Douglas Partners
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Report on Geotechnical and Preliminary Acid Sulfate Soil Investigation

Proposed Stages 1 & 2, Extension of Existing Aquaculture Facility, Captain Cook Highway, Port Douglas

Prepared for
Gold Coast Marine Aquaculture

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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Report on Geotechnical and Preliminary Acid Sulfate Soil Investigation Proposed Stages 1 and 2, Extension of Existing Aquaculture Facility Captain Cook Highway, Port Douglas

1. Introduction

This report presents the results of a geotechnical and preliminary acid sulfate soil investigation carried out for a proposed Stages 1 and 2 extension of an existing aquaculture facility situated at Port Douglas. The work will also include the development of a new processing plant. The investigation was carried out for Gold Coast Marine Aquaculture.

The scope of work for this investigation comprised 34 boreholes within the proposed area of the expansion, followed by laboratory testing, engineering evaluation, analysis and reporting.

The purpose of the investigation was to provide the following information:

- description of investigation methodology;
- descriptive bore logs and summary of subsurface soil conditions and groundwater levels encountered at the test locations;
- results of screening and laboratory testing for acid sulfate soils;
- interpretative comments on the presence or otherwise of acid sulfate soils (ASS), and a summary of appropriate treatment during construction including preliminary lime neutralisation rate (if applicable);
- results of geotechnical laboratory testing;
- comments on site preparation earthworks;
- comments on the suitability of excavated material for re-use as filling;
- comments on excavation conditions to the investigated depth of excavation;
- dispersion potential of encountered soils;
- site classification of foundation soil reactivity (shrink-swell) with reference to AS2870 - 2011 (Ref 1); and
- allowable bearing pressures for high level footings, for plant building location.

This report does not address the construction or stability of the proposed ponds and separating bund walls.

A layout drawing of the proposed ponds, and a detail survey plan of the site, was provided by the client to assist the investigation.

This report should be read in conjunction with the notes entitled ‘About this Report’ in Appendix A and other explanatory notes, and should be kept in its entirety without separation of individual pages or sections.

2. Site Description

The site is located approximately five kilometres north west of Craiglea, at Port Douglas, on the north-eastern side of the Captain Cook Highway, as shown on Drawing 1 in Appendix B.

The Stage 1 extension is located on an area of approximately 25 hectares (approximately 500 m by 500 m) currently used for the cultivation of sugar cane (refer Figure 1), located between the Captain Cook Highway and the existing aquaculture ponds. Generally, ground surface levels across the Stage 1 site slope very gently down to the north east. Several swale drains along cane headlands dissect the site, as shown in Figure 2.

Figure 1: Stage 1, looking west from the approximate location of Bore 6

Figure 2: Typical drain within the Stage 1 area , looking west from the approximate location of Bore 11

The Stage 2 extension (where it is also proposed to locate the processing plant), is located to the north-west of the existing aquaculture ponds. This area is also currently used for the cultivation of sugar cane, and is relatively flat (refer Figure 3).

Figure 3: Stage 2, looking south west from a location east of Bore 26

3. Geology

Reference to the Mossman 1:250,0000 Queensland Department of Mines Geological Series Sheet (SE 55-1), and accompanying explanatory notes, indicates that the site is located on two separately mapped geological units. Quaternary aged deposits are indicated for the lower lying, north-eastern portion of the site, which are indicated to typically comprise "mainly quartzose to lithic sublabile sand, muddy sand, silt, mud, rare peat; undivided coastal (supratidal, intertidal, beach-ridge, dune, coastal flat and swamp) deposits". Tertiary to Quarternary aged deposits are indicated for the south-western, more elevated portions of the site, which are indicated to typically comprise "mainly sand, silt, mud and gravel; older, unconsolidated to semi-consolidated residual and colluvial deposits".

The natural subsurface materials encountered within the boreholes during the investigation comprised silty and sandy clays and silty and clayey sands, considered to be mostly of alluvial origin, and hence consistent with the above described Quaternary aged geological deposits. Although not specifically described on the borelogs as such, the encountered cohesive alluvial soils also included some bands/layers of weaker strength consistency (typically soft to firm, or firm), that may represent the 'muds' referred to in the soil descriptions above from the published geological maps.

4. Field Work Methods

The field work was carried out between 28 April and 1 May 2015, and comprised 34 boreholes (designated Bores 1 to 34), which were penetrated to depths of between 2.5 m and 2.8 m. The approximate borehole locations are shown on Drawing 1 in Appendix B.

The bores were advanced using a hydraulic percussion push-tube soil sampling rig, mounted on the rear of a 4WD utility. This rig features 50 mm OD and 35 mm OD tubes which each sample a core of soil, of respectively 38 mm diameter to 1.4 m depth, then 28 mm diameter below 1.4 m depth. Representative disturbed soil samples were collected from the collected soil cores from these bores.

Pocket penetrometer (pp) tests were carried out on the recovered soil core produced by the percussion push-tube rig in cohesive soil to provide additional information on strength consistency. A dynamic cone penetrometer (DCP) test was carried out adjacent to the Bores 6, 11, 16, 17 and 21 in Stage 1, and Bores 26 to 34 in Stage 2. DCP tests were performed to depths of between 0.9 m and 2.5 m.

The boreholes were reinstated using the excavated spoil.

Samples for ASS testing (385 in total) were collected at approximately 0.25 m depth intervals to approximately 2.5 m depth in all the boreholes. The samples were placed in snap-lock bags and then stored on ice for transportation to the DP Cairns office, where they were frozen prior to delivery of selected samples to the analytical laboratory.

All field work was carried out in the presence of an experienced geo-scientist and/or geotechnical engineer who logged and collected samples from the boreholes, carried out in-situ testing and recorded groundwater observations.

The test location co-ordinates shown on the bore reports were determined using a handheld GPS unit relative to GDA94 datum, and are typically accurate to within approximately 5 m. Surface levels at the bore locations were interpolated from the supplied survey plan.

5. Field Work Results

The subsurface conditions encountered in the boreholes are described on the borehole logs in Appendix C. The DCP results are also presented on the logs (where applicable). The logs should be read in conjunction with the general notes in Appendix A, which explain descriptive terms and classification methods used in their preparation.

Stage 1 (Bores 1 to 25)

TOPSOIL

Topsoil was encountered from the ground surface to 0.1 m depth in each bore, and generally comprised sandy silt clay, silty clay, clayey silt, sand, or sandy silt , with some rootlets.

COHESIVE SOILS

Cohesive soils were encountered beneath the topsoil, and typically comprised silty clay, sandy clay and sandy silty clay, and generally continued to termination depth in each bore.

Some bands of silty sand, silty clayey sand / clayey sand / sand were observed within this mostly cohesive profile, in Bores 3, 6, 7, 11, 12, 13, 16, 17 and 21, at various depths, with densities that varied from dense to medium dense.

Strength consistencies in the cohesive soils were stiff, or stronger, except at the following locations and depths:

- firm to stiff silty clay in Bore 1 from 0.1 m to 0.3 m depth;
- firm silty clay in Bore 3 from 1.0 m to 1.3 m depth;
- soft to firm silty clay in Bore 4 from 0.6 m to 1.5 m depth;
- firm sandy silty clay in Bore 5 from 1.8 m to 2.0 mmm depth;
- firm silty clay in Bore 10 from 0.9 m to 1.3 m depth;
- firm sandy silty clay in Bore 11 from 1.6 m to 1.9 m depth;
- soft to firm silty clay in Bore 13 from 0.3 m to 1.3 m depth;
- firm, and firm to stiff, silty clay in Bore 14 from 1.6 m to 2.0 m depth;
- soft to firm silty clay in Bore 15A from 0.7 m to 1.1 m depth;
- firm silty clay from 0.4 m to 0.5 m depth, and firm sandy silty clay from 2.0 m to 2.2m depth, in Bore 15B;
- sandy clay which was firm from 0.3 m to 0.5 m depth, and soft to firm from 0.5 m to 0.6m depth, in Bore 16;
- firm silty clay from 0.4 m to 0.5 m depth, then soft to 0.6 m depth, and soft to firm from 2.1 m to 2.2 m depth, in Bore 18;
- soft to firm silty clay in Bore 20 from 1.7 m to 1.8 m depth;
- soft to firm sandy clay from 2.0 m depth to 2.5 m depth (termination) in Bore 22; and
- soft, soft to firm, and firm silty clay in Bore 25 from 0.9 m to 1.4 m depth.

These above listed ‘soft’ zones (ie strength consistencies of soft to firm, firm, or firm to stiff) may possibly represent the ‘muds’ described in the published geological maps .

Stage 2 (Bores 26 to 34)

TOPSOIL	Silty clay topsoil with some rootlets was encountered from the ground surface to 0.1 m to 0.15 m depth at each of the .
UPPER COHESIVE SOILS	Cohesive soils were encountered beneath the topsoil, and continued to 0.35 m to 0.5 m depth in each bore. The cohesive soils typically comprised silty clay, sandy clay, silty sandy clay, and was either of stiff or very stiff, or stiff to very stiff, strength consistency.
GRANULAR SOILS	Granular soils were encountered beneath the upper cohesive soils, and continued to 1.4 m to 1.8 m depth in each bore, except Bore 27, where they continued to bore termination depth of 2.5 m. The granular soils typically comprised silty sand or clayey sand, and were mostly medium dense, with some dense zones and some loose to medium dense zones.
LOWER COHESIVE SOILS (not in Bore 27)	Silty clay or sandy clay was encountered beneath the granular soils (but not in Bore 27), and continued to bore termination depth of 2.5 m in all bores, except Bore 32 where a deep layer of medium dense clayey sand was encountered from 2.3 m to 2.5 m (termination depth). Strength consistencies in the lower cohesive soils were stiff, or stronger, except for a layer of firm sandy clay in Bore 28 from 1.8 m to 2.5 m depth, and a layer of firm to stiff sandy clay in Bore 31 from 1.7 m to 2.5 m depth. Both these layers may possibly represent the 'muds' described in the published geological maps

Free groundwater was observed in some of the boreholes as summarised in Table 1 below. It should be noted, however, that groundwater levels are affected by climatic conditions and by soil permeability, and therefore may vary with time and location. Port Douglas is located within the tropics and is particularly susceptible to 'wet' and 'dry' seasonal variations in rainfall.

Table 1: Summary of Groundwater Observations

Bore Hole	Date	Surface Level (m AHD)	Measured Groundwater Depth (m)	Groundwater Level (m AHD)
3	28 April 2015	2.6	1.3	1.3
16	29 April 2015	1.8	2.4	- 0.6
17*	29 April 2015	2.4	2.5	- 0.1
20	29 April 2015	4.0	1.4	2.6
25*	1 May 2015	4.2	0.9	3.3
26	29 April 2015	2.2	0.9	1.3
27	1 May 2015	2.3	0.9	1.4
28	1 May 2015	1.9	1.0	0.9
29	1 May 2015	2.2	0.9	1.3
30	1 May 2015	2.3	0.7	1.6
31	1 May 2015	1.8	1.1	0.7
32	1 May 2015	1.9	1.2	0.7
33	1 May 2015	2.0	1.0	1.0

*Slight seepage

6. Laboratory Testing

6.1 Geotechnical

Geotechnical laboratory testing comprising six Atterberg limits, linear shrinkage (including field moisture) and particle size distribution tests. The results of these tests are summarised in Table 2, and detailed test report sheets included in Appendix D.

In addition to these tests, eight Emerson class number and cation exchange capacity (exchangeable sodium percentage - ESP) tests, were carried with a summary of the test results shown in Table 3, and detailed test report sheets included in Appendix D.

All laboratory testing was carried out by NATA accredited laboratories.

Table 2: Summary of Geotechnical Laboratory Test Results

Test Location	Depth (m)	Material	W (%)	Atterberg Limit/Linear Shrinkage				Particle Size Distribution Test		
				LL (%)	PL (%)	PI (%)	LS (%)	Gravel (%)	Sand (%)	Silt and Clay (%)
Bore 4	1.0 – 1.25	Silty Clay	15.8	36	13	23	12.0	-	-	-
Bore 7	0.65 – 0.95	Silty Clay	11.9	28	16	12	7.0	-	-	-
Bore 11	0.65 – 0.90	Clayey Sand	-	-	-	-	-	2	71	27
Bore 19	0.5 – 0.75	Silty Clay	15.2	38	11	27	13.5	-	-	-
Bore 21	0.75 – 1.0	Silty Sand	-	-	-	-	-	2	62	36
Bore 23	0.55 – 0.80	Silty Clay	8.0	30	13	17	8.0	-	-	-
Bore 27	0.40 – 0.65	Silty Sand	-	-	-	-	-	1	79	20
Bore 28	0.75 – 1.0	Silty Sand	-	-	-	-	-	1	74	25
Bore 32	0.85 – 1.1	Silty Sand	-	-	-	-	-	1	81	18
Bore 33	0.30 – 0.45	Silty Sandy Clay	13.0	24	16	8.0	4.0	-	-	-
Bore 34	0.10 – 0.40	Silty Sandy Clay	12.7	22	16	6.0	4.0	-	-	-
	0.60 – 0.90	Clayey Sand	-	-	-	-	-	1	74	25

Notes: W = Field Moisture Content LL = Liquid Limit PI = Plasticity Index
PL = Plastic Limit LS = Linear Shrinkage

Table 3: Summary of Emerson Class Laboratory Test Results

Test Location	Depth (m)	Material	W (%)	Emerson Class Number	Exchangeable Sodium Percentage
Bore 1	0.3 – 0.50	Silty Clay	7.9	3	49.5
Bore 5	0.85 – 1.10	Silty Clay	12.5	2	24.9
Bore 10	1.00 – 1.25	Silty Clay	1.0	2	20.6
Bore 22	0.10 – 0.30	Silty Clay	11.7	3	34.7
Bore 24	0.25 – 0.50	Silty Clay	10.3	2	20.8
Bore 27	0.25 – 0.40	Sandy Clay	-	2	8.3
Bore 28	0.25 – 0.50	Silty Sandy Clay	12.5	3	32.5
Bore 30	1.65 – 1.90	Sandy Clay	13.2	2	37.4

6.2 Acid Sulfate Soils

Field screening and chemical laboratory testing for ASS was carried out with reference to the QASSIT Guidelines 1998 (Ref 2), the Soil Management Guidelines 2014 (Ref 3) and the Laboratory Methods Guidelines 2004 (Ref 4).

Each of the 385 ASS samples collected from the bores were subjected to screening tests. These samples were screened by measurement of pH after the addition of distilled water (pH_F) and peroxide (pH_{FOX}) in DP's Cairns office. This was in order to give an approximate indication of either the presence of actual acid sulfate soils (AASS) or potential acid sulfate soils (PASS) conditions.

Based on the results of the screening tests, 38 samples were subjected to more definitive analysis using the Chromium Suite of tests. These samples were selected based on the results of the screening tests. The Chromium Suite tests were conducted by SGS Pty Ltd. The results of the screening tests and the results of the Chromium Suite laboratory tests are provided in Appendix D. The Chromium Suite laboratory tests, and selected screening results, are summarised in Table 4 below.

Table 4: Summary of Significant ASS Field Screening and Chemical Laboratory Testing

Test Location	Depth (m)	Sample Description	Screening Test Results				Chromium Suite Test Results (% w/w S)			
			pH_F	pH_{FOX}	ΔpH	Reaction (1,2,3,4)* F**	pH_{KCL}	Chromium Reducible Sulfur (S_{CR})	Total Actual Acidity (s-TAA)	Existing + Potential Acidity
Bore 1	0.1 – 0.30	Silty Clay	5.7	4.0	1.7	1F	6.0	0.007	<0.01	0.01
	0.30 – 0.5	Silty Clay	5.0	3.9	1.4	1	5.8	<0.005	<0.01	0.01
Bore 2	0.0 – 0.1	Topsoil – Silty Clay	5.7	3.0	2.7	1F	5.7	0.01	0.02	0.03
Bore 3	0.5 – 0.75	Silty Clay	5.1	4.3	0.8	1	4.9	<0.005	0.04	0.05
Bore 4	0.75 – 1.0	Silty Clay	4.6	3.8	0.8	1	5.1	<0.005	0.03	0.03
Bore 5	0.85 – 1.1	Silty Clay	4.5	3.7	0.8	1	5.1	<0.005	0.04	0.04
Bore 6	1.9 – 2.2	Silty Clay	5.8	5.7	0.1	2	5.8	<0.005	0.01	0.01
Bore 7	0.0 – 0.1	Sand	4.9	3.0	1.9	1F	5.9	0.007	0.02	0.02
Bore 8	0.35 – 0.6	Silty Clay	5.8	4.5	1.3	3	5.8	<0.005	0.01	0.01
Bore 9	0.3 – 0.55	Silty Clay	5.8	5.4	0.4	3	5.6	<0.005	0.01	0.01
Bore 10	1.0 – 1.25	Silty Clay	5.1	4.7	0.4	1	5.8	<0.005	0.01	0.01
Bore 11	0.9 – 1.2	Sand	4.2	3.8	0.4	1	6.0	<0.005	<0.01	<0.01
Bore 12	0.65 – 0.80	Sandy Silty Clay	6.3	4.8	1.5	1	6.0	<0.005	<0.01	<0.01
Bore 13	0.3 – 0.5	Silty Clay	5.5	5.4	0.3	4	5.2	<0.005	0.02	0.02
	0.8 – 1.0	Silty Clay	5.4	5.4	0.0	3	5	<0.005	0.02	0.02
Bore 14	0.0 – 0.1	Topsoil – Silty Clay	5.5	3.5	2.0	1F	5.3	0.007	0.03	0.04
Bore 15B	0.1 - 0.25	Silty Clay	5.4	3.5	1.9	1F	5.1	<0.005	0.04	0.04
Bore 16	0.1 - 0.3	Silty Sand	6.3	3.4	2.9	1F	5.6	<0.005	0.02	0.02
Bore 17	2.0 – 2.2	Clayey Sand	5.6	4.6	1.0	2	5.6	<0.005	0.01	0.01
Bore 18	0.8 – 1.05	Silty Clay	5.2	4.6	0.6	1	5.2	<0.005	0.03	0.03
Bore 19	0.75 – 1.0	Silty Clay	5.7	4.4	1.3	1	4.8	<0.005	0.04	0.04
Bore 20	0 – 0.1	Topsoil – Silty Clay	6.2	4.7	1.5	2F	5.6	<0.005	0.02	0.02
Bore 21	0.5 – 0.75	Silty Sand	5.9	3.9	2.0	1	5.6	<0.005	0.01	0.01
Bore 22	0.1 – 0.3	Silty Clay	6.0	4.1	1.9	2F	4.8	<0.005	0.04	0.04
Bore 23	0 – 0.1	Topsoil – Silty Clay	5.5	3.7	1.8	2F	5.4	<0.005	0.03	0.03
	0.3 – 0.55	Silty Clay	6.1	4.5	1.6	1	5.8	0.009	<0.01	0.02
Bore 24	0.25 – 0.5	Silty Clay	6.0	5.1	0.9	2F	5.7	<0.005	0.01	0.02
Bore 25	2.4 – 2.5	Silty Sandy Clay	5.5	4.1	1.4	4	5.9	<0.005	0.01	0.01
Bore 26	1.1 -1.35	Clayey Sand	5.2	3.8	1.4	1	6.4	<0.005	<0.01	<0.01
Bore 27	1.1 -1.4	Silty Sand	5.0	3.6	1.4	1	5.8	<0.01	<0.01	<0.01
Bore 28	0.25 – 0.5	Silty Sandy Clay	4.8	3.8	1.0	1	5.3	<0.005	0.05	0.05
	1.25 – 1.5	Silty Sand	4.4	3.4	1.0	1	5.8	<0.005	<0.01	<0.01
Bore 29	1.6 – 1.85	Sandy Clay	5.1	3.4	1.7	4	4.9	0.012	0.04	0.06
Bore 30	1.65 – 1.9	Sandy Clay	5.0	4.2	0.8	3	5.2	<0.005	0.02	0.02
Bore 31	1.1 -1.2	Silty Sand	3.9	3.1	0.8	2	5.8	<0.005	<0.01	<0.01
Bore 32	0.35 – 0.6	Silty Sand	4.6	3.7	0.9	1	5.3	<0.005	0.02	0.02
Bore 33	1.2 – 1.5	Clayey Sand	5.4	3.5	1.9	2	5.8	<0.005	<0.01	<0.01
Bore 34	0.9 – 1.15	Clayey Sand	4.4	3.5	0.9	1	5.2	<0.005	0.01	0.01

Notes to Table:

* 1 – denotes slight effervescence: 2 – denotes moderate reaction: 3 – denotes vigorous reaction: 4 – denotes very strong effervescence accompanied by escape of gas/heat

** F – indicates a bubbly/froth reaction (organics)

7. Comments

7.1 Proposed Aquaculture Facility Extension Development

It is understood that the existing aquaculture facility at Port Douglas will be extended, in two stages. The first stage will include the development of approximately 25 hectares, while the second stage will include a development of approximately nine hectares, which will also include a new processing plant. At this stage, no details have been provided regarding the proposed ponds, however it is understood that that the ponds will be excavated up to approximately 1.5 m below existing ground level, with discussions on site indicating that the ponds will be lined with HDPE liners.

In addition to this, at the time of writing this report, no details have been provided to Douglas Partners regarding the size or expected loads of the new processing plant building proposed for the Stage 2 extension.

7.2 Appreciation of Subsurface Conditions

The subsurface conditions, as described in Section 5, appear to comprise mostly alluvial soils, predominately of at least stiff strength consistency, but with some 'soft' zones (ie strength consistencies of soft to firm, firm, or firm to stiff), and/or granular soils of at least estimated loose to medium density. The relatively low elevation of the site, along with the encountered alluvial soil profile which includes 'soft' zones which may possibly represent 'mud', indicate the possible presence of ASS.

Groundwater was encountered in several boreholes from 0.7 m to 2.5 m depth, as summarised in Table 1.

The above items are further discussed in the following sections of this report.

The zones of cohesive soil with strength consistencies of soft to firm, or firm, or firm to stiff, may also present problems for construction of the ponds with regard to bund-wall stability and compaction, and traffickability across the site, however these issues were beyond the scope of the current investigation. Such 'soft' material, however, was not encountered in Bores 33 and 34, located in the vicinity of the proposed processing plant, although it would be prudent to include additional probing during footings inspection, as a contingency.

7.3 Site Preparation for Processing Plant

It is recommended that the following site preparation be carried out on site, prior to the commencement of filling or construction activities associated with the processing plant:

- Remove any existing surface vegetation, existing 'uncontrolled' filling (if any) and organic topsoil (soil containing significant roots and rootlets), and any deleterious, wet or highly compressible materials where encountered at proposed foundation level. Where the formation level is to be raised, all deleterious material should still be removed and the natural foundation soils test rolled and prepared as below.

- Moisture condition (by wetting or drying) the exposed foundation soils to achieve a moisture content within 2% of Standard optimum moisture content (OMC), and compact to at least 98% Standard maximum dry density ratio.
- Test roll the complete surface of the subgrade, as exposed after excavation, with a minimum 12 tonne static weight smooth drum roller (in non-vibratory mode), in order to detect the presence of any soft or loose zones, which should be excavated out and replaced with approved filling.
- Place approved filling, if required in order to raise the site or to replace any deleterious material, in layers not exceeding 200 mm loose thickness, with each layer compacted to a dry density ratio of at least 98% Standard with moisture content maintained within 2% of OMC during and after compaction, or alternatively to a minimum density index of 75% for granular filling (i.e. sand or gravel). Neither filling, nor replacement filling, should contain individual particles greater than 75 mm, and should comprise well graded material.
- Undertake 'Level 1' testing, including full time observation of filling, in accordance with AS 3798–2007 (Ref 5), if the filling or replacement filling is to be 'controlled', and deemed sufficient for support of upper level footings or pavements.

It should be noted that where the groundwater level is close to the surface being compacted (especially in Stage 2), then vibrating actions may result in such groundwater rising by capillary action. In order to minimise this, it is suggested that limiting compaction equipment to non-vibratory modes may be appropriate.

The above procedures will require geotechnical inspection and testing services to be employed during construction.

It should be noted that bands of 'soft' clays were encountered at varying depths across the site. Should these materials be exposed during excavation (such as for ponds), then precautions will be specifically required with respect to traffickability and the stability of bund walls. These precautions are beyond the scope of this current investigation report.

7.4 Re-use of Excavated Material as Fill

Excluding the surficial topsoil, it is suggested that the majority of the soil material encountered in the test bores may be suitable for re-use as engineered filling. This is provided it is moisture conditioned, and placed and compacted as indicated in Section 7.3 of this report. Material not considered suitable for re-use as engineered filling, includes:

- any cobbles or boulders, larger than about 75 mm maximum dimension;
- any 'soft' soil, or 'mud', where it is not practical to moisture condition to improve the strength consistency to close to OMC (refer Section 7.3);
- any soil which has not been appropriately treated to neutralise the potential acidity associated with the site soils (refer Section 7.8); and
- any deleterious non-soil material, such as organic matter.

This preliminary assessment should be confirmed on-site by suitably qualified personnel.

