April 2016

MINTO WAREHOUSING AND LOGISTICS HUB

Geotechnical Investigation for Warehousing Development

Submitted to:
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Report Number. 1648232-002-R-Rev0

Distribution:

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REPORT

Golder Associates

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1.0 INTRODUCTION

The proposed development relates to the development of 5 and 9 Culverston Road, Minto, being legally described as Lot 3 in DP 817793 and Lot 400 in DP 875711, for the purpose of a Warehouse and Logistics Hub (the Proposal).

The proposal seeks approval for the construction and use of a Warehouse and Logistics Hub that will play a vital role in the storage and distribution of goods for businesses and that will create employment opportunities. The proposed development involves:

- Bulk earthworks across the site to provide four (4) building pads;
- Provision of infrastructure and services;
- Four (4) Warehouse facilities;
- Ancillary hardstand areas, car parking and external storage hardstand area.

In total, the development will be carried out over three (3) stages as follows;

- Stage 1 – Warehouse 1A;
- Stage 2 – Warehouse 1B + 1C; and
- Stage 3 – Warehouse 1D

The site is currently used for industrial purposes being the storage and processing of motor vehicles. The proposed operation of the site will be for the purpose of storage and distribution of Fast Moving Consumer Goods.

The proposal seeks to establish an innovative operation that will benefit businesses that operate on a local and national scale.

The site is located within the Campbelltown Local Government Area (LGA) and is identified within the 4(b) Industry B zone pursuant to the Campbelltown (Urban Area) Local Environmental Plan 2002 (CLEP 2002). The proposed development is permissible with consent on the subject site. Under the provisions of Draft Campbelltown Local Environmental Plan 2014 the site is zoned IN1 General Industrial Zone. The proposal is permissible with development consent in the 4(b) Industry B Zone and the draft CLEP2014 IN1 General Industrial Zone and will be contextually appropriate. The Secretary's Environmental Assessment Requirements (SEARs) were issued for the Proposed Warehouse and Logistics Hub (SSD 7500) in March 2016. The SEARs requirements addressed in this report are summarised in Table 1**.**

This report describes a preliminary geotechnical assessment of the site conducted by Golder Associates Pty Ltd (Golder). The objective of the investigation was to assess the subsurface conditions, including soil/rock profiles and to provide preliminary recommendations for development. A Contamination Assessment Report comprising a Phase 1 Preliminary Site Investigation and Limited Phase 2 Detailed Site Investigation was completed concurrently to the geotechnical investigation and has been presented in a separate document. (Ref: 1648232-003-R-Rev0 Phase I and Limited Phase II Environmental Site Assessment).

Table 1: Secretary's Environmental Assessment Requirements (SEARs)

Requirement Category	Location (in SEARS Document)	Requirement	Section in report where requirement has been addressed
SEARs General Requirements	Attachment 1	"Acid Sulfate Soil Manual (ASSMAC)"	Section 2 – Acid Sulfate Soils. Not anticipated to be encountered after desktop study, Section 2.0. For analytical results see Golder ESA (1648232-003-R-Rev0)
SEARs General Requirements	Attachment 1	Erosion and Sediment Controls "Managing Urban Stormwater: Soils & Construction (Landcom)"	Section 5.5 - Soil Dispersion and Erosion
SEARs General Requirements	SEARs Requirements	"Clauses 6 and 7 of Schedule 2 of the Environmental Planning and Assessment Regulation 2000."	See Golder ESA (1648232-003-R-Rev0)
SEARs General Requirements (Key Issues)	SEARs Requirements	"Soils and Water - including…An assessment of potential impacts of surface and groundwater impacts associated with the development."	See Golder ESA (1648232-003-R-Rev0)
Technical and Policy Guidelines - Soils and Water (Groundwater)	Attachment 1	"National Water Quality Management Strategy Guidelines for Groundwater Protection in Australia" (ARMCANZ/ANZECC)	See Golder ESA (1648232-003-R-Rev0)
DPI Water – Groundwater Assessment	Attachment A	"An assessment of the potential for groundwater contamination (considering both the impacts of the proposal on groundwater contamination and the impacts of contamination on the proposal)."	See Golder ESA (1648232-003-R-Rev0)

2.0 SITE CONDITIONS & GEOLOGY

The subject site is identified as 5 and 9 Culverston Road, Minto, being legally described as Lot 3 in DP 817793 and Lot 400 in DP 875711. The entire site exhibits an area of approximately 29.63ha. The site has been historically developed for industry and is currently used for a vehicle storage and processing facility. Photographs of the site taken during the investigation are included in Appendix C. The site is predominately covered by asphalt spray seal or concrete hardstand areas with grass and sparse vegetation around the fringes of the site. Two existing soil stockpiles running roughly north-south, parallel to Culverston Road were also observed. The existing attributes of the site are noted as follows:

- Existing development on the site comprises hardstand, shade structures and a warehouse building.
- The site is generally clear of vegetation, with the exception of planting adjacent to the site boundaries.
- Access is obtained via Culverston Road from the round-about intersection of Culverston Road and Airds Road.
- The site's eastern boundary corresponds with a drainage corridor and the Main Southern Railway line while the site's western boundary corresponds with the Bow Bowing Canal. The site's northern boundary also corresponds with a drainage channel.

The site exhibits three (3) street frontages being Airds Road to the north and west and Rose Payten Drive to the south, which is elevated in respect of the site. The site is divided by Culverston Road running north-west through the northern and central portions of the site. To the east the site adjoins a drainage corridor and the Main Southern Railway line.

The 1:100,000 Woolongong-Port Hacking Geological Sheet (GS 9029-9129, 1985) indicates that ground conditions at the site comprise of Quaternary paleochannel deposits, including fluvial sand, clay and silt. The paleochannel is underlain by Ashfield Shale and Hawkesbury Sandstone.

Acid Sulfate Risk Maps (ASRIS) indicate the area is in a region with no known occurrence of acid sulfate soils. Acid sulfate soils are generally only expected at elevations of less than 5 m AHD in coastal areas (RTA,2005), and are not expected at the site due to its elevation of approximately 45 to 50 m AHD.

Interpretation of the aerial imagery indicates the likely presence of a former creek running through the site that was backfilled sometime between 1984 and 1990.

The subsurface conditions encountered by the boreholes are consistent with the published geological information in the area.

3.0 FIELD WORK

Field work was carried out between 15 February and 17 February 2016, and comprised the following work.

- Drilling geotechnical boreholes at eight locations, GA-BH01 to GA-BH08, using a truck mounted drilling rig with a tungsten carbide bit (TC bit) through soil to the depths indicated below. A 190 mm diameter diatube was used to penetrate through the existing pavement in GA-BH07 and GA-BH08. Standard Penetration Tests (SPTs) were carried out at 1.5 m intervals to assess strength and gather samples for laboratory testing. Boreholes were backfilled with drill cuttings generated from the drilling process. Spoil generated in boreholes requiring a piezometer was disposed of at a licensed facility. Boreholes can be divided into two categories, large diameter boreholes and piezometer installed boreholes.
  - Large diameter boreholes (GA-BH01, GA-BH03, GA-BH06 and GA-BH07)
    - Extended to 3 m depth;
    - Bulk samples collected for geotechnical laboratory testing; and
    - Used a 200 mm diameter TC bit.
  - Piezometer installed boreholes (GA-BH02, GA-BH04, GA-BH05 and GA-BH08)

  - Extended to 8 m depth; and
  - 50 mm PVC slotted screen piezometer installed, with monument.

- Hand auger excavations at four locations (GA-HA01 to GA-HA04, inclusive) were advanced to a maximum 1.5 m depth within the existing soil stockpiles. Environmental sampling was undertaken at all hand auger borehole locations.

A site plan showing each discreet investigation location is attached as Figure 1. The investigation locations were provided on drawing reference 116001_A_SD_MP-02 dated 27/1/16.

The weather was hot and dry during the investigation, with no rain recorded in the week prior to the works being carried out. (Rainfall observations from Campbelltown Mt Annan, station 068257).

A geotechnical engineer from Golder positioned the test locations, observed the drilling and conducted the excavation, logged the materials encountered and collected the samples. Borehole and hand auger reports as well as explanation sheets used in their preparation are presented in APPENDIX A.

Each test location was positioned using a digital GPS accurate to about ±0.05 m. A summary of the locations and details of the investigations are provided in Table 2.

Table 2: Summary of field work

Test Location	Coordinates (MGA94 zone 56 ±5 m)		Termination Depth (m)	Termination Level (m AHD)	Termination Reason	Completion Remark
GA-BH01	299913	6231088	3.00	44.33	Target Depth	Backfilled
GA-BH02	299920	6231514	7.96	38.60	Target Depth	Piezometer Installed
GA-BH03	300103	6231470	3.00	43.39	Target Depth	Backfilled
GA-BH04	300128	6230957	8.00	40.48	Target Depth	Piezometer Installed
GA-BH05	300314	6231342	8.00	39.72	Target Depth	Piezometer Installed
GA-BH06	300252	6231035	3.00	44.88	Target Depth	Backfilled
GA-BH07	300165	6230798	3.00	45.82	Target Depth	Backfilled
GA-BH08	300063	6230627	8.00	42.28	Target Depth	Piezometer Installed
GA-HA01	300168	6231122	0.60	47.00	Refusal	Backfilled
GA-HA02	300113	6231380	1.50	47.27	Target Depth	Backfilled
GA-HA03	300155	6231308	1.00	46.14	Refusal	Backfilled
GA-HA04	300108	6231450	1.50	46.97	Target Depth	Backfilled

3.1 Subsurface Conditions

This section of the report describes generalised soil units encountered in the boreholes and hand auger holes.

A summary of the subsurface conditions is provided in Table 3 and descriptions of the various soil units are shown below.

Table 3: Summary of subsurface conditions

Test Location	Depth Range (Thickness, m)			
	Fill			Unit 2 - Alluvium
	Unit 1A - Topsoil	Unit 1B - Hardstand Pavement	Unit 1C - Fill	
GA-BH01	-	-	0 – 2.0	2.0 – 3.0*
GA-BH02	0 – 0.3	-	0.3 – 3.4	3.4 – 7.96*
GA-BH03	0 – 0.1	-	0.1 - 2.8	2.8 – 3.0*
GA-BH04	0 – 0.1	-	0.1 – 3.0	3.0 – 8.0*
GA-BH05	0 – 0.4	-	0.4 – 4.2	4.2 – 8.0*
GA-BH06	-	-	0 – 3.0*	-
GA-BH07	-	0 – 0.4	0.4 – 1.6	1.6 – 3.0*
GA-BH08	-	0 – 0.2	0.2 – 4.4	4.4 – 8.0*

* Limit of investigation

Variations to the above generalised profile occur. The individual borehole reports, included in Appendix A, should be referred to for further information.

Unit 1 – Fill

Unit 1A - Topsoil

Topsoil was only observed on the fringes of the site, generally associated with the surrounding garden areas. Topsoils generally consisting of clays and silts, were encountered in four boreholes (GA-BH02, GA-BH03, GA-BH04 and GA-BH05). The topsoils generally extend to depths between 0.1 m and 0.4 m depth below ground surface, with an average thickness of 200 mm. At the time of the investigation the topsoil was generally dry and underlain by “Fill” (i.e. soil Unit 1c described below).

