APPENDIX **J**

Marine sediment properties assessment

APPENDIX J

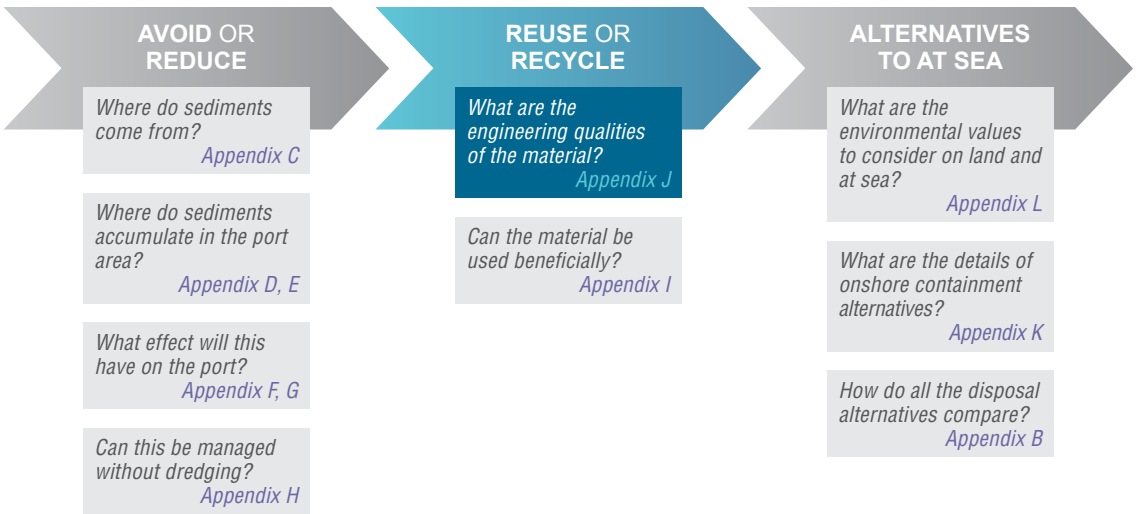
Marine sediment properties assessment

SYNOPSIS

Independent technical specialist

Advisian | **23 March 2016**

Hay Point sustainable sediment management assessment approach



Purpose of study:

To understand the engineering properties of marine sediments that naturally accumulate in the navigational areas of the Port of Hay Point in order to inform a comprehensive analysis of potential beneficial re-uses of this material, considering current and future maintenance dredging needs.

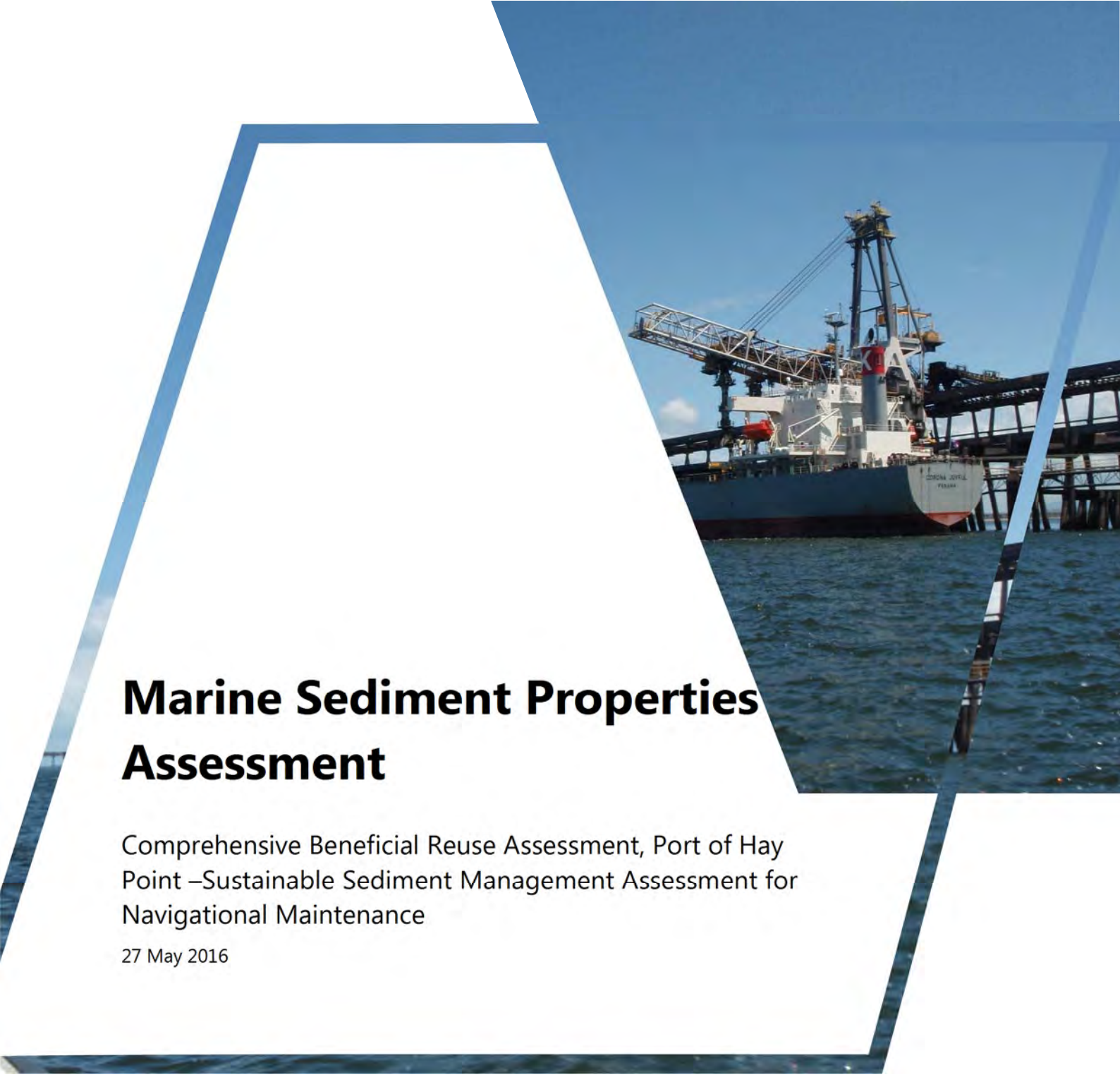
Broad study approach:

Representative samples were collected from all Port navigational areas in March 2016. Laboratory analysis was conducted to determine:

- Particle size distribution (incl. hydrometer)
- Carbonate content
- Atterberg Limits and Linear Shrinkage
- Specific Gravity
- Moisture Content
- Bulk unit weight
- Minimum/maximum density
- Constant Head Permeability
- Falling Head Permeability
- 1D consolidation (8 loadings)
- Direct shear box (100mm) – Single Stage
- Consolidated isotropic undrained triaxial – 3 Stage
- X-ray diffractometry
- Acid Sulphate Soils presence/potential

Key findings:

- Naturally accumulating material was found to be predominately fine silts and clays, generally greater than 50%, but over 90% in some areas.
- Clay-rich, finer materials were generally found inshore, near existing jetties and berths.
- This finer material constitutes most of the maintenance dredging requirements at the Port by volume.
- The finer material has very high moisture content, which is likely to limit beneficial reuse options. Furthermore, it contains high plasticity clays and low to medium compressibility, increasing the potential to swell and shrink, making it unsuitable for heavy load bearing re-uses.
- The further offshore samples collected, such as the outer departure path, contained coarse sands, with some of the farthest offshore sites being above 90% sand.
- All samples were identified as extremely saline and if placed on land without treatment, would likely degrade soil quality, cause vegetation toxicity and impact surface and ground waters.
- High Potential Acid Sulphate Soil (PASS) was detected in 9 of the 16 sampling locations generally in the apron and berth pocket areas.
- Analysis of the acid neutralising capacity (ANC) indicated if bought ashore, the marine sediments are unlikely to require treatment via neutralisation with lime.



Marine Sediment Properties Assessment

Comprehensive Beneficial Reuse Assessment, Port of Hay Point –Sustainable Sediment Management Assessment for Navigational Maintenance

27 May 2016

Level 3, 60 Albert St
Brisbane QLD 4000
Australia

301310-09537-00-EN-REP-0001

www.**advisian**.com

Advisian
WorleyParsons Group

Synopsis

A sediment sampling exercise was completed to permit description and testing of materials expected to be removed as part of a proposed dredging program. The findings of the sampling exercise and subsequent geotechnical and environmental laboratory testing are presented.

Disclaimer

Project No: 301310-09537-00-EN-REP-0001 – Comprehensive Beneficial Reuse Assessment, Port of Hay Point: Marine Sediment Properties Assessment

Rev	Description	Author	Review	Advisian Approval	Date
0	Original Issue	pp A Kochnieff	L Stalley	B Boylson	27 May 16

Table of Contents

Table List

Figures List

Appendix List

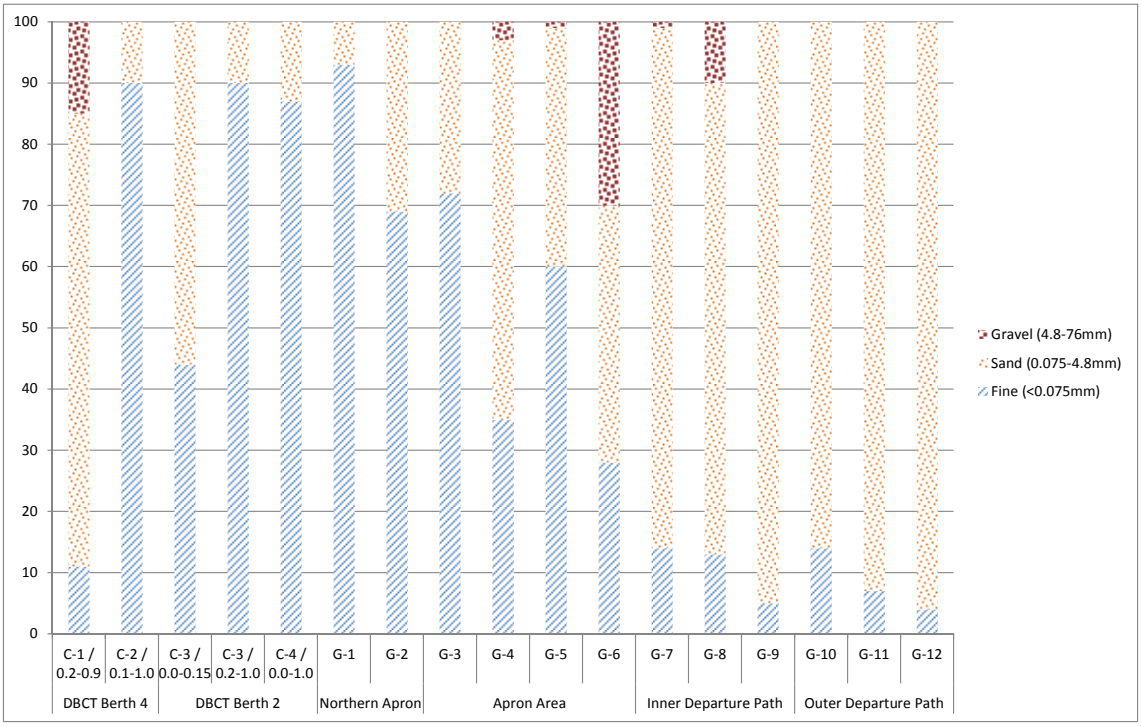
Executive summary

The purpose of this investigation was to identify and classify marine sediment materials and investigate their acid generating capacity and geotechnical properties for consideration of potential reuse options. This included sampling sediments at 16 locations within the Port of Hay Point navigational areas: inner and outer departure paths, apron areas and DBCT Berths 2 and 4. The number of sampling locations selected was in general accordance with requirements for a pilot study outlined in the NAGD, 2009.

Geotechnical results

A number of geotechnical tests were undertaken on selected samples. This included Particle Size Distribution to determine the texture of material (i.e. clay, silt, sands), Atterberg limit tests to determine liquid and plastic limits, carbonate content, particle density to assess soil compaction, permeability and moisture content to assess transmission of liquids and potential effort required to dry sediments, direct shear and consolidated undrained triaxial tests to assess strength and consolidation and X-ray diffraction (XRD) and X-ray fluorescence (XRF) to assess mineral, chemical and trace element composition.

The sediment materials encountered consisted of clayey and silty sands and silty clays. In general the fine grained (clay-rich) materials were encountered inshore, in the vicinity of the existing jetties and berths, while coarser materials were encountered within the channels. The composition and location of sediment material samples is presented below:



The fine particle material sourced from the inshore areas is expected to be very difficult to use as an earthworks material in its current saturated state, and significant moisture conditioning by drying or use of admixtures, e.g. lime/cement, will be required to permit use as an earthworks material. For the sand-rich sediment materials, moisture is still expected to be an issue, though the sand-rich composition is expected to make handling with conventional earthmoving plant achievable, the high moisture content may limit effective compaction, and some moisture conditioning should be expected.

Atterberg Limits and linear shrinkage tests were undertaken on fine grained materials. These tests indicated that fine grained material (predominated encountered within the berth pockets and apron areas) is indicative of low to high plasticity clay with the average being high plasticity.

Linear shrinkage results (ranging from 5.5 to 22%) indicate a potential for swelling in fine grained materials, most of which were above the critical potential for expansion limit of 8%. This is supported by oedometer tests, which recorded swelling at less than 160kPa loading. The potential for swelling of compacted fine grained materials should therefore be considered when identifying potential reuse options.

Carbonate sediments are characterised as weak and likely to have low bearing capacity. However, as carbonate content within tested samples was below 50% (i.e. ranging from 8.2 to 47.4%), the sediment material sampled are not considered to be carbonate sediments.

The permeability of material for samples collected in the departure channels was indicative of sands, while the permeability for samples collected in the berth areas was indicative of clays.

X-ray Diffraction and X-ray Fluorescence tests were undertaken on two samples: C3 (DBCT Bert 2 area) sandy clay and G9 (Inner Departure Path area) sand. The tests indicated that sample C3 may be used to form a binding agent by the introduction and mixing of an alkaline geopolymer hardener chemicals. While sample G9 cannot be used as a binding agent it may form the body matter in a useful material with the introduction of a binding agent.

The results of geotechnical testing is summarised below:

Area		Berth pockets				Apron Areas				Inner Departure Path				Outer Departure Path			
Statistics		*Low*	*High*	*Average*	*SD*	*Low*	*High*	*Average*	*SD*	*Low*	*High*	*Average*	*SD*	*Low*	*High*	*Average*	*SD*
Carbonate Content	%	8.2	29.5	21.6	7.4	22.2	47.4	28.6	8.5	16.5	31.1	22.3	6.3	15.0	20.4	16.9	2.5
Plasticity (PI)	%	25	72.0	High	N/A	14.0	56.0	High	N/A	Non plastic	Non plastic	Non plastic	N/A	Non plastic	Non plastic	Non plastic	N/A
Linear Shrinkage	%	9.5	22.0	17.5	4.8	5.5	19.0	12.8	5.0	Non plastic	Non plastic	Non plastic	N/A	Non plastic	Non plastic	Non plastic	N/A
Moisture Content	%	19.3	117.0	90.9	41.3	37.7	159.2	90.7	41.4	22.2	27.1	24.5	2.0	22.8	33.5	27.6	4.4
Particle Specific Gravity	t/m^3	2.56	2.6	2.6	0.0	2.5	2.7	2.6	0.0	2.6	2.6	2.6	0.0	2.6	2.7	2.6	0.0

Geochemical results

Based on the ASS (Acid Sulfate Soil) analysis, samples comprised of fine textured material (i.e. silts and silty clays) and generally located in the apron and berth pocket areas was PASS (Potential Acid Sulfate Soil). Samples comprised of coarser textured material (i.e. sands) and generally located in the departure channel, were not PASS.

Although the fine textured samples are PASS, these contained adequate Acid Neturalising Capacity (ANC) to buffer inherent acidity to negligible concentrations. This indicates that the sediments are unlikely to require ASS treatment through neutralisation using lime.

All samples are considered extremely saline. If sediments are placed on land without treatment, salinity will degrade the quality of terrestrial soils and may cause vegetation toxicity issues. Untreated, these saline sediments may also impact the quality of groundwater and surface waters.

Low OM (Organic Material) was reported for all samples analysed, however, the highest OM (i.e. 1-2%) was report for finer textured samples. Courser textured samples, primarily located in the departure channel, contained OM less than the laboratory Practical Quantification Limit (PQL).

1 Introduction

1.1 Terms of Reference

North Queensland Bulk Ports Corporation (NQBP) has commenced the Port of Hay Point – Sustainable Sediment Management (SSM) Assessment for Navigational Maintenance Project ('The SSM Project'). This project is the long-term strategic assessment for ongoing management of marine sediments at the Port of Hay Point.

As part of the SSM Project, NQBP need to understand the properties of the marine sediments that naturally accumulate in the navigational areas of the Port of Hay Point that include the inner and outer departure paths, apron areas and Dalrymple Bay Coal Terminal (DBCT) Berths 2 and 4. Refer to Figure 1.1.

To assist with the SSM Project, Advisian (WorleyParsons Group) were commissioned to undertake a two phased program that consisted of:

1. A sampling and analysis program to assess the geotechnical engineering and ASS properties of marine sediments recently deposited within the navigational areas at the Port of Hay Point described above. This recent deposited marine sediment is known as maintenance material as it requires removal during maintenance dredging.

2. A comprehensive comparison of the range of beneficial reuse options for the maintenance material marine sediments.

This report provides a description of the works undertaken to complete the first phase of the program.

1.2 Purpose

The purpose of the marine sediment properties assessment was to identify and classify marine sediment materials and investigate their acid generating capacity for consideration of potential reuse options.

1.3 Scope of work

The marine sediment properties assessment scope of works included the following:

- Review of historical acid sulfate and geotechnical information pertaining the sampling areas
- Generate a sediment sampling plan approved by the Great Barrier Reef Marine Park Authority (GBRMPA)
- Collect sediment cores from four locations across DBCT Berth 2 and 4
- Collect sediment grabs from 16 locations across the inner and outer departure paths, apron area and northern apron area

- Describe (log), photograph and collect sediment samples and dispatch to laboratory for analysis and testing
- Prepare a marine sediment properties assessment report
- It is not intended to undertake contamination studies since recent contaminate studies have been completed by NQBP.

1.4 Legislative framework

In Queensland, the State Planning Policy (SPP) 2/02 sets out the State's interest concerning development involving acid sulfate soils (ASS) in low-lying coastal areas. The SPP 2/02 has effect under the *Sustainable Planning Act 2009* (SPA) and applies to all land, soil and sediment at or below 5mAHD (Australian Height Datum) where the natural ground level is less than 20mAHD (Queensland Government 2002). Within this area, the SPP2/02 applies to all development involving excavating or removing 100m^3 or more of soil or sediment, or filling of land involving 500m^3 or more of material with an average depth of 0.5m or greater.