7.5 Excavation Conditions

7.5.1 Excavation

Excavation for the proposed aquaculture ponds is anticipated to encounter both granular and cohesive alluvial soil materials. It is anticipated that these alluvial soils will be readily excavatable by conventional earthmoving plant (i.e. backhoe or excavator), however dewatering is expected to be required below the water table (refer Section 7.5.2). Furthermore, the 'soft' cohesive soils (muds) may also prove difficult to traffic for construction equipment.

7.5.2 Dewatering

Dewatering is expected to be required during construction due to the presence of a relatively shallow groundwater table (refer Table 1).

The localised use of pump and sump methods of dewatering may be suitable for any seepage flows through the relatively impermeable silty clays/sandy clays, but only where this soil does not contain appreciable amounts of or distinct bands of sand or silty sand.

Short term construction dewatering in areas that contain sands and/or sand seams below the water-table (especially the Stage 2 development), will probably require a well or spear-point system, capable of extracting the likely high flows from these relatively permeable soils. These construction dewatering methods should remain in place until the ponds are operational to prevent any groundwater lifting the HDPE liners proposed for use within the ponds.

7.6 Dispersion Potential of Encountered Soils

One of the measures of a fine grained soil to exhibit dispersion (internal erosion or piping under water seepage or flow), is the amount of cationic exchangeable sodium available, measured as exchangeable sodium percentage (ESP). Sodic soils are indicated as being prone to dispersion and non-sodic soils unlikely to be dispersive.

Based on the relationships outlined by Northcote and Skene (Ref 6), soils with an ESP of greater than 14% are "strongly sodic", and 6% to 14% are "sodic". Similarly, work by the NSW Department of Agriculture and Fisheries (Ref 7), suggests that soils with an ESP greater than 10% are "highly sodic" or between 5% and 10% are "marginally sodic".

The results of the chemical laboratory testing (refer Table 3) indicate that the samples tested have ESPs of between approximate 20 % and 50%, except for one result of approximately 8%. On the basis of this testing, it is considered that the soils are "strongly sodic" and are likely to be susceptible to dispersive-type erosion.

Emerson Class testing (which is relatively qualitative and arguably subjective) is a physical indication of dispersion potential compared to the chemical ESP testing. Fell et al (Ref 8) suggests that soils with an Emerson Class of 4 or less should be treated with caution in water retention situations due to their dispersive nature. In general, however, Emerson Class Numbers of 1 and 2 in clay soils are

considered to be associated with very high potential for erosion, 3 with high potential, 7 and 8 with a low potential, and 4 to 6 less definitive and generally medium potential (Ref 9).

The results of Emerson Class Number testing (refer Table 3) are consistent with the ESP results, with Emerson Class Numbers of 2 and 3 recorded for the eight samples tested. These results indicate that the tested material has a high to very high potential for dispersion (ie internal erosion by piping under long term saturated conditions).

It should be noted that the Emerson Class testing, referred above, was carried out using distilled water. If the water being stored in the ponds has a high dissolved salt content, then the potential for dispersion may be reduced.

7.7 High Level Footings and Site Classification (Plant Facilities)

The proposed processing plant facilities will be located within Stage 2 of the proposed expansion, within the vicinity of Bores 33 and 34. Based upon the materials encountered within these two boreholes, (shallow cohesive soils of at least stiff consistency, over medium dense silty/clayey sands), high-level footings are considered suitable provided that site preparation is carried out as outlined in Section 7.3.

At the time of writing this report, no details were provided regarding the proposed processing plant, and as such, all recommendations regarding high level footing in Section 7.7.1 of this report should be considered preliminary and reassessed once building loads have been determined.

7.7.1 High level Footings

Tied edge beams and tied internal beams and load support thickenings of the slab, founded on either 'controlled' filling, placed under 'Level 1' inspection and testing as specified in Section 7.3, or shallow cohesive soils of at least stiff consistency, or deeper medium dense silty sand/clayey sand, as encountered in Bores 33 and 34, could also be designed for a maximum allowable bearing pressure of 100 kPa. Slab panels should be designed for a maximum net allowable bearing pressure of 20 kPa.

Independent pad or strip footings not tied to the slab, founded in 'controlled' filling, placed under 'Level 1' inspection and testing as specified in Section 7.3, or shallow cohesive soils of at least stiff consistency, or deeper medium dense silty sand/clayey sand, as encountered in Bores 33 and 34, could also be designed for a maximum allowable bearing pressure of 100 kPa.

In order to adopt the above design value, the base of any such footing excavation should be compacted by either rammer, plate vibrator or other appropriate hand guided equipment. This is required to negate the loosening effects of the backhoe/excavator teeth.

All footing excavations should be inspected by a suitably qualified geotechnical engineer prior to the placement of reinforcing steel. Due to the presence of 'soft' clays (of variable thickness and depth), at various locations across the site (but excluding Bores 33 and 34), it is suggested that such inspections include probing by dynamic penetrometer to improve the confidence level that Bores 33 and 34 are representative of the foundation soils beneath all proposed plant footings.

7.7.2 Site Classification

Site classification of foundation soil reactivity provides an indication of the propensity of the ground surface to move with seasonal variation in moisture. AS 2870 - 2011 (Ref 1) is only applicable to residential structures and arguably structures with similar footing loads and spacings to residential dwellings, as outlined within AS 2870 - 2011 (Ref 1). For footing loads and spacings beyond those considered in AS 2870 - 2011 (Ref 1), footings should be designed by engineering principles.

An in-house computer program, REACTIVE, was used to calculate characteristic surface movement (y_s) for the site, based on procedures presented in AS 2870 - 2011 (Ref 1), the soil profiles revealed in the test pits, and the results of the laboratory tests.

An instability index value of 1.0% per ΔpF was selected for the shallow cohesive soils encountered in Bores 33 and 34, and 0.5% per ΔpF was selected for the deeper medium dense silty sand/clayey sand, based on approximate in-house correlations using the plasticity test results.

It should be noted that AS 2870-2011 (Ref 1) provides recommended values of change in suction (Δu) and depth of design suction (H_s) for major and regional centres throughout Australia. Values are not, however, included for North Queensland. Based on previous experience in the area and on published data (Ref 10) relating climatic conditions to suction, a value of 1.2pF was adopted for Δu and 1.5 m for H_s in the REACTIVE calculations. This is based on a 'Wet Coastal' climatic zone.

Based on the above procedures, the site of the proposed processing plant (refer Drawing 1), is classified as Class S (Slightly Reactive), when assessed in accordance with AS 2870 - 2011 (Ref 1). This is provided that site preparation is carried out as outlined in Section 7.3 for slab-on-ground structures. If filling is placed to raise the proposed processing plant site surface levels then this classification should be reviewed.

No assessment of the effects of trees (either existing or proposed) has been made in this site classification, and reference to the requirements in AS 2870-2011 (Ref 1) should be made by the building designer in this regard.

This classification is dependant upon proper site maintenance, which should be carried out in accordance with CSIRO Sheet BTF 18 (Ref 11).

7.8 Acid Sulfate Soils

Testing for the 385 ASS samples obtained from the boreholes, was undertaken as described in Section 6.2.

The following comments are made with reference to the QASSIT Guidelines (Ref 2) and The Soil Management Guidelines (Ref 3), and with reference to the summary of test results presented in Table 4 and the screening test results included in Appendix D.

- The values of pH_F from the screening tests were between 3.9 and 7.1. Where $pH_F > 4$, this indicates that if ASS are present they have not oxidised and AASS conditions are not present. A single sample only recorded a pH_F result of less than 4 (Bore 31 at 1.1 m to 1.2 m depth), indicating that AASS conditions are possible in this area.

- The values of pH_{FOX} from the screening tests are between 2.6 and 6.8. Where $pH_{FOX} < 3$, along with a strong reaction to peroxide, and pH_{FOX} reading at least one pH unit below pH_F, this is a strong indicator of PASS conditions. Three tests recorded pH_{FOX} results of less than 3 (Bore 6, Bore 28 and Bore 31 each at 0 to 0.1 m depth) while four tests recorded pH_{FOX} results of equal to 3 (Bore 2, Bore 4, Bore 7 and Bore 34 each at 0 to 0.1 m depth). It should, however, be noted that all of these results were recorded within the topsoil which contained organic matter, which could indicate a reaction between the peroxide and the organic matter.

The calculated 'existing plus potential' acidity for each of the 38 samples submitted for Chromium Suite tests is summarised in Table 3. In general, the methods for determining 'existing plus potential' acidity have been derived with reference to the latest revision of the Soil Management Guidelines, 2014 (Ref 3) and the Laboratory Methods Guidelines 2004 (Ref 4), and can be summarised as follows:

Existing plus Potential Acidity	=	Potential Acidity (S_{CR})	+	Actual Acidity (TAA)	+	Retained Acidity (S_{NAS})

For greater than 1000 tonnes of soil disturbance, as is expected to be the case for the proposed aquaculture facility extension, the action criterion which triggers a requirement for ASS disturbance to be managed is independent of the soil type, and is equal to a calculated net acidity of greater than or equal to 0.03% sulfur.

Of the 38 samples submitted for Chromium Suite testing, 26 samples returned net acidity values of less than the action criterion of 0.03% Sulfur, four samples equalled the action criterion, and eight samples returned a net acidity value in excess of the action criterion, as summarised in Table 5.

Table 5: Summary of Chromium Suite Testing Equal to, or Exceeding, the Action Criterion of 0.03% Sulfur

Test Location	Depth (m)	Material	Net Acidity (% w/w S)
Bore 2	0.0 -0.1	Topsoil – Silty Clay	0.03
Bore 3	0.5 – 0.75	Silty Clay	0.05
Bore 4	0.75 – 1.0	Silty Clay	0.03
Bore 5	0.85 – 1.1	Silty Clay	0.04
Bore 14	0.0 – 0.10	Topsoil – Silty Clay	0.04
Bore 15B	0.10 – 0.25	Silty Clay	0.04
Bore 18	0.8 – 1.05	Silty Clay	0.03
Bore 19	0.75 – 1.0	Silty Clay	0.04
Bore 22	0.10 – 0.30	Sandy Clay	0.04
Bore 23	0.0 – 0.1	Topsoil – Silty Clay	0.03
Bore 28	0.25 – 0.50	Silty Sandy Clay	0.05
Bore 29	1.60 – 1.85	Sandy Clay	0.06

The samples with a recorded net acidity equal to or in excess of the action criteria were all from cohesive soils, and it is noted that most of these samples were within the 1.5 m depth zone of disturbance of the proposed aquaculture pond expansion.

It should be noted that, for these 12 samples, the results indicated that most, but not all, exceedences were due to the acid trail (TAA), rather than the sulfur trail (S_{CR}) (refer Table 4). It is thus considered that much of the site soil is naturally acidic, and has little potential, if any, for generation of further acidity on exposure to air and oxidation. Nevertheless, an Acid Sulfate Soil Management Plan (ASSMP) should be prepared covering the management of any disturbance to the site. This ASSMP should include the addition of lime for neutralising purposes. This should be further addressed in the ASSMP. In addition, the ASSMP is likely to include requirements for the following:

- bunding and drainage of areas of disturbance;
- control and monitoring of any run-off water that is collected by this bunding or drainage; and
- regular inspections.

Control and monitoring of groundwater for de-watering extraction will also require to be addressed within the ASSMP.

For the net acidity value of up to 0.06% sulfur indicated for these samples, a liming rate of approximately 5 kg of C_aCO_3/tonne of soil should be considered for initial planning purposes. The application and mixing of lime should be further addressed in the ASSMP.

The recently updated Soil Management Guidelines, 2014 (Ref 4), indicate that the assessment of whether or not a soil is AASS or PASS should be determined using only the 'existing plus potential' acidity calculation, and not the 'net acidity' calculation, as advocated by the Laboratory Management Guidelines (Ref 4). The 'net acidity' approach was previously based on the ABA equation (Ref 4), which includes an Acid Neutralising Capacity (ANC) term, which, when relevant, allows the calculated 'existing plus potential' acidity to be reduced by the subtraction of the ANC term (divided by an appropriate 'fineness factor'), under certain conditions. In any case, no ANC was indicated by the 38 Chromium Suite tests undertaken, and hence for these particular results, the 'existing plus potential acidity, calculated as advocated in the current Soil Management Guidelines, would be equal to the 'net acidity', calculated using the ABA equation.

8. Limitations

Douglas Partners (DP) has prepared this report for this project at Port Douglas in accordance with DP's proposal CNS150039 dated 11 March 2015 and acceptance received from Gold Coast Marine Aquaculture dated 8 April 2015. The work was carried out under DP Conditions of Engagement. This report is provided for the exclusive use of Gold Coast Marine Aquaculture for this project only and for the purposes as described in the report. It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during this investigation. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life.

This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

9. References

1. Australian Standard AS 2870–2011 “Residential Slabs and Footings”, Standards Australia.
2. Ahern CR, Ahern MR, and Powell, B (1998), “Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1998”, QASSIT, Department of Natural Resources, Resource Sciences Centre, Indooroopilly, Queensland, Australia.
3. Dear S-E, Ahern CR, O’Brien LE, Dobos SK, McElea AE, Moore NG, & Watling KM, 2014, “Queensland Acid Sulfate Soil Technical Manual: Soil Management Guidelines”, Brisbane, Department of Science, Information Technology, Innovation and the Arts, Queensland Government.
4. Ahern CR, McElnea AE, Sullivan LA (2004), “Acid Sulfate Soils Laboratory Methods Guidelines”, in “Queensland Acid Sulfate Soils Manual 2004”. Department of Natural Resources, Mines and Energy, Indooroopilly, Queensland, Australia.
5. Australian Standard AS3798-2007, “Guidelines on Earthworks for Commercial and Residential Developments”, Standards Australia.
6. Northcote, K. and Skene. J: “Australian Soils with Saline and Sodic Properties”, CSIRO, 1972.
7. Pope, K. and Abbott, T: “Understanding Salinity and Sodicity Measurement: Information on Salinity”, NSW Agriculture and Fisheries, Orange, NSW, 1989.
8. Fell, R, MacGregor, P, and Stapledon, D, “Geotechnical Engineering of Earth Embankment Dams” AA Balkema, 1992.
9. “Erosion Hazard Assessment”, Brisbane City Council, Corporate eForms, June 2006.
10. Fox, E. “A Climate-Based Design Depth of Moisture Change Map of Queensland and the Use of Such Maps to Classify Sites under AS 2870-1996:, Australian Geomechanics, Vol 35, Number 4, December 2000.
11. Sheet BTF 18 “Foundation Maintenance and Footing Performance: A Homeowner’s Guide”, CSIRO 2003.

Douglas Partners Pty Ltd

Appendix A

About this Report
Sampling Methods
Soil Descriptions
Symbols and Abbreviations

About this Report

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Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Sampling Methods

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Sampling

Sampling is carried out during drilling or test pitting to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling provide information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing it to obtain a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Test Pits

Test pits are usually excavated with a backhoe or an excavator, allowing close examination of the in-situ soil if it is safe to enter into the pit. The depth of excavation is limited to about 3 m for a backhoe and up to 6 m for a large excavator. A potential disadvantage of this investigation method is the larger area of disturbance to the site.

Large Diameter Augers

Boreholes can be drilled using a rotating plate or short spiral auger, generally 300 mm or larger in diameter commonly mounted on a standard piling rig. The cuttings are returned to the surface at intervals (generally not more than 0.5 m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube samples.

Continuous Spiral Flight Augers

The borehole is advanced using 90-115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in clays and sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are disturbed and may be mixed with soils from the sides of the hole. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively low reliability, due to the remoulding, possible mixing or softening of samples by groundwater.

Non-core Rotary Drilling

The borehole is advanced using a rotary bit, with water or drilling mud being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from the rate of penetration. Where drilling mud is used this can mask the cuttings and reliable identification is only possible from separate sampling such as SPTs.

Continuous Core Drilling

A continuous core sample can be obtained using a diamond tipped core barrel, usually with a 50 mm internal diameter. Provided full core recovery is achieved (which is not always possible in weak rocks and granular soils), this technique provides a very reliable method of investigation.

Standard Penetration Tests

Standard penetration tests (SPT) are used as a means of estimating the density or strength of soils and also of obtaining a relatively undisturbed sample. The test procedure is described in Australian Standard 1289, Methods of Testing Soils for Engineering Purposes - Test 6.3.1.

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of, say, 4, 6 and 7 as:

  4,6,7
  N=13

- In the case where the test is discontinued before the full penetration depth, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm as:

  15, 30/40 mm

The results of the SPT tests can be related empirically to the engineering properties of the soils.

Dynamic Cone Penetrometer Tests / Perth Sand Penetrometer Tests

Dynamic penetrometer tests (DCP or PSP) are carried out by driving a steel rod into the ground using a standard weight of hammer falling a specified distance. As the rod penetrates the soil the number of blows required to penetrate each successive 150 mm depth are recorded. Normally there is a depth limitation of 1.2 m, but this may be extended in certain conditions by the use of extension rods. Two types of penetrometer are commonly used.

- Perth sand penetrometer - a 16 mm diameter flat ended rod is driven using a 9 kg hammer dropping 600 mm (AS 1289, Test 6.3.3). This test was developed for testing the density of sands and is mainly used in granular soils and filling.
- Cone penetrometer - a 16 mm diameter rod with a 20 mm diameter cone end is driven using a 9 kg hammer dropping 510 mm (AS 1289, Test 6.3.2). This test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various road authorities.

Description and Classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard AS 1726, Geotechnical Site Investigations Code. In general, the descriptions include strength or density, colour, structure, soil or rock type and inclusions.

Soil Types

Soil types are described according to the predominant particle size, qualified by the grading of other particles present:

Type	Particle size (mm)
Boulder	>200
Cobble	63 - 200
Gravel	2.36 - 63
Sand	0.075 - 2.36
Silt	0.002 - 0.075
Clay	<0.002

The sand and gravel sizes can be further subdivided as follows:

Type	Particle size (mm)
Coarse gravel	20 - 63
Medium gravel	6 - 20
Fine gravel	2.36 - 6
Coarse sand	0.6 - 2.36
Medium sand	0.2 - 0.6
Fine sand	0.075 - 0.2

The proportions of secondary constituents of soils are described as:

Term	Proportion	Example
And	Specify	Clay (60%) and Sand (40%)
Adjective	20 - 35%	Sandy Clay
Slightly	12 - 20%	Slightly Sandy Clay
With some	5 - 12%	Clay with some sand
With a trace of	0 - 5%	Clay with a trace of sand

Definitions of grading terms used are:

- Well graded - a good representation of all particle sizes
- Poorly graded - an excess or deficiency of particular sizes within the specified range
- Uniformly graded - an excess of a particular particle size
- Gap graded - a deficiency of a particular particle size with the range

Cohesive Soils

Cohesive soils, such as clays, are classified on the basis of undrained shear strength. The strength may be measured by laboratory testing, or estimated by field tests or engineering examination. The strength terms are defined as follows:

Description	Abbreviation	Undrained shear strength (kPa)
Very soft	vs	<12
Soft	s	12 - 25
Firm	f	25 - 50
Stiff	st	50 - 100
Very stiff	vst	100 - 200
Hard	h	>200

Cohesionless Soils

Cohesionless soils, such as clean sands, are classified on the basis of relative density, generally from the results of standard penetration tests (SPT), cone penetration tests (CPT) or dynamic penetrometers (PSP). The relative density terms are given below:

Relative Density	Abbreviation	SPT N value	CPT qc value (MPa)
Very loose	vl	<4	<2
Loose	l	4 - 10	2 -5
Medium dense	md	10 - 30	5 - 15
Dense	d	30 - 50	15 - 25
Very dense	vd	>50	>25

Soil Descriptions

Soil Origin

It is often difficult to accurately determine the origin of a soil. Soils can generally be classified as:

- Residual soil - derived from in-situ weathering of the underlying rock;
- Transported soils - formed somewhere else and transported by nature to the site; or
- Filling - moved by man.

Transported soils may be further subdivided into:

- Alluvium - river deposits
- Lacustrine - lake deposits
- Aeolian - wind deposits
- Littoral - beach deposits
- Estuarine - tidal river deposits
- Talus - scree or coarse colluvium
- Slopewash or Colluvium - transported downslope by gravity assisted by water. Often includes angular rock fragments and boulders.

Symbols & Abbreviations

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Introduction

These notes summarise abbreviations commonly used on borehole logs and test pit reports.

Drilling or Excavation Methods

C	Core Drilling
R	Rotary drilling
SFA	Spiral flight augers
NMLC	Diamond core - 52 mm dia
NQ	Diamond core - 47 mm dia
HQ	Diamond core - 63 mm dia
PQ	Diamond core - 81 mm dia

Water

▷	Water seep
▽	Water level

Sampling and Testing

A	Auger sample
B	Bulk sample
D	Disturbed sample
E	Environmental sample
U_{50}	Undisturbed tube sample (50mm)
W	Water sample
pp	pocket penetrometer (kPa)
PID	Photo ionisation detector
PL	Point load strength Is(50) MPa
S	Standard Penetration Test
V	Shear vane (kPa)

Description of Defects in Rock

The abbreviated descriptions of the defects should be in the following order: Depth, Type, Orientation, Coating, Shape, Roughness and Other. Drilling and handling breaks are not usually included on the logs.

Defect Type

B	Bedding plane
Cs	Clay seam
Cv	Cleavage
Cz	Crushed zone
Ds	Decomposed seam
F	Fault
J	Joint
Lam	lamination
Pt	Parting
Sz	Sheared Zone
V	Vein

Orientation

The inclination of defects is always measured from the perpendicular to the core axis.

h	horizontal
v	vertical
sh	sub-horizontal
sv	sub-vertical

Coating or Infilling Term

cln	clean
co	coating
he	healed
inf	infilled
stn	stained
ti	tight
vn	veneer

Coating Descriptor

ca	calcite
cbs	carbonaceous
cly	clay
fe	iron oxide
mn	manganese
slt	silty

Shape

cu	curved
ir	irregular
pl	planar
st	stepped
un	undulating

Roughness

po	polished
ro	rough
sl	slickensided
sm	smooth
vr	very rough

Other

fg	fragmented
bnd	band
qtz	quartz

Symbols & Abbreviations

Graphic Symbols for Soil and Rock

General


Asphalt


Road base


Concrete


Filling

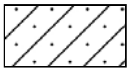
Soils


Topsoil

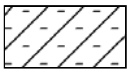

Peat


Clay

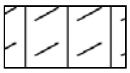

Silty clay

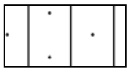

Sandy clay

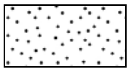

Gravelly clay

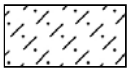

Shaly clay

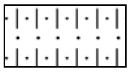

Silt


Clayey silt


Sandy silt

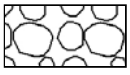

Sand

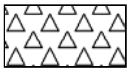

Clayey sand


Silty sand


Gravel


Sandy gravel


Cobbles, boulders

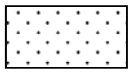

Talus

Sedimentary Rocks

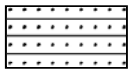

Boulder conglomerate

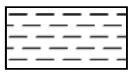

Conglomerate


Conglomeratic sandstone

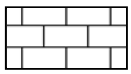

Sandstone


Siltstone


Laminite

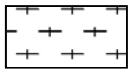

Mudstone, claystone, shale

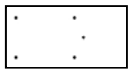

Coal


Limestone

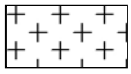
Metamorphic Rocks

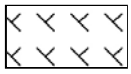

Slate, phyllite, schist

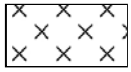

Gneiss

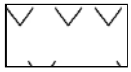

Quartzite

Igneous Rocks


Granite


Dolerite, basalt, andesite


Dacite, epidote


Tuff, breccia


Porphyry

Appendix B

Drawing 1

Locality Plan

Stage 2

Stage 1

Area of proposed processing plant

CAPTAIN COOK HIGHWAY

0 50 100 150

SCALE 1: 4,000 (A3)

LEGEND:-

Test Bore Location and Number

NOTE:-

1. Plan adapted from Drawing No.5555 S CD 02_R2007 provided by Gold Coast Marine Aquaculture .
2. Test locations are approximate only and are shown with reference to existing and proposed site features.
3. Contour interval - 0.2m

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CLIENT: Gold Coast Marine Aquaculture		TITLE: **Test Location Plan**	PROJECT No: 77733.00
OFFICE: Cairns	DRAWN BY: JT	**Proposed Aquaculture Facility Extensions - Stage 1&2**	DRAWING No: 1
SCALE: As shown	DATE: July 2015	**Captain Cook Highway, Port Douglas**	REVISION: 0

P:\Cairns\77733\Drawing 1.dwg

Appendix C

Results of Field Work (Bores 1 to 34)

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 1.8 m AHD
EASTING: 333508
NORTHING: 8174930
DIP/AZIMUTH: 90°/--

BORE No: 1
PROJECT No: 77733
DATE: 28/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.0	TOPSOIL - brown sandy silty clay topsoil with some rootlets		D	0.0				
	0.1	SILTY CLAY - firm to stiff orange brown and brown silty clay with some fine to medium grained sand		D	0.1				
				D	0.2		pp = 100 kPa		
		- stiff to very stiff and light grey mottled orange brown with some sand below approximately 0.3 m depth		D	0.3				
				D	0.5		pp = 200 kPa		
				D	0.75		pp = 200 kPa		
1				D	1.0		pp = 200 kPa		1
				D	1.25		pp = 200 kPa		
				D	1.5		pp = 200 kPa		
				D	1.75		pp = 200 kPa		
0				D	2.0				2
	2.0	SANDY SILTY CLAY - stiff light grey mottled orange brown silty clayey sand/sandy silty clay. Sand fraction fine grained		D	2.1		pp = 150 kPa		
	2.3	SILTY CLAY - very stiff light grey mottled orange brown silty clay with some fine grained sand		D	2.3				
				D	2.4		pp = 250 kPa		
				D	2.5				
-1				D	2.6		pp = 250 kPa		
	2.8	Bore discontinued at 2.8m depth			2.8				