Unit 1B – Hardstand Pavement

An asphalt or concrete hardstand covers the majority of the site. An asphalt pavement surface approximately 30 mm thick was encountered at two borehole locations (GA-BH07 and GA-BH08). The asphalt was observed to be generally dark grey, poorly bound and was underlain by a thin layer of sub-base gravelly sand, extending to depths of 0.4 m and 0.2 m below the ground surface.

Unit 1C – Fill

Two soil stockpiles running roughly north-south, parallel to Culverston Road were observed during the investigation. Existing fill material was encountered at all borehole locations and generally comprises medium plasticity silty clay, clay and sandy clay with some angular gravel. It was generally found immediately beneath the topsoil/asphalt pavement or at existing ground surface level and extended to depths between 1.6 m and 4.4 m below ground surface.

Fill was also encountered in all of the hand auger locations within the soil stockpiles. All hand auger holes terminated within the fill unit.

In situ testing (SPTs and pocket penetrometers) indicate the fill is generally very stiff, with firm layers encountered immediately below sub-base layers in boreholes GA-BH07 and GA-BH08.

Unit 2 – Alluvium

The alluvial material encountered generally comprises high plasticity grey and brown clay and was encountered beneath the Unit 1C fill in all boreholes. The exception to this is borehole GA-BH06, which was terminated within the fill at 3 m depth. The alluvium was found at depths as shallow as 1.6 m (GA-BH07) but generally began at about 3 m and continued to greater than 8 m depth below ground surface.

In situ testing (SPTs and pocket penetrometers) indicated the fill is generally stiff to very stiff, with some zones of firm or hard material (GA-BH04).

3.2 Groundwater

A summary of groundwater inflows observed during drilling and prior to sampling is presented in Table 4.

Table 4: Summary of groundwater observations

Borehole ID	Depth below surface level (RL, m AHD)	
	15/2/2016	26/2/2016
GA-BH01	Groundwater not encountered to 3m depth	NA
GA-BH02	6.3 m (RL 40.3 m)	4.7 m (41.9 m)
GA-BH03	Groundwater not encountered to 3m depth	NA
GA-BH04	4.4 m (RL 44.1 m)	3.4 m (45.1 m)
GA-BH05	5.02 m (RL 42.7 m)	3.2 m (44.5 m)
GA-BH06	Groundwater not encountered to 3m depth	NA
GA-BH07	Groundwater not encountered to 3m depth	NA
GA-BH08	4.5 m (RL 45.8 m)	4.7 m (45.6 m)

Groundwater conditions could change seasonally or in response to infiltration.

4.0 LABORATORY TESTING

Bulk and disturbed samples recovered from selected boreholes were forwarded to the NATA accredited, Macquarie Geotech laboratory at Alexandria for testing. A summary of the results of the geotechnical laboratory testing is provided in Table 5 and laboratory test certificates are provided in APPENDIX B. The test methods followed are noted on the reports.

The borehole reports in Appendix A have been updated to reflect these laboratory test results.

Table 5: Results of geotechnical laboratory testing

Test Location	Depth (m)	Soil Unit	Field Moisture Content (%)	Atterberg Limits			Particle Size Distribution (%)			Emerson Crumb	CBR / Swell (%)	Aggressivity			
				LL (%)	PL (%)	PI (%)	Fine (<75µm)	Sand (75µm – 2.0 mm)	Gravel (>2.0 mm)			pH	SO_4 (%/PPM)	Cl (%/PPM)	EC (uS/cm)
			AS1289 2.1.1	AS1289 3.1.1 – 3.3.1			AS1289 3.6.1			AS1289 3.8.1	AS128 9 5.5.1	AS1289 4.3.1	AS1289 4.2.1	RMS T1010	AS1289 4.4.1
GA-BH01	0.5-0.95	Fill	14.6	45	19	26	84	16	0			7.7	0.02 / 208	0.03 / 257	164.7
GA-BH02	0.5-0.95	Fill	-									7.2	0.03 / 284	0.03 / 270	182
GA-BH02	2.0-2.45	Fill	9.8												
GA-BH03	0.5-0.95	Fill	14.1	45	19	26	70	28	2	5					
GA-BH03	2.0-2.8	Fill	-	36	19	17					4.5 / 0.8				
GA-BH06	1-1.45	Fill	17.6												
GA-BH07	2.0-3.0	Clay	-	52	20	32					2.5 / 1.0				
GA-BH08	0.5-0.95	Fill	13.9				75	24	1						
GA-BH08	2.0-2.45	Fill								5					

5.0 DISCUSSION AND PRELIMINARY RECOMMENDATIONS

We understand that the proposed development is to comprise four detached warehouses and associated hardstand pavement areas. We also understand that up to an additional 1 m of fill will be placed across the site to raise it above design flood levels.

Parameters for excavation support and foundation design are provided below for preliminary design. Our understanding is that all proposed structures will be lightly loaded and will only require shallow footings.

The hand auger holes and associated sampling were carried to allow an assessment of the fill for offsite disposal. Test results and advice for these materials are provided in the Environmental Site Assessment, referenced above.

5.1 General Site Preparation and Earthworks

The following comments and recommendations are presented for earthworks and general site preparation:

- Prior to any construction on site, the proposed building footprint and pavement areas should be stripped of any remaining vegetation, topsoil, and root affected or otherwise deleterious material and hardstand materials. This material should be either disposed to spoil or stockpiled for later landscaping purposes. Stripping on this site is expected to be required to depths up to 0.4m, with an average depth of approximately 0.2 mm.
- Following site stripping and prior to placement of any fill to raise site levels, the exposed subgrade materials should be proof rolled. The proof roll should be carried out with a minimum 10t smooth drum roller in the presence of an experienced earthworks practitioner. Any identified soft or “unsuitable” zones should be removed and backfilled.
- The medium plasticity silty clay fill should be reused with caution. Details on preparation and treatment of this material is provided in Section 5.3
- Approved materials required beneath proposed road and parking areas for bulk filling should be placed in layers not exceeding 300 mm loose thickness and compacted to a minimum density ratio of 95% Standard Maximum Dry Density (SMDD) (AS1289-5.1.1 or equivalent). Clayey fill should be placed and maintained at 60% to 90% of standard Optimum Moisture Content (OMC).
- Where engineered fill is required beneath the proposed building structures, it should be compacted to a minimum density ratio of 98% SMDD within ±2% of OMC. The fill used to support structures should be nominated by the contractor and approved by an experienced geotechnical engineer.
- Trafficability of the medium plastic clayey soils will be reduced upon wetting. Surface improvements such as placement of a gravel layers may need to be considered to establish suitable working platforms.
- Any additional filling should be placed and compacted in accordance with Campbelltown City Council’s engineering guidelines for filling, and as described in Australian Standards AS3798-2007 *Guidelines on Earthworks for Commercial and Residential Developments*. Filling on site should be compacted under Level 1 Monitoring and Testing as described in Australian Standards AS3798-2007.

5.2 Excavation Conditions

All soil units should be able to be excavated using a hydraulic excavator or bulldozer. Excavations of the hardstand (Unit 1B) may require a jack-hammer or ripping attachment for economic excavation. Contractors should be provided with the borehole logs and photographs and make their own assessment on the suitability and productivity of specific plant.

Plant used for excavation could produce vibrations with the potential to impact services adjacent to the work. If existing services are near to excavations we suggest that an assessment be made of the risks associated to the services prior to the commencement of the excavation.

5.2.1 Dewatering

Groundwater was observed between 4.4 m and 6.3 m depth below the ground surface and is expected that it would not be encountered within the likely depths of proposed excavation works at the site (typically, less than 1 m, based on the available details of proposed development).

If groundwater is encountered during the works, then the geotechnical consultant should be contacted during bulk earthworks to assess the need for subsoil drainage or other provisions.

Surface water flows should be diverted away from open excavations.

5.3 Material Reuse

Following stripping of the site and removal of topsoils and hardstands etc, further site levelling operations may produce clayey fill soils which could be reused or removed from site.

Locally won clayey fill materials (Unit 1C) could be reused for bulk filling of the site above design flood levels. These clayey fill materials are generally medium plasticity, with zones of high plasticity, and are likely to be sensitive to changes in moisture content. These changes in moisture content have the potential to result in shrinkage and swelling of the clayey soils.

While suitable for re-use as General Fill (with reference to AS3798-2007) the clayey soils will require close attention to moisture control during placement, and design will need to consider the potential implications of areas filled with these potentially expansive clays (particularly on Site Classification to AS2870 and shrink-swell potential).

Design and construction implications of expansive clays could be reduced by adding lime as a stabilising agent prior to reuse as fill, but stabilisation trials would need to be conducted during detailed design.

With careful management, the Unit 1C soils may be capable of being used as pavement subgrade materials, however they are not considered suitable as pavement base or sub-base materials.

Engineered fill beneath the proposed structures will likely need to be imported.

As groundwater is generally greater than 4.4 m below surface level, it is unlikely that excessively wet materials will be encountered. However, this could vary depending on local rainfall conditions at the time of construction/excavation. If wet clays are encountered during construction, they must be satisfactorily dried prior to reuse or removed from site.

Alluvial clays (Unit 2) are not anticipated to be encountered during earthworks.

Further testing of the existing fill materials across the site should be carried out during subsequent stages of development and an experienced geotechnical professional should be consulted to assess the suitability materials proposed to be used at the site.

5.4 Pavement Earthworks

5.4.1 Design CBR

New access roads and pavements are likely to be required as part of the redevelopment. Limited laboratory testing has been carried out and indicate the following CBR and swell values:

- Unit 1C: Fill – CBR of 4.5% with 0.8% swell after soaking (based on one sample).
- Unit 2: Alluvium – CBR of 2.5% with 1% swell after soaking (based on one sample).

Based on the laboratory testing results above and previous experience of clayey fills (Unit 1C) we recommend that preliminary pavement design cautiously adopt a CBR value of 4% for Unit 1C and 2% for Unit 2 alluvial clay. However, it's unlikely that alluvial clays will form the subgrade for pavements at this site.

Alternative pavement subgrade CBR values may be applicable if fill materials are to be imported.

Further CBR testing to refine this value should be carried out during subsequent stages of development.

5.4.2 Subgrade Preparation

Loose gravel, oversized fill materials or deleterious material, such as topsoil, wood and refuse, should be stripped from the pavement footprint. Footings of existing structures and existing hardstand should also be removed.

New pavements or roads for the site will be underlain by clay fill (Unit 1C) and/or imported fill, depending on final levelling requirements for the site.

Given the laboratory CBR values obtained for the Unit 1C fill material and the potential swelling capacity of the clay, it may be useful to modify their engineering properties prior to constructing pavements. Improvement of the subgrade conditions could be achieved through the addition of lime to the clayey soils or alternatively subgrade replacement using a suitable granular fill material.

The cohesive nature of clay makes it susceptible to moisture variations. Therefore it should be anticipated that some moisture conditioning and drying back of the subgrade may be necessary prior to compaction and placement of subsequent fill layers. The required time period to prepare the subgrade is likely to be dependent on the prevailing weather conditions at the time of construction. For lightly loaded pavements, subgrade material beneath roads should be compacted to a minimum 98% Standard Maximum Dry Density (SMDD), or as required by Council or the specified pavement design.