The Department of Environment and Resource Management (DERM – previously known as NR&M) has published comprehensive guidelines for ASS management, sampling and analysis. These guidelines also provide technical and procedural advice to avoid environmental harm and achieve best practice environmental management. They include:

- Queensland Acid Sulfate Soil Technical Manual – Legislation and Policy Guide, version 2.2 (Dear *et al.,* 2004)
- Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1998, version 4.0 (Ahern *et al.,* 1998)
- Queensland Acid Sulfate Soil Technical Manual – Soil Management Guidelines, 2002, version 3.8 (Dear *et al.,* 2002)
- Queensland Acid Sulfate Soil Technical Manual Acid Sulfate Soils – Laboratory Methods Guidelines, 2004, version 2.1 (Ahern *et al.,* 2004).

Methodology for the assessment of marine sediments is guided by the above policies. In addition to the above the following guidelines and standards were used to inform the sediment assessment methodology:

- Australian Standard (AS) 1726-1993: Geotechnical site investigations
- Australian Soil Classification for Geotechnical Purposes (AS1726)
- National Assessment Guidelines for Dredging (NAGD, 2009).

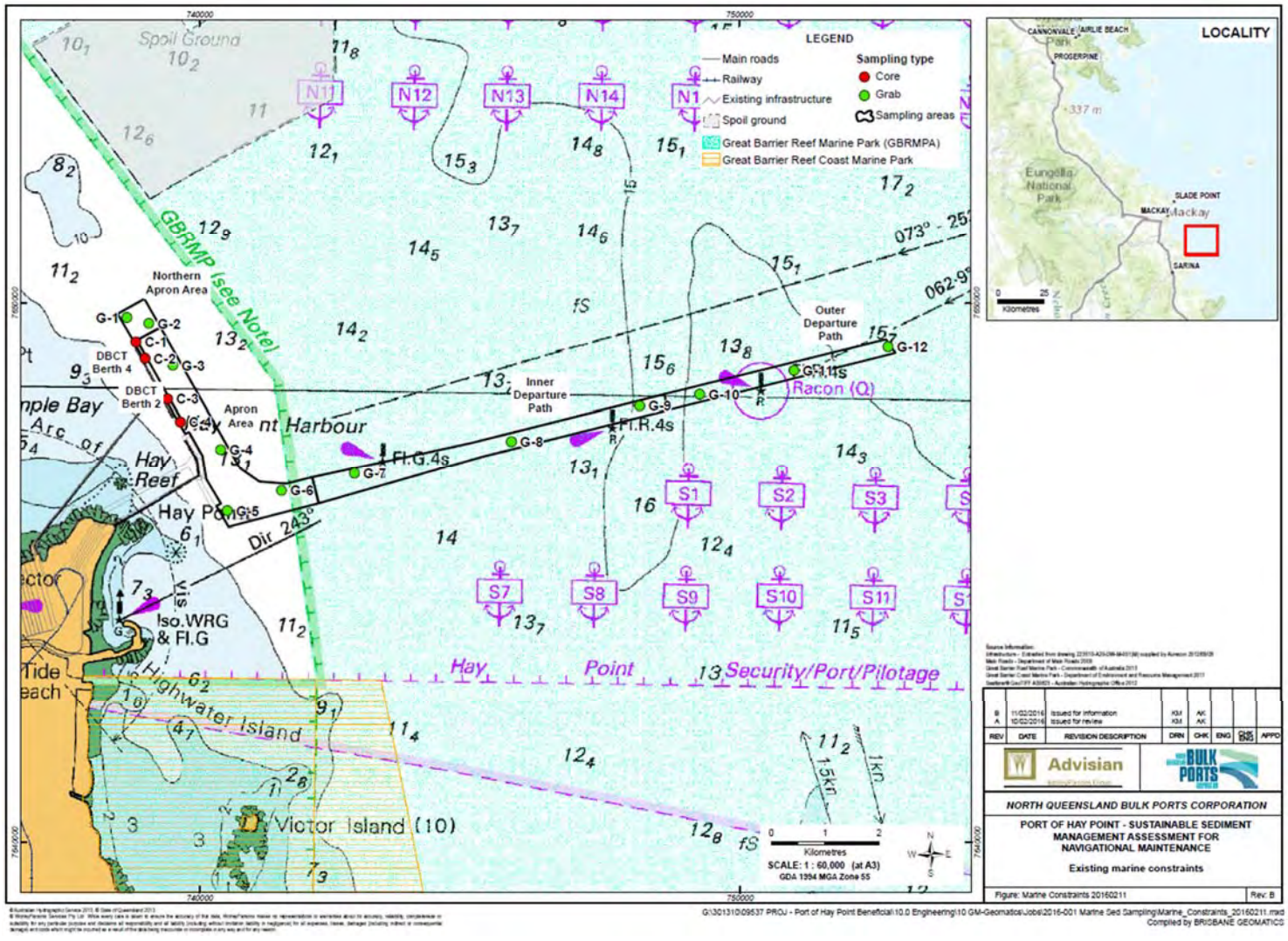


Figure 1.1: Existing marine constraints

2 Background and site information

2.1 Background

The Port of Hay Point is located within central Queensland, 40km south of Mackay, and is one of the largest coal export ports in the world. The port facilities consist of two terminals: DBCT and Hay Point Coal Terminal (HPCT) comprised of four and three berth pockets respectively. Refer to Figure 1.1. Both terminals are serviced by a marine apron area for manoeuvring ships and departure paths (inner and outer channels) that facilitate the movement of ships between the offshore moorings to the berths at DBCT and HPCT.

Sedimentation of these areas occurs naturally caused by the transportation of material from ocean currents, swell and tides. These materials require periodic removal from the navigational areas to maintain safe and efficient operational depths. The commonly adopted approach is to remove materials through dredging and relocation of material offshore. However, as offshore relocation of materials is discouraged by recent legislative changes (*Queensland Sustainable Ports Development Act 2015*), it is prudent that new alternatives be investigated. Such alternatives may include the beneficial reuse of material onshore. In order to thoroughly investigate and assess alternatives an understanding of the sediment material's properties and characteristics is required.

2.2 Contaminant studies

Based on recent sediment characterisation studies completed by NQBP and undertaken by Ports and Coastal Environmental Pty Ltd (PACE, 2013) as part of proposed maintenance dredging programs, material dredged from five of the six navigational areas (refer Section 1: inner and outer channels, apron and north apron areas, DBCT Berths 2 and 4) to be investigated was suitable for ocean disposal. In accordance with the NAGD, 2009, these areas have been categorised as 'probably clean'. Only one area (DBCT Berth 2) was subject to further contaminant studies and was therefore categorised as 'probably contaminated'. Under the NAGD, data collected within the last five years is classified as reliable and can support maintenance material sediment characterisation. As this and other contaminant studies have already given the marine sediments a contaminant profile, this report does not contain or examine any further contaminant information.

2.3 Acid Sulfate Soil studies

Based on a review of previous information provided by NQBP, only one ASS study, undertaken by WorleyParsons in 2013 for the Dudgeon Point Environmental Impact Study, has been completed. This was a preliminary investigation and included Chromium Suite analysis of 23 homogenised samples from 16 locations at various depths ranging from 0.0-0.5m, 0.5-1.0m and 1.0-1.5m below the seabed. This sampling was undertaken north of the DBCT at the proposed Dudgeon Point terminal capital dredging areas. This study indicated sediments tested were potential ASS (PASS) with potential oxidisable sulfur ranging from less than the laboratory detection level of 3 moles H+/t to 48 moles H+/t. These samples also contained sufficient acid neutralising capacity to reduce net acidity to below the laboratory detection level of 10 moles H+/t negating the need for

treatment (e.g. mixing lime through the sediments) if the sediment materials were dredged and brought onshore. This therefore suggests that the sediments are unlikely to pose an ASS problem.

2.4 Geotechnical studies

Past work reported by PACE presents a summary of particle size testing undertaken as part of previous sediment assessments. In general the inshore areas are dominated by clay-rich sediments, while further from the shore, the clay content decreases and sand-rich sediment material predominate, with some secondary gravel.

Aside from the particle size analysis, no past geotechnical testing results have been made available for review.

3 Methodology

3.1 General

The marine sediment properties assessment was comprised of two components: 1) an assessment of existing information, preselection of sampling location and development of a sampling plan, and 2) an assessment of marine sediments including a sampling program. The latter was comprised of piston coring and grab sampling at 16 locations (refer figure 3-1) focused on understanding the geotechnical engineering and ASS properties of the marine sediments.

3.2 Sediment Sampling Plan

In preparation for the field work a Sediment Sampling Plan was prepared with the purpose of characterising the engineering and geotechnical properties of the material to understand the sediments' suitability for beneficial reuse options. The sampling plan included a description of the proposed sampling locations, sampling and laboratory analytical methods and schedule. The Sediment Sampling Plan is contained in Appendix A.

3.3 Sampling intensity

The number of sampling locations was determined for a pilot study using Table 6 (Minimum number of sampling locations) of the NAGD, 2009. Although the NAGD focuses on contaminant studies, it provides a robust framework for sample program design (based on potential dredge volumes) and ensures a consistent approach with previous studies completed. Based on this approach, the minimum number of sampling locations recommended for the potential dredge volume from the navigational areas (approximately 268,400m^3) is 12 (NAGD, 2009). However, 16 locations were sampled to provide additional data. This number of locations is considered as the appropriate intensity for both the geotechnical and ASS sampling components of this study.

Using aerial photography, these locations were preselected across all navigation areas then adjusted based on bathymetry information to target areas of accretion (i.e. sediment build up) to ensure full profile sampling of the maintenance materials. The locations sampled are provided in Table 3.A and presented in Figure 3.1.

Table 3.A: Field sampling locations and coordinates

Sampling location	Area	Sample type	Easting (MGA55)	Northing (MGA55)	Longitude (WGS84)	Latitude (WGS84)
C-1	DBCT Berth 4	Core	738824	7649280	149.30100	-21.24250
C-2		Core	738991	7648970	149.30300	-21.24520
C-3	DBCT Berth 2	Core	739410	7648220	149.30700	-21.25200
C-4		Core	739649	7647790	149.30900	-21.25580
G-1	Northern Apron Area	Grab	738656	7649740	149.30000	-21.23840
G-2		Grab	739065	7649620	149.30300	-21.23930
G-3	Apron Area	Grab	739508	7648840	149.30800	-21.24630
G-4		Grab	740394	7647270	149.31700	-21.26040
G-5		Grab	740518	7646130	149.31800	-21.27070
G-6		Grab	741522	7646500	149.32800	-21.26720
G-7	Inner Departure Path	Grab	742870	7646830	149.34100	-21.26410
G-8		Grab	745777	7647420	149.36800	-21.25830
G-9		Grab	748157	7648090	149.39100	-21.25200
G-10	Outer Departure Path	Grab	749267	7648300	149.40200	-21.24990
G-11		Grab	751013	7648740	149.41900	-21.24570
G-12		Grab	752758	7649180	149.43500	-21.24140

Note:
MGA55: Map Grid of Australia – central meridian (55)
WGS84: World Geodetic System 1984

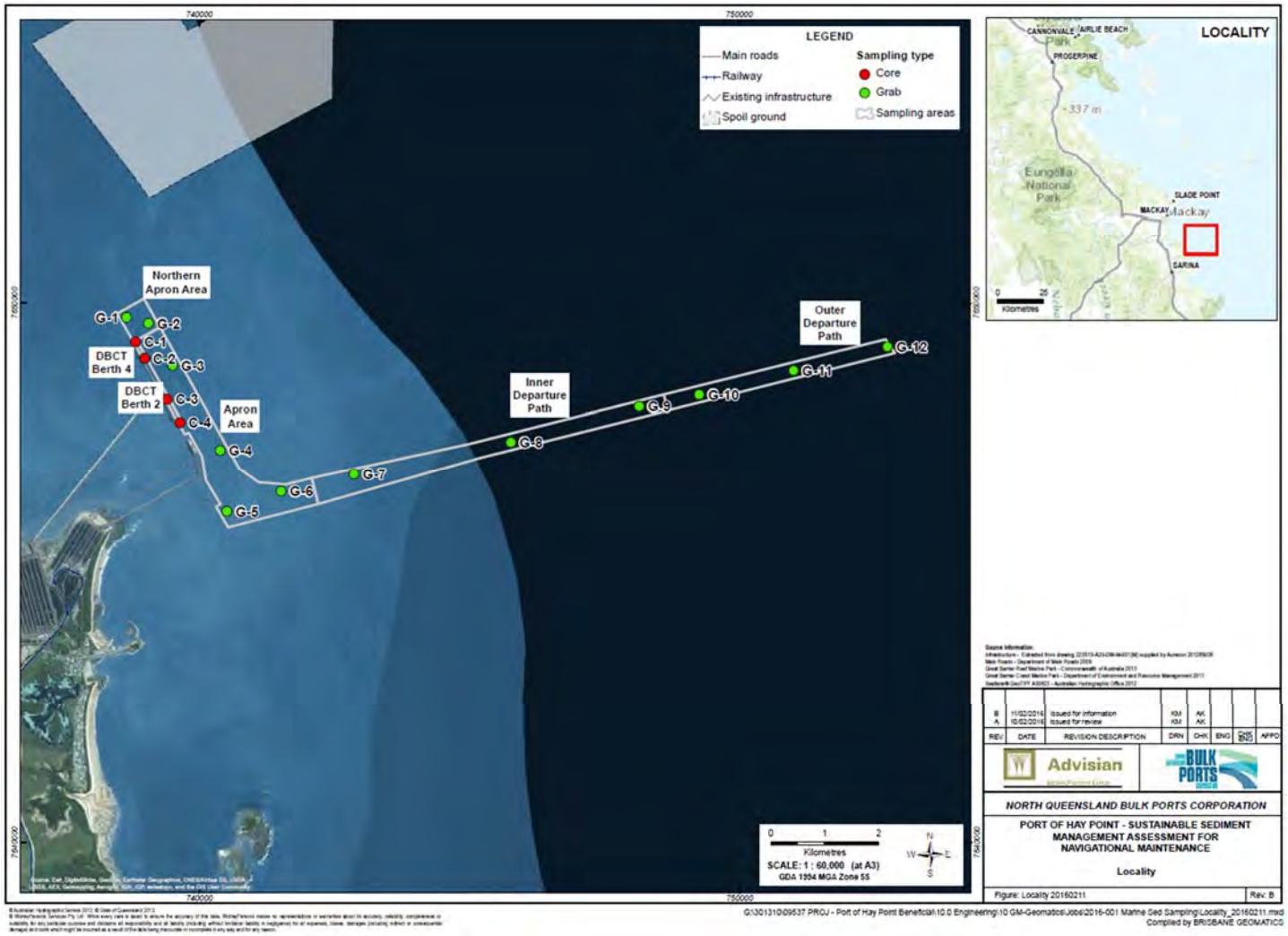


Figure 3.1: Sampling locations

3.4 Field methodology

The sampling program was undertaken from 13 to 19 March 2016. The results of the field testing are discussed in Section 4.

Field sampling procedures conforming to Advisian's Quality Assurance / Quality Control (QA / QC) protocols were carried out to minimise the potential for cross contamination and preserve the sample integrity. A summary of the methodology adopted during the field investigation is provided in Table 3.B.

Table 3.B: Sampling activities

Activity	Details
Sampling locations	Sampling locations were selected and optimised using aerial imagery and bathymetry information. The co-ordinates of the locations were then uploaded onto a Garmin 76CSx Global Positioning System (GPS) unit with an accuracy of +/-5m. The Garmin was used to navigate to the locations and, if required, also re-position the locations due to site conditions.
Sediment sampling	Samples were collected using two methods: 1) a diver operated piston corer from the sea floor and 2) a boat deployed grab sampler. **Piston Coring:** The piston corer is constructed of stainless steel, has an internal barrel length of 1.2m and an internal diameter of 62mm. The corer was lowered over the side of the vessel to the seabed where a commercial diver would receive the piston corer and use it to collect a sediment core to a depth of 1m. Once a sediment core had been collected, the piston corer was retrieved by rope to the surface and the sediment core extruded manually into a plastic core tray for geotechnical core logging. **Grab Sampling:** The grab sampler is constructed of stainless steel and has an approximate grab payload of 10kg. Using a pulley system, the grab sampler was deployed from the boat and lowered to the sea floor where it would trigger shut and capture sediments. The grab sampler was then lifted back to the surface where it was opened and sediments placed directly into steel mixing bowls.
Sediment logging	Logging of sediments was undertaken in general accordance with the methods of soil description set out in AS1726: Geotechnical Site Investigations (1993).
Soil sampling & storage	Once logged, sediment material collected by grab sampler was homogenised by placing it into large stainless steel bowls and mixed by hand using powderless nitrile gloves. Where cores were retrieved by the piston corer at locations C-1, C-2, C-3, C-4, discrete samples were collected at approximate 0.25m intervals from the top to the base of the core.

Activity	Details
	Sediment samples were then collected and placed into laboratory supplied 250ml and 125ml glass jars with zero head space and zip lock bags and stored on ice in eskies. Samples collected for geotechnical testing were bulk sampled and placed into plastic bags and zip tied.
Decontamination	Decontamination between samples included washing of all sampling equipment with ambient sea water and a laboratory grade detergent (Decon 90), and successive rinsing with deionised water.
Labelling	Sample bags and jars were labelled with the date, the abbreviated project location (Hay Pt), the location number / depth, sampler's initials and date of sampling. For instance a sample collected at C-1 at a depth of 0.0-0.1m was labelled as follows: C-1/0.0-0.1 (sample I.D.) AK (initials of sampler) 17/03/16 (date sampled)
Dispatch	All samples collected were delivered to TNT or TOLL courier depots daily. Samples to be tested for ASS parameters were transported under chain of custody documentation to Advanced Analytical Australia's (AAA) Sydney laboratory. Here, samples were logged and stored in a fridge until analysed. triplicate samples were dispatched by AAA to Australian Laboratory Services (ALS) in Stafford, Brisbane. Samples to be tested for geotechnical parameters were transported to Trilab in Geebung, Brisbane. Samples to be tested for reactivity as a 'binding' agent were transported to Wagner's, cement laboratory in Pinkenba, Brisbane.

3.5 Laboratory analysis

3.5.1 Acid Sulfate Soils analysis

The presence of PASS was assessed using the chromium suite of analysis (S_{CR}). The chromium suite, along with the Suspension Peroxide Oxidation Combined Acidity and Sulfur (SPOCAS) suite, is the ASS assessment recommended by Ahern et al (2003) and the most recent guidelines, *Queensland Acid Sulfate Soil Technical Manual – Soil Management Guideline* (Dear *et al*., 2002).

A total of 34 sediment samples were collected for laboratory analysis. All samples collected were submitted to AAA for analysis, with the exception of one duplicate sample (D2A) that was submitted to ALS.

National Association of Testing Authorities (NATA) accredited analysis undertaken at the laboratory, included:

- Chromium Suite (S_{CR})
- Electrical conductivity (EC)
- Salinity (total soluble salts) (TSS)
- Salinity Chloride (Cl^-)
- Organic Matter (OM).

Additional analysis, not NATA accredited, included preliminary ASS screening field pH (pH_f) and field peroxide pH (pH_{fox}).

3.5.2 Acid Sulfate Soils Quality Assurance / Quality Control

A limited field QA/QC program was undertaken for the purpose of providing an assessment of analytical reliability. QA/QC samples included the collection of one blind (D1A) and one split (D2A) duplicate samples collected at C-4/0.9-1.0. Field QA/QC results are discussed in Section 4.3.8.