RIG: Push tube rig **DRILLER:** Koci **LOGGED:** Koci **CASING:** Uncased

TYPE OF BORING: 50 mm diameter push tube to 1.4 m, 35 mm diameter push tube to 2.8 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.0 m AHD
EASTING: 333437
NORTHING: 8174852
DIP/AZIMUTH: 90°/--

BORE No: 2
PROJECT No: 77733
DATE: 28/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
2									5 10 15 20
	0.0	TOPSOIL - brown sandy silty clay topsoil with some rootlets		D	0.0				
	0.1	SILTY CLAY - very stiff brown silty clay with trace fine to coarse grained sand		D	0.1				
					0.35		pp = 250 kPa		
		- light grey mottled orange brown below 0.4 m depth		D	0.5		pp = 250 kPa		
	0.7	SANDY SILTY CLAY - very stiff light grey mottled orange brown sandy silty clay. Sand fraction medium to coarse grained		D	0.7				
					0.8		pp = 250 kPa		
1	1			D	1.0		pp = 250 kPa		1
					1.25		pp = 250 kPa		
	1.4	SILTY CLAY - very stiff light grey mottled orange brown silty clay with some medium to coarse grained sand		D	1.5		pp = 250 kPa		
				D	1.75		pp = 250 kPa		
				D	1.9		pp = 250 kPa		
0	2								2
				D	2.25		pp = 250 kPa		
		- stiff below approximately 2.3 m depth		D	2.5		pp = 250 kPa		
					2.7		pp = 250 kPa		
	2.8	Bore discontinued at 2.8m depth							

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Koci **CASING:** Uncased

TYPE OF BORING: 50 mm diameter push tube to 1.4 m, 35 mm diameter push tube to 2.8 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.6 m AHD
EASTING: 333365
NORTHING: 8174765
DIP/AZIMUTH: 90°/--

BORE No: 3
PROJECT No: 77733
DATE: 28/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.0								
	0.1	TOPSOIL - brown silty clay topsoil with trace fine grained sand and some rootlets		D	0.0				
		SILTY CLAY - very stiff brown silty clay with trace fine grained sand		D	0.1				
		- light grey mottled orange brown below 0.3 m depth		D	0.3		pp = 200 kPa		
2				D	0.5		pp = 250 kPa		
				D	0.75		pp = 200 kPa		
	1.0	SILTY CLAY - firm light grey mottled brown silty clay		D	1.0		pp = 75 - 100 kPa		1
				D	1.2		pp = 75 - 100 kPa	▼	
	1.3	SANDY SILTY CLAY - firm to stiff light grey sandy silty clay. Sand fraction medium grained		D	1.3				
				D	1.4		pp = 100 kPa		
1		- stiff below approximately 1.5 m depth		D	1.5		pp = 100 kPa		
				D	1.7		pp = 150 kPa		
	1.8	SILTY CLAYEY SAND - estimated medium dense light grey silty clayey sand. Sand fraction medium grained		D	1.8				
	2			D	2.05				2
	2.2	SILTY CLAY - stiff light grey mottled brown slightly sandy silty clay. Sand fraction medium grained		D	2.2				
				D	2.3		pp = 150 kPa		
	2.5	Bore discontinued at 2.5m depth			2.5				
0									

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 50 mm diameter push tube to 1.4 m, 35 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: Free groundwater observed at 1.3 m depth

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 3.3 m AHD
EASTING: 333306
NORTHING: 8174688
DIP/AZIMUTH: 90°/--

BORE No: 4
PROJECT No: 77733
DATE: 28/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.0	TOPSOIL - brown silty clay topsoil with some rootlets		D	0.0				
	0.1	SILTY CLAY - very stiff grey brown silty clay with trace fine grained sand		D	0.1				
3				D	0.25		pp = 300 kPa		
		- light grey mottled orange brown below 0.3 m depth		D	0.5		pp = 150 kPa		
	0.6	- stiff below 0.5 m depth SILTY CLAY - soft to firm light grey mottled orange brown silty clay		D	0.75		pp = 50 kPa		
				D	1.0		pp = 50 kPa		1
2				D	1.25		pp = 50 kPa		
	1.5	SILTY CLAY - very stiff light grey mottled orange brown slightly sandy silty clay. Sand fraction medium to coarse grained		D	1.5		pp = 350 kPa		
				D	1.75		pp = 350 kPa		
				D	2.0		pp = 350 kPa		2
1				D	2.25		pp = 350 kPa		
	2.5	Bore discontinued at 2.5m depth		D	2.5		pp = 350 kPa		

RIG: Push tube rig **DRILLER:** Koci **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 50 mm diameter push tube to 1.4 m, 35 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 3.9 m AHD
EASTING: 333244
NORTHING: 8174615
DIP/AZIMUTH: 90°/--

BORE No: 5
PROJECT No: 77733
DATE: 28/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.0	TOPSOIL - brown clayey silt topsoil with trace fine grained sand and some rootlets		D	0.0				
	0.1	SILTY CLAY - very stiff grey brown silty clay with trace fine grained sand		D	0.1				
		- light grey mottled orange brown below 0.3 m depth		D	0.35				
		- stiff below 0.5 m depth		D	0.6				
				D	0.85				
3	1	- some sand (medium to coarse grained) below 1.0 m depth		D	1.1				1
	1.4	SANDY SILTY CLAY - stiff light grey mottled orange brown sandy silty clay. Sand fraction medium to coarse grained		D	1.4				
				D	1.65				
		- firm below 1.8 m depth		D	1.8				
2	2	- very stiff below 2.0 m depth		D	2.0				2
				D	2.25				
	2.5	SILTY CLAY - very stiff light grey mottled orange brown silty clay with some fine grained sand		D	2.5				
	2.8	Bore discontinued at 2.8m depth			2.8				
1									

RIG: Push tube rig **DRILLER:** Koci **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 50 mm diameter push tube to 1.4 m, 35 mm diameter push tube to 2.8 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.2 m AHD
EASTING: 333500
NORTHING: 8174801
DIP/AZIMUTH: 90°/--

BORE No: 7
PROJECT No: 77733
DATE: 28/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.0								
	0.1	TOPSOIL - brown fine grained sand topsoil with some silt and rootlets		D	0.0				
		SILTY CLAY - very stiff grey brown silty clay with some fine grained sand		D	0.1				
2		- light grey mottled orange brown below 0.3 m depth		D	0.4		pp = 250 kPa		
				D	0.65				
				D	0.9		pp = 250 kPa		
	1.0	SAND - loose medium to dense light grey mottled orange brown fine to medium grained sand with some silt and clay		D	1.0				1
1	1.3	SANDY SILTY CLAY - stiff light grey mottled orange brown sandy silty clay. Sand fraction fine to medium grained		D	1.3				
				D	1.55				
				D	1.8		pp = 150 kPa		
	2.0			D	2.0		pp = 150 kPa		2
	2.1	SILTY CLAY - very stiff light grey mottled orange brown silty clay with fine grained sand		D	2.1				
0				D	2.3		pp = 250 kPa		
				D	2.4		pp = 250 kPa		
	2.5	Bore discontinued at 2.5m depth			2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 50 mm diameter push tube to 1.4 m, 35 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 1.8 m AHD
EASTING: 333567
NORTHING: 8174884
DIP/AZIMUTH: 90°/--

BORE No: 6
PROJECT No: 77733
DATE: 28/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
	0.0	TOPSOIL - light brown fine grained sand topsoil with some silt and rootlets		D	0.0				
	0.1	SAND - medium dense brown fine grained sand with trace silt and clay		D	0.1				
		- dense below 0.3 m depth							
		- light grey and medium grained below 0.4 m depth		D	0.4				
	0.5	SILTY CLAY - very stiff light grey mottled orange brown silty clay with some medium grained sand		D	0.5		pp = 250 kPa		
		- firm to stiff 0.7 m to 0.8 m depth		D	0.7		pp = 250 kPa		
				D	0.75				
1	1			D	1.0		pp = 250 kPa		1
				D					
	1.3	SANDY SILTY CLAY - stiff light grey mottled orange brown sandy silty clay. Sand fraction medium grained		D	1.3		pp = 150 kPa		
	1.4	SILTY CLAY - very stiff light grey mottled orange brown silty clay with some fine to medium grained sand		D	1.35				
				D	1.4				
				D	1.65		pp = 250 kPa		
0				D	1.9				
	2			D					2
				D	2.2		pp = 250 kPa		
				D	2.5				
				D					
-1	2.8	Bore discontinued at 2.8m depth			2.8				

RIG: Push tube rig **DRILLER:** Koci **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 50 mm diameter push tube to 1.4 m, 35 mm diameter push tube to 2.8 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.8 m AHD
EASTING: 333429
NORTHING: 8174716
DIP/AZIMUTH: 90°/--

BORE No: 8
PROJECT No: 77733
DATE: 28/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.0	TOPSOIL - brown clayey silt topsoil with trace fine grained sand		D	0.0				
	0.1	SILTY CLAY - very stiff grey brown silty clay with trace fine grained sand		D	0.1				
		- light grey mottled orange brown below 0.3 m depth		D	0.35		pp = 250 kPa		
				D	0.6				
				D	0.85		pp = 250 kPa		
	1			D	1.1				1
				D	1.35		pp = 250 kPa		
				D	1.6				
		- stiff and slightly sandy below 1.7 m depth. Sand fraction medium grained		D	1.85		pp = 150 kPa		
	2			D	2.1				2
				D	2.35		pp = 150 kPa		
	2.5	Bore discontinued at 2.5m depth		D	2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 50 mm diameter push tube to 1.4 m, 35 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 3.4 m AHD
EASTING: 333365
NORTHING: 8174640
DIP/AZIMUTH: 90°/--

BORE No: 9
PROJECT No: 77733
DATE: 28/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
									5 10 15 20
		TOPSOIL - brown clayey silt topsoil with trace fine grained sand		D	0.0				
	0.1	SILTY CLAY - very stiff grey brown silty clay with trace fine grained sand		D	0.1				
		- light grey mottled orange brown below 0.3 m depth		D	0.3				
3		- stiff below 0.4 m depth		D	0.55				
		- very stiff below 0.7 m depth		D	0.8				
	1			D	1.05				1
				D	1.3				
2		- some sand below 1.6 m depth. Sand fraction medium to coarse grained		D	1.55				
		- slightly sandy below 1.6 m depth. Sand fraction medium to coarse grained		D	1.8				
	2			D	2.05				2
				D	2.3				
1				D					
	2.5	Bore discontinued at 2.5m depth			2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 50 mm diameter push tube to 1.4 m, 35 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 4.0 m AHD
EASTING: 333308
NORTHING: 8174568
DIP/AZIMUTH: 90°/--

BORE No: 10
PROJECT No: 77733
DATE: 28/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
									5 10 15 20
	0.0				0.0				
	0.1	TOPSOIL - brown clayey silt topsoil with trace fine grained sand and some roots		D	0.1				
		SILTY CLAY - very stiff brown silty clay with trace fine grained sand		D	0.15		pp = 250 kPa		
		- light grey mottled orange brown below 0.2 m depth			0.25				
				D	0.4		pp = 250 kPa		
		- stiff below 0.5 m depth			0.5		pp = 150 kPa		
				D					
					0.75		pp = 150 kPa		
	0.9			D					
3	1	SILTY CLAY - firm light grey silty clay with some fine to medium grained sand			1.0		pp = 75 kPa		1
				D					
					1.25		pp = 75 kPa		
	1.3	SILTY CLAY - very stiff light grey silty clay with trace sand		D					
					1.5		pp = 300 kPa		
				D					
					1.75		pp = 300 kPa		
				D					
		- stiff below 1.9 m depth							
2	2				2.0		pp = 175 kPa		2
				D					
					2.25		pp = 175 kPa		
				D					
	2.5				2.5		pp = 175 kPa		
		Bore discontinued at 2.5m depth							

RIG: Push tube rig **DRILLER:** Koci **LOGGED:** Koci **CASING:** Uncased

TYPE OF BORING: 50 mm diameter push tube to 1.4 m, 35 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 1.8 m AHD
EASTING: 333652
NORTHING: 8174821
DIP/AZIMUTH: 90°/--

BORE No: 11
PROJECT No: 77733
DATE: 28/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
	0.0	TOPSOIL - brown silty clay topsoil with some fine grained sand and rootlets		D	0.0				
	0.1	SILTY CLAY - very stiff grey brown silty clay with some fine grained sand		D	0.1				
	0.4	CLAYEY SAND - medium dense light grey mottled orange brown fine to medium grained clayey sand with some silt and clay		D	0.4				
				D	0.65				
		- medium to coarse grained below 1.0 m depth - loose to medium dense below 1.1 m depth		D	0.9				
	1.2	SILTY CLAY - stiff light grey mottled orange brown slightly sandy silty clay. Sand fraction fine to coarse grained		D	1.2				
	1.3	SAND - medium dense light grey mottled orange brown fine to coarse grained sand with some silt and clay - dense below 1.4 m depth		D	1.3				
	1.6	SANDY SILTY CLAY - firm light grey mottled orange brown sandy silty clay. Sand fraction fine to coarse grained		D	1.6				
	1.9	SILTY CLAY - firm to stiff light grey mottled orange brown slightly sandy silty clay with trace fine to medium subrounded gravel. Sand fraction fine to medium grained		D	1.8		pp = 75 kPa		
				D	2.0		pp = 100 kPa		
				D	2.15				
				D	2.4		pp = 100 kPa		
	2.5	Bore discontinued at 2.5m depth			2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 50 mm diameter push tube to 1.4 m, 35 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.5 m AHD
EASTING: 333582
NORTHING: 8174737
DIP/AZIMUTH: 90°/--

BORE No: 12
PROJECT No: 77733
DATE: 28/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.0								
		TOPSOIL - brown clayey silt topsoil with some fine grained sand and some rootlets		D	0.0				
	0.1	SILTY CLAY - very stiff brown silty clay with some fine to medium grained sand		D	0.1				
					0.2		pp = 250 kPa		
		- stiff and light grey mottled orange brown below 0.3 m depth		D	0.3		pp = 250 kPa		
	0.4	SANDY SILTY CLAY - firm to stiff light grey mottled orange brown sandy silty clay. Sand fraction fine to medium grained		D	0.4				
2					0.5		pp = 100 kPa		
					0.65				
				D	0.7		pp = 100 kPa		
	0.8	SILTY CLAY - very stiff light grey mottled orange brown silty clay with some fine to medium grained sand		D	0.8				
	1				1.05				1
				D	1.2		pp = 250 kPa		
				D	1.3				
1					1.5		pp = 250 kPa		
				D	1.6				
	1.8	SILTY CLAYEY SAND - estimated medium dense light grey mottled orange brown silty clayey medium to coarse grained sand		D	1.8				
	2				2.05				2
				D	2.3				
0				D					
	2.5	Bore discontinued at 2.5m depth			2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 50 mm diameter push tube to 1.4 m, 35 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.8 m AHD
EASTING: 333506
NORTHING: 8174649
DIP/AZIMUTH: 90°/--

BORE No: 13
PROJECT No: 77733
DATE: 28/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.0	TOPSOIL - brown silty clay topsoil with some fine grained sand and some roots		D	0.0				
	0.1	SILTY CLAY - stiff grey brown silty clay with trace fine grained sand		D	0.1				
					0.2		pp = 150 kPa		
	0.3	SILTY CLAY - soft to firm light grey mottled orange brown silty clay		D	0.3		pp = 50 kPa		
					0.4		pp = 50 kPa		
	0.5	SILTY CLAY - stiff to very stiff, light grey mottled orange brown silty clay		D	0.5		pp = 200 kPa		
					0.7		pp = 200 kPa		
2	0.8	SILTY CLAY - firm light grey mottled orange brown silty clay		D	0.8		pp = 75 kPa		
	1	- soft to firm below 1.0 m depth		D	1.0		pp = 50 kPa		1
		- soft with some fine to medium grained sand below 1.2 m depth		D	1.25		pp = 25 - 50 kPa		
	1.3	SILTY CLAY - stiff light grey mottled orange brown silty clay with trace sand		D	1.5		pp = 150 kPa		
				D	1.7				
1				D	1.75		pp = 150 kPa		
	1.9	SANDY SILTY CLAY - stiff to very stiff light grey mottled orange brown sandy silty clay. Sand fraction medium grained		D	1.9				
	2				2.0		pp = 200 kPa		2
	2.1	CLAYEY SAND - light grey mottled orange brown slightly silty clayey medium grained sand		D	2.1				
	2.3	SANDY CLAY - stiff to very stiff light grey mottled orange brown sandy silty clay. Sand fraction medium grained		D	2.3				
					2.4		pp = 300 kPa		
0	2.5	Bore discontinued at 2.5m depth			2.5				

RIG: Push tube rig **DRILLER:** Koci **LOGGED:** Koci **CASING:** Uncased

TYPE OF BORING: 50 mm diameter push tube to 1.4 m, 35 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 3.5 m AHD
EASTING: 333444
NORTHING: 8174574
DIP/AZIMUTH: 90°/--

BORE No: 14
PROJECT No: 77733
DATE: 28/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
									5 10 15 20
	0.1	TOPSOIL - brown silty clay topsoil with some fine grained sand and rootlets		D	0.0				
		SILTY CLAY - very stiff grey brown silty clay with trace fine grained sand		D	0.1				
					0.25		pp = 250 kPa		
		- light grey mottled orange brown below 0.3 m depth		D					
3					0.5		pp = 250 kPa		
				D					
					0.75		pp = 250 kPa		
				D					
	1				1.0		pp = 250 kPa		1
				D					
					1.25				
				D					
2					1.5		pp = 100 kPa		
		- firm to stiff below 1.5 m depth							
		- firm below 1.6 m depth		D	1.6		pp = 75 kPa		
					1.75				
				D					
					1.9		pp = 100 kPa		
		- firm to stiff below 1.9 m depth							
	2				2.0		pp = 150 kPa		2
		- stiff and slightly sandy below 2.0 m depth		D					
					2.25		pp = 150 kPa		
		- some sand below 2.3 m depth		D					
1	2.5				2.5		pp = 150 kPa		
		Bore discontinued at 2.5m depth							

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 50 mm diameter push tube to 1.4 m, 35 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 4.1 m AHD
EASTING: 333390
NORTHING: 8174504
DIP/AZIMUTH: 90°/--

BORE No: 15A
PROJECT No: 77733
DATE: 29/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 1mm)
									5 10 15 20
4	0.1	TOPSOIL - brown silty clay topsoil with trace fine grained sand and rootlets		D	0.0				
		SILTY CLAY - stiff grey brown silty clay with trace fine grained sand		D	0.1				
					0.2		pp = 150 kPa		
		- becomes light grey brown and orange mottled below 0.25 m depth		D	0.25				
					0.5		pp = 150 kPa		
				D					
	0.7	SILTY CLAY - soft to firm light grey brown mottled orange brown silty clay			0.7		pp = 50 kPa		
					0.75				
					0.8		pp = 50 kPa		
				D					
	1				1.0				1
3	1.1	SILTY CLAY - stiff light grey and orange brown mottled silty clay		D	1.1		pp = 150 kPa		
					1.25				
				D					
					1.5				
				D					
					1.75				
		- becomes very stiff below 1.8 m depth			1.8		pp = 350 kPa		
				D					
	2				2.0		pp = 350 kPa		2
2				D					
					2.2		pp = 350 kPa		
	2.3	CORE LOSS			2.3				
	2.5	Bore discontinued at 2.5m depth							

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 4.1 m AHD
EASTING: 333392
NORTHING: 8174504
DIP/AZIMUTH: 90°/--

BORE No: 15B
PROJECT No: 77733
DATE: 29/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
4	0.1	TOPSOIL - brown silty clay topsoil with trace fine grained sand and rootlets		D	0.0				
		SILTY CLAY - stiff grey brown silty clay with trace fine grained sand		D	0.1				
		- becomes light grey brown mottled orange brown below 0.2 m depth			0.2		pp = 150 kPa		
					0.25				
					0.3		pp = 150 kPa		
		- becomes firm below 0.4 m depth			0.4		pp = 75 kPa		
		- becomes stiff below 0.5 m depth			0.5		pp = 150 kPa		
				D					
		- becomes very stiff below 0.7 m depth			0.7		pp = 250 kPa		
					0.75				
				D					
3	1				1.0				1
				D					
					1.25				
				D					
					1.5		pp = 250 kPa		
				D					
					1.75				
				D					
2	2 2.0	SANDY SILTY CLAY - firm light grey and orange mottled sandy silty clay. Sand fraction fine grained		D	2.0				2
					2.1		pp = 75 kPa		
	2.2	SILTY CLAY - stiff light grey and orange mottled silty clay with trace fine grained sand			2.2				
				D	2.3		pp = 150 kPa		
	2.5	Bore discontinued at 2.5m depth			2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 1.8 m AHD
EASTING: 333700
NORTHING: 8174782
DIP/AZIMUTH: 90°/--

BORE No: 16
PROJECT No: 77733
DATE: 29/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
	0.0	TOPSOIL - brown sandy silt topsoil with trace clay and some rootlets. Sand fraction fine grained		D	0.0				
	0.1	SILTY SAND - dense brown silty sand with some clay. Sand fraction fine to medium grained		D	0.1				
	0.3	SANDY CLAY - firm brown grey and orange sandy clay. Sand fraction fine to medium grained		D	0.3				
					0.4		pp = 75 kPa		
		- soft to firm and becoming light grey and orange mottled below 0.5 m depth			0.5		pp = 25 kPa		
	0.6	CLAYEY SAND - medium dense light grey and orange mottled clayey sand. Sand fraction fine to medium grained		D	0.6				
		- becoming light grey below 0.7 m depth			0.7				
-1		- loose to medium dense from 0.9 m to 1.0 m depth		D					
	1								1
	1.1	SANDY CLAY - firm to stiff light grey and orange mottled sandy clay. Sand fraction fine to medium grained		D	1.1		pp = 100 kPa		
					1.25				
				D					
					1.5		pp = 100 kPa		
				D					
0		- becomes very stiff below 1.7 m depth			1.75				
				D					
	2				2.0		pp = 150 kPa		2
		- becomes stiff below 2.1 m depth		D					
	2.3	CLAYEY SAND - estimated medium dense light grey with orange mottled clayey sand. Sand fraction fine to medium grained		D	2.3			▼	
	2.5	Bore discontinued at 2.5m depth			2.5				
-1									

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: Free groundwater observed at 2.4 m depth

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.4 m AHD
EASTING: 333633
NORTHING: 8174701
DIP/AZIMUTH: 90°/--

BORE No: 17
PROJECT No: 77733
DATE: 29/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
	0.0	TOPSOIL - brown silty clay topsoil with trace fine grained sand and rootlets		D	0.0				
	0.1	SILTY CLAY - stiff brown silty clay with trace fine grained sand		D	0.1				
					0.25				
		- becomes yellow brown below 0.3 m depth		D	0.3		pp = 150 kPa		
2	0.4	SILTY SANDY CLAY - stiff light grey and yellow brown mottled silty sandy clay. Sand fraction fine grained		D	0.4				
					0.6		pp = 150 kPa		
	0.7	CLAYEY SAND - medium dense light grey and yellow brown mottled clayey sand. Sand fraction fine to medium grained		D	0.7				
		- becomes red brown and light grey mottled below 0.9 m depth		D	0.9				
	1								1
				D	1.15				
	1.3	SANDY CLAY - very stiff light grey sandy clay. Sand fraction fine to medium grained		D	1.3				
1					1.4		pp = 250 kPa		
				D	1.55				
		- becomes light grey and yellow brown mottled below 1.7 m depth		D	1.7				
	2								2
	2.0	CLAYEY SAND - estimated medium dense red and yellow brown clayey sand. Sand fraction fine to medium grained		D	2.0		pp = 250 kPa		
	2.2	SANDY CLAY - very stiff light grey sandy clay with trace fine to medium grained quartz gravel. Sand fraction fine to medium grained		D	2.2				
0					2.3		pp = 250 kPa		
					2.4		pp = 250 kPa	▼	
	2.5	Bore discontinued at 2.5m depth			2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: Slight seepage observed from 2.5 m depth

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.8 m AHD
EASTING: 333555
NORTHING: 8174613
DIP/AZIMUTH: 90°/--