5.5 Soil Dispersion and Erosion

Two soil samples, one from Unit 1C and one from Unit 2 were tested for Emerson class to assess the dispersive potential of the materials. The laboratory test results indicate that both materials had an Emerson Class number of 5, constituting non-dispersive behaviour. The site is relatively flat which further reduces the risk of soil dispersion and erosion.

Although the soils are classified as non-dispersive in their natural state, they do have the potential to become dispersive when they are remoulded due to the break-down of soil bonds.

It is worth noting that the site is bounded by concrete water channels on all sides, and erosion control is recommended (despite the non-dispersive soil characteristics) to prevent sediments entering the surrounding waterways during construction.

Due to these reasons, we recommend that soils should not be subjected to concentrated water flow over or through the soil profile.

5.6 Foundations

5.6.1 Site Classification

Structures that are lightly loaded and less sensitive to differential settlement may be supported on a slab-on-ground or shallow footings on engineered fill. Laboratory tests indicate the existing silty clay fill (Unit 1C) is less plastic than the underlying alluvial soils (Unit 2).

Should lightly loaded structures be supported by slabs-on-ground they should be designed based on a site classification of ‘Class P’ (filled site) as defined by AS 2870-1996. However, the type and thickness of the imported fill used to support the structures may allow an alternative classification. This alternative approach should be addressed during subsequent stages of development.

To limit shrinkage and swelling of the foundation materials, particular care should be taken to reduce potential variations in soil moisture content, such as by the inclusion of site drainage in the design.

5.6.2 Foundation Options

Foundations for lightly loaded structures are expected to comprise shallow pad footings or possibly slabs-on-ground.

A preliminary estimate of serviceability bearing pressure for shallow pad footings is 150 kPa, assuming that fill beneath the warehouse footings will be imported select fill. Once the warehouses have been developed

further, additional investigations into the consistency and stiffness of the underlying existing clayey fills should be carried out. Depending on the outcomes of the additional investigations, some localised treatments of the existing clayey fills might be required beneath isolated pad footing locations. .

Slabs on ground will need to consider the potential for differential settlements due to the potential variability of the underlying clayey fill (Unit 1C). More thorough site investigations are required to assist in managing this risk and detailed settlement analyses will need to be carried out through close collaboration between geotechnical and structural engineers.

Heavier structures could be constructed on piles founded beneath the fill. Additional geotechnical investigation would be needed to confirm the depth and load bearing characteristics of underlying soils and rock to assist with detailed design if deeper footing options were required.

6.0 FURTHER INVESTIGATION

Additional investigation locations are advised to better inform designers of the potential geotechnical risks associated with:

- The varying thicknesses of fill across the site and potential ground improvement options;
- Identification of the former watercourse, which may contain deeper alluvial soils, gravels or compressible cohesive material; and
- Engineering behaviours of the soils across the site to support the proposed structures, pavements and for material reuse.

We recommend that further investigations comprise (but not limited to) additional boreholes, test pits, laboratory testing and potentially geophysics to provide better spatial subsurface information.

7.0 LIMITATIONS

Your attention is drawn to the document “Limitations”, which is included in Appendix D of this report. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be. The document is not intended to reduce the level of responsibility accepted by Golder Associates, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

Report Signature Page

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MINTO INTERMODAL TERMINAL

TACTICAL

INVESTIGATION LOCATIONS

LEGEND

- Boreholes with standpipe installed
- Hand augered borehole
- Large diameter borehole

COPYRIGHT

Base map provided by LPI.
Figure provided by Tactical.

0 15 30 60 90 120 150 metres

SCALE (at A4) 1:7,000

DATUM GDA 94, PROJECTION MGA Zone 55

PROJECT: **1648232**
DATE: **17/03/2016**
DRAWN: **NS**
CHECKED: **BMS**

FIGURE 1

Golder Associates

File Location: J:\geo\2016\1648232_Tactical_GIContam_Minto\Technical Docs\GIS\Project

APPENDIX A

Borehole Logs and Hand Auger Reports

REPORT OF BOREHOLE: GA-BH01

SHEET: 1 OF 1 REV:

CLIENT: Tactical Group
PROJECT: Minto Warehousing and Logistics Hub
LOCATION: Culverston Road
JOB NO: 1648232

COORDS: 299913.0 m E 6231087.0 m N MGA94 56
SURFACE RL: 47.33 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

DRILL RIG: Hydrapower Scout
CONTRACTOR: Hagstrom
LOGGED: AV DATE: 16/2/16
CHECKED: BMS DATE: 19/2/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT	L	GWNE	0	47.33	GA-BH01_01 0.10 m DS x 2, Trip 4, Dup 4 PID = 0 ppm				FILL: Silty Gravelly SAND fine to coarse grained, grey with off white, fine to medium grained igneous and sandstone angular gravels			FILL
				0.60 46.73	PID = 0 ppm GA-BH01_02 0.50 m Jar				FILL: Silty CLAY medium plasticity, orange brown with dark grey, with some sand, trace organics (grasses)	D		PP @ 0.8 m > 400 kPa
			1		GA-BH01_03 SPT 0.50-0.95 m 5, 6, 8 N=14							
				1.50 45.83	GA-BH01_04 1.00 m Jar				As above becoming dark brown, with trace fine angular gravels			
			2	*2.00* 45.33	GA-BH01_05 SPT 2.00- 2.45 m 5, 9, 10 N=19 GA-BH01_06 BDS 2.00-3.00 m			CH	CLAY high plasticity, orange brown with grey, trace organics (rootlets)	M (<PL)	VSt	ALLUVIUM PP @ 2.3 m > 400 kPa
			3	44.33	GA-BH01_07 3.00 m Jar				END OF BOREHOLE @ 3.00 m TARGET DEPTH BACKFILLED			
			4									
			5									
			6									
			7									
			8									
			9									
			10									

REPORT OF BOREHOLE: GA-BH02

SHEET: 1 OF 1 REV:

CLIENT: Tactical Group
COORDS: 299920.0 m E 6231513.0 m N MGA94 56
DRILL RIG: Hydrapower Scout

PROJECT: Minto Warehousing and Logistics Hub
SURFACE RL: 46.56 m DATUM: AHD
CONTRACTOR: Hagstrom

LOCATION: Culverston Road
INCLINATION: -90°
LOGGED: AV DATE: 17/2/16

JOB NO: 1648232
HOLE DEPTH: 7.96 m
CHECKED: BMS DATE: 19/2/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT	L		0	46.56	GA-BH02_01 0.10 m 2 x DS, Jar PID = 5.6 ppm				TOPSOIL: Clayey SILT medium plasticity, brown to pale brown, with some sand and cemented clay gravels, trace organics (rootlets)			TOPSOIL
				0.30 46.26								FILL
				0.70 45.86	GA-BH02_02 0.50 m Jar				FILL: Silty SAND fine to coarse grained, pale brown and off white, sub-angular medium sedimentary gravel			
			1		GA-BH02_03 SPT 0.50-0.95 m 7, 12, 16 N=28 PID = 5.1 ppm GA-BH02_04 1.00 m Jar PID = 10.3 ppm				FILL: Silty CLAY medium plasticity, brown, with cemented angular medium gravels, trace fine sub-angular gravels	D		PP @ 0.8m >400kPa
			2	*2.00* 44.56	GA-BH02_05 SPT 2.00-2.45 m 7, 10, 10 N=20				As above becoming dark brown			PP @ 2.3m >400kPa
			3	*3.40* 43.16				CH	CLAY high plasticity, grey and orange brown, with some dark grey staining			ALLUVIUM
			4		GA-BH02_06 Jar SPT 3.50-3.95 m 5, 8, 12 N=20							PP @ 3.8m >400kPa
			5		GA-BH02_07 SPT 5.00-5.45 m 5, 7, 9 N=16					M (<PL)	VSt	PP @ 5.2m >400kPa
	M		6	*5.90* 40.66					As above with increasing grey content			
					GA-BH02_08 Jar SPT 6.50-6.95 m							PP @ 6.6m 100-200kPa
			7	*6.87* 39.69	3, 3, 21 N=24			CH	CLAY high plasticity, grey	M (>PL)		
					GA-BH02_09 DS 7.40 m							
			8	38.60					END OF BOREHOLE @ 7.96 m TARGET DEPTH PIEZOMETER INSTALLED			
			9									
			10									

REPORT OF BOREHOLE: GA-BH03

SHEET: 1 OF 1 REV:

CLIENT: Tactical Group
PROJECT: Minto Warehousing and Logistics Hub
LOCATION: Culverston Road
JOB NO: 1648232

COORDS: 300103.0 m E 6231469.0 m N MGA94 56
SURFACE RL: 46.39 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

DRILL RIG: Hydrapower Scout
CONTRACTOR: Hagstrom
LOGGED: AV DATE: 17/2/16
CHECKED: BMS DATE: 19/2/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT	L	GWNE	0	0.10 46.29	GA-BH03_01 0.10 m 2 x DS, Jar PID = 0 ppm				TOPSOIL: Gravelly Sandy CLAY medium plasticity, dark brown, with some fine to coarse angular sedimentary and igneous gravel, trace organics (rootlets)			TOPSOIL FILL
				0.60 45.79	GA-BH03_02 0.50 m Jar				FILL: Gravelly Sandy CLAY medium plasticity, off white and pale brown, with some fine to coarse sedimentary gravel and some angular cemented clay gravels			
			1		GA-BH03_03 SPT 0.50-0.95 m 5, 7, 11 N=18 PID = 0.7 ppm				FILL: Silty CLAY medium plasticity, dark brown, with some orange brown and grey cemented clay gravels, trace sand with angular igenous gravels			PP @ 0.8m: > 400kPa
				1.40 44.99	GA-BH03_04 1.00 m Jar PID = 1.5 ppm				FILL: Silty CLAY medium plasticity, grey, with some sand, orange brown, red and dark grey mineral staining	D		
			2		GA-BH03_05 SPT 2.00-2.45m 5, 11, 15 N=26 GA-BH03_06 BDS 2.00-2.80 m							PP @ 2.0m: >400kPa
				2.60 43.79 2.80					FILL: As above becoming dark brown			
	M			43.59				CH	CLAY high plasticity, orange brown and grey	M (<PL)	VSt	ALLUVIUM
			3	43.39					END OF BOREHOLE @ 3.00 m TARGET DEPTH BACKFILLED			
			4									
			5									
			6									
			7									
			8									
			9									
			10									

REPORT OF BOREHOLE: GA-BH04

SHEET: 1 OF 1 REV:

CLIENT: Tactical Group
PROJECT: Minto Warehousing and Logistics Hub
LOCATION: Culverston Road
JOB NO: 1648232

COORDS: 300128.0 m E 6230957.0 m N MGA94 56
SURFACE RL: 48.48 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 8.00 m

