



APPENDIX E

Civil, Structural and Geotechnical Reports

E1. Response to DGRs E2. Stormwater Concept Plan E3. Erosion and Sediment Control
Plan E4. Geotechnical Report 1 (October 2009) E5. Geotechnical Report 2 (June 2010)
E6. Civil and Structural Engineering Report E7. Site Audit Interim Advice







E1: Response to DGRs

Prepared by SCP Consulting Pty Ltd

STRUCTURAL & CIVIL ENGINEERING WORKS

EXECUTIVE SUMMARY

In summary, the structural and civil engineering works required for the proposed development will generally comprise the following:

- 1. Sediment and Erosion Control:
 - To protect local drainage systems from pollutants generated during construction activity.
- 2. Bulk Earthworks and Soil Contamination:

_ To provide a basement level and suitable foundation for the proposed structure.

Site contamination investigation was undertaken by Argus in October 2009. The soil samples analysed were generally lower than the relevant regulatory guideline criteria. The report stated that the risk to human health and the environment associated with soil contamination on the site are low in context of the proposed use of the site.

- 3. Stormwater Drainage and Stormwater Quality:
 - To provide a stormwater collection and conveyance system incorporating on-site stormwater detention to ensure that stormwater runoff from the site does not have a detrimental effect on the proposed development, neighbouring properties and downstream drainage systems.
 - To provide stormwater quality improvement devices as part of the stormwater drainage system to ensure that stormwater pollutants are removed from stormwater runoff prior to discharging from the site to ensure there is no detrimental effect on the downstream drainage system and receiving waterway.
 - To provide a drainage connection to Council's existing stormwater system in Susan Street to provide a lawful point of discharge from the development site.
 - All rainwater re-use to be designed and detailed by the services consultant.
- 4. Roads and Carparking:
 - To provide entry and exit points to the site.
 - To provide all weather access to the proposed development.
- 5. Pedestrian Walkways, Footways and General Site Regrading:
 - To provide accessible roads, car parks, pedestrian links and landscaped areas throughout the site.
 - The proposed civil engineering works will be designed and constructed in accordance with Council and the relevant Service Authorities standards and requirements, Building Code of Australia and the relevant Australian Standards.

1. DESIGN STANDARDS AND CODES

The structural and civil engineering works will be designed in accordance with the latest issue of all relevant design standards, codes and other statutory and authority requirements. As a minimum requirement, the design will be based on but not limited to:

- AS 1170.0 2002 SAA Loading Code Part 0 General Principles
- AS 1170.1 2002 SAA Loading Code Part 1 Dead and Live Loads
- AS 1170.2 2002 SAA Loading Code Part 2 Wind Loads
- AS 1170.4 2007 SAA Loading Code Part 4 Earthquake Loads
- AS 4100 1998 Steel Structures
- AS 3600 2009 Concrete Structures
- AS 3700 2001 Masonry Structures
- AS 2159 1995 Piling Code
- AS 4678 2002 Retaining Structures Code
- Council's Civil Works Specification
- Council's Water Management Development Control Plan
- Managing Urban Stormwater: Soils and Construction Manual
- Australian Rainfall & Runoff
- Australian Water Quality Runoff
- AS 3500.3 Stormwater Drainage
- AS 2890.1 Off Street Car Parking
- AS 2890.2 Commercial Parking Facilities
- AS 1742 Manual of Uniform Traffic Control Devices
- New South Wales Roads & Traffic Authority (RTA) Traffic Control at Worksites manual
- Austroads Pavement Design, A Guide to the Structural Design of Road Pavements

2. BUILT FORM

SCP Consulting has provided structural input into the architectural planning by reviewing the following building elements:

•	Column Sizes:-	Preliminary column sizes (minimum dimensions) are being assesses so as to comply with both strength and fire resistance.
•	Building Stability:-	Earthquake & Wind resisting lift and stair cores are to be strategically located such that the building does not twist or deflect excessively.
•	Floor Framing:-	The structural framing and orientation of the floor beams within the floor slab system will take into account the direction of mechanical a/c ducts, building cantilevers and the required fire resistance.

3. GROUND WATER

Refer to the Geotechnical Investigation Report prepared by Aargus Pty Ltd on 15 June 2010.

4. SEDIMENT AND EROSION CONTROL

Temporary sediment and erosion control measures will be designed to be incorporated into the construction works and sequencing of the project to ensure that the proposed construction activities on site do not pollute local drainage systems nor have a detrimental effect on downstream waterways.

A concept Sediment and Erosion Control Plan has been provided in Appendix E3.

6. BULK EARTHWORKS and SOIL CONTAMINATION

The excavation will extend to RL 23.90 which is approximately 12m below street level. The bulk of the excavation will occur in Class IV/V shales. All vertical excavation faces will be completely shored to support all external ground. Temporary anchors for the shoring will be required and approval will be obtained from the local authorities.

The site was investigated by Aargus Pty Ltd to conduct an Environmental Site Assessment (ESD) in October 2009.

Based on the results of this investigation it is considered that the risks to human health and the environment associated with the soil contamination at the site are low.

The site is therefore considered suitable for ongoing use and the proposed development.

The criteria to assess soil contamination by the Argus report was the National Environmental Protection Council (1999) National Environmental Protection (Assessment of site contamination) Measure (NEPM). Also with respect human health, the analytical results were assessed against risk based health investigation (HIL) guidelines appropriate for industrial and commercial development (HIL 'F').

The NEPM 1999 does not include investigation levels for TPH and BTEX. These were assessed using the NSW EPA (1994) "Guidelines for Assessing Service Station sites"

All soil acidity and salinity is addressed in the Geotechnical Investigation Report prepared by Aargus Pty Ltd on 15 June 2010.

6. STORMWATER DRAINAGE

Stormwater drainage for the site will be designed to collect and convey stormwater drainage via a conventional piped stormwater drainage system for storm events up to and including a 1 in 20 year Average Recurrence Interval (ARI) storm event.

On-site stormwater detention (OSD) will be provided in accordance with Sydney Water's requirements as outlined in their advice dated 10 March 2010 (see Attachment A). In summary, a minimum storage of 81m3 and a maximum site discharge of 152l/s will be provided.

The site is located at a high point within the local drainage catchment and is therefore not affected by flooding or external overland flow paths. Provision will be made for the safe conveyance of storm flows via overland flow paths within the development site for storm events up to the 1 in 100 year ARI storm event. Adequate freeboard will be provided within defined overland flow paths within the development site to allow some protection from overland flows generated from storm events larger than a 1 in 100 year ARI event.

Stormwater pollution control devices will be incorporated into the site stormwater drainage system to assist with the removal of sediment, oils and hydrocarbons from stormwater runoff from the road and carpark areas.

A concept Stormwater Drainage Plan showing the OSD and discharge/connection point has been provided in Appendix E2.

All rainwater collection for re-use will be design and detailed by the services consultant (SKM).

7. ROADS AND CARPARKS

Design and document the new roads and footpaths so that the geometry complies with the relevant standards.

Swept turning paths of suitable design vehicles will be reviewed and considered in the design.

Design and document traffic control staging plans in accordance with the RTA's Traffic Control at Worksites manual. This will allow staging of the construction works while maintaining vehicular access to hospital facilities during construction of the civil works.

8. PEDESTRIAN WALKWAYS / FOOTWAYS AND GENERAL SITE GRADING

Design and document the proposed pedestrian walkways and footways within the hospital site. Locations and treatments shall be provided by the architect and landscape architect.

Design and document the grading of site areas between the buildings and roads to ensure that the areas are adequately drained.

Design and document pedestrian control staging plans in accordance with the RTA's Traffic Control at Worksites manual. This will allow staging of the construction works while maintaining pedestrian access to hospital facilities during construction of the civil works.





E2: Stormwater Concept Plan

Prepared by SCP Consulting Pty Ltd







E3: Erosion and Sediment Control Plan

Prepared by SCP Consulting Pty Ltd







E4: Geotechnical Investigation Report 1

Prepared by Aargus Pty Ltd (October 2009)



ACN 063 579 313 Environmental Services - Remediation - Geotechnical Engineering - Drilling

LIFEHOUSE AT RPA LIMITED

CAPITAL INSIGHT PTY LTD

PAGE CHEST PAVILLION AND BROWN STREET OUTPATIENT BUILDING

MISSENDEN ROAD, CAMPERDOWN

GEOTECHNICAL INVESTIGATION

Report No.:GS2948/1Prepared By:AC:MCDate:19th October 2009Client:Lifehouse at RPA Ltdc/o Capital Insight Pty Ltd77 Berry St, North Sydney NSW, 2060

Aargus Pty Ltd Telephone: 1300 137 038 Facsimile: 1300 136 038 Website: www.aargus.net NSW: PO Box 398 Drummoyne NSW 2047 QLD: PO Box 1340 Fortitude Valley QLD 4006 VIC: Unit 3/21-23 Beverage Drive Tullamarine VIC 3043 SA: PO Box 3143 Rundle Mall SA 5000

Other office locations in Australia - Greece - South Korea - Spain - Lebanon

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1.0 INTRODUCTION

This report details the results of a Geotechnical Investigation carried out at the Page Chest Pavillion and Brown Street Outpatient Buildings in Missenden Road, Camperdown.

The investigation was commissioned by Mr Tim Dugan, CEO of Lifehouse at RPA.

The purpose of the geotechnical assessment was to determine the details of the sites surface and subsurface conditions in order to provide advice and recommendations from a geotechnical viewpoint for the design and construction of the proposed Lifehouse Building.

2.0 PROPOSED DEVELOPMENT

At the time of preparation of this report, the following documentation was provided to us:

- A Geotechnical brief titled "Brief for Provision of Services for Geotechnical Engineer", Referenced 18102-70409-6.3-PC-pc-Geotech-V4, prepared by Capital Insights Pty Ltd.
- Document titled "Conditions of Engagement Geotechnical Engineer", Referenced 18104-70409-6.3-PC-pc-Engage Geotech, prepared by Capital Insights Pty Ltd.

With reference to the above listed documents, the following is understood:

- The proposed development involves the demolition of existing site features and the construction of the Lifehouse Building, which will have up to eleven-storeys above ground and will contain two levels of below-ground basement.
- The proposed building will be linked by below ground tunnels to the adjacent oncology building to the west, King George V Building to the north and the main RPA campus to the east.
- The site is bounded by Salisbury Road to the north, Susan Street to the west, Brown Street to the south and Missenden Road to the east.
- Two existing brick buildings are present within the site. A multi-storey building "Page Chest Building" is located in the northern portion of the site, whilst a single-storey building "Brown Street Outpatients Building" is located in the southern portion of the site, we understand that these buildings will be demolished as part of the development.

3.0 METHOD OF INVESTIGATION

In order to gain an understanding of the sites geotechnical conditions and to provide the necessary information for the geotechnical assessment, the following fieldwork was carried out over the period covering the 6th October 2009 to 12th October 2009 under the supervision of a Senior Engineering Geologist, Senior Geotechnical Engineer and a Geotechnical Engineer from our office:

- A detailed walk-over inspection of the site by a Geotechnical Engineer/ Engineering Geologist.
- On-site subsurface services locating by a specialist sub-contractor using electromagnetic detection equipment.
- Concrete coring at the intended borehole locations
- Drilling of five (5) boreholes, at locations as near as possible to client nominated locations. The boreholes were drilled using a truck-mounted drill rig fully equipped for geotechnical investigations, in order to identify the subsurface soil and/or rock profile. The boreholes were drilled initially using a V-bit attached to solid flight augers to refusal in bedrock, and further continued using a T-C bit in the weathered shale bedrock. The boreholes were then advanced into the Shale bedrock using NMLC diamond rock coring techniques.
- Recovered rock cores were carefully boxed on site and returned to our laboratory for testing.
- Reinstatement of the boreholes with the displaced soils and a concrete cap.

Borehole locations are shown on Figure 1 attached to this report.

4.0 SURFACE AND SUBSURFACE CONDITIONS

4.1. Location

The site is located within the south western extents of Camperdown bordered by Missenden Road, Susan St, Salisbury road and Brown Street.

4.2. Topography

The site generally slopes down towards the North West at grades of between about 1° & 2° , with the surrounding topography gently undulating with overall ground slopes dipping from West to East.

4.3. Site Description

The site is near rectangular in shape, covering an area of approximately 4160m², and measures approximately 104m along the Eastern (Missenden Rd) and Western Boundaries (Susan Street), and approximately 40m along the Northern (Salisbury Road) and Southern (Brown Street) boundaries. The northern half of the footprint of the proposed development is currently occupied by the multi storey "Page Chest Pavilion" and the southern half of the site by a single storey brick building with basement level.

Existing subsurface pedestrian tunnels extend from the "Page Chest Building" to buildings to the north, east and west. Based on the presence of these tunnels, we anticipate that at least one basement level may be present below this building.

The existing buildings cover the entire site area with the exception of a small grassed area located within the south-eastern corner of the site.

4.4. Regional Geology

Reference to the Sydney 1:100,000 Geological Series Sheet 9130 Edition 1, 1983 indicates that the site is underlain by Ashfield Shale (Rwa) of the Wianamatta Group, which comprises black to dark grey shale and laminite.

4.5. Subsurface Conditions

Subsurface conditions encountered within the boreholes are detailed on the engineering logs presented in Appendix A of this report and have been summarised as follows:

PAVEMENT ASPHALTIC CONCRETE, to depths of between about 0.055m (BH4) and 0.11m (BH1), underlain by
CONCRETE, to depths of between about 0.175m (BH5) and 0.31m (BH1), underlain by,
ROADBASE, CLAY & ASH, to depths of between about 0.3m (BH4) and 0.4m (BH1), underlain by,
RESIDUAL CLAY & Silty CLAY: medium to high plasticity, pale orange , orange, red and pale grey, to depths of between about 1.2m (BH5) and 1.9m (BH4), underlain by,
CLAY & Silty CLAY: medium plasticity, pale grey and red brown, interbedded with ironstone and shale gravel layers, to depths of between about 3.2m (BH1) and 5.5m (BH3 & BH4), underlain by,

BEDROCK SHALE, extremely weathered, very low strength, brown and dark grey, to depths of between about 4.0m (BH1) and 7.6m (BH4), overlying,

SHALE, distinctly weathered, low to medium strength, dark grey, to borehole termination depths of between about 7.55m (BH1) and depths 10.85m (BH5).

The following should also be noted:

- BH5 did not encounter Asphaltic Concrete.
- BH5 did not have a roadbase layer below the concrete pavement.
- BH5 encountered uncontrolled, poorly compacted fill comprising silty sands and silty clay to a depth of about 1.2m below existing ground surface levels.

Depth (m)	BH 1	BH 2	BH 3	BH 4	BH 5
Approx. Surface RL	33.8m	38.0m	38.5m	38.8m	38.8m
Asphaltic Concrete	0-0.11	0 - 0.10	0-0.06	0 - 0.055	NE
Concrete	0.11 - 0.31	0.10 - 0.30	0.06 - 0.24	0.055 - 0.245	0-0.175
Roadbase	0.31 - 0.40	0.30 - 0.40	0.24 - 0.39	0.245 - 0.30	NE
Fill	NE	NE	NE	NE	0.175 - 1.2
Residual Clay	0.40 - 1.30	0.40 - 1.3	0.39 - 1.9	0.30 - 1.6	NE
Interbedded Clay & shale/ironstone	1.3-3.2	1.3 – 3.3	1.9 - 5.5	1.6 - 5.5	1.2 - 5.4
VL St Shale	3.2-4.0	3.3 - 4.5	5.5 - 7.0	5.5 - 7.65	5.4 -6.8
L-M St Shale	4.0-7.55+	4.5 - 10.3+	7.0 - 10.45+	7.65 - 9.95+	6.8 - 10.85+
V Bit Refusal	1.3	1.3	1.9	1.6	1.2
Borehole Termination	7.55	10.3	10.45	9.95	10.85
Depth					

Table 1: Summary of Soil and Rock Properties

Notes :

Units are in metres (m)

Reduced Levels (RL) estimated from survey plan Not Encountered (NE) Very Low Strength (VL) Low to Medium Strength (L-M)

4.6. Groundwater Conditions

Groundwater was encountered in BH 4 at a depth of approximately 6.7m. Water used for rock coring techniques prevented the measuring of groundwater during the process of rock coring. It should be noted however, that fluctuations in the level of groundwater might occur due to variations in rainfall and/or other factors.

5.0 LABORATORY TESTING

Recovered rock cores from all boreholes were returned to our NATA accredited laboratory for testing. The testing carried out on the rock samples was the Point Load Strength Index Test. The Point Load Strength Indices for the rock cores and the assessed rock strengths, in accordance with Australian Standards (Reference 1), are summarised in the following table, Table 2.

Borehole	Depth (m)	Diametral I _{s(50)} (MPa)	Axial I _{s(50)} (MPa)	Assessed Strength
1	5.75	NT	0.50	М
1	6.31	NT	0.25	L
1	6.69	NT	0.72	М
1	7.22	NT	0.54	М
2	7.32	0.16	0.38	М
2	7.76	0.21	0.60	М
2	8.25	0.36	0.46	М
2	8.67	0.38	0.56	М
2	9.25	0.48	0.72	М
2	9.93	0.06	0.56	М
3	7.85	0.17	0.44	М
3	8.29	0.10	0.33	М
3	8.75	0.33	0.36	М
3	9.14	0.15	0.40	М
3	9.84	0.25	0.89	М
3	10.14	0.13	0.59	М
4	7.58	0.10	0.03	VL
4	8.47	0.45	0.28	М
4	9.38	0.27	0.13	L
5	7.85	0.35	0.61	М

 Table 2: Point Load Strength Test Results

5	8.32	0.64	0.63	М
5	8.73	0.31	0.30	М
5	9.20	0.35	0.38	М
5	9.87	0.38	0.48	М
5	10.43	0.23	0.55	М

Notes: Units are in metres (m) Not Tested (NT) VL – Very Low Strength L – Low Strength M – Medium Strength

Based on the rock core strengths (Table 2) and the rock discontinuities (shown in the core logs), the bedrock from the proposed development site is classified for foundation design purposes in accordance with Pells et al (Reference 2) as detailed in Table 3

Borehole	Depth	Rock Classification							
Dorenoie	(m)	(Reference 2)							
1	4.00 - 7.55	Class IV							
2	4.50 - 10.30	Class IV							
3	7.00 - 10.43	Class IV							
	7.65 - 8.38	Class V							
4	8.38 - 9.42	Class IV							
-	9.42 - 9.65	Class V							
	9.65 - 9.95	Class IV							
	7.72 - 9.26	Class IV							
5	9.26 - 9.37	Class V							
	9.37 - 10.84	Class IV							

 Table 3: Rock Classification

6.0 COMMENTS AND RECOMMENDATIONS

6.1. Existing Fill Materials

Fill material was encountered at each borehole location comprising asphaltic concrete, concrete and road base pavement materials within BH1, BH2, BH3 & BH4. Fill within BH5 was poorly compacted and comprised sand, clay and gravels. We note that the existing roads do not form part of the development and as such, for design purposes, the pavement materials may be neglected for the purposes of this report.

6.2. Excavation Conditions

Based on the limited drawings provided, excavation is proposed for two basement levels with a possibility of a third basement level being excavated. As such, it is expected that excavations will extend to depths of between about 6.0m and 9.0m below existing ground surface levels.

Excavations will encounter limited fill materials and natural clays, extremely weathered shale and clayey shale and low to medium strength shale bedrock.

Excavations of these materials may be achieved using conventional earthmoving equipment such as excavators or dozers.

Trafficability problems may arise locally during wet weather, or if water is allowed to pond on these materials. However as seepage was encountered during augering of the overburden soils and weathered bedrock in BH4 at a depth of 6.7m, we do anticipate some groundwater seepage into the proposed excavations. It should be noted however, that groundwater conditions of a site might change with climatic and other factors. It is our assessment that groundwater inflow during excavation, if any, may be adequately handled by a conventional sump and pump system without impacting on regional groundwater levels.

6.3. Retaining Structures and Batter Slopes

Materials likely to be encountered during excavation are likely to comprise minor fill, natural clays, possibly with some interbedding of ironstone and shale. Very steep or vertical faces could not be maintained in these materials. Excavations in these materials would need to be appropriately battered or retained by engineered retaining structures prior to excavation.

For unsupported cuts in these materials, up to a height of about 2.0m, the recommended batter slopes are presented in the following Table 4.

	Temp	orary	Permanent				
Material	(Horizonta	l : Vertical)	(Horizontal : Vertical)				
	Exposed	Protected	Exposed	Protected			
Fill & clays	1.5:1.0	1.0:1.0	2.5:1.0	2.0:1.0			

Table 4: Recommended Batter Slopes For Unsupported Cuts (not exceeding 2m in height)

Surface protection of the cut slope can be provided by shotcrete. If required, the shotcrete may be reinforced. Adequate surface and sub-surface drainage must be provided to prevent the build-up of hydrostatic pressures behind the installed shotcrete.