BORE No: 18
PROJECT No: 77733
DATE: 29/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.0	TOPSOIL - brown silty clay topsoil with trace fine grained sand and rootlets		D	0.0				
	0.1	SILTY CLAY - stiff grey brown silty clay with trace fine grained sand		D	0.1				
					0.2		pp = 150 kPa		
		- becomes light grey and yellow brown mottled below 0.3 m depth			0.3		pp = 150 kPa		
	0.4	SILTY CLAY - firm light grey silty clay		D					
					0.45		pp = 75 kPa		
		- becomes soft below 0.5 m depth			0.5		pp = 50 kPa		
					0.55				
	0.6	SILTY CLAY - stiff light grey and red brown mottled silty clay		D	0.6		pp = 150 kPa		
					0.8		pp = 250 kPa		
		- becomes very stiff with trace medium grained sand below 0.8 m depth		D					
	1								1
					1.05				
		- becomes light grey below 1.1 m depth		D	1.2		pp = 250 kPa		
					1.3				
				D					
					1.55				
				D					
					1.8		pp = 250 kPa		
				D					
	2								2
					2.05				
	2.1	SILTY CLAY - soft to firm light grey silty clay		D	2.1		pp = 50 kPa		
	2.2	SILTY CLAY - very stiff light grey silty clay			2.2		pp = 250 kPa		
		- becomes red brown and orange brown mottled below 2.3 m depth			2.3				
				D	2.4		pp = 250 kPa		
	2.5	Bore discontinued at 2.5m depth			2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 3.5 m AHD
EASTING: 333493
NORTHING: 8174536
DIP/AZIMUTH: 90°/--

BORE No: 19
PROJECT No: 77733
DATE: 29/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
									5 10 15 20
		TOPSOIL - brown silty clay topsoil with trace fine grained sand and rootlets		D	0.0				
	0.1	SILTY CLAY - very stiff grey brown silty clay with trace fine grained sand		D	0.1 0.15		pp = 250 kPa		
					0.25				
				D	0.3		pp = 250 kPa		
					0.35		pp = 150 kPa		
		- becomes stiff and yellow grey brown below 0.35 m depth			0.4		pp = 150 kPa		
3					0.5		pp = 100 kPa		
		- becomes firm to stiff and light grey with red brown mottled below 0.5 m depth		D					
		- becomes stiff below 0.6 m depth			0.6		pp = 150 kPa		
					0.75				
				D					
	1				1.0				1
				D					
					1.2		pp = 250 kPa		
		- becomes very stiff and light grey with yellow brown mottled below 1.2 m depth			1.25				
				D					
2					1.5		pp = 250 kPa		
				D					
					1.75				
				D					
	2				2.0		pp = 250 kPa		2
				D					
		- becomes orange brown with red brown mottled below 2.3 m depth			2.3				
				D					
1	2.5	Bore discontinued at 2.5m depth			2.5		pp = 250 kPa		

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 4.0 m AHD
EASTING: 333435
NORTHING: 8174466
DIP/AZIMUTH: 90°/--

BORE No: 20
PROJECT No: 77733
DATE: 29/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
									5 10 15 20
		TOPSOIL - brown silty clay topsoil with trace fine grained sand		D	0.0				
	0.1	SILTY CLAY - very stiff grey brown silty clay with trace fine grained sand		D	0.1				
					0.2		pp = 250 kPa		
				D	0.25				
					0.3		pp = 250 kPa		
		- becomes light grey brown and orange mottled with trace fine to medium grained sand below 0.5 m depth		D	0.5		pp = 150 kPa		
					0.7		pp = 150 kPa		
		- becomes very stiff and grey and red brown mottled with trace fine grained sand below 0.8 m depth		D	0.8		pp = 250 kPa		
3	1								1
				D	1.05				
		- becomes grey and orange brown mottled below 1.2 m depth		D	1.2		pp = 250 kPa		
					1.45			▼	
				D	1.5		pp = 250 kPa		
		- becomes soft to firm below 1.7 m depth			1.7		pp = 50 - 75 kPa		
		- becomes stiff below 1.8 m depth		D	1.8		pp = 150 kPa		
					1.95				
2	2			D	2.0		pp = 150 kPa		2
					2.2				
				D					
	2.5	Bore discontinued at 2.5m depth			2.5		pp = 150 kPa		

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: Free groundwater observed at 1.4 m depth

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 1.9 m AHD
EASTING: 333772
NORTHING: 8174723
DIP/AZIMUTH: 90°/--

BORE No: 21
PROJECT No: 77733
DATE: 29/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
	0.0	TOPSOIL - brown silty clay topsoil with trace fine grained sand and gravel and rootlets		D	0.0				
	0.1	SILTY SAND - dense brown with orange mottled silty sand with clay. Sand fraction fine grained		D	0.1				
				D	0.25				
		- medium dense below 0.4 m depth		D	0.5				
		- becomes light grey with orange mottled below 0.7 m depth		D	0.75				
1	1.0	SANDY CLAY - firm to stif light grey with orange mottled sandy clay. Sand fraction fine to medium grained		D	1.0		pp = 100 kPa		
				D	1.25				
				D	1.5		pp = 100 kPa		
				D	1.75				
0				D	2.1		pp = 150 kPa		
2		- becomes stiff and light grey below 2.1 m depth		D	2.25				
		- becomes light grey and yellow brown mottled below 2.3m depth		D	2.4		pp = 150 kPa		
	2.5	Bore discontinued at 2.5m depth			2.5				
-1									

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.2 m AHD
EASTING: 333708
NORTHING: 8174640
DIP/AZIMUTH: 90°/--

BORE No: 22
PROJECT No: 77733
DATE: 29/4/2015
SHEET 1 OF 2

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
									5 10 15 20
	0.1	TOPSOIL - brown silty clay topsoil with trace fine grained sand and rootlets		D	0.0				
		SILTY CLAY - very stiff grey brown silty clay with trace fine grained sand		D	0.1		pp = 250 kPa		
		- becomes grey brown and yellow brown mottled below 0.3 m depth		D	0.3		pp = 250 kPa		
		- becomes grey and yellow brown mottled below 0.5 m depth		D	0.5		pp = 250 kPa		
		- becomes stiff below 0.7 m depth		D	0.7		pp = 150 kPa		
	1			D	1.0		pp = 150 kPa		1
				D	1.25				
				D	1.5		pp = 150 kPa		
	1.6	SANDY CLAY - stiff grey and yellow mottled sandy clay. Sand fraction fine grained		D	1.6				
				D	1.7		pp = 150 kPa		
				D	1.85				
				D	1.9		pp = 150 kPa		
	2 2.0			D	2.0		pp = 50 - 75 kPa		2
				D	2.1				
				D	2.35				
				D	2.4		pp = 50 - 75 kPa		
	2.5				2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.8 m AHD
EASTING: 333635
NORTHING: 8174554
DIP/AZIMUTH: 90°/--

BORE No: 23
PROJECT No: 77733
DATE: 1/5/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.0	TOPSOIL - brown silty clay topsoil with trace fine grained sand and rootlets		D	0.0				
	0.1	SILTY CLAY - very stiff grey brown silty clay with trace fine grained sand		D	0.1		pp = 250 kPa		
		- light grey mottled orange brown below 0.3 m depth		D	0.3		pp = 250 kPa		
				D	0.5		pp = 250 kPa		
				D	0.55				
2				D	0.8				
	1			D	1.0		pp = 250 kPa		1
				D	1.05				
				D	1.3				
				D	1.5		pp = 250 kPa		
				D	1.55				
1				D	1.8				
		- light grey mottled red brown below 1.9 m depth		D	2.0		pp = 250 kPa		
	2			D	2.05				2
		- trace organic material at 2.1 m depth							
		- light grey with white mottled below 2.2 m depth		D	2.3				
				D	2.4		pp = 250 kPa		
	2.5	Bore discontinued at 2.5m			2.5				
0									

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 3.4 m AHD
EASTING: 333567
NORTHING: 8174473
DIP/AZIMUTH: 90°/--

BORE No: 24
PROJECT No: 77733
DATE: 1/5/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.0	TOPSOIL - brown silty clay topsoil with trace sand and rootlets		D	0.0				
	0.1	SILTY CLAY - very stiff grey brown silty clay with trace fine grained sand		D	0.1				
		- light brown and yellow brown mottled below 0.25 m depth		D	0.25				
		- grey and yellow brown mottled below 0.5 m depth		D	0.5				
	0.8	SILTY CLAY - very stiff light grey with orange brown mottled silty clay with fine grained sand		D	0.8				
		- stiff below 0.9 m depth		D	1.05				
		- very stiff below 1.1 m depth		D	1.3				
	1.6	SILTY SANDY CLAY - stiff light grey with orange brown and white mottled silty sandy clay. Sand fraction fine grained		D	1.6				
				D	1.85				
		- very stiff below 2.1 m depth		D	2.1				
				D	2.3				
	2.5	Bore discontinued at 2.5m			2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 4.2 m AHD
EASTING: 333509
NORTHING: 8174405
DIP/AZIMUTH: 90°/--

BORE No: 25
PROJECT No: 77733
DATE: 1/5/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 0mm)
	0.0	TOPSOIL - brown silty clay topsoil with trace fine grained sand and rootlets		D	0.0				
4	0.1	SILTY CLAY - very stiff grey brown silty clay with trace fine grained sand		D	0.1				
		- grey brown and orange mottled below 0.3 m depth		D	0.3				
				D	0.55				
				D	0.8				
	0.9	SILTY CLAY - soft light grey and orange brown mottled silty clay with some fine grained sand		D	0.9		pp < 50 kPa	▼	
1		- soft to firm below 1.0 m depth			1.0		pp = 75 - 100 kPa		1
	1.1	SILTY CLAY - stiff light grey and orange brown mottled silty clay		D	1.05 1.1		pp = 150 kPa		
3				D	1.2				
	1.4	SILTY SANDY CLAY - stiff light grey with white and orange brown mottled silty sandy clay. Sand fraction fine grained		D	1.4 1.5		pp = 150 kPa		
				D	1.65				
				D	1.9 2.0		pp = 150 kPa		2
2				D	2.15				
				D	2.4		pp = 150 kPa		
	2.5	Bore discontinued at 2.5m			2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: Slight seepage observed from 0.9 m depth

REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.2 m AHD
EASTING: 333390
NORTHING: 8175345
DIP/AZIMUTH: 90°/--

BORE No: 26
PROJECT No: 77733
DATE: 29/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
									5 10 15 20
		TOPSOIL - dark brown silty clay with fine grained sand topsoil		D	0.0				
	0.15	SANDY CLAY - stiff orange brown with grey brown mottled sandy clay. Sand fraction fine grained		D	0.15		pp = 150 kPa		
				D	0.3		pp = 150 kPa		
	0.35	CLAYEY SAND - medium dense light grey with orange brown mottled clayey sand with silt. Sand fraction fine grained		D	0.35				
				D	0.6				
		- dense below 0.9 m depth		D	0.85			▼	
				D	1.1				
		- very dense below 1.4 m depth		D	1.35				
	1.6	SILTY CLAY -stiff to very stiff light grey with orange brown mottled silty clay with fine to medium grained sand		D	1.6		pp = 200 kPa		
				D	1.8		pp = 200 kPa		
		- becoming very stiff at 2.0 m depth		D	1.85				
				D	2.0		pp = 250 kPa		
				D	2.1				
				D	2.3				
	2.5	Bore discontinued at 2.5m depth			2.5		pp = 250 kPa		

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: Free groundwater observed at 0.9 m depth

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.3 m AHD
EASTING: 333309
NORTHING: 8175235
DIP/AZIMUTH: 90°/--

BORE No: 27
PROJECT No: 77733
DATE: 1/5/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
	0.0	TOPSOIL - dark brown silty clay topsoil with trace fine grained sand		D	0.0				
	0.1	SILTY CLAY - stiff dark brown and red brown mottled silty clay with trace fine to medium grained sand		D	0.1 0.15		pp = 150 kPa		
	0.25	SANDY CLAY - stiff to very stiff grey brown and orange brown mottled sandy clay. Sand fraction fine to medium grained		D	0.25 0.35		pp = 200 kPa pp = 200 kPa		
	0.4	SILTY SAND - medium dense light grey with orange brown mottled silty sand. Sand fraction fine to medium grained - dense below 0.6 m depth		D D	0.4 0.65				
		- orange brown below 0.85 m depth		D	0.85			▼	
		- very dense orange brown and grey mottled with fine to coarse grained sand below 1.1 m depth - dense light grey below 1.2 m depth		D	1.1				
	1.4	CLAYEY SAND - dense light grey with orange brown mottled clayey sand. Sand fraction fine to medium grained - medium dense below 1.6 m depth		D D	1.4 1.65				
		- dense fine to coarse grained clayey sand below 2.1 m depth		D D	1.9 2.2				
	2.5	Bore discontinued at 2.5m			2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: Free groundwater observed at 0.9 m depth

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 1.9 m AHD
EASTING: 333502
NORTHING: 8175326
DIP/AZIMUTH: 90°/--

BORE No: 28
PROJECT No: 77733
DATE: 1/5/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
	0.0	TOPSOIL - dark brown silty clay topsoil with trace fine grained sand and rootlets		D	0.0				
	0.1	SILTY CLAY - very stiff dark brown with red brown mottled silty clay with trace fine to medium grained sand		D	0.1				
					0.2		pp = 250 kPa		
	0.25	SILTY SANDY CLAY - stiff light grey brown with orange brown mottled silty sandy clay. Sand fraction fine grained			0.25				
				D	0.3		pp = 150 kPa		
					0.4		pp = 150 kPa		
	0.5	SILTY SAND - loose to medium dense light red with orange mottled silty sand with clay. Sand fraction fine grained		D	0.5				
					0.75				
				D					
1	1				1.0			▼	1
				D					
		- light grey with fine and medium grained sand below 1.1 m depth							
		- medium dense below 1.2 m depth			1.25				
				D					
					1.5				
		- loose to medium dense below 1.6 m depth		D					
	1.8	SANDY CLAY - firm light grey sandy clay. Sand fraction fine to medium grained with trace coarse grained sand			1.8		pp = 75 kPa		
0				D					
	2				2.0		pp = 75 kPa		2
					2.05				
				D					
					2.3				
		- light grey with orange mottled below 2.4 m depth		D	2.4		pp = 75 kPa		
	2.5	Bore discontinued at 2.5m			2.5				
-1									

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: Free groundwater observed at 1.0 m depth

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.2 m AHD
EASTING: 333437
NORTHING: 8175252
DIP/AZIMUTH: 90°/--

BORE No: 29
PROJECT No: 77733
DATE: 1/5/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
	0.0	TOPSOIL - dark brown silty clay topsoil with trace fine grained silt and rootlets		D	0.0				
	0.1	SILTY CLAY - very stiff dark brown and red brown mottled silty clay with trace fine grained sand		D	0.1				
					0.2		pp = 250 kPa		
	0.25	SILTY SANDY CLAY - stiff light grey brown with orange brown mottled silty sandy clay. Sand fraction fine grained		D	0.25				
					0.3		pp = 150 kPa		
					0.45		pp = 150 kPa		
	0.5	SILTY SAND - medium dense light grey with orange mottled silty sand with clay. Sand fraction fine grained		D	0.5				
					0.75				
		- loose below 0.9 m depth		D				▼	
	1	- loose and light grey with red brown mottled below 1.0 m depth		D	1.0				1
		- medium dense light grey and sand fraction fine to medium grained below 1.2 m depth		D	1.25				
	1.5	CLAYEY SAND - dense light grey with orange mottled clayey sand. Sand fraction fine to medium grained		D	1.5				
	1.6	SANDY CLAY - stiff light grey with orange brown mottled sandy clay. Sand fraction fine to medium grained with trace coarse grained sand		D	1.6		pp = 150 kPa		
					1.8		pp = 150 kPa		
					1.85				
		- stiff to very stiff below 1.9 m depth		D	1.9		pp = 200 kPa		
	2								2
				D	2.1				
					2.3				
		- very stiff below 2.4 m depth		D	2.4		pp = 250 kPa		
	2.5	Bore discontinued at 2.5m			2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: Free groundwater observed at 0.9 m depth

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.3 m AHD
EASTING: 333357
NORTHING: 8175154
DIP/AZIMUTH: 90°/--

BORE No: 30
PROJECT No: 77733
DATE: 1/5/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
	0.0	TOPSOIL - dark brown silty clay with trace fine grained sand and rootlets		D	0.0				
	0.1	SILTY CLAY - very stiff dark brown with red brown mottled silty clay with trace fine grained sand - stiff below 0.2 m depth		D	0.1 0.15		pp = 250 kPa		
2	0.3	SILTY SANDY CLAY - stiff light grey brown with orange brown mottled silty sandy clay. Sand fraction fine grained		D	0.3 0.35		pp = 150 kPa		
	0.4	SILTY SAND - medium dense light grey with orange mottled silty sand with clay. Sand fraction fine grained		D	0.4				
				D	0.65			▼	
		- orange brown with red brown mottled below 0.8 m depth - light grey with orange mottled below 0.9 m depth		D	0.9				
	1	- dense below 1.0 m depth - sand fraction fine to medium grained below 1.1 m depth		D	1.15				1
1		- medium dense below 1.2 m depth		D					
	1.4	SANDY CLAY - very stiff to stiff light grey sandy clay. Sand fraction fine to medium grained		D	1.4 1.5		pp = 200 kPa		
				D	1.65 1.7		pp = 200 kPa		
	1.9	SILTY CLAY - stiff light grey with orange brown mottled silty clay with some fine to medium grained sand		D	1.9 2.0		pp = 150 kPa		
	2			D	2.15				2
0				D	2.3				
	2.5	Bore discontinued at 2.5m			2.5		pp = 150 kPa		

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: Free groundwater observed at 0.7 m depth

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 1.8 m AHD
EASTING: 333593
NORTHING: 8175285
DIP/AZIMUTH: 90°/--

BORE No: 31
PROJECT No: 77733
DATE: 1/5/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
	0.0	TOPSOIL - dark brown silty clay topsoil with trace fine grained sand and rootlets		D	0.0				
	0.1	SILTY CLAY - stiff dark brown with red brown mottled silty clay with fine grained sand		D	0.1				
					0.2		pp = 150 kPa		
	0.25	SILTY SANDY CLAY - stiff light grey and yellow brown mottled silty sandy clay. Sand fraction fine grained		D	0.25				
					0.3		pp = 150 kPa		
	0.35	SILTY SAND - medium dense light grey and yellow brown mottled silty sand with clay		D	0.35				
					0.6				
		- loose to medium dense light grey with trace clay below 0.6 m depth		D					
					0.85				
	1			D					1
		- yellow brown below 1.1 m depth		D	1.1			▼	
		- medium dense below 1.2 m depth		D	1.2				
					1.4				
		- light grey with yellow brown mottled below 1.4 m depth		D					
	1.6	- loose below 1.5 m depth		D	1.6				
	1.7	CLAYEY SAND - loose light grey and yellow mottled clayey sand. Sand fraction fine grained		D	1.7		pp = 100 kPa		
		SANDY CLAY - firm to stiff light grey with orange brown mottled sandy clay. Sand fraction fine grained		D					
					1.9		pp = 100 kPa		
		- light grey with orange brown and red brown mottled below 1.9 m depth		D					
	2								2
					2.1		pp = 100 kPa		
		- red brown with fine to coarse grained sand below 2.1 m depth		D					
					2.3		pp = 100 kPa		
		- red brown, orange brown and light grey below 2.3 m depth		D	2.4		pp = 100 kPa		
	2.5	Bore discontinued at 2.5m			2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: Free groundwater observed at 1.1 m depth

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 1.9 m AHD
EASTING: 333538
NORTHING: 8175222
DIP/AZIMUTH: 90°/--

BORE No: 32
PROJECT No: 77733
DATE: 1/5/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
	0.0	TOPSOIL - dark brown silty clay topsoil with trace fine grained sand and rootlets		D	0.0				
	0.1	SILTY CLAY - stiff dark brown and red brown mottled silty clay with trace fine grained sand		D	0.1				
	0.25	SILTY SANDY CLAY - stiff light grey brown and yellow brown mottled silty sandy clay. Sand fraction fine grained		D	0.25				
	0.35	SILTY SAND - loose to medium dense light grey and yellow brown mottled silty sand with clay. Sand fraction fine grained		D	0.35				
		- medium to dense from 0.6 m depth		D	0.6				
				D	0.85				
		- yellow brown below 1.1m depth		D	1.1				
		- light grey with yellow brown mottled below 1.2 m depth		D	1.2			▼	
	1.5	CLAYEY SAND - loose light grey and yellow brown mottled clayey sand. Sand fraction fine to medium grained		D	1.5				
	1.6	SANDY CLAY - stiff light grey with brown mottled sandy clay. Sand fraction fine to medium grained		D	1.6		pp = 150 kPa		
				D	1.8		pp = 150 kPa		
				D	1.85				
				D	2.1				
		- light grey below 2.2 m depth		D	2.2		pp = 150 kPa		
	2.3	CLAYEY SAND - estimated medum dense light grey clayey sand. Sand faction fine grained		D	2.3				
	2.5	Bore discontinued at 2.5m			2.5				

Dynamic Penetrometer Test (blows per 100mm): 5, 10, 15, 20

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: Free groundwater observed at 1.2 m depth

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.0 m AHD
EASTING: 333467
NORTHING: 8175137
DIP/AZIMUTH: 90°/--

BORE No: 33
PROJECT No: 77733
DATE: 1/5/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
2	0.0	TOPSOIL - brown silty clay topsoil with trace fine grained sand and rootlets		D	0.0				
	0.1	SILTY CLAY - stiff dark brown and red brown mottled silty clay with trace fine grained sand		D	0.1 0.15		pp = 150 kPa		
	0.3	SILTY SANDY CLAY - stiff light grey and yellow brown mottled silty sandy clay. Sand fraction fine grained		D	0.3 0.4		pp = 150 kPa		
	0.45	SILTY SAND - medium dense light grey and yellow brown mottled silty sand with clay. Sand fraction fine to medium grained		D	0.45				
		- loose to medium dense and light grey below 0.7 m depth		D	0.8				
1	1	- sand fraction fine to coarse grained		D	1.05			▼	1
	1.2	CLAYEY SAND - medium dense to dense light grey clayey sand with silt. Sand fraction fine to coarse grained		D	1.2				
	1.5	SANDY CLAY - stiff light grey with yellow brown mottled sandy clay. Sand fraction fine to medium grained		D	1.5 1.6		pp = 150 kPa		
				D	1.75				
0	2			D	2.0		pp = 150 kPa		2
				D	2.25				
				D	2.4		pp = 150 kPa		
	2.5	Bore discontinued at 2.5m			2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: Free groundwater observed at 1.0 m depth

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

Douglas Partners
Geotechnics / Environment / Groundwater

BOREHOLE LOG

CLIENT: Gold Coast Marine Aquaculture
PROJECT: Prop Aquaculture Facility Extensions
LOCATION: Captain Cook Highway, Port Douglas

SURFACE LEVEL: 2.0 m AHD
EASTING: 333425
NORTHING: 8175086
DIP/AZIMUTH: 90°/--

BORE No: 34
PROJECT No: 77733
DATE: 29/4/2015
SHEET 1 OF 1

RL	Depth (m)	Description of Strata	Graphic Log	Sampling & In Situ Testing: Type	Depth	Sample	Results & Comments	Water	Dynamic Penetrometer Test (blows per 100mm)
2	0.1	TOPSOIL - brown silty clay with trace fine grained sand topsoil and rootlets		D	0.0				
		SILTY SANDY CLAY - very stiff brown silty sandy clay. Sand fraction fine grained		D	0.1		pp = 250 kPa		
	0.4				0.3		pp = 250 kPa		
		CLAYEY SAND - medium dense light grey and orange brown mottled clayey sand. Sand fraction fine grained		D	0.4				
				D	0.6				
				D	0.9				
1	1			D	1.15				1
		- dense below 1.3 m depth		D	1.4				
				D	1.6				
		- very dense below 1.6 m depth		D	1.8		pp = 250 kPa		
	1.8	SANDY CLAY - very stiff light grey orange mottled sandy clay. Sand fraction fine grained		D	2.0		pp = 250 kPa		
0	2			D	2.05				2
				D	2.3		pp = 250 kPa		
	2.5	Bore discontinued at 2.5m depth		D	2.5				

RIG: Push tube rig **DRILLER:** Hanna **LOGGED:** Hanna **CASING:** Uncased

TYPE OF BORING: 35 mm diameter push tube to 1.4 m, 50 mm diameter push tube to 2.5 m depth

WATER OBSERVATIONS: No free groundwater observed

REMARKS:

☐ Sand Penetrometer AS1289.6.3.3
☒ Cone Penetrometer AS1289.6.3.2

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	G	Gas sample	PID	Photo ionisation detector (ppm)
B	Bulk sample	P	Piston sample	PL(A)	Point load axial test Is(50) (MPa)
BLK	Block sample	U_x	Tube sample (x mm dia.)	PL(D)	Point load diametral test Is(50) (MPa)
C	Core drilling	W	Water sample	pp	Pocket penetrometer (kPa)
D	Disturbed sample	▷	Water seep	S	Standard penetration test
E	Environmental sample	▼	Water level	V	Shear vane (kPa)

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Appendix D

Laboratory Results

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77733 - ASS Screening Test Results