DRILL RIG: Hydrapower Scout
CONTRACTOR: Hagstrom
LOGGED: AV DATE: 15/2/16
CHECKED: BMS DATE: 19/2/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT	L		0	0.10 48.38	GA-BH04_01 0.10 m DS, Jar				TOPSOIL: Silty CLAY high plasticity, pale brown, trace rootlets and trace fine to coarse sub-angular gravels			TOPSOIL
					GA-BH04_02 0.50 m Jar				FILL: Gravelly SILT low plasticity, grey brown, angular fine to coarse inferred igneous gravels with some sand, trace off white sand and fine gravels			FILL
			1		GA-BH04_03 SPT 0.50-0.95 m 11, 14, 23 N=37					D		
					GA-BH04_04 1.00 m Jar							
				1.80 46.68					FILL: CLAY medium plasticity, brown and orange brown, trace dark grey fine angular gravels, trace rootlets			
			2		GA-BH04_05 SPT 2.00-2.45 m 6, 7, 9 N=16							
			3	3.00 45.48				CH	CLAY high plasticity, grey and brown			ALLUVIUM
	L				GA-BH04_06 DS, Jar SPT 3.50-3.95 m 1, 3, 4 N=7					M (<PL)	F	
		▽	4									
			5	5.00 43.48	GA-BH04_07 SPT 5.00-5.45 m 4, 6, 6 N=12				As above with some dark brown sand and fine inferred igneous gravels with rounded gravel content increasing with depth		St	
			6							M (>PL)		
	M			6.60 41.88	GA-BH04_08 SPT 6.50-6.64 m 21/140mm N=R			CH	CLAY high plasticity, dark grey, trace medium rounded gravel		H	
			7									
			8	40.48					END OF BOREHOLE @ 8.00 m TARGET DEPTH PIEZOMETER INSTALLED			
			9									
			10									

REPORT OF BOREHOLE: GA-BH05

SHEET: 1 OF 1 REV:

CLIENT: Tactical Group
PROJECT: Minto Warehousing and Logistics Hub
LOCATION: Culverston Road
JOB NO: 1648232

COORDS: 300314.0 m E 6231342.0 m N MGA94 56
SURFACE RL: 47.72 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 8.00 m

DRILL RIG: Hydrapower Scout
CONTRACTOR: Hagstrom
LOGGED: AV DATE: 15/2/16
CHECKED: BMS DATE: 19/2/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT			0	47.72	GA-BH05_01 DS 0.10 m Jar				TOPSOIL: Sandy SILT low plasticity, pale brown, trace sub-angular fine to medium pale grey granular gravel, trace rootlets			TOPSOIL
				0.40 47.32	GA-BH05_02 0.50 m Jar				FILL: Silty CLAY medium plasticity, pale brown, trace sub-angular fine to medium gravel			FILL
	L		1		GA-BH05_03 SPT 0.50-0.95 m 7, 9, 14 N=23 GA-BH05_08 1.00 m Jar						VSt	
			2		GA-BH05_04 SPT 2.00-2.45 m 5, 10, 12 N=22					D		
			3									
				3.60 44.12	GA-BH05_05 Jar, DS SPT 3.50-3.95 m 6, 9, 9 N=18			CH	FILL: CLAY medium plasticity, pale brown, trace angular gravel		St - VSt	
	M		4	*4.20* 43.52				CH	CLAY high plasticity, grey with pale brown	M (<PL)		ALLUVIUM
		▽	5		GA-BH05_06 Jar, DS SPT 5.00-5.45 m 5, 6, 7 N=13							
			6								St	
				6.40 41.32	SPT 6.50-6.52 m 10/20mm N=R				As above with some dark grey fine to medium sub-rounded gravels	M (>PL)		
	H		7		GA-BH05_07 DS 7.50 m							
			8	39.72					END OF BOREHOLE @ 8.00 m TARGET DEPTH PIEZOMETER INSTALLED			
			9									
			10									

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GAP gINT FN. F01a RL3

REPORT OF BOREHOLE: GA-BH06

SHEET: 1 OF 1 REV:

CLIENT: Tactical Group
PROJECT: Minto Warehousing and Logistics Hub
LOCATION: Culverston Road
JOB NO: 1648232

COORDS: 300252.0 m E 6231035.0 m N MGA94 56
SURFACE RL: 47.88 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

DRILL RIG: Hydrapower Scout
CONTRACTOR: Hagstrom
LOGGED: AV DATE: 16/2/16
CHECKED: BMS DATE: 19/2/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
ADT	L	GWNE	0	47.88	GA-BH06_01 0.10 m				FILL: Silty Gravelly SAND fine to coarse grained, low plasticity, pale brown, fine to coarse angular igneous gravel	D		FILL
				0.30 47.58	2 x DS, Jar PID = 9.1 ppm GA-BH06_02 0.50 m				FILL: CLAY medium plasticity, brown with red brown, with some dark grey fine to medium sub-angular gravels, with some organics (decomposed grasses)			
				0.90 46.98	Jar, Dup 02, Trip 02 GA-BH06_03 SPT 0.50-0.95 m							PP @ 0.8m: 300-400kPa
			1	1.10 46.78	3, 4, 7 N=11 GA-BH06_04 1.00 m				FILL: CLAY medium plasticity, dark grey			
	M				Jar GA-BH06_05 SPT 1.00-1.45 m 5, 8, 8 N=16 PID = 0.4 ppm GA-BH06_07 BDS 1.10-2.50 m				FILL: CLAY medium plasticity, brown with some grey, trace fine to medium sub-angular gravel	M		PP @ 1.2m: 300-400kPa
			2		GA-BH06_06 Jar SPT 2.50-2.95 m 3, 4, 5 N=9							PP @ 2.6m: 200kPa
			3	44.88					END OF BOREHOLE @ 3.00 m TARGET DEPTH BACKFILLED			
			4									
			5									
			6									
			7									
			8									
			9									
			10									

REPORT OF BOREHOLE: GA-BH07

SHEET: 1 OF 1 REV:

CLIENT: Tactical Group
PROJECT: Minto Warehousing and Logistics Hub
LOCATION: Culverston Road
JOB NO: 1648232

COORDS: 300165.0 m E 6230798.0 m N MGA94 56
SURFACE RL: 48.82 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 3.00 m

DRILL RIG: Hydrapower Scout
CONTRACTOR: Hagstrom
LOGGED: AV DATE: 16/2/16
CHECKED: BMS DATE: 19/2/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DTC			0	48.79					ASPHALT dark grey, 28mm angular igneuous aggregate, poorly bound, (30 mm thickness)			ASPHALT PAVEMENT
				0.40 48.42	GA-BH07_01 0.15 m 2 x DS, Jar GA-BH07_06 BDS 0.15-1.50 m PID = 0.1 ppm GA-BH07_02 GA-BH07_03 0.50 m Jar SPT 0.50-0.95 m 3, 3, 4 N=7 PID = 0.2 ppm GA-BH07_04 1.00 m Jar PID = 0.2 ppm GA-BH07_05 SPT 2.00-2.45m 5, 7, 9 N=16 GA-BH07_07 BDS 2.00-3.00 m				FILL: Silty Gravelly SAND fine to coarse grained, medium plasticity, pale brown to grey, fine to coarse sub-angular gravel			FILL Inferred sub-base
				0.70 48.12					FILL: CLAY medium plasticity, dark red brown with dark grey, trace organics, trace fine sub-angular gravel	D		
ADT	L	GWNE	1	*1.60* 47.22					FILL: CLAY medium plasticity, dark grey, trace grey off white and red brown fine sub-angular gravels			FILL PP @ 0.8m: 100-200kPa
			2					CH	Silty CLAY high plasticity, red brown with some grey	M (<PL)	St - VSt	ALLUVIUM PP @ 2.3m: >400kPa
			3	45.82					END OF BOREHOLE @ 3.00 m TARGET DEPTH BACKFILLED WITH COLD MIX PLUG			
			4									
			5									
			6									
			7									
			8									
			9									
			10									

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GAP gINT FN. F01a
RL3

REPORT OF BOREHOLE: GA-BH08

SHEET: 1 OF 1 REV:

CLIENT: Tactical Group
PROJECT: Minto Warehousing and Logistics Hub
LOCATION: Culverston Road
JOB NO: 1648232

COORDS: 300063.0 m E 6230626.0 m N MGA94 56
SURFACE RL: 50.28 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 8.00 m

DRILL RIG: Hydrapower Scout
CONTRACTOR: Hagstrom
LOGGED: AV DATE: 16/2/16
CHECKED: BMS DATE: 19/2/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	DEPTH RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
DTC			0	0.20 50.08	GA-BH08_01 0.10 m 2 x DS, Jar PID = 0.3 ppm GA-BH08_02 0.50 m Jar				ASPHALT dark grey, 28mm angular igneuous aggregate, poorly bound, (10 mm thickness) FILL: Gravelly SAND fine to coarse grained, grey to pale grey brown FILL: Silty CLAY medium plasticity, brown to red brown with pockets of dark grey, with some fine to medium sub-angular gravels			ASPHALT PAVEMENT FILL Sub-base FILL PP @ 0.8m: 200-300kPa
			1		GA-BH08_03 SPT 0.50-0.95 m 2, 2, 2 N=4 PID = 0.6 ppm GA-BH08_04 1.00 m Jar							
				1.80 48.48	PID = 0.3 ppm				As above with trace organics (rootlets), trace sub-angular fine gravels			
	L		2		GA-BH08_05 SPT 2.00-2.45 m 4, 7, 11 N=18					M		PP @ 2.3m: 200-400kPa
			3		GA-BH08_06 SPT 3.50-3.95 m 5, 9, 11 N=20							PP @ 3.8m: >400kPa
ADT			4	4.40 45.88				CH	CLAY high plasticity, brown and grey, with some fine and trace medium sub-angular igneous gravel			ALLUVIUM
			5		GA-BH08_07 Jar, Trip 03, Dup 03 SPT 5.00-5.45 m 6, 7, 10 N=17							PP @ 5.2m: 200-300kPa
	M		6							M (>PL)	VSt	
			7		GA-BH08_08 SPT 6.50-6.54 m 15/40mm N=R							
			8	42.28					END OF BOREHOLE @ 8.00 m TARGET DEPTH PIEZOMETER INSTALLED			
			9									
			10									

REPORT OF HAND AUGERED BOREHOLE: GA-HA01

SHEET: 1 OF 1 REV:

CLIENT: Tactical Group
PROJECT: Minto Warehousing and Logistics Hub
LOCATION: Culverston Road
JOB NO: 1648232

COORDS: 300168.0 m E 6231122.0 m N MGA94 56
SURFACE RL: 47.60 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 0.60 m

LOGGED: JND DATE: 15/2/16
CHECKED: BMS DATE: 29/2/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	M-H	GWNE	0.0	47.60	GA-HA01-001 DS 0.00-0.10 m R = 0A PID = 1.4 ppm				FILL: Silty CLAY low to medium plasticity, brown with red and orange, low liquid limit silt, with some medium to coarse grained sandstone gravel, with some sandstone cobbles	D		INFERRED FILL
			0.5		GA-HA01-002 DS 0.50-0.10 m DUP01/TRIP01 R = 0A PID = 0.5 ppm							
				47.00					END OF HAND AUGER @ 0.60 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			1.0									
			1.5									
			2.0									

This report of hand augered borehole must be read in conjunction with accompanying notes and abbreviations. It has been prepared for environmental purposes only, without attempt to consider geotechnical properties or the geotechnical significance of the materials encountered. As such it should not be relied upon for geotechnical purposes.

