	18								18
164									
	19								19
163									

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

TYPE OF BORING: Solid flight auger (TC-bit) to 14.50m

WATER OBSERVATIONS: Free groundwater observed on hole completion at 14.95m on 31/3/11 and at 12.75m on 1/4/11

REMARKS: Hole backfilled on 1/4/11

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 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				4.0				4
	4.0	SILTY CLAY - very stiff to hard, orange brown silty clay		S			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		
		6.0m: becoming moist			5.95				
	6								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							
	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: 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
					0.2				Concrete
	0.4	SILTY CLAY - hard, orange brown silty clay, dry		B	0.3				
		SILTY CLAY - hard, orange brown, silty clay with a trace of ironstone gravel, dry							Bentonite
	1								1
181				S	1.3		7,22,20 N = 42		
				E	1.75				
	2	2.0m: very stiff			2.0				2
180				S	2.5		16,29,25 N = 54		
	3				2.95				3
179	4	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					4.45				
	5								5
177	5.5	SILTY CLAY - very stiff, brown silty clay, moist		S	5.5		5,8,12 N = 20		
	6				5.95				6
176	7	7.0 SILTY CLAY - hard, brown, silty clay with a trace of sand, dry		S	7.0		10,13,21 N = 34		7
175					7.45				
	8								Backfilled with gravel
174				S	8.5		8,16,19 N = 35		8
	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 / 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 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		Machine slotted PVC screen
		SAND - dense, medium to coarse grained sand, dry							
11		10.95m: rounded quartz gravel							11
171				S	11.5 11.95		16,25,25 N = 50		
12				A	12.5				12
170									
13	13.1	SAND - dense, medium to coarse grained, brown sand with some clay and rounded quartz gravel (to 50mm diameter), saturated		S	13.0 13.45		12,12,19 N = 31	▼	13
169									
14									14
	14.4	CLAYEY SAND - dense, medium to coarse grained, clayey sand with some rounded quartz gravel, wet		A S	14.4 14.5 14.95		10,15,25 N = 40 (no sample recovered)		
168									
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: 182.3 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 107
PROJECT No: 72320.00
DATE: 6 - 7/4/2011
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	0.07	ASPHALT - 70mm thick							
	0.4	FILLING (ROADBASE) - angular blue metal gravel and sand							
		FILLING - poorly compacted, red brown, silty clay filling with granite gravel, slag and some sand, moist		S	1.35		3,3,2 N = 5		
181	1				1.8				
				E	1.9				
	2				2.0				
	2.2			A	2.2				
180	2.4	FILLING - poorly compacted, medium grained sand filling with some clay, moist		E	2.4				
		Bore discontinued at 2.4m - hole abandoned due to obstruction							
	3								
179									
	4								
178									
	5								
177									
	6								
176									
	7								
175									
	8								
174									
	9								
173									

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

TYPE OF BORING: Pot holing to 1.30m; Solid flight auger to 2.40m

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: 182.3 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 107A
PROJECT No: 72320.00
DATE: 7/4/2011
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	0.07	ASPHALT - 70mm thick							
	0.4	FILLING (ROADBASE) - brown, angular blue metal gravel filling with sand, dry		E	0.4 0.5				
		SILTY CLAY - apparently very stiff, red brown silty clay, dry							
181	1								1
	1.5	SILTY CLAY - very stiff, red brown, silty clay with some ironstone gravel, dry			1.5				
				S E	1.6 1.95		7,9,18 N = 27		
180	2								2
	2.5	SILTY CLAY - stiff, red brown, silty clay with a trace of ironstone gravel, dry			2.5				
				S	2.95		6,6,8 N = 14		
179	3								3
	4.0	SILTY CLAY - very stiff, red brown, silty clay with a trace of ironstone gravel, dry			4.0				
178	4			S	4.45		5,8,14 N = 22		4
	5								5
177					5.5				
	6			S	5.95		6,9,14 N = 23		6
176	7				7.0				7
				S	7.45		4,6,11 N = 17		
175	8								8
	8.5	SILTY CLAY - stiff to very stiff, red brown and grey, silty clay, moist			8.5				
174				S	8.95		6,7,9 N = 16		
	9								9
173	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 13.0m

WATER OBSERVATIONS: Free groundwater observed at 13.10m on SPT sampler

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: 182.3 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 107A
PROJECT No: 72320.00
DATE: 7/4/2011
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	11	SILTY CLAY - hard, red brown silty clay, moist		S	10.45		9,14,30 N = 44		
171	11.5	SILTY CLAY - stiff, mottled orange brown and grey, silty clay, moist 12.0m: gravel		S	11.5 11.95		5,6,7 N = 13		
170	12								
169	13 13.0	SILTY CLAY - hard, orange brown silty clay, moist		S	13.0		8,15,19 N = 34	▼	
	13.45	Bore discontinued at 13.45m			13.45				
168	14								
167	15								
166	16								
165	17								
164	18								
163	19								

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

TYPE OF BORING: Pot holing to 1.2m; Solid flight auger (TC-bit) to 13.0m

WATER OBSERVATIONS: Free groundwater observed at 13.10m on SPT sampler

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 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		
177					4.45				
	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, moist *(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)

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BOREHOLE LOG

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

SURFACE LEVEL: 182.4 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 109
PROJECT No: 72320.00
DATE: 1 - 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	0.4	FILLING (TOPSOIL) - poorly compacted, dark brown, silty clay filling (topsoil) with some sand, moist		E	0.1 0.2				
		SILTY CLAY - apparently stiff, orange brown silty clay, dry		B A	0.4 0.5 0.6				
181	1.0	SILTY CLAY - stiff, orange brown silty clay, dry		S	1.0 1.45		4,4,9 N = 13		
180	2			S	2.5 2.95		4,5,7 N = 12		
179	3								
178	4.0	SILTY CLAY - very stiff, orange brown silty clay, dry		S	4.0 4.45		7,11,14 N = 25		
	5	5.0m: trace of ironstone gravel							
177				S	5.5 5.95		7,10,12 N = 22		
176	6								
175	7.0	SILTY CLAY - stiff, orange brown, silty clay with a trace of ironstone gravel, dry		S	7.0 7.45		4,7,8 N = 15		
174	8								
	8.5	SILTY CLAY - hard, red brown, silty clay with a trace of ironstone gravel, dry		S	8.5 8.95		10,12,21 N = 33		
173	9								
					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)

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BOREHOLE LOG

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

SURFACE LEVEL: 182.4 AHD
EASTING:
NORTHING:
DIP/AZIMUTH: 90°/--

BORE No: 109
PROJECT No: 72320.00
DATE: 1 - 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
	10.15	10.10m: rounded quartz gravel		S	10.15		20 refusal		
		Bore discontinued at 10.15m - target depth achieved							

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)

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Appendix D

Laboratory Results