Temporary surface protection may also be provided by means of covering with plastic sheeting. It should be noted however, that the plastic sheeting should extend at least 2m behind the crest of the cut face, augmented with a v-drain near the crest of the cut face to divert all surface runoff from the cut face.

As excavation progresses, the cut faces should be inspected by a Geotechnical Engineer or Engineering Geologist, to assess localised shotcreting requirements, batter slope stability and to assess the suitability of recommended parameters for the design of retaining structures.

However, we note that it is anticipated that the majority of site excavations will extend to site boundaries and as such, insufficient area will be available to batter the majority of proposed excavation faces. Batter slopes, steeper than those recommended above would need to be retained by engineered retaining structures prior to excavation. Appropriate retaining structures would comprise either contiguous pile or discrete soldier pile walls, installed prior to excavation and in-filled with concrete panels to form the wall during excavation. Retaining walls may be socketed into and founded in medium strength or better shale bedrock, as a cantilever wall, below the bulk excavation level.

The pressure distribution on such retaining structures may be assumed to be triangular and estimated as follows:

$$p_h = \gamma kH + qk$$

Where,

 $p_{h} = \text{Horizontal pressure } (kN/m^{2})$ $\gamma = \text{Wet density } (kN/m^{3})$ $k = \text{Coefficient of earth pressure } (k_{a} \text{ or } k_{o})$ H = Retained height (m)

q = Surcharge pressure behind retaining wall (kN/m^2)

For the design of flexible retaining structures, where some lateral movement is acceptable, an active earth pressure coefficient is recommended. Should it be critical to limit the horizontal deformation of a retaining structure, use of an earth pressure

coefficient at rest should be considered. Recommended parameters for the design of retaining structures are presented in the following Table 5.

Founding Material	Unit Weight (kN/m ³)	Active Earth Pressure Coefficient	Passive earth pressure	At rest earth pressure Coefficent	
Fill	18	0.50	Ignore	0.60	
Natural Overburden Soils – Stiff Consistency	18	0.40	Ignore	0.55	
Natural Overburden Soils – Hard Consistency	20	0.25	Ignore	0.40	
Shale Bedrock, weathered, low and medium strength	20	0.20	200kPa	0.30	

 TABLE 5: Design Parameters For Retaining Structures

The foregoing coefficients assume that the ground level behind the retaining structures is horizontal and the retained material is effectively drained.

The design of any retaining structure should be checked for bearing capacity, overturning, sliding and overall stability of the slope.

Should the retaining structures be anchored or strutted, the earth pressure may be assumed to be rectangular and estimated as 5.5H kPa for the residual soil profile and 4H for the Class V shale bedrock, where H is the retained height.

Should retained soil be subject to groundwater pressure, additional earth pressure resulting from groundwater should be allowed for in the design.

A qualified Structural Engineer should check the design of any retaining structures for bearing capacity, overturning, sliding and overall stability of the slope.

Surcharge loading from neighbouring structures (if present) should also be taken into account in the design of retaining structures should it be within the zone of influence of the excavation. The zone of influence is defined as a plane projected from the toe of the excavation into the excavation face upwards towards the ground surface at 45 degrees from horizontal.

Where permanent retaining structures have not been provided to retain the excavation, the building wall at the lower ground floor level should be designed to provide permanent support to the excavation faces.

6.4. Floor Slabs

"Uncontrolled" fill was encountered in BH5 only, there is a potential that these materials may be encountered at other locations at existing ground surface levels. However, we anticipate that the majority of the site will be excavated to depths of between about 6.0m and 9.0m below existing ground surface levels, exposing extremely weathered shale bedrock or better. Concrete infill slabs may be utilised at these depths.

If isolated ground bearing slabs are required at existing ground surface levels, existing uncontrolled fill materials must be excavated and replaced in a "controlled" manner to form a platform for support of the ground bearing slabs. The existing fill material is considered suitable for reuse as "Controlled" fill provided all over size, deleterious and other demolition refuse is sieved and removed prior to reuse and subject to appropriate moisture conditioning.

If ground floor slabs are bearing on varying materials of distinct types (controlled fill and bedrock or residual clays and bedrock) differential settlement of the slabs is likely to occur unless a very rigid slab is used. Therefore, we recommend that where varying subgrade materials are exposed across the footprint of ground bearing slabs, these materials should be over-ripped to a depth of 0.3m, mixed to homogenise and recompacted to a minimum dry density ratio of 100% standard within 2% of optimum moisture content (OMC).

Ground bearing slabs founded on constructed fill platforms (by replacement of suitable portions of the existing "uncontrolled" fill) may be designed for a Modulus of Subgrade Reaction value of 15kPa/mm

6.5. Footings

Based on the limited documentation provided, we anticipate that footings for the proposed building will need to bear on shale bedrock. We anticipate that shale bedrock will be exposed at or near bulk excavation level. As such, shallow or deep footings below bulk excavations are considered suitable for the proposed development.

Shallow or deep footings founded and socketed a minimum of 0.3m into the respective classes of shale bedrock may be designed for the serviceability end bearing capacities detailed in Table 6.

Founding Material	Serviceability End Bearing Capacity
Shale (Class V)	600kPa
Shale (Class IV)	1000kPa

 TABLE 6: Serviceability End Bearing Capacity of Footings.

Likewise, bored shoring piers, comprising discrete soldier piers or contiguous piles founded and socketed into at least Class IV shale bedrock or better, may be design for a vertical loading of 1000kPa end bearing.

We recommend that bored piers are socketed at least 0.3m into the respective rock class, in order to confirm that the recommended serviceability end bearing capacity has been achieved.

It should be noted that a zone of influence of 1.5 times the pile diameter or minimum footing dimension is to be considered for foundation design. Therefore, should the zone of influence of footings extend between rock classes, the lower of the rock class should be adopted.

The total settlement of piers and shoring piers founded in shale bedrock under the recommended serviceability end bearing capacity is estimated to not exceed about 1% of the minimum footing dimension or pier diameter and the differential settlements are estimated to be about half of the estimated total settlements.

It is recommended that all footings are founded below and outside the zone of influence of excavations.

It must be noted however, that foundations pertaining to the same structure are to be founded on similar materials to minimise the potential for differential movement.

7.0 LIMITATIONS & GENERAL COMMENTS

The assessment of the sub-surface profile at the proposed development site and the recommendations presented in this report are based on information from five boreholes drilled at client nominated locations. Significant differences in geotechnical conditions occur across the site and as such, there is a possibility that the actual geotechnical conditions across the site could differ from the inferred geotechnical model (on which our recommendations are based) presented in this report. Groundwater seepage was only encountered in one of the boreholes during augering in the overburden soils and weathered bedrock. There is however, a possibility that groundwater levels or minor seepage could be encountered during excavation.

We recommend that this office is contacted immediately for further advice if the subsurface and groundwater conditions encountered during construction vary from those presented in this report.

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

For and on behalf of Aargus Engineering

Reviewed by

Adrian Collins Geotechnical Engineer

Dlufutt

Matthew Cupitt BSc (App Geol) Senior Engineering Geologist

APPENDICES

Appendix A

Figure 1 Site Plan Engineering Logs Core Logs of Boreholes Core Box Photographs

APPENDIX A

Figure 1 – Site Plan

Borehole Logs

Cored Logs of Boreholes

Core Photographs

Site Plan





Job No:	GS2948
Hole No:	BH 1
Sheet	1 of 3

	Client: Capital Insight Limited Test Location: Refer to Fig 1												
Project: Lifehouse at RPA								Test	Test Method: Truck Mounted Drill Rig				
	Project Location: Missenden Road, Camperdown								Coordinates: - Logged by: мс				
								Surfa	ice Le	vel:Existing Date:6/10/09			
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification	Descr AC: 110 mm CONCRETE: 200mm	iption		Moisture Condition	Consistency/ Rel. Density	Additional Comments Pavement	Depth (m)		
	DS				FILL: Roadbase, Ash and	Clay							
		0.5		CI-CF	CLAY: medium - high plas grading to pale grey	sticity,	pale orange	M > Wp	St - VSt	Residual	0.5		
		1.0									1.0		
					Interbedded SHALE / IRO					V-bit refusal at 1.3m	\square		
		1.5			very low - low strength, pa	ale gre	y and red brown				1.5		
		1.5									1.5		
											Щ		
		2.0									2.0		
		2.0									2.0		
											$\left - \right $		
		2.5									2.5		
		2.0									2.0		
											\square		
		3.0									3.0		
					SHALE: very low - low s	trenat	h, dark grev. DW			Bedrock	$\left - \right $		
							, <u>.</u> , <u>.</u>						
		3.5									3.5		
Exp	lanatory No	otes	:	I	1			1	1	1			
	<u>nsistency</u>				Density Index	<u>Sam</u>			Moist				
VS	Very Soft	Sof	t		VL Very Loose L Loose	B D	Bulk Sample Disturbed Sample			ry oist			
S F	Firm				MD Medium Dense		Undisturbed Sample	•	W V				
St	Stiff				D Dense		(50mm diam.)			lastic Limit			
VSt			f		VD Very Dense	Ν	S.P.T. Value		-	quid Limit			
н	Hard												



 Job No:
 GS2948

 Hole No:
 BH 1

 Sheet
 2 of 3

_	Client: Capital Insight Limited Test Location: Refer to Fig 1													
	ject:				Life	house at RPA			Test Method: Truck Mounted Drill Rig					
Pro	ject Loca	tion:			Mis	senden Road, Camper	down		Coordinates: - Logged b Surface Level:Existing Date:6/10					
									Surfa	ice Le	vel:Existing	Date:6/10/09		
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification		Descrij	ption		Moisture Condition	Consistency/ Rel. Density	Additional	Comments	Depth (m)	
		4.0			SH	ALE: low - medium stre	ngth,	dark grey, DW			Moderate to Resistance f		4.0	
											TC Bit refusa	al at 5.7m	<u> </u>	
Dry						Refer to Cor	ed B⊦	l Log					\vdash	
		6.0											6.0	
		0.0											0.0	
		65											6.5	
		6.5											0.0	
													\square	
		7.0											7.0	
Exp	lanatory N	otes	:								1		\square	
	<u>isistency</u>					nsity Index	<u>Sam</u>			Moist	ure			
vs		Very Soft VL Very Loose B Bulk Sample								ry				
S	Soft				L	Loose	D	Disturbed Sample			oist			
F	Firm					Medium Dense Dense	U50	Undisturbed Sample	•	W N				
St VSt	Stiff Very	Stif	f		D VD	Very Dense	N	(50mm diam.) S.P.T. Value			lastic Limit quid Limit			
1400	. v c i y	Jul			• U		1.4			*** LI	gaia Littill		- 1	



Job No: GS 2948 Hole No: BH 1 Sheet: 3 of 3

Aargus AUSTRALIA CORELOG OF TEST HOLE

	ent:						Capital Insight Limited						Hole	Cor	nme	nced: 6/10/2009	
	ojec						Lifehouse at RPA Limited									ted: 6/10/2009	
Pro	ojec	t Lc	catio	n:			Missenden Road, Camperdown						Supe Chec			y: MC	
Dri		ode	ŀ				Slope:	90°					Chec			rface: Existing	
							•	50								-	
Ba	rrel	Тур	e/L	enç	gth:		NMLC Bearing:	-						Dat	tum:		
D	rillin	<u> </u>	form	atic	n		Rock Substance	-					1			Rock Mass Defects	_
Method	Case - Lift	Groundwater	Samples /		Depth (m)	Graphic Log	Substance Description	Weathering	EL VL Estimated M Strength EVH			ls(50) MPa	30 100 Defect	300 1000 Spacing	Defect Description	Depth (m)	
					5.5		Started Coring at 5.7 m SHALE: Grey	Fr					0.50				5.5
N M L C					<u>5.0</u> <u>5.5</u> 7.0		STIALL. Grey						0.25			5.93 - Subvertical Fracture 6.27 - Fracture 45° 6.4 - Subvertical Fracture	6.0
					7.5		End Of Borehole at 7.55m						0.34			7.3 - Fracture 45°	7.5 8.0 8.5
AS AD R W NM	AD Auger Drilling Barrel withdrawn water level R Roller / Tricone date shown					Casing used Barrel withdrawn water level date shown Water inflow Partial drilling water loss	Weat Fr SW DW XW	the	Fre Sliq Dis	sh ghtly	tly V	athered /eather weather	ed	EL VL L M H VH	Low 0 Medium 0 High 1	Pa < 0.03 03 - 0.1 .1 - 0.3 .3 - 1.0 .0 - 3.0 0 - 10.0 >10.0	



Job No:	GS 2948
Hole No:	BH 2
Sheet	1 of 3

Clie	ent:				Capital Insight Limited	Test	Locat	ion: Refer to Fig 1			
	ject:				Lifehouse at RPA					od: Truck Mounted Drill Rig	
Pro	ject Locat	tion	:		Missenden Road, Campe	rdown			dinate		ML
								Surfa	ice Le	evel:Existing Date:7/10/09)
Groundwater								Moisture Condition	Consistency/ Rel. Density	Additional Comments	Depth (m)
				-	AC: 100mm thick				-	Pavement	
	DS				Concrete: 200mm thick Roadbase: Gravels					Basecourse	
	DS			CI	CLAY: medium plasticity,			M≥	St	Subbase	
		0.5		CI	CLAY: medium plasticity,	orange	e brown	Wp	St	Residual	
	DS	0.5						vvp			0.5
			1								
				CI	CLAY: medium plasticity,	pale g	rey mottled	M =	St -		
		1.0	1		yellow		-	Wp	VSt		1.0
				CI	CLAY: medium plasticity,			M<	Н		
		1.5			yellow and brown with sor gravels	ne we	athered shale	Wp			1.5
		-			graveis						
		-									
			1								
		2.0]								2.0
		0.5									
		2.5									2.5
											Н
			1								Н
		3.0									3.0
											\square
		<u> </u>								V Bit Refusal at 3.3m	\vdash
		<u> </u>			SHALE: brown and dark g	IRAV V	erv low			Bedrock	
		3.5			strength, XW	,.⊖y, v					3.5
			1								H
	lanatory N	otes	5:								
	<u>isistency</u>				Density Index	Sam			Moist		
vs						В	Bulk Sample			Dry	
S						Disturbed Sample		M M W V	loist		
						Undisturbed Sample (50mm diam.)	;		vet Plastic Limit		
	/St Very Stiff VD Very Dense N S.P.T. Value								iquid Limit		
Н	Hard		•								
<u> </u>											



Job No:	GS 2948
Hole No:	BH 2
Sheet	2 of 3

Client:					Dital Insight Limited			Test	Locat	ion: Refer to	Fig 1	
Project:	:				house at RPA						unted Drill Rig	
	Location	:			senden Road, Camp	erdown		Coor	dinate	es: -	Logged by:	ML
					· · ·					evel:Existing	Date:7/10/09	
Groundwater Samples/	Field Tests Depth (m)	Graphic Log	Unified Classification		Des	cription		Moisture Condition	Consistency/ Rel. Density	Additiona	I Comments	Depth (m)
	4.0 4.0 4.5 5.0 5.0 6.0 6.0 6.0 6.5				ALE: dark grey black, ength							4.0 4.5 5.0 5.5 6.0 6.0 6.5 7.0
Dry	ton (Notor				Refer to C	orea Br	LOG					
Explanal Consiste	tory Notes	5 .		Don	<u>isity Index</u>	Sam	ماد		Moist	uro		
VS	-	Ft			Very Loose	<u>Sam</u> B	Bulk Sample			ure)ry		
-	Very Sof	I L								-		
S	Soft				Loose	D	Disturbed Sample			loist /ot		
F	Firm				Medium Dense	050	Undisturbed Sample	•	W W			
St	Stiff			D	Dense		(50mm diam.)		-	lastic Limit		
VSt	Very Stif	ff		VD	Very Dense	N	S.P.T. Value		WII	iquid Limit		
Н	Hard	•			,					.qa.a =		



CORELOG OF TEST HOLE

Clie				<u> </u>		-	Capital Insight L	imited						Holo	<u> </u>	mn	ne	aced: 7/10/2000		
Pro							Lifehouse at RP			Hole Commenced: 7/10/2009 Hole Completed: 7/10/2009										
			cati	on:			Missenden Road		own					Supe						
	, 							<i>·</i>						Chec						
Dril	II M	ode	1:						Slope:	90°				•				face: Existing		
Bar	Barrel Type / Length: NMLC Bearing: Drilling Information Rock Substance														Da	atur	n:			
Dr	illin			nati	on			Rock	Substance									Rock Mass Def	ects	
	ΪĤ	Groundwater	/ \$	sts	(L	Graphic Log				ing		Estimated	3	MPa	100	Delect	Spacing			(i
Method	Case - Lift	nndv	Samples	Field Tests	Depth (m)	phic				Weathering		Estimated	200		Ċ	a c	g			Depth (m)
Met	Cas	0 U	San	lel	Cep	Gra	Subs	tance Descrip	tion	Nea	<u>ы</u> .	- ZuZi		ls(50)	200	300		Defect Desc	ription) ep
-	Ŭ	Ŭ	0,		7.0	-		Coring at 7.			П		ÍΪ	1-	Ĩ	Ť				7.0
							SHALE: dark gr			Fr	11									
				[_							0.38		Ш				
																Ш	I.			
					7.5											Ш	I.			7.5
																Ш	I.	7.6 - Fracture 6	50°	
				ŀ										0.60		Ш	I.			
				ŀ	_											Ш	I.			
				ŀ	0.0											Ш	I.			
				ŀ	8.0											Ш	I.			8.0
				ŀ	_									0.46		Ш				-
Ν				ŀ										0.40		Ш	I.	8.38 - Crushed		
м				ŀ												Ш	I.	Seam 2mm thi	ck	
L					8.5											Ш	Ъ			8.5
С				ľ										0.56						
				ľ																
				ľ																
				ſ	9.0															9.0
														0.72						
					_															
				ŀ	9.5											н		9.44 - Joint 60°		9.5
				ŀ	_										L	63		9.67 - Fracture 9.68 - XW Sea		-
				ŀ	-										H.	11		5 mm thick		
				ŀ	-									0.56				9.71 - Joint, Cu	irved	
				ŀ	10.0									0.00		H		Slicken sides	nveu,	10.0
				ŀ	10.0											Ш	I.	9.79 - Joint, Cu	rved.	10.0
				ľ												Ш	I.	Slicken sides	,	
				ľ																
							End of	Borehole at	10.3m		11	П		I		ΠĪ				
				-	10.5															10.5
Key	- Me	etho	d	1			Case - lift			Weat	the	ring		1			Stre	l ength	ls (50) MF	Pa
AS		Aug	er So	rew	ina		Casing used			Fr		Fresh					FI	Extremely Low		< 0.03
AD			er Di				Barrel withdrawn	water le	evel	SW			/ WP	athered				Very Low		3 - 0.
R		-	er / T		-			date sh		DW		• •		Veather			L	Low		3 - 0. 1 - 0.:
w							xw			-	weather			M	Medium		3 - 1.0			
	NMLC NMLC Core Drill Partial drilling water loss										2.9		54			High		0 - 3.0		
	HQ Wireline Core Drill Complete drilling water loss																Very High		- 10.0	
,		Q Wireline Core Drill Complete drilling water loss																Extremely High		>10.0

Job No: GS 2948 Hole No: BH 2 Sheet: 3 of 3



 Job No:
 GS 2948

 Hole No:
 BH 3

 Sheet
 1 of 4

Clie	ent:				Capital Insight Limited		Test Location: Refer to Fig 1						
	ject:				Lifehouse at RPA			Test	Metho	od: Truck Mounted Drill Rig			
Pro	ject Locat	ion:			Missenden Road, Camper	rdown			dinate	<u> </u>	AC		
								Surfa	ace Le	evel:Existing Date:9/10/09			
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification	AC: 60mm thick			Moisture Condition	Consistency/ Rel. Density		Depth (m)		
					CONCRETE: 180MM thick	<							
	DS				ROADBASE: Gravels						\vdash		
		0.5		ı CI-C⊦	SILTY CLAY: medium to h	nigh pl	asticity, orange	M≥	St		0.5		
	ES/DS				red	0 1	<i>,</i> , ,	Wp					
	DS			CI-C⊦	AS ABOVE but pale grey	and re	ed						
		1.0									1.0		
	DS	<u> </u>		CI	SILTY CLAY: medium plas	sticity	nale arey and	M≥	VSt -		\vdash		
	00				orange	Sticity	pale grey and	Wp	St		\vdash		
								¹¹			\square		
		1.5									1.5		
											\square		
	DS	2.0			INTERBEDDED SHALE /					V Bit Refusal at 2.0m	2.0		
	03				CLAY: red brown and pale						\vdash		
						gicy					\square		
		2.5									2.5		
											\square		
											\square		
		2.0									2.0		
		3.0									3.0		
											\square		
											\square		
		3.5									3.5		
	langta: P												
	lanatory No <u>isistency</u>	otes	-		Density Index	Sam	nles		Moist	liro			
vs	Very	Sof	t		VL Very Loose	B	Bulk Sample)ry			
s	Soft		-		L Loose	D	Disturbed Sample			loist			
F	Firm				MD Medium Dense	U50	Undisturbed Sampl	е	W V	Vet			
St	Stiff				D Dense		(50mm diam.)		-	Plastic Limit			
VSt	-		f		VD Very Dense	Ν	S.P.T. Value		WI Li	iquid Limit			
Н	Hard												