GAP gINT FN. F01a
RL3

REPORT OF HAND AUGERED BOREHOLE: GA-HA02

SHEET: 1 OF 1 REV:

CLIENT: Tactical Group
PROJECT: Minto Warehousing and Logistics Hub
LOCATION: Culverston Road
JOB NO: 1648232

COORDS: 300113.0 m E 6231380.0 m N MGA94 56
SURFACE RL: 48.77 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 1.50 m

LOGGED: NS DATE: 26/2/16
CHECKED: BMS DATE: 29/2/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	M	GWNE	0.0	48.77					FILL: Clayey SILT fine, low - medium plasticity, pale brown, with sandstone pebbles	D		INFERRED FILL Rootlets
			1.5	47.27	GA-HA02 1.50 m R = 0A PID = 0.1 ppm				END OF HAND AUGER @ 1.50 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			2.0									

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GAP gINT FN. F01a
RL3

REPORT OF HAND AUGERED BOREHOLE: GA-HA03

SHEET: 1 OF 1 REV:

CLIENT: Tactical Group
PROJECT: Minto Warehousing and Logistics Hub
LOCATION: Culverston Road
JOB NO: 1648232

COORDS: 300155.0 m E 6231308.0 m N MGA94 56
SURFACE RL: 47.14 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 1.00 m

LOGGED: JND DATE: 15/2/16
CHECKED: BMS DATE: 29/2/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	M	GWNE	0.0	47.14	GA-HA03-001 DS 0.00-0.10 m R = 0A PID = 1 ppm				FILL: Clayey Gravelly SILT low plasticity, brown, fine to medium grained sub angular to rounded sandstone gravels gravel, low to medium plasticity clay, trace fine grained, sub rounded sand	D		INFERRED FILL
			0.5									
					GA-HA03-002 DS 0.90-0.10 m R = 0A PID = 3.5 ppm							
			1.0	46.14					END OF HAND AUGER @ 1.00 m TARGET DEPTH GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			1.5									
			2.0									

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GAP gINT FN. F01a
RL3

REPORT OF HAND AUGERED BOREHOLE: GA-HA04

SHEET: 1 OF 1 REV:

CLIENT: Tactical Group
PROJECT: Minto Warehousing and Logistics Hub
LOCATION: Culverston Road
JOB NO: 1648232

COORDS: 300108.0 m E 6231450.0 m N MGA94 56
SURFACE RL: 48.47 m DATUM: AHD
INCLINATION: -90°
HOLE DEPTH: 1.50 m

LOGGED: NS DATE: 26/2/16
CHECKED: BMS DATE: 29/2/16

Drilling					Sampling		Field Material Description					
METHOD	PENETRATION RESISTANCE	WATER	DEPTH (metres)	*DEPTH* RL	SAMPLE OR FIELD TEST	RECOVERED	GRAPHIC LOG	USCS SYMBOL	SOIL/ROCK MATERIAL DESCRIPTION	MOISTURE CONDITION	CONSISTENCY DENSITY	STRUCTURE AND ADDITIONAL OBSERVATIONS
HA	M	GWNE	0.0	48.47					FILL: Silty CLAY low - medium plasticity, brown, fine grained silt, with some pebbles	D		INFERRED FILL Rootlets
			1.5	46.97	GA-HA03 1.50 m R = 0A PID = 0.1 ppm				END OF HAND AUGER @ 1.50 m REFUSAL GROUNDWATER NOT ENCOUNTERED BACKFILLED			
			2.0									

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GAP gINT FN. F01a
RL3

APPENDIX B

Laboratory Test Certificates

MOISTURE CONTENT TEST REPORT

Client:	Golder Associates	**Job No:**	S16069
Address:	124 Pacific Highway St Leonards NSW 2065	**Report No:**	S9045-MC
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016_001)		

Test Procedure:

- ☑ AS 1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (Standard method).
- ☐ AS4133 1.1.1 Rock moisture content tests - Determination of the moisture content of rock - Oven drying method (standard method)
- ☐ RMS T120 Moisture content of road construction materials (Standard method)
- ☐ RMS T262 Determination of moisture content of aggregates (Standard method)

Sampling:	Sampled by Client	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		

Sample No.	Source	Sample Description	Moisture Content %
S9045	GA-BH01_03 0.5-0.95m	silty CLAY: with sand.	**14.6**
S9047	GA-BH02_05 2-2.45m	silty CLAY	**9.8**
S9048	GA-BH03_03 0.5-0.95m	silty CLAY: with sand.	**14.1**
S9050	GA-BH06_05 1-1.45m	silty CLAY	**17.6**
S9052	GA-BH08_03 0.5-0.95m	silty CLAY: with sand.	**13.9**

Notes:

NATA

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Authorised Signatory:

Chris Lloyd

7/03/2016

Date:

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Unit 8/10
Bradford Street
Alexandria NSW 2015

SOIL CLASSIFICATION REPORT

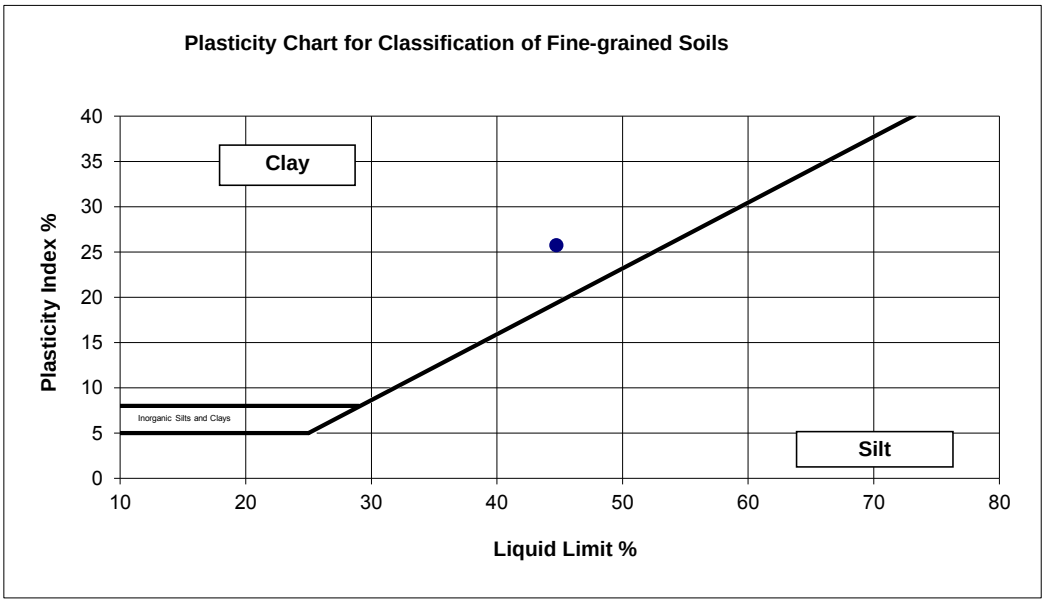
Client:	Golder Associates	**Source:**	GA-BH01_03 0.5-0.95m
Address:	124 Pacific Highway St Leonards NSW 2065	**Sample Description:**	silty CLAY: with sand.
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016_001)	**Report No:**	S9045-PI
Job No:	S16069	**Lab No:**	S9045

Test Procedure:

- ☑ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
- ☐ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
- ☑ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
- ☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
- ☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
- ☐ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling:	Sampled by Client	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		

Liquid Limit (%):	45	**Linear Shrinkage (%):**	-
Plastic Limit (%):	19	**Field Moisture Content (%):**	14.6
Plastic Index:	26		



Soil Preparation Method: Dry Sieved
Soil History: Air Dried
Soil Condition: NA

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SOIL CLASSIFICATION REPORT

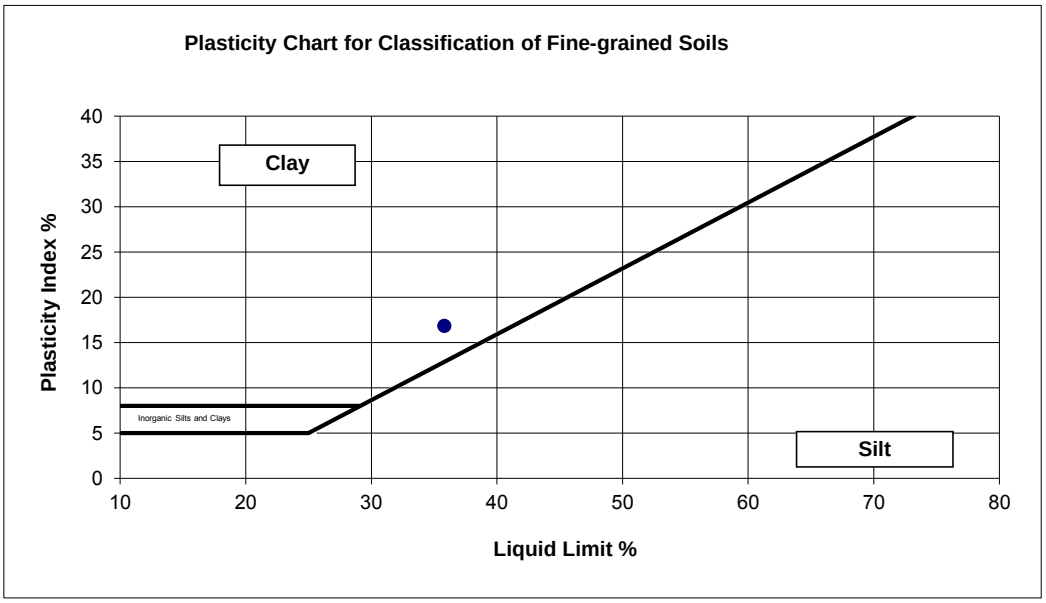
Client:	Golder Associates	**Source:**	GA-BH03_06 2-2.8m
Address:	124 Pacific Highway St Leonards NSW 2065	**Sample Description:**	silty CLAY: with sand.
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016_001)	**Report No:**	S9049-PI
Job No:	S16069	**Lab No:**	S9049

Test Procedure:

- ☑ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
- ☐ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
- ☑ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
- ☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
- ☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
- ☐ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling:	Sampled by Client	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		

Liquid Limit (%):	36	**Linear Shrinkage (%):**	-
Plastic Limit (%):	19	**Field Moisture Content (%):**	-
Plastic Index:	17		