Bore Location	Depth (m)	Sample Description	Screening Test Results			
			pH_F	pH_{FOX}	pH	Reaction (1,2,3,4)* F**
1	0.0 - 0.1	Topsoil - silty clay	5.8	3.9	1.9	1F
	0.1 - 0.2	Silty clay	5.7	4	1.7	1F
	0.3 - 0.5	Silty clay	5	3.9	1.1	1
	0.5 - 0.75	Silty clay	4.4	3.8	0.6	1
	0.75 - 1.0	Silty clay	4.9	4.2	0.7	1
	1.0 - 1.25	Silty clay	5.3	4.5	0.8	1
	1.25 - 1.5	Silty clay	5.3	4.6	0.7	1
	1.5 - 1.75	Silty clay	5.6	4.9	0.7	1
	1.75 - 2.0	Silty clay	6	5.6	0.4	1
	2.0 - 2.3	Silty clayey sand/sandy silty clay	6.1	5.8	0.3	1
	2.3 - 2.5	Silty clay	6.3	6	0.3	1
2	0.0 - .01	Topsoil - silty clay	5.7	3	2.7	1F
	0.1 - 0.35	Silty clay	5.6	3.8	1.8	1F
	0.35 - 0.7	Silty clay	5.5	4	1.5	1
	0.7 - 1.0	Sandy silty clay	5.3	4.4	0.9	1
	1.0 - 1.25	Sandy silty clay	5	4.4	0.6	1
	1.25 - 1.5	Sandy silty clay	4.8	4.8	0	1
	1.5 - 1.75	Sandy silty clay	5.4	4.6	0.8	1
	1.75 - 1.9	Sandy silty clay	4.8	4.8	0	1
	1.9 - 2.25	Silty clay	4.8	4.7	0.1	1
	2.25 - 2.5	Silty clay	4.8	4.8	0	1
3	0.0 - 0.1	Topsoil - silty clay	5.7	3.6	2.1	1F
	0.1 - 0.3	Silty clay	5.9	4	1.9	1F
	0.3 - 0.5	Silty clay	5.4	4.3	1.1	1
	0.5 - 0.75	Silty clay	5.1	4.3	0.8	1
	0.75 - 1.0	Silty clay	5.5	4.6	0.9	1
	1.0 - 1.3	Silty clay	5.5	4.7	0.8	1
	1.3 - 1.5	Sandy silty clay	5.4	4.7	0.7	1
	1.5 - 1.8	Sandy silty clay	5.3	4.6	0.7	1
	1.8 - 2.05	Silty clayey sand	5.1	4.7	0.4	1
	2.05 - 2.2	Silty clayey sand	5.8	4.5	1.3	1
	2.2 - 2.5	Silty clay	5.9	5	0.9	1
4	0.0 - 0.1	Topsoil - silty clay	5.3	3	2.3	1F
	0.1 - 0.25	Silty clay	5.6	3.7	1.9	1F
	0.25 - 0.5	Silty clay	4.4	3.8	0.6	1
	0.5 - 0.75	Silty clay	5	4.2	0.8	1
	0.75 - 1.0	Silty clay	4.6	3.8	0.8	1
	1.0 - 1.25	Silty clay	5.2	4.7	0.5	1
	1.25 - 1.5	Silty clay	5.3	4.2	1.1	1
	1.5 - 1.75	Silty clay	5.3	4.4	0.9	1
	1.75 - 2.0	Silty clay	5.4	4.5	0.9	1
	2.0 - 2.25	Silty clay	5.5	4.5	1	1
	2.25 - 2.5	Silty clay	5.2	4.7	0.5	1

Notes to Table:

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77733 - ASS Screening Test Results

Bore Location	Depth (m)	Sample Description	Screening Test Results			
			pH_F	pH_{FOX}	pH	Reaction (1,2,3,4)* F**
5	0.0 - 0.1	Topsoil - silty clay	5.5	3.3	2.2	1F
	0.1 - 0.35	Silty clay	5.5	4	1.5	1F
	0.35 - 0.6	Silty clay	4.5	4.1	0.4	1
	0.6 - 0.85	Silty clay	4.9	4	0.9	1
	0.85 - 1.1	Silty clay	4.5	3.7	0.8	1
	1.1 - 1.4	Silty clay	4.8	4.2	0.6	1
	1.4 - 1.65	Sandy silty clay	4.7	4.5	0.2	1
	1.65 - 1.8	Sandy silty clay	5.6	4.7	0.9	1
	1.8 - 2.0	Sandy silty clay	5.5	4.4	1.1	1
	2.0 - 2.25	Sandy silty clay	5.5	5	0.5	1
	2.25 - 2.5	Sandy silty clay	6.1	5	1.1	1
6	0.0 - 0.1	Topsoil -Sand	5.6	2.9	2.7	1F
	0.1 - 0.4	Sand	5.7	3.8	1.9	2
	0.4 - 0.5	Sand	5.9	4.5	1.4	1
	0.5 - 0.75	Silty clay	5.6	4.7	0.9	1
	0.75 - 1.0	Silty clay	5.8	4.6	1.2	1
	1.0 - 1.3	Silty clay	5.9	5.2	0.7	1
	1.3 - 1.4	Sandy silty clay	5.7	3.9	1.8	1
	1.4 - 1.65	Silty clay	5.9	5	0.9	1
	1.65 - 1.9	Silty clay	5.8	5.4	0.4	1
	1.9 - 2.2	Silty clay	5.8	5.7	0.1	2
	2.2 - 2.5	Silty clay	6	6	0	1
7	0.0 - 0.1	Sand	4.9	3	1.9	1F
	0.1 - 0.4	Silty clay	5.4	4.2	1.2	1F
	0.4 - 0.65	Silty clay	5.4	4.4	1	1
	0.65 - 0.9	Silty clay	5.9	4.6	1.3	1
	0.9 - 1.0	Silty clay	5.5	4.3	1.2	1
	1.0 - 1.3	Sandy silty clay	5.4	4.4	1	1
	1.3 - 1.55	Sandy silty clay	5.6	4.8	0.8	1
	1.55 - 1.8	Sandy silty clay	5.8	4.9	0.9	1
	1.8 - 2.1	Sandy silty clay	5.6	5.2	0.4	1
	2.1 - 2.35	Silty clay	5.6	5.5	0.1	1
	2.35 - 2.5	Silty clay	4.9	5.2	-0.3	1
8	0.0 - 0.1	Topsoil - silty clay	6	3.3	2.7	1F
	0.1 - 0.35	Silty clay	5.9	4.2	1.7	1F
	0.35 - 0.6	Silty clay	5.8	4.5	1.3	3
	0.6 - 0.85	Silty clay	6.1	4.8	1.3	1
	0.85 - 1.1	Silty clay	5.8	4.7	1.1	1
	1.1 - 1.35	Silty clay	5.6	4.8	0.8	1
	1.35 - 1.6	Silty clay	4.6	4.5	0.1	1
	1.6 - 1.85	Silty clay	4.9	4.7	0.2	1
	1.85 - 2.1	Silty clay	5.1	4.7	0.4	1
	2.1 - 2.35	Silty clay	5.4	4.8	0.6	1
	2.35 - 2.5	Silty clay	5.6	5.3	0.3	1

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77733 - ASS Screening Test Results

Bore Location	Depth (m)	Sample Description	Screening Test Results			
			pH_F	pH_{FOX}	pH	Reaction (1,2,3,4)* F**
9	0.0 - 0.1	Topsoil - silty clay	5.5	3.1	2.4	1F
	0.1 - 0.3	Silty clay	5.7	4.2	1.5	1F
	0.3 - 0.55	Silty clay	5.8	5.4	0.4	3
	0.55 - 0.8	Silty clay	5.8	5.4	0.4	1
	0.8 - 1.05	Silty clay	5.9	5.7	0.2	1
	1.05 - 1.3	Silty clay	5.9	5.5	0.4	1
	1.3 - 1.55	Silty clay	6	5.6	0.4	1
	1.55 - 1.8	Silty clay	5.8	5.3	0.5	1
	1.8 - 2.05	Silty clay	6.2	5.3	0.9	1
	2.05 - 2.3	Silty clay	6.1	5.7	0.4	1
	2.3 - 2.5	Silty clay	6.4	5.6	0.8	1
10	0.0 - 0.1	Topsoil - silty clay	6.1	3.9	2.2	1F
	0.1 - 0.25	Silty clay	5.9	5	0.9	1F
	0.25 - 0.5	Silty clay	5.4	4.7	0.7	1
	0.5 - 0.75	Silty clay	5.5	5.3	0.2	2
	0.75 - 1.0	Silty clay	4.9	4.7	0.2	1
	1.0 - 1.25	Silty clay	5.1	4.7	0.4	1
	1.25 - 1.5	Silty clay	5.5	5.3	0.2	1
	1.5 - 1.75	Silty clay	5.6	5.2	0.4	1
	1.75 - 2.0	Silty clay	6.2	5.5	0.7	1
	2.0 - 2.25	Silty clay	6.3	5.3	1	1
	2.25 - 2.5	Silty clay	6.4	5.5	0.9	1
11	0.0 - 0.1	Topsoil - silty clay	5.6	3.4	2.2	1F
	0.1 - 0.4	Silty clay	5.8	3.8	2	1F
	0.4 - 0.65	Sand	5.7	4.2	1.5	1
	0.65 - 0.9	Sand	5.6	4	1.6	1
	0.9 - 1.2	Sand	4.2	3.8	0.4	1
	1.2 - 1.3	Silty clay	5	3.9	1.1	1
	1.3 - 1.6	Sand	4.9	4.2	0.7	1
	1.6 - 1.9	Sandy silty clay	4.9	4.2	0.7	1
	1.9 - 2.15	Silty clay	5.9	3.5	2.4	1
	2.15 - 2.4	Silty clay	6.2	4.6	1.6	1
	2.4 - 2.5	Silty clay	5.6	4.9	0.7	1
12	0.0 - 0.1	Topsoil - silty clay	5.3	3.3	2	1F
	0.1 - 0.3	Silty clay	5.7	3.6	2.1	1F
	0.3 - 0.4	Silty clay	6.2	4.9	1.3	1
	0.4 - 0.65	Sandy silty clay	6.6	5.1	1.5	1
	0.65 - 0.8	Sandy silty clay	6.3	4.8	1.5	1
	0.8 - 1.05	Silty clay	6.3	5.3	1	1
	1.05 - 1.3	Silty clay	6.3	5.5	0.8	1
	1.3 - 1.6	Silty clay	6.3	5.3	1	1
	1.6 - 1.8	Silty clay	6.5	5.5	1	1
	1.8 - 2.05	Silty clayey sand	6.4	5.1	1.3	1
	2.05 - 2.3	Silty clayey sand	6.3	5.2	1.1	1
	2.3 - 2.5	Silty clayey sand	6.3	5.4	0.9	1

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77733 - ASS Screening Test Results

Bore Location	Depth (m)	Sample Description	Screening Test Results			
			pH_F	pH_{FOX}	pH	Reaction (1,2,3,4)* F**
13	0.0 - 0.1	Topsoil - silty clay	5.6	3.7	1.9	1F
	0.1 - 0.3	Silty clay	5.4	4.1	1.3	1F
	0.3 - 0.5	Silty clay	5.5	5.4	0.1	4
	0.5 - 0.8	Silty clay	5.4	5.2	0.2	1
	0.8 - 1.0	Silty clay	5.4	5.4	0	3
	1.0 - 1.25	Silty clay	5.6	5	0.6	1
	1.25 - 1.5	Silty clay	5.9	5.5	0.4	1
	1.5 - 1.7	Silty clay	5.7	4.6	1.1	1
	1.7 - 1.9	Silty clay	6.2	5.3	0.9	1
	1.9 - 2.1	Sandy silty clay	6	5.6	0.4	1
	2.1 - 2.3	Sand	6.2	5.4	0.8	1
	2.3 - 2.5	Sandy silty clay	6.3	5.4	0.9	1
14	0.0 - 0.1	Topsoil - silty clay	5.5	3.5	2	1F
	0.1 - 0.25	Silty clay	5.5	4	1.5	1F
	0.25 - 0.5	Silty clay	5.7	4.4	1.3	1
	0.5 - 0.75	Silty clay	5.6	4.7	0.9	1
	0.75 - 1.0	Silty clay	5.8	4.7	1.1	1
	1.0 - 1.25	Silty clay	5.7	4.8	0.9	1
	1.25 - 1.5	Silty clay	5.1	4.5	0.6	1
	1.5 - 1.75	Silty clay	5.3	4.6	0.7	1
	1.75 - 2.0	Silty clay	5.3	4.6	0.7	1
	2.0 - 2.25	Silty clay	5.8	4.9	0.9	1
	2.25 - 2.5	Silty clay	6.2	5	1.2	1
15B	0.0 - 0.1	Silty clay	5.7	3.1	2.6	1F
	0.1 - 0.25	Silty clay	5.4	3.5	1.9	1F
	0.25 - 0.5	Silty clay	6	4.4	1.6	1
	0.5 - 0.75	Silty clay	6.1	5	1.1	1
	0.75 - 1.0	Silty clay	5.5	4.4	1.1	1
	1.0 - 1.25	Silty clay	5.9	4.9	1	1
	1.25 - 1.5	Silty clay	6	4.9	1.1	1
	1.5 - 1.75	Silty clay	6.2	5.5	0.7	1
	1.75 - 2.0	Silty clay	6.4	5.4	1	1
	2.0 - 2.2	Sandy silty clay	6.6	5.6	1	1
	2.2 - 2.5	Silty clay	6.2	5.2	1	1
16	0.0 - 0.1	Topsoil - silty clay	6.3	3.5	2.8	1F
	0.1 - 0.3	Silty sand	6.3	3.4	2.9	1F
	0.3 - 0.6	Sandy clay	6.1	4.3	1.8	1
	06. - 0.7	Clayey sand	6.2	4.6	1.6	1
	0.7 - 1.0	Sandy clay	6.1	4.8	1.3	1
	1.0 - 1.25	Sandy clay	5.8	4.8	1	1
	1.25 - 1.5	Sandy clay	6	5	1	1
	1.5 - 1.75	Sandy clay	6.1	4.6	1.5	1
	1.75 - 2.0	Sandy clay	5.9	4.9	1	1
	2.0 - 2.3	Clayey sand	5.8	5.1	0.7	1
	2.3 - 2.5	Clayey sand	6.1	5.4	0.7	1

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77733 - ASS Screening Test Results

Bore Location	Depth (m)	Sample Description	Screening Test Results			
			pH_F	pH_{FOX}	pH	Reaction (1,2,3,4)* F**
17	0.0 - 0.1	Topsoil - silty clay	5.9	3.3	2.6	1F
	0.1 - 0.25	Silty clay	6.2	4	2.2	1F
	0.25 - 0.4	Silty clay	6	4.9	1.1	1
	0.4 - 0.7	Silty sandy clay	6.3	5	1.3	1
	0.7 - 0.9	Clayey sand	6.2	4.7	1.5	1
	0.9 - 1.15	Clayey sand	6.3	5	1.3	1
	1.15 - 1.3	Clayey sand	5.9	4.7	1.2	1
	1.3 - 1.55	Sandy clay	5.1	4.2	0.9	1
	1.55 - 1.7	Sandy clay	5.6	4.7	0.9	1
	1.7 - 2.0	Sandy clay	5.6	5	0.6	1
	2.0 - 2.2	Clayey sand	5.6	4.6	1	2
	2.2 - 2.5	Sandy clay	5.7	5.1	0.6	1
18	0.0 - 0.1	Topsoil - silty clay	5.5	3.3	2.2	1F
	0.1 - 0.3	Silty clay	5.8	3.9	1.9	1F
	0.3 - 0.55	Silty clay	5.9	4.9	1	1
	0.55 - 0.8	Silty clay	5.9	4.8	1.1	1
	0.8 - 1.05	Silty clay	5.2	4.6	0.6	1
	1.05 - 1.3	Silty clay	5.8	4.8	1	1
	1.3 - 1.55	Silty clay	5.8	4.9	0.9	1
	1.55 - 1.8	Silty clay	5.7	5.3	0.4	1
	1.8 - 2.05	Silty clay	6	5.4	0.6	1
	2.05 - 2.3	Silty clay	5.9	5.4	0.5	1
	2.3 - 2.5	Silty clay	5.9	5.3	0.6	1
19	0 - 0.1	Topsoil - silty clay	5.7	3.5	2.2	2F
	0.1 - .25	Silty clay	6.2	4.2	2	2F
	0.25 - 0.5	Silty clay	6	4.7	1.3	1
	0.5 - 0.75	Silty clay	6	4.7	1.3	1
	0.75 - 1.0	Silty clay	5.7	4.4	1.3	1
	1.0 - 1.25	Silty clay	5.6	4.6	1	1
	1.25 - 1.5	Silty clay	5.6	4.6	1	1
	1.5 - 1.75	Silty clay	5.5	4.2	1.3	1
	1.75 - 2.0	Silty clay	6	4.9	1.1	1
	2.0 - 2.3	Silty clay	5.9	4.8	1.1	1
	2.3 - 2.5	Silty clay	5.8	4.6	1.2	1
20	0 - 0.1	Topsoil - silty clay	6.2	3.8	2.4	2F
	0.1 - 0.25	Silty clay	6.2	4.7	1.5	2F
	0.25 - 0.5	Silty clay	6	4	2	1
	0.5 - 0.8	Silty clay	5.9	4.8	1.1	1
	0.8 - 1.05	Silty clay	5.9	4.7	1.2	1
	1.05 - 1.2	Silty clay	5.7	4.7	1	1
	1.2 - 1.45	Silty clay	5.7	4.8	0.9	1
	1.45 - 1.7	Silty clay	5.6	4.6	1	1
	1.7 - 1.95	Silty clay	5.7	4.7	1	1
	1.95 - 2.2	Silty clay	5.8	5	0.8	1
	2.2 - 2.5	Silty clay	6.1	5.4	0.7	1

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77733 - ASS Screening Test Results

Bore Location	Depth (m)	Sample Description	Screening Test Results			
			pH_F	pH_{FOX}	pH	Reaction (1,2,3,4)* F**
21	0 - 0.1	Topsoil - silty clay	5.7	3.2	2.5	2F
	0.1 - 0.25	Silty sand	5.7	3.9	1.8	2F
	0.25 - 0.5	Silty sand	5.8	4.1	1.7	2F
	0.5 - 0.75	Silty sand	5.9	3.9	2	1
	0.75 - 1.0	Silty sand	5.4	4.1	1.3	1
	1.0 - 1.25	Sandy clay	5.6	4.4	1.2	1
	1.25 - 1.5	Sandy clay	5.7	4.8	0.9	1
	1.5 - 1.75	Sandy clay	5.6	4.9	0.7	1
	1.75 - 2.1	Sandy clay	5.7	4.4	1.3	1
	2.1 - 2.35	Sandy clay	5.8	5	0.8	1
	2.35 - 2.5	Sandy clay	5.9	5.1	0.8	1
22	0 - 0.1	Topsoil - silty clay	6	3.6	2.4	2F
	0.1 - 0.3	Silty clay	6	4.1	1.9	2F
	0.3 - 0.5	Silty clay	5.8	4.7	1.1	1
	0.5 - 0.7	Silty clay	5.7	4.8	0.9	1
	0.7 - 1.0	Silty clay	5.7	5.1	0.6	1
	1.0 - 1.25	Silty clay	5.8	5.1	0.7	1
	1.25 - 1.5	Silty clay	6.3	5	1.3	1
	1.5 - 1.6	Silty clay	6.2	5.3	0.9	1
	1.6 - 1.85	Sandy clay	6.4	5.6	0.8	1
	1.85 - 2.1	Sandy clay	6.5	6	0.5	1
	2.1 - 2.35	Sandy clay	6.7	5.3	1.4	1
	2.35 - 2.5	Sandy clay	6.8	5.3	1.5	1
23	0 - 0.1	Topsoil - silty clay	5.5	3.7	1.8	2F
	0.1 - 0.3	Silty clay	6	4.6	1.4	2F
	0.3 - 0.55	Silty clay	6.1	4.5	1.6	1
	0.55 - 0.8	Silty clay	6.3	5.4	0.9	1
	0.8 - 1.05	Silty clay	6.2	5.9	0.3	1
	1.05 - 1.3	Silty clay	6.5	5.9	0.6	1
	1.3 - 1.55	Silty clay	6.7	5.7	1	1
	1.55 - 1.8	Silty clay	6.8	6.1	0.7	1
	1.8 - 2.05	Silty clay	6.8	6.1	0.7	1
	2.05 - 2.3	Silty clay	7.1	6.3	0.8	1
	2.3 - 2.5	Silty clay	7.1	6.8	0.3	1
24	0 - 0.1	Topsoil - silty clay	6.6	3.4	3.2	2F
	0.1 - 0.25	Silty clay	6	4.1	1.9	2F
	0.25 - 0.5	Silty clay	6	5.1	0.9	2F
	0.5 - 0.8	Silty clay	6.2	5	1.2	1
	0.8 - 1.05	Silty clay	6.3	5.6	0.7	1
	1.05 - 1.3	Silty clay	6.4	5.8	0.6	1
	1.3 - 1.6	Silty clay	6.5	5.8	0.7	1
	1.6 - 1.85	Silty sandy clay	6.5	5.8	0.7	1
	1.85 - 2.1	Silty sandy clay	6.8	6.2	0.6	1
	2.1 - 2.3	Silty sandy clay	6.9	6.3	0.6	1
	2.3 - 2.5	Silty sandy clay	6.9	6.4	0.5	1

Notes to Table:

* 1 - denotes slight effervescence: 2 - denotes moderate reaction: 3 - denotes vigorous reaction: 4 - denotes very strong effervescence accompanied by escape of gas/heat

** F - indicates a bubbly/froth reaction (organics)

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77733 - ASS Screening Test Results

Bore Location	Depth (m)	Sample Description	Screening Test Results			
			pH_F	pH_{FOX}	pH	Reaction (1,2,3,4)* F**
25	0 - 0.1	Topsoil - silty clay	5.5	3.3	2.2	2F
	0.1 - 0.3	Silty clay	6.2	4.9	1.3	2F
	0.3 - 0.55	Silty clay	6.3	5	1.3	1
	0.55 - 0.8	Silty clay	6.4	5.2	1.2	1
	0.8 - 1.05	Silty clay	6.4	4.3	2.1	1
	1.05 - 1.2	Silty clay	6.5	4.7	1.8	1
	1.2 - 1.4	Silty clay	6.6	5.1	1.5	1
	1.4 - 1.65	Silty sandy clay	6.5	5.4	1.1	1
	1.65 - 1.9	Silty sandy clay	6	5	1	1
	1.9 - 2.15	Silty sandy clay	6.1	4.7	1.4	1
	2.15 - 2.4	Silty sandy clay	5.6	4.3	1.3	1
	2.4 - 2.5	Silty sandy clay	5.5	4.1	1.4	4
26	0 - 0.15	Topsoil - silty clay	6	3.1	2.9	2F
	0.15 - 0.35	Sandy clay	5.8	4.3	1.5	2F
	0.35 - 0.6	Clayey sand	5.4	4.3	1.1	1
	0.6 - 0.85	Clayey sand	5.1	4.2	0.9	1
	0.85 - 1.1	Clayey sand	4.8	4	0.8	1
	1.1 - 1.35	Clayey sand	5.2	3.8	1.4	1
	1.35 - 1.6	Clayey sand	5.2	4.4	0.8	1
	1.6 - 1.85	Silty clay	5.1	3.8	1.3	1
	1.85 - 2.1	Silty clay	5.4	4.1	1.3	1
	2.1 - 2.35	Silty clay	6	4.2	1.8	1
	2.35 - 2.5	Silty clay	6.3	4.6	1.7	1
27	0 - 0.1	Topsoil - silty clay	5.3	3.1	2.2	2F
	0.1 - 0.25	Silty clay	5.4	3.2	2.2	2F
	0.25 - 0.4	Sandy clay	5.9	4.2	1.7	1
	0.4 - 0.65	Silty sand	6.1	4.6	1.5	1
	0.65 - 0.85	Silty sand	6.1	4.4	1.7	1
	0.85 - 1.1	Silty sand	5.4	4.4	1	1
	1.1 - 1.4	Silty sand	5	3.6	1.4	1
	1.4 - 1.65	Silty sand	5	4	1	1
	1.65 - 1.9	Clayey sand	5.1	4.2	0.9	2
	1.9 - 2.2	Clayey sand	5.5	4.5	1	2
	2.2 - 2.5	Clayey sand	5.2	4.2	1	2
28	0 - 0.1	Topsoil - silty clay	4.5	2.6	1.9	1F
	0.1 - 0.25	Silty clay	5.6	3.5	2.1	1F
	0.25 - 0.5	Silty sandy clay	4.8	3.8	1	1
	0.5 - 0.75	Silty sand	4.4	3.6	0.8	1
	0.75 - 1.0	Silty sand	4.3	3.7	0.6	1
	1.0 - 1.25	Silty sand	3.9	3.7	0.2	1
	1.25 - 1.5	Silty sand	4.4	3.4	1	1
	1.5 - 1.8	Silty sand	4.3	3.4	0.9	1
	1.8 - 2.05	Sandy clay	4.4	3	1.4	1
	2.05 - 2.3	Sandy clay	4.3	3.5	0.8	1
	2.3 - 2.5	Sandy clay	4.5	3.7	0.8	1

Notes to Table:

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77733 - ASS Screening Test Results