Job No:	GS 2948
Hole No:	BH 3
Sheet	2 of 4

Clier						Dital Insight Limited	-		Test	Locat	tion: Refer to Fig 1	
Proj						house at RPA			Test	Metho	od: Truck Mounted Drill Ri	g
	ect Loca	tion			Mis	senden Road, Camper	rdown		Coor	dinate	es: - Logged by:	AC
									Surfa	ace Le	evel:Existing Date:9/10/0)9
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification		Descri	iption		Moisture Condition	Consistency/ Rel. Density	Additional Comments	Depth (m)
	DS	4.0			AS	ALE: brown and grey, I	and bi				Bedrock	4.0 4.0 4.5 5.0 5.0 6.0 6.0 6.5 6.5 7.0
Expl	anatory N	otes			met	dium strength, DW-XW			I	I	resistance	
	sistency	5.03	•		Den	sity Index	Sam	ples		Moist	ture	
VS	Very	Sof	ť			Very Loose	B	Bulk Sample			Dry	
s	Soft				L	Loose	D	Disturbed Sample			loist	
F	Firm				_	Medium Dense		Undisturbed Sample	2	W V		
	Stiff				D	Dense	0.50	(50mm diam.)	,			
St			f		-		N			-	Plastic Limit	
VSt	Very		ľ		۷V	Very Dense	Ν	S.P.T. Value		VVI L	iquid Limit	
Н	Harc	1										



Job No:	GS 2948
Hole No:	BH 3
Sheet	3 of 4

Clie				-		pital Insight Limited			Test	Locat	ion: Refer to Fig 1	
Proj	ject:					ehouse at RPA			Test	Metho	od: Truck Mounted Drill Rig	
Proj	ject Locat	ion:			Mis	senden Road, Campere	down		Coor	dinate	es: - Logged by:	AC
									Surfa	ice Le	vel:Existing Date:9/10/09)
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification		Descrip	ption		Moisture Condition	Consistency/ Rel. Density		Depth (m)
					As	ABOVE					Medium TC bit	\square
											resistance	\vdash
												\square
		7.5										7.5
Dry						Refer to Cored	Boreł	nole Log				
												\square
		8.0										8.0
												\square
		8.5										8.5
												\vdash
												\square
												\square
		9.0										9.0
												\square
												\vdash
		9.5										9.5
		###										10.0
												10.0
												Ш
		###										10.5
Expl	lanatory N	otes	:	<u> </u>	I				1	1	1	
	sistency				Den	nsity Index	<u>Sam</u>	ples		<u>Moist</u>	ure	
vs	Very	Sof	t		VL	Very Loose	в	Bulk Sample			Pry	
S	Soft				L	Loose	D	Disturbed Sample			loist	
F	Firm					Medium Dense	U50	Undisturbed Sample	9	W W		
St VSt	Stiff Very	Stif	f		D VD	Dense Very Dense	N	(50mm diam.) S.P.T. Value		-	lastic Limit iquid Limit	
H	Hard				۷U	VOLY DELISE				991 L		
<u> </u>												


CORELOG OF TEST HOLE

Cli	ent:						Capital Insight Limited						Hole	e C	on	nme	nced: 9/10/2009	
Pro	ojec	t:					Lifehouse at RPA						Hole	e C	on	nple	ted: 9/10/2009	
Pro	ojec	t Lo	cat	ion:			Missenden Road, Camperdown						Supe	er١	/ise	ed b	y: AC	
								_					Che					
	II M						Slope:	90°						F	R.L	. Su	rface: Existing	
Ва	rrel	Тур	be /	Ler	ngth		NMLC Bearing:	-						0)at	um:		
Di	rillin		for	mat	ion		Rock Substance		-					+			Rock Mass Defect	is I
p	Case - Lift	Groundwater	les /	Field Tests	(m)	Graphic Log		Weathering		100000 it 0		strengtn	MPa		Defect	Spacing		(ш
Method	ase	roun	Samples	ield ⁻	Depth (m)	iraph	Cultatores Description	/eath	I.				ЕН s(50)		00	300 1000		u Depth (m)
2	0	0	S	ш		U	Substance Description	5	H	<u>₹</u> . ∏	<u>,∑:</u>	Ī	<u>≞ ∽</u>	30	-		Defect Descripti	on 🖸
					7.5		Start Coring at 7.50m											7.5
					7.67		CORE LOSS 0.17m		-									
					7.71		SHALE:dark grey with light grey laminae	Fr									7.76 - Joint 45°	
1						*****	and iron indurated bands		Π	Π		Π	0.44	ŀ	Π	Π		
					8.0		SHALE: dark grey with light grey laminae									Ш		8.0
													0.33	,		Ш		
													0.55	Ί				
N M					8.5													8.5
L													0.36	5				
С																		\vdash
	9.0				9.0													9.0
													0.40	1				-
1					9.5													9.5
1																		
1													0.89)				
1					10.0								0.59)				10.0
1																		
1																		
					10.5													10.5
							End of Borehole at 10.43m		Ш	ĻÏ						ļÏ		
	/ - M						Case - lift	Weat	the	erin	g					St	rength Is (50) MPa
AS		Aug			-		Casing used	Fr			esh		4	-1			Extremely Low	< 0.03
AD R		Aug Roll		rillin Tricc	-		Barrel withdrawn water level date shown	SW DW			-	-	eathereo Weathe		1		. Very Low Low	0.03 - 0.1 0.1 - 0.3
W		Was			nie		Water inflow	XW				-	weathe			M	Medium	0.1 - 0.3 0.3 - 1.0
	LC				Drill		Partial drilling water loss			-^	a UII	iory	und	וס ו	-	н	High	1.0 - 3.0
					e Dri		Complete drilling water loss										l Very High	3.0 - 10.0
																	Extremely High	>10.0

Job No: GS 2948 Hole No: BH 3 Sheet 4 of 4



 Job No:
 GS 2948

 Hole No:
 BH 4

 Sheet
 1 of 4

Clie	ent:				Capital Insight Limited	Test	Locat	ion: Refer to Fig 1	
	ject:				Lifehouse at RPA	Test	Metho	d: Truck Mounted Drill Rig	
Pro	ject Locat	ion			Missenden Road, Camperdown		dinate		MC
						Surfa	ice Le	vel:Existing Date:8/10/09	
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification	Description	Moisture Condition	Consistency/ Rel. Density	Additional Comments	Depth (m)
	DS			-	AC: 55mm thick CONCRETE: 190mm thick ROADBASE/ASH	_	-	Pavement	
		0.5	C	I-CH	CLAY: medium to high plasticity, orange red	M> Wp	St	Residual	0.5
	DS								
	DS	1.0		CI	CLAY: medium plasticity, pale grey and white	M> Wp	VSt - St		1.0
		1.5							1.5
					INTERBEDDED SHALE AND CLAY: very low			V bit refusal at 1.6m	
					strength, pale grey and red brown with ironstone layers				
		2.0							2.0
		2.5							2.5
		3.0							3.0
		3.5							3.5
Exn	lanatory N	L otes	 :			1	1	1	
	isistency				Density Index Samples		Moist	ure	
vs	Very	Sof	t		VL Very Loose B Bulk Sample			Iry	
s	Soft				L Loose D Disturbed Sample			oist	
F	Firm				MD Medium Dense U50 Undisturbed Sample	9	W V		
St	Stiff	o			D Dense (50mm diam.)		-	lastic Limit	
VSt H	Very Hard		Γ		VD Very Dense N S.P.T. Value		VVI Li	iquid Limit	



Job No:	GS 2948
Hole No:	BH 4
Sheet	2 of 4

Clie		_ ` `			Capital Insight Limited	Bon		Test	Locat	ion: Refer to Fig 1	
	ject:				Lifehouse at RPA					od: Truck Mounted Drill Rig	
	ject Locat	ion			Missenden Road, Cam	perdown		Coor	dinate	es: - Logged by:	MC
								Surfa	ice Le	evel:Existing Date:8/10/09)
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification		scription		Moisture Condition	Consistency/ Rel. Density	Additional Comments	Depth (m)
		4.0			AS ABOVE		DW with very			Bedrock	4.0
•		6.0 6.5 7.0			low strength bands					Groundwater seepage encountered at 6.7m	6.0 6.5 7.0
	lanatory N <u>sistency</u> Very Soft Firm Stiff	Sof			Density IndexVLVery LooseLLooseMDMedium DenseDDense	<u>Sam</u> B D U50	<u>ples</u> Bulk Sample Disturbed Sample Undisturbed Sampl (50mm diam.)	е	M M W W)ry loist	
VSt H			f		VD Very Dense	Ν	S.P.T. Value			iquid Limit	



Job No:GS 2948Hole No:BH 4Sheet3 of 4

Clie	ent:					pital Insight Limited			Test	Locat	ion: Refer to Fig 1	
Pro	ject:				Life	house at RPA			Test	Metho	od: Truck Mounted Drill Ri	g
Pro	ject Loc	ation	:		Mis	senden Road, Camper	down		Coor	dinate	es: - Logged by:	MC
			-		-				Surfa	ice Le	vel:Existing Date:8/10/0)9
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification		Descri	ption		Moisture Condition	Consistency/ Rel. Density	Additional Comments	Depth (m)
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		8.0										8.0
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		0.0	1									0.0
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	lanatory	Notes	s:		D	a ita la da v	0			N		
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vs S	Sof		i i			Loose	D	Disturbed Sample			loist	
F	Firi					Medium Dense		Undisturbed Sample)	W V		
St	Stil				D	Dense		(50mm diam.)			lastic Limit	
VSt		y Stil	ff		VD	Very Dense	Ν	S.P.T. Value			iquid Limit	
Н	Ha											



NQ,HQ Wireline Core Drill

Complete drilling water loss

3.0 - 10.0

>10.0

VH Very High

EH Extremely High

CORELOG OF TEST HOLE Client: Capital Insight Limited Hole Commenced: 8/10/2009 Project: Lifehouse at RPA Hole Completed: 8/10/2009 Project Location: Missenden Road, Camperdown Supervised by: AC Checked by: Drill Model: Slope: 90° R.L. Surface: Existing Barrel Type / Length: NMLC Bearing: Datum: -**Drilling Information** Rock Substance Rock Mass Defects Spacing Groundwater MPa Graphic Log Estimated Weathering Defect Field Tests Strength Depth (m) Case - Lift E Samples / Method Depth (s(50) Substance Description Defect Description 7.0 7.0 Start Coring at 7.10m SHALE: light and dark grey EW 0.03 7.5 7.6-XWS, 40mm thick SW-7.75-Joint, 45° Fr 7.81-Joint, 45° Ν 7.85-Joint 45° 8.05-Joint, 45° 8.0 Μ 8.0 L 8.12-Joint, 45° С 8.20-CS, 5mm thick 8.28-Joint 45° & CS 0.28 5mm thick 8.5 8.38-Joint, 20° 8.5 8.6-Joint, 45° SHALE: dark grey with light grey laminae and iron indurated bands 8.72-Joint,45° 9.0 9.0 SHALE: dark grey with light grey 9.08-Joint, 50° laminae 0.13 9.42-Joint, 45° 9.48-Joint, 45° 9.5 9.5 9.51-Joint, 45° MW-9.6-Joint, 45° SW 9.65-Joint, 45° FR 10.0 10.0 End of Borehole At 9.95m Key - Method Case - lift Weathering ls (50) MPa Strength AS Auger Screwing Casing used Fr Fresh EL Extremely Low < 0.03 AD Auger Drilling Barrel withdrawn water level SW Slightly weathered VL Very Low 0.03 - 0.1 0.1 - 0.3 R Roller / Tricone date shown DW **Distinctly Weathered** L Low w xw 0.3 - 1.0 Washbore Water inflow Extremely weathered М Medium Partial drilling water loss NMLC NMLC Core Drill 1.0 - 3.0 H High



 Job No:
 GS 2948

 Hole No:
 BH 5

 Sheet
 1 of 5

Clie					Capital Insight Limited			Test	Locat	ion: Refer to Fig 1	
	ject:				Lifehouse at RPA					od: Truck Mounted Drill Rig	
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Groundwater	// sts	<u>ج</u>	Graphic Log	Unified Classification					Consistency/ Rel. Density		Ē
	ples	h h	hic	ed sific				ture	siste Der		u) h
Grot	Samples/ Field Tests	Depth (m)	Grap	Unified Classific	Descri	intion		Moisture Condition	Cons Rel. I	Additional Comments	Depth (m)
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	ES				FILL: Silty Sand: brown ar		t brown with	М			
		0.5			ironstone and shale grave	15					0.5
		0.0									0.0
		1.0			FILL: Silty Clay: dark bro	wn wi	th sandstone and	M ≥			1.0
		1.0			ironstone gravels, med			Wp			1.0
					_						
	DS		C	H-CI	SILTY CLAY: medium to h	• •	•	M =	St -		
		1.5			grey and orange brown wi medium to high plasticity	ith Iro	nstone gravels,	Wp	VSt		1.5
		1.5			inediatin to high plasticity						1.5
		-									
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		_									
		3.0									3.0
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S	Soft				L Loose	D	Disturbed Sample			loist	
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VSt		Stif	f		VD Very Dense	N	S.P.T. Value		-	iquid Limit	
н	Hard				-						



Job No:	GS 2948
Hole No:	BH 5
Sheet	2 of 5

Clie	-	_1 \			Capital Insight Limited					ion: Refer to I		
	ject:				Lifehouse at RPA					od: Truck Mou		
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								Surfa	ice Le	vel:Existing	Date:12/10/0	9
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification	Descri AS ABOVE	ption		Moisture Condition	Consistency/ Rel. Density	Additional	Comments	Depth (m)
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					gravels							
		4 5										4.5
		4.5										4.5
		5.0										5.0
										V Bit Refusa	l at 5.4m	
	DS	5.5			SHALE: grey brown, low s	strengt	h, XW to DW			Bedrock		5.5
		6.0										6.0
		6.5										6.5
												Щ
												\vdash
	DS				SHALE: dark grey, low to	mediu	m strength, SW					
		7.0										7.0
	lanatory No	otes	:		Development	0						
Con VS	<u>sistency</u> Very	Sof	ŧ		Density Index VL Very Loose	<u>Sam</u> B	<u>pies</u> Bulk Sample		Moistu D D	<u>ure</u> ry		
vs S	very Soft	301	ι		L Loose	D	Disturbed Sample			oist		
F	Firm				MD Medium Dense		Undisturbed Sample	;	W W			
St	Stiff				D Dense		(50mm diam.)		-	lastic Limit		
VSt		Stif	f		VD Very Dense	Ν	S.P.T. Value		WI Li	quid Limit		
Н	Hard											



 Job No:
 GS 2948

 Hole No:
 BH 5

 Sheet
 3 of 5

Clie						al Insight Limi				Test	Locat	ion: Refer to	Fig 1	
Pro						use at RPA				Test	Metho	d: Truck Mo	unted Drill Rig	
Proj	ect Locat	ion			Misse	nden Road, (Camperc	lown		Coo	dinate	es: -	Logged by:	AC
										Surf	ace Le	vel:Existing	Date:12/10/0	9
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification			Descrip	otion		Moisture Condition	Consistency/ Rel. Density	Additiona	I Comments	Depth (m)
		<u> </u>			AS AE	BOVE								
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	sistency				Density	<u>y Index</u>		Sam	oles		<u>Moist</u>	ure		
vs	Very	Sof	t			ery Loose		в	Bulk Sample			iry		
S	Soft					oose		D	Disturbed Sample	1		oist		
F	Firm					edium Dense		U50	Undisturbed Samp	le	W Wn D			
St VSt	Stiff Very	Stif	f			ense ery Dense		N	(50mm diam.) S.P.T. Value			lastic Limit iquid Limit		
H	Hard					Jy Dense		14			VVI (_			
<u> </u>														



CORELOG OF TEST HOLE

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					ngth		NMLC Bearing:	-						D	atu	m:			
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	ff	Groundwater	/	ts	(Graphic Log		ng		ated	th		MPa		ect	Spacing			
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M													0.50						
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																11	Sides 9.31-Joint 45°		
					9.5									H	1		9.37-Joint 45°,	Slicken	9.5
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					10.0														10.0
													0.55						
					10.5														10.5
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AS		Aug	er S	Crev	/ina		Casing used	Fr		Fre	sh					F	Extremely Low	e	0.03
AD		Aug			-		÷.	SW				wea	athered				Very Low		- 0.1
R		-		Tricc	-		date shown	DW		-	-		/eathere			L	Low		- 0.3
W		Was	shbc	re			Water inflow	XW		Ext	rem	ely v	weather	ed		м	Medium	0.3	- 1.0
		NM					Partial drilling water loss									н	High		- 3.0
NQ	,HQ	Wire	eline	Cor	e Dri	II	Complete drilling water loss										Very High		10.0
																ΙEΗ	Extremely High		>10.0



CORELOG OF TEST HOLE

			_0	G	Ur		ESTHOLE			1			1 40/40/000	1
	ent: ojec						Capital Insight Limited Lifehouse at RPA						iced: 12/10/2009 ed: 12/10/2009	9
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	<u> </u>		Jour	1011.							ked l			
Dri	II M	ode	el:				Slope:	90°					face: Existing	
Ba	rrol	Tvr) a	ام	ngth		NMLC Bearing:	_			Datu	ım.	_	
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-		<u> </u>				b		_	ğ	ø		1		
	Ξ	wat	s /	sts	я)	Lo		ring	Estimated Strength	MPa	Defect	Spacing		Ê
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Method	Case - Lift	Groundwater	Samples /	Field Tests	Depth (m)	Graphic Log	Substance Description	Weathering	U V V V V V V V V V V V V V V V V V V V	ы Is(50)	30 100	0000	Defect Descr	Depth (m)
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N														
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, tey								""Cdl	lioning				-	5 (00) mi a
AS		Aug			-		Casing used	Fr	Fresh				Extremely Low	< 0.03
AD R		Aug Roll			-		Barrel withdrawn water level	SW	Slightly we				Very Low Low	0.03 - 0.1
к W		Koll Was			пе		date shown Water inflow	DW XW	Distinctly V Extremely			L M	Low Medium	0.1 - 0.3 0.3 - 1.0
		NMI			Drill		Partial drilling water loss		Exactionally		54		High	1.0 - 3.0
NQ	,HQ	Wire	eline	Cor	e Dri	II	Complete drilling water loss					VH	Very High	3.0 - 10.0
												EH	Extremely High	>10.0



GS 2948 – BH 1 (5.70m – 7.55m)



GS 2948 - BH2 (7.00m - 10.24m)



GS 2948 - BH 3 (7.50m - 10.43m)



GS 2948 - BH 4 (7.10m - 9.95m)



GS 2948 – BH 5 (7.72m – 10.84m)





E5: Geotechnical Investigation Report 2

Prepared by Aargus Pty Ltd (June 2010)



Environmental - Remediation - Engineering - Laboratories - Drilling

GEOTECHNICAL INVESTIGATION REPORT

LIFEHOUSE AT RPA

MISSENDEN ROAD CAMPERDOWN

Prepared for

Lifehouse at RPA C/- Capital Insight Pty Ltd

Report No. GS2948/1-B 15th June 2010

HEAD OFFICE: PO Box 398 Drummoyne NSW 1470

Telephone: 1300 137 038 Facsimile: 1300 136 038 Email: admin@aargus.net Website: www.aargus.net Aargus Pty Ltd ACN 063 579 313 Aargus Engineering Pty Ltd ACN 050 212 710 Aargus Laboratories Pty Ltd ACN 086 993 937

Other office locations in NSW - QLD - VIC - SA and 4 overseas countries

15th June 2010

GS2948/1-B AC:MC

Lifehouse at RPA C/- Capital Insight Pty Ltd Level 6, 77 Berry Street <u>NORTH SYDNEY NSW 2060</u> Email: <u>phill.castle@capitalinsight.com.au</u>, <u>elisabeth.wallace@capitalinsight.com.au</u>

ATTENTION: Mr. Phill Castle and Ms Elizabeth Wallace

Dear Sir and Madam,

RE: Proposed Lifehouse at RPA Facility Missenden Road, Camperdown Further Geotechnical Investigation

This report presents and interprets the findings of the geotechnical investigation carried out at the subject site, known as the Page Chest Pavillion and Brown Street Outpatient Buildings in Missenden Road, Camperdown. The investigation was carried out between 10th May 2010 and 26th May 2010. The geotechnical site investigation was commissioned by Miss Elisabeth Wallace from Capital Insight Pty Ltd, and was carried out in general accordance with the Aargus Engineering fee proposal dated 12th April 2010.

