Casuarina Police Station
Geotechnical Site Investigation

14681-00-SS-RP-001

15 August 2007
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<table>
<thead>
<tr>
<th>REV</th>
<th>DESCRIPTION</th>
<th>ORIG</th>
<th>REVIEW</th>
<th>WORLEY-PARSONS APPROVAL</th>
<th>DATE</th>
<th>CLIENT APPROVAL</th>
<th>DATE</th>
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<tbody>
<tr>
<td>A</td>
<td>Issued for internal review</td>
<td>M Grinceri</td>
<td>S Paterson</td>
<td>N/A</td>
<td>14 Aug 07</td>
<td>N/A</td>
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<td>Issued for client review</td>
<td>M Grinceri</td>
<td>S Paterson</td>
<td>N/A</td>
<td>15 Aug 07</td>
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1. INTRODUCTION

It is proposed to upgrade the existing police facilities on Lot 4802 Dripstone Rd, Casuarina by the demolition of the existing building and the construction of new facilities. The new building will comprise a single storey reinforced masonry structure built on a slab on grade with strip footings. There will be a two storey high section surrounding the entrance to the building.

The scope of this site investigation was to provide:

- Determine the subsurface conditions;
- Provide a site classification in accordance with AS2870-1996;
- Locate and map underground services on the site.
2. PRELIMINARIES

2.1 Regional Geology

The regional geology for this site (Doyle 2001) comprises laterite materials composed of pisolite and nodular iron stone gravels, ferricrete and duricrust. This in turn overlies rocks of the Darwin Formation which comprises claystone, silicified claystone and clayey sand. The dominant clay mineral in the claystone is montmorillonite; this claystone weathers under favourable conditions to a kaolinitic silicified claystone locally known as "porcellanite".

Staff at the police station indicated that the building had been standing since Cyclone Tracey in 1974 and all parts of the lot were developed.

2.2 Site Investigation Method

The site investigation comprised:

- 5x 200 mm diameter, 1.8 m deep solid auger boreholes with recovered material logged in accordance with AS1726-1993;
- Dynamic Cone Penetrometer (DCP) testing adjacent to each borehole;
- 2x Ground Penetrating Radar (GPR) traverses for subsurface conditions;
- Service locations by GPR, induction probe and potholing machine.

At the end of the investigation all holes were backfilled with cuttings and in paved areas the top 100 mm of each hole was filled with rapid set concrete.

The search for services took place from 26th to 30th July 2007, with the geotechnical investigation being undertaken on 27th July 2007.

A site plan showing the location of geotechnical investigation points is given in Appendix 1, auger hole logs including DCP results are given in Appendix 2.

A map of services with Lot 4802 that were located during the investigation is given in Appendix 3.

The location of services with the verge was not determined as the location, quantity and nature of services within this area may change without notice. Furthermore, up to date plans of these services can be obtained from the service providers or Dial Before You Dig.
The GPR traverses with a basic interpretation are given in Appendix 4.

2.3 Limitations to Service Locations

Although a reasonable effort was expended to attempt to locate all the services within the site, it is impossible to guarantee that all services present have been located. Within this investigation no specific effort was expended to locate all pipes and cables associated with the reticulation system. Those reticulation items that have been mapped were located as part of the effort to find other services.

Furthermore, it was not possible to track the location of services within the buildings on site.
3. RESULTS AND DISCUSSION

3.1 Subsurface Conditions

Geological units identified on the site comprised the following:

*Silty SAND*

Fine to medium grained, grey to grey-brown silty sand. This material underlay areas with grass. This material was 0.15 m thick in 14681BH02 varying to 0.6 m thick in 14681BH05. This material is inferred as the original topsoil material on the site.

*Roadbase materials*

The paved areas of the site were topped with 0.05 m thick spray seal bitumen with crushed rock. This material appears to have been applied more than once and had been patched numerous times using a mixture of spray seal, hotmix and concrete.

In 14681BH04 it appears that the seal was underlain by a 100 mm thick Silty GRAVEL base course. In other areas the spray seal appeared to have been laid on compacted site materials.

