Dear Brett,

Please find below a report on the geotechnical investigation carried out at 823 Botany Road, Rosebery, New South Wales (herein referred to as the ‘site’).

1 PROJECT INFORMATION

1.1 INTRODUCTION

Geo-Environmental Engineering Pty Ltd (GEE) was commissioned by KJM Project Management Pty Ltd to carry out a geotechnical investigation of the site which relates to the proposed alterations and additions to an existing commercial development.

GEE understands that the investigation was required to assist with the proposed design and construction of the building additions, in particular a new addition to the rear of the site.

Plans of the proposed development are provided in Appendix A.
1.2 **PROPOSED DEVELOPMENT**

Based on the architectural plans prepared by Fyffe Design Services (*Appendix A*), it is proposed to construct a child care centre on the site by making alterations and additions to the existing commercial building. Of particular significance to this geotechnical investigation is the addition of a raised outdoor play area over the car park at the rear (eastern end) of the site, which will also be covered by shade structures. This new addition is proposed to be supported by steel columns over pile footings.

1.3 **OBJECTIVE AND SCOPE OF WORK**

The objectives of the investigation was to assess the subsurface conditions at the rear (eastern end) of the site to assist with future design and construction of the new building addition.

To satisfy the above objectives, GEE completed the following scope of work:

- Review of available geological maps and reports held within our files,
- The drilling and logging of 4 borehole and the performance of Standard Penetration Tests (SPTs) to assess the subsurface conditions,
- The collection of soil samples for selective geotechnical testing, and
- Engineering assessment and reporting.
2 SITE INFORMATION

2.1 SITE DESCRIPTION

The site is located on the south-eastern corner of Botany Road and Harcourt Parade. The site covers an area of approximately 1,000m² and occupies the following legal allotments:

◊ Lot 1 in Deposited Plan (DP) 838607, and
◊ Lot 1 in DP 127598

At the time of the field investigation, there was a warehouse style building, with a mezzanine level office area, occupying the majority of the central and western part of the site. At the eastern end of the site was a concrete paved parking area with vehicle access from Harcourt Parade.

Of particular significance to the proposed development and future footings is the presence of a Sydney Water 150mm diameter Cast Iron (CI) sewer pipe beneath the eastern end of the site. A manhole above the sewer, which is located within Harcourt Parade, indicates that the invert depth at the manhole is 3.7m below ground surface (bgs). A copy of the Sydney Water Dial-Before-You-Dig (DBYD) plan, showing the location of the sewer, is provided in Appendix B.

2.2 TOPOGRAPHY

The site is relatively flat and according to spot heights shown on the architectural plans (Appendix A), the surface elevation across the site is between approximately 11m and 12m above Australian Height Datum (AHD).

2.3 REGIONAL GEOLOGY

A review of the regional geological map (reference 1) indicates that the site is underlain by the quaternary aged sediment formation comprising “medium to fine grained ‘marine’ sands with podsols”. These unconsolidated sediments form what is more commonly known as the ‘Botany Sands’ formation and comprise a sequence of marine and aeolian (dune) sands contained in the Botany Basin. The thickness of the ‘Botany Sands’ formation ranges from less than 10m (around the perimeter of the Botany Basin) to in excess of 60 m (in the central parts of the basin). Given that the site is located near the centre of the Basin, GEE estimates that the thickness of sand sediments in the area of the site to be at the higher end of the range.
Bedrock beneath the site is expected to comprise sandstone from the Hawkesbury Sandstone formation which typically comprises medium to very coarse grained sandstone and minor laminated mudstone and siltstone lenses.

2.4 **Regional Hydrogeology**

Permanent groundwater is likely to be unconfined and present within the ‘Botany’ Sands’ formation, with a deeper aquifer likely to be confined within the underlying Hawkesbury Sandstone formation. The direction of groundwater flow is likely to follow the general topography of the regional area and flow in a southerly direction towards Mill Pond and Lachland Swamps.

2.5 **Acid Sulfate Soil**

Acid Sulfate Soil is naturally occurring sediments and soils containing iron sulfides (principally iron sulfide, iron disulfide or their precursors). Oxidation of these soils through exposure to the atmosphere or through lowering of groundwater levels results in the generation of sulfuric acid.

Land that may contain potential acid sulfate soils was mapped by the NSW Department of Land and Water Conservation (DLWC) and based on these maps local Councils produced their own acid sulfate soil maps to be used for planning purposes.

The DLWC Acid Sulfate Soil Risk Map (reference 2), indicates that the site lies within an area with no known occurrences of acid sulphate soil and land activities within this area are "...not likely to be affected by acid sulphate soil materials”.

The ASS Planning Map produced by the City of Sydney Council (reference 3) indicates that the site lies within an area defined as “Class 5”. In accordance with the acid sulphate soil manual (reference 4) and clause 7.14 of Council's Local Environment Plan (LEP) 2012, a preliminary assessment of acid sulfate soil and potentially a management plan is recommended for any "Works within 500 metres of adjacent Class 1, 2, 3 or 4 land that is below 5 metres Australian Height Datum and by which the watertable is likely to be lowered below 1 metre Australian Height Datum on adjacent Class 1, 2, 3 or 4 land".

Firstly, the surface elevation is a minimum of 11m AHD which is higher than the 5m AHD limit specified above. Additionally, de-watering is not required as part of the proposed construction works. In this regard, there is no need for an acid sulphate soil assessment or management plan.
3 METHOD OF INVESTIGATION

The site investigation was undertaken by Stephen McCormack from GEE on the 23\textsuperscript{rd} September 2015, and comprised the following activities:

- The drilling and logging of 4 boreholes (BH1 to BH4) in the eastern portion of the site at locations requested by the structural engineer engaged on this project, and
- The performance SPTs within each of the boreholes to assess the consistency and relative density of the subsurface soils.

The boreholes were drilled using a mechanical rig owned and operated by the Site Drilling and Investigation (SDI), using 110mm diameter solid flight augers (SFA) equipped with a tungsten carbide (TC) drill-bit. Each borehole was advanced through any fill material and into the natural, undisturbed soil profile before terminating at depths of between 4.95m and 6.45m bgs.

The SPTs were performed at regular intervals within each borehole, and throughout the full depth of the soil profile, in accordance with Australian Standard Test Method AS1289.6.3.1 (reference 5).

The location of the boreholes, were estimated using measurements from existing features and is shown on Figure 1. A copy of the borehole logs is provided in Appendix C.
4 INVESTIGATION RESULTS

4.1 SUBSURFACE CONDITIONS

The site stratigraphy, as observed in the boreholes comprised near surface filling overlying natural sand and silty sand which was typical of the Botany Sand formation. Bedrock was not encountered and is expected to be beyond 15m depth in this part of Sydney. Detailed descriptions of the subsurface conditions on site is provided in Appendix C, while the generalised soil profile is provided in Table 1.

**Table 1: Summary of Subsurface Conditions**

<table>
<thead>
<tr>
<th>Layer / Unit</th>
<th>Description</th>
<th>Depth to Top of Layer (m)</th>
<th>Consistency / Relative Density(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FILL</td>
<td>CONCRETE: double slab of reinforced concrete. At BH2 and BH3 the two slabs were separated by a layer of crushed sandstone.</td>
<td>Surface</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>SAND / silty SAND: dark grey and brown, fine to medium grained sand with minor gravel content (including slag).</td>
<td>0.28 – 0.48</td>
<td>Loose</td>
</tr>
<tr>
<td></td>
<td><strong>Encountered at BH2 and BH4 only</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NATURAL SOIL</td>
<td>SAND / Silty SAND: dark grey and dark brown, fine to medium grained, moist.</td>
<td>0.1 – 1.3</td>
<td>Very loose to loose</td>
</tr>
<tr>
<td></td>
<td>SAND: mid grey to pale grey with minor brown and dark brown streaks, fine to medium grained, moist becoming wet below approximately 2.7m.</td>
<td>2.2 – 2.4</td>
<td>Loose</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3.0 – 4.0</td>
<td>Medium dense</td>
</tr>
</tbody>
</table>

4.1.1 GROUNDWATER

Permanent groundwater (i.e. the water table) was encountered during the drilling of all boreholes at depths of between 2.6m and 2.9m bgs. Taking into account the approximate surface elevation at each borehole location, this equates to a water level of approximately 9m AHD.
4.2 **Laboratory Test Results**

Representative samples of soil were collected during the fieldwork and submitted to Envirolab Services for NATA accredited testing of resistivity, sulphate, chloride and pH to provide a preliminary assessment of the exposure classification (or aggressiveness/corrosiveness potential) of the soil with respect to future buried steel and/or concrete (e.g. footings). The laboratory test results are presented in **Appendix D**, while a summary of the results is provided below.

To determine the aggressiveness of the soil and water environment on concrete or steel, the chemical test results are compared to Tables 6.1 and 6.3 from Section 6 of the Australian Standard AS 2159 - 2009 (reference 6). This section provides assessment criteria to assess the ‘exposure classification’ for a concrete or steel pile. The Standard has two classes of soil conditions:

(A) high permeability soils below groundwater; and  
(B) low permeability soils and all soils above groundwater.

For this site, condition ‘B’ soil is considered most appropriate for soils above the water table and condition A for soils below the water table. Based on the chemical testing results, the standard provides a range of ‘exposure classifications’ from non-aggressive to very severe. For the range of chemical conditions in the soil surrounding the structure, the condition leading to the most severe aggressive conditions is adopted.

A summary of the soil results is provided in **Table 2**.

**Table 2: Exposure classification (aggressivity) test results**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Type</th>
<th>Soil Condition</th>
<th>pH</th>
<th>Resistivity ohm.cm</th>
<th>Chloride mg/kg</th>
<th>Sulphate SO₄ mg/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>BH1 / 0.5 – 1.0</td>
<td>SAND</td>
<td>B</td>
<td>5.0</td>
<td>5,000</td>
<td>29</td>
<td>120</td>
</tr>
<tr>
<td>BH1 / 2.7 – 3.0</td>
<td>SAND</td>
<td>A</td>
<td>6.2</td>
<td>98,000</td>
<td>&lt;10</td>
<td>&lt;10</td>
</tr>
<tr>
<td>BH1 / 4.5 – 4.95</td>
<td>SAND</td>
<td>A</td>
<td>6.3</td>
<td>69,000</td>
<td>&lt;10</td>
<td>&lt;10</td>
</tr>
<tr>
<td>BH2 / 3.0 – 3.45</td>
<td>SAND</td>
<td>B</td>
<td>6.0</td>
<td>41,000</td>
<td>&lt;10</td>
<td>&lt;10</td>
</tr>
</tbody>
</table>
The aggressivity potential of an environment on concrete is dependent on the sulphate, and pH levels of the soil. Based on the above test results, and taking the most severe aggressive condition for each of the soil samples, the natural soil and bedrock is considered to be mildly-aggressive towards buried concrete. According to Table 4.8.1 of Australian Standard AS 3600-2009 (reference 7), mildly-aggressive soil conditions within a B-class soil environment is commensurate with an exposure classification of ‘A2’.

The corrosive potential of an environment on unprotected steel is dependent on pH, chloride, and resistivity levels of the soil. The above test results indicate that the natural clay soil and bedrock profile is non aggressive towards unprotected steel.
5 DISCUSSION

5.1 FOUNDATIONS

It is recommended that footings for the proposed new building addition at the eastern end of the site be founded within the natural, undisturbed, sand formation. Additionally, the design of appropriate footings will need to consider the adjoining sewer pipe.

Sydney Water requires that "no part of the weight of the building works is transmitted to Sydney Water's asset [e.g. sewer pipe] and so eliminates, as far as practicable, the possibility of the asset being damaged by the building works" (reference 8). By protecting the Sydney Water asset from additional loads, and potential damage, the proposed development is also protected at some future time, should repairs to the asset be required.

In this regard, it is important that foundations for the new development be extended below the 'Zone of Influence' of a pipeline asset. The 'Zone of Influence' is defined by Sydney Water as the envelope within which above-ground and/or below-ground building works have the potential to exert influence on an asset. For sand soil, the 'Zone of Influence' is conservatively depicted as the area above a 1Vertical:2 Horizontal line which extends upwards from the bottom side of the pipe trench.

With this in mind and the subsurface conditions encountered during the field investigations, in particular the depth of very loose and loose soil, GEE recommends that footings be founded below at least 4.0m depth, which is below the depth of the sewer and within natural undisturbed sand which is at least medium dense in consistency.

Considering the ground conditions and the likelihood of the sandy soils to collapse (particularly below the water table), suitable footings comprise grout or concrete injected Continuous Flight Auger (CFA) piles, or screw piles. Suggested design parameters for the proposed pile footings are provided below:
Table 3: Footing Design Parameters

<table>
<thead>
<tr>
<th>Layer</th>
<th>Bulk Density (kN/m³)</th>
<th>Allowable End Bearing Pressure (kPa)</th>
<th>Average allowable shaft adhesion (kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural SAND / Silty SAND - Very Loose and Loose</td>
<td>18</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Natural SAND - medium dense or better</td>
<td>19</td>
<td>200</td>
<td>20¹</td>
</tr>
</tbody>
</table>

Note 1: Shaft adhesion not applicable for screw piles because of the small diameter

Finally, footing systems should be designed by a suitably qualified and experienced structural engineer and the footings inspected by a geotechnical engineer during the excavation/piering stage, to confirm that the design founding conditions have been achieved.

5.1.1 Aggressivity / Exposure Classification

Based on the limited exposure classification test results (Section 4.2.1), and in accordance with AS 2159-2009 (reference 6), the subsurface concrete structures (e.g. footings) should be designed based on mildly-aggressive soil conditions for concrete. According to Australian Standard AS 3600-2009 (reference 7), the equivalent exposure classification is ‘A2’.

With respect to unprotected steel, the clay soil and bedrock profile is considered to be non-aggressive.
CONCLUSION

GEE considers that sufficient information has been gained to be confident of the subsurface conditions across the site, to assist with design and construction of the proposed new building addition.

The geotechnical issues associated with the proposed development have been addressed by the investigation and are discussed in this report. If, during construction, any conditions are encountered that vary significantly from those described or inferred in the above report, it is a condition of the report that we be advised so that those conditions, and the conclusions discussed in the report, can be reviewed and alternative recommendations assessed, if appropriate.

GEE will be pleased to assist with any further advice or geotechnical services required in regard to the proposed development.
7 **GENERAL LIMITATIONS**

Soil and rock formations are variable. The logs or other information presented as part of this report indicate the approximate subsurface conditions only at the specific test locations. Boundaries between zones on the logs or stratigraphic sections are often not distinct, but rather are transitional and have been interpreted.

The precision with which subsurface conditions are indicated depends largely on the frequency and method of sampling, and on the uniformity of subsurface conditions. The spacing of test sites also usually reflects budget and schedule constraints. Groundwater conditions described in this report refer only to those observed at the place and under circumstances noted in the report. The conditions may vary seasonally or as a consequence of construction activities on the site or adjacent sites.

Where ground conditions encountered at the site differ significantly from those anticipated in the report, either due to natural variability of subsurface conditions or construction activities, it is a condition of this report that GEE be notified of any variations and be provided with an opportunity to review the recommendations of this report. Recognition of changed soil and rock conditions requires experience and it is recommended that a suitably experienced geotechnical engineer be engaged to visit the site with sufficient frequency to detect if conditions have changed significantly.

The comments given in this report are intended only for the guidance of the design engineer, or for other purposes specifically noted in the report. The number of boreholes or test excavations necessary to determine all relevant underground conditions which may affect construction costs, techniques and equipment choice, scheduling, and sequence of operations would normally be greater than has been carried out for design purposes. Contractors should therefore rely on their own additional investigations, as well as their own interpretations of the borehole data in this report, as to how subsurface conditions may affect their work.
If you have any questions about the content of this report, please do not hesitate to contact the undersigned.

Yours sincerely

Stephen McCormack
Principal

REFERENCES


Approximate Site Boundary
APPENDIX A

Proposed Development Plans (6 Sheets)
APPENDIX B

Sydney Water Sewer Plan (1 Sheet)
APPENDIX C
Borehole Logs (5 Sheets)
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Sands</th>
<th>Graphic Log Symbol</th>
<th>Material Description</th>
<th>Consistency / Density</th>
<th>Moisture</th>
<th>Samples / Tests</th>
<th>Observations / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.45</td>
<td>180mm reinforced</td>
<td>SP</td>
<td>SAND - dark grey, fine to medium grained, with some silt.</td>
<td>very loose to loose</td>
<td>moist</td>
<td>BH1 0.5-1.0m</td>
<td></td>
</tr>
<tr>
<td>1.45</td>
<td>180mm reinforced</td>
<td>SP</td>
<td>SAND - pale grey, fine to medium grained.</td>
<td>loose</td>
<td>moist</td>
<td>BH1 1.5-1.95m</td>
<td></td>
</tr>
<tr>
<td>1.45</td>
<td>180mm reinforced</td>
<td>SP</td>
<td>Silty SAND - dark grey, fine to medium grained.</td>
<td>loose</td>
<td>moist</td>
<td>BH1 2.7-3.0m</td>
<td></td>
</tr>
<tr>
<td>1.45</td>
<td>180mm reinforced</td>
<td>SP</td>
<td>SAND - mid grey, fine to medium grained. becoming brown with some dark brown streaks.</td>
<td>medium dense</td>
<td></td>
<td>BH1 3.0-3.45m</td>
<td></td>
</tr>
<tr>
<td>1.45</td>
<td>180mm reinforced</td>
<td>SP</td>
<td>Hole Terminated at 6.45m</td>
<td></td>
<td></td>
<td>BH1 4.5-4.95m</td>
<td></td>
</tr>
<tr>
<td>1.45</td>
<td>180mm reinforced</td>
<td>SM</td>
<td>SAND - mid grey, fine to medium grained. becoming brown with some dark brown streaks.</td>
<td>medium dense</td>
<td></td>
<td>BH1 5.0-5.45m</td>
<td></td>
</tr>
</tbody>
</table>

**Materials:**
- **Fill**
- **Natural**

**Notes:**
- Hole Terminated at 6.45m
- Surface: concrete

**Additional Comments:**
- Moisture: D (Dry), Dp (Damp), SM (Slightly Moist), M (Moist), VM (Very Moist), W (Wet), Sd (Saturated)
### Geotechnical Investigation

**Project Number:** G15121ROS  
**Location / Site:** 823 Botany Road, Rosebery NSW  
**Client:** KJM Project Management Pty Ltd

**Drilling Company:** Site Drilling & Investigation  
**Date Started:** 23/09/2015  
**Ground Level:** RL11.8m (approx)  
**Drill Method:** SFA  
**Date Completed:** 23/09/2015  
**Easting:**  
**Equiment:** Edson 100  
**Northing:**  
**Hole Depth:** 6.45 m

<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Graphic Log</th>
<th>Material Description</th>
<th>Consistency / Density</th>
<th>Moisture</th>
<th>SPT</th>
<th>Observations / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>SP</td>
<td>180mm reinforced.</td>
<td>moist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td>SM</td>
<td>180mm reinforced.</td>
<td>very loose to loose</td>
<td>moist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.0</td>
<td>SP</td>
<td>Fill</td>
<td>very loose to loose</td>
<td>moist</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.0</td>
<td>Natural</td>
<td>Silty SAND- dark grey, fine to medium grained.</td>
<td>moist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.0</td>
<td>Natural</td>
<td>SAND- pale grey with some dark grey, fine to medium grained. becoming brown below 2.5m and occasional pocket of dark grey clayey silt / peat.</td>
<td>loose</td>
<td>wet</td>
<td>1  2  3  4  16</td>
<td>BH2 1.5-1.95m  11415 (N=7)</td>
</tr>
<tr>
<td>6.0</td>
<td>Natural</td>
<td>predominately brown below 4m.</td>
<td>medium dense</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.0</td>
<td>Natural</td>
<td>Hole Terminated at 6.45m</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Additional Comments**

- **Soil Flight Auger / SPT (SFA):**
- **Samples / Tests:**
- **Drawings:**
- **Checking:**
- **Logging:**
- **Graphic Log:**
- **Material Type:**
- **Damp:**
- **Slightly Moist:**
- **Moist:**
- **Very Moist:**
- **Wet:**
- **Saturated:**
- **Dry:**

**Logged By:** Stephen McCormack  
**Date:** 23/09/2015  
**Checked By:** Stephen McCormack  
**Date:** 29/09/2015
## Borehole Log Report

**Project Name:** Geotechnical Investigation  
**Location / Site:** 823 Botany Road, Rosebery NSW  
**Drilling Company:** Site Drilling & Investigation  
**Drill Method:** SFA  
**Equipment:** Edson 100  
**Client:** KJM Project Management Pty Ltd  
**Equipment:** Geo Environmental Engineering Pty Ltd  
**Date Started:** 23/09/2015  
**Date Completed:** 23/09/2015  
**Ground Level:** RL 11.85m (approx)  
---

### Materials and Observations

<table>
<thead>
<tr>
<th>ID No.</th>
<th>Material Description</th>
<th>Consistency / Density</th>
<th>Moisture</th>
<th>SPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>150mm reinforced.</td>
<td>very loose</td>
<td>moist</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>FILL- Crushed Sandstone.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>130mm reinforced.</td>
<td>very loose</td>
<td>moist</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Silty SAND / SAND- dark brown and dark grey, fine to coarse grained.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>SAND- mid grey, fine to medium grained.</td>
<td>very loose to loose</td>
<td>moist</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>predominately brown below 3.5m.</td>
<td>medium dense</td>
<td>wet</td>
<td></td>
</tr>
</tbody>
</table>

### Observations / Comments

- **Surface:** Concrete
- **Hole Terminated at 6.45m**

### Additional Comments

- **Moisture:**
  - D: Dry
  - Dp: Damp
  - SM: Slightly Moist
  - M: Moist
  - VM: Very Moist
  - W: Wet
  - Sd: Saturated

---

**Logged By:** Stephen McCormack  
**Date:** 23/09/2015  
**Checked By:** Stephen McCormack  
**Date:** 29/09/2015
<table>
<thead>
<tr>
<th>Depth (m)</th>
<th>Material Type</th>
<th>Material Description</th>
<th>Consistency / Density</th>
<th>Moisture</th>
<th>Additional Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface: concrete</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>Fill</td>
<td>150mm reinforced.</td>
<td>very loose to loose</td>
<td>moist</td>
<td></td>
</tr>
<tr>
<td>2.0</td>
<td></td>
<td>130mm reinforced.</td>
<td>very loose to loose</td>
<td>moist</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Silty SAND- dark grey, fine to medium grained, with a trace of gravel.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Silty SAND / SAND- dark grey with some grey bands, fine to medium grained.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SAND- pale grey, fine to medium grained.</td>
<td>loose</td>
<td>moist</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>relatively thin layer (&lt;0.1m) of black clayey silt/peat at 3.1m depth.</td>
<td>medium dense</td>
<td>wet</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hole Terminated at 4.95m</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Observations / Comments**

- BH4 1.5-1.95m: 3, 3, 4, N=7
- BH4 3.0-3.45m: 5, 10, 12, N=22
- BH4 4.5-4.95m: 8, 15, 17, N=32

---

**Methods**

- Graphic Log
- Soil Flight Auger
- SPT

---

**Samples / Tests**

- ID No.
- SPT

---

**Geotechnical Investigation**

- **Location / Site:** 823 Botany Road, Rosebery NSW
- **Drilling Company:** Site Drilling & Investigation
- **Drill Method:** SFA
- **Equipment:** Edson 100

---

**Ground Level:** RL11.7m (approx)

---

**Logged By:** Stephen McCormack  
**Date:** 23/09/2015

---

**Checked By:** Stephen McCormack  
**Date:** 29/09/2015
APPENDIX D

Laboratory Report (6 Sheets)
CERTIFICATE OF ANALYSIS

134922

Client:
Geo-Environmental Engineering
82 Bridge St
Lane Cove
NSW 2066

Attention: Steve McCormack

Sample log in details:
Your Reference: G15121ROS
No. of samples: 4 Soils
Date samples received/completed instructions received 24/09/15 / 24/09/15

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:
Date results requested by: / Issue Date: 1/10/15 / 30/09/15
Date of Preliminary Report: Not Issued
NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. Tests not covered by NATA are denoted with *.

Results Approved By:

[Signature]
Jacinta Hurst
Laboratory Manager
<table>
<thead>
<tr>
<th>Misc Inorg - Soil</th>
<th>Our Reference:</th>
<th>UNITS</th>
<th>134922-1</th>
<th>134922-2</th>
<th>134922-3</th>
<th>134922-4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Your Reference</td>
<td>--------------</td>
<td>BH1</td>
<td>BH1</td>
<td>BH1</td>
<td>BH2</td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td>--------------</td>
<td>0.5-1.0</td>
<td>2.7-3.0</td>
<td>4.5-4.95</td>
<td>3.0-3.45</td>
<td></td>
</tr>
<tr>
<td>Type of sample</td>
<td>--------------</td>
<td>Soil</td>
<td>Soil</td>
<td>Soil</td>
<td>Soil</td>
<td></td>
</tr>
<tr>
<td>pH 1:5 soil:water</td>
<td>pH Units</td>
<td>5.0</td>
<td>6.2</td>
<td>6.3</td>
<td>6.0</td>
<td></td>
</tr>
<tr>
<td>Chloride, Cl 1:5</td>
<td>mg/kg</td>
<td>29</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td></td>
</tr>
<tr>
<td>Sulphate, SO4 1:5</td>
<td>mg/kg</td>
<td>120</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td>&lt;10</td>
<td></td>
</tr>
<tr>
<td>Resistivity in</td>
<td>ohmm</td>
<td>50</td>
<td>980</td>
<td>690</td>
<td>410</td>
<td></td>
</tr>
</tbody>
</table>

*Resistivity in soil*
<table>
<thead>
<tr>
<th>Method ID</th>
<th>Methodology Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inorg-001</td>
<td>pH - Measured using pH meter and electrode in accordance with APHA latest edition, 4500-H+. Please note that the results for water analyses are indicative only, as analysis outside of the APHA storage times.</td>
</tr>
<tr>
<td>Inorg-081</td>
<td>Anions - a range of Anions are determined by Ion Chromatography, in accordance with APHA latest edition, 4110-B.</td>
</tr>
<tr>
<td>Inorg-002</td>
<td>Conductivity and Salinity - measured using a conductivity cell at 25oC in accordance with APHA 22nd ED 2510 and Rayment &amp; Lyons. Resistivity is calculated from Conductivity.</td>
</tr>
<tr>
<td>QUALITY CONTROL</td>
<td>UNITS</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------</td>
</tr>
<tr>
<td>Date prepared</td>
<td></td>
</tr>
<tr>
<td>Date analysed</td>
<td></td>
</tr>
<tr>
<td>pH 1:5 soil:water</td>
<td>pH Units</td>
</tr>
<tr>
<td>Chloride, Cl 1:5 soil:water</td>
<td>mg/kg</td>
</tr>
<tr>
<td>Sulphate, SO4 1:5 soil:water</td>
<td>mg/kg</td>
</tr>
<tr>
<td>Resistivity in soil*</td>
<td>ohm.m</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>QUALITY CONTROL</th>
<th>UNITS</th>
<th>Dup. Sm#</th>
<th>Duplicate results</th>
<th>Spike Sm#</th>
<th>Spike % Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Misc Inorg - Soil</td>
<td></td>
<td>[NT]</td>
<td>[NT]</td>
<td>134922-2</td>
<td>25/09/2015</td>
</tr>
<tr>
<td>Date prepared</td>
<td></td>
<td>[NT]</td>
<td>[NT]</td>
<td>134922-2</td>
<td>25/09/2015</td>
</tr>
<tr>
<td>Date analysed</td>
<td></td>
<td>[NT]</td>
<td>[NT]</td>
<td>[NR]</td>
<td>[NR]</td>
</tr>
<tr>
<td>pH 1:5 soil:water</td>
<td>pH Units</td>
<td>[NT]</td>
<td>[NT]</td>
<td>[NR]</td>
<td>[NR]</td>
</tr>
<tr>
<td>Chloride, Cl 1:5 soil:water</td>
<td>mg/kg</td>
<td>[NT]</td>
<td>[NT]</td>
<td>134922-2</td>
<td>110%</td>
</tr>
<tr>
<td>Sulphate, SO4 1:5 soil:water</td>
<td>mg/kg</td>
<td>[NT]</td>
<td>[NT]</td>
<td>134922-2</td>
<td>109%</td>
</tr>
<tr>
<td>Resistivity in soil*</td>
<td>ohm.m</td>
<td>[NT]</td>
<td>[NT]</td>
<td>[NR]</td>
<td>[NR]</td>
</tr>
</tbody>
</table>
Report Comments:

Asbestos ID was analysed by Approved Identifier: Not applicable for this job
Asbestos ID was authorised by Approved Signatory: Not applicable for this job

INS: Insufficient sample for this test
NA: Test not required
<: Less than
PQL: Practical Quantitation Limit
RPD: Relative Percent Difference
>: Greater than
NT: Not tested
NA: Test not required
LCS: Laboratory Control Sample
Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.

Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.

Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.

LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.

Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.

Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.

Spikes for Physical and Aggregate Tests are not applicable.

For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.

Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

In circumstances where no duplicate and/or sample spike has been reported at 1 in 10 and/or 1 in 20 samples respectively, the sample volume submitted was insufficient in order to satisfy laboratory QA/QC protocols.

When samples are received where certain analytes are outside of recommended technical holding times (THTs), the analysis has proceeded. Where analytes are on the verge of breaching THTs, every effort will be made to analyse within the THT or as soon as practicable.