3.5.3 Geotechnical testing

The geotechnical tests listed in Table 3.C were undertaken to provide data for classification of the sediment material and to assess engineering behaviour. In addition cement laboratory testing was undertaken to assess the binding characteristics to examine the suitability as a binding agent in cement products (Table 3.D).

Table 3.C: Summary of geotechnical testing

Test	Number
Particle size distribution (incl. hydrometer)	17
Carbonate content	17
Atterberg Limits and Linear Shrinkage	13
Specific Gravity	16
Moisture Content	17
Bulk unit weight	1
Minimum/maximum density	2
Constant Head Permeability	2
Falling Head Permeability	2
1D consolidation (8 loadings)	2
Direct shear box (100mm) – Single Stage	2
Consolidated isotropic undrained triaxial – 3 Stage	2

Table 3.D: Summary of Cement laboratory testing

Test	Number
X-ray diffraction	2
X-ray fluorescence	2

A summary table of the results is presented in Appendix C, while copies of the laboratory test certificates are provided in Appendix D.

3.5.4 Cement laboratory testing

In addition to the standard geotechnical testing for classification of the sediment material, two selected samples have been tested to investigate their chemistry and reactive properties for their potential utilisation in geopolymer reaction to assess the potential for use as a binding agent in products like concrete, bricks and stabilised engineering fill material. X-ray diffraction and x-ray fluorescence testing methods were undertaken and copies of the cement laboratory results are presented in Appendix D.

4 Sediment Characteristics

4.1 General

This section describes the findings from the field investigation undertaken, including the sediment materials encountered (Section 4.2) and results of laboratory analysis (Sections 4.3 and 4.4). Borelogs are presented in Appendix B, a summary result tables are provided in Appendix C and the laboratory reports and QA / QC certificates as well as chain of custody and sample receipt documentation are provided in Appendix D. The sampling locations are illustrated in Figure 3.1.

4.2 Physical description of sediment material

The materials encountered during the sampling comprised a variable mix of silty sand, clayey sand, poorly sorted sand and high plasticity clays and silts.

The sand was generally quartz-rich with some secondary carbonate grains and occasional shell fragments. The colour of the sand was generally brown and grey brown.

The clay / silt was generally dark grey in colour, and was noted to be between very soft and soft.

Detailed descriptions and photographs of the sediment material encountered are presented on the bore logs in (Appendix B). An example photograph of the typical cores and grab samples collected are provided in Table 4.A.

In general the sediment material in the berth and apron area (core samples 1 to 4 and Grab samples 1 to 6) are fine grained (i.e. *containing more than 50% by mass of material smaller than 75μm*) and sediment material in the inner and outer departure path (grab samples G7 to G12) are coarse grained (*defined as material containing more than 50% by mass of material larger than 75μm).*

Table 4.A: Typical core and grab samples collected

	
Photo 1: Example of a typical grab sample collected. This photo shows a sample from location G-1	**Photo 2:** Example of a typical core sample collected. This photo shows a sample collected at C-4

4.3 Results of Acid Sulfate Soils testing

4.3.1 Background

The *Queensland Acid Sulfate Soil Technical Manual – Soil Management Guidelines* (Dear et al. 2002) provides action criteria that are used to compare the results of laboratory analysis. These action criteria are based on texture (fine, medium, coarse) with the most stringent criteria (0.03 %S or 18 mol H^+/tonne) applied to course textured sediments and disturbances greater than 1000 tonnes. Although a range of textures were encountered, the 0.03 %S or 18 mol H^+/tonne criteria is used in this report as the assumed disturbance would be greater than 1000 tonnes.

4.3.2 Preliminary screening

These tests are used to provide an indication of the presence of actual and potential acidity by measuring the difference between pH_F to pH_{FOX}. Changes greater than 1 pH unit, pH_{FOX} values less than 3 and a strong reaction rate can be indicative of a PASS. The following results were reported:

- pH_F values ranged from pH 8.4 to pH 9.3. This indicates the sediment material selected for screening tests are moderately alkaline to very strongly alkaline
- pH_{Fox} values ranged from pH 6.3 to pH 8.2. These results indicate that AASS may not be of concern due to the high pH (>5), however due to the shell content within a number of samples that may contribute to the increase of pH, PASS may still be of concern
- Initial reactions were assessed following the addition of hydrogen peroxide and ranged from slight to high. Initial high reactions were reported for 14 samples, however pH_{fox} values for these samples are above pH 7. These strong reactions may be indicative of shell content (carbonate).

Used in combination with soil profiling and other field observations, screening results can be used as a preliminary assessment of ASS. However, these results are inconclusive and further laboratory assessment using the Chromium Suite is provided in Sections 4.3.3 to 4.3.6 below.

4.3.3 Actual acidity

Actual acidity is assessed by the measurement of Titratable Actual Acidity (TAA). The determination of pH potassium chloride (pH_{KCl}) is a means of estimating the actual soil acidity which is used to calculate TAA.

All samples had a pH_{KCl} value >8.7 indicating strongly alkaline sediments, likely to contain properties (i.e., carbonates) in large enough quantities to neutralize any existing acidity. This correlates well with field data that identified significant shell content in the sediment.

TAA at all sample locations was less than the laboratory practical quantitation limit (PQL) of 5 mole H^+/t, which is also less than the QASSIT guideline of 18 mole H^+/t. This indicates all samples have very little or no actual acidity.

4.3.4 Retained acidity

Retained acidity is the acidity stored in largely insoluble compounds such as jarosite and other iron and aluminium sulfate minerals which are not measured by the TAA titration. Retained acidity is only measured when the pH_{KCl} is <4.5 or when yellow mottles of jarosite, natrojarosite, schwertmannite, etc. have been noted in the sample. Retained acidity (or net acid soluble sulfur (S_{NAS})) is estimated by subtracting S_{KCl} from S_{HCl}.

As pH_{KCl} is greater than pH 4.5 in all samples analysed, retained acidity was not determined.

Note that the total extractable sulfate (S_{KCl}) result provides a measure of adsorbed and soluble sulfate, including gypsum if present. That is, both inorganic (ASS) and organic forms of sulfur and is determined during the TAA process (Section 4.3.3). As retained acidity was not determined, S_{KCl} data is not used to assess ASS.

4.3.5 Potential acidity

Potential acidity is assessed through the measurement of Chromium Reducible Sulphur (S_{CR}). Sixteen of the 24 samples analysed have S_{CR} concentrations greater than the QASSIT guideline of 0.03% and 18 moles H+ / t. These samples were predominately comprised of fine textured material and were collected from within the apron, northern apron and DBCT Berths 2 and 4 (i.e. locations C-1, C-2, C-3, C-4, G-1, G-2, G-3, G-5 and G-7). Sample G-7 was located in the outer departure channel. These S_{CR} concentrations ranged from 0.03 to 0.29 % and 21 to 180 moles H+ / t.

Remaining samples with S_{CR} concentrations below the QASSIT guideline were comprised of coarser material (predominately sand) and were generally located further from shore (i.e. at the eastern boundary of the apron area, i.e. locations G-4 and G-6) and generally in the outer departure channel (locations G-8 to G-12). These S_{CR} concentrations ranged from <0.005 to 0.02 % and <3 to 13 moles H+ / t.

4.3.6 Acid Neutralising Capacity, Net Acidity and Liming

Acid neutralizing capacity (ANC) is the natural ability of soil to buffer acidity either through the dissolution of calcium and/or magnesium carbonates (i.e. shells), cation exchange reaction, reaction of organic and clay fractions or other soil minerals. The effectiveness of neutralization can be hindered somewhat depending on the available forms for acid buffering. For example, where carbonates are stored in coarse shells, acid buffering may not be readily available. In the laboratory, samples are ground making any carbonates (such as shell fragments) more available for neutralisation therefore 'over estimating' ANC. This is somewhat accounted for by 1.5 correction factor incorporated into liming rates reported with the final acid base accounting. A pH_{KCl} greater >6.5 (Section 4.3.3) is one attribute that indicates the presence of carbonates. The greater the pH is above 6.5, the more likely that the ANC will be effective.

Net acidity is the final measure of acidity within a sample once the acid neutralising capacity has been subtracted from the sum of all acids (actual, potential and retained) and is known as acid-base accounting (ABA). In general, the following equation describes the ABA used in ASS determination:

Net Acidity = Potential Sulfidic Acidity + Actual Acidity + Retained Acidity – measured ANC/FF

Note: FF refers to the fineness factor (generally 1.5) applied to liming rates.

Net acidity was below the laboratory PQL (10 moles H^+/t) in all samples analysed and hence below the QASSIT guidelines of 18 moles H^+/t. This correlates to a liming rate which is also below a laboratory PQL of 0.75 kg CaCO3/t, i.e. as there is no net acidity in samples, no liming (i.e. treatment) is required.

4.3.7 Salinity and Organic Matter

A range of salinity parameters and organic matter were determined for selected samples to provide an indication of the initial environmental risk to native vegetation, groundwater and surface water and rehabilitation if maintenance sediment is untreated and reused on land. Based on the analysis the following ranges were reported:

- Salinity – Total Soluble Salts (TSS) ranged from 9490 to 50600 mg/kg
- Chloride (Cl-) ranged from 4940 to 31800 mg/kg
- Electrical Conductivity (EC) ranged from 2920 to 15600 µS/cm
- Organic Matter (OM) ranged from 1 to 2%.

Higher salinity, CL- and EC (i.e. >20000 mg/kg and >10000 µS/cm) are reported for samples with finer textures (i.e. silty clay), with the highest concentrations (50600 mg/kg, 31800 mg/kg and 15600 µS/cm) detected in sample G-1. Finer textured material is located closer to shore.

Sandy textured sediments generally located in the departure channel were reported with lower salinity, Cl- and EC values (generally <20000 mg/kg and <10000 µS/cm). The lowest concentrations (9490 mg/kg, 4940 mg/kg and 2920 µS/cm) detected in sample G-12 which is also the most sandy (PSD: 96% sand) and furthest from shore.

All samples are considered extremely saline (i.e. < 1210 µS/cm) according to Rayment and Lyons, 2011 salinity ratings.

OM ranged from less than the laboratory PQL to 2%. Samples with finer textures contained the highest (i.e., 1-2%) OM, while courser textured samples, collected primarily from the departure channel, contained the OM less than the laboratory PQL.

4.3.8 QA / QC

The Relative Percent Difference (RPD) was calculated on primary sample (C-4/0.9-1.0) and field duplicates (D1A and D2A), the results of which are presented in Table 3 of Appendix C. Outliers were calculated on *potential acidity* (S_{CR}) and *net acidity without ANCE* exceeding the typical RPD acceptance criteria. This is due to the variation in the results caused by sample heterogeneity, primarily due to available sample volume, in sample D2A. Although this has generated an RPD exceedance it does not change the outcome of this report because the S_{CR} concentrations for sample D2A are still greater than the QASSIT guideline criteria, similarly, as are the S_{CR} concentrations for C-4/0.9-1.0 and D1A. The results are therefore still considered acceptable.

4.4 Results of Geotechnical Testing

4.4.1 Moisture content

The moisture content is defined as the ratio of the mass of water to the mass of solids. The moisture content is important to determine the amount of effort required to dry out sediment material for various reuse options, including targeting the optimum moisture content for compaction.

Moisture content results for the samples vary between approximately 84% and 160% for the fine grained sediment material, and between approximately 19% and 49% for the coarse grained sediment material.

The fine grain sediment materials (sample locations C1 to C4 and G1 to G6) have very high moisture content typical of fine marine sediments. The sample locations G7 to G12 have coarser grained material, fewer voids to retain moisture and consequent have lower moisture content.

4.4.2 Particle size distribution

A summary of the particle size distribution results is presented in Table 4.B and illustrated in a graph representation in Figure 4.1 below.

Table 4.B: Summary of particle size distribution results

Sample Location	Depth Interval (m)	Particle size distribution (incl. hydrometer)		
		Fines	Sand	Gravel
		%	%	%
C-1	0.2 - 0.9m	11	74	15
C-2	0.1 - 1.0m	90	10	0
C-3	0.0 - 0.15m	44	56	0
C-3	0.2 - 1.0m	90	10	0
C-4	0.0 - 1.0m (2 bags combined)	87	13	0
G-1	N/A (grab sample)	93	7	0
G-2	N/A (grab sample)	69	31	0
G-3	N/A (grab sample)	72	28	0
G-4	N/A (grab sample)	35	62	3
G-5	N/A (grab sample)	60	39	1

Sample Location	Depth Interval (m)	Particle size distribution (incl. hydrometer)		
		Fines	Sand	Gravel
		%	%	%
G-6	N/A (grab sample)	28	42	30
G-7	N/A (grab sample)	14	85	1
G-8	N/A (grab sample)	13	77	10
G-9	N/A (grab sample)	5	95	0
G-10	N/A (grab sample)	14	86	0
G-11	N/A (grab sample)	7	93	0
G-12	N/A (grab sample)	4	96	0

Note: In sample Location name a 'C' indicates core sample method and 'G' indicates a grab sample.

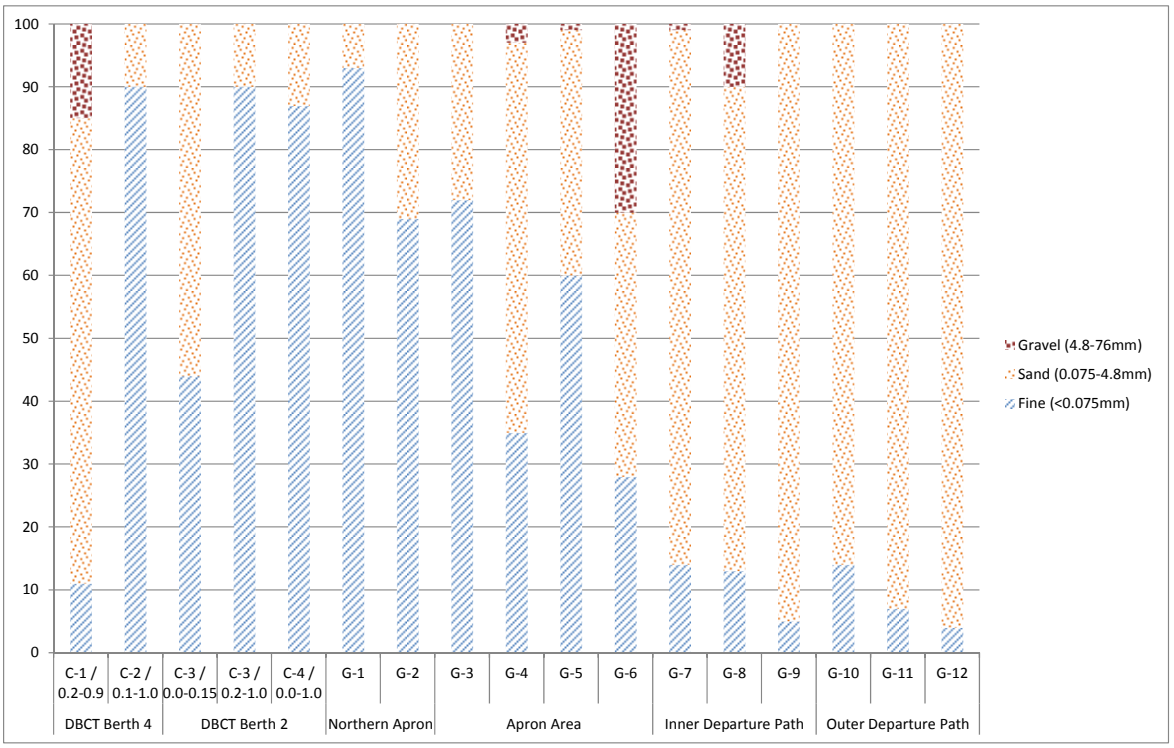


Figure 4.1: Particle size distribution classified by gravel/sand/fine proportions and by sample location

4.4.3 Atterberg limits

Atterberg liquid and plastic limit tests are designed to reflect the influence of water content, grain size and mineral composition on mechanical behaviour of clays and silts.

Results for the Atterberg limits have been obtained for each sample in which the fines content obtained from the particle size analysis was found to be above 12%.

The samples of fine grained sediment material tested are indicative of low to high plasticity clay. For all samples tested, the moisture contents were found to be higher than the corresponding liquid limits, indicating the insitu sediments are very wet and soft fine grained materials. Linear shrinkage results were recorded to vary between 5.5% and 22.0% for the materials tested.

The results are summarised on the plasticity chart presented as Figure 4.2.

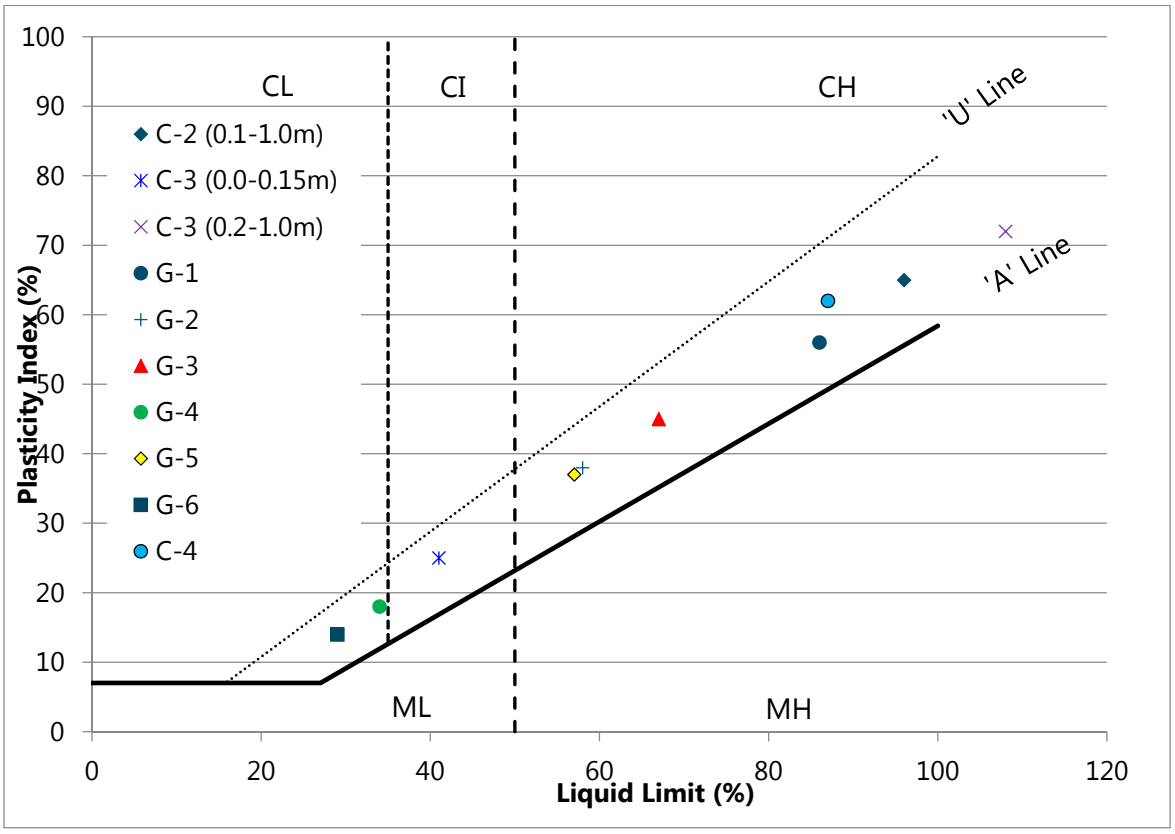


Figure 4.2: Plasticity chart plotting results of Atterberg Limits tests

4.4.4 Carbonate content

Due to the presence of shells and secondary carbonate in the sediment, carbonate content tests were undertaken as carbonate sediment / soils are weak and have low bearing capacity.