*Gravely SAND*

This material comprised fine to medium grained sand with fine to medium grained gravel, red-brown, with pisolith gravel and silt. This material varied from 0.2 m thick in 14681BH05 to 0.65 m thick in 14681BH01. This material appears to be the naturally occurring laterite soil and lies directly on the site bedrock in all points except 14681BH04.

*Clayey GRAVEL*

This material was only found in 14681BH04 and may represent a more weathered form of the bedrock. The material comprised a 0.6 m thick, fine to medium grained gravel with medium to high plasticity clay.

*CLAYSTONE*

The bedrock material was found between 0.45 m (14681BH02) and 1.1 m (14681BH04) with a typical depth of 0.6 m. It comprised a highly fractured, very low strength, extremely weathered claystone. Fractures are soil filled and chips returned on the auger showed distinct bedding. This material was typically white, red, brown, orange and maroon with minor secondary iron cementation and staining.
The interpreted Claystone upper surface on the GPR scans; taken from a correlation between the borehole geology and scan features, show that the Claystone surface typically varies between 0.4 m and 0.6 m below ground level, with an undulating upper surface. The fractures in the rock are responsible for the multiple signals from the Claystone.

It does not appear that Porcellanite is present on the site as this material returns a reflection similar to Figure 1.

Figure 1  Typical GPR scan of porcellanite. The indurated upper surface and reverse strength profile result in the single reflection off the upper surface.

3.2 Site Classification

Based on a visual tactile assessment of the subsurface materials encountered on the site a site classification of Class S in accordance with AS2870-1996 is appropriate for this site.

3.3 Fill Materials

To preserve the site classification all structural fill materials should comprise granular material with less than 15% finer than 75 \( \mu \text{m} \) and no material greater than 20 mm placed in loose layers not exceeding 200 mm thick and compacted to a minimum 92% MMDD.

Due to the presence of montmorillonite clay within the claystone bedrock, the crushed and remoulded Claystone may produce a high plasticity, expansive clay fill. If used as fill this material may be detrimental to the performance of foundations and may affect the classification of the site. Remoulded claystone should be avoided as a structural fill material and foundation excavations into the claystone should be cleaned of any remoulded material.

3.4 Foundation Design

For a 0.4 m wide strip footing founded at 0.3 m below the current ground surface an allowable bearing capacity of 150 kPa would be suitable for design.
For a 0.6 m by 0.6 m square pad footing founded at 0.3 m below the current ground level an allowable bearing capacity of 200 kPa would be suitable for design.

For uplift design the following factors should be used:

- Silty SAND \( \phi' = 36^\circ, \gamma = 18 \text{ kN/m}^3 \)
- Gravely SAND \( \phi' = 37^\circ, \gamma = 20 \text{ kN/m}^3 \)
- Clayey GRAVEL \( \phi' = 37^\circ, \gamma = 20 \text{ kN/m}^3 \)
- Clay Stone UCS = 125 kPa, \( \gamma = 18 \text{ kN/m}^3 \)

Footing excavations should be inspected by a qualified geotechnical engineer or engineering geologist prior to construction to confirm that the material encountered conforms to the requirements of the footing system. If material encountered is different from that encountered during the investigation then advice should be sought from the engineering geologist.

With slightly reactive sites, changes from the moisture conditions at the time of construction can result in adverse effects upon the performance of the footings. Footing maintenance in accordance with Appendix B of AS2870-1996 should reduce these effects. Further information on site classification and foundation maintenance requirements in accordance with the Standard are given in the CSIRO pamphlet BTF 18 "Foundation Maintenance and Footing Performance: A Homeowner's Guide".
4. CONCLUSION

A site investigation of Lot 4802 Dripstone Road, Casuarina was conducted for the purpose of the construction of new police facilities on the site. The ground conditions were found to generally comprise Silty SAND and Gravely SAND overlying extremely weathered CLAYSTONE. Internal services on the lot were identified and mapped.
5. REFERENCES


Australian Standard AS2870-1996 Residential Slabs and Footings – Construction. Standards Australia

6. IMPORTANT INFORMATION ON INTERPRETATION, USE AND LIABILITY OF THIS REPORT

This report has been prepared in accordance with a specific brief and scope of work. It should be read in its entirety.