Soil Preparation Method: Dry Sieved
Soil History: Air Dried
Soil Condition: NA

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SOIL CLASSIFICATION REPORT

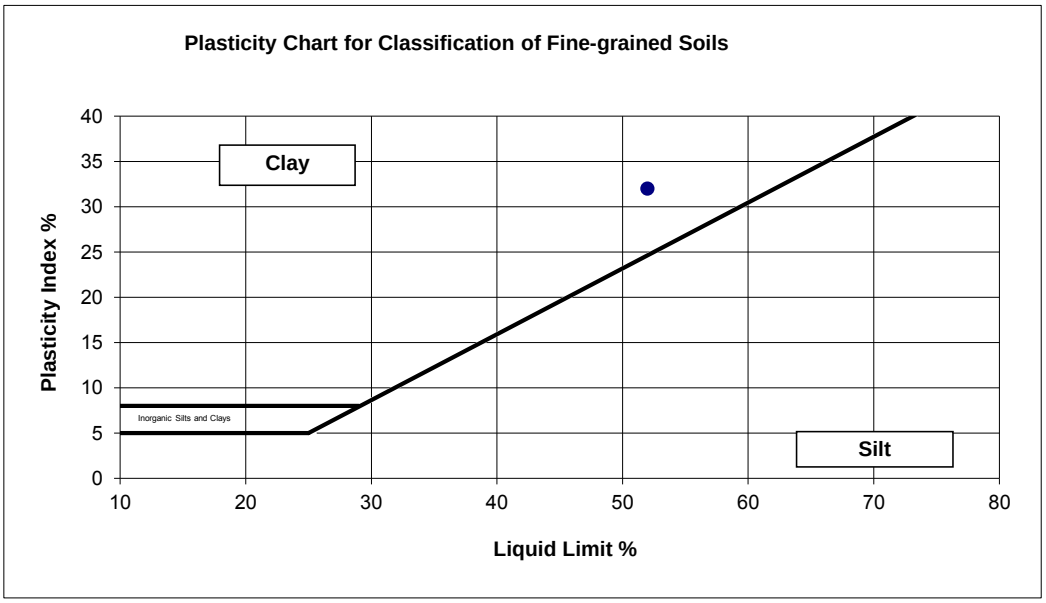
Client:	Golder Associates	**Source:**	GA-BH07_07 2-3m
Address:	124 Pacific Highway St Leonards NSW 2065	**Sample Description:**	silty CLAY
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016_001)	**Report No:**	S9051-PI
Job No:	S16069	**Lab No:**	S9051

Test Procedure:

- ☑ AS1289 2.1.1 Soil moisture content tests (Oven drying method)
- ☐ AS1289 3.1.1 Soil classification tests - Determination of the liquid limit of a soil - Four point casagrande method
- ☑ AS1289 3.1.2 Soil classification tests - Determination of the liquid limit if a soil - One point Casagrande method (subsidiary method)
- ☑ AS1289 3.2.1 Soil classification tests - Determination of the plastic limit of a soil - Standard method
- ☑ AS1289 3.3.1 Soil classification tests - Calculation of the plasticity Index of a soil
- ☐ AS1289 3.4.1 Soil classification tests - Determination of the linear shrinkage of a soil - Standard method

Sampling:	Sampled by Client	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		

Liquid Limit (%):	52	**Linear Shrinkage (%):**	-
Plastic Limit (%):	20	**Field Moisture Content (%):**	-
Plastic Index:	32		



Soil Preparation Method: Dry Sieved
Soil History: Air Dried
Soil Condition: NA

NATA Accredited Laboratory Number: 14874

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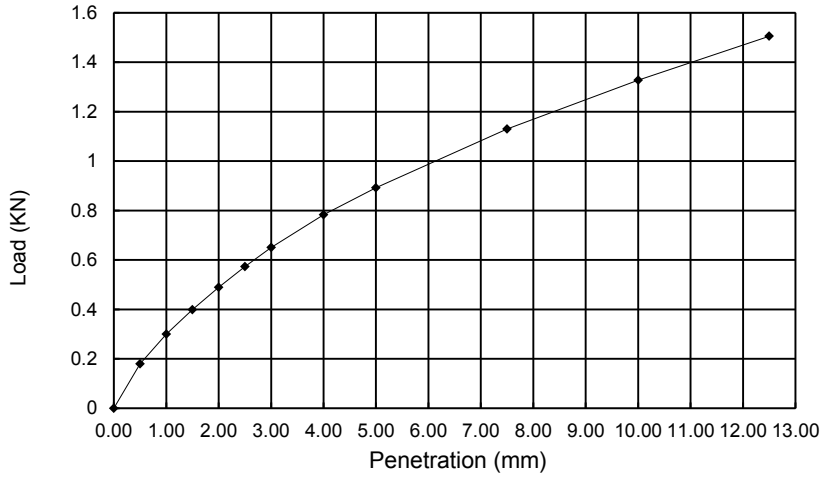
CALIFORNIA BEARING RATIO REPORT

Client:	Golder Associates	**Source:**	GA-BH03_06 2-2.8m
Address:	124 Pacific Highway St Leonards NSW 2065	**Sample Description:**	silty CLAY: with sand.
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016_001)	**Report No.:**	S9049-CBR
Job No.:	S16069	**Lab No.:**	S9049

Test Procedure:

- ☑ AS1289 6.1.1 Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen
- ☑ AS1289 5.1.1 Soil compaction and density tests - Determination of the dry density/moisture content relationship of a soil using standard compactive effort
- ☑ AS1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (standard method

Sampling:	Sampled by Client	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		



Compaction and Placement Data

Compaction Used	Standard	Dry Density				
Maximum Dry Density t/m^3	1.74	At Compaction	1.74	t/m^3	100.0	% Comp.
Optimum Moisture Content %	18.1	After Soaking	1.73	t/m^3	99.0	% Comp.

No. of Layers	3	Moisture Content			Moisture Ratio (%)
Blows per Layer	53	At Compaction	%	18.2	101
Drop of Rammer mm	300	After Soaking	%	20.0	110
Mass of Rammer kg	2.7	After Penetration (Top 30mm)	%	21.0	116
Surcharge Used kg	4.5	After Penetration (Entire Depth)	%	19.3	107
% Ret. 19mm Sieve	0	Swell After 4 Days Soaking	%	0.8	

Note: material coarser than +19mm Sieve was discarded (as per test method)

California Bearing Ratio

CBR (4-day Soaked) = 4.5 % at 2.5 mm Penetration

Notes:

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DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

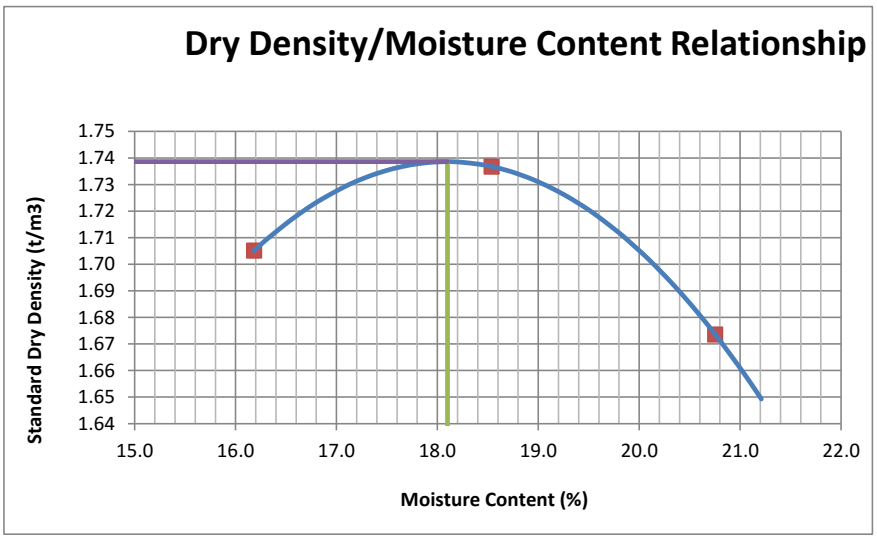
Client:	Golder Associates	**Source:**	GA-BH03_06 2-2.8m
Address:	124 Pacific Highway St Leonards NSW 2065	**Sample Description:**	silty CLAY: with sand.
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016_001)	**Report No:**	S9049-MDD
Job No:	S16069	**Lab No:**	S9049

Test Procedure:

☑ AS1289.5.1.1 Determination of the dry density/moisture content relation of a soil using standard compactive effort

☑ AS1289.2.1.1 Determination of the moisture content of a soil - Oven drying method (Standard method)

Sampling:	Sampled by Client	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		



Maximum Dry Density (t/m^3)	1.739
Optimum Moisture Content (%)	18.1
Percentage Oversize on 19mm sieve (%)	0
Percentage Oversize on 37.5mm sieve (%)	0

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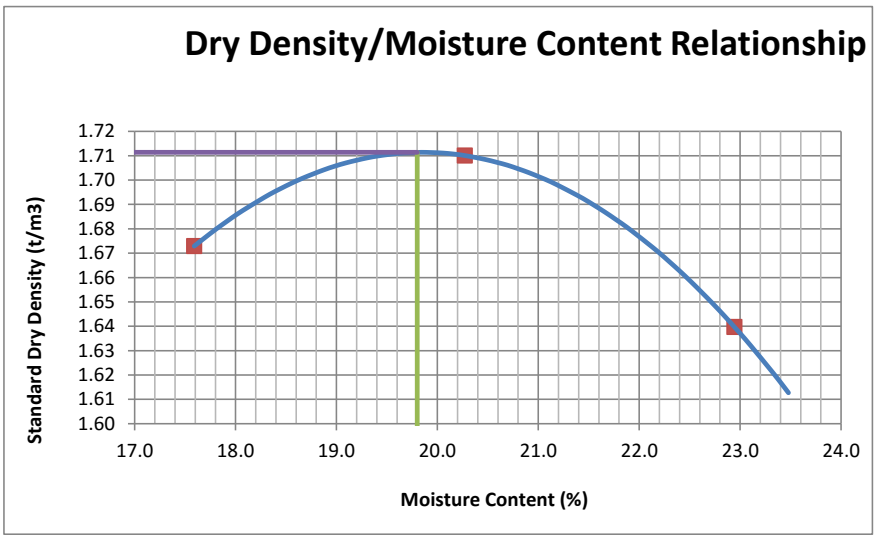
DRY DENSITY / OPTIMUM MOISTURE CONTENT REPORT

Client:	Golder Associates	**Source:**	GA-BH07_07 2-3m
Address:	124 Pacific Highway St Leonards NSW 2065	**Sample Description:**	silty CLAY
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016_001)	**Report No:**	S9051-MDD
Job No:	S16069	**Lab No:**	S9051

Test Procedure:
- ☑ AS1289.5.1.1 Determination of the dry density/moisture content relation of a soil using standard compactive effort
- ☑ AS1289.2.1.1 Determination of the moisture content of a soil - Oven drying method (Standard method)

Sampling:	Sampled by Client	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		



Maximum Dry Density (t/m^3)	1.711
Optimum Moisture Content (%)	19.8
Percentage Oversize on 19mm sieve (%)	0
Percentage Oversize on 37.5mm sieve (%)	0

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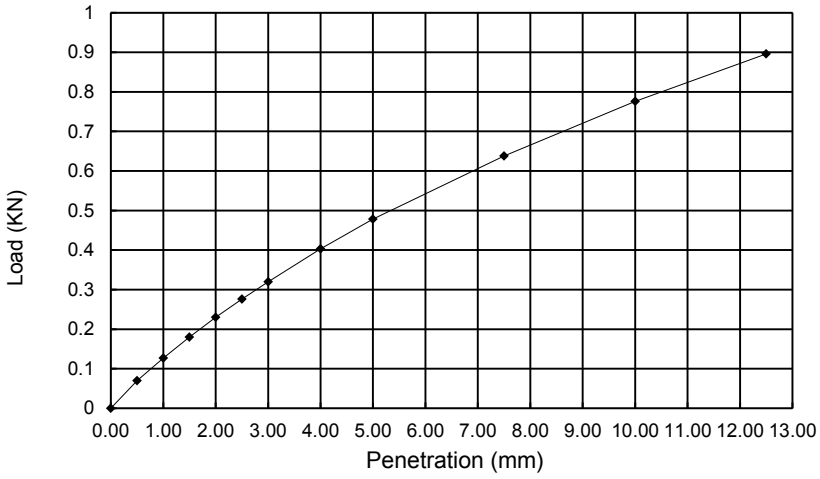
CALIFORNIA BEARING RATIO REPORT

Client:	Golder Associates	**Source:**	GA-BH07_07 2-3m
Address:	124 Pacific Highway St Leonards NSW 2065	**Sample Description:**	silty CLAY
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016_001)	**Report No.:**	S9051-CBR
Job No.:	S16069	**Lab No.:**	S9051

Test Procedure:

- ☑ AS1289 6.1.1 Soil strength and consolidation tests - Determination of the California Bearing Ratio of a soil - Standard laboratory method for a remoulded specimen
- ☑ AS1289 5.1.1 Soil compaction and density tests - Determination of the dry density/moisture content relationship of a soil using standard compactive effort
- ☑ AS1289 2.1.1 Soil moisture content tests - Determination of the moisture content of a soil - Oven drying method (standard method

Sampling:	Sampled by Client	**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		



Compaction and Placement Data

Compaction Used	Standard	Dry Density			
Maximum Dry Density t/m^3	1.71	At Compaction	1.69 t/m^3	99.0	% Comp.
Optimum Moisture Content %	19.8	After Soaking	1.68 t/m^3	98.0	% Comp.