The purpose of the geotechnical investigation is to assess the existing site conditions in order to provide recommendations from a geotechnical viewpoint for the design and construction of the proposed Lifehouse facility.

It is understood that the proposed development involves the demolition of the existing structures within the site and construction of a new multi level facility with nine levels above ground and three basement levels. Formation of the basement levels is expected to entail excavations of up to 14m deep.



Based on the results of this investigation, it is considered that the subject site is **suitable** for the proposed development, in accordance with the recommendations provided in this report.



EXECUTIVE SUMMARY

The purpose of the geotechnical investigation undertaken by Aargus Engineering was to assess the existing site conditions in order to provide recommendations from a geotechnical viewpoint for the design and construction of the proposed development.

Materials expected to be encountered to the base of the proposed excavations for the development are likely to comprise residual silty clays with some ironstone and shale layers overlying shale at a depth of between about 3.3m and 6.2m below existing ground surface levels.

Excavation of materials overlying the bedrock profile may be achieved using conventional earthmoving equipment such as bulldozers and excavators. A 30 tonne excavator may readily excavate into the shale bedrock to depths of between about 6m and 8m below existing ground surfaces levels. Considerable difficultly excavating with such a machine alone may be encountered below these depths, however, excavation in conjunction with heavy ripping from a bulldozer will readily achieve excavation to bulk excavation levels of up to 14m below existing ground surface levels.

Excavation of isolated sections of high strength bedrock may require the use of excavator mounted vibratory rock breaking equipment. Test hammering combined with vibration monitoring in the presence of a Geotechnical Engineer/Engineering Geologist should be carried out at the time of commencement of hammering and periodically throughout excavation to confirm that induced vibrations in surrounding structures do not exceed acceptable vibration limits detailed in this report.

For excavations in topsoil, natural residual clayey sands, distinctly weathered bedrock, batter slopes (if appropriate subject to set-back distances from site boundaries) should conform to that presented in Table 6 of this report. Recommended parameters for the design of retaining structures are presented in Table 7.

We anticipate that bedrock will be exposed at bulk excavation level within the proposed development. As such, to minimise the potential for differential settlement, all footings must be taken to found on bedrock of similar bearing characteristics as that exposed. Footings socketed a nominal 0.3m into Class III shale bedrock may be designed for an allowable bearing pressure of 2000kPa.



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0

15/06/2010

Initial Issue

Issued By:

Adrian Collins BE (Civil & Enviro) DipEngPrac Geotechnical Engineer Date: 15/06/2010

Matthew Cupitt BSc (App Geol) Senior Engineering Geologist



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LIST OF APPENDICES

- APPENDIX A IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL REPORT
- APPENDIX B BOREHOLE LOCATION PLAN (FIGURE 1) &

SITE LOCALITY MAP (FIGURE 2)

- APPENDIX C ENGINEERING BOREHOLE LOGS
- APPENDIX D CORE BOX PHOTOGRAPHS
- APPENDIX E LABORATORY RESULTS



1.0 INTRODUCTION

This geotechnical site investigation was commissioned by Miss Elizabeth Wallace of Capital Insight Pty Ltd, on behalf of Lifehouse at RPA, owner of the site, and was carried out in general accordance with the Aargus Engineering fee proposal dated 12th April 2010. This investigation was carried out in addition to our previous geotechnical assessment of the site referenced GS2948-A and dated 19th October 2009.

2.0 **OBJECTIVES**

The purpose of this further geotechnical investigation is to determine details of the site's surface and subsurface conditions in order to provide supplementary advice and recommendations from a geotechnical viewpoint for the design and construction of the proposed Lifehouse Building to complement the information obtained from the initial geotechnical investigation conducted in October 2009, addressing the requirements of the geotechnical brief prepared by SCP Consulting Pty Ltd. This investigation includes the following:

- Method of investigation.
- Surface and sub-surface conditions.
- Results of Laboratory testing, including CBR value, pH, chlorides and sulfates.
- Groundwater conditions, groundwater level and management, if encountered.
- Excavation conditions.
- Temporary and Permanent batter slopes for excavations in rock if appropriate.
- Provision of earth pressure parameters for design of retaining structures.
- Appropriate footings including footing types, founding depths, serviceability bearing pressures and anticipated settlements.
- Recommendations on earthworks and subgrade preparation.
- Vibration control, management, and monitoring accompanied by appropriate excavation techniques.
- Site specific "Subsoil Class" for Earthquake Design in accordance with AS1170.4.
- Any other relevant geotechnical recommendations and design parameters.
- Recommendations on supplementary geotechnical investigation following demolition of Building 14 occupying the northern portion of the site.



3.0 SCOPE OF WORKS

Fieldwork for this geotechnical investigation was carried out between 10th May 2010 and 26th May 2010 by our drilling crew and supervised by a Geotechnical Engineer from Aargus Engineering, and comprised the following:

- A detailed walk-over inspection of the site by a Geotechnical Engineer/ Engineering Geologist.
- Drilling of four (4) boreholes, at locations as near as possible to client nominated locations. The boreholes were drilled using a truck-mounted drill rig fully equipped for geotechnical investigations, in order to identify the subsurface soil and rock profile. The boreholes were drilled initially using a V-bit attached to solid flight augers to refusal in bedrock, and further continued using a T-C bit in the weathered shale bedrock. The boreholes were then advanced into the Shale bedrock using NMLC diamond rock coring techniques to depths of about 20m.
- Standard Penetration Tests (SPT) at regular depth intervals during drilling within each borehole in the overburden soils to assess the in-situ soil strength.
- Recovered rock cores were carefully boxed on site and returned to our laboratory for testing.
- Concrete coring at the location of BH9.
- Collection of two (2) representative soil samples from approximate subgrade level of external paved areas for laboratory Californian Bearing Ratio (CBR) testing.
- Testing of recovered soil samples in the overburden soil profile to assess its aggressivity to steel and concrete structures, and hence exposure classification for piles
- Installation of one (1) standpipe in BH 8.
- Reinstatement of the boreholes with the displaced soils.

The encountered subsurface materials and their relative strengths have been recorded and logged as Engineering Borehole Logs and are attached in Appendix C of this report. The approximate borehole locations are shown on the attached site plan referenced Figure 1 in Appendix B. The locality map of the subject site is attached and referenced Figure 2, also in Appendix B.



4.0 AVAILABLE INFORMATION

4.1. Document Review

At the time of preparation of this report, the following documentation was made available to us:

- A Geotechnical brief, referenced 2010-076-PS, dated 1st April 2010, prepared by SCP Consulting Pty Ltd.
- An architectural drawing titled 'Ground Floor Plan', referenced Project No. 08500, Drawing No. SK 107 revision B, prepared by Rice Daubney, dated 4th May 2010
- A detailed survey prepared by Whelans Insites Pty Ltd, titled 'Plan Showing Detail and Levels Royal Prince Alfred Hospital Camperdown', referenced Job Ref G163SC Sheet 1 of 2 and Sheet 2 of 2, dated 28th October 2009.

4.2. Proposed Development

Upon review of the above listed documents, we now understand the following:

- The proposed development involves the construction of the Lifehouse Building, which will have up to nine-storeys above ground and will contain three levels of below-ground basement.
- The proposed building will be linked by sub-ground tunnels to the adjacent oncology building to the west, King George V Building to the north and the main RPA campus to the east.
- The site is bounded by Salisbury Road to the north, Susan Street to the west, Brown Street to the south and Missenden Road to the east.
- A multi-storey building "Page Chest Building" (Building 14) occupies the northern portion of the site.
- The "Brown Street Outpatients Building" located in the southern portion of the site had been demolished since our geotechnical investigation fieldwork in October 2009.
- The lowest excavation level is at RL23.60m
- The bulk excavation level for Level 3 is RL28.20m at the northern end of the site.



 Proposed foundations comprising piles are to be founded and socketed into Class II and Class III rock.

4.3. Location

The site is located centrally within Camperdown. More specifically, it is located on the western side of Missenden Road, about 75m north of the intersection between Carillon Avenue and Missenden Road. The locality map of the subject site is attached in Appendix B and referenced Figure 2.

4.4. Regional Geology

Reference to the Sydney 1:100,000 Geological Series Sheet 9130 Edition 1, 1983 indicates that the site is underlain by Ashfield Shale (Rwa) of the Wianamatta Group, which comprises black to dark grey shale and laminite.

The Soil Landscape Map of Sydney, Series Sheet 9130, Second Edition, indicates that the site is underlain by Blacktown Group Soils pertaining to a Residual Landscape. Blacktown Group Landscape is described as gently undulating rises on Wianamatta Group shales and Hawkesbury sandstones. Local relief to 30m, slopes are usually <5%. Broad rounded crests and ridges with gently inclined slopes. Cleared eucalypt woodland and tall open forest. The soils are described as shallow to moderately deep (<100cm) Red and Brown Podzolic soils on crests, upper slopes and well drained areas, deep (150-300cm) Yellow Podzolic soils and Soloths on lower slopes and in areas of poor drainage.

5.0 FINDINGS OF INVESTIGATION

The findings of this geotechnical investigation are summarised in the following sections.

5.1. Site Description

The site is near rectangular in shape, covering an area of approximately 4160m², and measures approximately 104m along the Eastern (Missenden Rd) and Western Boundaries (Susan Street), and approximately 40m along the Northern (Salisbury Road) and Southern (Brown Street) boundaries. The northern half of the footprint of the proposed development is currently occupied by the multi storey "Page Chest Pavilion", which is currently



undergoing demolition works and the southern half of the site is vacant as the previous single storey brick building had been demolished.

5.2. Sub-Surface Conditions

Subsurface conditions encountered within the boreholes are detailed on the attached Engineering Logs, presented in Appendix C of this report. The subsurface conditions encountered have been summarised as follows:

PAVEMENT (BH9 only)	ASPHALTIC CONCRETE, to depths of about 0.07m (BH9), underlain by
	CONCRETE, to depths of about 0.27m (BH9), underlain by,
	ROADBASE, to depths of about 0.37m (BH9), underlain by,
RESIDUAL	Silty CLAY: medium to high plasticity, pale orange , orange and pale grey, to depths of between about 0.37m (BH9) and 2.5m (BH7), underlain by,
	Silty CLAY: medium plasticity, pale grey and orange brown, interbedded with ironstone and shale gravel layers, to depths of between about 3.3m (BH6) and 6.2m (BH7), underlain by,
BEDROCK	SHALE, extremely weathered, very low strength, brown and pale grey, to depths of between about 4.5m (BH6) and 6.6m (BH7), overlying,
	SHALE, distinctly weathered to slightly weathered, low to medium strength, dark grey, to borehole termination depths of between about 19.9m (BH9) and depths 20.2m (BH6).

The following should also be noted:

• BH 7 encountered uncontrolled, poorly compacted fill comprising silty sandy clay to a depth of about 0.5m below existing ground surface levels.



Depth (m)	BH 6	BH 7	BH 8	BH 9
Approx. Surface RL	~ 35.92m	~ 36.85m	~ 36.10m	~ 35.40m
Asphaltic Concrete	NE	NE	NE	0 - 0.07
Concrete	NE	NE	NE	0.07 - 027
Roadbase	NE	NE	NE	0.27 - 037
Fill	NE	0 - 0.50m	NE	NE
Residual Clay	0.00 - 1.00	0.50 - 2.50	0.00 - 1.30	0.37 - 1.00
Interbedded Clay & Shale/Ironstone	1.00 - 3.30	2.50 - 6.20	1.30 - 4.30	1.00 - 5.60
VL St Shale	3.30 - 4.50	6.20 - 6.60	4.30 - 4.70	5.60 - 5.90
L-M St Shale	4.50 - 20.2+	6.60 - 20.1+	4.70 - 20.18+	5.90 - 19.86
V Bit Refusal	3.30	6.20	4.30	5.60
TC Bit Refusal	7.00	7.00	6.65	6.30
Borehole Termination Depth	20.2	20.1	20.18	19.86

Table 1: Summary of Soil and Rock Properties

Notes : Units are in metres (m)

Reduced Levels (RL) estimated from survey plan Not Encountered (NE) Very Low Strength (VL) Low to Medium Strength (L-M)

5.3. Groundwater Conditions

A standpipe piezometer was installed upon completion of drilling in BH8 to a depth of 20.18m. Groundwater levels were measured in BH 8 at depths detailed in Table 2 below:

Borehole	Date	Depth (m)	Approximate RL. (m)
8	26/05/10	13.98	~RL 23.02
8	17/06/10	2.8	~RL 34.20

Table 2: Groundwater Levels



It should be noted however, that fluctuations in the level of groundwater might occur due to variations in rainfall and/or other factors.

6.0 LABORATORY TESTING

6.1. Point Load Strength Test Results

Recovered rock cores from all boreholes were returned to our NATA accredited laboratory for testing. The testing carried out on the rock samples was the Point Load Strength Index Test. The Point Load Strength Indices for the rock cores and the assessed rock strengths, in accordance with Australian Standards (Reference 1), are summarised in the following table, Table 3.

Desichele	Depth	Diametral I _{s(50)}	Axial I _{s(50)}	Assessed
Borehole	(m)	(MPa)	(MPa)	Strength
	7.90	0.15	1.84	Н
	8.73	0.35	1.70	Н
	9.60	0.13	0.98	М
	10.50	0.30	0.60	М
	11.51	0.70	0.90	М
	12.58	0.06	0.57	М
6	13.84	0.02	0.63	М
	14.76	0.04	0.58	М
	15.72	0.06	0.27	L
	16.55	0.06	0.47	М
	17.87	0.11	0.72	М
	18.54	0.12	0.78	М
	19.78	0.38	1.32	Н
7	6.80	0.19	1.13	Н
	7.72	0.11	0.86	М
	8.82	0.11	0.42	М
	9.72	0.02	0.48	М
	10.80	0.17	0.54	М
	11.77	0.23	0.91	М
	12.68	0.05	0.91	М
	13.61	0.09	0.45	М
	14.83	0.11	0.43	М

Table 3: Point Load Strength Test Results



	15.87	0.320	0.20	L
	16.27	0.26	0.29	L
	17.50	0.20	0.43	М
	18.32	0.32	0.39	М
	19.63	0.21	0.31	М
	7.48	0.09	0.77	М
	8.87	0.21	0.62	М
	9.77	0.25	0.64	М
	10.80	0.13	0.44	М
	11.72	0.19	0.58	М
	12.72	0.13	0.19	L
8	13.83	0.32	0.29	L
	14.76	0.17	0.33	М
	15.80	0.03	0.32	М
	16.52	3.41	3.55	VH
	17.83	0.17	0.31	М
	18.62	0.01	0.18	L
	19.76	0.26	0.48	М
	6.84	0.32	0.24	L
	7.53	0.24	0.36	М
	8.90	0.21	0.40	М
	9.85	0.46	0.66	М
	10.52	0.43	0.84	М
	11.65	0.15	0.46	М
9	12.70	0.28	0.18	L
	13.60	0.21	0.02	L
	14.65	0.07	0.14	L
	15.62	0.15	0.40	М
	16.87	0.05	0.29	L
	17.73	0.02	0.31	М
	18.82	0.17	0.47	М
	19.45	0.11	0.30	М

Notes:

L – Low Strength

M – Medium Strength

- H High Strength
- VH Very High Strength



Based on the rock core strengths (Table 2) and the rock discontinuities (shown in the core logs), the bedrock from the proposed development site is classified for foundation design purposes in accordance with Pells et al (Reference 2) as detailed in Table 4

Borehole	Depth	Rock Classification
Dorenoie	(m)	(Reference 2)
6	7.00 - 9.50	Class IV
, v	9.50 - 20.20	Class III
7	6.18 - 20.10	Class III
8	6.65 - 20.18	Class III
9	6.30 - 8.20	Class IV
,	8.20 - 19.86	Class III

Table 4: Rock Classification

6.2. CBR Results

Recovered soil samples from two boreholes were returned to our NATA accredited laboratory for testing. The testing carried out on the soil samples was a California Bearing Ratio. The results are summarised in the following table, Table 4

		CBR Value (%)
Borehole	Depth (m)	2.5 / 5.0mm
		Penetration
7	0.5 - 1.0	3 / 3
8	0.2 - 0.5	9 / 12

Table 4 – Laboratory Test Results

6.3. Exposure Classification

Recovered soil samples from two boreholes were sent to SGS Australia. a NATA accredited laboratory for testing. The testing carried out on the soil samples was Chlorides, Sulphates and pH. The results are summarised in the following table, Table 5



Borehole	Depth	Chloride	Sulphate	pН
Dorenoie	(m)	(mg/kg)	(mg/kg)	(pH Units)
	0.1 - 0.6	13	46	5
8	1.0 - 1.2	9.1	82	5.3
Ŭ	1.4 - 1.7	3	22	5.7
	2.5 - 2.82	2.3	28	6.1
	0.4 - 0.6	2.9	47	4.9
9	1.0 - 1.45	3.7	33	4.8
	2.5 - 2.95	3.4	58	5.6
	4.0 - 4.23	4.1	130	5.5

Table 5: Laboratory Test Results

7.0 DISCUSSION & RECOMMENDATIONS

7.1. General

Based on the results of this investigation, we consider that subsurface conditions comprise residual silty clays and silty clays with interbedded ironstone and shale bands overlying shale bedrock. Depth to bedrock within the footprint of the proposed development is in the order of 3.30m to 6.20m below existing ground surface levels.

The proposed development involves the construction of the Lifehouse Building, which will have up to nine-storeys above ground and will contain three levels of belowground basement. The proposed building will be linked by sub-ground tunnels to the adjacent oncology building to the west, King George V Building to the north and the main RPA campus to the east.

A multi-storey building "Page Chest Building" (Building 14) occupies the northern portion of the site. The "Brown Street Outpatients Building" located in the southern portion of the site has been demolished since our geotechnical investigation fieldwork in October 2009.

The lowest excavation level is at RL23.60m. The bulk excavation level for Level 3 is RL28.20m at the northern end of the site.



7.2. Excavation Conditions and Vibration Control

Based on the limited drawings provided, excavation is proposed for three basement levels. It is expected that excavations will extend to depths of up to 14.0m below existing ground surface levels to RL of 23.60.

Materials expected to be encountered to the base of the proposed excavations for the development are likely to comprise residual silty clays with some ironstone and shale layers overlying shale at a depth of between about 3.3m and 6.2m below existing ground surface levels.

Excavation of materials overlying the bedrock profile may be achieved using conventional earthmoving equipment such as bulldozers and excavators. A 30 tonne excavator may readily excavate into the shale bedrock to depths of between about 6m and 8m below existing ground surfaces levels. Considerable difficultly excavating with such a machine alone may be encountered below these depths, however, excavation in conjunction with heavy ripping from a bulldozer will readily achieve excavation to bulk excavation levels of up to 14m below existing ground surface levels.

Excavation of isolated sections of high strength bedrock may require the use of excavator mounted vibratory rock breaking equipment. Test hammering combined with vibration monitoring in the presence of a Geotechnical Engineer/Engineering Geologist should be carried out at the time of commencement of hammering and periodically throughout excavation to confirm that induced vibrations in surrounding structures do not exceed acceptable vibration limits detailed following.

Induced vibrations in structures adjacent to the excavation should not exceed a Peak Particle Velocity (PPV) of 5mm/sec for structures in good condition, or 2mm/sec for structures in poor condition or heritage structures. If vibrations in adjacent structures exceed these PPV's or if vibrations appear excessive, this office should be contacted immediately for further advice.

Trafficability problems may arise locally during wet weather, or if water is allowed to pond on materials expected to be encountered during excavation. A groundwater level of



approximately ~ RL 23.02m was measured in BH8 after drilling and ~RL34.2m On 17^{th} June 2010. As such, we do anticipate minor groundwater seepage into the proposed excavations and if left to pond on the excavation surfaces, trafficability problems may arise.

It should be noted however, that groundwater conditions of a site might change with climatic and other factors.

7.3. Dewatering Conditions

The groundwater level in BH8 was measured upon completion of drilling at 13.98m (~RL 23.02) below existing ground surface levels . Groundwater had risen to 2.8m (~RL34.2) when measured on 17th June 2010. The proposed basement excavation is expected to be in the order of 14.0m deep. Therefore, groundwater will be encountered during excavation. However, due to the very slow recharge rate of the monitoring well, we anticipate that groundwater infiltration will be minor only and that dewatering of the excavation will be adequately handled by appropriately located sumps within the base of the proposed excavation. The sumps should be intermittently pumped to remove collected groundwater.

It should be noted that lowering of groundwater levels outside the site perimeters could adversely impact existing foundation conditions of adjacent structures, underground services and roads, due to settlement. To ensure that lowering of the groundwater table will not result in settlement of neighbouring structures, the following needs to be considered if inflow rates encountered are significant:

- Assessment of the rates of ground water inflow.. This information will be required by a specialist contractor to determine model parameters for assessment of the ground water draw down, ground water recharge rates and settlements of the subsurface soils within adjacent properties.
- Installation of a cut-off wall, such as a contiguous reinforced concrete retaining wall within the site boundaries or around the basement excavation, socketed into the underlying shale bedrock. Although this wall is considered a non-watertight retaining wall, under moderate ground water inflows, it can be made watertight by shotcrete placement between the piles. As some water seepage



through the wall of contiguous piles is unavoidable during the initial stage of construction, this system is not recommended where some water leakage (and some settlement) from the adjacent property is not acceptable in situations where high groundwater inflows are encountered.