Bore Location	Depth (m)	Sample Description	Screening Test Results			
			pH_F	pH_{FOX}	pH	Reaction (1,2,3,4)* F**
29	0 - 0.1	Topsoil - silty clay	5.7	2.7	3	1F
	0.1 - 0.25	Silty clay	5.8	3.2	2.6	1F
	0.25 - 0.5	Silty sandy clay	5.2	4.2	1	1
	0.5 - 0.75	Silty sand	5.4	4.3	1.1	1
	0.75 - 1.0	Silty sand	5.4	4.3	1.1	1
	1.0 - 1.25	Silty sand	4.7	3.9	0.8	1
	1.25 - 1.5	Clayey sand	4.8	4	0.8	1
	1.5 - 1.6	Sandy clay	5.1	3.8	1.3	1
	1.6 - 1.85	Sandy clay	5.1	3.4	1.7	4
	1.85 - 2.1	Sandy clay	5.3	4	1.3	4
	2.1 - 2.3	Sandy clay	5.1	3.9	1.2	4
	2.3 - 2.5	Sandy clay	5.5	4.1	1.4	1
30	0 - 0.1	Topsoil - silty clay	5.2	3.4	1.8	1F
	0.1 - 0.3	Silty clay	5.5	3.9	1.6	1F
	0.3 - 0.4	Silty sandy clay	5.1	4.1	1	1
	0.4 - 0.65	Silty sand	5.1	4.1	1	1
	0.65 - 0.9	Silty sand	4.9	3.9	1	1
	0.9 - 1.15	Silty sand	4.6	3.7	0.9	1
	1.15 - 1.4	Silty sand	4.8	3.9	0.9	1
	1.4 - 1.65	Sandy clay	4.8	4.1	0.7	1
	1.65 - 1.9	Sandy clay	5	4.2	0.8	3
	1.9 - 2.15	Silty clay	5.3	3.9	1.4	3
	2.15 - 2.3	Silty clay	4.8	4.1	0.7	3
	2.3 - 2.5	Silty clay	5.4	4.2	1.2	1
31	0 - 0.1	Topsoil - silty clay	5	2.8	2.2	3F
	0.1 - 0.25	Silty clay	5.4	3.1	2.3	3F
	0.25 - 0.35	Silty sandy clay	5.1	3.5	1.6	2F
	0.35 - 0.6	Silty sand	4.5	3.6	0.9	2
	0.6 - 0.85	Silty sand	4.5	3.8	0.7	1
	0.85 - 1.1	Silty sand	4.4	3.8	0.6	1
	1.1 - 1.2	Silty sand	3.9	3.1	0.8	2
	1.2 - 1.4	Silty sand	4.7	3.7	1	1
	1.4 - 1.6	Silty sand	4.5	3.5	1	1
	1.6 - 1.7	Clayey sand	4.3	3.7	0.6	2
	1.7 - 1.9	Sandy clay	4.4	3.7	0.7	2
	1.9 - 2.1	Sandy clay	4.5	3.8	0.7	2
	2.1 - 2.3	Sandy clay	4.5	3.8	0.7	2
	2.3 - 2.5	Sandy clay	4.3	3.7	0.6	3
32	0 - 0.1	Topsoil - silty clay	4.8	3.3	1.5	2F
	0.1 - 0.25	Silty clay	4.9	3.6	1.3	2F
	0.25 - 0.35	Silty sandy clay	4.8	3.9	0.9	1
	0.35 - 0.6	Silty sand	4.6	3.7	0.9	1
	0.6 - 0.85	Silty sand	4.6	3.9	0.7	1
	0.85 - 1.1	Silty sand	4.7	4	0.7	1
	1.1 - 1.2	Silty sand	4.6	3.8	0.8	1
	1.2 - 1.5	Silty sand	4.9	3.9	1	1
	1.5 - 1.6	Clayey sand	5	4.1	0.9	1
	1.6 - 1.85	Sandy clay	5.2	4.1	1.1	1
	1.85 - 2.1	Sandy clay	5.4	3.9	1.5	1
	2.1 - 2.3	Sandy clay	5.6	4.3	1.3	2
	2.3 - 2.5	Clayey sand	5.9	5.3	0.6	1

Notes to Table:

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77733 - ASS Screening Test Results

Bore Location	Depth (m)	Sample Description	Screening Test Results			
			pH_F	pH_{FOX}	pH	Reaction (1,2,3,4)* F**
33	0 - 0.1	Topsoil - silty clay	4.9	3.3	1.6	2F
	0.1 - 0.3	Silty clay	5.6	3.6	2	2F
	0.3 - 0.45	Silty sand clay	5.3	4.2	1.1	1
	0.45 - 0.8	Silty sand	5.9	4.2	1.7	1
	0.8 - 1.05	Silty sand	5.7	4.7	1	1
	1.05 - 1.2	Silty sand	5.8	4.5	1.3	1
	1.2 - 1.5	Clayey sand	5.4	3.5	1.9	2
	1.5 - 1.75	Sandy clay	5.9	4.7	1.2	2
	1.75 - 2.0	Sandy clay	6.2	4.2	2	2
	2.0 - 2.25	Sandy clay	6	5.1	0.9	2
	2.25 - 2.5	Sandy clay	6.2	5.8	0.4	2
34	0 - 0.1	Topsoil - silty clay	5.1	3	2.1	2F
	0.1 - 0.4	Silty sandy clay	5.6	3.3	2.3	2F
	0.4 - 0.6	Clayey sand	5	3.7	1.3	1
	0.6 - 0.9	Clayey sand	4.5	3.7	0.8	1
	0.9 - 1.15	Clayey sand	4.4	3.5	0.9	1
	1.15 - 1.4	Clayey sand	4.6	3.7	0.9	1
	1.4 - 1.65	Clayey sand	5	3.9	1.1	1
	1.65 - 1.8	Clayey sand	5.6	5	0.6	2
	1.8 - 2.05	Sandy clay	5.8	5	0.8	2
	2.05 - 2.3	Sandy clay	7	6	1	2
	2.3 - 2.5	Sandy clay	6.9	7.2	-0.3	2

Notes to Table:

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Results of Moisture Content, Plasticity and Linear Shrinkage Tests

Client:	Gold Coast Marine Aquaculture	**Project No:**	77733
		Report No:	T15-473
Project:	Proposed Stage 1 & 2 Existing Aquaculture Facility	**Report Date:**	13/05/2015
		Date Sampled:	
Location:	Captain Cook Highway, Port Douglas	**Date of Test:**	12/05/2015
		Page:	1 of 1

Test Location	Depth (m)	Description	Code	W_F %	W_L %	W_P %	PI %	*LS %
Bore 4	1.0 – 1.25		2.5	15.8	36	13	23	12.0
Bore 7	0.65 – 0.95		2.5	11.9	28	16	12	7.0
Bore 19	0.5 – 0.75		2.5	15.2	38	11	27	13.5
Bore 23	0.55 – 0.8		2.5	8.0	30	13	17	8.0
Bore 33	0.3 – 0.45		2.5	13.0	24	16	8	4.0
Bore 34	0.1 – 0.4		2.5	12.7	22	16	6	4.0

Legend:

W_F Field Moisture Content
W_L Liquid limit
W_P Plastic limit
PI Plasticity index
LS Linear shrinkage from liquid limit condition (Mould length 125 mm)

Code:

Sample history for plasticity tests

1. Air dried
2. Low temperature (<50°C) oven dried
3. Oven (105°C) dried
4. Unknown

Method of preparation for plasticity tests

5. Dry sieved
6. Wet sieved
7. Natural

*Specify if sample crumbled CR or curled CU

Test Methods:

Moisture Content:	AS 1289 2.1.1
Liquid Limit:	AS 1289 3.1.2
Plastic Limit:	AS 1289 3.2.1
Plasticity Index:	AS 1289 3.3.1
Linear Shrinkage:	AS 1289 3.4.1

Sampling Methods: Sampled by DP Cairns Engineering Department

Remarks:

NATA Accredited Laboratory Number: 828

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

Tested: AP
Checked: DP

Dean Pollock
Laboratory Manager

Douglas Partners
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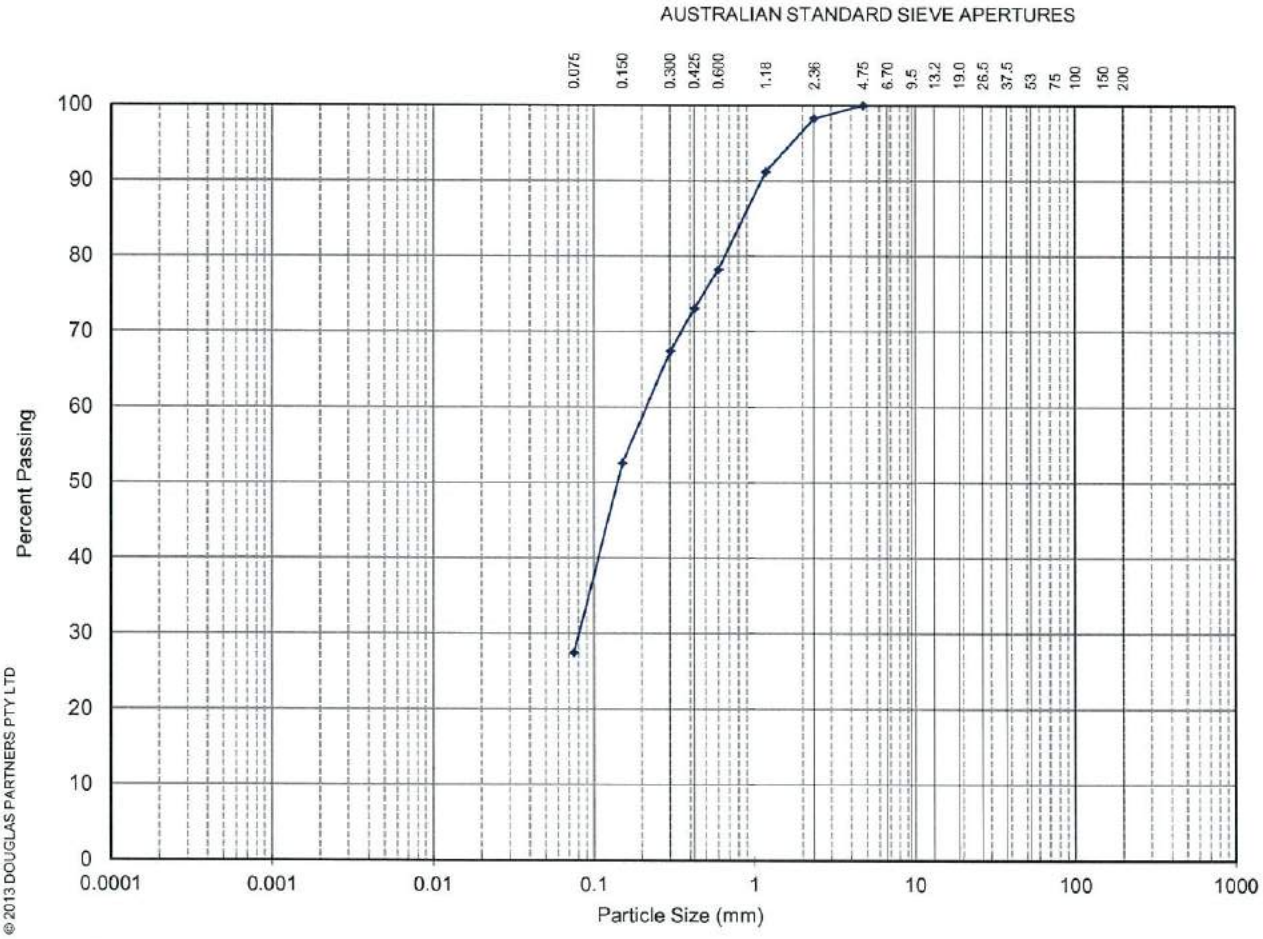
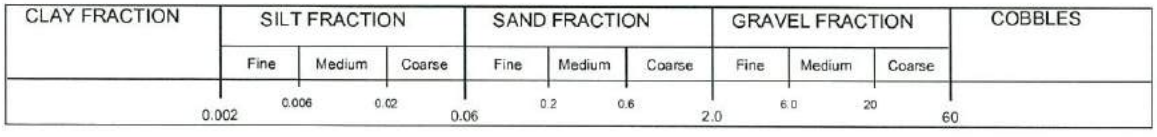
Results of Particle Size Distribution

Client :	Gold Coast Marine Aquaculture	**Project No. :**	77733
		Report No. :	T15-478
Project :	Proposed Stage 1 & 2 Existing Aquaculture Facility	**Report Date :**	15/05/2015
Location :	Captain Cook Highway, Port Douglas	**Date Sampled:**	
Test Location:	Bore 11	**Date of Test:**	14/05/2015
Depth / Layer:	0.65-0.9m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	100%
2.36	98%
1.18	91%
0.600	78%
0.425	73%
0.300	67%
0.150	53%
0.075	27%



Description: Silty sand with a trace of gravel

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by DP Cairns Engineering Department

Remarks:

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Tested:	SM
Checked:	DP

DPollock
Dean Pollock
Laboratory Manager

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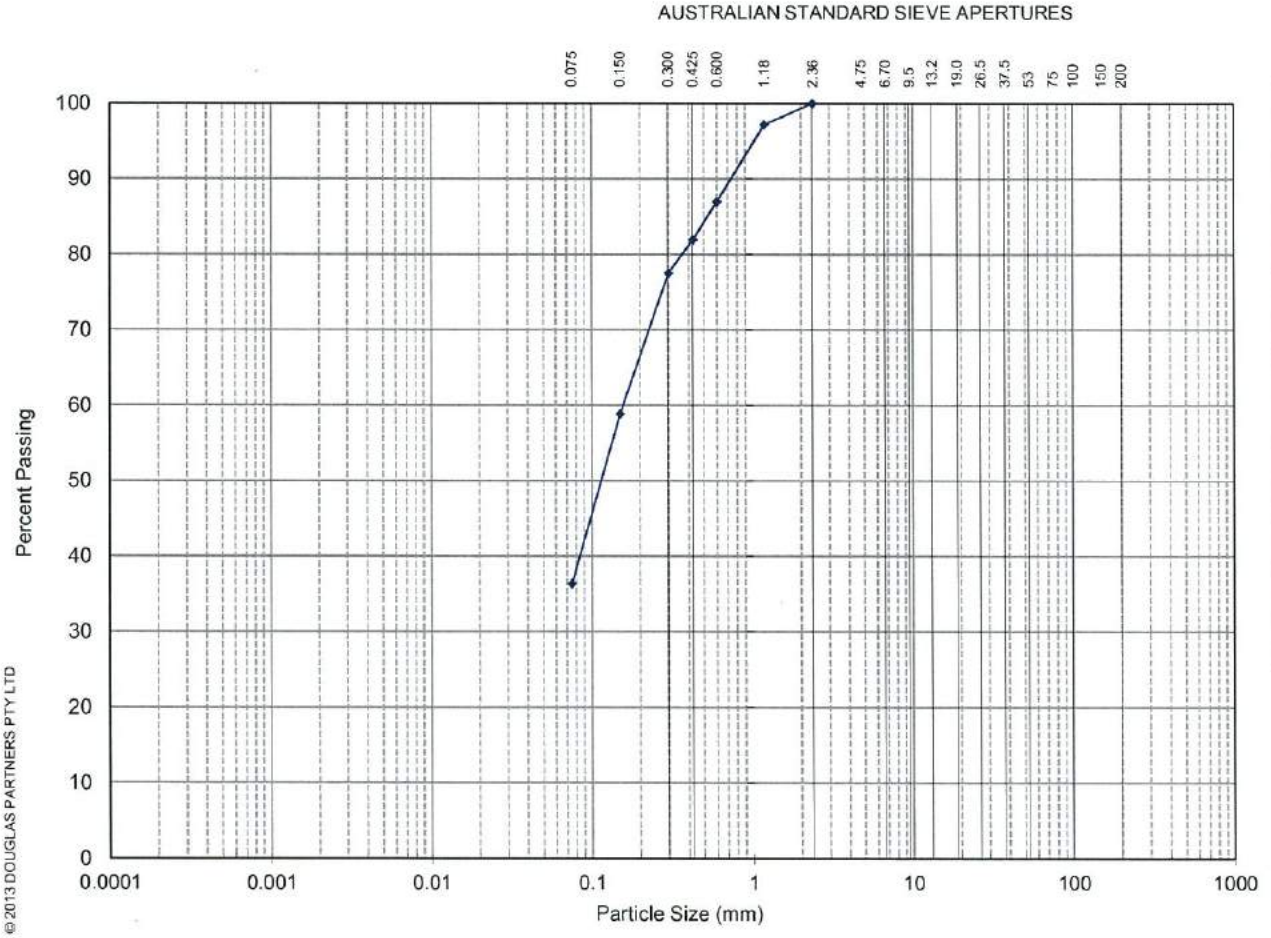
Results of Particle Size Distribution

Client :	Gold Coast Marine Aquaculture	**Project No. :**	77733
		Report No. :	T15-479
Project :	Proposed Stage 1 & 2 Existing Aquaculture Facility	**Report Date :**	15/05/2015
Location :	Captain Cook Highway, Port Douglas	**Date Sampled:**	
Test Location:	Bore 21	**Date of Test:**	14/05/2015
Depth / Layer:	0.75-1.0m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	~
2.36	100%
1.18	97%
0.600	87%
0.425	82%
0.300	78%
0.150	59%
0.075	36%

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	

Description: Silt and sand

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by DP Cairns Engineering Department

Remarks:

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Checked:	DP

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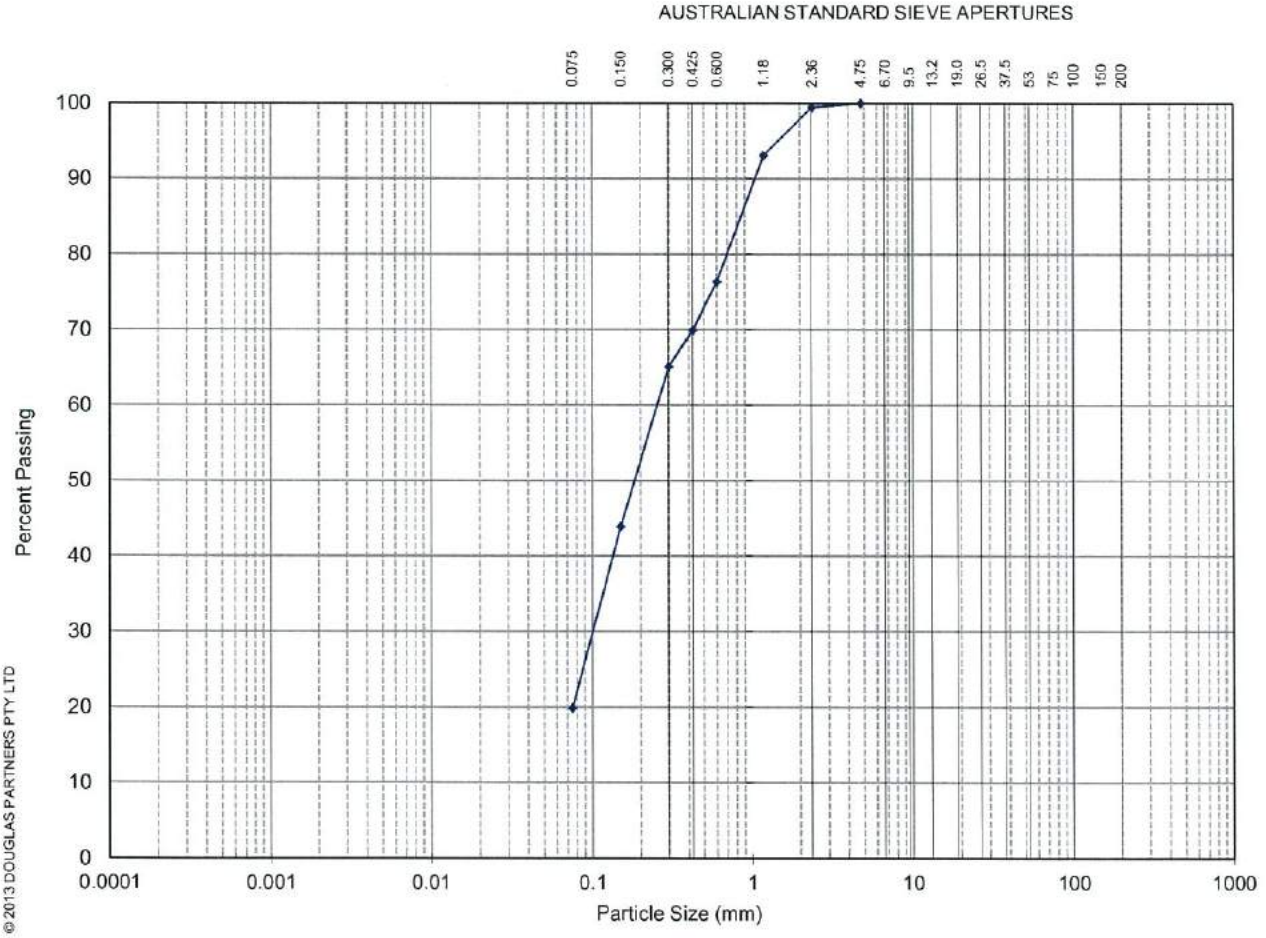
Results of Particle Size Distribution

Client :	Gold Coast Marine Aquaculture	**Project No. :**	77733
		Report No. :	T15-480
Project :	Proposed Stage 1 & 2 Existing Aquaculture Facility	**Report Date :**	15/05/2015
Location :	Captain Cook Highway, Port Douglas	**Date Sampled:**	
Test Location:	Bore 27	**Date of Test:**	14/05/2015
Depth / Layer:	0.4-0.65m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	100%
2.36	99%
1.18	93%
0.600	76%
0.425	70%
0.300	65%
0.150	44%
0.075	20%

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02		0.06	0.2	0.6	2.0	6.0	20	60

Description: Silty sand with a trace of gravel

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by DP Cairns Engineering Department

Remarks:

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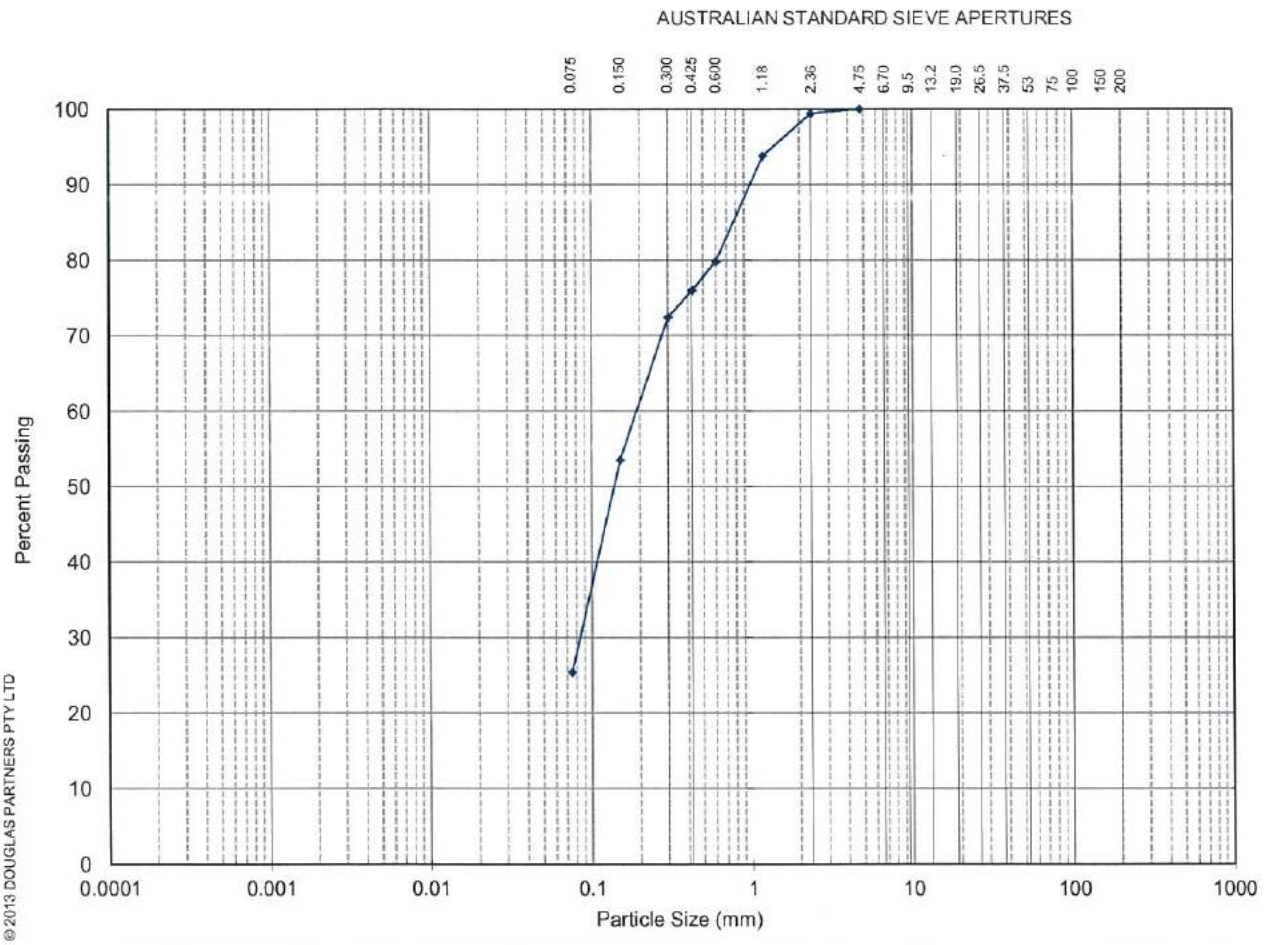
Results of Particle Size Distribution