Carbonate Content tests undertaken on 17 samples of the material recorded a range of results between 8.2% and 47.4% with an average value of 23.3%.

A carbonate content of 50% is generally taken as the threshold value for a soil being regarded as a carbonate soil for the purposes of engineering design. On that basis, none of the sediment encountered is regarded as carbonate sediment.

4.4.5 Density tests

Particle density tests were undertaken on 16 samples of the recovered sediment. The recorded densities ranged between 2.53 t/m^3 and 2.67 t/m^{3}with an average value of 2.61 t/m^3.

In addition to the particle density tests, max/min tests were conducted on two samples of sand from locations G-9 and G-11. The testing recorded a range of dry density between 1.29 t/m^3 and 1.65 t/m^3 for sample G-9, and between 1.27 t/m^3 and 1.60 t/m^3 for sample G-11. Corresponding moisture contents taken post-testing were 22.4% and 24% for G-9 and G-11 respectively.

4.4.6 Strength and consolidation

Strength and consolidation tests were undertaken on samples of remoulded and moisture conditioned sediments in order to provide indicative parameters for material following reworking and field placement. The results are summarised below.

Two direct shear tests (single stage) were undertaken on remoulded samples of sand from the G9 and G11 grab samples. The tests yielded the following results.

Table 4.C: Direct shear tests

Sample	Remoulded Bulk Density (t/m^3)	Effective Cohesion	Friction Angle	
			Peak	Residual
		kPa	Degrees	Degrees
G-9	1.87	0	33	32
G-11	1.84	0	35	33

In addition to the shear box testing, consolidated undrained triaxial tests were undertaken on two remoulded samples. The following results were obtained:

Table 4.D: Consolidated undrained triaxial tests

Sample	Remoulded Bulk Density (t/m^3)	Effective Cohesion	Friction Angle
		kPa	Degrees
C-2	1.87	5	30
C-3	1.88	3	26

Oedometer tests undertaken on two reconstituted samples from locations C-2 and C-3 recorded results indicative of very low to medium compressibility over the pressure ranges tested. Notably, in both tests, the samples were noted to swell until the 160kPa pressure stage.

4.4.7 Permeability

To provide an indication on post-compaction permeability, two samples of sand from locations G-9 and G-11 were subjected to constant head permeability testing, while two samples of clay from locations C-2 and C-3 were subjected to falling head permeability tests.

The constant head test results on the sand recorded permeabilities of 2.4 x 10^{-5}ms^{-1} and 2.8 x 10^{-5} ms^{-1} for samples from G-9 and G-11 respectively. These premeabilities are typical of sand materials.

For the clay samples, measured permeabilities are 3.3 x 10^{-11} ms^{-1} and 9.3 x 10^{-11} ms^{-1} for samples from C-2 and C-3 respectively. These premeabilities are typical of clay materials.

4.4.8 Cement laboratory testing

Sediment material testing in Wagner's Brisbane cement laboratory was undertaken using both the X-ray diffraction (XRD) and X-ray fluorescence (XRF) test methods to provide a quantitative analysis (% weight) of mineral composition and chemical or trace element composition respectively, to assess the potential suitability as a binding agent in products including concrete, bricks and stabilised engineering fill material. *Two samples C3 (DBCT Berth 2 area) and G9 (Inner Departure Path area) were selected for XRD and XRF testing.* The results in brief can be summarised as:

- Sample C3 *(DBCT Berth 2 area)* was shown in the XRD test to be 65% or more in a crystalline mineral form, chiefly quartz. This part of the material would not be reactable by a geopolymer reaction. The XRD test showed that the remainder, 35% may well be in an amorphous form that could be reactable in a geopolymer reaction.
- Sample C3 *(DBCT Berth 2 area)* was shown in the XRF test to be chiefly comprised of silicon dioxide. In combination the XRF and XRD tests show that this material may be able to be formed into a binding agent by the introduction and mixing of an alkaline geopolymer hardener chemicals. There is no way of determining if this would be the case without conducting a series of laboratory trials aimed at successfully formulating a geopolymer paste using this material in addition to an alkaline comenent and possibly other alumino-silicate materials.
- Sample G9 *(Inner Departure Path area)* was shown in the XRD test to be almost 100% in a crystalline mineral form, chiefly quartz. This material would not be reactable by a geopolymer reaction.
- Sample G9 *(Inner Departure Path area)* was shown in the XRF test to be chiefly comprised of silicon dioxide. In combination the XRF and XRD tests show that this material is not reactable as a geopolymeric binding agent. It however could form the body matter in a useful material with the introduction of a binding agent.

5 Conclusions

5.1 General

The purpose of this investigation was to identify and classify marine sediment materials and investigate their acid generating capacity and geotechnical properties for consideration of potential reuse options. This included sampling sediments at 16 locations within the Port of Hay Point navigational areas: inner and outer departure paths, apron areas and DBCT Berths 2 and 4. The number of sampling locations selected was in general accordance with requirements for a pilot study outlined in the NAGD, 2009.

5.2 Physical characteristics

The sediment materials encountered consisted of clayey and silty sands and silty clays. In general the fine grained (clay-rich) materials were encountered inshore, in the vicinity of the existing jetties and berths. Samples obtained within the channel tended to comprise predominantly quartz sand, with some secondary gravel, with fines representing only a minor constituent. The sand portion comprises predominantly quartz, with secondary calcium carbonate, expected to be from shell fragments.

A typical feature of the fine grained sediment materials was the very high moisture content, generally in exceedance of the liquid limit of the material. As a result, material sourced from the inshore areas is expected to be very difficult to use as an earthworks material in its current state, and significant moisture conditioning by drying or use of admixtures, e.g. lime/cement, will be required to permit use as an earthworks material.

For the sand-rich sediment materials, moisture is still expected to be an issue, though the sand-rich composition is expected to make handling with conventional earthmoving plant achievable, the high moisture content may limit effective compaction, and some moisture conditioning should be expected.

The fine grained materials have recorded linear shrinkage between 5.5% and 22.0%. Based on work conducted by Altmeyer (1955) cited in Carter and Bentley (1991), a linear shrinkage above 8% indicates a material with a critical potential for expansion. While there is some limitation to using shrinkage limit results to predict potential for swelling, the high linear shrinkage results recorded on the fine grained soils highlights a potential for swelling. This is further supported by the oedometer tests on recompacted soils, which recorded swelling at less than 160kPa loading. The potential for swelling of compacted fine grained materials should therefore be considered when identifying potential reuse options as the volume and strength of the soil materials will vary based on their water content.

5.3 Geochemical characteristics

Based on the ASS analysis, PASS, in concentrations greater than the QASSIT action criteria of 0.03% and 18 moles H+ / t, was detected in 16 samples from nine locations. These samples were mainly comprised of fine textured material (i.e. silts and silty clays) generally located in the apron and

berth pocket areas. PASS, in concentrations less than the QASSIT guideline were reported in courser material (i.e. sand and silty sand) generally located in the departure channel.

ANC (Acid Neutralising Capacity) was detected in all samples submitted for ASS analysis with concentrations sufficient to negate acidity. That is, net acidity was less than the laboratory PQL of 10 moles H+ / t and therefore below the QASSIT guideline of 18 moles H+ / t. This buffering potential is expected to arise from the presence of carbonate grains within the sediments. These data indicate that the marine sediments tested are unlikely to require treatment through neutralisation using lime.

All samples are considered extremely saline. If sediments are placed on land without treatment, salinity will degrade the quality of terrestrial soils and may cause vegetation toxicity issues. Untreated, these saline sediments may also impact the quality of groundwater and surface waters.

Low OM (Organic Material) was reported for all samples analysed, however, the highest OM (i.e. 1-2%) was report for finer textured samples. Courser textured samples, primarily located in the departure channel, contained OM less than the laboratory PQL.

6 References

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, Resources Sciences Centre, Indooroopilly.

Ahern, CR, Mcelnea, AE, Sullivan, LA, 2004. *Acid Sulfate Soils – Laboratory Method Guidelines*. Queensland Department of Natural Resources, Mines and Energy, Indooroopilly, Queensland, Australia.

Altmeyer, W.T., 1955 Discussion of engineering properties of expansive clays. *Proceedings ASCE Journal of Soil Mechanics and Foundation Division,* 81.

Carter, M. and Bentley, S.P., 1991. Correlations of Soil Properties. Pentech Press. London.

Dear, SE, Moore, NG, Dobos, SK, Watling, KM and Ahern, CR, 2002. *Soil Management Guidelines In Queensland Acid Sulfate Soil Technical Manual*. Department of Natural Resources and Mines, Indooroopilly, Queensland, Australia.

Ports and Coastal Environmental Pty Ltd (PACE) (2014) Port of Hay Point, DBCT Berths 1 and 2 - Sediment Characterisation Report. No. 2014002 – 002.

Queensland Government, 2002. *State Planning Policy 2/02 – Planning and Managing Development Involving Acid Sulfate Soils*. Queensland Government, Brisbane.

Rayment, GE and Lyons, DJ 2011, Soil Chemical Methods – Australasia, CSIRO Publ., Collingwood, VIC.

Standards Australia. 1993. AS1726: Geotechnical site investigations.

Appendix A Sediment Sampling Plan

Advisian
WorleyParsons Group

Memorandum

To:	Kevin Kane	**Date:**	11 February 2016
CC:	Stephanie Veldhuis	**From:**	Alex Kochnieff
Doc No:	301310-09537-00-PM-MEM-0001	**File Loc:**	G:\301310\09537 PROJ - Port of Hay Point Beneficial\10.0 Engineering\10 EN-Environmental\Sediment\Field
Subject:	Sediment Sampling Plan	**Project:**	Port of Hay Point Beneficial Reuse Assessment

Hello Kevin,

This memorandum details a summary of the scope of works we intend to carry out at the Port of Hay Point, including a description of the proposed sampling locations, sampling and laboratory analytical methods and schedule.

1. Purpose

To collect soil samples from at least 12 locations at the Port of Hay Point navigational infrastructure areas: inner and outer departure paths, apron area, northern apron area and DBCT berths 2 and 4, to characterise their engineering and geochemical properties. This characterisation will assist in understanding the sediment suitability for its beneficial reuse and / or treatment as an alternative to ocean disposal.

2. Sampling locations

The field assessment will focus on understanding the geotechnical engineering and ASS properties of the marine sediments through a preliminary field sampling and analysis program designed in general accordance with a pilot study and Table 6 (Minimum number of sampling locations) of the National Assessment Guidelines for Dredging (2009). Although the NAGD focuses on contaminant studies, it provides a robust framework for sample program design and will be consistent with previous contaminant studies previously completed.

Based on the justification above for sampling intensity, a minimum of 12 locations will be sampled with an additional four locations (total 16 locations) selected as back up in case of poor weather, conditions and / or early refusal. The locations have been selected based on bathymetry information which indicates areas of accretion (i.e. sediment build up). As such, sampling locations have been targeted in these accretions, but also evenly across all navigational areas.

The proposed sampling locations are listed in Table 1 and presented in Figure 1.

Table 1: Proposed sample locations

Sampling location ID	Area	Sample type	Easting (MGA55)	Northing (MGA55)	Longitude (WGS84)	Latitude (WGS84)
C-1	DBCT Berth 4	Core	738824	7649280	149.30100	-21.24250
C-2	DBCT Berth 4	Core	738991	7648970	149.30300	-21.24520
C-3	DBCT Berth 2	Core	739410	7648220	149.30700	-21.25200
C-4	DBCT Berth 2	Core	739649	7647790	149.30900	-21.25580
G-1	Northern Apron Area	Grab	738656	7649740	149.30000	-21.23840
G-10	Outer Departure Path	Grab	749267	7648300	149.40200	-21.24990
G-11	Outer Departure Path	Grab	751013	7648740	149.41900	-21.24570
G-12	Outer Departure Path	Grab	752758	7649180	149.43500	-21.24140
G-2	Northern Apron Area	Grab	739065	7649620	149.30300	-21.23930
G-3	Apron Area	Grab	739508	7648840	149.30800	-21.24630
G-4	Apron Area	Grab	740394	7647270	149.31700	-21.26040
G-5	Apron Area	Grab	740518	7646130	149.31800	-21.27070
G-6	Apron Area	Grab	741522	7646500	149.32800	-21.26720
G-7	Inner Departure Path	Grab	742870	7646830	149.34100	-21.26410
G-8	Inner Departure Path	Grab	745777	7647420	149.36800	-21.25830
G-9	Inner Departure Path	Grab	748157	7648090	149.39100	-21.25200

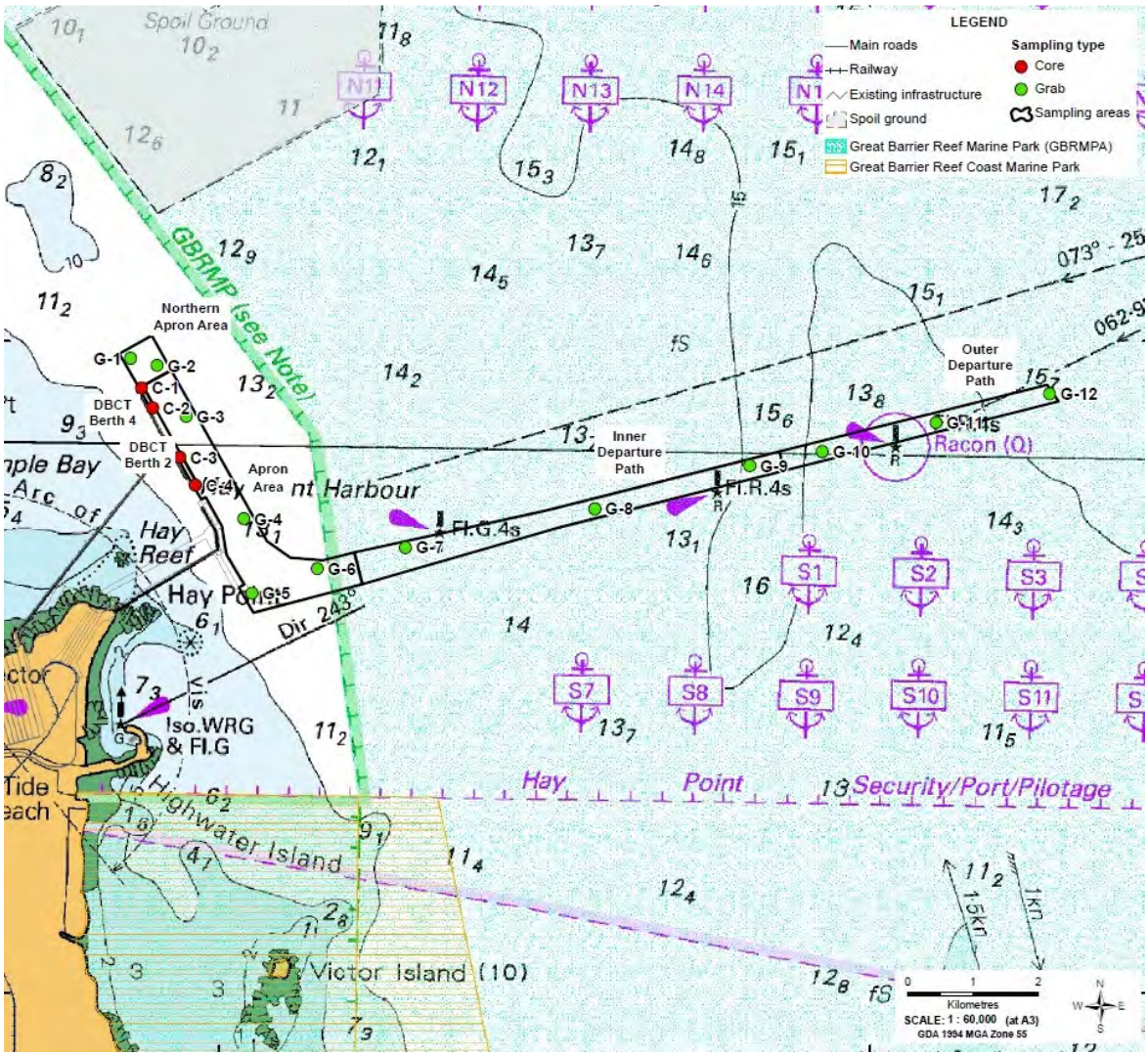


Figure 1: Proposed sampling locations

3. Sample Collection Methods

Two methods of sediment sampling are proposed:

1) grab sampling using a van-Veen grab within the inner and outer departure paths, apron area, northern apron area where maintenance sediments are expected to be thin. The van-Veen grab is capable of capturing 10 kg of material per grab
2) coring using a handheld piston corer within DBCT berths 2 and 4 where sediments are expected to be thicker. The piston corer is stainless steel and 1.2m in length.

Sampling will be undertaken from a survey vessel, adequately equipped for diving, sampling and sample processing procedures.

The sediment grab sampler will be deployed from the survey vessel by an environmental engineer and geotechnical engineer. The grab sampler will be lowered to the seabed using a pulley system or similar. Both personnel are suitability experienced in geochemical and geotechnical assessment of sediments respectively.

The piston coring will be undertaken from the seabed by professional commercial divers: *Subsea Diving & Salvage Pty Ltd* (SDS). Refer to **Section 6**. Sediments will be collected by lowering the piston corer from the survey vessel to positioned diver. To obtain adequate sample volumes several cores may need to be obtained.

Sediment grab samples will be logged, photographed, homogenised and transferred to sample bags before being consigned under chain-of-custody documentation to the analytical laboratory (AAA) for laboratory analysis. Sample homogenisation will be performed using a large stainless steel bowl and gloved (powderless nitrile) hands. Decontamination between samples will include washing of all sampling equipment with ambient sea water and a laboratory grade detergent (Decon 90), and successive rinsing with deionised water. Samples will be stored in coolers with ice bricks and remain cold until receipt by the laboratory for analysis, upon which they were again stored under refrigerated condition.

Core samples will be extruded into a core tray where they will be logged and photographed. Samples will be collected down the profile were separate horizons are identified and placed into laboratory supplied sample bags. Even though the material texture is expected to be consistent throughout the profile, these cores will not be homogenised as there is a possibility for material variability through the profile. The consistency of the profile will be based on texture assessment in the field. Where consistent profiles are encountered, the number of samples selected for analysis may be reduced to avoid duplication. Where homogenising is required following the completion of field works, samples may be homogenised at the laboratory.

4. Laboratory analysis

Sediment samples are proposed to be analysed for a range of geochemical parameters as presented in Table 2. The table includes those samples to be analysed for field quality control/quality assurance purposes.

The exact number of geotechnical tests per sample per location can't be specified at this stage as it will be dependent on the sediment texture at the time of sampling. Geotechnical testing will therefore be specified once field logging / characterisation of samples has been completed as certain geotechnical tests are only applicable to certain soil types, and not others. The total number of samples proposed per geotechnical test is presented in Table 3.