- Lowering of the groundwater level by pumping prior to excavation. If required, a specialised contractor should design an appropriate pumping system using the information obtained by the standpipe piezometers and subsequent groundwater modelling.
- Alternatively, install a watertight permanent retaining wall, such as a secant grout injected pile wall or bentonite diaphragm wall, taken to found and socket into the underlying shale bedrock.

Consideration should be given to ground water movements subsequent to the installation of the cut off wall and long term affects of the changes to the ground water flows on adjacent properties around and down slope of the site.

7.4. Batter Slopes and Retaining Structures

Materials to be encountered during excavation are likely to comprise minor fill, natural clays, possibly with some interbedding of ironstone and shale. Very steep or vertical faces could not be maintained in these materials. Excavations in these materials would need to be appropriately battered or retained by engineered retaining structures prior to excavation.

For unsupported cuts in these materials, up to a height of about 3.0m, the recommended batter slopes are presented in the following Table 6.

Material	Temporary (Horizontal : Vertical)		Permanent (Horizontal : Vertical)		
	Exposed	Protected	Exposed	Protected	
Fill & clays	1.5:1.0	1.0:1.0	2.5:1.0	2.0:1.0	
Low strength	1.0:1.0	0.5:1.0	1.0:1.5	1.0:1.0	
Shale 1.0:1.0		0.3.1.0	1.0.1.5	1.0.1.0	

 Table 6: Recommended Batter Slopes For Unsupported Cuts

 (not exceeding 3m in height)



Temporary subvertical excavations in Class III shale may be considered appropriate upon inspection by a Geotechnical Consultant.

Surface protection of the cut slope can be provided by shotcrete. If required, the shotcrete may be reinforced. Adequate surface and sub-surface drainage must be provided to prevent the build-up of hydrostatic pressures behind the installed shotcrete.

Temporary surface protection may also be provided by means of covering with plastic sheeting. It should be noted however, that the plastic sheeting should extend at least 2m behind the crest of the cut face, augmented with a v-drain near the crest of the cut face to divert all surface runoff from the cut face.

As excavation progresses, the cut faces should be inspected by a Geotechnical Engineer or Engineering Geologist, to assess localised shotcreting requirements, batter slope stability and to assess the suitability of recommended parameters for the design of retaining structures.

The pressure distribution on such retaining structures may be assumed to be triangular and estimated as follows:

$$p_h = \gamma k H + q k$$

Where,

 $\begin{array}{ll} p_{h} & = \text{Horizontal pressure } (kN/m^{2}) \\ \gamma & = \text{Wet density } (kN/m^{3}) \\ k & = \text{Coefficient of earth pressure } (k_{a} \text{ or } k_{o}) \\ H & = \text{Retained height } (m) \\ q & = \text{Surcharge pressure behind retaining wall } (kN/m^{2}) \end{array}$

For the design of flexible retaining structures, where some lateral movement is acceptable, an active earth pressure coefficient is recommended. Should it be critical to limit the horizontal deformation of a retaining structure, use of an earth pressure coefficient at rest should be considered. Recommended parameters for the design of retaining structures are presented in the following Table 7.



Founding Material	Unit Weight (kN/m ³)	Active Earth Pressure Coefficient	Passive earth pressure	At rest earth pressure Coefficent
Fill	18	0.50	Ignore	0.60
Natural Overburden Soils – Stiff Consistency	18	0.40	Ignore	0.55
Natural Overburden Soils – Hard Consistency	19	0.25	Ignore	0.40
Shale Bedrock, weathered, low and medium strength	20	0.20	200kPa	0.30

Table 7: Design Parameters For Retaining Structures

The foregoing coefficients assume that the ground level behind the retaining structures is horizontal and the retained material is effectively drained.

The design of any retaining structure should be checked for bearing capacity, overturning, sliding and overall stability of the slope.

Should the retaining structures be anchored or strutted, the earth pressure may be assumed to be rectangular and estimated as 5.5H kPa for the residual soil profile and 4H for the Class IV and III shale bedrock, where H is the retained height.

Should retained soil be subject to groundwater pressure, additional earth pressures resulting from groundwater should be allowed for in the design.

A qualified Structural Engineer should check the design of any retaining structures for bearing capacity, overturning, sliding and overall stability of the slope.

Surcharge loading from neighbouring structures (if present) should also be taken into account in the design of retaining structures should the structure be within the zone of influence of the excavation. The zone of influence is defined as a plane projected from the toe of the excavation into the excavation face upwards towards the ground surface at 45 degrees from horizontal.


Where permanent retaining structures have not been provided to retain the excavation, the building walls below ground should be designed to provide permanent support to the excavation faces.

Where temporary batters as detailed above cannot be utilised during excavation, or it is undesirable to utilise such batter slopes, excavation faces must be retained prior to excavation. Suitable pre excavation retaining structures may comprise contiguously bored piled concrete retaining walls, secant bored pile retaining walls, diaphragm retaining walls or concrete soldier piled retaining walls with concrete infill panels. Soldier piles should not exceed a spacing of 3D.

Due to high angle jointing encountered within the boreholes during this investigation, we consider that all piles installed prior to excavation for pre-excavation retaining structures must extend below the base of bulk excavations to prevent founding on these adversely orientated jointed bedrock above the excavation base.

7.5. Floor Slabs

"Uncontrolled" fill was encountered in BH2 only, there is a potential that these materials may be encountered at other locations at existing ground surface levels. However, we anticipate that the majority of the site will be excavated to depths of up to 14m below existing ground surface levels, exposing extremely weathered shale bedrock or better. Concrete infill slabs may be utilised at these depths.

If isolated ground bearing slabs are required at existing ground surface levels, existing uncontrolled fill materials must be excavated and replaced in a "controlled" manner to form a platform for support of the ground bearing slabs. The existing fill material is considered suitable for reuse as "Controlled" fill provided all over-size, deleterious and other demolition refuse is sieved and removed prior to reuse and subject to appropriate moisture conditioning.

If ground floor slabs are bearing on varying materials of distinct types (controlled fill and bedrock or residual clays and bedrock) differential settlement of the slabs is likely to occur unless a very rigid slab is used. Therefore, we recommend that where varying subgrade



materials are exposed across the footprint of ground bearing slabs, these materials should be over-ripped to a depth of 0.3m, mixed to homogenise and recompacted to a minimum dry density ratio of 100% standard within 2% of optimum moisture content (OMC).

Ground bearing slabs founded on constructed fill platforms (by replacement of suitable portions of the existing "uncontrolled" fill) may be designed for a Modulus of Subgrade Reaction value of 15kPa/mm.

7.6. Footings

Based on the limited documentation provided, we anticipate that footings for the proposed building will need to bear on shale bedrock. We anticipate that shale bedrock will be exposed at or near bulk excavation level. As such, shallow or deep footings below bulk excavations are considered suitable for the proposed development.

Shallow or deep footings founded and socketed a minimum of 0.3m into the respective classes of shale bedrock may be designed for the serviceability end bearing capacities detailed in Table 8.

Founding Material	Serviceability End Bearing Capacity
Shale (Class V)	600kPa
Shale (Class IV)	1000kPa
Shale (Class III)	2000kPa

TABLE 8: Serviceability End Bearing Capacity of Footings.

Likewise, bored shoring piers, comprising discrete soldier piers or contiguous piles founded and socketed into at least Class III shale bedrock or better, may be designed for a vertical loading of 2000kPa end bearing with an ultimate shaft adhesion of 350kPa.

We recommend that bored piers are socketed at least 0.3m into the respective rock class, in order to confirm that the recommended serviceability end bearing capacity has been achieved.



It should be noted that a zone of influence of 1.5 times the pile diameter or minimum footing dimension is to be considered for foundation design. Therefore, should the zone of influence of footings extend between rock classes, the lower of the rock class should be adopted.

The total settlement of piers and shoring piers founded in shale bedrock under the recommended serviceability end bearing capacity is estimated to not exceed about 1% of the minimum footing dimension or pier diameter and the differential settlements are estimated to be about half of the estimated total settlements.

It is recommended that all footings are founded below and outside the zone of influence of excavations.

It must be noted however, that foundations pertaining to the same structure are to be founded on similar materials to minimise the potential for differential movement.

7.7. Pile Exposure Classification

Based on the results of laboratory testing, under AS2159-1995 the exposure classification for piles are found to be **Non Aggressive**.

7.8. Subsoil Class for Earthquake Design

Under AS1170.4- 1993, site specific subsoil class parameters are as follows:

- An acceleration co efficient (a) of < 0.09
- A site factor (S) for general structures of 0.67 where founded on shale bedrock.

7.9. Pavement Design

Based on the results of the laboratory testing, a subgrade CBR of 3% has been adopted for pavement thickness determination. We note that based on a CBR of 3% it is likely that subgrade replacement will be required to facilitate a suitable pavement for the proposed development



8.0 CONCLUSION

This report presents and interprets the findings of the geotechnical investigation carried out at the subject site, known as the proposed Lifehouse building at RPA, Missenden Road in Camperdown between 10th May 2010 and 26th May 2010.

The recommendations presented in this report are based on the following:

- Findings of the geotechnical investigation at the site comprising the drilling of four boreholes only.
- The geotechnical model developed based on the results of the geotechnical investigation and previous geotechnical investigation.
- Groundwater seepage may be encountered during the proposed excavations.
- The information presented in the architectural drawings.

Based on the results of findings, it is considered that the subject site is **suitable** for the proposed development, in accordance with the recommendations provided in this report.

For and on behalf of Aargus Engineering

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Adrian Collins BE (Civil & Enviro) DipEngPrac Geotechnical Engineer

Reviewed By

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Matthew Cupitt BSc (App Geol) Senior Engineering Geologist



LIMITATIONS

The assessment of the sub-surface profile within the proposed development area and the recommendations presented in this report are based on limited information from the excavation of four boreholes located within the proposed development footprint.

The recommendations and advice presented in this report on rock condition is considered to be indicative only. Site inspection by a consulting Geotechnical Engineer or Engineering Geologist are to be undertake at the time of excavation and upon encountering rock to confirm the rock conditions on which this geotechnical investigation report have been based.

The comments and recommendations provided in this report are provided on the basis that permanent groundwater seepage and/or groundwater table is present within the anticipated depth of excavation.

There is a possibility that the actual geotechnical conditions across the site could differ from the inferred geotechnical model (on which our recommendations are based) presented in this report. We recommend that this office is contacted immediately for further advice or if sub-surface and groundwater conditions encountered during excavation and construction vary from those presented in this report.



APPENDIX A

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL REPORT



IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

More construction problems are caused by site subsurface conditions than any other factor. As troublesome as subsurface problems can be, their frequency and extent have been lessened considerably in recent years, due in large measure to programs and publications of ASFE/ The Association of Engineering Firms Practicing in the Geosciences.

The following suggestions and observations are offered to help you reduce the geotechnicalrelated delays, cost-overruns and other costly headaches that can occur during a construction project.

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is based on a subsurface exploration plan designed to incorporate a unique set of project-specific factors. These typically include the general nature of the structure involved, its size and configuration, the location of the structure on the site and its orientation, physical concomitants such as access roads, parking lots, and underground utilities, and the level of additional risk which the client assumed by virtue of limitations imposed upon the exploratory program.

To help avoid costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of the report may affect its recommendations.

Unless your consulting geotechnical engineer indicates otherwise, your geotechnical engineering report should NOT be used:

• when the nature of the proposed structure is changed: for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an un-refrigerated one,

• when the size or configuration of the proposed structure is altered,

• when the location or orientation of the proposed structure is modified,

• when there is a change of ownership, or for application to an adjacent site.

Geotechnical engineers cannot accept responsibility for problems which may develop if they are not consulted after factors considered in their report's development have changed.

Geotechnical reports present the results of investigations carried out for a specific project and usually for a specific phase of the project. The report may not be relevant for other phases of the project, or where project details change.

The advice herein relates only to this project and the scope of works provided by the Client.

Soil and Rock Descriptions are based on AS1726-1993, using visual and tactile assessment except at discrete locations where field and/or laboratory tests have been carried out. Refer to the attached terms and symbols sheets for definitions.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

exploration identifies actual subsurface Site conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by geotechnical engineers who then render an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those inferred to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than a report indicates. Actual conditions in areas not sampled may differ from predictions. Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact. For this reason, most experienced owners retain their geotechnical consultants through the construction stage, to identify variances, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly changing natural forces. Because a geotechnical engineering report is based on conditions which existed at the time of subsurface exploration, *construction decisions should not be based on a geotechnical engineering report whose adequacy may have been affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions, and thus, the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

Subsurface conditions can change with time and can vary between test locations. Construction activities at or adjacent to the site and natural events such as flood, earthquake or groundwater fluctuations can also affect the subsurface conditions.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND PERSONS

Geotechnical engineers' reports are prepared to meet the specific needs of specific individuals. A report prepared for a consulting civil engineer may not be adequate for a construction contractor, or even some other consulting civil engineer. Unless indicated otherwise, this report was prepared expressly for the client involved and expressly for purposes indicated by the client. Use by any other persons for any purpose, or by the client for a different purpose, may result in problems.

No individual other than the client should apply this report for its intended purpose without first conferring with the geotechnical engineer. No person should apply this report for any purpose other than that originally contemplated without first conferring with the geotechnical engineer.

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professional develop their plans based on misinterpretations of a geotechnical engineering report. To help avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review the adequacy of their plans and specifications relative to geotechnical issues.

The interpretation of the discussion and recommendations contained in this report are based on extrapolation/interpretation from data obtained at discrete locations. Actual conditions in areas not sampled or investigated may differ from those predicted

BORING LOGS SHOULD NOT BE SEPARATED FROM THE ENGINEERING REPORT

Final boring logs are developed by geotechnical engineers based upon their interpretation of field logs (assembled by site personnel) and laboratory evaluation of field samples. Only final boring logs customarily are included in geotechnical engineering reports. These logs should not under any circumstances be redrawn for inclusion in architectural or other design drawings because drafters may commit errors or omissions in the transfer process. Although photographic reproduction eliminates this problem, it does nothing to minimize the possibility of contractors misinterpreting the logs during bid preparation. When this occurs, delays, disputes and unanticipated costs are the alltoo-frequent result.

To minimise the likelihood of boring log give contractors misinterpretation, ready access in the complete geotechnical engineering report prepared or authorized for Those who do not provide such their use. access may proceed under mistaken disclaiming impression that simply responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes which aggravate them to disproportionate scale.

READ RESPONSIBILITY

CLAUSES CLOSELY

Because geotechnical engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims lodged against geotechnical being consultants. To help prevent this problem, geotechnical engineers have developed clauses for use in model written transmittals. These are not exculpatory clauses designed to foist geotechnical engineers' liabilities onto someone else. Rather, they are definitive clauses which identify where geotechnical engineers' responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your geotechnical engineering report, and you are encouraged to read them closely. Your geotechnical engineer will be pleased to give full and frank answers to your questions.

OTHER STEPS YOU CAN TAKE TO REDUCE RISK

Your consulting geotechnical engineer will be pleased to discuss other techniques which can be employed to mitigate risk. In addition, ASFE has developed a variety of materials which may be beneficial. Contact ASFE for a complimentary copy of its publications directory.

FURTHER GENERAL NOTES

Groundwater levels indicated on the logs are taken at the time of measurement and may not reflect the actual groundwater levels at those specific locations. It should be noted that groundwater levels can fluctuate due to seasonal and tidal activities.

This report is subject to copyright and shall not be reproduced either totally or in part without the express permission of the Company. Where information from this report is to be included in contract documents or engineering specifications for the project, the entire report should be included in order to minimise the likelihood of misinterpretation.

APPENDIX B

BOREHOLE & IN-SITU TEST LOCATION PLAN (FIGURE 1) SITE LOCALITY MAP (FIGURE 2)



Site Plan



Site Locality



Reference: whereis.com.au (2010)

		Aargus	Environmental- Remediation- Engineering- Dr	rilling - Laboratories	
Drawn:	AC		Lifehouse at RPA		
Approved:	ML		C/- Capital Insight Pty Ltd		Figure 2
Date:	2/6/10		RPA Lifehouse Missenden Road, Camperdown	Action	
Scale:	NTS		Site Locality Map	Aargus	Job No: GS2948-B

APPENDIX C

ENGINEERING BOREHOLE LOGS &

PENETRATION RESISTANCE OF SOIL TEST REPORT – GRAPHIC





Job No:	GS2948-B
Hole No:	BH 6
Sheet	1 of 6

Clie		•		ehous		RPA			Test I	Locati	ion: Refer to Fig 1	
	ject:			A Life							od: Drill Rig	
	ject Location					Road, Camperdow	n		Coord	dinate	es: - Logged by: A	
									Surfa	ce Le	vel:Existing Date: 10/5/10)
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log				escript			Consistency/ Rel. Density		Depth (m)
		0.5		CI - CH				high plasticity, grey brown	M≥ Wp	St - F	RESIDUAL	0.5
	1, 1, 12 N = 13	1.5			In			AY: very low strength nd pale grey		St	Moderate V-bit resistance	1.5
	1,9,4/10mm	2.0		CI - CH				high plasticity, grey i ironstone gravels		VSt	Moderate - High V-bit resistance	2.0 2.5 3.0
-	Refusal N > 13	3.5			SH			wn, XW, VL-L strength sheet 2 of 6			V-bit refusal BEDROCK Bands of High TC bit resistance	3.5
	lanatory Notes <u>isistency</u> Very So Soft Firm Stiff Very St Hard	oft			VL L MD D	nsity Index Very Loose Loose Medium Dense Dense Very Dense	B D	nples Bulk Sample Disturbed Sample Undisturbed Sample (50mm diam.) S.P.T. Value		WW WpP	oist	