Client :	Gold Coast Marine Aquaculture	**Project No. :**	77733
		Report No. :	T15-481
Project :	Proposed Stage 1 & 2 Existing Aquaculture Facility	**Report Date :**	15/05/2015
Location :	Captain Cook Highway, Port Douglas	**Date Sampled:**	
Test Location:	Bore 28	**Date of Test:**	14/05/2015
Depth / Layer:	0.75-1.0m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	100%
2.36	99%
1.18	94%
0.600	80%
0.425	76%
0.300	72%
0.150	54%
0.075	25%

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02	0.06	0.2	0.6	2.0	6.0	20	60	

Description: Silty sand

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by DP Cairns Engineering Department

Remarks:

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Tested:	SM
Checked:	DP

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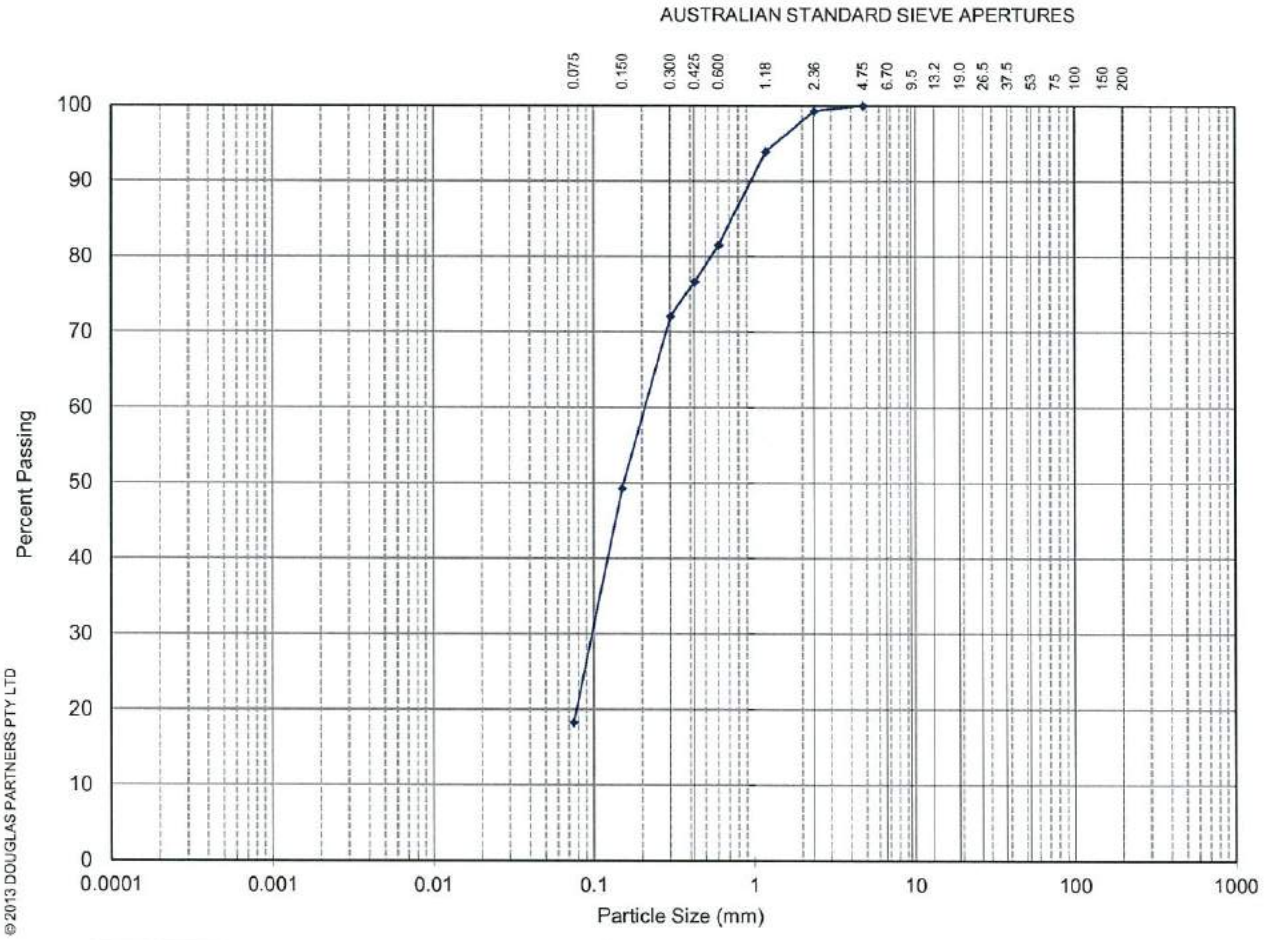
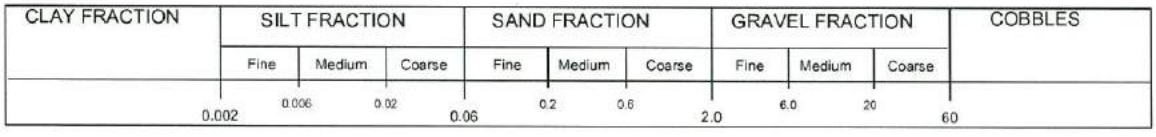
Results of Particle Size Distribution

Client :	Gold Coast Marine Aquaculture	**Project No. :**	77733
		Report No. :	T15-482
Project :	Proposed Stage 1 & 2 Existing Aquaculture Facility	**Report Date :**	15/05/2015
Location :	Captain Cook Highway, Port Douglas	**Date Sampled:**	
Test Location:	Bore 32	**Date of Test:**	14/05/2015
Depth / Layer:	0.85-1.1m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	100%
2.36	99%
1.18	94%
0.600	81%
0.425	77%
0.300	72%
0.150	49%
0.075	18%



Description: Slightly silty sand with a trace of gravel

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by DP Cairns Engineering Department

Remarks:

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory Number: 828
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

Tested:	SM
Checked:	DP

DPollock
Dean Pollock
Laboratory Manager

Douglas Partners
Geotechnics / Environment / Groundwater

Douglas Partners Pty Ltd
ABN 75 053 980 117
www.douglaspartners.com.au
29 Civil Road
Garbutt QLD 4814
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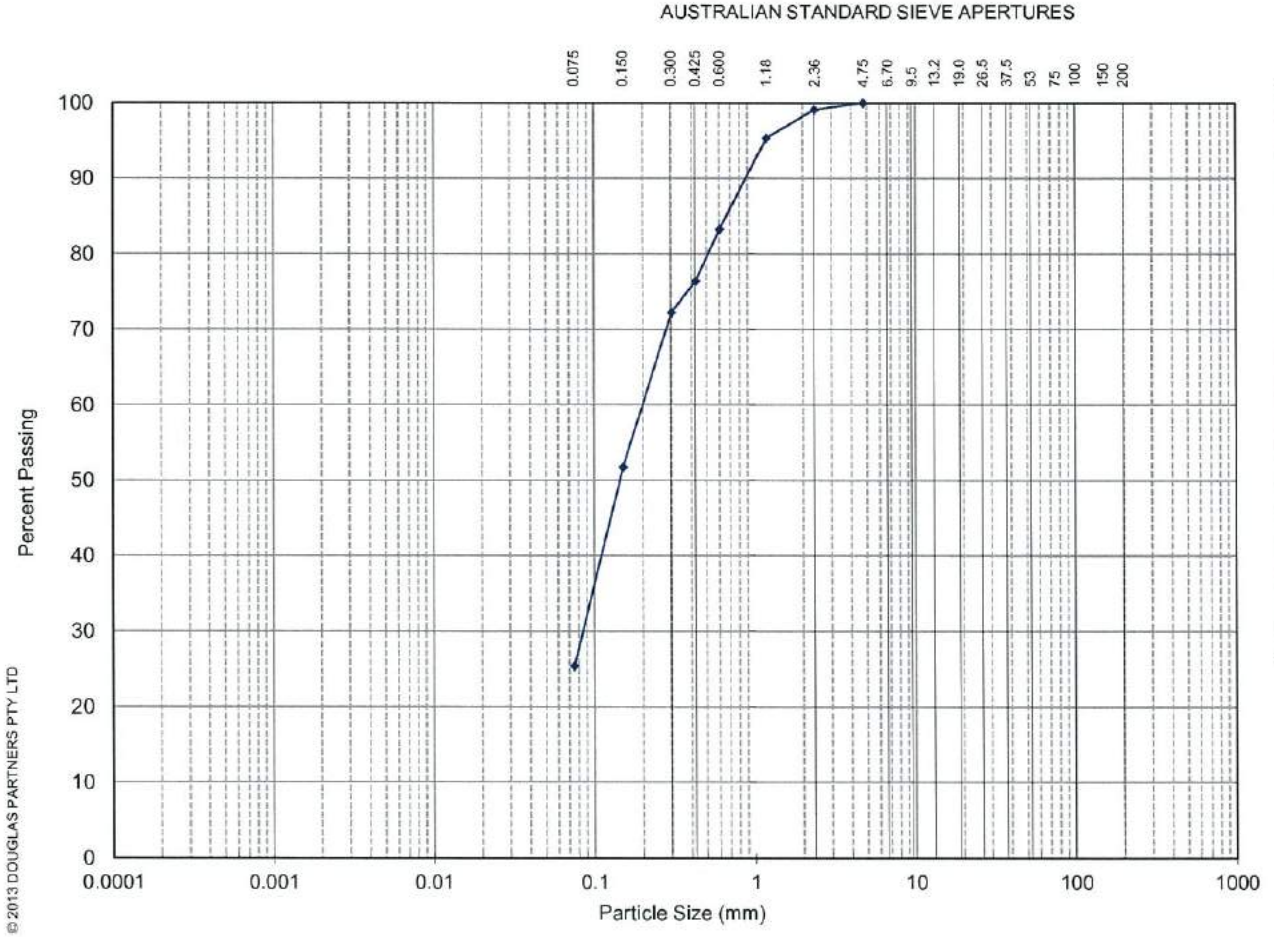
Fax (07) 4725 1224

Results of Particle Size Distribution

Client :	Gold Coast Marine Aquaculture	**Project No. :**	77733
		Report No. :	T15-483
Project :	Proposed Stage 1 & 2 Existing Aquaculture Facility	**Report Date :**	15/05/2015
Location :	Captain Cook Highway, Port Douglas	**Date Sampled:**	
Test Location:	Bore 34	**Date of Test:**	14/05/2015
Depth / Layer:	0.6-0.9m	**Page:**	1 of 1



Sieve Size (mm)	% Passing
75.0	~
53.0	~
37.5	~
26.5	~
19.0	~
13.2	~
9.5	~
6.7	~
4.75	100%
2.36	99%
1.18	95%
0.600	83%
0.425	76%
0.300	72%
0.150	52%
0.075	25%

CLAY FRACTION	SILT FRACTION			SAND FRACTION			GRAVEL FRACTION			COBBLES
	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	
0.002	0.006	0.02		0.06	0.2	0.6	2.0	6.0	20	60

Description: Silty sand with a trace of gravel

Test Method(s): AS 1289.3.6.1

Sampling Method(s): Sampled by DP Cairns Engineering Department

Remarks:

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

NATA Accredited Laboratory Number: 828
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025

Tested:	SM
Checked:	DP

DPollock
Dean Pollock
Laboratory Manager

ANALYTICAL REPORT

WORLD RECOGNISED ACCREDITATION

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Dan Martin	Manager	Jon Dicker
Client	DOUGLAS PARTNERS PTY LTD	Laboratory	SGS Cairns Environmental
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Telephone	07 4055 1550	Telephone	+61 07 4035 5111
Facsimile	07 4055 1774	Facsimile	+61 07 4035 5122
Email	dan.martin@douglaspartners.com.au	Email	AU.Environmental.Cairns@sgs.com
Project	**77733**	SGS Reference	**CE115186 R0**
Order Number	(Not specified)	Report Number	0000025332
Samples	39	Date Reported	18 May 2015
Date Started	12 May 2015	Date Received	08 May 2015

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(3146)