Our agreed lump sum fee price incorporates the intensity of laboratory analysis identified in Table 2 and Table 3.

Table 2: Proposed geochemical laboratory testing

Sample location ID	Area	Sample type	ASS - pHf/pHfox	ASS - Chromium Suite	EC	Salinity (Total Soluble Salts)	Salinity Chloride	Organic Matter
C-1	DBCT Berth 4	Core	5	3	2	2	2	2
C-2	DBCT Berth 4	Core	2 (2)	2 (2)	2	2	2	2
C-3	DBCT Berth 2	Core	5	3	2	2	2	2
C-4	DBCT Berth 2	Core	4	2	2	2	2	2
G-1	Northern Apron Area	Grab	1	1	1	1	1	1
G-2	Northern Apron Area	Grab	1	1	1	1	1	1
G-3	Apron Area	Grab	1	1	1	1	1	1
G-4	Apron Area	Grab	1	1	1	1	1	1
G-5	Apron Area	Grab	1	1	1	1	1	1
G-6	Apron Area	Grab	1		1	1	1	1
G-7	Inner Departure Path	Grab	1	1	1	1	1	1
G-8	Inner Departure Path	Grab	1	1	1	1	1	1
G-9	Inner Departure Path	Grab	1	1	1	1	1	1
G-10	Outer Departure Path	Grab	1	1	1	1	1	1
G-11	Outer Departure Path	Grab	1	1	1	1	1	1
G-12	Outer Departure Path	Grab	1	1	1	1	1	1
	Total		30	23	20	20	20	20

Note Quality control / field duplicates are denoted by the red text.

Table 3: Geotechnical laboratory tests

Sampling location ID	Area
Particle size distribution (incl. hydrometer)	20
Carbonate content	20
Atterberg Limits	20
Specific Gravity	20
Bulk/dry unit weight and moisture content	20
Minimum/maximum density	4
Permeability (excluding STD compaction)	4
1D consolidation (8 loadings)	2
Direct shear box (100mm)	2
Consolidated isotropic undrained triaxial test.	2

5. Timeframe

Our current proposed field program start date is Tuesday 16 February 2016; however the logistics of the program are currently being discussed with Dalrymple Bay Coal Terminal. The program will necessarily be undertaken considering infrastructure access and weather constraints.

6. Vessel and diving operations

All diving operations will be completed by Subsea Diving & Salvage Pty Ltd (SDS). SDS are based locally within Mackay Harbour and operate under the Australian Standards and New Zealand Standards AS.NZS 2299.1.2015 – Occupational Diving operations. All diving will be completed under the responsibility of a Dive Supervisor whom:

> *….assumes responsibility for the health and welfare of any, other person in a workplace by providing instruction, direction, assistance, advice or service, is deemed an accountable person in accordance with the Workplace Health & Safety Regulations 1998. All management and supervisory staff (which include those with Responsibility for students) are therefore considered "accountable persons".*

Further information regarding dive operations may be provided on request. We will separately develop a project specific Job Hazard Analysis plan.

Diving will be dependent upon access and timing of the low tides which for the current proposed execution timeframe are due in the afternoon of Tuesday and Wednesday (16 and 17 February).

Appendix B Borelogs

PISTON SAMPLER LOG

WorleyParsons

TEST ID: ***C-1***
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***17.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***17.3.2016***
LOCATION:	***DBCT Berth 4***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor:	Subsea Diving and Salvage	**Bore Size:**	62mm	**Easting:**	738824	**Surface RL:**	Not recorded
Equipment:	Piston Sampler	**Final Depth:**	1.0m	**Northing:**	8000000	**Ref. System:**	GDA94 / MGA Zone 55

Method	RL (mAHD) / Depth (m)	Geological Unit	Graphic Log	Material Description	Consistency / Strength	Cementation / Weathering	Geotechnical Sample	Lab Test Results: PSD % Clay	% Silt	% Sand	% Gravel	Plasticity: Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	Field Records / Comments
Piston Sampler		Marine Sediments		Clayey SILT (MH-CH): high plasticity; dark grey; with fine to coarse grained, subangular to subrounded sand of quartz and carbonates.	VS	Uc										
	0.25			SAND (SP-SC): fine to coarse grained (predominantly medium to coarse), subangular to subrounded, quartz and carbonates; brown speckled white and orange-brown; with low plasticity fines; with fine to medium grained gravel of quartz and lithics.	L		D	5	6	74	15					
	0.50															
	0.75															
	1.00			Clayey SILT (MH-CH): high plasticity; dark grey; with fine to coarse grained, subangular to subrounded sand of quartz and carbonates.	VS-S											

C-1 terminated at 1m

0.00m to 1.00m

PISTON SAMPLER LOG

WorleyParsons

TEST ID: ***C-2***
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***14.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***14.3.2016***
LOCATION:	***DBCT Berth 4***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor:	Subsea Diving and Salvage	**Bore Size:**	62mm	**Easting:**	738991	**Surface RL:**	Not recorded
Equipment:	Piston Sampler	**Final Depth:**	1.0m	**Northing:**	8000000	**Ref. System:**	GDA94 / MGA Zone 55

Method	RL (mAHD) / Depth (m)	Geological Unit	Graphic Log	Material Description	Consistency / Strength	Cementation / Weathering	Geotechnical Sample	Lab Test Results: PSD % Clay	% Silt	% Sand	% Gravel	Plasticity: Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	Field Records / Comments
Piston Sampler	0.00	Marine Sediments		Silty CLAY (CH): high plasticity; dark grey; with fine to coarse grained, subangular to subrounded sand of quartz, carbonates and mafics; trace of fine to medium gravel sized shell fragments; trace of organic fibres; sulfurous odour. …trace of sand; occasional pockets of sandy clay	VS	Uc										
	0.25						D	48	42	10	0	31	96	65	20.0	
	0.50															
	0.75															
	1.00															

C-2 terminated at 1m

0.00m to 1.00m

PISTON SAMPLER LOG

WorleyParsons

TEST ID: *C-3*
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***17.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***17.3.2016***
LOCATION:	***DBCT Berth 2***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor: Subsea Diving and Salvage **Bore Size:** 62mm **Easting:** 739410 **Surface RL:** Not recorded

Equipment: Piston Sampler **Final Depth:** 1.0m **Northing:** 8000000 **Ref. System:** GDA94 / MGA Zone 55

Method	RL (mAHD) / Depth (m)	Geological Unit	Graphic Log	Material Description	Consistency / Strength	Cementation / Weathering	Geotechnical Sample	Lab Test Results: PSD % Clay	% Silt	% Sand	% Gravel	Plasticity: Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	Field Records / Comments
Piston Sampler		Marine Sediments		Clayey SAND (SC): fine to coarse grained, subangular to subrounded, quartz, carbonates and mafics; grey; medium plasticity fines; trace of fine grained, subangular to subrounded gravel of quartz and carbonates.	VL-L	Uc	D	22	22	56	0	16	41	25	9.5	
				Silty CLAY (CH): high plasticity; dark grey; trace of fine to coarse grained, subangular to subrounded sand of quartz and carbonates; trace of fine to medium gravel sized shells and shell fragments; slight sulfurous odour.	VS-S											PVC tube sample taken from 0.0-0.33m; however, due to very soft consistency the sample slumped and could not be considered 'undisturbed'
	0.25															
	0.50						D	52	38	10	0	36	108	72	22.0	
	0.75															
	1.00															

C-3 terminated at 1m

0.00m to 1.00m

PISTON SAMPLER LOG

WorleyParsons

TEST ID: *C-4*
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***17.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***17.3.2016***
LOCATION:	***DBCT Berth 2***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor: Subsea Diving and Salvage **Bore Size:** 62mm **Easting:** 739649 **Surface RL:** Not recorded

Equipment: Piston Sampler **Final Depth:** 1.0m **Northing:** 8000000 **Ref. System:** GDA94 / MGA Zone 55

Method	RL (mAHD) / Depth (m)	Geological Unit	Graphic Log	Material Description	Consistency / Strength	Cementation / Weathering	Geotechnical Sample	Lab Test Results: PSD % Clay	% Silt	% Sand	% Gravel	Plasticity: Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	Field Records / Comments
Piston Sampler	0.25	Marine Sediments		Silty CLAY (CH): high plasticity; dark grey; trace of fine to coarse grained, subangular to subrounded sand of quartz and carbonates; trace of fine to medium grained gravel of siliceous calcarenite fragments; trace organic fibres; slight sulfurous odour.	VS	Uc	D	48	39	13	0	25	87	62	18.5	
	0.50															
	0.75															
	1.00															

C-4 terminated at 1m

0.00m to 1.00m

GRAB SAMPLER LOG

WorleyParsons

TEST ID: ***G-1***
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***16.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***16.3.2016***
LOCATION:	***Northern Apron Area***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor:	Subsea Diving and Salvage	**Bore Size:**	NA	**Easting:**	738656	**Surface RL:**	Not recorded
Equipment:	Grab Sampler	**Final Depth:**	NA	**Northing:**	8000000	**Ref. System:**	GDA94 / MGA Zone 55

Method	Geological Unit	Material Description	Cementation / Weathering	Lab Test Results								Field Records / Comments
				PSD				Plasticity				
				% Clay	% Silt	% Sand	% Gravel	Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	
Grab Sampler	Marine Sediments	Clayey SILT (CH): high plasticity; dark grey; trace of fine to medium grained, subangular to subrounded sand of quartz and carbonates; trace of organic fibres.	Uc	43	50	7	0	30	86	56	19.0	Grab sample taken from seabed surface

Photograph of G-1 sample

GRAB SAMPLER LOG

WorleyParsons

TEST ID: ***G-2***
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***14.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***14.3.2016***
LOCATION:	***Northern Apron Area***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor:	Subsea Diving and Salvage	**Bore Size:**	NA	**Easting:**	739065	**Surface RL:**	Not recorded
Equipment:	Grab Sampler	**Final Depth:**	NA	**Northing:**	8000000	**Ref. System:**	GDA94 / MGA Zone 55

Method	Geological Unit	Material Description	Cementation / Weathering	Lab Test Results								Field Records / Comments
				PSD				Plasticity				
				% Clay	% Silt	% Sand	% Gravel	Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	
Grab Sampler	Marine Sediments	Sandy CLAY (CH): high plasticity; dark grey; fine to coarse grained (predominantly fine to medium), subangular to rounded sand of quartz, carbonates and mafics; trace of fine to medium grained gravel of subangular quartz and silicieous calcarenite fragments and platy shell fragments; occasional pockets of high plasticity clay; trace of organic fibres.	Uc	33	36	31	0	20	58	38	15.0	Grab sample taken from seabed surface

Photograph of G-2 sample

GRAB SAMPLER LOG

WorleyParsons

TEST ID: ***G-3***
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***16.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***16.3.2016***
LOCATION:	***Apron Area***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor:	Subsea Diving and Salvage	**Bore Size:**	NA	**Easting:**	739508	**Surface RL:**	Not recorded
Equipment:	Grab Sampler	**Final Depth:**	NA	**Northing:**	8000000	**Ref. System:**	GDA94 / MGA Zone 55

Method	Geological Unit	Material Description	Cementation / Weathering	Lab Test Results								Field Records / Comments
				PSD				Plasticity				
				% Clay	% Silt	% Sand	% Gravel	Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	
Grab Sampler	Marine Sediments	Silty CLAY (CH): high plasticity; dark grey; with fine to coarse grained, subangular to subrounded sand of quartz and carbonates; numerous pockets (~10mm diameter) of high plasticity clay; trace of organic fibres.	Uc	35	37	28	0	22	67	45	16.5	Grab sample taken from seabed surface

Photograph of G-3 sample

GRAB SAMPLER LOG

WorleyParsons

TEST ID: ***G-4***
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***16.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***16.3.2016***
LOCATION:	***Apron Area***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor:	Subsea Diving and Salvage	**Bore Size:**	NA	**Easting:**	740394	**Surface RL:**	Not recorded
Equipment:	Grab Sampler	**Final Depth:**	NA	**Northing:**	8000000	**Ref. System:**	GDA94 / MGA Zone 55

Method	Geological Unit	Material Description	Cementation / Weathering	Lab Test Results								Field Records / Comments
				PSD				Plasticity				
				% Clay	% Silt	% Sand	% Gravel	Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	
Grab Sampler	Marine Sediments	Clayey SAND (SC): fine to coarse grained, subangular to subrounded, carbonates, quartz and mafics; dark brown-grey; low to medium plasticity fines; trace of fine to coarse grained gravel of shell fragments and siliceous calcarenite fragments; occasional pockets (up to 15mm diameter) of medium plasticity clay; trace of organic fibres.	Uc	18	17	62	3	16	34	18	6.5	Grab sample taken from seabed surface

Photograph of G-4 sample

GRAB SAMPLER LOG

WorleyParsons

TEST ID: ***G-5***
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***16.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***16.3.2016***
LOCATION:	***Apron Area***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor:	Subsea Diving and Salvage	**Bore Size:**	NA	**Easting:**	740518	**Surface RL:**	Not recorded
Equipment:	Grab Sampler	**Final Depth:**	NA	**Northing:**	8000000	**Ref. System:**	GDA94 / MGA Zone 55

Method	Geological Unit	Material Description	Cementation / Weathering	Lab Test Results								Field Records / Comments
				PSD				Plasticity				
				% Clay	% Silt	% Sand	% Gravel	Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	
Grab Sampler	Marine Sediments	Sandy CLAY (CH): high plasticity; dark grey; fine to medium grained, subangular to subrounded sand of quartz, carbonates and mafics; trace of fine to coarse grained gravel of silicieous calcarenite fragments; occasional pockets (up to 30mm diameter) of high plasticity clay; trace of organic fibres.	Uc	30	30	39	1	20	57	37	14.0	Grab sample taken from seabed surface

Photograph of G-5 sample

GRAB SAMPLER LOG

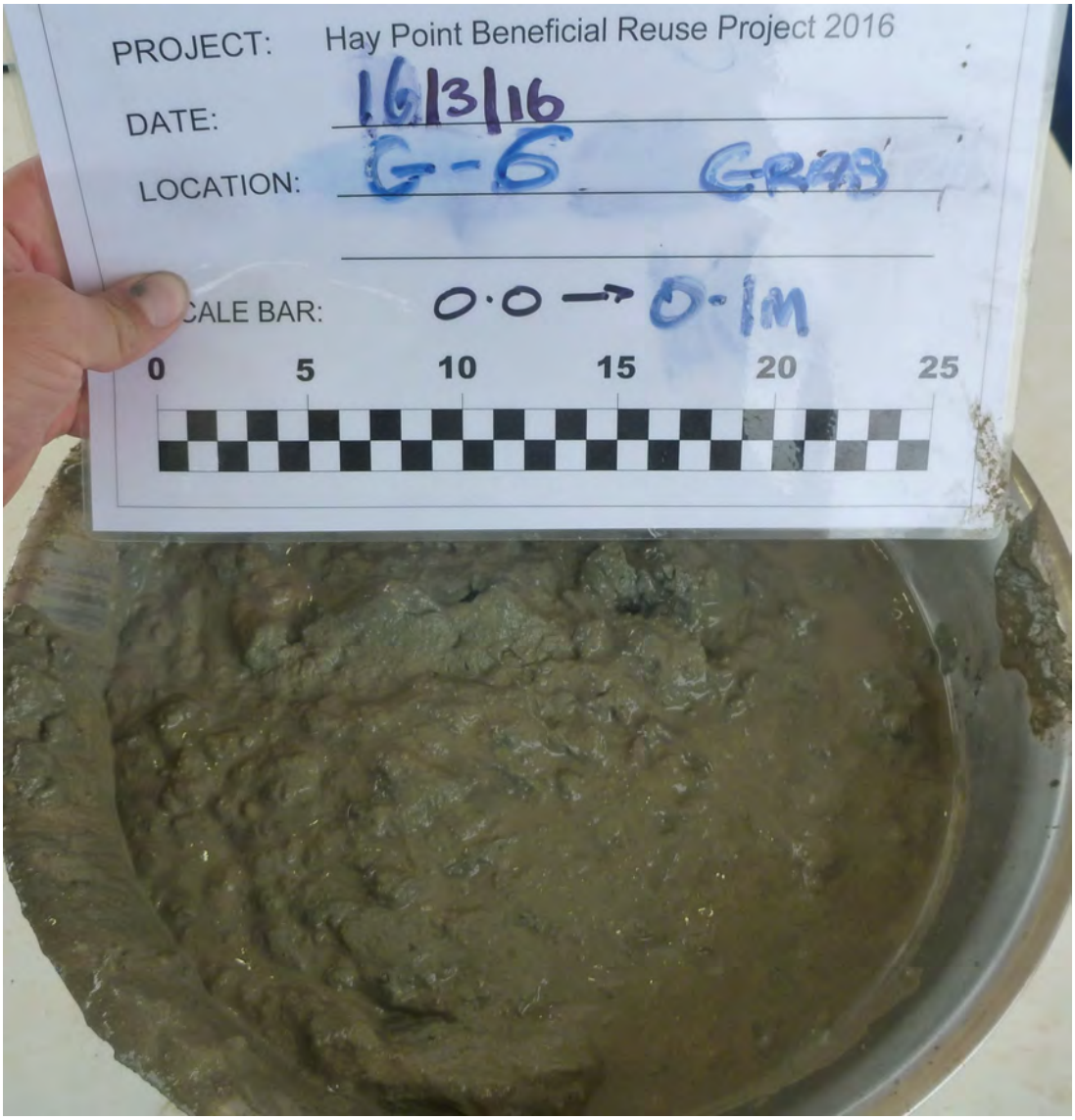
WorleyParsons

TEST ID: ***G-6***
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***16.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***16.3.2016***
LOCATION:	***Apron Area***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor:	Subsea Diving and Salvage	**Bore Size:**	NA	**Easting:**	741522	**Surface RL:**	Not recorded
Equipment:	Grab Sampler	**Final Depth:**	NA	**Northing:**	8000000	**Ref. System:**	GDA94 / MGA Zone 55

Method	Geological Unit	Material Description	Cementation / Weathering	Lab Test Results								Field Records / Comments
				PSD				Plasticity				
				% Clay	% Silt	% Sand	% Gravel	Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	
Grab Sampler	Marine Sediments	Clayey SAND (SC): fine to coarse grained, subangular to subrounded, carbonates, quartz and mafics; dark brown-grey; low plasticity fines; with fine to coarse grained, subangular gravel of weakly to moderately cemented siliceous calcarenite fragments; trace of fine to medium gravel sized shell fragments; trace of organic fibres; sulfurous odour.	Uc	13	15	42	30	15	29	14	5.5	Grab sample taken from seabed surface



Photograph of G-6 sample

GRAB SAMPLER LOG

WorleyParsons

TEST ID: ***G-7***
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***16.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***16.3.2016***
LOCATION:	***Inner Departure Path***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor:	Subsea Diving and Salvage	**Bore Size:**	NA	**Easting:**	742870	**Surface RL:**	Not recorded
Equipment:	Grab Sampler	**Final Depth:**	NA	**Northing:**	8000000	**Ref. System:**	GDA94 / MGA Zone 55

Method	Geological Unit	Material Description	Cementation / Weathering	Lab Test Results: PSD % Clay	PSD % Silt	PSD % Sand	PSD % Gravel	Plasticity: Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	Field Records / Comments
Grab Sampler	Marine Sediments	Silty SAND (SM): fine to coarse grained, subrounded quartz and platy shell fragments; grey-brown; low plasticity fines; trace of fine to medium gravel sized shell fragments.	Uc	6	8	85	1	NP	NP	NP	NP	Grab sample taken from seabed surface

Photograph of G-7 sample

GRAB SAMPLER LOG

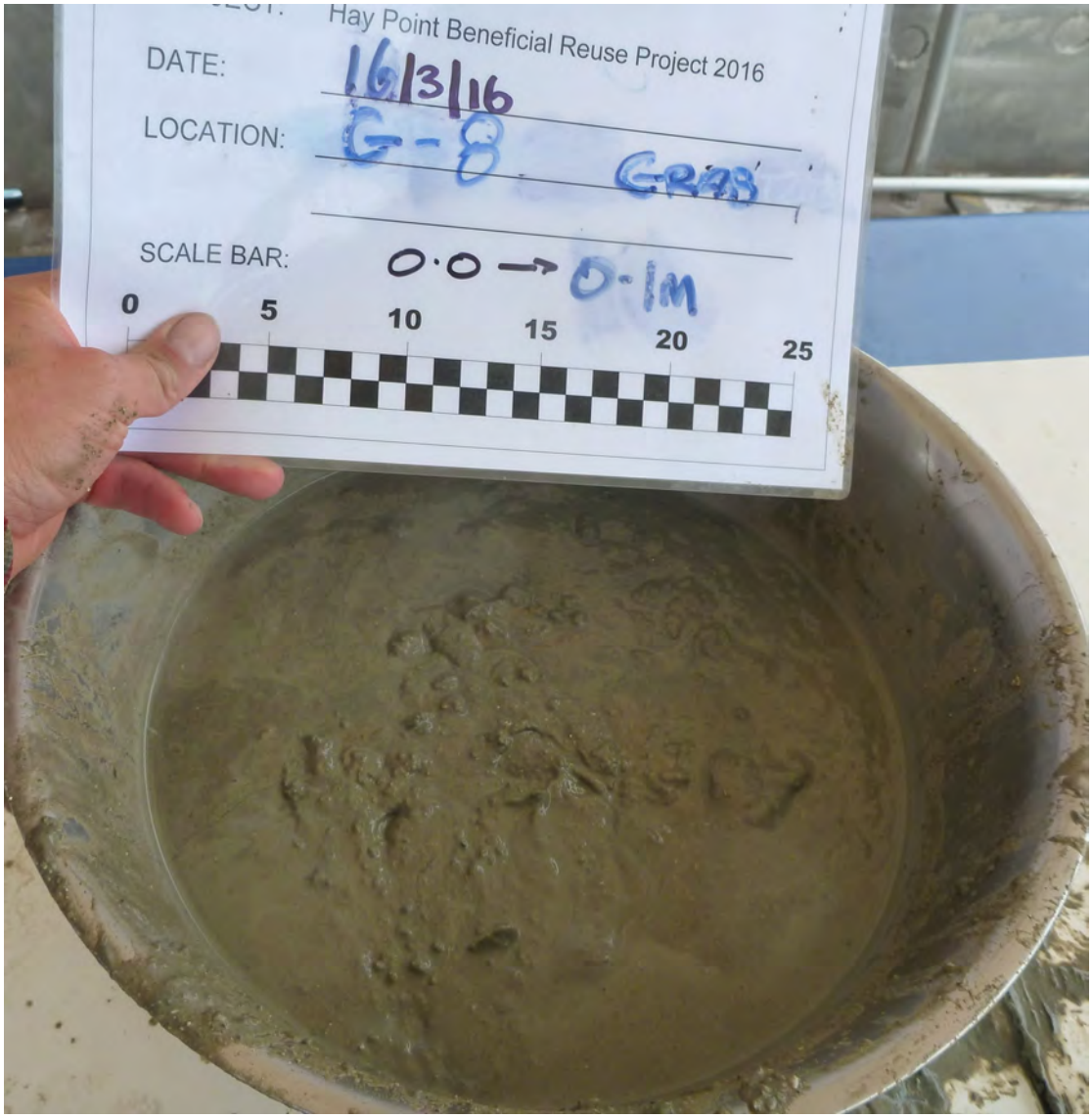
WorleyParsons

TEST ID: ***G-8***
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***16.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***16.3.2016***
LOCATION:	***Inner Departure Path***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor:	Subsea Diving and Salvage	**Bore Size:**	NA	**Easting:**	745777	**Surface RL:**	Not recorded
Equipment:	Grab Sampler	**Final Depth:**	NA	**Northing:**	8000000	**Ref. System:**	GDA94 / MGA Zone 55

Method	Geological Unit	Material Description	Cementation / Weathering	Lab Test Results: PSD: % Clay	% Silt	% Sand	% Gravel	Plasticity: Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	Field Records / Comments
Grab Sampler	Marine Sediments	Silty SAND (SM): fine to coarse grained, subangular to subrounded, quartz, carbonates and mafics; grey-brown; low plasticity fines; with fine to medium grained gravel of irregular siliceous calcarenite fragments, subrounded lithic fragments and platy shell fragments; trace organics.	Uc	0	13	77	10	NP	NP	NP	NP	Grab sample taken from seabed surface



Photograph of G-8 sample

GRAB SAMPLER LOG

WorleyParsons

TEST ID: ***G-9***
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***16.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***16.3.2016***
LOCATION:	***Inner Departure Path***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor:	Subsea Diving and Salvage	**Bore Size:**	NA	**Easting:**	748157	**Surface RL:**	Not recorded
Equipment:	Grab Sampler	**Final Depth:**	NA	**Northing:**	8000000	**Ref. System:**	GDA94 / MGA Zone 55

Method	Geological Unit	Material Description	Cementation / Weathering	Lab Test Results: PSD % Clay	PSD % Silt	PSD % Sand	PSD % Gravel	Plasticity: Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	Field Records / Comments
Grab Sampler	Marine Sediments	SAND (SP): fine to coarse grained (predominantly fine to medium), subangular to subrounded, quartz, carbonates and mafics; grey-brown speckled white and black; with fine to medium gravel sized shell fragments; trace fines.	Uc	2	3	95	0					Grab sample taken from seabed surface

Photograph of G-9 sample

GRAB SAMPLER LOG

WorleyParsons

TEST ID: ***G-10***
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***16.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***16.3.2016***
LOCATION:	***Outer Departure Path***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor:	Subsea Diving and Salvage	**Bore Size:**	NA	**Easting:**	749267	**Surface RL:**	Not recorded
Equipment:	Grab Sampler	**Final Depth:**	NA	**Northing:**	8000000	**Ref. System:**	GDA94 / MGA Zone 55

Method	Geological Unit	Material Description	Cementation / Weathering	Lab Test Results: PSD: % Clay	% Silt	% Sand	% Gravel	Plasticity: Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	Field Records / Comments
Grab Sampler	Marine Sediments	Silty SAND (SM): fine to medium grained, subangular to subrounded, quartz, carbonates and mafics; brown-grey; low plasticity fines; trace of coarse sand to medium gravel sized shell fragments; trace organics.	Uc	5	9	86	0	NP	NP	NP	NP	Grab sample taken from seabed surface

Photograph of G-10 sample

GRAB SAMPLER LOG

WorleyParsons

TEST ID: ***G-11***
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***16.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***16.3.2016***
LOCATION:	***Outer Departure Path***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor:	Subsea Diving and Salvage	**Bore Size:**	NA	**Easting:**	751013	**Surface RL:**	Not recorded
Equipment:	Grab Sampler	**Final Depth:**	NA	**Northing:**	8000000	**Ref. System:**	GDA94 / MGA Zone 55

Method	Geological Unit	Material Description	Cementation / Weathering	Lab Test Results								Field Records / Comments
				PSD				Plasticity				
				% Clay	% Silt	% Sand	% Gravel	Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	
Grab Sampler	Marine Sediments	SAND (SP): fine to medium grained, subangular to subrounded, quartz, carbonates and mafics; grey-brown; with low plasticity silt; trace of coarse sand to medium gravel sized shell fragments; trace organics.	Uc	2	5	93	0					Grab sample taken from seabed surface

Photograph of G-11 sample

GRAB SAMPLER LOG

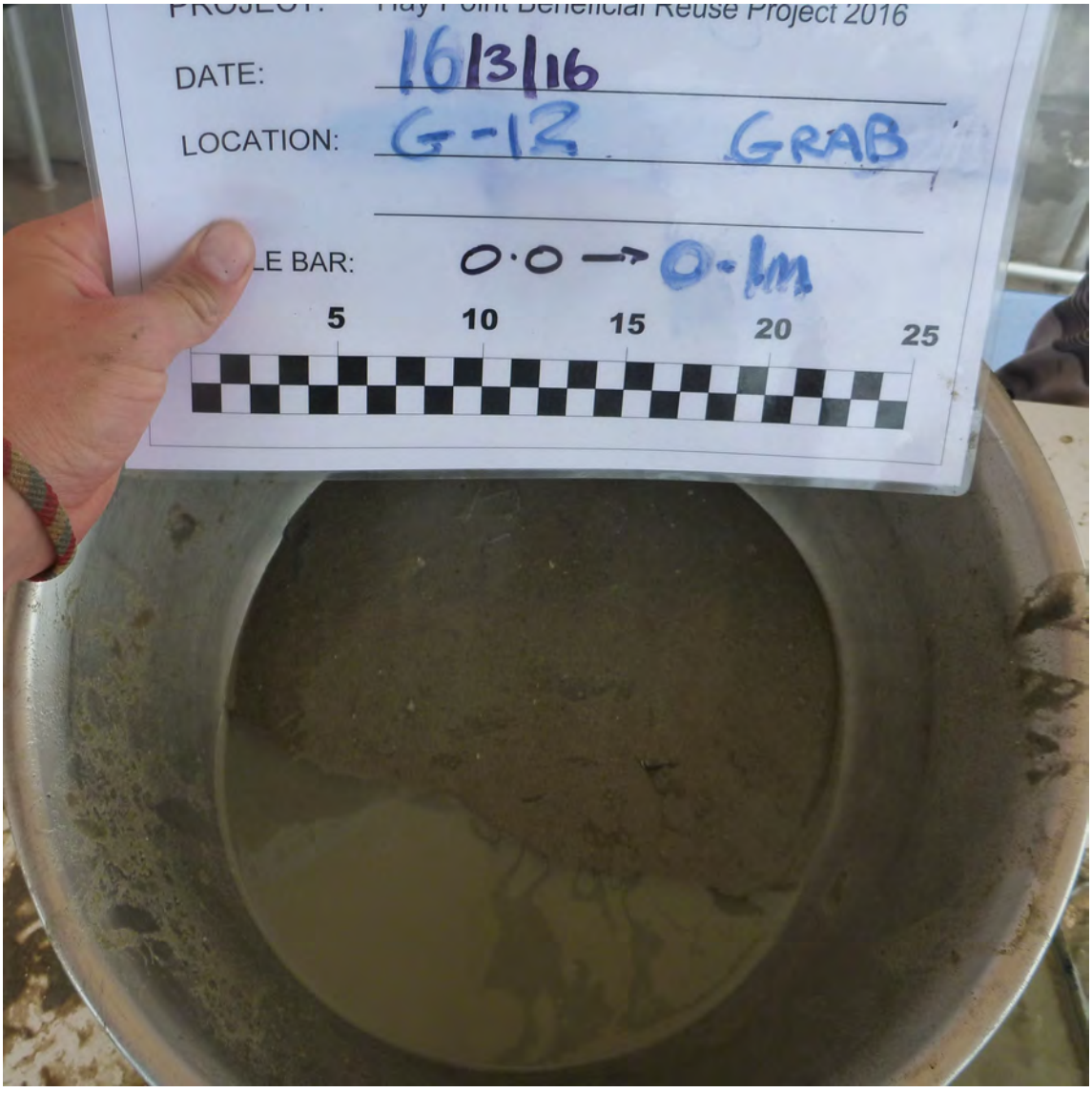
WorleyParsons

TEST ID: ***G-12***
SHEET: 1 OF 1

CLIENT:	***NQBP***	DATE COMMENCED:	***16.3.2016***
PROJECT:	***Comprehensive Beneficial Reuse Assessment***	DATE COMPLETED:	***16.3.2016***
LOCATION:	***Outer Departure Path***	LOGGED BY:	***AK***
JOB NUMBER:	***301310-09537***	CHECKED BY:	***JH***

Contractor:	Subsea Diving and Salvage	**Bore Size:**	NA	**Easting:**	752758	**Surface RL:**	Not recorded
Equipment:	Grab Sampler	**Final Depth:**	NA	**Northing:**	8000000	**Ref. System:**	GDA94 / MGA Zone 55

Method	Geological Unit	Material Description	Cementation / Weathering	Lab Test Results: PSD: % Clay	% Silt	% Sand	% Gravel	Plasticity: Plastic Limit	Liquid Limit	Plasticity Index	Linear Shrinkage (%)	Field Records / Comments
Grab Sampler	Marine Sediments	SAND (SP): fine to medium grained, subangular to subrounded, quartz, carbonates and mafics; grey-brown; trace fines; trace of coarse sand to medium gravel sized shell fragments; trace organics.	Uc	1	3	96	0					Grab sample taken from seabed surface



Photograph of G-12 sample

Appendix C Summary of laboratory results

Advisian
WorleyParsons Group

Table 3: Relative Percentage Difference Results

Sample ID		C-4	D1A	D2A				
Sample Depth		0.9-1.0	0.9-1.0	0.9-1.0				
Date		17-Mar-16	17-Mar-16	17-Mar-16				
Analyte		**Primary Result (AAA)**	**Blind Sample Result (AAA)**	**Split Sample Result (ALS)**	**AAA Laboratory Limit of Report**	**ALS Laboratory Limit of Report**	**Blind Duplicate RPD**	**Split Duplicate RPD**
Screening Analysis	pH (F)	9	8.8	8.3	0.1	0.1	2.25	8.09
	pH (Fox)	7.6	7.8	6.4	0.1	0.1	2.60	17.14
	Reaction Rate	N/A	N/A	N/A		1	N/A	N/A
Actual Acidity	pH KCl	8.9	8.9	8.8	0.1	0.1	0.00	1.13
	sulfidic - Titratable Actual Acidity	< 0.01	< 0.01	< 0.02	0.01	0.02	N/A	N/A
	Titratable Actual Acidity	< 5	< 5	< 2	5	2	N/A	N/A
Potential Acidity	Chromium Reducible Sulfur	0.29	0.33	0.069	0.005	0.005	12.90	123.12
	acidity - Chromium Reducible Sulfur	180	210	43	3	10	15.38	122.87
Retained Acidity	HCl Extractable Sulfur			NT	0.005	N/A	N/A	N/A
	KCl Extractable Sulfur	0.091	0.11	NT	0.005	N/A	18.91	ID
	sulfidic - Net Acid Soluble Sulfur	NT	NT	NT	0.005	N/A	N/A	N/A
Acid Neutralising Capacity	Acid Neutralising Capacity	16	15	15.3	0.05	0.01	6.45	4.47
	sulfidic - Acid Neutralising Capacity	5	5	4.91	0.05	0.01	0.00	1.82
Acid Base Accounting	Net Acidity (sulfur units)	< 0.01	< 0.01	< 0.02	0.01	0.02	N/A	N/A
	Net Acidity (acidity units)	< 10	< 10	< 10	10	10	N/A	N/A
	Liming Rate	< 0.75	< 0.75	< 1	0.75	1	N/A	N/A
	a-Net Acidity without ANCE	180	210	43	10	10	15.38	122.87
	Liming rate without ANCE	14	16	3	0.75	1	13.33	129.41

Notes

Shading indicates results exceeds the typical acceptance criteria 30% to 50%, AS4482.1

RPD	Relative Percent Difference (%).
N/A	Not Applicable
NT	Not Tested
ID	Indeterminable
*	Sample concentrations greater than 10 times the limit of reporting are excluded from the RPD assessment. Refer to QA/QC section of report.