No. of Layers	3	Moisture Content			Moisture Ratio (%)
Blows per Layer	53	At Compaction	%	20.5	104
Drop of Rammer mm	300	After Soaking	%	22.2	112
Mass of Rammer kg	2.7	After Penetration (Top 30mm)	%	23.2	117
Surcharge Used kg	4.5	After Penetration (Entire Depth)	%	21.9	110
% Ret. 19mm Sieve	0	Swell After 4 Days Soaking	%	1.0	

Note: material coarser than +19mm Sieve was discarded (as per test method)

California Bearing Ratio

CBR (4-day Soaked) = 2.5 % at 5.0 mm Penetration

Notes:

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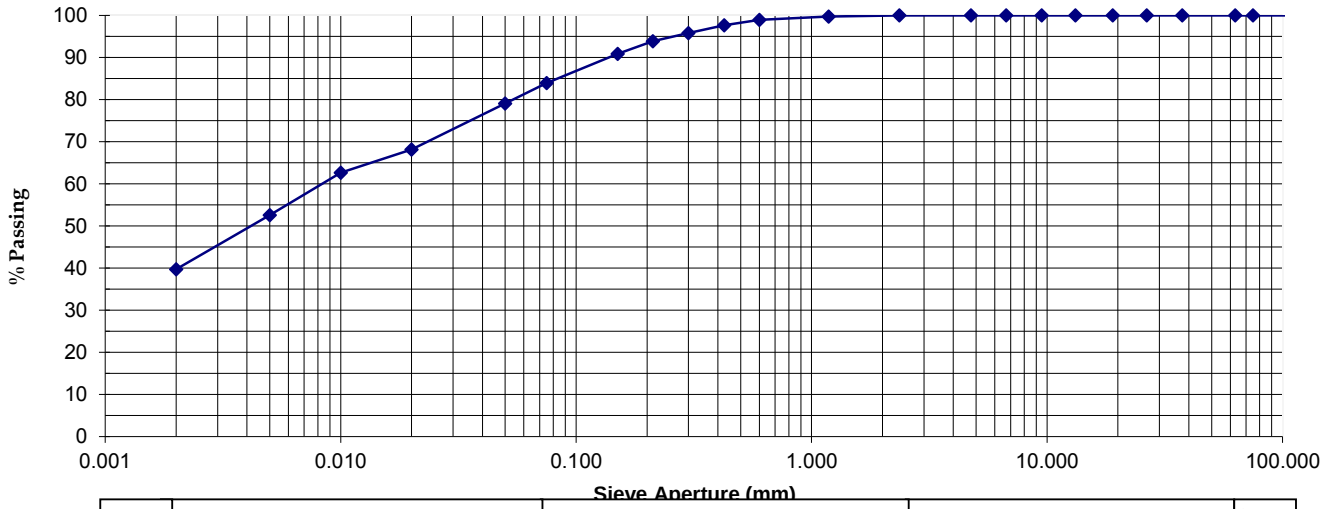
PARTICLE SIZE DISTRIBUTION (HYDROMETER) REPORT

Client:	Golder Associates	**Source:**	GA-BH01_03 0.5-0.95m
Address:	124 Pacific Highway St Leonards NSW 2065	**Sample Description:**	silty CLAY: with sand.
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016_001)	**Report No.:**	S9045-HYD
Job No.:	S16069	**Lab No.:**	S9045

Test Procedure: ☑ AS1289.3.6.3 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer
☑ AS1289.3.6.1 Soil classification tests - Determination of particle size distribution of a soil standard method sieving

Sampling: Sampled by Client | Date Sampled: Unknown

Preparation: Prepared in accordance with the test method



Clay	Silt	Sand	Gravel	Cobbles

Sieve Apperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	-		1.180	100	
75	-		0.600	99	
63	-		0.425	98	
37.5	-		0.300	96	
26.5	-		0.212	94	
19.0	-		0.150	91	
13.2	-		0.075	84	
9.5	-		0.050	79	
6.7	-		0.020	68	
4.75	-		0.010	63	
2.36	100		0.005	53	
			0.002	40	

Loss in Pre-treatment of Material (%)	0
Method of Dispersion:	Sodium Hexametaphosphate / Sodium Carbonate
Hydrometer Type:	ASTM

NATA Accredited Laboratory Number: 14874

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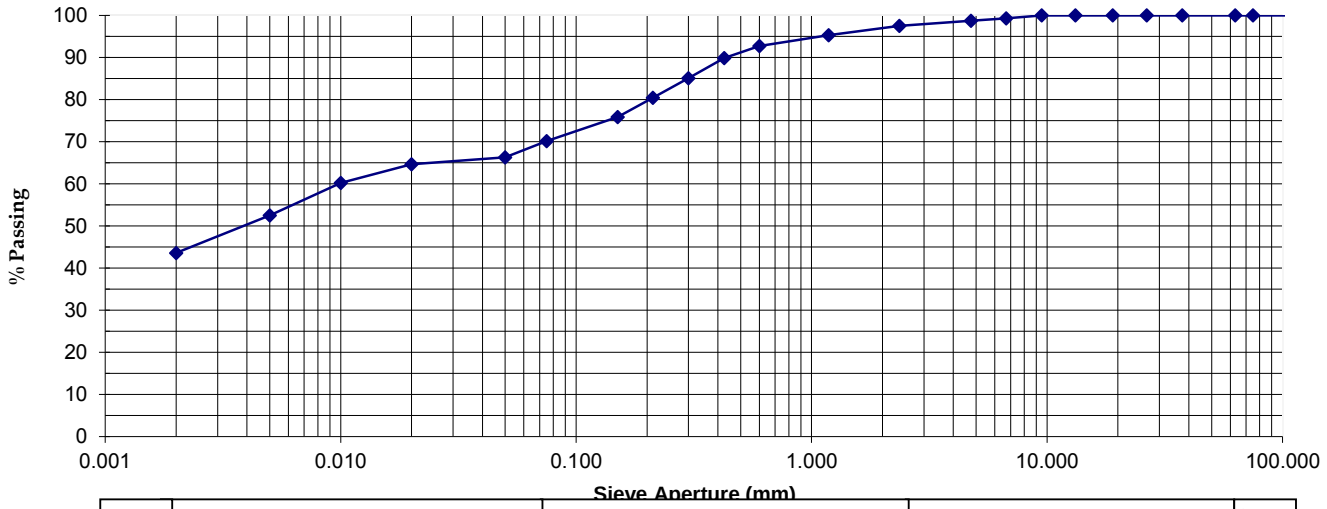
PARTICLE SIZE DISTRIBUTION (HYDROMETER) REPORT

Client:	Golder Associates	**Source:**	GA-BH03_03 0.5-0.95m
Address:	124 Pacific Highway St Leonards NSW 2065	**Sample Description:**	silty CLAY: with sand.
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016_001)	**Report No.:**	S9048-HYD
Job No.:	S16069	**Lab No.:**	S9048

Test Procedure: ☑ AS1289.3.6.3 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer
☑ AS1289.3.6.1 Soil classification tests - Determination of particle size distribution of a soil standard method sieving

Sampling: Sampled by Client | Date Sampled: Unknown

Preparation: Prepared in accordance with the test method



Clay	Silt	Sand	Gravel	Cobbles

Sieve Apperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	-		1.180	95	
75	-		0.600	93	
63	-		0.425	90	
37.5	-		0.300	85	
26.5	-		0.212	80	
19.0	-		0.150	76	
13.2	-		0.075	70	
9.5	100		0.050	66	
6.7	99		0.020	65	
4.75	99		0.010	60	
2.36	98		0.005	53	
			0.002	44	

Loss in Pre-treatment of Material (%)	0
Method of Dispersion:	Sodium Hexametaphosphate / Sodium Carbonate
Hydrometer Type:	ASTM

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

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Date: 7/03/2016

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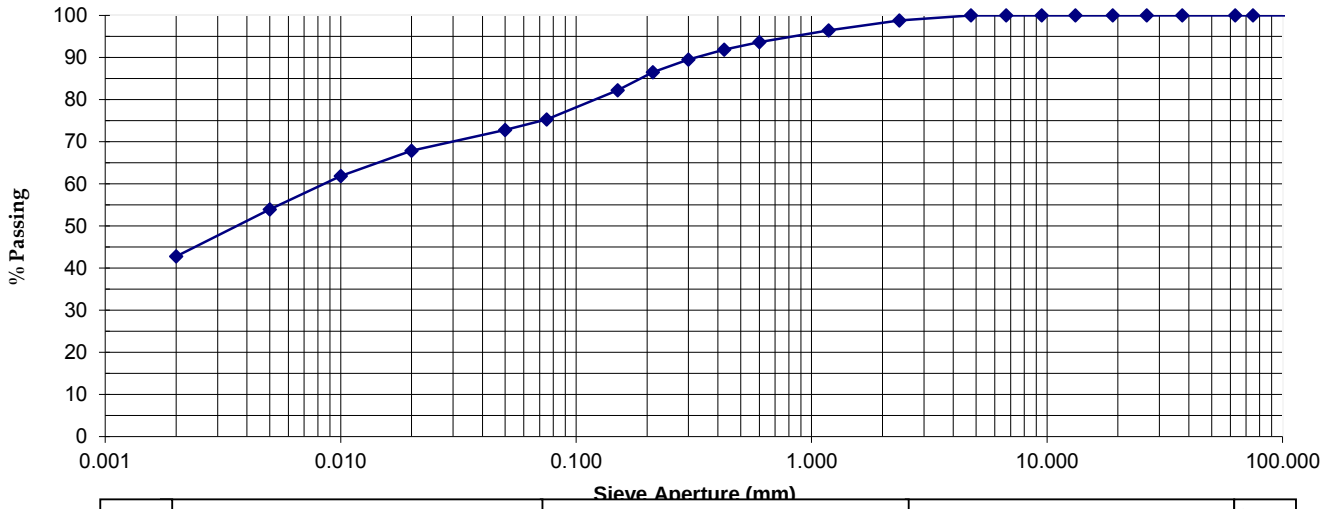
PARTICLE SIZE DISTRIBUTION (HYDROMETER) REPORT