SIGNATORIES

Anthony Nilsson
Operations Manager

Jon Dicker
Manager Northern QLD

Maristela Ganzan
Metals Team Leader

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.001 Soil 01 May 2015 Bore 1 0.1-0.3	CE115186.002 Soil 01 May 2015 Bore 1 0.3-0.5	CE115186.003 Soil 01 May 2015 Bore 2 0.0-0.1	CE115186.004 Soil 01 May 2015 Bore 3 0.5-0.75
Moisture Content Method: AN002 Tested: 8/5/2015						
% Moisture	%	0.5	**11.3**	**7.9**	**11.6**	**11.6**
TAA (Titratable Actual Acidity) Method: AN219 Tested: 14/5/2015						
pH KCl	pH Units	-	**6.0**	**5.8**	**5.7**	**4.9**
Titratable Actual Acidity	kg H2SO4/T	0.25	<0.25	<0.25	**0.74**	**1.3**
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5	<5	<5	**15**	**27**
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	<0.01	<0.01	**0.02**	**0.04**
Sulphur (SKCl)	%w/w	0.005	-	-	-	-
Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 14/5/2015						
Chromium Reducible Sulphur (Scr)	%	0.005	**0.007**	<0.005	**0.010**	<0.005
Chromium Reducible Sulphur (Scr)	moles H+/T	5	<5	<5	**6**	<5
Chromium Suite Net Acidity Calculations Method: AN220 Tested: 14/5/2015						
s-Net Acidity	%w/w S	0.01	**0.01**	**0.01**	**0.03**	**0.05**
a-Net Acidity	moles H+/T	5	**8**	**7**	**21**	**29**
Liming Rate	kg CaCO3/T	0.1	NA	NA	**1.6**	**2.2**
Verification s-Net Acidity	%w/w S	-20	NA	NA	NA	NA
a-Net Acidity without ANCBT	moles H+/T	5	**8**	**7**	**21**	**29**
Liming Rate without ANCBT	kg CaCO3/T	0.1	NA	NA	**1.6**	**2.2**
Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) Method: AN122 Tested: -						
Exchangeable Sodium, Na	mg/kg	2	-	**440**	-	-
Exchangeable Sodium, Na	meq/100g	0.01	-	**1.9**	-	-
Exchangeable Sodium Percentage	%	0.1	-	**49.5**	-	-
Exchangeable Potassium, K	mg/kg	2	-	**100**	-	-
Exchangeable Potassium, K	meq/100g	0.01	-	**0.25**	-	-
Exchangeable Potassium Percentage	%	0.1	-	**6.6**	-	-
Exchangeable Calcium Percentage	%	0.1	-	**17.4**	-	-
Exchangeable Calcium, Ca	mg/kg	2	-	**130**	-	-
Exchangeable Calcium, Ca	meq/100g	0.01	-	**0.67**	-	-
Exchangeable Magnesium, Mg	mg/kg	2	-	**120**	-	-
Exchangeable Magnesium, Mg	meq/100g	0.02	-	**1.0**	-	-
Exchangeable Magnesium Percentage	%	0.1	-	**26.5**	-	-
Cation Exchange Capacity	meq/100g	0.02	-	**3.9**	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.001 Soil 01 May 2015 Bore 1 0.1-0.3	CE115186.002 Soil 01 May 2015 Bore 1 0.3-0.5	CE115186.003 Soil 01 May 2015 Bore 2 0.0-0.1	CE115186.004 Soil 01 May 2015 Bore 3 0.5-0.75
Emerson Class Number Method: AN009 Tested: -						
Emerson Class Number	No unit	1	-	**3**	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.005 Soil 01 May 2015 Bore 4 0.75-1.0	CE115186.006 Soil 01 May 2015 Bore 5 0.85-1.1	CE115186.007 Soil 01 May 2015 Bore 6 1.9-2.2	CE115186.008 Soil 01 May 2015 Bore 7 0.0-0.1
Moisture Content Method: AN002 Tested: 8/5/2015						
% Moisture	%	0.5	**12.4**	**12.5**	**8.9**	**12.5**
TAA (Titratable Actual Acidity) Method: AN219 Tested: 14/5/2015						
pH KCl	pH Units	-	**5.1**	**5.1**	**5.8**	**5.9**
Titratable Actual Acidity	kg H2SO4/T	0.25	**1.0**	**1.2**	**0.37**	**0.49**
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5	**21**	**25**	**7**	**10**
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	**0.03**	**0.04**	**0.01**	**0.02**
Sulphur (SKCl)	%w/w	0.005	-	-	-	-
Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 14/5/2015						
Chromium Reducible Sulphur (Scr)	%	0.005	<0.005	<0.005	<0.005	**0.007**
Chromium Reducible Sulphur (Scr)	moles H+/T	5	<5	<5	<5	<5
Chromium Suite Net Acidity Calculations Method: AN220 Tested: 14/5/2015						
s-Net Acidity	%w/w S	0.01	**0.03**	**0.04**	**0.01**	**0.02**
a-Net Acidity	moles H+/T	5	**22**	**25**	**7**	**14**
Liming Rate	kg CaCO3/T	0.1	**1.6**	**1.9**	NA	NA
Verification s-Net Acidity	%w/w S	-20	NA	NA	NA	NA
a-Net Acidity without ANCBT	moles H+/T	5	**22**	**25**	**7**	**14**
Liming Rate without ANCBT	kg CaCO3/T	0.1	**1.6**	**1.9**	NA	NA
Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) Method: AN122 Tested: -						
Exchangeable Sodium, Na	mg/kg	2	-	**190**	-	-
Exchangeable Sodium, Na	meq/100g	0.01	-	**0.84**	-	-
Exchangeable Sodium Percentage	%	0.1	-	**24.9**	-	-
Exchangeable Potassium, K	mg/kg	2	-	**80**	-	-
Exchangeable Potassium, K	meq/100g	0.01	-	**0.20**	-	-
Exchangeable Potassium Percentage	%	0.1	-	**6.1**	-	-
Exchangeable Calcium Percentage	%	0.1	-	**5.3**	-	-
Exchangeable Calcium, Ca	mg/kg	2	-	**36**	-	-
Exchangeable Calcium, Ca	meq/100g	0.01	-	**0.18**	-	-
Exchangeable Magnesium, Mg	mg/kg	2	-	**260**	-	-
Exchangeable Magnesium, Mg	meq/100g	0.02	-	**2.1**	-	-
Exchangeable Magnesium Percentage	%	0.1	-	**63.6**	-	-
Cation Exchange Capacity	meq/100g	0.02	-	**3.4**	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE115186.005 Soil 01 May 2015 Bore 4 0.75-1.0	CE115186.006 Soil 01 May 2015 Bore 5 0.85-1.1	CE115186.007 Soil 01 May 2015 Bore 6 1.9-2.2	CE115186.008 Soil 01 May 2015 Bore 7 0.0-0.1
Emerson Class Number Method: AN009 Tested: -							
Emerson Class Number	No unit	1		-	**2**	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.009 Soil 01 May 2015 Bore 8 0.35-0.6	CE115186.010 Soil 01 May 2015 Bore 9 0.34-0.55	CE115186.011 Soil 01 May 2015 Bore 10 1.0-1.25	CE115186.012 Soil 01 May 2015 Bore 11 0.9-1.2
Moisture Content Method: AN002 Tested: 8/5/2015						
% Moisture	%	0.5	**12.2**	**11.8**	**1.0**	**10.0**
TAA (Titratable Actual Acidity) Method: AN219 Tested: 14/5/2015						
pH KCl	pH Units	-	**5.8**	**5.6**	**5.8**	**6.0**
Titratable Actual Acidity	kg H2SO4/T	0.25	**0.37**	**0.31**	**0.37**	<0.25
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5	**7**	**6**	**7**	<5
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	**0.01**	**0.01**	**0.01**	<0.01
Sulphur (SKCl)	%w/w	0.005	-	-	-	-
Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 14/5/2015						
Chromium Reducible Sulphur (Scr)	%	0.005	<0.005	<0.005	<0.005	<0.005
Chromium Reducible Sulphur (Scr)	moles H+/T	5	<5	<5	<5	<5
Chromium Suite Net Acidity Calculations Method: AN220 Tested: 14/5/2015						
s-Net Acidity	%w/w S	0.01	**0.01**	**0.01**	**0.01**	<0.01
a-Net Acidity	moles H+/T	5	**7**	**7**	**7**	**6**
Liming Rate	kg CaCO3/T	0.1	NA	NA	NA	NA
Verification s-Net Acidity	%w/w S	-20	NA	NA	NA	NA
a-Net Acidity without ANCBT	moles H+/T	5	**7**	**7**	**7**	**6**
Liming Rate without ANCBT	kg CaCO3/T	0.1	NA	NA	NA	NA
Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) Method: AN122 Tested: -						
Exchangeable Sodium, Na	mg/kg	2	-	-	**140**	-
Exchangeable Sodium, Na	meq/100g	0.01	-	-	**0.59**	-
Exchangeable Sodium Percentage	%	0.1	-	-	**20.6**	-
Exchangeable Potassium, K	mg/kg	2	-	-	**52**	-
Exchangeable Potassium, K	meq/100g	0.01	-	-	**0.13**	-
Exchangeable Potassium Percentage	%	0.1	-	-	**4.6**	-
Exchangeable Calcium Percentage	%	0.1	-	-	**1.8**	-
Exchangeable Calcium, Ca	mg/kg	2	-	-	**10**	-
Exchangeable Calcium, Ca	meq/100g	0.01	-	-	**0.05**	-
Exchangeable Magnesium, Mg	mg/kg	2	-	-	**250**	-
Exchangeable Magnesium, Mg	meq/100g	0.02	-	-	**2.1**	-
Exchangeable Magnesium Percentage	%	0.1	-	-	**73.0**	-
Cation Exchange Capacity	meq/100g	0.02	-	-	**2.9**	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.009 Soil 01 May 2015 Bore 8 0.35-0.6	CE115186.010 Soil 01 May 2015 Bore 9 0.34-0.55	CE115186.011 Soil 01 May 2015 Bore 10 1.0-1.25	CE115186.012 Soil 01 May 2015 Bore 11 0.9-1.2
Emerson Class Number Method: AN009 Tested: -						
Emerson Class Number	No unit	1	-	-	**2**	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.013 Soil 01 May 2015 Bore 12 0.65-0.8	CE115186.014 Soil 01 May 2015 Bore 13 0.3-0.5	CE115186.015 Soil 01 May 2015 Bore 13 0.8-1.0	CE115186.016 Soil 01 May 2015 Bore 14 0.0-0.1
Moisture Content Method: AN002 Tested: 8/5/2015						
% Moisture	%	0.5	**10.5**	**11.7**	**12.0**	**22.2**
TAA (Titratable Actual Acidity) Method: AN219 Tested: 14/5/2015						
pH KCl	pH Units	-	**6.0**	**5.2**	**5.0**	**5.3**
Titratable Actual Acidity	kg H2SO4/T	0.25	<0.25	**0.49**	**0.67**	**0.98**
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5	<5	**10**	**14**	**20**
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	<0.01	**0.02**	**0.02**	**0.03**
Sulphur (SKCl)	%w/w	0.005	-	-	-	-
Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 14/5/2015						
Chromium Reducible Sulphur (Scr)	%	0.005	<0.005	<0.005	<0.005	**0.007**
Chromium Reducible Sulphur (Scr)	moles H+/T	5	<5	<5	<5	<5
Chromium Suite Net Acidity Calculations Method: AN220 Tested: 14/5/2015						
s-Net Acidity	%w/w S	0.01	<0.01	**0.02**	**0.02**	**0.04**
a-Net Acidity	moles H+/T	5	<5	**9**	**14**	**24**
Liming Rate	kg CaCO3/T	0.1	<0.1	NA	NA	**1.8**
Verification s-Net Acidity	%w/w S	-20	NA	NA	NA	NA
a-Net Acidity without ANCBT	moles H+/T	5	<5	**9**	**14**	**24**
Liming Rate without ANCBT	kg CaCO3/T	0.1	<0.1	NA	NA	**1.8**
Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) Method: AN122 Tested: -						
Exchangeable Sodium, Na	mg/kg	2	-	-	-	-
Exchangeable Sodium, Na	meq/100g	0.01	-	-	-	-
Exchangeable Sodium Percentage	%	0.1	-	-	-	-
Exchangeable Potassium, K	mg/kg	2	-	-	-	-
Exchangeable Potassium, K	meq/100g	0.01	-	-	-	-
Exchangeable Potassium Percentage	%	0.1	-	-	-	-
Exchangeable Calcium Percentage	%	0.1	-	-	-	-
Exchangeable Calcium, Ca	mg/kg	2	-	-	-	-
Exchangeable Calcium, Ca	meq/100g	0.01	-	-	-	-
Exchangeable Magnesium, Mg	mg/kg	2	-	-	-	-
Exchangeable Magnesium, Mg	meq/100g	0.02	-	-	-	-
Exchangeable Magnesium Percentage	%	0.1	-	-	-	-
Cation Exchange Capacity	meq/100g	0.02	-	-	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.013 Soil 01 May 2015 Bore 12 0.65-0.8	CE115186.014 Soil 01 May 2015 Bore 13 0.3-0.5	CE115186.015 Soil 01 May 2015 Bore 13 0.8-1.0	CE115186.016 Soil 01 May 2015 Bore 14 0.0-0.1
Emerson Class Number Method: AN009 Tested: -						
Emerson Class Number	No unit	1	-	-	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE115186.017 Soil 01 May 2015 Bore 15 0.1-0.25	CE115186.018 Soil 01 May 2015 Bore 16 0.1-0.3	CE115186.019 Soil 01 May 2015 Bore 17 2.0-2.2	CE115186.020 Soil 01 May 2015 Bore 18 0.8-1.05
Moisture Content Method: AN002 Tested: 8/5/2015							
% Moisture	%	0.5		**14.1**	**10.5**	**10.6**	**11.6**
TAA (Titratable Actual Acidity) Method: AN219 Tested: 14/5/2015							
pH KCl	pH Units	-		**5.1**	**5.6**	**5.6**	**5.2**
Titratable Actual Acidity	kg H2SO4/T	0.25		**1.3**	**0.49**	**0.37**	**0.86**
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5		**27**	**10**	**7**	**17**
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01		**0.04**	**0.02**	**0.01**	**0.03**
Sulphur (SKCl)	%w/w	0.005		-	-	-	-
Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 14/5/2015							
Chromium Reducible Sulphur (Scr)	%	0.005		<0.005	<0.005	<0.005	<0.005
Chromium Reducible Sulphur (Scr)	moles H+/T	5		<5	<5	<5	<5
Chromium Suite Net Acidity Calculations Method: AN220 Tested: 14/5/2015							
s-Net Acidity	%w/w S	0.01		**0.04**	**0.02**	**0.01**	**0.03**
a-Net Acidity	moles H+/T	5		**28**	**11**	**8**	**18**
Liming Rate	kg CaCO3/T	0.1		**2.1**	NA	NA	**1.4**
Verification s-Net Acidity	%w/w S	-20		NA	NA	NA	NA
a-Net Acidity without ANCBT	moles H+/T	5		**28**	**11**	**8**	**18**
Liming Rate without ANCBT	kg CaCO3/T	0.1		**2.1**	NA	NA	**1.4**
Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) Method: AN122 Tested: -							
Exchangeable Sodium, Na	mg/kg	2		-	-	-	-
Exchangeable Sodium, Na	meq/100g	0.01		-	-	-	-
Exchangeable Sodium Percentage	%	0.1		-	-	-	-
Exchangeable Potassium, K	mg/kg	2		-	-	-	-
Exchangeable Potassium, K	meq/100g	0.01		-	-	-	-
Exchangeable Potassium Percentage	%	0.1		-	-	-	-
Exchangeable Calcium Percentage	%	0.1		-	-	-	-
Exchangeable Calcium, Ca	mg/kg	2		-	-	-	-
Exchangeable Calcium, Ca	meq/100g	0.01		-	-	-	-
Exchangeable Magnesium, Mg	mg/kg	2		-	-	-	-
Exchangeable Magnesium, Mg	meq/100g	0.02		-	-	-	-
Exchangeable Magnesium Percentage	%	0.1		-	-	-	-
Cation Exchange Capacity	meq/100g	0.02		-	-	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.017 Soil 01 May 2015 Bore 15 0.1-0.25	CE115186.018 Soil 01 May 2015 Bore 16 0.1-0.3	CE115186.019 Soil 01 May 2015 Bore 17 2.0-2.2	CE115186.020 Soil 01 May 2015 Bore 18 0.8-1.05
Emerson Class Number Method: AN009 Tested: -						
Emerson Class Number	No unit	1	-	-	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE115186.021 Soil 01 May 2015 Bore 19 0.75-1.0	CE115186.022 Soil 01 May 2015 Bore 20 0.0-0.1	CE115186.023 Soil 01 May 2015 Bore 21 0.5-0.75	CE115186.024 Soil 01 May 2015 Bore 22 0.1-0.3
Moisture Content Method: AN002 Tested: 8/5/2015							
% Moisture	%	0.5		**12.8**	**11.8**	**10.7**	**11.7**
TAA (Titratable Actual Acidity) Method: AN219 Tested: 14/5/2015							
pH KCl	pH Units	-		**4.8**	**5.6**	**5.6**	**5.5**
Titratable Actual Acidity	kg H2SO4/T	0.25		**1.3**	**0.61**	**0.37**	**1.2**
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5		**26**	**12**	**7**	**24**
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01		**0.04**	**0.02**	**0.01**	**0.04**
Sulphur (SKCl)	%w/w	0.005		-	-	-	-
Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 14/5/2015							
Chromium Reducible Sulphur (Scr)	%	0.005		<0.005	<0.005	<0.005	<0.005
Chromium Reducible Sulphur (Scr)	moles H+/T	5		<5	<5	<5	<5
Chromium Suite Net Acidity Calculations Method: AN220 Tested: 14/5/2015							
s-Net Acidity	%w/w S	0.01		**0.04**	**0.02**	**0.01**	**0.04**
a-Net Acidity	moles H+/T	5		**27**	**14**	**9**	**25**
Liming Rate	kg CaCO3/T	0.1		**2.0**	NA	NA	**1.9**
Verification s-Net Acidity	%w/w S	-20		NA	NA	NA	NA
a-Net Acidity without ANCBT	moles H+/T	5		**27**	**14**	**9**	**25**
Liming Rate without ANCBT	kg CaCO3/T	0.1		**2.0**	NA	NA	**1.9**
Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) Method: AN122 Tested: -							
Exchangeable Sodium, Na	mg/kg	2		-	-	-	**390**
Exchangeable Sodium, Na	meq/100g	0.01		-	-	-	**1.7**
Exchangeable Sodium Percentage	%	0.1		-	-	-	**34.7**
Exchangeable Potassium, K	mg/kg	2		-	-	-	**110**
Exchangeable Potassium, K	meq/100g	0.01		-	-	-	**0.28**
Exchangeable Potassium Percentage	%	0.1		-	-	-	**5.6**
Exchangeable Calcium Percentage	%	0.1		-	-	-	**27.8**
Exchangeable Calcium, Ca	mg/kg	2		-	-	-	**280**
Exchangeable Calcium, Ca	meq/100g	0.01		-	-	-	**1.4**
Exchangeable Magnesium, Mg	mg/kg	2		-	-	-	**190**
Exchangeable Magnesium, Mg	meq/100g	0.02		-	-	-	**1.6**
Exchangeable Magnesium Percentage	%	0.1		-	-	-	**31.9**
Cation Exchange Capacity	meq/100g	0.02		-	-	-	**4.9**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.021 Soil 01 May 2015 Bore 19 0.75-1.0	CE115186.022 Soil 01 May 2015 Bore 20 0.0-0.1	CE115186.023 Soil 01 May 2015 Bore 21 0.5-0.75	CE115186.024 Soil 01 May 2015 Bore 22 0.1-0.3
Emerson Class Number Method: AN009 Tested: -						
Emerson Class Number	No unit	1	-	-	-	**3**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.025 Soil 01 May 2015 Bore 23 0.0-0.1	CE115186.026 Soil 01 May 2015 Bore 23 0.3-0.55	CE115186.027 Soil 01 May 2015 Bore 24 0.25-0.5	CE115186.028 Soil 01 May 2015 Bore 25 2.5-2.5
Moisture Content Method: AN002 Tested: 8/5/2015						
% Moisture	%	0.5	**9.6**	**8.1**	**10.3**	**11.1**
TAA (Titratable Actual Acidity) Method: AN219 Tested: 14/5/2015						
pH KCl	pH Units	-	**5.4**	**5.8**	**5.7**	**5.9**
Titratable Actual Acidity	kg H2SO4/T	0.25	**0.80**	<0.25	**0.43**	**0.43**
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5	**16**	<5	**9**	**9**
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	**0.03**	<0.01	**0.01**	**0.01**
Sulphur (SKCl)	%w/w	0.005	-	-	-	-
Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 14/5/2015						
Chromium Reducible Sulphur (Scr)	%	0.005	<0.005	**0.009**	<0.005	<0.005
Chromium Reducible Sulphur (Scr)	moles H+/T	5	<5	**5**	<5	<5
Chromium Suite Net Acidity Calculations Method: AN220 Tested: 14/5/2015						
s-Net Acidity	%w/w S	0.01	**0.03**	**0.02**	**0.02**	**0.01**
a-Net Acidity	moles H+/T	5	**18**	**10**	**11**	**9**
Liming Rate	kg CaCO3/T	0.1	**1.4**	NA	NA	NA
Verification s-Net Acidity	%w/w S	-20	NA	NA	NA	NA
a-Net Acidity without ANCBT	moles H+/T	5	**18**	**10**	**11**	**9**
Liming Rate without ANCBT	kg CaCO3/T	0.1	**1.4**	NA	NA	NA
Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) Method: AN122 Tested: -						
Exchangeable Sodium, Na	mg/kg	2	-	-	**160**	-
Exchangeable Sodium, Na	meq/100g	0.01	-	-	**0.71**	-
Exchangeable Sodium Percentage	%	0.1	-	-	**20.8**	-
Exchangeable Potassium, K	mg/kg	2	-	-	**120**	-
Exchangeable Potassium, K	meq/100g	0.01	-	-	**0.30**	-
Exchangeable Potassium Percentage	%	0.1	-	-	**8.8**	-
Exchangeable Calcium Percentage	%	0.1	-	-	**33.4**	-
Exchangeable Calcium, Ca	mg/kg	2	-	-	**230**	-
Exchangeable Calcium, Ca	meq/100g	0.01	-	-	**1.1**	-
Exchangeable Magnesium, Mg	mg/kg	2	-	-	**150**	-
Exchangeable Magnesium, Mg	meq/100g	0.02	-	-	**1.3**	-
Exchangeable Magnesium Percentage	%	0.1	-	-	**37.0**	-
Cation Exchange Capacity	meq/100g	0.02	-	-	**3.4**	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.025 Soil 01 May 2015 Bore 23 0.0-0.1	CE115186.026 Soil 01 May 2015 Bore 23 0.3-0.55	CE115186.027 Soil 01 May 2015 Bore 24 0.25-0.5	CE115186.028 Soil 01 May 2015 Bore 25 2.5-2.5
Emerson Class Number Method: AN009 Tested: -						
Emerson Class Number	No unit	1	-	-	**2**	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.029 Soil 01 May 2015 Bore 26 1.1-1.35	CE115186.030 Soil 01 May 2015 Bore 27 1.1-1.4	CE115186.031 Soil 01 May 2015 Bore 28 1.25-1.5	CE115186.032 Soil 01 May 2015 Bore 28 0.25-0.5
Moisture Content Method: AN002 Tested: 8/5/2015						
% Moisture	%	0.5	**11.8**	**11.0**	**11.8**	**12.5**
TAA (Titratable Actual Acidity) Method: AN219 Tested: 14/5/2015						
pH KCl	pH Units	-	**6.4**	**5.8**	**5.8**	**5.3**
Titratable Actual Acidity	kg H2SO4/T	0.25	<0.25	<0.25	<0.25	**1.6**
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5	<5	<5	<5	**32**
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	<0.01	<0.01	<0.01	**0.05**
Sulphur (SKCl)	%w/w	0.005	-	-	-	-
Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 14/5/2015						
Chromium Reducible Sulphur (Scr)	%	0.005	<0.005	<0.005	<0.005	<0.005
Chromium Reducible Sulphur (Scr)	moles H+/T	5	<5	<5	<5	<5
Chromium Suite Net Acidity Calculations Method: AN220 Tested: 14/5/2015						
s-Net Acidity	%w/w S	0.01	<0.01	<0.01	<0.01	**0.05**
a-Net Acidity	moles H+/T	5	<5	**6**	<5	**33**
Liming Rate	kg CaCO3/T	0.1	<0.1	NA	<0.1	**2.5**
Verification s-Net Acidity	%w/w S	-20	NA	NA	NA	NA
a-Net Acidity without ANCBT	moles H+/T	5	<5	**6**	<5	**33**
Liming Rate without ANCBT	kg CaCO3/T	0.1	<0.1	NA	<0.1	**2.5**
Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) Method: AN122 Tested: -						
Exchangeable Sodium, Na	mg/kg	2	-	-	-	**210**
Exchangeable Sodium, Na	meq/100g	0.01	-	-	-	**0.92**
Exchangeable Sodium Percentage	%	0.1	-	-	-	**32.5**
Exchangeable Potassium, K	mg/kg	2	-	-	-	**200**
Exchangeable Potassium, K	meq/100g	0.01	-	-	-	**0.50**
Exchangeable Potassium Percentage	%	0.1	-	-	-	**17.7**
Exchangeable Calcium Percentage	%	0.1	-	-	-	**22.2**
Exchangeable Calcium, Ca	mg/kg	2	-	-	-	**130**
Exchangeable Calcium, Ca	meq/100g	0.01	-	-	-	**0.63**
Exchangeable Magnesium, Mg	mg/kg	2	-	-	-	**95**
Exchangeable Magnesium, Mg	meq/100g	0.02	-	-	-	**0.78**
Exchangeable Magnesium Percentage	%	0.1	-	-	-	**27.6**
Cation Exchange Capacity	meq/100g	0.02	-	-	-	**2.8**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.029 Soil 01 May 2015 Bore 26 1.1-1.35	CE115186.030 Soil 01 May 2015 Bore 27 1.1-1.4	CE115186.031 Soil 01 May 2015 Bore 28 1.25-1.5	CE115186.032 Soil 01 May 2015 Bore 28 0.25-0.5
Emerson Class Number Method: AN009 Tested: -						
Emerson Class Number	No unit	1	-	-	-	**3**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE115186.033 Soil 01 May 2015 Bore 29 1.6-1.85	CE115186.034 Soil 01 May 2015 Bore 30 1.65-1.9	CE115186.035 Soil 01 May 2015 Bore 31 1.1-1.2	CE115186.036 Soil 01 May 2015 Bore 32 0.35-0.6
Moisture Content Method: AN002 Tested: 8/5/2015							
% Moisture	%	0.5		**13.5**	**13.2**	**14.3**	**12.7**
TAA (Titratable Actual Acidity) Method: AN219 Tested: 14/5/2015							
pH KCl	pH Units	-		**4.9**	**5.2**	**5.8**	**5.3**
Titratable Actual Acidity	kg H2SO4/T	0.25		**1.3**	**0.61**	<0.25	**0.49**
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5		**27**	**12**	<5	**10**
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01		**0.04**	**0.02**	<0.01	**0.02**
Sulphur (SKCl)	%w/w	0.005		-	-	-	-
Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 14/5/2015							
Chromium Reducible Sulphur (Scr)	%	0.005		**0.012**	<0.005	<0.005	<0.005
Chromium Reducible Sulphur (Scr)	moles H+/T	5		**8**	<5	<5	<5
Chromium Suite Net Acidity Calculations Method: AN220 Tested: 14/5/2015							
s-Net Acidity	%w/w S	0.01		**0.06**	**0.02**	<0.01	**0.02**
a-Net Acidity	moles H+/T	5		**35**	**13**	**6**	**11**
Liming Rate	kg CaCO3/T	0.1		**2.6**	NA	NA	NA
Verification s-Net Acidity	%w/w S	-20		NA	NA	NA	NA
a-Net Acidity without ANCBT	moles H+/T	5		**35**	**13**	**6**	**11**
Liming Rate without ANCBT	kg CaCO3/T	0.1		**2.6**	NA	NA	NA
Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) Method: AN122 Tested: -							
Exchangeable Sodium, Na	mg/kg	2		-	**200**	-	-
Exchangeable Sodium, Na	meq/100g	0.01		-	**0.85**	-	-
Exchangeable Sodium Percentage	%	0.1		-	**37.4**	-	-
Exchangeable Potassium, K	mg/kg	2		-	**130**	-	-
Exchangeable Potassium, K	meq/100g	0.01		-	**0.34**	-	-
Exchangeable Potassium Percentage	%	0.1		-	**14.8**	-	-
Exchangeable Calcium Percentage	%	0.1		-	**1.8**	-	-
Exchangeable Calcium, Ca	mg/kg	2		-	**8**	-	-
Exchangeable Calcium, Ca	meq/100g	0.01		-	**0.04**	-	-
Exchangeable Magnesium, Mg	mg/kg	2		-	**130**	-	-
Exchangeable Magnesium, Mg	meq/100g	0.02		-	**1.0**	-	-
Exchangeable Magnesium Percentage	%	0.1		-	**46.0**	-	-
Cation Exchange Capacity	meq/100g	0.02		-	**2.3**	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.033 Soil 01 May 2015 Bore 29 1.6-1.85	CE115186.034 Soil 01 May 2015 Bore 30 1.65-1.9	CE115186.035 Soil 01 May 2015 Bore 31 1.1-1.2	CE115186.036 Soil 01 May 2015 Bore 32 0.35-0.6
Emerson Class Number Method: AN009 Tested: -						
Emerson Class Number	No unit	1	-	**2**	-	-

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name CE115186.037 Soil 01 May 2015 Bore 33 1.2-1.5	CE115186.038 Soil 01 May 2015 Bore 34 0.9-1.1	CE115186.039 Soil 01 May 2015 Bore 27 0.25-0.4
Moisture Content Method: AN002 Tested: 8/5/2015					
% Moisture	%	0.5	**10.6**	**10.6**	-
TAA (Titratable Actual Acidity) Method: AN219 Tested: 14/5/2015					
pH KCl	pH Units	-	**5.8**	**5.2**	-
Titratable Actual Acidity	kg H2SO4/T	0.25	<0.25	**0.37**	-
Titratable Actual Acidity (TAA) moles H+/tonne	moles H+/T	5	<5	**7**	-
Titratable Actual Acidity (TAA) S%w/w	%w/w S	0.01	<0.01	**0.01**	-
Sulphur (SKCl)	%w/w	0.005	-	-	-
Chromium Reducible Sulphur (CRS) Method: AN217 Tested: 14/5/2015					
Chromium Reducible Sulphur (Scr)	%	0.005	<0.005	<0.005	-
Chromium Reducible Sulphur (Scr)	moles H+/T	5	<5	<5	-
Chromium Suite Net Acidity Calculations Method: AN220 Tested: 14/5/2015					
s-Net Acidity	%w/w S	0.01	<0.01	**0.01**	-
a-Net Acidity	moles H+/T	5	**6**	**8**	-
Liming Rate	kg CaCO3/T	0.1	NA	NA	-
Verification s-Net Acidity	%w/w S	-20	NA	NA	-
a-Net Acidity without ANCBT	moles H+/T	5	**6**	**8**	-
Liming Rate without ANCBT	kg CaCO3/T	0.1	NA	NA	-
Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) Method: AN122 Tested: -					
Exchangeable Sodium, Na	mg/kg	2	-	-	**58**
Exchangeable Sodium, Na	meq/100g	0.01	-	-	**0.25**
Exchangeable Sodium Percentage	%	0.1	-	-	**8.3**
Exchangeable Potassium, K	mg/kg	2	-	-	**180**
Exchangeable Potassium, K	meq/100g	0.01	-	-	**0.46**
Exchangeable Potassium Percentage	%	0.1	-	-	**15.1**
Exchangeable Calcium Percentage	%	0.1	-	-	**61.5**
Exchangeable Calcium, Ca	mg/kg	2	-	-	**370**
Exchangeable Calcium, Ca	meq/100g	0.01	-	-	**1.9**
Exchangeable Magnesium, Mg	mg/kg	2	-	-	**55**
Exchangeable Magnesium, Mg	meq/100g	0.02	-	-	**0.45**
Exchangeable Magnesium Percentage	%	0.1	-	-	**15.0**
Cation Exchange Capacity	meq/100g	0.02	-	-	**3.0**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	CE115186.037 Soil 01 May 2015 Bore 33 1.2-1.5	CE115186.038 Soil 01 May 2015 Bore 34 0.9-1.1	CE115186.039 Soil 01 May 2015 Bore 27 0.25-0.4
Emerson Class Number Method: AN009 Tested: -						
Emerson Class Number	No unit	1		-	-	**2**

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Chromium Reducible Sulphur (CRS) **Method: ME-(AU)-[ENV]AN217**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chromium Reducible Sulphur (Scr)	LB026335	%	0.005	<0.005	0 - 15%	113%
Chromium Reducible Sulphur (Scr)	LB026335	moles H+/T	5	<5		

Exchangeable Cations and Cation Exchange Capacity (CEC/ESP/SAR) **Method: ME-(AU)-[ENV]AN122**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Exchangeable Sodium, Na	LB026413	mg/kg	2		0 - 12%	96%
Exchangeable Sodium, Na	LB026413	meq/100g	0.01	<0.01	0 - 12%	NA
Exchangeable Sodium Percentage	LB026413	%	0.1	<0.1	1 - 7%	NA
Exchangeable Potassium, K	LB026413	mg/kg	2		1 - 3%	110%
Exchangeable Potassium, K	LB026413	meq/100g	0.01	<0.01	1 - 3%	NA
Exchangeable Potassium Percentage	LB026413	%	0.1		1 - 4%	NA
Exchangeable Calcium Percentage	LB026413	%	0.1	<0.1	1 - 2%	NA
Exchangeable Calcium, Ca	LB026413	mg/kg	2		0 - 5%	112%
Exchangeable Calcium, Ca	LB026413	meq/100g	0.01	<0.01	0 - 5%	NA
Exchangeable Magnesium, Mg	LB026413	mg/kg	2		1 - 4%	96%
Exchangeable Magnesium, Mg	LB026413	meq/100g	0.02	<0.02	1 - 4%	NA
Exchangeable Magnesium Percentage	LB026413	%	0.1		0 - 1%	NA
Cation Exchange Capacity	LB026413	meq/100g	0.02	<0.02	1 - 5%	NA

TAA (Titratable Actual Acidity) **Method: ME-(AU)-[ENV]AN219**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH KCl	LB026342	pH Units	-	5.4	0 - 9%	98%
Titratable Actual Acidity	LB026342	kg H2SO4/T	0.25	<0.25	0 - 5%	NA
Titratable Actual Acidity (TAA) moles H+/tonne	LB026342	moles H+/T	5	<5	0 - 5%	96%
Titratable Actual Acidity (TAA) S%w/w	LB026342	%w/w S	0.01	<0.01	0 - 5%	97%

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN002	The test is carried out by drying (at either 40°C or 105°C) a known mass of sample in a weighed evaporating basin. After fully dry the sample is re-weighed. Samples such as sludge and sediment having high percentages of moisture will take some time in a drying oven for complete removal of water.
AN004	Soils, sediments and sludges are pulverised using an LM2 ringmill. The dry sample is pulverised to a particle size of >90% passing through a -75µm sieve.
AN009	The method follows AS1289 3.8.1 - 2006. Soils are divided into seven classes on the basis of their coherence in water, with one further class being distinguished by the presence of calcium-rich minerals. Class 1: Air-dried crumbs of soil show a strong dispersion reaction, i.e., a colloidal cloud covers nearly the whole of the bottom of the beaker, usually in a very thin layer. The reaction should be evident within 10min. In extreme cases all the water in the beaker becomes cloudy, leaving only a coarse residue in a cloud of clay.
AN009	Class 2: Air-dried crumbs of soil show a moderate to slight reaction. A moderate reaction consists of an easily recognisable cloud of colloids in suspension, usually spreading in thin streaks on the bottom of the beaker. A slight reaction consists of the bare hint of cloud in water at the surface of the crumbs. Class 3: The soil remoulded at the plastic limit disperses in water. Class 4: The remoulded soil does not disperse in water. Calcium carbonate (calcite) or calcium sulfate (gypsum) is present. Class 5: The remoulded soil does not disperse in water and the 1:5 soil/water suspension remains dispersed after 5 min.
AN009	Class 6: The remoulded soil does not disperse in water and the 1:5 soil/water suspension begins to flocculate within 5 min. Class 7: The air-dried crumbs of soil remain coherent in water and swells. Class 8: The air-dried crumbs of soil remain coherent in water and do not swell.
AN122	Exchangeable Cations, CEC and ESP: Soil sample is extracted in 1 M Ammonium Acetate at pH=7 (or 1M Ammonium Chloride at pH=7) with cations (Na, K, Ca & Mg) then determined by ICP OES/ICP MS and reported as Exchangeable Cations. For saline soils, these results can be corrected for water soluble cations and reported as Exchangeable cations in meq/100g or soil can be pretreated (aqueous ethanol/aqueous glycerol) prior to extraction. Cation Exchange Capacity (CEC) is the sum of the exchangeable cations in meq/100g.
AN122	The Exchangeable Sodium Percentage (ESP) is calculated as the exchangeable sodium divided by the CEC (all in meq/100g) times 100. ESP can be used to categorise the sodicity of the soil as below: ESP < 6% non-sodic ESP 6-15% sodic ESP >15% strongly sodic Method is refernced to Rayment and Higginson, 1992, sections 15D3 and 15N1.-
AN217	Dried pulped sample is mixed with acid and chromium metal in a rapid distillation unit to produce hydrogen sulphide (H2S) which is collected and titrated with iodine (I2(aq)) to measure SCR.
AN219	Dried pulped sample is extracted for 4 hours in a 1 M KCl solution. The ratio of sample to solution is 1:40. The extract is titrated for acidity. Calcium, magnesium, and sulphur are determined by ICP-AES.
AN220	Chromium Suite: Scheme for the calculation of net acidities and liming rates using a Fineness Factor of 1.5.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	This analysis is not covered by the scope of accreditation.	QFH	QC result is above the upper tolerance
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	The sample was not analysed for this analyte
^	Performed by outside laboratory.	NVL	Not Validated

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

Some totals may not appear to add up because the total is rounded after adding up the raw values.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here:
http://www.sgs.com.au/~/media/Local/Australia/Documents/ Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf