GEOTECHNICS PTY LTD
CONSULTING GEOTECHNICAL ENGINEERS

# GEOTECHNICAL INVESTIGATION & ACID SULFATE SOILS (ASS) ASSESSMENT

**FOR**

## FEROS HOTEL GROUP PTY LTD

*120 Queen Street, Berry, New South Wales*

*Report No: 22/3973A*

*Project No: 32015/7024D-G*

May 2023

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# 1. INTRODUCTION

This report presents the results of a combined Geotechnical Investigation and Acid Sulfate Soils (ASS) Assessment carried out by STS Geotechnics Pty Limited (STS) for the proposed alterations and additions to be carried out at 120 Queen Street, Berry, New South Wales. Reference to the Shoalhaven City Council LEP indicates the site is in a Class 5 area with respect to Acid Sulfate Soils (ASS).

The following drawings were provided to assist with the preparation of this report:

- Architectural drawings prepared by H&E Architects, Project 2709, Rev 01, Drawing DA1-0000 to DA1-9801, dated 18/05/2023.

Based on the drawings provided, the proposed additions and alterations include a new accommodation building with a single level basement car park which will require excavating about 3 metres below the existing ground surface. Additional excavations may be required for footings or service trenches.

The purpose of the investigation was to provide information on:

- Site conditions and regional geology,
- Subsurface conditions
- Site Classification according to AS2870 (soil reactivity),
- Excavation conditions,
- Safe batter slopes,
- Retaining wall design parameters,
- Foundation design parameters including foundation options,
- Exposure classification/soil aggressiveness according to AS2870 and AS2159, and
- ASS assessment and need for an ASS Management Plan.

The investigation was undertaken in accordance with STS proposal P22-557 dated September 20, 2022.

Our scope of work did not include a contamination assessment.

# 2. NATURE OF THE INVESTIGATION

## 2.1. Fieldwork

The fieldwork consisted of drilling ten (10) boreholes numbered BH1 to BH10 (inclusive), at the locations shown on attached Drawing No. 22/3973**.** Restricted site access dictated the borehole

locations. Except for BH9 and BH10, the boreholes were drilled using drilling rigs. BH9 and BH10 were drilled using a hand auger. BH1 to BH7 (inclusive) were drilled using a utility mounted Christie Drilling rig and BH8 was drilled using a mini-Christie drilling rig, both rigs are owned, and operated by STS. Soil strengths were assessed by undertaking a Dynamic Cone Penetrometer (DCP) test adjacent to each borehole location.

Drilling operations were undertaken by one of STS's senior technical officers who also logged the subsurface conditions encountered.

Representative soil samples were collected from the boreholes for subsequent laboratory testing.

### 2.2. Laboratory Testing

To assess the soil for its aggressiveness, selected representative soil samples were tested to determine the following:

- pH,
- Sulphate content ($SO_4$),
- Chloride content (Cl) and
- Electrical Conductivity (EC).

To assist with determining the site classification, three Shrink Swell tests were carried out on selected representative soil samples.

Detailed test reports are given in Appendix B.

## 3. GEOLOGY AND SITE CONDITIONS

The Shoalhaven Coastal Quaternary geological series sheet at a scale of 1:100,000 indicates that the site is underlain by Pleistocene terrace, with materials comprising silt, clay, fluvial sand and gravel.

At the time of the fieldwork, an existing hotel, was present with surrounding paved driveways, grassed areas, shrubs, and trees. The surface profile falls approximately 1 metre to the north. The site is bound by Queen Street to the north and residential and commercial buildings in the surrounding properties.

## 4. SUBSURFACE CONDITIONS

When assessing the subsurface conditions across a site from a limited number of boreholes, there is the possibility that variations may occur between test locations. The data derived from the site investigation programme are extrapolated across the site to form a geological model and an engineering opinion is rendered about overall subsurface conditions and their likely behaviour

regarding the proposed development. The actual condition at the site may differ from those inferred, since no subsurface exploration programme, no matter how comprehensive, can reveal all subsurface details and anomalies, particularly on a site such as this where there have been previous developments.

The subsurface conditions generally comprise fill overlying silty clays and weathered sandstone. The fill is present from surface to the depths of 0.2 to 1.1 metres. In BH9 the hand auger could not be penetrated the fill below a depth of 0.9 metres. In BH1 to BH7 the fill is underlain by stiff, becoming very stiff with depth, silty clays to the depth of drilling, 3.5 metres. In BH8 auger refusal occurred in weathered sandstone at a depth of, 3.8 metres. In BH10 drilling with hand auger was discontinued at a depth of 3.0 metres.

No groundwater was observed during the fieldwork.

The subsurface conditions observed are recorded on the borehole logs given in Appendix A. An explanation of the terms used on the logs is also given in Appendix A. Notes relating to geotechnical reports are also attached.

# 5. GEOTECHNICAL DISCUSSION

## 5.1. Site Classification (AS2870)

The classification has been prepared in accordance with the guidelines set out in the "Residential Slabs and Footings" Code, AS2870 – 2011.

To assist with determining the site classification, three shrink/swell tests were carried out on selected representative soil samples retrieved from the site. The detailed test report is attached and summarised in Table 5.1.

Table 5.1 – Shrink Swell Test Summary

| Location | Depth (m) | Material Description | Shrink/Swell Index (% per ΔpF) |
|---|---|---|---|
| BH1 | 1.0 – 1.2 | SILTY CLAY: medium to high plasticity, red/brown | 2.5 |
| BH4 | 0.6 – 0.9 | SILTY CLAY: medium to high plasticity, red/brown | 3.2 |
| BH6 | 0.6 – 0.8 | SILTY CLAY: medium to high plasticity, red/brown | 2.5 |

Because there are trees and existing dwelling present, abnormal moisture conditions (AMC) prevail at the site. (Refer to Section 1.3.3 of AS2870).

Because of the AMC and fill greater than 400mm, the site is classified a *Problem Site (P).* it is not appropriate to re-classify the site.

Foundation design and construction consistent with this classification shall be adopted as specified in the above referenced standard and in accordance with the design parameters provided below.

## 5.2. Excavation Conditions and Safe Batter Slopes

The basement excavation of about 3 metres below the existing ground level is expected to encounter fill and natural silty clays. Excavators without assistance should be able to remove the soils to this depth.

In the short term, dry cut slopes in clayey soils should remain stable at an angle of 1(H) to 1(V). In the long-term dry cut slopes in clayey soils formed at an angle of 2(H) to 1(V) should remain stable. Slopes cut at this angle would be subject to erosion unless protected by topsoil and diversion drains at the crest of the slopes. The above temporary batters should remain stable provided that all surcharge loads, including construction loads, are kept at a distance of at least 2h (where 'h' is the height of the batter in metres) from the crest of the batter. If steeper batters are to be used, then these must be supported by shotcrete and soil nail system designed by a suitable experienced structural or geotechnical engineer.

Where space for temporary batters is not available, a suitable retention system will be required for the support of the entire depth of excavation. Soldier piles with shotcrete infill are suitable for this site.

Excavations on the subject site should not extend below the zone of influence of any adjacent structure footings, without first installing temporary support or discussing the works with a geotechnical engineer.

## 5.3. Retaining Wall Design Parameters

The major consideration when selecting earth pressure coefficients for the design of retaining walls is the need to limit deformations that can take place outside the excavation. When considering the design of the supports, it will be necessary to allow for the loading from structures in adjoining properties, any ground surface slope, and any water table present. Where the structures in adjoining properties are within the zone of influence of the excavation, it will be necessary to adopt $K_o$ conditions when designing the temporary support. Anchors or props can be used to provide the required support.

If anchors extend into adjoining property, it will be necessary to obtain the permission of the property owners. When props or anchors are used for support, a rectangular earth pressure distribution should be adopted on the active side of the support. $K_o$ should also be used to design the permanent support.