Client:	Golder Associates	**Source:**	GA-BH08_03 0.5-0.95m
Address:	124 Pacific Highway St Leonards NSW 2065	**Sample Description:**	silty CLAY: with sand.
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016_001)	**Report No.:**	S9052-HYD
Job No.:	S16069	**Lab No.:**	S9052

Test Procedure: ☑ AS1289.3.6.3 Soil classification tests - Determination of the particle size distribution of a soil - Standard method of fine analysis using a hydrometer
☑ AS1289.3.6.1 Soil classification tests - Determination of particle size distribution of a soil standard method sieving

Sampling: Sampled by Client | Date Sampled: Unknown

Preparation: Prepared in accordance with the test method



Clay	Silt	Sand	Gravel	Cobbles

Sieve Apperture: (mm)	% Passing	Specification (..) Envelope	Sieve Aperture: (mm)	% Passing	Specification (..) Envelope
200	-		1.180	96	
75	-		0.600	94	
63	-		0.425	92	
37.5	-		0.300	90	
26.5	-		0.212	87	
19.0	-		0.150	82	
13.2	-		0.075	75	
9.5	-		0.050	73	
6.7	-		0.020	68	
4.75	100		0.010	62	
2.36	99		0.005	54	
			0.002	43	

Loss in Pre-treatment of Material (%)	0
Method of Dispersion:	Sodium Hexametaphosphate / Sodium Carbonate
Hydrometer Type:	ASTM

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

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Date: 7/03/2016

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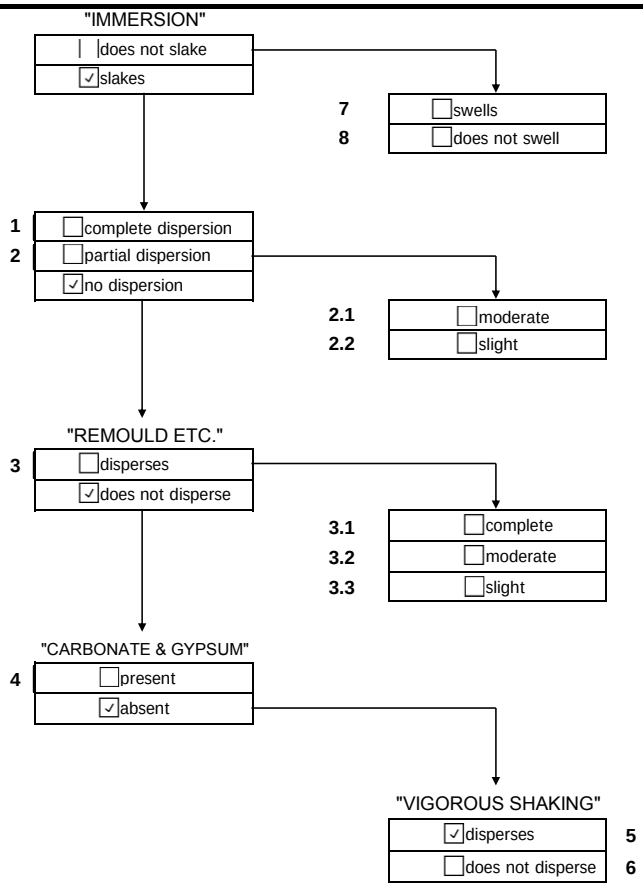
EMERSON CLASS REPORT

Client:	Golder Associates	**Source:**	GA-BH03_03 0.5-0.95m
Address:	124 Pacific Highway St Leonards NSW 2065	**Sample Description:**	silty CLAY: with sand.
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016_001)	**Report No:**	S9048-ECT
Job No:	S16069	**Lab No:**	S9048

Test Procedure: ☑ AS1289 3.8.1 Soil classification tests - Dispersion - Determination of Emerson class number of a soil

Sampling: Sampled by Client **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method



Water Type	**Distilled**
Water Source	**-**
Water Temperature (°c)	**26**

RESULT:

Emerson Class No.	**5**

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

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Date: 7/03/2016

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EMERSON CLASS REPORT

Client:	Golder Associates	**Source:**	GA-BH08_05 2-2.45m
Address:	124 Pacific Highway St Leonards NSW 2065	**Sample Description:**	silty CLAY
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016_001)	**Report No:**	S9048-ECT
Job No:	S16069	**Lab No:**	S9048

Test Procedure: ☑ AS1289 3.8.1 Soil classification tests - Dispersion - Determination of Emerson class number of a soil

Sampling: Sampled by Client | **Date Sampled:** Unknown

Preparation: Prepared in accordance with the test method

"IMMERSION"

- ☐ does not slake
- ☑ slakes
  - 7 ☐ swells
  - 8 ☐ does not swell

1 ☐ complete dispersion
2 ☐ partial dispersion
☑ no dispersion
- 2.1 ☐ moderate
- 2.2 ☐ slight

"REMOULD ETC."

3 ☐ disperses
☑ does not disperse
- 3.1 ☐ complete
- 3.2 ☐ moderate
- 3.3 ☐ slight

"CARBONATE & GYPSUM"

4 ☐ present
☑ absent

"VIGOROUS SHAKING"

- ☑ disperses 5
- ☐ does not disperse 6

Water Type	**Distilled**
Water Source	**-**
Water Temperature (°c)	**26**

RESULT:

Emerson Class No.	**5**

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SOIL CHEMICAL PROPERTIES REPORT

Client:	Golder Associates	**Source:**	GA-BH01_03 0.5-0.95m
Address:	124 Pacific Highway St Leonards NSW 2065	**Sample Description:**	silty CLAY: with sand
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016-001)	**Report No:**	B26388-SCP
Job No:	S16069	**Lab No:**	B26388 (S9045)

Test Procedure:

☑	AS1289 4.2.1	Soil Chemical Tests - Determination of a sulfate content of a natural soil and the sulfate content of the groundwater - Normal Method
☑	AS1289 4.3.1	Soil Chemical Tests - Determination of the pH value of a soil - Electrometric method
☐	AS 1289 4.4.1	Soil Chemical Tests - Determination of the electrical resistivity of a soil - Method for sands and granular material
☐	RMS T123	pH value of a soil (electrometric method)
☐	RMS T185	Resistivity of sands and granular road construction materials
☐	RMS T200	Chloride content of roadbase
☑	RMS T1010	Quantitative determination of chlorides in soil
☐	RMS T1011	Quantitative determination of sulphates in soil
☐	BS1377(1990 pt.3)	Water soluble sulphate content
☐	APHA 4500 H+B	pH
☐	APHA 4500 SO4 2-B	Sulphate
☐	APHA 4500 Cl-B	Chloride
☑	APHA 2510 & 2520-B	Electrical Conductivity
☐	TAI B117	Sulphides Present (This service Not Covered by NATA Accreditation)

Sampling:		**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		

Sulphides Present	-
Sulphate content (ppm)	208.0
Sulphate content (%)	0.02
Chloride ion content (ppm)	257.0
Chloride ion content (%)	0.03
pH	7.7
Electrical Conductivity (uS/cm)	164.7
Mean Resistivity Ω.m	-
(Resisitivity) Density ratio (R_D)	-
(Resisitivity) Density index (I_D)	-

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Bradley Morris

7/03/2016

Date:

Macquarie Geotechnical
3 Watt Drive
Bathurst NSW 2795

SOIL CHEMICAL PROPERTIES REPORT

Client:	Golder Associates	**Source:**	GA-BH02_03 0.5-0.95m
Address:	124 Pacific Highway St Leonards NSW 2065	**Sample Description:**	silty CLAY: with sand
Project:	Minto Warehousing Development - Culverston Road, Minto (1648232 2016-001)	**Report No:**	B26389-SCP
Job No:	S16069	**Lab No:**	B26389 (S9046)

Test Procedure:

☑	AS1289 4.2.1	Soil Chemical Tests - Determination of a sulfate content of a natural soil and the sulfate content of the groundwater - Normal Method
☑	AS1289 4.3.1	Soil Chemical Tests - Determination of the pH value of a soil - Electrometric method
☐	AS 1289 4.4.1	Soil Chemical Tests - Determination of the electrical resistivity of a soil - Method for sands and granular material
☐	RMS T123	pH value of a soil (electrometric method)
☐	RMS T185	Resistivity of sands and granular road construction materials
☐	RMS T200	Chloride content of roadbase
☑	RMS T1010	Quantitative determination of chlorides in soil
☐	RMS T1011	Quantitative determination of sulphates in soil
☐	BS1377(1990 pt.3)	Water soluble sulphate content
☐	APHA 4500 H+B	pH
☐	APHA 4500 SO4 2-B	Sulphate
☐	APHA 4500 Cl-B	Chloride
☑	APHA 2510 & 2520-B	Electrical Conductivity
☐	TAI B117	Sulphides Present (This service Not Covered by NATA Accreditation)

Sampling:		**Date Sampled:**	Unknown
Preparation:	Prepared in accordance with the test method		

Sulphides Present	-
Sulphate content (ppm)	283.5
Sulphate content (%)	0.03
Chloride ion content (ppm)	270.3
Chloride ion content (%)	0.03
pH	7.2
Electrical Conductivity (uS/cm)	182.0
Mean Resistivity Ω.m	-
(Resisitivity) Density ratio (R_D)	-
(Resisitivity) Density index (I_D)	-

NATA

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. This document shall not be reproduced, except in full.

NATA Accredited Laboratory Number: 14874

Authorised Signatory:

Bradley Morris

7/03/2016

Date:

MACQUARIE GEOTECH

Macquarie Geotechnical
3 Watt Drive
Bathurst NSW 2795

APPENDIX C

Site Photographs

1. Culverston Rd, facing south, which runs through the middle of the Site. The Site fences/boundaries are visible on both sides.

2. Facing north, in the middle of the facility.

3. In the middle of the northern side of the facility, facing southwest

4. Facing west, in the middle of the western border of the facility. The surrounding facilties and sloping edges into the channel are visible.

5. Facing south following the western border of the Site, near GA-BH01

6. In the middle of the western border of the facility, facing east. The carwash bays are visible to the right side of the photo.

7. Facing north, along the western border of the Site (north of the middle of the Site)

8. The far northwestern corner of the Site, facing southeast, near GA-BH02

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9. The northeastern corner of the Site, facing south

10. The main warehouse building, in the middle of the facility, facing southwest

11. In the middle of the eastern section of the facility (on the east side of Culverston Rd), facing east

12. In the northeastern corner of the eastern section of the facility (on the east side of Culverston Rd), facing north, near GA-BH05

13. Drainage channel at north part of the site, typical of drainage channels encompassing the site

14. The southern section of the Site, facing northwest, near GA-BH08

APPENDIX D

Limitations

IMPORTANT INFORMATION RELATING TO THIS REPORT

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