The responsibility of WorleyParsons is solely to the Client. This report is not intended for, and should not be relied upon, by any third party. No liability is undertaken to any third party.

Ground conditions are subject to continuing natural and man-made processes. It can exhibit a variety of properties that vary from place to place, and can change with time.

Site investigation involves gathering and assimilating data by means such as inspection, drilling, excavation, probing, sampling and testing. The collected data is only directly relevant to the ground at the place where and the time when the investigation was performed.

Any interpretation or recommendation given in this report shall be understood to be based on judgement and experience, not on greater knowledge of facts other than those reported.

If different ground or site conditions are encountered during construction activities or subsequent to the investigation performed for this report, either due to natural variability of subsurface conditions or previous construction activities, WorleyParsons should be notified of the differences and provided with an opportunity to review the recommendations contained in this report.

The location of services is a process of detection and deductive reasoning to determine the location and type of service. Although all care to locate all the services present has been made no guarantee can be made that all services present have been located and correctly identified. WorleyParsons takes no responsibility or liability for the locations given for the services on the site, whether they have been located or not.
Appendix 1– Site Plan
DEPARTMENT OF PLANNING
AND INFRASTRUCTURE

SITE INVESTIGATION
LOCATIONS

CASUARINA POLICE STATION
UPGRADE

LEGEND

AUGER HOLE

GPR GEOLOGY SCAN

Easting (m AMG84)

Noting (m AMG84)

1:500
31 AUG 2007
310-14681-G01
Appendix 2– Borehole Logs
**Excavation Log**

**Client:** Department of Planning and Infrastructure  
**Project:** Site Investigation  
**Location:** Casuarina Police Station  
**Job Number:** 310/14681

<table>
<thead>
<tr>
<th>RL (m GDA)</th>
<th>Depth (m)</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>0.2</td>
<td>None</td>
</tr>
<tr>
<td>0.5</td>
<td>0.2</td>
<td>Asphalts: Gravelly SAND: fine to medium grained, fine grained gravel, red-brown, trace silt, pisolithic gravel. with clay, becomes darker trace lithic fragments</td>
</tr>
<tr>
<td>1.0</td>
<td>0.2</td>
<td>Claystone: white, red-brown, orange, iron cemented in places, appears to be highly fractured rock with soil-filled fractures. Auger cuttings comprise rock fragments to 25 mm with distinct bedding and medium plasticity Silty CLAY.</td>
</tr>
<tr>
<td>1.5</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>3.0</td>
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<td>4.0</td>
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<td>5.0</td>
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<td>7.0</td>
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<td>7.5</td>
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<td>8.0</td>
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<tr>
<td>10.0</td>
<td>0.2</td>
<td></td>
</tr>
</tbody>
</table>

**Extraction NO:** 14681BH01  
**Date Commenced:** 27/07/2007  
**Date Completed:** 27/07/2007  
**Checked By:** M Grinceri  
**Logged By:**  

**Support:** None  
**Equipment Model:** 3 tonne excavator with auger  
**Hole Width (m):** 0.2  
**Hole Length (m):** 1.7

**Excavation NO:** End of 14681BH01 at 1.7m  
**Maximum depth of auger:**

**Notes:**  
- Precollared asphalt for DCP testing to prevent damage to instrument, readings commence at 0.1m.  
- DCP Refusal. Increased torque required for drilling.  
- Excavator lifting when drilling to get penetration.
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Material Description</th>
<th>Moisture Condition</th>
<th>Consistency / Strength</th>
<th>Cementation / Weathering</th>
<th>DCP N100</th>
<th>Field Records / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>Silty SAND: fine grained, low plasticity silt, grey with with claystone lithic fragments.</td>
<td>M</td>
<td>VD</td>
<td>8</td>
<td>Grass on surface.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gravelly SAND: fine to medium grained, fine grained gravel, orange-brown, with silt, pisolitic gravel.</td>
<td></td>
<td></td>
<td></td>
<td>30 for 80mm, DCP refusal.</td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>CLAYSTONE: purple, brown, white, appears to be highly fractured rock with soil filled fractures.</td>
<td>VLS</td>
<td>XW</td>
<td></td>
<td>Drilling becomes more difficult.</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>Claystone becomes stronger, less fractured.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>End of 14681BH02 at 1.8m</td>
<td></td>
<td></td>
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</tr>
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</table>
### EXCAVATION LOG

**CLIENT:** Department of Planning and Infrastructure  
**PROJECT:** Site Investigation  
**LOCATION:** Casuarina Police Station  
**JOB NUMBER:** 310/14681  
**EXCAVATION NO:** 14681BH03  
**DATE COMMENCED:** 27/07/2007  
**DATE COMPLETED:** 27/07/2007  
**LOGGED BY:** M Grinceri  
**CHECKED BY:**

<table>
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<tr>
<th>Method</th>
<th>Support</th>
<th>Method</th>
<th>Support</th>
<th>Geological Unit</th>
<th>Description</th>
<th>Moisture Condition</th>
<th>Consistency/Strength</th>
<th>Cementation/Weathering</th>
<th>DCP N100</th>
<th>Field Records/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auger</td>
<td>None</td>
<td>Gravelly SAND</td>
<td>fine to medium grained, fine to medium grained gravel, dark brown, with root fibres, and pisolithic gravel</td>
<td>M</td>
<td>VD</td>
<td>41</td>
<td>Roots from mahogany trees.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>CLAYSTONE</td>
<td>red-brown, brown, orange, white, weathered rock with soil filled fractures, intact pieces of rock to 25 mm returning on auger</td>
<td>D</td>
<td>VLS</td>
<td>XW</td>
<td>Torque increased in drilling.</td>
<td></td>
<td></td>
<td></td>
</tr>
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<td></td>
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</tr>
</tbody>
</table>

Claystone appears to become less fractured.

Becomes much harder to drill.

End of 14681BH03 at 1.8m
Tourque increased while drilling.

100mm precollar for DCP to prevent damage to instrument.

Larger rock chips returned on auger.

End of 14681BH04 at 1.8m
<table>
<thead>
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<th>Depth (m)</th>
<th>Material Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>SM: Silty SAND: fine to medium grained, low plasticity silt, grey-brown, root fibres, with Gravel, red-brown, no roots.</td>
</tr>
<tr>
<td>1.0</td>
<td>SP: Gravely SAND: fine to medium grained, fine to medium grained gravel, red-brown, pisolithic gravel, with silt.</td>
</tr>
<tr>
<td>1.5</td>
<td>CLAYSTONE: red-brown, orange, purple, white, weathered rock with soil filled fractures.</td>
</tr>
<tr>
<td>2.0</td>
<td>End of 14681BH05 at 1.8m</td>
</tr>
</tbody>
</table>

Field Records / Comments:
- Grass on surface.
- 20 for 25 mm. DCP refusal.
- Increased torque on auger.
- High torque required for drilling.

Auger cuttings comprise chips and shavings of rock.
Appendix 3– Service Plan
Appendix 4– Geology GPR Scans
14681GPR1 GROUND PENETRATING RADAR SCAN

CASUARINA POLICE STATION UPGRADE

DEPARTMENT OF PLANNING AND INFRASTRUCTURE

INTERPRETED TOP OF CLAYSTONE

COMPARE 14681BH02

HV POWER CABLE

COMPARE 14681BH01

STORMWATER PIPE (OBLIQUE TO SCAN)

WATER PIPE

COMPARE 14681BH05

INTERPRETED TOP OF CLAYSTONE

STORMWATER PIPE

SEE AXES 15 AUG 2007

310-14681-G01

A3

B
ASSORTED SERVICES IN VERGE

INTERPRETED TOP OF CLAYSTONE

STORMWATER

WATER

COMPARE 14681BH01

COMMON TRENCH WITH HV AND LV POWER AND WATER

0 5 10 15 20 25 30 35 40
Distance (m)

0

-2

-4

-6

Depth (m)

0

-2

-4

-6

Distance (m)

0

-2

-4

-6

Depth (m)

INTERPRETED TOP OF CLAYSTONE

COMPARE 14681BH04

LV POWER

40 45 50 55 60 65 70 75
Distance (m)

40

45

50

55

60

65

70

75

0

-2

-4

-6

Depth (m)

40

45

50

55

60

65

70

75

0

-2

-4

-6

Depth (m)