The parameters used to proportion retaining wall support depends on whether the walls can be permitted to deflect. For walls, which cannot be permitted to deflect, an at rest earth pressure

coefficient (Ko) of 0.6 should be adopted for the soils. For walls that can be allowed to deflect, an active earth pressure coefficient (Ka) of 0.4 should be adopted for the soils. A passive earth pressure coefficient (Kp) of 2.5 may be used for the stiff or better natural silty clays. A bulk density of 19 kN/m$^3$ may be used for the natural silty clays.

## 5.4. Foundation Design Parameters

The fill encountered in the site does not appear to be placed as controlled engineered fill, therefore we do not recommend founding any structural load within the fill.

Pad and/or strip footings founded in the stiff to very stiff natural materials underlying the fill may be proportioned using an allowable bearing pressure of 100 kPa. The minimum depth of founding must comply with the requirements of AS2870.

Once bulk excavation for the basement are complete, very stiff natural silty clays will be exposed at the base of the excavation. Footings founded in very stiff natural silty clays may be proportioned using an allowable bearing pressure of 200 kPa.

Piles founded in very stiff silty clays may be proportioned using an allowable end bearing pressure of 300 kPa, provided their depth to diameter ratio exceeds a value of 4. An allowable adhesion value of 20 kPa may be adopted for the portion of the shaft within natural soils and below a depth of 0.5 metres.

If a higher load carrying capacity is required, piles founded in weathered sandstone may be proportioned using an allowable end bearing pressure of 800 kPa. An allowable adhesion value of 80 kPa may be adopted for the portion of the shaft in weathered rock. When piles are founded in rock the adhesion within the overlying soils must be ignored.

To ensure the bearing values given can be achieved, care should be taken to ensure the base of the excavations is free of all loose material prior to concreting. To this end, it is recommended that all excavations be concreted as soon as possible, preferably immediately after excavating, cleaning, inspecting and approval. Pile excavations should not be left open overnight. The possibility of groundwater inflow needs to be considered when drilling the piles and pouring concrete.

The slab may be designed for movements consistent with a *Highly Reactive (H1)* classification. Where fill is present, piles will be required to suspend the slab.

During foundation construction, should the subsurface conditions vary to those inferred in this report, a suitably experienced geotechnical engineer should review the design and recommendations given above to determine if any alterations are required.

### 5.5. Soil Aggressiveness

The aggressiveness or erosion potential of an environment in building materials, particularly concrete and steel is dependent on the levels of soil pH and the types of salts present, generally sulfates and chlorides. To determine the degree of aggressiveness, the test values obtained are compared to Tables 6.4.2 (C) and 6.5.2 (C) in AS2159 – 2009 Piling – Design and Installation. The test results are summarised in Table 5.2.

Table 5.2 – Soil Aggressiveness Summary

| Sample No. | Location | Depth (m) | pH | Sulfate (mg/kg) | Chloride (mg/kg | Electrical Conductivity (dS/m) | |
|---|---|---|---|---|---|---|---|
| | | | | | | $EC_{1:5}$ | $EC_e$ |
| S1 | BH1 | 0.8 | 6.2 | 280 | 130 | 0.196 | 1.6 |
| S2 | BH3 | 1.0 | 6.9 | 230 | 10 | 0.152 | 1.2 |
| S3 | BH4 | 2.0 | 5.3 | 200 | <10 | 0.095 | 0.8 |

The soils on the site are cohesive and above groundwater. Therefore, soil conditions B are considered appropriate (AS2159).

A review of the durability aspects indicates that:

- pH : minimum value of 5.3
- $SO_4$ : maximum value of 280 mg/kg (ppm) < 5000 ppm
- Cl : maximum value of 130 mg/kg (ppm) < 5000 ppm
- $EC_e$ : maximum value of 1.6 dS/m

In accordance with AS2159-2009 the exposure classification for the onsite soils is mildly aggressive to concrete and non-aggressive for steel. In accordance with AS2870-2011 the soils are classified as A2.

Reference to DLWC (2002) "Site Investigations for Urban Salinity" indicates that an $EC_e$ values of 0.8 to 1.6 dS/m are consistent with the presence of non-saline soils.

## 6. ACID SULFATE SOIL ASSESSMENT

### 6.1. Introduction

ASS is the common name given to sediments and soils containing iron sulfides which, when exposed to oxygen generate sulfuric acid. Natural processes formed most acid sulfate sediments when certain conditions existed in the Holocene geological period (the last 10,000 years). Formation conditions require the presence of iron-rich sediments, sulfate (usually from seawater), removal of reaction products such as bicarbonate, the presence of sulfate reducing bacteria and a plentiful

supply of organic matter. It should be noted that these conditions exist in mangroves, salt marsh vegetation or tidal areas, and at the bottom of coastal rivers and lakes.

The relatively specific conditions under which acid sulfate soils are formed usually limit their occurrence to low lying parts of coastal floodplains, rivers, and creeks. This includes areas with saline or brackish water such as deltas, coastal flats, backswamps and seasonal or permanent freshwater swamps that were formerly brackish. Due to flooding and stormwater erosion, these sulfidic sediments may continue to be re-distributed through the sands and sediments of the estuarine floodplain region. Sulfidic sediment may be found at any depth in suitable coastal sediments – usually beneath the water table.

Any lowering in the water table that covers and protects potential ASS will result in their aeration and the exposure of iron sulfide sediments to oxygen. The lowering in the water table can occur naturally due to seasonal fluctuations and drought or any human intervention, when carrying out any excavations during site development. Potential ASS can also be the exposed to air during physical disturbance with the material at the disturbance face, as well as the extracted material, both potentially being oxidised. The oxidation of iron sulfide sediments in potential ASS results in ASS soils.

Successful management of areas with ASS is possible but must consider the specific nature of the site and the environmental consequences of development. While it is preferable that sites exhibiting acid sulfate characteristics are not disturbed, management techniques have been devised to minimise and manage impacts in certain circumstances.

When works involving the disturbance of soil or the change of groundwater levels are proposed in coastal areas, a preliminary assessment should be undertaken to determine whether acid sulfate soils are present and if the proposed works are likely to disturb these soils.

## 6.2. Presence of ASS

Reference to the Burrier/ Berry ASS Risk Map (Edition Two, December 1997) indicates that the property is within an area with no known occurrence of ASS. It should be noted that maps are a guide only.

The following geomorphic or site criteria are normally used to determine if acid sulfate soils are likely to be present:

- sediments of recent geological age (Holocene epoch)
- soil horizons less than 5 in AHD
- marine or estuarine sediments and tidal lakes
- in coastal wetlands or back swamp areas

### 6.3. Assessment

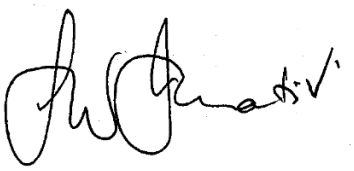
Available maps suggest that the proposed site has a surface elevation of approximately RL 12metres AHD. The site is underlain by weathered sandstone. The observed site conditions are not consistent with the geomorphic criteria necessary for the presence of ASS. No groundwater was observed in the boreholes during the site drilling, and as no basement levels are proposed there will be no need to undertake any dewatering. As a result, site development will not result in the lowering of the groundwater where nearby ASS may be present and will therefore not expose ASS to oxidation. Based on our onsite observations, it is our opinion that the proposed construction will not intercept any ASS nor result on the lowering of any groundwater. Therefore, land management activities are unlikely to be affected by ASS materials.

Our assessment is the proposed construction will not require the preparation of an Acid Sulfate Soil Management Plan.

## 7. FINAL COMMENTS

During construction, should the subsurface conditions vary from those inferred above, we would be contacted to determine if any changes should be made to our recommendations. The exposed bearing surfaces for footings should be inspected by a geotechnical engineer to ensure the allowable pressure given has been achieved.

*Mrigesh Tamang*
*Senior Geotechnical Engineer*
*STS Geotechnics Pty Limited*



*Laurie Ihnativ*
*Principal Geotechnical Engineer*
*STS Geotechnics Pty Limited*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|---|---|---|
| STS Geotechnics Pty. Ltd. | Scale: Unknown | Date: January 2023 |
| Client: FEROS HOTEL GROUP PTY LTD | | |
| GEOTECHNICAL INVESTIGATION<br>BERRY HOTEL—120 QUEEN STREET, BERRY<br>BOREHOLE AND PENETROMETER LOCATIONS | Project No. 32015/7024D-G | |
| | Drawing No: 22/3973 | |

# Important Information

GEOTECHNICS PTY LTD
CONSULTING GEOTECHNICAL ENGINEERS

## INTRODUCTION

These notes have been provided to outline the methodology and limitations inherent in geotechnical reporting. The issues discussed are not relevant to all reports and further advice should be sought if there are any queries regarding any advice or report. When copies of reports are made, they should be reproduced in full.

## GEOTECHNICAL REPORTS

Geotechnical reports are prepared by qualified personnel on the information supplied or obtained and are based on current engineering standards of interpretation and analysis.

Information may be gained from limited subsurface testing, surface observations, previous work and is supplemented by knowledge of the local geology and experience of the range of properties that may be exhibited by the materials present. For this reason, geotechnical reports should be regarded as interpretative rather than factual documents, limited to some extent by the scope of information on which they rely.

Where the report has been prepared for a specific purpose (eg. design of a three-storey building), the information and interpretation may not be appropriate if the design is changed (eg. a twenty storey building). In such cases, the report and the sufficiency of the existing work should be reviewed by STS Geotechnics Pty Limited in the light of the new proposal.

Every care is taken with the report content, however, it is not always possible to anticipate or assume responsibility for the following conditions:

- Unexpected variations in ground conditions. The potential for this depends on the amount of investigative work undertaken.
- Changes in policy or interpretation by statutory authorities.
- The actions of contractors responding to commercial pressures.

If these occur, STS Geotechnics Pty Limited would be pleased to resolve the matter through further investigation, analysis or advice.

## UNFORSEEN CONDITIONS

Should conditions encountered on site differ markedly from those anticipated from the information contained in the report, STS Geotechnics Pty Limited should be notified immediately. Early identification of site anomalies generally results in any problems being more readily resolved and allows re-interpretation and assessment of the implications for future work.

## SUBSURFACE CONDITIONS

Logs of a borehole, recovered core, test pit, excavated face or cone penetration test are an engineering and/or geological interpretation of the subsurface conditions. The reliability of the logged information depends on the drilling/testing method, sampling and/or observation spacings and the ground conditions. It is not always possible or economic to obtain continuous high quality data. It should also be recognised that the volume or material observed or tested is only a fraction of the total subsurface profile.

Interpretation of subsurface information and application to design and construction must take into consideration the spacing of the test locations, the frequency of observations and testing, and the possibility that geological boundaries may vary between observation points.

Groundwater observations and measurements outside of specially designed and constructed piezometers should be treated with care for the following reasons:

- In low permeability soils groundwater may not seep into an excavation or bore in the short time it is left open.
- A localised perched water table may not represent the true water table.
- Groundwater levels vary according to rainfall events or season.
- Some drilling and testing procedures mask or prevent groundwater inflow.

The installation of piezometers and long term monitoring of groundwater levels may be required to adequately identify groundwater conditions.

## SUPPLY OF GETEOECHNICAL INFORMATION OR TENDERING PURPOSES

It is recommended tenderers are provided with as much geological and geotechnical information that is available and that where there are uncertainties regarding the ground conditions, prospective tenders should be provided with comments discussing the range of likely conditions in addition to the investigation data.

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# APPENDIX A – BOREHOLE LOGS AND EXPLANATION SHEETS

**STS Geotechnics Pty Ltd**

# GEOTECHNICAL LOG - NON CORE BOREHOLE

| | | | |
|---|---|---|---|
| Client: Feros Hotel Group Pty Ltd | Project: 32015/7024D-G | **BOREHOLE NO.:** | **BH 1** |
| Project: Berry Hotel, 120 Queen Street, Berry | Date : November 8, 2022 | Sheet 1 of 1 | |
| Location: Refer to Drawing No. 22/3973 | Logged: MB Checked By: MT | | |

| WATER TABLE | SAMPLES | DEPTH (m) | DESCRIPTION OF DRILLED PRODUCT<br>Soil Name, grain size /plasticity, colour; secondary constituents (Inc. Description) , minor constituents including other remarks | SYMBOL | CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels) | MOISTURE |
|---|---|---|---|---|---|---|
| | S1 @ 0.8 m | | FILL: SANDY GRAVEL: grey/brown | GM | - | D |
| | U50 | 1.0 | SILTY CLAY: medium to high plasticity, red/brown | CI | STIFF | D-M |
| | | | | | VERY STIFF | |
| | | 2.0 | | | | |
| | | 3.0 | | | | |
| | | | BOREHOLE DISCONTINUED AT 3.5 M | | | |
| | | 4.0 | | | | |
| | | 5.0 | | | | |

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100

Angle from Vertical (°):

Drill Bit: Spiral

**STS Geotechnics Pty Ltd**

# GEOTECHNICAL LOG - NON CORE BOREHOLE

| | | |
|---|---|---|
| Client: Feros Hotel Group Pty Ltd | Project: 32015/7024D-G | **BOREHOLE NO.: BH 2** |
| Project: Berry Hotel, 120 Queen Street, Berry | Date : November 8, 2022 | Sheet 1 of 1 |
| Location: Refer to Drawing No. 22/3973 | Logged: MB Checked By: MT | |

| WATER TABLE | SAMPLES | DEPTH (m) | DESCRIPTION OF DRILLED PRODUCT<br>Soil Name, grain size /plasticity, colour; secondary constituents (Inc. Description) , minor constituents including other remarks | SYMBOL | CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels) | MOISTURE |
|---|---|---|---|---|---|---|
| | | | FILL: SANDY GRAVEL: grey | GW | - | D |
| | | | SILTY CLAY: medium to high plasticity, red/brown | CI | STIFF | D-M |
| | | 1.0 | | | VERY STIFF | |
| | | 2.0 | | | | |
| | | 3.0 | | | | |
| | | | BOREHOLE DISCONTINUED AT 3.5 M | | | |
| | | 4.0 | | | | |
| | | 5.0 | | | | |

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100

Angle from Vertical (°):

Drill Bit: Spiral

**STS Geotechnics Pty Ltd**

# GEOTECHNICAL LOG - NON CORE BOREHOLE

| | | | |
|---|---|---|---|
| Client: Feros Hotel Group Pty Ltd | Project: 32015/7024D-G | **BOREHOLE NO.:** | **BH 3** |
| Project: Berry Hotel, 120 Queen Street, Berry | Date : November 8, 2022 | Sheet 1 of 1 | |
| Location: Refer to Drawing No. 22/3973 | Logged: MB Checked By: MT | | |

| WATER TABLE | SAMPLES | DEPTH (m) | DESCRIPTION OF DRILLED PRODUCT<br>Soil Name, grain size /plasticity, colour; secondary constituents (Inc. Description) , minor constituents including other remarks | SYMBOL | CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels) | MOISTURE |
|---|---|---|---|---|---|---|
| | | | FILL: SANDY GRAVEL: grey | GW | - | D |
| | S2<br>@ 1.0 m | 1.0 | SILTY CLAY: medium to high plasticity, red/brown, trace of fine to medium grained gravel | CI | STIFF<br>VERY STIFF | M |
| | | 2.0 | | | | |
| | | 3.0 | | | | |
| | | | BOREHOLE DISCONTINUED AT 3.5 M | | | |
| | | 4.0 | | | | |
| | | 5.0 | | | | |

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100

Angle from Vertical (°):

Drill Bit: Spiral

**STS Geotechnics Pty Ltd**

# GEOTECHNICAL LOG - NON CORE BOREHOLE

| | | | |
|---|---|---|---|
| Client: Feros Hotel Group Pty Ltd | Project: 32015/7024D-G | **BOREHOLE NO.:** | **BH 4** |
| Project: Berry Hotel, 120 Queen Street, Berry | Date : November 8, 2022 | Sheet 1 of 1 | |
| Location: Refer to Drawing No. 22/3973 | Logged: MB Checked By: MT | | |

| WATER TABLE | SAMPLES | DEPTH (m) | DESCRIPTION OF DRILLED PRODUCT<br>Soil Name, grain size /plasticity, colour; secondary constituents (Inc. Description) , minor constituents including other remarks | SYMBOL | CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels) | MOISTURE |
|---|---|---|---|---|---|---|
| | S4 @ 0.2 m | | FILL: SANDY GRAVEL: grey | GW | - | D |
| | | | SILTY CLAY: medium to high plasticity, red/brown | CL | STIFF | M |
| | U50 | 1.0 | | | | |
| | | | | | VERY STIFF | |
| | S5 @ 1.5 m | 2.0 | | | | |
| | | 3.0 | | | | |
| | | | BOREHOLE DISCONTINUED AT 3.5 M | | | |
| | | 4.0 | | | | |
| | | 5.0 | | | | |

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100

Angle from Vertical (°):

Drill Bit: Spiral

**STS Geotechnics Pty Ltd**

# GEOTECHNICAL LOG - NON CORE BOREHOLE

| | | | |
|---|---|---|---|
| Client: Feros Hotel Group Pty Ltd | Project: 32015/7024D-G | **BOREHOLE NO.:** | **BH 5** |
| Project: Berry Hotel, 120 Queen Street, Berry | Date : November 8, 2022 | Sheet 1 of 1 | |
| Location: Refer to Drawing No. 22/3973 | Logged: MB Checked By: MT | | |

| WATER TABLE | SAMPLES | DEPTH (m) | DESCRIPTION OF DRILLED PRODUCT<br>Soil Name, grain size /plasticity, colour; secondary constituents (Inc. Description) , minor constituents including other remarks | SYMBOL | CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels) | MOISTURE |
|---|---|---|---|---|---|---|
| | | | FILL: SANDY GRAVEL: grey | GS | - | D |
| | | | SILTY CLAY: medium to high plasticity, red/brown | CI | STIFF | M |
| | | 1.0 | | | VERY STIFF | |
| | S3<br>@ 2.0 m | 2.0 | | | | |
| | | 3.0 | | | | |
| | | | BOREHOLE DISCONTINUED AT 3.5 M | | | |
| | | 4.0 | | | | |
| | | 5.0 | | | | |

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100

Angle from Vertical (°):

Drill Bit: Spiral

**STS Geotechnics Pty Ltd**

# GEOTECHNICAL LOG - NON CORE BOREHOLE

| | | |
|---|---|---|
| Client: Feros Hotel Group Pty Ltd | Project: 32015/7024D-G | **BOREHOLE NO.: BH 6** |
| Project: Berry Hotel, 120 Queen Street, Berry | Date : November 8, 2022 | Sheet 1 of 1 |
| Location: Refer to Drawing No. 22/3973 | Logged: MB Checked By: MT | |

| WATER TABLE | SAMPLES | DEPTH (m) | DESCRIPTION OF DRILLED PRODUCT<br>Soil Name, grain size /plasticity, colour; secondary constituents (Inc. Description) , minor constituents including other remarks | SYMBOL | CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels) | MOISTURE |
|---|---|---|---|---|---|---|
| | | | FILL: SILTY GRAVELLY CLAY: low to medium plasticity, dark brown | CI | - | M |
| | U50 | | SILTY CLAY: medium to high plasticity, red/brown | CI | STIFF | M |
| | | 1.0 | | | VERY STIFF | |
| | | 2.0 | | | | |
| | | 3.0 | | | | |
| | | | BOREHOLE DISCONTINUED AT 3.5 M | | | |
| | | 4.0 | | | | |
| | | 5.0 | | | | |

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100

Angle from Vertical (°):

Drill Bit: Spiral

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# GEOTECHNICAL LOG - NON CORE BOREHOLE

| | | |
|---|---|---|
| Client: Feros Hotel Group Pty Ltd | Project: 32015/7024D-G | **BOREHOLE NO.: BH 7** |
| Project: Berry Hotel, 120 Queen Street, Berry | Date : November 8, 2022 | Sheet 1 of 1 |
| Location: Refer to Drawing No. 22/3973 | Logged: MB Checked By: MT | |

| WATER TABLE | SAMPLES | DEPTH (m) | DESCRIPTION OF DRILLED PRODUCT<br>Soil Name, grain size /plasticity, colour; secondary constituents (Inc. Description) , minor constituents including other remarks | SYMBOL | CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels) | MOISTURE |
|---|---|---|---|---|---|---|
| | | | FILL: SILTY GRAVELLY CLAY: low plasticity, dark brown | CI | - | D |
| | | 1.0 | | | | |
| | | | SILTY CLAY: medium to high plasticity, red/brown | CH | STIFF<br>VERY STIFF | M |
| | | 2.0 | | | | |
| | | 3.0 | | | | |
| | | | BOREHOLE DISCONTINUED AT 3.5 M | | | |
| | | 4.0 | | | | |
| | | 5.0 | | | | |

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Christie

Hole Diameter (mm): 100

Angle from Vertical (°):

Drill Bit: Spiral

**STS Geotechnics Pty Ltd**

# GEOTECHNICAL LOG - NON CORE BOREHOLE

| | | |
|---|---|---|
| Client: Feros Hotel Group Pty Ltd | Project: 32015/7024D-G | **BOREHOLE NO.: BH 8** |
| Project: Berry Hotel, 120 Queen Street, Berry | Date : December 19, 2022 | Sheet 1 of 1 |
| Location: Refer to Drawing No. 22/3973 | Logged: EJ/M: Checked By: MT | |

| WATER TABLE | SAMPLES | DEPTH (m) | DESCRIPTION OF DRILLED PRODUCT<br>Soil Name, grain size /plasticity, colour; secondary constituents (Inc. Description) , minor constituents including other remarks | SYMBOL | CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels) | MOISTURE |
|---|---|---|---|---|---|---|
| | | | FILL: SAND: fine to medium grained, brown | SP | - | D |
| | | 1.0 | SILTY CLAY: medium plasticity, brown, trace of gravel | CI | STIFF | M |
| | | 2.0 | | | VERY STIFF | |
| | | | SILTY CLAY: low plasticity, brown, trace of gravel | CL | VERY STIFF | M |
| | | 3.0 | SILTY CLAY: low plasticity, brown | CL | VERY STIFF | M |
| | | 4.0 | AUGER REFUSAL AT 3.8 M ON WEATHERED SANDSTONE | | | |
| | | 5.0 | | | | |

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Mini Christie

Hole Diameter (mm): 100

Angle from Vertical (°):

Drill Bit: Spiral

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# GEOTECHNICAL LOG - NON CORE BOREHOLE

| | | |
|---|---|---|
| Client: Feros Hotel Group Pty Ltd | Project: 32015/7024D-G | **BOREHOLE NO.: BH 9** |
| Project: Berry Hotel, 120 Queen Street, Berry | Date : December 19, 2022 | Sheet 1 of 1 |
| Location: Refer to Drawing No. 22/3973 | Logged: EJ/M: Checked By: MT | |

| WATER TABLE | SAMPLES | DEPTH (m) | DESCRIPTION OF DRILLED PRODUCT<br>Soil Name, grain size /plasticity, colour; secondary constituents (Inc. Description) , minor constituents including other remarks | SYMBOL | CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels) | MOISTURE |
|---|---|---|---|---|---|---|
| | | | FILL: GRAVELLY SAND: fine to medium grained, brown, gravel and stones | GW | - | D |
| | | 1.0 | HAND AUGER REFUSAL AT 0.9 M | | | |
| | | 2.0 | | | | |
| | | 3.0 | | | | |
| | | 4.0 | | | | |
| | | 5.0 | | | | |

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

Contractor: STS

Equipment: Hand Auger/Shovel

Hole Diameter (mm): 100

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Angle from Vertical (°):

Drill Bit: Spiral

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# GEOTECHNICAL LOG - NON CORE BOREHOLE

| | | |
|---|---|---|
| Client: Feros Hotel Group Pty Ltd | Project: 32015/7024D-G | **BOREHOLE NO.: BH 10** |
| Project: Berry Hotel, 120 Queen Street, Berry | Date : December 19, 2022 | Sheet 1 of 1 |
| Location: Refer to Drawing No. 22/3973 | Logged: EJ/M Checked By: MT | |

| WATER TABLE | SAMPLES | DEPTH (m) | DESCRIPTION OF DRILLED PRODUCT<br>Soil Name, grain size /plasticity, colour; secondary constituents (Inc. Description) , minor constituents including other remarks | SYMBOL | CONSISTENCY (cohesive soils) or RELATIVE DENSITY (sands and gravels) | MOISTURE |
|---|---|---|---|---|---|---|
| | | | FILL: SAND: fine to medium grained, brown, gravel | SP | - | D-M |
| | | | SILTY CLAY: medium plasticity, brown, trace of gravel | CI | STIFF | M |
| | | 1.0 | | | VERY STIFF | |
| | | 2.0 | SILTY CLAY: low plasticity, brown, trace of gravel | CL | VERY STIFF | M |
| | | 3.0 | HAND AUGER DISCONTINUED AT 3.0 M | | | |
| | | 4.0 | | | | |
| | | 5.0 | | | | |

D - disturbed sample U - undisturbed tube sample B - bulk sample

WT - level of water table or free water N - Standard Penetration Test (SPT)

S - jar sample

NOTES: See explanation sheets for meaning of all descriptive terms and symbols

Contractor: STS

Equipment: Hand Auger

Hole Diameter (mm): 100

Angle from Vertical (°):

Drill Bit: Spiral

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**STS Geotechnics Pty Ltd**
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 | Email: enquiries@stsgeo.com.au



# *Dynamic Cone Penetrometer Test Report*

Project: BERRY HOTEL - 120 QUEEN STREET, BERRY
**Client: FEROS HOTEL GROUP PTY LTD**
Address: 105 Parraweena Road, Taren Point
Test Method: AS 1289.6.3.2

Project No.: 32015/7024D-G
Report No.: 22/3972
Report Date: 14/11/2022
Page: 1 of 2

| Site No. | P1 | P2 | P3 | P4 | P5 | P6 |
|---|---|---|---|---|---|---|
| Location | Refer to Drawing No. 22/3973 | Refer to Drawing No. 22/3973 | Refer to Drawing No. 22/3973 | Refer to Drawing No. 22/3973 | Refer to Drawing No. 22/3973 | Refer to Drawing No. 22/3973 |
| Date Tested | 8/11/2022 | 8/11/2022 | 8/11/2022 | 8/11/2022 | 8/11/2022 | 8/11/2022 |
| Starting Level | Surface Level | Surface Level | Surface Level | Surface Level | Surface Level | Surface Level |
| Depth (m) | Penetration Resistance (blows / 150mm) | | | | | |
| 0.00 - 0.15 | * | * | * | * | * | 2 |
| 0.15 - 0.30 | * | * | * | * | * | 2 |
| 0.30 - 0.45 | * | * | * | 4 | 3 | 3 |
| 0.45 - 0.60 | * | * | * | 4 | 4 | 5 |
| 0.60 - 0.75 | * | * | 3 | 3 | 4 | 5 |
| 0.75 - 0.90 | * | 3 | 4 | 5 | 5 | 6 |
| 0.90 - 1.05 | 4 | 3 | 6 | 5 | 4 | 6 |
| 1.05 - 1.20 | 4 | 5 | 6 | 5 | 8 | 6 |
| 1.20 - 1.35 | 3 | 4 | 6 | 7 | 8 | 6 |
| 1.35 - 1.50 | 4 | 5 | 15 | 10 | 11 | 9 |
| 1.50 - 1.65 | 6 | 6 | 15 | 10 | 11 | 13 |
| 1.65 - 1.80 | 6 | 7 | 15 | 16 | 23+ | 23+ |
| 1.80 - 1.95 | 9 | 7 | 23+ | 23+ | Refusal | Refusal |
| 1.95 - 2.10 | 10 | 13 | Refusal | Refusal | | |
| 2.10 - 2.25 | 15 | 14 | | | | |
| 2.25 - 2.40 | 23+ | 14 | | | | |
| 2.40 - 2.55 | Refusal | 23+ | | | | |
| 2.55 - 2.70 | | Refusal | | | | |
| 2.70 - 2.85 | | | | | | |
| 2.85 - 3.00 | | | | | | |
| 3.00 - 3.15 | | | | | | |
| 3.15 - 3.30 | | | | | | |
| 3.30 - 3.45 | | | | | | |
| 3.45 - 3.60 | | | | | | |
| 3.60 - 3.75 | | | | | | |

Remarks: * Pre drilled prior to testing

Approved Signatory.....
Technician: MB
Orlando Mendoza - Laboratory Manager

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**STS Geotechnics Pty Ltd**
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 | Email: enquiries@stsgeo.com.au



# *Dynamic Cone Penetrometer Test Report*

Project: BERRY HOTEL - 120 QUEEN STREET, BERRY
**Client: FEROS HOTEL GROUP PTY LTD**
Address: 105 Parraweena Road, Taren Point
Test Method: AS 1289.6.3.2

Project No.: 32015/7024D
Report No.: 22/3972
Report Date: 14/11/2022


| Site No. | P7 | P8 | P9 | P10 | | |
|---|---|---|---|---|---|---|
| Location | Refer to Drawing No. 22/3973 | Refer to Drawing No. 22/3973 | Refer to Drawing No. 22/3973 | Refer to Drawing No. 22/3973 | | |
| Date Tested | 8/11/2022 | 19/12/2022 | 19/12/2022 | 19/12/2022 | | |
| Starting Level | Surface Level | Surface Level | Surface Level | Surface Level | | |
| Depth (m) | Penetration Resistance (blows / 150mm) | | | | | |
| 0.00 - 0.15 | 4 | 8 | 22/R | 9 | | |
| 0.15 - 0.30 | 4 | 13 | * | 4 | | |
| 0.30 - 0.45 | 3 | 11 | 22/R | 5 | | |
| 0.45 - 0.60 | 2 | 7 | | 4 | | |
| 0.60 - 0.75 | 2 | 3 | | 6 | | |
| 0.75 - 0.90 | 2 | 5 | | 8 | | |
| 0.90 - 1.05 | 2 | 6 | | 7 | | |
| 1.05 - 1.20 | 3 | 4 | | 8 | | |
| 1.20 - 1.35 | 6 | 5 | | 6 | | |
| 1.35 - 1.50 | 10 | 6 | | 9 | | |
| 1.50 - 1.65 | 11 | 6 | | 10 | | |
| 1.65 - 1.80 | 14 | 8 | | 7 | | |
| 1.80 - 1.95 | 18 | 7 | | 6 | | |
| 1.95 - 2.10 | 23+ | 8 | | 8 | | |
| 2.10 - 2.25 | Refusal | 10 | | 10 | | |
| 2.25 - 2.40 | | 8 | | 9 | | |
| 2.40 - 2.55 | | 9 | | 10 | | |
| 2.55 - 2.70 | | 9 | | 10 | | |
| 2.70 - 2.85 | | 8 | | 8 | | |
| 2.85 - 3.00 | | Discontinued | | Discontinued | | |
| 3.00 - 3.15 | | | | | | |
| 3.15 - 3.30 | | | | | | |
| 3.30 - 3.45 | | | | | | |
| 3.45 - 3.60 | | | | | | |
| 3.60 - 3.75 | | | | | | |

Remarks: * Pre drilled prior to testing

Approved Signatory..... .....