Job No:	GS2948-B
Hole No:	BH 6
Sheet	2 of 6

Clie	ent:		Life	ehouse	e at RPA	Test	Locat	ion: Refer to Fig 1
	oject:				house			od: Drill Rig
	ject Location				en Road, Camperdown		dinate	
	-				· ·			evel:Existing Date: 10/5/10
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification	Description Continued from sheet 1 of 6 SHALE: pale grey and brown, XW, VL-L strengt	u Moisture Condition	Consistency/ Rel. Density	Additional Comments
		4.0			grading to dark grey, DW, L strength			Low - Moderate TC-bit resistance
		5.5 6.0 6.5			grading to dark grey, SW-F, L-M strength			High - Very High TC bit resistance
		7.0			Refer to Cored Borehole Log Continued on sheet 3 of 6			TC bit refusal 7.0
	lanatory Notes	51			-			
	nsistency				Density Index Samples		<u>Moist</u>	
VS	Very So	oft			VL Very Loose B Bulk Sample)ry
S F	Soft				L Loose D Disturbed Sample			loist
F	Firm				MD Medium Dense U50 Undisturbed Sample D Dense (50mm diam)		W N	
St VSt	Stiff Vory St	iff			D Dense (50mm diam.) VD Very Dense N S.P.T. Value		-	Plastic Limit
VSt H	t Very St Hard	uπ			VD Very Dense N S.P.T. Value		VVIL	iquid Limit



	ent:		_00			EST NOLE						Lala	<u></u>		2000d:10/E/10		
	ent: bject					A Lifehouse					Hole Commenced:10/5/10 Hole Completed:13/5/10						
			catior	. .		ssenden Road, Camperdown									by: AC		
	Jee		Cation	ı.	IVIIC	senden Road, Gamperdown						Chec					
Dri	II M	ode	el:			Slo	ope:	90° R.L. Surface: Existing									
Ba	rrel	Tvr	be / Le	nath		NMLC Be	aring:	_					Da	tum)' -		
			forma		I		stance	_						tum: - Rock Mass Defects			
					_		stanoc			-				-		.013	
	μ	Groundwater	/	Ē	Graphic Log			ing		Estimated	gth	MPa	Defect	Spacing		-	
g	-	νpc	Tes	<u>د</u>	jc			her	:	stim	Strength		Det	Spa		2	
Method	Case - Lift	ino.	Samples / Field Tests	Depth (m)	apł			Weathering				s(50)	0	~8	8	ption	
ž	ő	ū	Sa Fie	ă	Ģ	Substance Description		Š	Ц,	<u>_∑</u> :	I I I I	ы Is(30 100	90 100 100	Defect Descri	ption	
						Continued from sheet 2 o	f 6										
				-													
				7.0		Start Coring at 7.0m										7.	
				7.0		SHALE: dark grey brown		XW									
						3 3 3 3											
															7.25m J, Sub \	/ert	
						CORE LOSS 0.40m											
				7.5												7.	
																_	
						SHALE: dark grey with light g	nrev	FR			+			_			
				8.0		laminae	JICY					1.84				8	
Ν				0.0												<u> </u>	
Μ																	
L																	
С																	
				8.5												8.	
				-								1.7					
												1.7				-	
				9.0												9.	
									-++		++						
						CORE LOSS 0.20m											
														_			
											++			_			
				9.5		CORE LOSS 0.10m					++	0.98		_		9.	
				-								0.90					
															9.86m J, 45°		
				10.0											Slicken Sides	10	
						Continued on sheet 4 of											
Key	' - Me	etho	d			Case - lift		Wea	theri	ng				S	trength Is	s (50) MPa	
AS		Aua	er Scre	wina		Casing used		Fr	Fr	esh				F	L Extremely Low	< 0.0	
AD						Barrel withdrawn water level		SW	SI	ightl		athered			L Very Low	0.03 - 0	
R			er / Trio	one		date shown		DW				veathere	d	L	Low	0.1 - 0	
W NM	V Washbore IMLC NMLC Core Drill					Water inflow Partial drilling water loss		HW EW				athered weather	ed	M H		0.3 - 1 1.0 - 3	
			eline Co			Complete drilling water loss			_/		,			V	H Very High	3.0 - 10	
														E	H Extremely High	>10	



	ent:					EST HOLE						T		<u></u>	m	nc	ncod:10/5/10		
	ojec					A Lifehouse							Hole Commenced:10/5/10 Hole Completed:13/5/10						
	-		cation			senden Road, Camperdowi	า										y: AC		
	.)			•			-						Checked by:						
Dri	II M	ode	1:				Slope:	90	0				R.L. Surface: Existing						
							-										-		
			e / Le			NMLC	Bearing:	-					Datum: - Rock Mass Defects						
	illin		forma	lion		Rock	Substance		T			T					Rock Mass De	erects	
	Ŧ	Groundwater	ts /		Graphic Log			bu		Estimated	gth		MPa	ţ	1.1	spacing			
p	- -	Ndv	les Tes	m)	lic L			Jeri		stim	trenç			Dofoct		spa			E)
Method	Case - Lift	JNO.	Samples / Field Tests	Depth (m)	aph			eatl		ш	S		s(50)		202	38			Depth (m)
ž	ő	ū	ы Т	ă	ū	Substance Descri		Š	Ц,	╧╶╌╴╴	M H Strength VH	Ξ	ls(30	300	000 000	Defect Desc	ription	ă
						Continued from she SHALE: dark grey with		FR		н					Н				
							riight grey				н.				Ш				
										н					Н				
				10.5						н			0.60		Н				10.5
										н					Н				
										н					Н		10.7m J, 45°		
										н					н		10.7111 J, 45		
				11.0						н					Н				11.0
										н					Н				
										н					Н				
										н					Н				
Ν				44.5						н			0.90		н				44.5
M				11.5						н			0.90		Н				11.5
L										н					н				
С										н					н				
										н					Ц		11.8m J, 80°		
				12.0						н							Slicken Sides	;	12.0
										н							11.95 J, 45° 12.05m J, Su	h Vort	
										н					п		Slicken Sides		
										н					н				
				12.5						н					Н				12.5
										н			0.57		н				
										н					н				
										н					н				
				13.0						н					н				13.0
															Ш		13.06m,XWS	,30mmt	
1						CORE LOSS 0.0)6m		Ц	Щ	μŢ	Щ		Ц	Щ				
				\vdash			10m	_	\square	╢	++	\parallel			\prod				
1				10 5		CORE LOSS 0.4	+UM												13.5
1				13.5		Continued on shee	et 5 of 6												13.5
Key	′ - Me	etho	t		\neg	Case - lift		We	ath	erin	g	11			+	Stre	ength	ls (50) M	Pa
AS		Δυσ	er Screv	wina		Casing used		Fr		Fres	:h					FI	Extremely Low	_	: 0.03
AS AD			er Drillir			Barrel withdrawn water	level	SW	' :	Sligh	ntly w		hered				Very Low		- 0.1
R			er / Tric	one			shown	DW	/ 1	Disti	inctly	we	athere	d		L	Low		- 0.3
W NM			shbore _C Core	Drill		Water inflow Partial drilling water loss		HW EW					nered eather	ed		M H	Medium High		- 1.0 - 3.0
			eline Co			Complete drilling water loss						,			,	VH	Very High	3.0 -	10.0
																EH	Extremely High	2	>10.0



	ent:		_00			EST HOLE							Hole	Co	mr	no	nced:10/5/10	
	ojec					A Lifehouse											ted:13/5/10	
			catio	า:		ssenden Road, Camperdowi	า						Supe					
						· •							Chec					
Dri	II M	ode	l:				Slope:	90'	0					R.	L.	Su	rface: Existing	
Ва	rrel	Тур	be / Le	ength	:	NMLC	Bearing:	-						Da	atu	ım:	-	
			forma			Rock	Substance				Rock Mass Defects							
		ter			g			5		eq	~		a	+	Ļ	bu		
	Lift	wa.	/ Si	Ê	c Lo			Bring		Estimated	ength		MPa	Defect	מומר	Spacing		(E
hoc	ė	nnc	h The	ţ,	phic			athe		Est	Stre		ô		ב	S		th (
Method	Case - Lift	Groundwater	Samples / Field Tests	Depth (m)	Graphic Log	Substance Descri	ption	Ve		Ľ,	M H Strength	ΞH	ls(50)	30	2 g	3000	Defect Descriptio	ے Depth (m)
	-	-				Continued from page			Π	T	TŤ	T		Ť	Ť	T	·	
							P 1 4			_	╆	_	0.00	\square		-	40.75 1.0 1.14	
						SHALE: dark grey with laminae	n light grey	FR					0.63				13.75m J, Sub Ve	rt
				14.0		aminac												14.0
				44.5														14.5
				14.5														14.5
													0.58					
N M				15.0													14.9m J, Sub Vert	15.0
Ċ																		
				15.5														15.5
													0.27					
													0.21					
				16.0														16.0
				_														
				16.5									0.47					16.5
				10.5									0.47				16.66 XWS, 20mn	
															L			
																	16.8m J, Sub Vert	
						CORE LOSS 0.07m			H	╉	╂╂	+		\mathbb{H}		+		
				17.0		Continued on pag	e 6 of 6		11									17.0
Key	/ - Me	etho	d	-		Case - lift		We	ath	erin	g	_	<u> </u>	11		Str	ength Is (50) MPa
AS		Aua	er Scre	wina		Casing used		Fr		Fres	sh					EI	Extremely Low	< 0.03
AD		Aug	er Drilli	ng		Barrel withdrawn water		SW	1	Slig	htly v		athered			VL	Very Low 0	.03 - 0.1
R W			er / Trio shbore	cone		date s Water inflow	shown	DW HW					eathered	d		L M	Low Medium	0.1 - 0.3 0.3 - 1.0
			_C Cor	e Drill		Partial drilling water loss		EW					veathered	əd		н	High	1.0 - 3.0
NQ	,HQ	Wire	eline Co	ore Dri	II	Complete drilling water loss												.0 - 10.0
L																ĿН	Extremely High	>10.0



Clie				01		EST NOLE					1	Hole	Co	mm	enco	ed:10/5/10		
Pro						A Lifehouse										:13/5/10		
	-		catior	:		senden Road, Camperdowr	า					Supe						
	-											Chec						
Dril	IM	ode	l:				Slope:	90 [°])				R.	L. S	Surfa	ce: Existing		
			be / Le			NMLC	Bearing:	-					Da	atun				
Dr	illin	g In	forma	tion		Rock	Substance	-							Ro	ck Mass De	fects	-
	t	ater	ູ່ທ		og			g	-	th ted		MPa	t	ing c	n			
σ	Case - Lift	Groundwate	Samples / Field Tests	Depth (m)	Graphic Log			ierir	:	Estimated Strength		Σ	Dafact	Spacing	5			Depth (m)
Method	se -	uno	ld n	pth	aph			eath	I	ŭ ŭ		s(50)						pth
Β	Ca	Ū	Sa Fie	De	ū	Substance Descri		Ň	<u>ц</u> ,	L Estimated M H Strength	ΗЦ	ls(30	300		Defect Desc	ription	De
						Continued from page SHALE: dark grey with		FR							17	7.2m J, 50°		
				<u> </u>			r light grey											
				17.5														17.5
												0.72						
				18.0														18.0
															18	3.16m J, 50		
				-											18	3.3m J, Un		
Ν				18.5												,		18.5
М												0.78						
L C																		
C																		
				19.0														19.0
															1			
																9.3m J, Un		
				19.5														19.5
												4 00						
				<u> </u>								1.32						
				20.0														20.0
															20)m J, Sub V	ert	
							1.00.00	_			\square			\square	Щ_			
						Borehole Terminated	at 20.20m											
				20.5														20.5
															\square			
Key	- Me	etho	d			Case - lift		Wea	ather	ing				S	Streng	th	ls (50) M	lPa
AS			er Scre			Casing used		Fr		esh						tremely Low	<	< 0.03
AD R			er Drillii or / Trio	•		Barrel withdrawn water		SW				thered	ч			ry Low		3 - 0.1
к W			er / Tric shbore	une		Water inflow	shown	DW HW		stinctly ghly w		athere	u	L		w edium		l - 0.3 3 - 1.0
			_C Core			Partial drilling water loss		EW				eathere	ed	Н) - 3.0
INQ,	ΠQ	vvire	eline Co	ie Dri	I	Complete drilling water loss										ery High tremely High		- 10.0 >10.0
L																,		



Job No:	GS2948-B
Hole No:	BH 7
Sheet	1 of 6

Cli	ent:				e at RPA	Test	locat	ion: Refer to Fig 1	
	oject:				house			od: Drill Rig	
	ject Location				en Road, Camperdown		dinate		١C
		-						vel:Existing Date: 13/5/10	
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification	Description	Moisture Condition	cy/ ity	Additional Comments	Depth (m)
		0.5		-	Silty Sandy CLAY: low to medium plasticity, dark brown and orange with concrete, bricks and woodchips	M≥ Wp	-	FILL Appears Poorly Compacted	0.5
	BS	1.0		CI - CH	Silty CLAY: medium to high plasticity, grey red and orange brown	M ≥ Wp	VSt	RESIDUAL	1.0
	3, 5, 8 N = 13	1.5							1.5
		2.0							2.0
		2.5							2.5
	3, 5, 17 N = 22				Interbedded Shale and CLAY: low strength orange brown and pale grey		Н	High V bit resistance	
		3.0		CI - CH	Silty CLAY: medium to high plasticity, grey mottled orange with ironstone gravels				3.0
		3.5			Continued over on page 2 of 6				3.5
-	olanatory Notes <u>nsistency</u> Very S Soft Firm Stiff t Very S Hard	oft			Density IndexSamplesVLVery LooseBBulk SampleLLooseDDisturbed SampleMDMedium DenseU50Undisturbed SampleDDense(50mm diam.)VDVery DenseNS.P.T. Value		М М W W Wp P	ry oist	



Job No:	GS2948-B
Hole No:	BH 7
Sheet	2 of 6

Cli	ent:		Life	ehouse	e at RPA	Test	Locat	ion: Refer to Fig 1	
Pro	oject:				house			od: Drill Rig	
Pro	oject Location	:	Mis	ssende	en Road, Camperdown		dinate		
						Surfa	ce Le	vel:Existing Date: 13/5/10)
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification	Description	Moisture Condition	Consistency/ Rel. Density		Depth (m)
		4.0			Continued from page 1 of 6 Silty CLAY: medium to high plasticity, grey mottled orange with ironstone gravels			RESIDUAL High - Very high V bit resistance	4.0
	2, 4, 5	4.0			Interbedded Shale and CLAY: low strength, orange brown and pale grey		St		4.0
-	N = 9	4.5							4.5
		5.0							5.0
	7, 8, 7	5.5					VSt		5.5
	N = 15	6.0						Very High V bit resistance	6.0
		6.5			SHALE: pale and dark grey, XW, VL - L strength			V bit refusal BEDROCK High - Very High TC bit resistance	6.5
					grading to dark grey, DW - SW, L - M strength			Very High TC bit resistance	
		7.0			Refer to Cored Borehole Log Contiuned on page 3 of 6			TC bit refusal	7.0
<u>Cor</u> VS S F	Soft Firm				Density IndexSamplesVLVery LooseBBulk SampleLLooseDDisturbed SampleMDMedium DenseU50Undisturbed Sample		M M W V	ry oist /et	
St VSt H	Stiff t Very St Hard	tiff			DDense(50mm diam.)VDVery DenseNS.P.T. Value			lastic Limit iquid Limit	



	ent:					ehouse at RPA					Hole (Com	mo	nced:13/5/10	
	ojec					PA Lifehouse								ted:18/5/10	
			ocatio	n:	Mis	ssenden Road, Camperdown	l				Super	vise	ed b		
											Chec				
Dri	ll M	ode	el:				Slope:	90°				R.L	Sı	urface: Existing	
Ва	rrel	Тур	be / L	engtl	n:	NMLC	Bearing:	-				Dat	tum	: -	
Dr	illin	g In	forma	tion		Rock	Substance							Rock Mass Defects	
		ter	4	,	bc			D	ted	ح	a	ਲ	ing		
0	Lift	dwa	es /	E E	С С			erin	Estimated	Strength	MPa	Defect	Spacing		(E)
Method	Case - Lift	Groundwater	Samples / Eield Tests	Depth (m)	Graphic Log			Weathering	ű	Sti	s(50)				Depth (m)
Me	Са	Ū	Sa	De	Ö	Substance Descrip		Ň	<u>srk</u>	I I I I I I I	ls(30 100		Defect Description	De
					-	Continued from pag Start Coring at 6.									
						SHALE: dark grey with		FR						6.28m XWS, 20mmt	
					1	laminae									
				6.5	ļ										6.5
					4										
											1.13				
					1										
				7.0	Į									7.00 1.45%	7.0
					-								а.	7.06m J, 45° Slicken Sides	
					1									Slicken Sides	
					1										
				7.5	4									7.40m J, 45°	7.5
					4						0.86			Slicken Sides	
											0.00				
					1										
				8.0	ļ										8.0
					4									8.15m J, Sub Vert	
						CORE LOSS 0.50m								o. ioni o, oub veit	╶┼╾┥
					1	Due to drilling equipment									
				8.5	ļ										8.5
					4										
											0.42				
					1										
				9.0	ļ										9.0
					-										
					1										
				9.5	1								н.	9.5m J, 45°	9.5
Kev	' - M	etho	d		I	Continued on page	94016	Wea	thering			Ш	Str	rength Is (50) N	MPa
									0					,	
AS AD		-	er Scro	•		Casing used Barrel withdrawn water	level	Fr SW	Fresh Slight		athered				< 0.03 3 - 0.1
R		Roll	er / Tri	cone		date s		DW	Distin	ctly w	eathered	ł	L	Low 0.1	1 - 0.3
W NM	LC		shbore LC Cor		I	Water inflow Partial drilling water loss		HW EW			thered weathere	ed	M H		3 - 1.0 0 - 3.0
			eline C			Complete drilling water loss						-	VH	Very High 3.0	- 10.0
													JE⊦	Extremely High	>10.0



		_00									Car		nced:13/5/10	1
Client: Projec					ehouse at RPA A Lifehouse								ted:18/5/10	
		cation			ssenden Road, Camperdowr	n							y: AC	
										Chec			<i>j</i>	
Drill M	ode	el:				Slope:	90°					-	Irface: Existing	
Barrel	Тур	be / Le	ngth	:	NMLC	Bearing:	-				Dat	um:	-	
		format			Rock	Substance							Rock Mass Defe	ects
	ter			g			D	pa	-	a	t	bu		
Lift	wai	ests	я)	СС			erinç	Estimated	angth	MPa	Defect	Spacing		Ê
- hoc	nnc	d To	th (phic			ath€	Est	Stre	ô				oth (
Method Case - Lift	Groundwater	Samples / Field Tests	Depth (m)	Graphic Log	Substance Descri	ption	Ve:		H H VH FH	ls(50)	30 100	3000 3000	Defect Descrip	Depth (m)
					Continued from page			ÍП	ΠŤ		Π	Π		
					SHALE: dark grey with	light grey	FR	111		0.40				
					laminae			111		0.48				
			10.0					111						10.0
								111						1010
								111						
								111						
			10.5					111						10.5
			10.5					111						10.5
								111						
								111		0.54				
								111						
			11.0					111				×.	11.08m J, 50°	11.0
								111					Slicken Sides	
								111						
								111						
			11.5					111					11.45m J, Un	11.5
								111						
								111		0.91				
								111						
			12.0					111						12.0
								111						
								111						
								111						
			12.5					111						12.5
								111						
								111		0.91				
								111						
			13.0					111						13.0
			10.0		Continued on page	e 5 of 6								
Key - M	etho	d			Case - lift		Wea	therin	g			Str	ength Is	s (50) MPa
AS	Aug	er Screv	wing		Casing used		Fr	Fres				EL	Extremely Low	< 0.03
AD	Aug	er Drillir	ng		Barrel withdrawn water		SW			athered		VL	Very Low	0.03 - 0.1
R W		er / Trico shbore	one		date s Water inflow	shown	DW HW		inctly w nly wea	eathere thered	a	L M	Low Medium	0.1 - 0.3 0.3 - 1.0
NMLC	NM	_C Core			Partial drilling water loss		EW			veather	ed	н	High	1.0 - 3.0
NQ,HQ	Wire	eline Co	re Dri	11	Complete drilling water loss								Very High Extremely High	3.0 - 10.0 >10.0
L							-					1		- 10.0



	ent:		_0(~~~~	mo	enced:13/5/10		
	jec						house at RPA A Lifehouse											ted:18/5/10		
			catic	n.			senden Road, Camperdowr											y: AC		
	jec		cauc		IV	113	senden Road, Camperdowi	I								(ed		y. AC		
Dri	IM	ode	١٠					Slope:	90)°							-	urface: Existing		
								-										C C		
			pe/L				NMLC	Bearing:	-							Dat				
Dr	illin	g In	form	atior	1	T	Rock	Substance	—	Т								Rock Mass Defe	cts	
	ų,	ater	-	2	0	DO.				D		nen:	÷	ć	МΓа	ğ	Spacing			_
σ	Case - Lift	Groundwater	Samples /	Depth (m)		Graphic Log			erir		Ectimotod		reng	2		Defect	Spac			Depth (m)
Method	se -	nn	Idu -	oth l	-	h			ath		ù	űi	S	ć	(nc)s					pth
Me	Ca	9 D	Sal	Del		פֿ	Substance Descrip		We	: =	5-	J∑:	H Strength	EH Io/6	ls(:	30 100		Defect Descrip	tion	Del
							Continued from page													
							SHALE: dark grey with	light grey	FF	R								_		
							laminae											_		
				13.	5													_		13.5
				13.										0.4	45			_		10.0
																		_		
																		_		
																		_		
				14.	.0													_		14.0
					_													_		
																		_		
				-														_		
				14.	5													14.54m J, 45°		14.5
																	H			
															40		ы	11.01	1	
					_									0.	43			14.84m CS, 20r	nmt	
				15.	0															15.0
				10.																10.0
																		15.35m J, Sub	/ert	
					_					_	\square			_				Slicken Sides		
				15.	.5	-	CORE LOSS 0.10m		_	+	╟									15.5
														0.	20					
				16.	.0															16.0
															20					
					_									0.	29					
				16.	.5															16.5
							Continued on page	e 6 of 6										16.51m J, 45°		
Key	- Me	ethoo	d			(Case - lift		W	eat	heri	ing					Str	rength Is	(50) MF	Pa
AS		Aug	er Scr	ewinc	J	0	Casing used		Fr			esh					EL	Extremely Low	<	0.03
AD		Aug	er Dril	ling			Barrel withdrawn water		SV	V	Sli	ghtl		eathei			VL	Very Low	0.03 -	- 0.1
R W			er / Tr shbore			,	date s Water inflow	nown	DV HV					weath athere		1	L M	Low Medium		- 0.3 - 1.0
NM	_C	NML	_C Co	re Dri		F	Partial drilling water loss		EV					weat		d	н	High	1.0 -	- 3.0
NQ,	HQ	Wire	eline C	ore D	rill	0	Complete drilling water loss											I Very High	3.0 -	
																		Extremely High	>	10.0



	.000						1121-1	0		
Client: Project:			fehouse at RPA PA Lifehouse						enced:13/5/10 eted:18/5/10	
Project Loc	cation:		issenden Road, Camperdowr	า				rvised b		
								ked by:		
Drill Model	:			Slope:	90°				urface: Existing	
Barrel Type	e / Lengt	h:	NMLC	Bearing:	-			Datum	n: -	
Drilling Inf			Rock	Substance					Rock Mass Defects	
ter	ŝ	bo			D	h ted	a	ing 4		
Method Case - Lift Groundwater	Samples / Field Tests Denth (m)	Graphic Log			erin	Estimated Strength	MPa	Defect Spacing		Depth (m)
Method Case - L Groundv		inde			ath	Str	s(50)			pth
Metho Case Groun	Sal Fie	n U			We	L Estimated M Strength H Strength EH	ls(30 100 300 1000	Defect Description	De
		_	Continued from page		FR					
			SHALE: dark grey with laminae	light grey	ГК					
	17	.0								17.0
		_							17.25m J, 45°	
	17	.5					0.43			17.5
	18	.0								18.0
		_								
							0.39			
	18	.5								18.5
	- H-	_								
									18.82m J, Sub Vert	
	19	.0								19.0
									19.14m J, Sub Vert	
	10	-							19.38m J, 45° 19.42m J, 45°	40.5
	19	.5					0.31		19.42111 J, 45	19.5
	20	0								20.0
	20	.0	Borehole Terminated	at 20.10m						20.0
Key - Method			Case - lift	-	Wea	thering		S	trength Is (50) N	1Pa
AS Auge	er Screwing		Casing used		Fr	Fresh		E	L Extremely Low	< 0.03
AD Auge	er Drilling		Barrel withdrawn water		SW	Slightly wea		V	L Very Low 0.03	3 - 0.1
	er / Tricone nbore		date s Water inflow	shown	DW HW	Distinctly w Highly weat		d L M		1 - 0.3 3 - 1.0
NMLC NML			Partial drilling water loss		EW	Extremely v				0 - 3.0
NQ,HQ Wirel	ine Core L	111	Complete drilling water loss							- 10.0 >10.0
								E	H Extremely High	>10.0



Job No:	GS2948-B
Hole No:	BH 8
Sheet	1 of 7

	ent:				e at RPA	Tes	Locat	tion: Refer to Fig 1
	oject:				house			od: Drill Rig
	oject Location				en Road, Camperdown		rdinate	
						Surf	ace Le	evel:Existing Date: 19/5/10
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log		Description	Moisture	Consistency/ Rel. Density	لا (٤) Additional Comments
				CI -	Silty CLAY: medium to high plasticity, grey	M ≥	St	Standpipe Installed to
	BS 2,10/50mm	0.5		CH	red and orange brown with ironstone gravels	Wp		a Depth of 20.18m. 18.0m Slotted, 2.18m Unslotted Filter Sock to 20.18m Graded Sand to 19.9m Bentonite Plug 0.28m RESIDUAL 1.0
	N>10							
					Interbedded Shale and CLAY: very low strength			
		1.5			grey brown			1.5
					9.09 2.01			
		2.0						2.0
		2.5						2.5
	14,17,20/50							
	mm Refusal							
	N > 37	3.0			grading to grey brown with ironstone gravels			3.0
		3.0						3.0
		3.5			grading to grey brown Continued on page 2 of 7			3.5
	planatory Notes	:		-			•	
	nsistency				Density Index Samples		<u>Moist</u>	
VS S	Very So Soft	oft			VLVery LooseBBulk SampleLLooseDDisturbed Sample			Dry 1oist
S F	Firm				MD Medium Dense U50 Undisturbed Sample		W V	
St	Stiff				D Dense (50mm diam.)			Plastic Limit
vs		iff			VD Very Dense N S.P.T. Value		-	iquid Limit
н	Hard							



Job No:	GS2948-B
Hole No:	BH 8
Sheet	2 of 7

Clie	ent:		-	ehouse	e at RPA	Test	Locat	ion: Refer to Fig 1	
Pro	ject:		RP	A Life	house			od: Drill Rig	
Pro	ject Location	:	Mis	ssende	en Road, Camperdown		dinate	<u> </u>	
						Surfa	ice Le	evel:Existing Date: 19/5/1	0
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification	Description	Moisture Condition	Consistency/ Rel. Density	Additional Comments	Depth (m)
					Continued from page 1 of 7			RESIDUAL	
					Interbedded Shale and CLAY: very low strength	M≥	St		
					grey brown	Wp			
		4.0							4.0
	3, 22/140	4.0							4.0
	Refusal								
	N > 22							V bit refusal	
					SHALE: dark grey, XW-DW, VL strength			BEDROCK	
		4.5							4.5
					grading to DW-SW, L strength			High TC bit resistance	
		5.0							5.0
		5.5							5.5
					grading to SW-FR, L-M strength			Very High TC bit	
								resistance	
		6.0							6.0
_									
•									
		6.5							6.5
		0.0			Refer to Cored Borehole Log			TC bit refusal	0.0
		7.0							7.0
					Continued on page 3 of 7				
	-	5:							
	-	oft			-				
	-	υn							
					· · · · · · · · · · · · · · · · · · ·				
VSt		tiff					-		
н	Hard				-				
Con VS S F St VSt		s: oft	L				М М W W Wp P	loist	_



						ESTHOLE										140/5/40		
	ent:					house at RPA										iced:19/5/10		
	ject		ootion			A Lifehouse										ed:21/5/10		
PIC	jec	LO	cation		IVIIS	senden Road, Camperdown						Super Check				. AC		
س	I M		1.					90 ^c)			Check				rfagge Eviating		
Dn		oue	1.			· · · · · · · · · · · · · · · · · · ·	Slope:	90					к.	L. (Su	rface: Existing		
Ва	rel	Тур	e / Lei	ngth	:	NMLC	Bearing:	-					Da	atu	m:	-		
			format				bstance								F	Rock Mass De	fects	
		er			g			1	4	2,		σ			gr			
	- Lift	vat	s / sts	(۲	Ľ			ring	Ectimated	ngth	b	MPa	Defect		spacing			μ)
po] - é	'nd	Te Te	ı) h	hic			the	ц т	Stre		â	ă	á ċ	አ			h (I
Method	Case .	Groundwater	Samples / Field Tests	Depth (m)	Graphic Log	Substance Description		/ea		M M H Strength	тт	s(50)	30 100	So	80	Defect Desc	rintion	Depth (m)
2	0	0	oг		0	Continued from page 2	of 7	5	<u>_ < m</u>	<u>ist</u>	<u>>ш</u>	<u> </u>	ы М	- ĕ ;	- ĕ	Delect Desc	приоп	
							011											
				6.5														6.5
						Start coring at 6.65m												
							tarov	FR					H	П				
						SHALE: dark grey with ligh laminae	it grey	гк										
				7.0		laminae										6.95m J, Sub	Vert	7.0
				7.0										H		0.0011 0, 000	VOIT	7.0
				7.5								0.77						7.5
				8.0												7.97m CS, 15	ommt	8.0
				8.5														8.5
				9.0								0.62						9.0
				9.5														9.5
				5.5		Continued on page 4 o	of 7											0.0
Key	- Me	etho	1			Case - lift		Wea	atheri	ng					Stre	ength	ls (50) M	IPa
AS		Δυσ	er Screv	vina		Casing used		Fr	Er/	esh					FI	Extremely Low		0.03
AS AD			er Drillin			Barrel withdrawn water level		SW			wea	athered				Very Low		- 0.1
R		Roll	er / Trico			date showr	ı	DW	Dis	stinct	ly w	eathered	ł		L	Low	0.1	- 0.3
W NM			hbore C Core	Drill		Water inflow Partial drilling water loss		HW EW				thered veathere	h		M H	Medium High		- 1.0 - 3.0
			line Core			Complete drilling water loss			LX	GOIL	ory v		u			Very High		- 3.0
						-										Extremely High		>10.0



					ESTHOLE								
Clien					house at RPA							menced:19/5/10	
Proje					A Lifehouse							pleted:21/5/10	
Proje	ct Lo	ocation	:	Mis	senden Road, Camperdowr	ו						d by: AC	
										Chec			
Drill N	Node	el:				Slope:	90°				R.L.	. Surface: Existing	
		be / Le		:	NMLC	Bearing:	-				Date	um: -	
Drilli	ng Ir	forma	tion		Rock	Substance						Rock Mass Defects	
	ter			g			0	ed	c	a	÷	Ð	
Method Case - Lift	Groundwater	Samples / Field Tests	я)	Graphic Log			ring	Estimated	M H Strength VH EH	MPa	Defect	Spacing	Ê
pol -	pu	ple I Te) ų	hic			the	Esti	Stre	â	Δ	<u>v</u>) Ļ
Method Case - I	lo lo	Samples / Field Test	Depth (m)	rap	Out-tana Daari		/ea		т т	ls(50)	30 100 300		_ Depth (m)
ΣC	0	ю́ш		G	Substance Descri		_ ≤ i		<u>≥±≶ü</u>	<u>s</u>	8 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	Defect Description	
					Continued from pages SHALE: dark grey with		FR			0.64			
			<u> </u>		laminae	light grey	1 1			0.04			
					laminae								
			10.0										10.0
			10.0										10.0
			10.5										10.5
										0.44			
			11.0										11.0
												11.21m XWS,20m	mt
			11.5									11.48m J, Sub Ver	t 11.5
										0.58			
										0.50			
			12.0										12.0
			12.0										12.0
			-										
			-										
												12.37m J, 45°	
			12.5										12.5
												12.52m J, 45°	
										0.19			
			13.0										13.0
Key - N	Aotha	d		\square	Continued on page	e 5 of 7	Mar	therin				Strength Is (50	MPa
rtey - l	vieti10	u		ľ	Case - IIII			therir	ıy			Suengui is (50	<i>i</i> wira
AS		er Screv			Casing used		Fr	Fre				EL Extremely Low	< 0.03
AD		er Drillir		E	Barrel withdrawn water		SW		htly wea			2	.03 - 0.1
R W		er / Tric shbore	one	,	date s Water inflow	nown	DW HW		tinctly w hly weat	eathered	a		0.1 - 0.3 0.3 - 1.0
		LC Core	Drill		Partial drilling water loss		EW			veathere	ed		1.0 - 3.0
		eline Co			Complete drilling water loss							VH Very High 3	.0 - 10.0
												EH Extremely High	>10.0



			_00			ESTHULE						1					
	ent:					house at RPA									iced:19/5/10		
	ojec					A Lifehouse									ed:21/5/10		
Pro	ojec	t Lo	cation	:	Mis	senden Road, Campero	dowr	ו				Super			r: AC		
												Chec					
Dri	II M	ode	l:					Slope:	90	0			R.L	. Su	rface: Existing		
Ва	rrel	Тур	be / Le	ngth	:	NMLC		Bearing:	-				Dat	um:			
Di	illin	g In	forma	tion		Ro	ock	Substance						F	Rock Mass Defe	ects	
		ter	~		g				D		ed c	a	×	ng			
	Case - Lift	Groundwater	Samples / Field Tests	Ê	Graphic Log				erin.		L Estimated M Strength VH	MPa	Defect	Spacing			Ê
ğ	- e	our	ald T L	ţ	bild				athe		Stre	ô		S			th (
Method	as	Srol	Samples / Field Test	Depth (m)	<u></u> Sraj	Substance De	ascrir	otion	Vea		프크	s(50)	000	3000 3000	Defect Descri	ntion	Depth (m)
2	0	0	<u>о</u> п		0	Continued from			>	ш>		<u> </u>	m ⊂ n	$\overline{0}$	Delect Desch	plion	
						SHALE: dark grey			FR								
						lamina		3 3 3 3									
				13.5													13.5
												0.29					
				14.0													14.0
				14.5													14.5
												0.33					
				15.0													15.0
																	<u> </u>
				15.5													15.5
												0.32					
				16.0													16.0
				16.5								3.55					16.5
L						Continued on	page	e 6 of 7									
Key	- M	etho	b		(Case - lift			We	ath	ering			Stre	ength le	s (50) MI	Pa
AS		Aua	er Screv	wina	c	Casing used			Fr	F	Fresh			EL	Extremely Low	<	0.03
AD		Aug	er Drillir	ng		Barrel withdrawn	vater		SW		Slightly we			VL	Very Low	0.03	- 0.1
R W			er / Tric shbore	one		water inflow	date s	hown	DW HW		Distinctly w		ł	L	Low Medium		- 0.3
			Snbore _C Core	Drill		Partial drilling water loss			EW		Highly wea Extremely		ed	M H	High		- 1.0 - 3.0
			eline Co			Complete drilling water loss				-	· · · · · · · · · · · · · · · · · · ·		-	VH	Very High	3.0 -	10.0
														EH	Extremely High	>	>10.0



Clie						EST HOLE				Hole	Com	me	enced:19/5/10	
Proj		:				PA Lifehouse							ted:21/5/10	
Proj	ect	Lo	cation		Mis	ssenden Road, Camperdown							y: AC	
Drill	Ma	. do	1.				Slope:	90°		Chec		-	Irface: Existing	
							-	90						
			e / Le			NMLC	Bearing:	-			Dati			
Dril			format	lion		Rock S	Substance	П		1			Rock Mass Defects	
	ŧ	Groundwate	sts	Ê	Graphic Log			ing	L Estimated M Strength EH Strength	MPa	Defect	Spacing		Ê
- Nor	-	νpu	ples Tes	h (n	hic			ther	Estim	∠	Def	Spa		h (n
Method	Case - Lift	Brou	Samples / Field Tests	Depth (m)	èrap	Substance Description	on	Veat	- ~ <u>-</u>	s(50)	30 100 300		Defect Description	Depth (m)
2		0	<u>о п</u>		0	Continued from page		> 1		<u> </u>	n ⊤ n) -		
						SHALE: dark grey with li	ght grey	FR						
						laminae CORE LOSS 0.20m			┼┼┍┩┼┼			╢	16.78m, J, Sub Vert	
				17.0		Due to drilling equipment								17.0
												Π	17.0m CS, 10mmt	
												11	17.23m J, 45° 17.34m J, 45°	
													17.48m J, 45°	
				17.5								Ц	Slicken Sides	17.5
													17.57m J, 45° Slicken Sides	
										0.31			Slicken Sides	
				18.0										18.0
				40.5									18.33m J, 45°	40.5
				18.5						0.18				18.5
				19.0									18.97m J, 45	19.0
													í	
				19.5										19.5
										0.48				
				20.0		Continued on name	7 of 7							20.0
Key -	Ме	thoo	ł			Continued on page 7 Case - lift		Wea	thering			Str	rength Is (50) N	/IPa
AS		Aua	er Screv	vina		Casing used		Fr	Fresh			FI	Extremely Low	< 0.03
AD	1	Aug	er Drillin	g		Barrel withdrawn water lev		SW	Slightly wea			VL	Very Low 0.0	3 - 0.1
R W			er / Trico hbore	one		date sho Water inflow	own	DW HW	Distinctly weat	thered		L M		1 - 0.3 3 - 1.0
NML			C Core			Partial drilling water loss		EW	Extremely v		əd	н	High 1.	0 - 3.0 - 10.0
INQ,F	iQ 1	vvire		e Dill	I	Complete drilling water loss						EH	I Very High 3.0 I Extremely High	- 10.0 >10.0



Client: Lifehouse at RPA Hole Commenced:19/5/10 Project: RPA Lifehouse Hole Completed:21/5/10 Project Location: Missenden Road, Camperdown Supervised by: AC Drill Model: Slope: 90° R.L. Surface: Existing	
Project Location: Missenden Road, Camperdown Supervised by: AC Checked by:	
Checked by:	
Drill Model: Slope: 90° R.L. Surface: Existing	
Barrel Type / Length: NMLC Bearing: - Datum: -	
Drilling Information Rock Substance Rock Mass Defect	cts
Method Method Groundwater Groundwater Samples / Samples / Field Tests Graphic Log Graphic Log Depth (m) Is(50) MPa Is(50) MPa	Ê
	th (
Method Method Groundwa Groundwa Groundwa Groundwa Graphic Lo Depth (m) Dath Method Image: Strengt Strengt Image: Strengt Strengt Image: Strengt Strengt	tion Depth (m)
Continued over from page 6 of 7	
Borehole Terminated at 20.18m	
20.5	20.5
	21.0
	21.0
	24.5
	21.5
	22.0
	22.5
	23.0
23.5	23.5
Key - Method Case - lift Weathering Strength Is ((50) MPa
AS Auger Screwing Casing used Fr Fresh EL Extremely Low AD Auger Drilling Barrel withdrawn water level SW Slightly weathered VL Very Low	< 0.03 0.03 - 0.1
R Roller / Tricone date shown DW Distinctly weathered L Low	0.03 - 0.1
W Washbore Water inflow HW Highly weathered M Medium	0.3 - 1.0
NMLC NMLC Core Drill Partial drilling water loss EW Extremely weathered H High NQ,HQ Wireline Core Drill Complete drilling water loss VH Very High	1.0 - 3.0 3.0 - 10.0
EH Extremely High	>10.0



Job No:	GS2948-B
Hole No:	BH 9
Sheet	1 of 6

Clie					e at RPA	Test	Locat	ion: Refer to Fig 1	
	ject:				house			od: Drill Rig	
Pro	ject Location	:	Mis	ssende	en Road, Camperdown		dinate		
						Surfa	ace Le	vel:Existing Date: 24/5/1	0
Groundwater	Samples/ Field Tests	Depth (m)	Graphic Log	Unified Classification	Description	Moisture Condition	Consistency/ Rel. Density	Additional Comments	Depth (m)
					AC 70mm thick			BASECOURSE	┥──┤
					CONCRETE 200mm thick			BASECOURSE	
					ROADBASE: Gravels 100mm thick		1	SUBBASE	
		0.5		CI -	Silty CLAY: medium to high plasticity, grey	M≥	St-	RESIDUAL	0.5
				СН	red and orange brown	Wp	VSt		
					ç				
									\square
		1.0					1.727		1.0
	1 7 40				grading to grey red and orange brown		VSt		$\mid - \mid$
	4, 7, 12				with ironstone gravels				┝─┤
	N = 19								
		· 1.5							1.5
		2.0							2.0
					grading to grey red and orange brown				
		2.5							2.5
		2.0							2.0
	4, 11, 10								
					grading to grey red and orange brown				
	N = 21				with ironstone gravels				\square
		3.0							3.0
									\vdash
									┝─┤
									┝─┤
		3.5							3.5
					Continued on page 2 of 6				
Exp	lanatory Notes	s:		-	· •		-	•	
	<u>isistency</u>				Density Index Samples		Moist		
VS	Very S	oft			VL Very Loose B Bulk Sample			lry	
S	Soft				L Loose D Disturbed Sample			loist	
F	Firm Stiff				MDMedium DenseU50Undisturbed SampleDDense(50mm diam.)			/et	
St VSt		liff			D Dense (50mm diam.) VD Very Dense N S.P.T. Value		-	lastic Limit iquid Limit	
H	Very S Hard				Very Dense IN O.F.I. Value		VVI LI		
<u> </u>	iaiu								



Job No:	GS2948-B
Hole No:	BH 9
Sheet	2 of 6

_	ent:					se at	Test	Test Location: Refer to Fig 1								
	oject:					se al fehou						od: Drill Rig				
	oject Lo	cation					Road, Camperdow	'n		Coord			AC			
'C	.,	50001	•				tead, campoidow					vel:Existing Date: 24/5/1				
Groundwater	Samples/	Field Tests	Depth (m)	Graphic Log	Unified	Classification	ſ	Descripti	on		Consistency/ Rel. Density		Depth (m)			
0	0)	<u>ш</u>		0		1			page 1 of 6	20						
	9,14/8	30mm	4.0				Silty CLAY: medi	um to h	high plasticity, grey n with ironstone	M≥ Wp	Η		4.0			
	Refusa															
			4.5			 Ir		and CL rey bro	AY: very low strength wn			Moderate - High V bit resistance	4.5			
			5.0									Very High V bit resistance	5.0			
			5.5				SHALE: grey b	prown, 2	XW, VL strength			V bit refusal BEDROCK	5.5			
			6.0				grading to g	grey, D	N, L strength			Very High TC bit resistance	6.0			
							Refer to C	ored B	orehole Log			TC bit refusal	\square			
			6.5										6.5			
			7.0				Continue	n n	age 3 of 6				7.0			
Exr	lanator	v Notes	;:			_	Continue	μα στι μ				1	1			
	Explanatory Notes: <u>Consistency</u>						nsity Index	San	<u>Moisture</u>							
VS	-						Very Loose	В	D Dry							
s	-						Loose	D	Bulk Sample Disturbed Sample			oist				
F		Firm				MD	Medium Dense	U50	Undisturbed Sample		W W					
St	t Stiff						Dense		(50mm diam.)	Wp Plastic Limit						
VS1 H		Very Si Hard	tiff			VD	Very Dense	Ν	S.P.T. Value		WI Li	iquid Limit				



Clie Pro	ent: ojec	t:				Life RP	ehouse at RPA A Lifehouse							Hole Commenced: 24/5/10 Hole Completed: 26/5/10 Supervised by: AC								
Pro	ojec	t Lo	cati	on:		Mis	ssenden Road, Camperdown							Supe Chec				oy: AC				
Dri	ll M	ode	l:				Slope:	9	0°				R.L. Surface: Existing									
			be / I				NMLC Bearing:	-							Da	atu						
Dr	illin		forn	nati	on		Rock Substance											Rock Mass Defects				
Method	Case - Lift	Groundwater	Samples /	Field Tests	Depth (m)	Graphic Log		2 on the original sector	vveatnering		Estimated	Strength		s(50) MPa	0 Defect		00 Spacing	8	Depth (m)			
Ň	Ű	Ū	ő	ιĒ	ŏ	Ū	Substance Description Continued from page 2 of 6	~	> <u>u</u>		! <u></u> ≥	∑ ∏	<u>⇒</u> ≞	lsi	30 100	202	6č	Defect Description	ŏ			
				ļ																		
				_			Start Coring at 6.30m SHALE: dark grey with light grey laminad	e F	R	+		H			_		\square		_			
				ļ	6.5							Ļ						6.44m J, 45°	6.5			
				ŀ			CORE LOSS 0.15m		_													
				ļ										0.24				6.75m J, 45°				
				ŀ	7.0							L							7.0			
				ļ								L										
				ŀ								L						7.22m CS, 30mmt				
				ļ								L										
				ŀ	7.5							L		0.36					7.5			
				ļ														7.63 J, Sub Vert				
				-			CORE LOSS 0.38m															
				t	8.0														8.0			
				ŀ	_			×	w		H	Н	-									
				t								L										
				ŀ	8.5			F	R			L							8.5			
					0.5							L							0.5			
				-								L						8.71, XWS, 10mmt				
				ŀ								L					h	0.7 I, XW3, Iomini	-			
				F	9.0							L		0.40					9.0			
				ŀ								L										
				ļ								L										
				ŀ	9.5							L							9.5			
Kov	′ - Me	otho	4				Continued on page 4 of 6 Case - lift		eath								Ctr	ength Is (50) I	MDa			
AS AD			er So er Dr				Casing used Barrel withdrawn water level	Fr S\			resl Sligh		wea	athered					< 0.03 3 - 0.1			
R W	Roller / Tricone date shown							D' H'						eathered	b		L M		1 - 0.3 3 - 1.0			
NM	MLC NMLC Core Drill Partial drilling water loss							E١						veathere	ed		Н	High 1.	0 - 3.0			
NQ,	,nQ	vvire	eiirie	COLE	e Drii	I	Complete drilling water loss											I Very High 3.0 I Extremely High	- 10.0 >10.0			



			.00			ESTHULE					I				
Clier						ehouse at RPA								nced: 24/5/10	
Proj			4:			A Lifehouse								ted: 26/5/10	
Proj	eci	LOG	cation		IVIIS	ssenden Road, Camperdowr	1				Supe Chec			y: AC	
Drill	Mo	dol					Slope:	90°)		Chec			Irface: Existing	
								30						-	
			e / Ler		:	NMLC	Bearing:	-				Dat	um:		
Drill	ling	Inf	ormat	ion		Rock	Substance	1 1			1			Rock Mass Defects	1
		ater	s		go			b	•	Estimated Strength	MPa	ಕ	ing		
	₩ -	2 Mg	Samples / Field Tests	Depth (m)	Graphic Log			erir	:	engt engt	Σ	Defect	Spacing		Depth (m)
tho	- e	nu	ld T Id T	oth	ihq			ath	1	Str Es	s(50)				oth
Method	Case	Groundwater	Sar Fie	De	G	Substance Descri	otion	Ve	,∠⊑	L Estimated M Strength VH Strength	ls(5	30 100		Defect Description	Del
						Continued from page									
						SHALE: dark grey with ligh	t grey laminae	FR							
											0.00			9.75m J, 45°	
				10.0							0.66			Slicken Sides 9.84m J, 45°	10.0
				10.0										Slicken Sides	10.0
														Oliciteri Oldes	
				10.5							0.84				10.5
				11.0											11.0
				11.0											11.0
				11.5							0.46				11.5
											0.40				
				12.0											12.0
				12.5											12.5
				12.5											12.5
											0.18			12.83m J, Sub Vert	
													Ш	12.88m CS, 20mmt	
				13.0		•									13.0
Key -	Met	hod				Continued on page Case - lift	e 5 of 6	Wea	ather	ring			Str	ength Is (50)	MPa
										0					
AS			er Screv			Casing used	loval	Fr		esh	othorsd			Extremely Low	< 0.03
AD R		•	er Drillin er / Tricc	•		Barrel withdrawn water date s		SW DW		ightly weat stinctly w		d	L	2	03 - 0.1 0.1 - 0.3
W	V	Vasl	nbore			Water inflow		НW	Hi	ighly wea	thered		М	Medium C	.3 - 1.0
			C Core line Cor			Partial drilling water loss Complete drilling water loss		EW	E	ktremely	weathere	ed	Н		.0 - 3.0 0 - 10.0
лvQ,П	ių V	vire		ย มก		Complete uniling water loss		1						Extremely High	>10.0
·								4					_	, ,	


CORELOG OF TEST HOLE

			-00			ESTHULE							1.04/5/40	
Clie						ehouse at RPA							iced: 24/5/10	
Pro	-					A Lifehouse				Hole Completed: 26/5/10 Supervised by: AC				
Pro	Jeci	[LO	cation	•	IVIIS	ssenden Road, Camperdowr	1						: AC	
-		_						(Check				
Dril	I Me	ode	I:				Slope:	90')		R.L.	Su	rface: Existing	
Bar	rel	Тур	e / Le	ngth	:	NMLC	Bearing:	-			Datu	ım:	-	
Dri	Illing	g In	forma	tion		Rock	Substance						Rock Mass Defects	
		L			D				ğ	a		g		
	Ψ	Groundwate	s / sts	(u	Graphic Log			ing	EL VL Estimated M Strength VH	MPa	Defect	Spacing		<u>د</u>
ро	-	√pu	Te	h (r	hic			hei	Estir		å	Sp		h (r
Method	Case - Lift	rou	Samples / Field Tests	Depth (m)	rap			eat		s(50)	80	88		Depth (m)
ž	Ű	Ū	ΰĒ	ă	Ū	Substance Descri		≥	┙┙っӗェŹΰ	n sl	$^{30}_{300}$	30	Defect Description	ŏ
						Continued from page								
						SHALE: dark grey with ligh	it grey laminae	FR					12.21m L. Sub Vort	
				<u> </u>									13.31m J, Sub Vert	
				13.5										13.5
				13.5						0.02				13.5
										0.02				
													13.84m J, Sub Vert	
				14.0									,	14.0
													14.17m J, Sub Vert	
				14.5										14.5
										0.14				
													4474 10114	
												۰.	14.74m J, Sub Vert	
				45.0										15.0
				15.0										15.0
				15.5										15.5
										0.40				
				16.0										16.0
				16.5		Continued on page	o 6 of 6			1				16.5
Key	- Me	ethoo	1			Continued on page		We	athering			Stre	ength Is (50) I	MPa
-								_						
AS AD			er Scre [.] er Drillir			Casing used Barrel withdrawn water	امرما	Fr SW	Fresh Slightly we	athered				< 0.03 3 - 0.1
R			er Driili er / Tric				shown	DW					2	1 - 0.3
W		Was	hbore			Water inflow		HW	Highly wea	athered		М	Medium 0.	3 - 1.0
			C Core			Partial drilling water loss		EW	Extremely	weathere				0 - 3.0
NQ,	ΗQ	vvire	eline Co	re Dri	11	Complete drilling water loss							Very High 3.0 Extremely High	- 10.0 >10.0
L								1						- 10.0



CORELOG OF TEST HOLE

Clier Proje	ject: RPA Lifehouse H								Hole Commenced: 24/5/10 Hole Completed: 26/5/10					
Proj	ect	Lo	catior	:	Mis	ssenden Road, Camperdown					ervised by: AC cked by:			
Drill	Mo	ode	l:				Slope:	90 [°]	D		R.L. Surface: Existing			
			e / Le		<u> </u>	NMLC	Bearing:	-			Datum	atum: -		
Dril	T	<u>ـ</u>	forma	tion		Rock	Substance					Rock Mass Defects		
Method	Case - Lift	Groundwatei	Samples / Field Tests	Depth (m)	Graphic Log	Substance Descrip	tion	Neathering	EL VL Estimated M H Strength	s(50) MPa	30 100 Defect 300 Spacing		Depth (m)	
		0	<u>0) IL</u>		0	Continued from pag	e 5 of 6			<u> </u>	<u> </u>			
				17.0		SHALE: dark grey with light	grey laminae	FR		0.29			17.0	
				17.5						0.31		17.6m J, 20°	17.5	
				18.5								18.2m J, Sub Vert 18.8m J, 45°	18.5	
				19.0						0.47		19.0m J, 45° Slicken Sides	19.0	
				19.5						0.30		19.8m J, Sub Vert	19.5	
				20.0		Borehole Terminated a	at 19.86m						20.0	
Key -	Me	ethoo	1	1		Case - lift		Wea	athering		s	trength Is (50) MF	Pa	
	C	Aug Rolle Was NML	er Scre er Drillin er / Tric hbore C Core line Cc	ng one e Drill		Casing used Barrel withdrawn water le date sh Water inflow Partial drilling water loss Complete drilling water loss		Fr SW DW HW EW	Distinctly v Highly wea	veathered athered	d L N ed H	L Very Low 0.03 Low 0.1 Medium 0.3 High 1.0 H Very High 3.0 -	0.03 - 0.1 - 0.3 - 1.0 - 3.0 10.0	

APPENDIX D

CORE PHOTOGRAPHS





BH 6 (7.00m - 20.20m)



Page 1 of 4



BH 7 (6.18m - 20.10m)





BH 8 (6.65m - 20.18m)





BH 9 (6.30m - 19.86m)



Page 4 of 4

APPENDIX E

LABORATORY TEST RESULTS





Aargus Laboratories Pty Ltd ACN: 086 993 937

Environmental - Remediation - Engineering - Laboratories - Drilling 446 Parramatta Road, Petersham NSW 2049 Ph: 1300 137 038 Fax: 1300 136 038

CALIFORNIA BEARING RATIO TEST REPORT

Client Ca	apital Insight				Job Number	LS2948-1	
Project RF	PA Lifehouse				Date	11/06/2010	
Location Mi	issenden Rd Ca	mperd	lown		Page	1 of 1	
SAMPLE DETAILS							
Test Number			MT 1	MT 2			
Date Sampled			24/05/2010	24/05/2010			
Test Location			BH2	BH 3			
Sample Depth			0.5 - 1.0m	0.2 - 0.5m			
LABORATORY COM	MPACTION		AS1289 5.1.1 (S	Standard)	AS1289 5.2.1	(Modified)	
Maximum Dry Densit	ty .	t/m ³	1.52	1.82			
Optimum Moisture C	ontent	%	25.5	16.3			
TEST RESULTS			AS1289.6.1.1				
Dry Density Before S	Soak	t/m ³	1.52	1.80			
Moisture Content Bet	fore Soak	%	26.7	17.3			
Density Ratio Before	e Soak	%	100.0	99.0			
Moisture Ratio Before	e Soak	%	105.0	106.0			
Dry Density After Soa	ak	t/m ³	1.48	1.80			
Moisture Content After	er Soak	%	30.7	18.1			
Moisture Cont. After	Test (Whole)	%	28.2	17.0			
Moisture Cont. After	Test (Top30mm)	%	30.6	17.6			
Material Retained 19	.0mm	%	3.6	8.1			
+19.0mm Crushed/In	ncluded (Y/N)		N	Ν			
Mass of Surcharge		Kg	4.5	4.5			
Compactive Effort			STD	STD			
Period of Soaking		days	4	4			
Swell After Soaking		%	3.1	0.1			
CBR value @ 2.5/5.0	Omm penetration	%	3 / 3	9 / 12			
Specification:			N/A		•	•	
Material Description:		MT1 MT2	Silty Clay Traces Of Gravel Grey Brown Silty Shaley Clay Light Brown				
		10112	City Charley City Ligi	IL DIOWIT			
Notes: 1.	Unless otherwise sta	ated the	e CBR test is not repea	ated if the 5.0mm valu	e exceeds the 2.5mm	n value	





ANALYTICAL REPORT

28 May 2010

Aargus Pty Ltd

446 Parramatta Road PETERSHAM NSW 2049

Attention:	Adrian Collins		
Your Reference:	GS2948-B - RPA Lifehouse - Car	nperdown	
Our Reference:	SE78608	Samples: Received:	8 Soils 27/05/2010
Preliminary Report S	Sent: Not Issued		

These samples were analysed in accordance with your written instructions.

For and on Behalf of: SGS ENVIRONMENTAL SERVICES

Sample Receipt: Production Manager: Angela Mamalicos Huong Crawford AU.SampleReceipt.Sydney@sgs.com Huong.Crawford@sgs.com

Results Approved and/or Authorised by:

Dong Liang

Dong Liang Quality Manager

Huong Crawford

Metals Signatory



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 Environmental Servic

 ABN 44 000 964 278
 t +61 (0)2 8594 0400

Environmental Services Unit 16/33 Maddox Street Alexandria NSW 2015 Australia t+61 (0)2 8594 0400 f+61 (0)2 8594 0499 www.au.sgs.com

Anions in soil						
Our Reference:	UNITS	SE78608-1	SE78608-2	SE78608-3	SE78608-4	SE78608-5
Your Reference		BH3	BH3	BH3	BH3	BH4
Depth		0.1-0.6	1.0-1.2	1.4-1.7	2.5-2.82	0.4-0.6
Sample Matrix		Soil	Soil	Soil	Soil	Soil
Date Extracted		28/05/2010	28/05/2010	28/05/2010	28/05/2010	28/05/2010
Date Analysed		28/05/2010	28/05/2010	28/05/2010	28/05/2010	28/05/2010
Chloride, Cl 1:5 soil:water	mg/kg	13	9.1	3.0	2.3	2.9
Sulphate, SO4 1:5 soil:water	mg/kg	46	82	22	28	47

Anions in soil				
Our Reference:	UNITS	SE78608-6	SE78608-7	SE78608-8
Your Reference		BH4	BH4	BH4
Depth		1.0-1.45	2.5-2.95	4.0-4.23
Sample Matrix		Soil	Soil	Soil
Date Extracted		28/05/2010	28/05/2010	28/05/2010
Date Analysed		28/05/2010	28/05/2010	28/05/2010
Chloride, Cl 1:5 soil:water	mg/kg	3.7	3.4	4.1
Sulphate, SO4 1:5 soil:water	mg/kg	33	58	130



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 Environmental Services
 Unit 16/33 Maddox Street
 Alexandria NSW 2015
 Australia

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 f + 61 (0)2 8594 0499
 www.au.sgs.com

REPORT NO: SE78608

Inorganics						
Our Reference:	UNITS	SE78608-1	SE78608-2	SE78608-3	SE78608-4	SE78608-5
Your Reference		BH3	BH3	BH3	BH3	BH4
Depth		0.1-0.6	1.0-1.2	1.4-1.7	2.5-2.82	0.4-0.6
Sample Matrix		Soil	Soil	Soil	Soil	Soil
Date Extracted- (pH 1:5 soil: Water)		28/05/2010	28/05/2010	28/05/2010	28/05/2010	28/05/2010
Date Analysed (pH 1:5 Soil: Water)		28/05/2010	28/05/2010	28/05/2010	28/05/2010	28/05/2010
pH 1:5 soil:water	pH Units	5.0	5.3	5.7	6.1	4.9

Inorganics				
Our Reference:	UNITS	SE78608-6	SE78608-7	SE78608-8
Your Reference		BH4	BH4	BH4
Depth		1.0-1.45	2.5-2.95	4.0-4.23
Sample Matrix		Soil	Soil	Soil
Date Extracted- (pH 1:5 soil: Water)		28/05/2010	28/05/2010	28/05/2010
Date Analysed (pH 1:5 Soil: Water)		28/05/2010	28/05/2010	28/05/2010
pH 1:5 soil:water	pH Units	4.8	5.6	5.5



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Environmental Services Unit 16/33 Maddox Street Alexandria NSW 2015 Australia t+61 (0)2 8594 0400 f+61 (0)2 8594 0499 www.au.sgs.com

REPORT NO: SE78608

Moisture						
Our Reference:	UNITS	SE78608-1	SE78608-2	SE78608-3	SE78608-4	SE78608-5
Your Reference		BH3	BH3	BH3	BH3	BH4
Depth		0.1-0.6	1.0-1.2	1.4-1.7	2.5-2.82	0.4-0.6
Sample Matrix		Soil	Soil	Soil	Soil	Soil
Date Analysed (moisture)		28/05/2010	28/05/2010	28/05/2010	28/05/2010	28/05/2010
Moisture	%	14	12	12	11	21

Moisture				
Our Reference:	UNITS	SE78608-6	SE78608-7	SE78608-8
Your Reference		BH4	BH4	BH4
Depth		1.0-1.45	2.5-2.95	4.0-4.23
Sample Matrix		Soil	Soil	Soil
Date Analysed (moisture)		28/05/2010	28/05/2010	28/05/2010
Moisture	%	18	15	13



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Method ID	Methodology Summary
SEI-038	Water Soluble Chloride
	Water Soluble Chloride
	After carrying out a 1:5 soil:water extraction, an aliquot of the extract is reacted with mercuric thiocyanate forming a mercuric chloride complex. In the presence of ferric iron, highly coloured ferric thiocyanate is formed which is proportional to the chloride concentration. Reference NEPM, Schedule B(3), 401 and APHA 4500CI-
	Water Soluble Sulphate
	After carrying out a 1:5 soil:water extraction ,sulphate in the extract is precipitated in an acidic medium with barium chloride. The resulting turbidity is measured photometrically at 405nm and compared with standard calibration solutions to determine the sulphate concentration in the sample. Reference NEPM, Schedule B(3), 401 and APHA 4500-SO42
AN101	pH - Measured using pH meter and electrode based on APHA 21st Edition, 4500-H+. For water analyses the results reported are indicative only as the sample holding time requirement specified in APHA was not met (APHA requires that the pH of the samples are to be measured within 15 minutes after sampling).
AN002	Preparation of soils, sediments and sludges undergo analysis by either air drying, compositing, subsampling and 1:5 soil water extraction where required. Moisture content is determined by drying the sample at $105 \pm 5^{\circ}$ C.



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REPORT NO: SE78608

QUALITY CONTROL Anions in soil	UNITS	LOR	METHOD	Blank	Duplicate Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Matrix Spike % Recovery Duplicate + %RPD
Date Extracted				28/05/1 0	[NT]	[NT]	LCS	28/05/10
Date Analysed				28/05/1 0	[NT]	[NT]	LCS	28/05/10
Chloride, Cl 1:5 soil:water	mg/kg	0.25	SEI-038	<0.2	[NT]	[NT]	LCS	97%
Sulphate, SO4 1:5 soil:water	mg/kg	0.5	SEI-038	<0.5	[NT]	[NT]	LCS	95%

QUALITY CONTROL	UNITS	LOR	METHOD	Blank
Inorganics				
Date Extracted- (pH 1:5 soil: Water)				[NT]
Date Analysed (pH 1:5 Soil: Water)				[NT]
pH 1:5 soil:water	pH Units	0	AN101	0.0

QUALITY CONTROL Moisture	UNITS	LOR	METHOD	Blank
Date Analysed (moisture)				[NT]
Moisture	%	1	AN002	<1



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Result Codes [INS] : Insufficient Sample for this test [NR] : Not Requested [NT] : Not tested [LOR] : Limit of reporting Report Comments

[RPD] : Relative Percentage Difference

- : Not part of NATA Accreditation
- [N/A] : Not Applicable

Samples analysed as received. Solid samples expressed on a dry weight basis.

Date Organics extraction commenced:

NATA Corporate Accreditation No. 2562, Site No 4354

Note: Test results are not corrected for recovery (excluding Air-toxics and Dioxins/Furans*) This document is issued by the Company subject to its General Conditions of Service (www.sgs.com/terms_and_conditions.htm). Attention is drawn to the limitations of liability, indemnification and jurisdictional issues established therein.

This document is to be treated as an original within the meaning of UCP 600. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law.

Quality Control Protocol

Method Blank: An analyte free matrix to which all reagents are added in the same volume or proportions as used in sample processing. The method blank should be carried through the complete sample preparation and analytical procedure. A method blank is prepared every 20 samples.

Duplicate: A separate portion of a sample being analysed that is treated the same as the other samples in the batch. One duplicate is processed at least every 10 samples.

Surrogate Spike: An organic compound which is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples. Surrogates are added to samples before extraction to monitor extraction efficiency and percent recovery in each sample.

Internal Standard: Added to all samples requiring analysis for organics (where relevant) or metals by ICP after the extraction/digestion process; the compounds/elements serve to give a standard of retention time and/or response, which is invariant from run-to-run with the instruments.

Laboratory Control Sample: A known matrix spiked with compound(s) representative of the target analytes. It is used to document laboratory performance. When the results of the matrix spike analysis indicates a potential problem due to the sample matrix itself, the LCS results are used to verify that the laboratory can perform the analysis in a clean matrix.

Matrix Spike: An aliquot of sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. A matrix spike is used to document the bias of a method in a given sample matrix.

Quality Acceptance Criteria

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here: http://www.au.sgs.com/sgs-mp-au-env-qu-022-qa-qc-plan-en-09.pdf



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