Technician: MB/EJ

Orlando Mendoza - Laboratory Manager

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# EXPLANATION OF NOTES, ABBREVIATIONS & TERMS USED ON BOREHOLE AND TEST PIT LOGS

## DRILLING/EXCAVATION METHOD

| | | | | | |
|---|---|---|---|---|---|
| **HA** | Hand Auger | **ADH** | Hollow Auger | **NQ** | Diamond Core - 47 mm |
| **DT** | Diatube Coring | **RT** | Rotary Tricone bit | **NMLC** | Diamond Core - 52 mm |
| **NDD** | Non-destructive digging | **RAB** | Rotary Air Blast | **HQ** | Diamond Core - 63 mm |
| **AD*** | Auger Drilling | **RC** | Reverse Circulation | **HMLC** | Diamond Core - 63 mm |
| ***V** | V-Bit | **PT** | Push Tube | **EX** | Tracked Hydraulic Excavator |
| ***T** | TC-Bit, e.g. AD/T | **WB** | Washbore | **HAND** | Excavated by Hand Methods |

## PENETRATION RESISTANCE

| | | |
|---|---|---|
| **L** | **Low Resistance** | Rapid penetration/ excavation possible with little effort from equipment used. |
| **M** | **Medium Resistance** | Penetration/ excavation possible at an acceptable rate with moderate effort from equipment used. |
| **H** | **High Resistance** | Penetration/ excavation is possible but at a slow rate and requires significant effort from equipment used. |
| **R** | **Refusal/Practical Refusal** | No further progress possible without risk of damage or unacceptable wear to equipment used. |

These assessments are subjective and are dependent on many factors, including equipment power and weight, condition of excavation or drilling tools and experience of the operator.

## WATER

**Standing Water Level** **Partial water loss**

**Water Seepage** **Complete Water Loss**

| | |
|---|---|
| **GWNO** | GROUNDWATER NOT OBSERVED - Observation of groundwater, whether present or not, was not possible due to drilling water, surface seepage or cave-in of the borehole/ test pit. |
| **GWNE** | GROUNDWATER NOT ENCOUNTERED - Borehole/ test pit was dry soon after excavation. However, groundwater could be present in less permeable strata. Inflow may have been observed had the borehole/ test pit been left open for a longer period. |

## SAMPLING AND TESTING

| | |
|---|---|
| **SPT** | Standard Penetration Testing to AS1289.6.3.3 2004 |
| 4,7,11 N=18 | 4,7,11 = Blows per 150mm. N = Blows per 300mm penetration following a 150mm seating drive |
| 30/80mm | Where practical refusal occurs, the blows and penetration for that interval are reported, N is not reported |
| RW | Penetration occurred under the rod weight only, N<1 |
| HW | Penetration occurred under the hammer and rod weight only, N<1 |
| HB | Hammer double bouncing on anvil, N is not reported |
| **Sampling** | |
| S1 | Jar sample – number indicates sample number |
| D | Disturbed Sample |
| B | Bulk disturbed Sample |
| U50 | Thin walled tube sample - number indicates nominal sample diameter in millimetres |
| **Testing** | |
| PP | Pocket Penetrometer test expressed as instrument reading in kPa |
| DCP | Dynamic Cone Penetrometer (AS1289.6.3.1 1997) |
| PSP | Perth Sand Penetrometer (AS1289.6.3.2 1997) |

## GEOLOGICAL BOUNDARIES

———— = Observed Boundary (Position known)

– – – – – – – – – – = Observed Boundary (Position approximate)

– –?– –?– –?– – = Boundary (Interpreted or inferred)

## ROCK CORE RECOVERY

TCR =Total Core Recovery (%)

$$= \frac{Length\ of\ core\ recovered}{Length\ of\ core\ run} \times 100$$

RQD = Rock Quality Designation (%)

$$= \frac{\sum Axial\ lengths\ of\ core > 100mm}{Length\ of\ core\ run} \times 100$$

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# METHOD OF SOIL DESCRIPTION USED ON BOREHOLE AND TEST PIT LOGS

FILL

COUBLES or BOULDERS

GRAVEL (GP or GW)

ORGANIC SOILS (OL, OH or Pt)

SILT (ML or MH)

CLAY (CL, CI or CH)

SAND (SP or SW)

Combinations of these basic symbols may be used to indicate mixed materials such as sandy clay

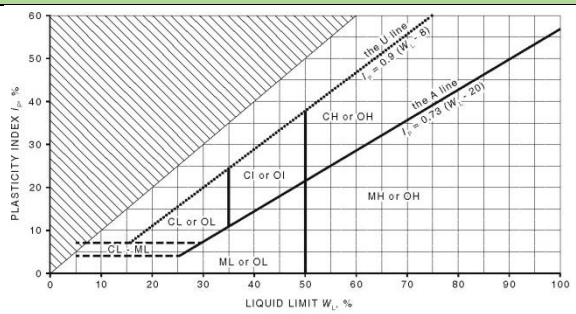
## CLASSIFICATION AND INFERRED STRATIGRAPHY

Soil is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS 1726:2017, Section 6.1 – Soil description and classification.

## PARTICLE SIZE CHARACTERISTICS

| Fraction | Components | Sub Division | Size mm |
|---|---|---|---|
| Oversize | BOULDERS | | >200 |
| | COBBLES | | 63 to 200 |
| Coarse grained soil | GRAVEL | Coarse | 19 to 63 |
| | | Medium | 6.7 to 19 |
| | | Fine | 2.36 to 6.7 |
| | SAND | Coarse | 0.6 to 2.36 |
| | | Medium | 0.21 to 0.6 |
| | | Fine | 0.075 to 0.21 |
| Fine grained soil | SILT | | 0.002 to 0.075 |
| | CLAY | | <0.002 |

## PLASTICITY PROPERTIES




## GROUP SYMBOLS

| Major Divisions | | Symbol | Description |
|---|---|---|---|
| COARSE GRAINED SOILS More than 65% of soil excluding oversize fraction is greater than 0.075mm | GRAVEL More than 50% of coarse fraction is >2.36mm | GW | Well graded gravel and gravel-sand mixtures, little or no fines, no dry strength. |
| | | GP | Poorly graded gravel and gravel-sand mixtures, little or no fines, no dry strength. |
| | | GM | Silty gravel, gravel-sand-silt mixtures, zero to medium dry strength. |
| | | GC | Clayey gravel, gravel-sand-clay mixtures, medium to high dry strength. |
| | SAND More than 50% of coarse fraction is <2.36 mm | SW | Well graded sand and gravelly sand, little or no fines, no dry strength. |
| | | SP | Poorly graded sand and gravelly sand, little or no fines, no dry strength. |
| | | SM | Silty sand, sand-silt mixtures, zero to medium dry strength. |
| | | SC | Clayey sand, sandy-clay mixtures, medium to high dry strength. |
| FINE GRAINED SOILS More than 35% of soil excluding oversized fraction is less than 0.075mm | Liquid Limit less < 50% | ML | Inorganic silts of low plasticity, very fine sands, rock flour, silty or clayey fine sands, zero to medium dry strength. |
| | | CL, CI | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, medium to high dry strength. |
| | | OL | Organic silts and organic silty clays of low plasticity, low to medium dry strength. |
| | Liquid Limit > than 50% | MH | Inorganic silts of high plasticity, high to very high dry strength. |
| | | CH | Inorganic clays of high plasticity, high to very high dry strength. |
| | | OH | Organic clays of medium to high plasticity, medium to high dry strength. |
| Highly Organic soil | | PT | Peat muck and other highly organic soils. |

## MOISTURE CONDITION

| Symbol | Term | Description |
|---|---|---|
| D | Dry | Non- cohesive and free running. |
| M | Moist | Soils feel cool, darkened in colour. Soil tends to stick together. |
| W | Wet | Soils feel cool, darkened in colour. Soil tends to stick together, free water forms when handling. |

Moisture content of cohesive soils shall be described in relation to plastic limit (PL) or liquid limit (LL) for soils with higher moisture content as follows: Moist, dry of plastic limit ($w$ < PL); Moist, near plastic limit ($w \approx$ PL); Moist, wet of plastic limit ($w$ < PL); Wet, near liquid limit ($w \approx$ LL), Wet, wet of liquid limit ($w$ > LL),

## CONSISTENCY

| Symbol | Term | Undrained Shear Strength (kPa) | SPT "N" # |
|---|---|---|---|
| VS | Very Soft | ≤ 12 | ≤ 2 |
| S | Soft | >12 to ≤ 25 | >2 to ≤ 4 |
| F | Firm | >25 to ≤ 50 | >4 to 8 |
| St | Stiff | >50 to ≤ 100 | >8 to 15 |
| VSt | Very Stiff | >100 to ≤ 200 | >15 to 30 |
| H | Hard | >200 | >30 |
| Fr | Friable | - | |

## DENSITY

| Symbol | Term | Density Index % | SPT "N" # |
|---|---|---|---|
| VL | Very Loose | ≤ 15 | 0 to 4 |
| L | Loose | >15 to ≤ 35 | 4 to 10 |
| MD | Medium Dense | >35 to ≤ 65 | 10 to 30 |
| D | Dense | >65 to ≤ 85 | 30 to 50 |
| VD | Very Dense | >85 | Above 50 |

In the absence of test results, consistency and density may be assessed from correlations with the observed behaviour of the material. # SPT correlations are not stated in AS1726:2017, and may be subject to corrections for overburden pressure, moisture content of the soil, and equipment type.

## MINOR COMPONENTS

| Term | Assessment Guide | Proportion by Mass |
|---|---|---|
| Add 'Trace' | Presence just detectable by feel or eye but soil properties little or no different to general properties of primary component | Coarse grained soils: ≤ 5%<br>Fine grained soil: ≤ 15% |
| Add 'With' | Presence easily detectable by feel or eye but soil properties little or no different to general properties of primary component | Coarse grained soils: 5 - 12%<br>Fine grained soil: 15 - 30% |
| Prefix soil name | Presence easily detectable by feel or eye in conjunction with the general properties of primary component | Coarse grained soils: >12%<br>Fine grained soil: >30% |

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# TERMS FOR ROCK MATERIAL STRENGTH AND WEATHERING

## CLASSIFICATION AND INFERRED STRATIGRAPHY

Rock is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS1726 – 2017, Section 6.2 – Rock identification, description and classification.

## ROCK MATERIAL STRENGTH CLASSIFICATION

| Symbol | Term | Point Load Index, $Is_{(50)}$ (MPa) # | Field Guide |
|---|---|---|---|
| VL | Very Low | 0.03 to 0.1 | Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 30 mm can be broken by finger pressure. |
| L | Low | 0.1 to 0.3 | Easily scored with a knife; indentations 1 mm to 3 mm show in the specimen with firm blows of pick point; has dull sound under hammer. A piece of core 150 mm long by 50 mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling. |
| M | Medium | 0.3 to 1 | Readily scored with a knife; a piece of core 150 mm long by 50 mm diameter can be broken by hand with difficulty. |
| H | High | 1 to 3 | A piece of core 150 mm long by 50 mm diameter cannot be broken by hand but can be broken with pick with a single firm blow; rock rings under hammer. |
| VH | Very High | 3 to 10 | Hand specimen breaks with pick after more than one blow; rock rings under hammer. |
| EH | Extremely High | >10 | Specimen requires many blows with geological pick to break through intact material; rock rings under hammer. |

**# Rock Strength Test Results**

▼ Point Load Strength Index, $Is_{(50)}$, Axial test (MPa)

● Point Load Strength Index, $Is_{(50)}$, Diametral test (MPa)

Relationship between rock strength test result ($Is_{(50)}$) and unconfined compressive strength (UCS) will vary with rock type and strength, and should be determined on a site-specific basis. However UCS is typically 20 x $Is_{(50)}$.

## ROCK MATERIAL WEATHERING CLASSIFICATION

| Symbol | | Term | Field Guide |
|---|---|---|---|
| RS | | Residual Soil | Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported. |
| XW | | Extremely Weathered | Rock is weathered to such an extent that it has soil properties - i.e. it either disintegrates or can be remoulded, in water. |
| DW | HW | Distinctly Weathered | Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores. In some environments it is convenient to subdivide into Highly Weathered and Moderately Weathered, with the degree of alteration typically less for MW. |
| | MW | | |
| SW | | Slightly Weathered | Rock slightly discoloured but shows little or no change of strength relative to fresh rock. |
| FR | | Fresh | Rock shows no sign of decomposition or staining. |

# ABBREVIATIONS AND DESCRIPTIONS FOR ROCK MATERIAL AND DEFECTS

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## CLASSIFICATION AND INFERRED STRATIGRAPHY

Rock is broadly classified and described in Borehole and Test Pit Logs using the preferred method given in AS1726 – 2017, Section 6.2 – Rock identification, description and classification.

## DETAILED ROCK DEFECT SPACING

**Defect Spacing**

| Spacing/width (mm) | Descriptor | Symbol |
|---|---|---|
| <20 | Extremely Close | EC |
| 20-60 | Very Close | VC |
| 60-200 | Close | C |
| 200-600 | Medium | M |
| 600-2000 | Wide | W |
| 2000-6000 | Very Wide | VW |

**Bedding Thickness (Stratification)**

| Term | Spacing (mm) |
|---|---|
| Thinly laminated | <6 |
| Laminated | 6 – 20 |
| Very thinly bedded | 20 – 60 |
| Thinly bedded | 60 – 200 |
| Medium bedded | 200 – 600 |
| Thickly bedded | 600 – 2,000 |
| Very thickly bedded | > 2,000 |

## ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT TYPES

| Defect Type | Abbr. | Description |
|---|---|---|
| Joint | JT | Surface of a fracture or parting, formed without displacement, across which the rock has little or no tensile strength. May be closed or filled by air, water or soil or rock substance, which acts as cement. |
| Bedding Parting | BP | Surface of fracture or parting, across which the rock has little or no tensile strength, parallel or sub-parallel to layering/ bedding. Bedding refers to the layering or stratification of a rock, indicating orientation during deposition, resulting in planar anisotropy in the rock material. |
| Contact | CO | The surface between two types or ages of rock. |
| Sheared Surface | SSU | A near planar, curved or undulating surface which is usually smooth, polished or slickensided. |
| Sheared Seam/ Zone (Fault) | SS/SZ | Seam or zone with roughly parallel almost planar boundaries of rock substance cut by closely spaced (often <50 mm) parallel and usually smooth or slickensided joints or cleavage planes. |
| Crushed Seam/ Zone (Fault) | CS/CZ | Seam or zone composed of disoriented usually angular fragments of the host rock substance, with roughly parallel near-planar boundaries. The brecciated fragments may be of clay, silt, sand or gravel sizes or mixtures of these. |
| Extremely Weathered Seam/ Zone | XWS/XWZ | Seam of soil substance, often with gradational boundaries, formed by weathering of the rock material in places. |
| Infilled Seam | IS | Seam of soil substance, usually clay or clayey, with very distinct roughly parallel boundaries, formed by soil migrating into joint or open cavity. |
| Vein | VN | Distinct sheet-like body of minerals crystallised within rock through typically open-space filling or crack-seal growth. |

NOTE: Defects size of <100mm SS, CS and XWS. Defects size of >100mm SZ, CZ and XWZ.

## ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT SHAPE AND ROUGHNESS

| Shape | Abbr. | Description | Roughness | Abbr. | Description |
|---|---|---|---|---|---|
| Planar | PR | Consistent orientation | Polished | POL | Shiny smooth surface |
| Curved | CU | Gradual change in orientation | Slickensided | SL | Grooved or striated surface, usually polished |
| Undulating | UN | Wavy surface | Smooth | SM | Smooth to touch. Few or no surface irregularities |
| Stepped | ST | One or more well defined steps | Rough | RO | Many small surface irregularities (amplitude generally <1mm). Feels like fine to coarse sandpaper |
| Irregular | IR | Many sharp changes in orientation | Very Rough | VR | Many large surface irregularities, amplitude generally >1mm. Feels like very coarse sandpaper |

**Orientation:** **Vertical Boreholes –** The dip (inclination from horizontal) of the defect.
**Inclined Boreholes –** The inclination is measured as the acute angle to the core axis.

## ABBREVIATIONS AND DESCRIPTIONS FOR DEFECT COATING

| Coating | Abbr. | Description |
|---|---|---|
| Clean | CN | No visible coating or infilling |
| Stain | SN | No visible coating but surfaces are discoloured by staining, often limonite (orange-brown) |
| Veneer | VNR | A visible coating of soil or mineral substance, usually too thin to measure (< 1 mm); may be patchy |

## DEFECT APERTURE

| Aperture | Abbr. | Description |
|---|---|---|
| Closed | CL | Closed. |
| Open | OP | Without any infill material. |
| Infilled | - | Soil or rock i.e. clay, silt, talc, pyrite, quartz, etc. |

# APPENDIX B – LABORATORY TEST RESULTS

STS GEOTECHNICS PTY LTD
CONSULTING GEOTECHNICAL ENGINEERS

**STS Geotechnics Pty Ltd**
14/1 Cowpasture Place, Wetherill Park NSW 2164
Phone: (02)9756 2166 | Email: enquiries@stsgeo.com.au



# *Shrink Swell Index Report*

Project: 20 QUEEN STREET, BERRY
**Client: FEROS HOTEL GROUP PTY LTD**
Address: 105 Parraweena Road, Taren Point 2229
Test Method: AS1289.7.1.1

Project No.: 32015
Report No.: 22/3945
Report Date: 11/11/2022
Page: 1 OF 1

Sampling Procedure: AS 1289.1.3.1 Clause 3.1.3.2 - Thin Walled Sampler

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| STS / Sample No. | | 7024D-L/1 | 7024D-L/2 | 7024D-L/3 | | | |
| Sample Location | | Borehole 1 Refer to Drawing | Borehole 4 Refer to Drawing | Borehole 6 Refer to Drawing | | | |
| Material Description | | Silty Clay, red brown/orange | Silty Sandy Clay, red brown | Silty Sandy Clay, red brown | | | |
| Depth (m) | | 0.8 - 1.0 | 0.6 - 0.9 | 1.0 - 1.2 | | | |
| Sample Date | | 8/11/2022 | 8/11/2022 | 8/11/2022 | | | |
| Shrink | Moisture Content (%) | 28.1 | 30.8 | 30.2 | | | |
| | Soil Crumbling | Nil | Nil | Nil | | | |
| | Extent of Cracking | Open Cracks | Nil | Open Cracks | | | |
| | Strain (%) | 4.5 | 5.8 | 4.6 | | | |
| Swell | Moisture Content Initial (%) | 28.5 | 30.2 | 30.2 | | | |
| | Moisture Content Final (%) | 29.4 | 32.2 | 32.9 | | | |
| | Strain (%) | 0.0 | 0.0 | 0.0 | | | |
| Inert Inclusions (%) | | <15 | <20 | <20 | | | |
| **Shrink Swell Index (%)** | | **2.5** | **3.2** | **2.5** | | | |

Remarks:

Approved Signatory.....

Technician: DH

Orlando Mendoza - Laboratory Manager

ALS Environmental

# CERTIFICATE OF ANALYSIS

| | | | |
|---|---|---|---|
| **Work Order** | : **ES2240412** | Page | : 1 of 2 |
| Client | : **STS Geotechnics** | Laboratory | : Environmental Division Sydney |
| Contact | : ENQUIRES STS | Contact | : Customer Services ES |
| Address | : Unit 14/1 Cowpasture Place<br>Wetherill Park 2164 | Address | : 277-289 Woodpark Road Smithfield NSW Australia 2164 |
| Telephone | : ---- | Telephone | : +61-2-8784 8555 |
| Project | : 32015 | Date Samples Received | : 09-Nov-2022 11:40 |
| Order number | : 2022-368 | Date Analysis Commenced | : 10-Nov-2022 |
| C-O-C number | : ---- | Issue Date | : 14-Nov-2022 12:33 |
| Sampler | : ---- | | |
| Site | : ---- | | |
| Quote number | : EN/222 | | |
| No. of samples received | : 5 | | |
| No. of samples analysed | : 5 | | |

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted, unless the sampling was conducted by ALS. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

**Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.**

## *Signatories*

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

| *Signatories* | *Position* | *Accreditation Category* |
|---|---|---|
| Ankit Joshi | Senior Chemist - Inorganics | Sydney Inorganics, Smithfield, NSW |

## General Comments

The analytical procedures used by ALS have been developed from established internationally recognised procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are fully validated and are often at the client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contract for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

## Analytical Results

| Sub-Matrix: **SOIL** (Matrix: **SOIL**) | | | Sample ID | 32015/S1 | 32015/S2 | 32015/S3 | 32015/S4 | 32015/S5 |
|---|---|---|---|---|---|---|---|---|
| | | | Sampling date / time | 08-Nov-2022 00:00 | 08-Nov-2022 00:00 | 08-Nov-2022 00:00 | 08-Nov-2022 00:00 | 08-Nov-2022 00:00 |
| *Compound* | *CAS Number* | *LOR* | *Unit* | ES2240412-001 | ES2240412-002 | ES2240412-003 | ES2240412-004 | ES2240412-005 |
| | | | | Result | Result | Result | Result | Result |
| **EA002: pH 1:5 (Soils)** | | | | | | | | |
| **pH Value** | ---- | 0.1 | pH Unit | **6.2** | **6.9** | **5.3** | **7.9** | **6.0** |
| **EA010: Conductivity (1:5)** | | | | | | | | |
| **Electrical Conductivity @ 25°C** | ---- | 1 | µS/cm | **196** | **152** | **95** | **211** | **202** |
| **EA055: Moisture Content (Dried @ 105-110°C)** | | | | | | | | |
| **Moisture Content** | ---- | 0.1 | % | **20.2** | **20.0** | **21.8** | **2.0** | **16.7** |
| **ED040S : Soluble Sulfate by ICPAES** | | | | | | | | |
| **Sulfate as SO4 2-** | 14808-79-8 | 10 | mg/kg | **280** | **230** | **200** | **210** | **300** |
| **ED045G: Chloride by Discrete Analyser** | | | | | | | | |
| **Chloride** | 16887-00-6 | 10 | mg/kg | **130** | **10** | <10 | **30** | **40** |