Advisian
WorleyParsons Group

Table 1: Acid Sulfate Soils Results

Sample	Sample type	Date	Screening Analysis			Actual Acidity			Potential Acidity		Retained Acidity			Acid Neutralising Capacity		Acid Base Accounting				
			pH (F)	pH (Fox)	Reaction Rate	pH KCl	sulfidic - Titratable Actual Acidity	Titratable Actual Acidity	Chromium Reducible Sulfur	acidity - Chromium Reducible Sulfur	HCl Extractable Sulfur	KCl Extractable Sulfur	sulfidic - Net Acid Soluble Sulfur	Acid Neutralising Capacity	sulfidic - Acid Neutralising Capacity	Net Acidity (sulfur units)	Net Acidity (acidity units)	Liming Rate	a-Net Acidity without ANCE	Liming rate without ANCE
			pH Unit	pH Unit	-	pH Unit	% pyrite S	mole H+ / t	% S	mole H+ / t	% S	% S	% pyrite S	% CaCO3	% pyrite S	% S	mole H+ / t	kg CaCO3/t	kg CaCO3/t	kg CaCO3/t
Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland 1998 - Action Criteria (> 1000 tonnes disturbed)			-	-	-	-	*0.03*	*18*	*0.03*	*18*	-	-	-	-	-	*0.03*	*18*	-	-	-
Laboratory Detection Limit - AAA			*0.1*	*0.1*		*0.1*	*0.01*	*5*	*0.005*	*3*	*0.005*	*0.005*	*0.005*	*0.05*	*0.05*	*0.01*	*10*	*0.75*	*10*	*0.75*
C-1 / 0.0-0.1	Piston core	17/03/2016	8.7	7.6	Slight	9.3	<0.01	<5	0.05	30		0.11		5	1.6	<0.01	<10	<0.75	30	2.3
C-1 / 0.25-0.35	Piston core	17/03/2016	9.1	8.2	Slight															
C-1 / 0.5-0.6	Piston core	17/03/2016	9.2	7.6	Slight	9.6	<0.01	<5	0.02	10		0.049		2.6	0.84	<0.01	<10	<0.75	10	0.75
C-1 / 0.75-0.85	Piston core	17/03/2016	9.2	8.1	Slight															
C-1 / 0.9-1.0	Piston core	17/03/2016	9	7.9	Slight	9.4	<0.01	<5	0.04	24		0.09		3.8	1.2	<0.01	<10	<0.75	24	1.8
C-2 / 0.0-0.1	Piston core	14/03/2016	8.5	7.5	High	8.9	<0.01	<5	0.22	140		0.13		15	4.7	<0.01	<10	<0.75	140	10
C-2 / 0.25-0.35	Piston core	14/03/2016	8.4	7.7	High															
C-2 / 0.5-0.6	Piston core	14/03/2016	8.5	7.6	High	9	<0.01	<5	0.18	110		0.039		18	5.6	<0.01	<10	<0.75	110	8.6
C-2 / 0.75-0.85	Piston core	14/03/2016	8.6	7.8	High															
C-2 / 0.9-1.0	Piston core	14/03/2016	8.7	7.6	High	9	<0.01	<5	0.15	93		0.017		17	5.3	<0.01	<10	<0.75	93	7
C-3 / 0.0-0.1	Piston core	17/03/2016	9	7.6	Slight	9.3	<0.01	<5	0.06	38		0.12		11	3.5	<0.01	<10	<0.75	38	2.9
C-3 / 0.25-0.35	Piston core	17/03/2016	8.6	7.3	High															
C-3 / 0.5-0.6	Piston core	17/03/2016	8.7	7.5	High	8.7	<0.01	<5	0.19	120		0.078		9.3	3	<0.01	<10	<0.75	120	8.9
C-3 / 0.75-0.85	Piston core	17/03/2016	8.7	7.6	High															
C-3 / 0.9-1.0	Piston core	17/03/2016	8.5	7.4	High	8.9	<0.01	<5	0.23	140		0.12		16	5.2	<0.01	<10	<0.75	140	11
C-4 / 0.0-0.1	Piston core	17/03/2016	9	7.8	High	9.1	<0.01	<5	0.11	67		0.096		16	5.2	<0.01	<10	<0.75	67	5.1
C-4 / 0.25-0.35	Piston core	17/03/2016	8.5	7.8	High															
C-4 / 0.5-0.6	Piston core	17/03/2016	9	7.7	High	9	<0.01	<5	0.16	98		0.08		17	5.5	<0.01	<10	<0.75	98	7.4
C-4 / 0.75-0.85	Piston core	17/03/2016	8.6	7.7	High															
C-4 / 0.9-1.0	Piston core	17/03/2016	9	7.6	High	8.9	<0.01	<5	0.29	180		0.091		16	5	<0.01	<10	<0.75	180	14
G-1	Grab sampler	16/03/2016	8.7	6.4	Slight	9	<0.01	<5	0.2	120		0.2		17	5.4	<0.01	<10	<0.75	120	9.3
G-2	Grab sampler	14/03/2016	8.7	7.3	Slight	9.1	<0.01	<5	0.12	77		0.16		11	3.5	<0.01	<10	<0.75	77	5.8
G-3	Grab sampler	16/03/2016	8.8	6.5	Slight	9.1	<0.01	<5	0.14	89		0.16		16	5.1	<0.01	<10	<0.75	89	6.7
G-4	Grab sampler	16/03/2016	9.2	6.5	Slight	9.4	<0.01	<5	0.01	7		0.072		11	3.4	<0.01	<10	<0.75	<10	<0.75
G-5	Grab sampler	16/03/2016	8.9	6.4	Slight	9.2	<0.01	<5	0.12	77		0.16		17	5.6	<0.01	<10	<0.75	77	5.8
G-6	Grab sampler	16/03/2016	9	6.6	Slight	9.4	<0.01	<5	<0.005	<3		0.094		16	5.3	<0.01	<10	<0.75	<10	<0.75
G-7	Grab sampler	16/03/2016	9.3	6.5	Slight	9.6	<0.01	<5	0.03	21		0.037		7	2.2	<0.01	<10	<0.75	21	1.6
G-8	Grab sampler	16/03/2016	9.3	6.5	Slight	9.6	<0.01	<5	0.02	13		0.058		8.3	2.7	<0.01	<10	<0.75	13	0.94
G-9	Grab sampler	16/03/2016	9.3	6.5	Slight	9.7	<0.01	<5	0.01	9		0.048		6.9	2.2	<0.01	<10	<0.75	<10	<0.75
G-10	Grab sampler	16/03/2016	9.2	6.5	Slight	9.6	<0.01	<5	<0.005	<3		0.04		11	3.5	<0.01	<10	<0.75	<10	<0.75
G-11	Grab sampler	16/03/2016	9.2	6.5	Slight	9.8	<0.01	<5	0.006	4		0.032		7.5	2.4	<0.01	<10	<0.75	<10	<0.75
G-12	Grab sampler	16/03/2016	9.2	6.3	Slight	9.8	<0.01	<5	0.01	7		0.025		3.5	1.1	<0.01	<10	<0.75	<10	<0.75
Min			8.4	6.3		8.7			0.006	4		0.017		2.6	0.84				10	0.75
Max			9.3	8.2		9.8			0.29	180		0.2		18	5.6				180	14
Mean			8.9	7.3		9.3			0.1	67.0		0.1		11.6	3.7				80.4	6.1

Notes

- Denotes no criteria for that parameter

Results with a yellow background and highlighted in red indicate concentrations exceeding guidelines.

Not tested Not tested

Reaction rate is a subjective assessment of the strength of the reaction to hydrogen peroxide: slight (minor bubbling) to very high (violent with frothing and heat produced)

pH_{FOX}

pH <3
pH 3 - 4
pH 4 - 5

Advisian
WorleyParsons Group

Table 2: Salinity and Organic Matter results

Sample		Date	Salinity and Organic Matter			
			Salinity - Total Soluble Salts	Chloride	Conductivity	Organic Matter
			mg/Kg	mg/kg	µS/cm	%
C-1 / 0.0-0.1	Piston core	17/03/2016	16800	7900	5170	1
C-1 / 0.25-0.35	Piston core	17/03/2016				
C-1 / 0.5-0.6	Piston core	17/03/2016				
C-1 / 0.75-0.85	Piston core	17/03/2016				
C-1 / 0.9-1.0	Piston core	17/03/2016	11400	5250	3510	<0.01
C-2 / 0.0-0.1	Piston core	14/03/2016	37300	22600	11500	2
C-2 / 0.25-0.35	Piston core	14/03/2016				
C-2 / 0.5-0.6	Piston core	14/03/2016				
C-2 / 0.75-0.85	Piston core	14/03/2016				
C-2 / 0.9-1.0	Piston core	14/03/2016	37000	22200	11400	2
C-3 / 0.0-0.1	Piston core	17/03/2016	14800	7000	4550	1
C-3 / 0.25-0.35	Piston core	17/03/2016				
C-3 / 0.5-0.6	Piston core	17/03/2016				
C-3 / 0.75-0.85	Piston core	17/03/2016				
C-3 / 0.9-1.0	Piston core	17/03/2016	29400	15400	9050	2
C-4 / 0.0-0.1	Piston core	17/03/2016	28100	13700	8650	2
C-4 / 0.25-0.35	Piston core	17/03/2016				
C-4 / 0.5-0.6	Piston core	17/03/2016	36600	21700	11300	2
C-4 / 0.75-0.85	Piston core	17/03/2016				
C-4 / 0.9-1.0	Piston core	17/03/2016				
G-1	Grab sampler	16/03/2016	50600	31800	15600	2
G-2	Grab sampler	14/03/2016	37200	22300	11400	2
G-3	Grab sampler	16/03/2016	37200	22700	11500	2
G-4	Grab sampler	16/03/2016	18500	9880	5690	1
G-5	Grab sampler	16/03/2016	31700	17900	9750	2
G-6	Grab sampler	16/03/2016	17200	9480	5290	1
G-7	Grab sampler	16/03/2016	11200	5240	3450	<0.01
G-8	Grab sampler	16/03/2016	12500	6180	3850	<0.01
G-9	Grab sampler	16/03/2016	11200	4940	3450	<0.01
G-10	Grab sampler	16/03/2016	13000	6750	4010	<0.01
G-11	Grab sampler	16/03/2016	10400	5530	3190	<0.01
G-12	Grab sampler	16/03/2016	9490	4990	2920	<0.01
Min			9490	4940	2920	1
Max			50600	31800	15600	2
Mean			23580	13172	7262	2

Notes

Results with a yellow background and highlighted in red indicate concentrations exceeding all adopted guidelines.

Not tested

NC Indicates no criteria currently specified for this analyte

Summary of Geotechnical Testing Results

Test ID	Depth Interval	Field Description	Particle size distribution			USCS Classification	Carbonate Content	Atterberg Limits and Linear Shrinkage			Linear Shrinkage	Moisture Content	Particle Specific Gravity
			Fines	Sand	Gravel			LL	PL	PI			
			%	%	%		%	%	%	%	%	%	t/m³
C-1	0.2 - 0.9m	SAND	11	74	15	SP-SC	8.23					19.3	2.63
C-2	0.1 - 1.0m	Silty CLAY	90	10	0	CH	27.4	96	31	65	20	111.9	2.6
C-3	0.0 - 0.15m	Silty/Clayey SAND	44	56	0	SC	22	41	16	25	9.5	48.4 to 91.3	2.61
C-3	0.2 - 1.0m	Silty CLAY	90	10	0	CH	21	108	36	72	22	117	2.59
C-4	0.0 - 1.0m (2 bags combined)	Silty CLAY	87	13	0	CH	29.5	87	25	62	18.5	115.2	2.56
G-1	N/A (grab sample)	Clayey SILT	93	7	0	CH	27.1	86	30	56	19	159.2	2.6
G-2	N/A (grab sample)	Sandy SILT	69	31	0	CH	24.6	58	20	38	15	108	2.62
G-3	N/A (grab sample)	Sandy SILT	72	28	0	CH	22.2	67	22	45	16.5	109.7	2.53
G-4	N/A (grab sample)	Silty SAND	35	62	3	SC	25.1	34	16	18	6.5	37.7	2.59
G-5	N/A (grab sample)	Sandy SILT	60	39	1	CH	25.3	57	20	37	14	84.3	2.67
G-6	N/A (grab sample)	Silty GRAVEL	28	42	30	SC	47.4	29	15	14	5.5	45.3	2.6

Test ID	Depth Interval	Field Description	Particle size distribution			USCS Classification	Carbonate Content	Atterberg Limits and Linear Shrinkage			Linear Shrinkage	Moisture Content	Particle Specific Gravity
G-7	N/A (grab sample)	SAND	14	85	1	SM	19.2	NP	NP	NP	NP	27.1	2.63
G-8	N/A (grab sample)	Sandy GRAVEL	13	77	10	SM	31.1	NP	NP	NP	NP	24.1	2.61
G-9	N/A (grab sample)	SAND	5	95	0	SP	16.5					22.2	2.61
G-10	N/A (grab sample)	Silty SAND	14	86	0	SP	20.4	NP	NP	NP	NP	33.5	2.65
G-11	N/A (grab sample)	SAND	7	93	0	SP-SC	15.2					22.8	2.61
G-12	N/A (grab sample)	SAND	4	96	0	SP	15					26.6	2.64

Summary of Geotechnical Testing Results

Test ID	Depth Interval	Field Description	Wet Density	Dry Density	Minimum/ maximum density	Permeability (reconstituted sample)	1D consolidation (8 loadings)	Direct shear box (100mm) – Single Stage			Consolidated isotropic undrained triaxial – 3 Stage (reconstituted sample)	
								c' (kPa)	Peak ϕ'	Residual ϕ'	c'	Peak ϕ'
			t/m^3	t/m^3	t/m^3	ms^{-1}		kPa	(°)	(°)	kPa	(°)
C-1	0.2 - 0.9m	SAND										
C-2	0.1 - 1.0m	Silty CLAY				3.3×10^{-11}	Completed				5	30
C-3	0.0 - 0.15m	Silty/Clayey SAND	1.5	0.79								
C-3	0.2 - 1.0m	Silty CLAY				9.3×10^{-11}	Completed				3	26
C-4	0.0 - 1.0m (2 bags combined)	Silty CLAY										
G-1	N/A (grab sample)	Clayey SILT										
G-2	N/A (grab sample)	Sandy SILT										
G-3	N/A (grab sample)	Sandy SILT										
G-4	N/A (grab sample)	Silty SAND										
G-5	N/A (grab sample)	Sandy SILT										

Test ID	Depth Interval	Field Description	Wet Density	Dry Density	Minimum/ maximum density	Permeability (reconstituted sample)	1D consolidation (8 loadings)	Direct shear box (100mm) – Single Stage			Consolidated isotropic undrained triaxial – 3 Stage (reconstituted sample)	
G-6	N/A (grab sample)	Silty GRAVEL										
G-7	N/A (grab sample)	SAND										
G-8	N/A (grab sample)	Sandy GRAVEL										
G-9	N/A (grab sample)	SAND			1.29 - 1.65	2.4×10^{-5}		0	33	32		
G-10	N/A (grab sample)	Silty SAND										
G-11	N/A (grab sample)	SAND			1.27-1.60	2.8×10^{-5}		0	35	33		
G-12	N/A (grab sample)	SAND										

Appendix D Laboratory certificates

WAGNERS

WAGNERS CEMENT PTY LTD
ACN: 126 029 481
ABN: 46 126 029 481

CEMENT
FLYASH
TRANSPORT

OFFICE:
47 PAMELA STREET
PINKENBA QUEENSLAND AUSTRALIA 4009

POSTAL ADDRESS:
PO Box 1394 Eagle Farm BC 4009

	INT. PREFIX	STD PREFIX	NUMBER
TELEPHONE:	(61 7)	(07)	3621 1111
FACSIMILE:	(61 7)	(07)	3621 1100

EMAIL: pinkenba@wagner.com.au
WEB: www.wagner.com.au

XRD CERTIFICATE OF ANALYSIS

Client:	EFC for Worley Parsons
Client Reference No.:	G9
Product:	X99
Sample Date:	16 March 2016
Date Received:	23 March 2016
Sample Identification:	160405-0025
Description:	Sustainable Sediment
Sampling Location:	Port of Hay Point
Testing Condition	As received
Testing Location	Pinkenba
Analytical technique	Bruker AXS D2 X-ray diffractomer
	CuKą1operated at 30 kV, 10 mA
Method of analysis	Scan region: 10 to 80 2Theta
	Step size: 0.02
	Time/step: 0.5s

TEST RESULTS

Minerals	Quantitative Analysis (wt%)
Quartz	99.91%
Cuprite	0.08%
Zirconium	0.01%

Other Tests	Quantitative Analysis (wt%)
None	

Remarks:

The above results apply only to the sample desrcibed above.
Sample and sampling details supplied by the client.
This document may only be reproduced in full.
Please destroy any paper copies and delete any electronic copies of previous issues
NATA Accreditaiton is not held for analysis uusing the X-ray Diffraction application

REPORTED BY:

T.Ramsey

WAGNERS

WAGNERS CEMENT PTY LTD
ACN: 126 029 481
ABN: 46 126 029 481

CEMENT
FLYASH
TRANSPORT

OFFICE:
47 PAMELA STREET
PINKENBA QUEENSLAND AUSTRALIA 4009

POSTAL ADDRESS:
PO Box 1394 Eagle Farm BC 4009

	INT. PREFIX	STD PREFIX	NUMBER
TELEPHONE:	(61 7)	(07)	3621 1111
FACSIMILE:	(61 7)	(07)	3621 1100

EMAIL: pinkenba@wagner.com.au
WEB: www.wagner.com.au

CEMENT TEST CERTIFICATE
FINAL
Prior Related Certificates: None

Certificate Number: C16-195
Product: Sustainable Sediment
Sample Identification: WQP160405-0025
Client: EFC for Worley Parsons
Client Reference No.: G9
Sampling Location: Port of Hay Point
Testing Condition As received
Testing Location Pinkenba

Certificate Issued: 27 April 2016
Sample Date: 16 March 2016
Date Received: 23 March 2016

TEST RESULTS

Test	LOI %
Result	32.7
Standard: AS 3583:1998	Part 2
Applicable limit(s) advised	None

Test	SiO2 %	Al2O3 %	Fe2O3 %	CaO %	MgO %	SO3 %	K_2O %	TiO_2 %
Result	90.7	1.3	1.1	4.6	0.4	0.1	0.29	0.24
Standard: Not applicable	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2
Applicable limit(s) advised	None	None	None	None	None	None	None	None

Test	P2O5 %	Na2O %	Cr2O3 %	ZnO %	MnO %	SrO %	Cl %
Result	0.04	0.49	0.056	0.001	0.03	0.02	0.224
Standard: Not applicable	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2
Applicable limit(s) advised	None	None	None	None	None	None	None

Remarks:

The above results apply only to the sample desrcibed above.
Sample and sampling details supplied by the client.
This document may only be reproduced in full.
Please destroy any paper copies and delete any electronic copies of previous issues
Analysis by XRF(GeoMajorQuant application); LOI by classical technique according to AS2350.2
NATA Accreditaiton is not held for analysis uusing the GeoMajorQuant application

REPORTED BY:

Approved Signatory
Tanya Ramsey

WAGNERS

WAGNERS CEMENT PTY LTD
ACN: 126 029 481
ABN: 46 126 029 481

CEMENT
FLYASH
TRANSPORT

OFFICE:
47 PAMELA STREET
PINKENBA QUEENSLAND AUSTRALIA 4009

POSTAL ADDRESS:
PO Box 1394 Eagle Farm BC 4009

	INT. PREFIX	STD PREFIX	NUMBER
TELEPHONE:	(61 7)	(07)	3621 1111
FACSIMILE:	(61 7)	(07)	3621 1100

EMAIL: pinkenba@wagner.com.au
WEB: www.wagner.com.au

XRD CERTIFICATE OF ANALYSIS

Client:	EFC for Worley Parsons
Client Reference No.:	C3
Product:	X99
Sample Date:	16 March 2016
Date Received:	23 March 2016
Sample Identification:	160405-0022
Description:	Sustainable Sediment
Sampling Location:	Port of Hay Point
Testing Condition	As received
Testing Location	Pinkenba
Analytical technique	Bruker AXS D2 X-ray diffractomer
	CuKą1operated at 30 kV, 10 mA
Method of analysis	Scan region: 10 to 80 2Theta
	Step size: 0.02
	Time/step: 0.5s

TEST RESULTS

Minerals	Quantitative Analysis (wt%)
Quartz	45.72%
Calcite	15.83%
Halite	3.82%
Ferrihydrite	0.90%
Dickite	25.85%
Montmorillonite	7.88%

Other Tests	Quantitative Analysis (wt%)
None	

Remarks:

The above results apply only to the sample desrcibed above.
Sample and sampling details supplied by the client.
This document may only be reproduced in full.
Please destroy any paper copies and delete any electronic copies of previous issues
NATA Accreditaiton is not held for analysis uusing the X-ray Diffraction application

REPORTED BY:

T.Ramsey

WAGNERS

WAGNERS CEMENT PTY LTD
ACN: 126 029 481
ABN: 46 126 029 481

CEMENT
FLYASH
TRANSPORT

OFFICE:
47 PAMELA STREET
PINKENBA QUEENSLAND AUSTRALIA 4009

POSTAL ADDRESS:
PO Box 1394 Eagle Farm BC 4009

	INT. PREFIX	STD PREFIX	NUMBER
TELEPHONE:	(61 7)	(07)	3621 1111
FACSIMILE:	(61 7)	(07)	3621 1100

EMAIL: pinkenba@wagner.com.au
WEB: www.wagner.com.au

CEMENT TEST CERTIFICATE
FINAL
Prior Related Certificates: None

Certificate Number: C16-194
Product: Sustainable Sediment
Sample Identification: WQP160405-0022
Client: EFC for Worley Parsons
Client Reference No.: C3
Sampling Location: Port of Hay Point
Testing Condition As received
Testing Location Pinkenba

Certificate Issued: 27 April 2016
Sample Date: 16 March 2016
Date Received: 23 March 2016

TEST RESULTS

Test	LOI %
Result	43.7
Standard: AS 3583:1998	Part 2
Applicable limit(s) advised	None

Test	SiO2 %	Al2O3 %	Fe2O3 %	CaO %	MgO %	SO3 %	K_2O %	TiO_2 %
Result	61.5	1	0.8	2.8	0.2	0	0.2	0.17
Standard: Not applicable	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2
Applicable limit(s) advised	None	None	None	None	None	None	None	None

Test	P2O5 %	Na2O %	Cr2O3 %	ZnO %	MnO %	SrO %	Cl %
Result	0.02	0.2	**	**	**	**	**
Standard: Not applicable	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2
Applicable limit(s) advised	None	None	None	None	None	None	None

**outside limit of detection

Remarks:

The above results apply only to the sample desrcibed above.
Sample and sampling details supplied by the client.
This document may only be reproduced in full.
Please destroy any paper copies and delete any electronic copies of previous issues
Analysis by XRF(GeoMajorQuant application); LOI by classical technique according to AS2350.2
NATA Accreditaiton is not held for analysis uusing the GeoMajorQuant application

REPORTED BY:

Approved Signatory
Tanya Ramsey

WAGNERS

WAGNERS CEMENT PTY LTD
ACN: 126 029 481
ABN: 46 126 029 481

CEMENT
FLYASH
TRANSPORT

OFFICE:
47 PAMELA STREET
PINKENBA QUEENSLAND AUSTRALIA 4009

POSTAL ADDRESS:
PO Box 1394 Eagle Farm BC 4009

	INT. PREFIX	STD PREFIX	NUMBER
TELEPHONE:	(61 7)	(07)	3621 1111
FACSIMILE:	(61 7)	(07)	3621 1100

EMAIL: pinkenba@wagner.com.au
WEB: www.wagner.com.au

XRD CERTIFICATE OF ANALYSIS

Client:	EFC for Worley Parsons
Client Reference No.:	G9
Product:	X99
Sample Date:	16 March 2016
Date Received:	23 March 2016
Sample Identification:	160405-0025
Description:	Sustainable Sediment
Sampling Location:	Port of Hay Point
Testing Condition	As received
Testing Location	Pinkenba
Analytical technique	Bruker AXS D2 X-ray diffractomer
	CuKą1operated at 30 kV, 10 mA
Method of analysis	Scan region: 10 to 80 2Theta
	Step size: 0.02
	Time/step: 0.5s

TEST RESULTS

Minerals	Quantitative Analysis (wt%)
Quartz	99.91%
Cuprite	0.08%
Zirconium	0.01%

Other Tests	Quantitative Analysis (wt%)
None	

Remarks:

The above results apply only to the sample desrcibed above.
Sample and sampling details supplied by the client.
This document may only be reproduced in full.
Please destroy any paper copies and delete any electronic copies of previous issues
NATA Accreditaiton is not held for analysis uusing the X-ray Diffraction application

REPORTED BY:

T.Ramsey

WAGNERS

WAGNERS CEMENT PTY LTD
ACN: 126 029 481
ABN: 46 126 029 481

CEMENT
FLYASH
TRANSPORT

OFFICE:
47 PAMELA STREET
PINKENBA QUEENSLAND AUSTRALIA 4009

POSTAL ADDRESS:
PO Box 1394 Eagle Farm BC 4009

	INT. PREFIX	STD PREFIX	NUMBER
TELEPHONE:	(61 7)	(07)	3621 1111
FACSIMILE:	(61 7)	(07)	3621 1100

EMAIL: pinkenba@wagner.com.au
WEB: www.wagner.com.au

CEMENT TEST CERTIFICATE
FINAL
Prior Related Certificates: None

Certificate Number: C16-195
Product: Sustainable Sediment
Sample Identification: WQP160405-0025
Client: EFC for Worley Parsons
Client Reference No.: G9
Sampling Location: Port of Hay Point
Testing Condition As received
Testing Location Pinkenba

Certificate Issued: 27 April 2016
Sample Date: 16 March 2016
Date Received: 23 March 2016

TEST RESULTS

Test	LOI %
Result	32.7
Standard: AS 3583:1998	Part 2
Applicable limit(s) advised	None

Test	SiO2 %	Al2O3 %	Fe2O3 %	CaO %	MgO %	SO3 %	K_2O %	TiO_2 %
Result	90.7	1.3	1.1	4.6	0.4	0.1	0.29	0.24
Standard: Not applicable	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2
Applicable limit(s) advised	None	None	None	None	None	None	None	None

Test	P2O5 %	Na2O %	Cr2O3 %	ZnO %	MnO %	SrO %	Cl %
Result	0.04	0.49	0.056	0.001	0.03	0.02	0.224
Standard: Not applicable	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2
Applicable limit(s) advised	None	None	None	None	None	None	None

Remarks:

The above results apply only to the sample desrcibed above.
Sample and sampling details supplied by the client.
This document may only be reproduced in full.
Please destroy any paper copies and delete any electronic copies of previous issues
Analysis by XRF(GeoMajorQuant application); LOI by classical technique according to AS2350.2
NATA Accreditaiton is not held for analysis uusing the GeoMajorQuant application

REPORTED BY:

Approved Signatory
Tanya Ramsey

WAGNERS

WAGNERS CEMENT PTY LTD
ACN: 126 029 481
ABN: 46 126 029 481

CEMENT
FLYASH
TRANSPORT

OFFICE:
47 PAMELA STREET
PINKENBA QUEENSLAND AUSTRALIA 4009

POSTAL ADDRESS:
PO Box 1394 Eagle Farm BC 4009

	INT. PREFIX	STD PREFIX	NUMBER
TELEPHONE:	(61 7)	(07)	3621 1111
FACSIMILE:	(61 7)	(07)	3621 1100

EMAIL: pinkenba@wagner.com.au
WEB: www.wagner.com.au

XRD CERTIFICATE OF ANALYSIS

Client:	EFC for Worley Parsons
Client Reference No.:	C3
Product:	X99
Sample Date:	16 March 2016
Date Received:	23 March 2016
Sample Identification:	160405-0022
Description:	Sustainable Sediment
Sampling Location:	Port of Hay Point
Testing Condition	As received
Testing Location	Pinkenba
Analytical technique	Bruker AXS D2 X-ray diffractomer
	CuKą1operated at 30 kV, 10 mA
Method of analysis	Scan region: 10 to 80 2Theta
	Step size: 0.02
	Time/step: 0.5s

TEST RESULTS

Minerals	Quantitative Analysis (wt%)
Quartz	45.72%
Calcite	15.83%
Halite	3.82%
Ferrihydrite	0.90%
Dickite	25.85%
Montmorillonite	7.88%

Other Tests	Quantitative Analysis (wt%)
None	

Remarks:

The above results apply only to the sample desrcibed above.
Sample and sampling details supplied by the client.
This document may only be reproduced in full.
Please destroy any paper copies and delete any electronic copies of previous issues
NATA Accreditaiton is not held for analysis uusing the X-ray Diffraction application

REPORTED BY:

T.Ramsey

WAGNERS

WAGNERS CEMENT PTY LTD
ACN: 126 029 481
ABN: 46 126 029 481

CEMENT
FLYASH
TRANSPORT

OFFICE:
47 PAMELA STREET
PINKENBA QUEENSLAND AUSTRALIA 4009

POSTAL ADDRESS:
PO Box 1394 Eagle Farm BC 4009

	INT. PREFIX	STD PREFIX	NUMBER
TELEPHONE:	(61 7)	(07)	3621 1111
FACSIMILE:	(61 7)	(07)	3621 1100

EMAIL: pinkenba@wagner.com.au
WEB: www.wagner.com.au

CEMENT TEST CERTIFICATE
FINAL
Prior Related Certificates: None

Certificate Number: C16-194
Product: Sustainable Sediment
Sample Identification: WQP160405-0022
Client: EFC for Worley Parsons
Client Reference No.: C3
Sampling Location: Port of Hay Point
Testing Condition As received
Testing Location Pinkenba

Certificate Issued: 27 April 2016
Sample Date: 16 March 2016
Date Received: 23 March 2016

TEST RESULTS

Test	LOI %
Result	43.7
Standard: AS 3583:1998	Part 2
Applicable limit(s) advised	None

Test	SiO2 %	Al2O3 %	Fe2O3 %	CaO %	MgO %	SO3 %	K_2O %	TiO_2 %
Result	61.5	1	0.8	2.8	0.2	0	0.2	0.17
Standard: Not applicable	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2
Applicable limit(s) advised	None	None	None	None	None	None	None	None

Test	P2O5 %	Na2O %	Cr2O3 %	ZnO %	MnO %	SrO %	Cl %
Result	0.02	0.2	**	**	**	**	**
Standard: Not applicable	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2	Part 2
Applicable limit(s) advised	None	None	None	None	None	None	None

**outside limit of detection

Remarks:

The above results apply only to the sample desrcibed above.
Sample and sampling details supplied by the client.
This document may only be reproduced in full.
Please destroy any paper copies and delete any electronic copies of previous issues
Analysis by XRF(GeoMajorQuant application); LOI by classical technique according to AS2350.2
NATA Accreditaiton is not held for analysis uusing the GeoMajorQuant application

REPORTED BY:

Approved Signatory
Tanya Ramsey

CHAIN OF CUSTODY

ALS Laboratory: please tick →

☐ADELAIDE 21 Burma Road Pooraka SA 5095 Ph: 08 8359 0890 E: adelaide@alsglobal.com

☐BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

☐GLADSTONE 46 Callemondah Drive Clinton QLD 4680 Ph: 07 7471 5600 E: gladstone@alsglobal.com

☐MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com

☐MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

☐MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

☐NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com

☐NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com

☐PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com

☐SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

☐TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townesville.environmental@alsglobal.com

☐WOLLONGONG 99 Kenny Street Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: Advisian	**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests e.g.. Ultra Trace Organics)	☐ Standard TAT **(List due date):**	**FOR LABORATORY USE ONLY (Circle)**
OFFICE: Level 3, 60 Albert St, Brisbane City, 4000		☐ Non Standard or urgent TAT **(List due date):**	Custody Seal Intact? Yes No N/A
PROJECT: Hay Point Beneficial Reuse **PROJECT NO.**301310-09537	**QUOTE NO.: EN16_007B**	**COC SEQUENCE NUMBER (Circle)**	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER: **PURCHASE ORDER NO.:**	**COUNTRY OF ORIGIN:** Australia	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Bill Boylson **CONTACT PH:**		OF: 1 2 3 4 5 6 7	Other comment:

SAMPLER: Alex Kochnieff	**SAMPLER MOBILE:** 0468 660 301	**RELINQUISHED BY:**	**RECEIVED BY:**	**RELINQUISHED BY:**	**RECEIVED BY:**
COC Emailed to AAA? (YES / NO)	**EDD FORMAT (or default):**	*Alex Kochnieff*	OTO		
Email Reports to (will default to PM if no other addresses are listed): alex.kochnieff@advisian.com		DATE/TIME: 18/03/16 08:00	DATE/TIME: 23/3/16 12:20	DATE/TIME:	DATE/TIME:
Email Invoice to (will default to PM if no other addresses are listed): PM					

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where **Metals** are required, specify **Total** (unfiltered bottle required) or **Dissolved** (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL BOTTLES	ASS - pH/pHfox	ASS - Chromium Suite	Electrical Conductivity	Salinity (total soluable salts	Salinity Chloride	Organic Matter		HOLD	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	D2A	17/03/2016 0:00	S	None	1 bag	1	1							
				TOTAL										

Environmental Division
Brisbane
Work Order Reference
EB1607996

Telephone : +61-7-3243 7222

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

SAMPLE RECEIPT NOTIFICATION (SRN)

Work Order	: **EB1607996**		
Amendment	: **2**		
Client	: **WORLEY PARSONS - INFRASTRUCTURE MWE**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALEX KOCHNIEFF	Contact	: Customer Services EB
Address	: LEVEL 3, 60 ALBERT STREET PO BOX 15081 CITY EAST BRISBANE QLD, AUSTRALIA 4000	Address	: 2 Byth Street Stafford QLD Australia 4053
E-mail	: alex.kochnieff@advisian.com	E-mail	: ALSEnviro.Brisbane@alsglobal.com
Telephone	: +61 07 3319 3940	Telephone	: +61-7-3243 7222
Facsimile	: +61 07 3319 7791	Facsimile	: +61-7-3243 7218
Project	: 301310-09537	Page	: 1 of 2
Order number	: ----	Quote number	: ES2015WORPAR0001 (EN/034/15)
C-O-C number	: ----	QC Level	: NEPM 2013 B3 & ALS QC Standard
Site	: ----		
Sampler	:		

Dates

Date Samples Received	: 23-Mar-2016 12:20 PM	Issue Date	: 11-Apr-2016
Client Requested Due Date	: 04-Apr-2016	Scheduled Reporting Date	: **04-Apr-2016**

Delivery Details

Mode of Delivery	: Carrier	Security Seal	: Intact.
No. of coolers/boxes	: 1	Temperature	: 22.7°C - Ice Bricks present
Receipt Detail	: SMALL FOAM ESKY	No. of samples received / analysed	: 1 / 1

General Comments

- This report contains the following information:
  - Sample Container(s)/Preservation Non-Compliances
  - Summary of Sample(s) and Requested Analysis
  - Proactive Holding Time Report
  - Requested Deliverables
- **11/4/2016: SRN has been resent to acknowledge changes made to the client entity as per client request. For any further information regarding these adjustments please contact client services at ALSEnviro.Brisbane@alsglobal.com.**
- Discounted Package Prices apply only when specific ALS Group Codes ('W', 'S', 'NT' suites) are referenced on COCs.
- Please direct any turn around / technical queries to the laboratory contact designated above.
- Sample Disposal - Aqueous (14 days), Solid (60 days) from date of completion of work order.
- Analysis will be conducted by ALS Environmental, Brisbane, NATA accreditation no. 825, Site No. 818 (Micro site no. 18958).
- **Breaches in recommended extraction / analysis holding times (if any) are displayed overleaf in the Proactive Holding Time Report table.**

Sample Container(s)/Preservation Non-Compliances

All comparisons are made against pretreatment/preservation AS, APHA, USEPA standards.

- **No sample container / preservation non-compliance exists.**

Summary of Sample(s) and Requested Analysis

Some items described below may be part of a laboratory process necessary for the execution of client requested tasks. Packages may contain additional analyses, such as the determination of moisture content and preparation tasks, that are included in the package.
If no sampling time is provided, the sampling time will default to 15:00 on the date of sampling. If no sampling date is provided, the sampling date will be assumed by the laboratory for processing purposes and will be shown bracketed without a time component.

Matrix: **SOIL**

Laboratory sample ID	Client sampling date / time	Client sample ID	SOIL - EA033 Chromium Suite for Acid Sulphate Soils	SOIL - EA037 ASS Field Screening Analysis
EB1607996-001	[17-Mar-2016]	D2A	✓	✓

Proactive Holding Time Report

Sample(s) have been received within the recommended holding times for the requested analysis.

Requested Deliverables

ALEX KOCHNIEFF

- *AU Certificate of Analysis - NATA (COA)	Email	alex.kochnieff@advisian.com
- *AU Interpretive QC Report - DEFAULT (Anon QCI Rep) (QCI)	Email	alex.kochnieff@advisian.com
- *AU QC Report - DEFAULT (Anon QC Rep) - NATA (QC)	Email	alex.kochnieff@advisian.com
- A4 - AU Sample Receipt Notification - Environmental HT (SRN)	Email	alex.kochnieff@advisian.com
- A4 - AU Tax Invoice (INV)	Email	alex.kochnieff@advisian.com
- Chain of Custody (CoC) (COC)	Email	alex.kochnieff@advisian.com
- EDI Format - ENMRG (ENMRG)	Email	alex.kochnieff@advisian.com
- EDI Format - ESDAT (ESDAT)	Email	alex.kochnieff@advisian.com
- EDI Format - WP (WP)	Email	alex.kochnieff@advisian.com
- EDI Format - XTab (XTAB)	Email	alex.kochnieff@advisian.com

INVOICE AU

- A4 - AU Tax Invoice (INV)	Email	accounts.payable@worleyparsons.com

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB1607996**	Page	: 1 of 4
Amendment	: **2**		
Client	: **WORLEY PARSONS - INFRASTRUCTURE MWE**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALEX KOCHNIEFF	Telephone	: +61-7-3243 7222
Project	: 301310-09537	Date Samples Received	: 23-Mar-2016
Site	: ----	Issue Date	: 11-Apr-2016
Sampler	: ----	No. of samples received	: 1
Order number	: ----	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA033-B: Potential Acidity							
Snap Lock Bag - frozen on receipt at ALS (EA033)							
D2A	**17-Mar-2016**	**05-Apr-2016**	17-Mar-2017	✓	**05-Apr-2016**	04-Jul-2016	✓
EA037: Ass Field Screening Analysis							
Snap Lock Bag - frozen on receipt at ALS (EA037)							
D2A	**17-Mar-2016**	**04-Apr-2016**	13-Sep-2016	✓	**04-Apr-2016**	13-Sep-2016	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
ASS Field Screening Analysis	EA037	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chromium Suite for Acid Sulphate Soils	EA033	1	1	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chromium Suite for Acid Sulphate Soils	EA033	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chromium Suite for Acid Sulphate Soils	EA033	1	1	**100.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
Chromium Suite for Acid Sulphate Soils	EA033	SOIL	In house: Referenced to Ahern et al 2004. This method covers the determination of Chromium Reducible Sulfur (SCR); pHKCl; titratable actual acidity (TAA); acid neutralising capacity by back titration (ANC); and net acid soluble sulfur (SNAS) which incorporates peroxide sulfur. It applies to soils and sediments (including sands) derived from coastal regions. Liming Rate is based on results for samples as submitted and incorporates a minimum safety factor of 1.5.
ASS Field Screening Analysis	* EA037	SOIL	In house: Referenced to Acid Sulfate Soils Laboratory Methods Guidelines, version 2.1 June 2004. As received samples are tested for pH field and pH fox and assessed for a reaction rating.

Preparation Methods	Method	Matrix	Method Descriptions
Drying only	EN020D	SOIL	In house
Drying at 85 degrees, bagging and labelling (ASS)	EN020PR	SOIL	In house

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB1607996**	Page	: 1 of 3
Amendment	: **2**		
Client	: **WORLEY PARSONS - INFRASTRUCTURE MWE**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALEX KOCHNIEFF	Contact	: Customer Services EB
Address	: LEVEL 3, 60 ALBERT STREET PO BOX 15081 CITY EAST BRISBANE QLD, AUSTRALIA 4000	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3319 3940	Telephone	: +61-7-3243 7222
Project	: 301310-09537	Date Samples Received	: 23-Mar-2016
Order number	: ----	Date Analysis Commenced	: 04-Apr-2016
C-O-C number	: ----	Issue Date	: 11-Apr-2016
Sampler	: ----		
Site	: ----		
Quote number	: ----		
No. of samples received	: 1		
No. of samples analysed	: 1		

NATA Accredited Laboratory 825
Accredited for compliance with ISO/IEC 17025.

NATA
WORLD RECOGNISED ACCREDITATION

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris		Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA033-A: Actual Acidity (QC Lot: 413783)									
EB1607996-001	D2A	EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	<0.02	0.00	No Limit
		EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	<2	0.00	No Limit
		EA033: pH KCl (23A)	----	0.1	pH Unit	8.8	8.8	0.00	0% - 20%
EA033-B: Potential Acidity (QC Lot: 413783)									
EB1607996-001	D2A	EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	0.069	0.065	6.17	0% - 50%
		EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	43	40	6.17	No Limit
EA033-C: Acid Neutralising Capacity (QC Lot: 413783)									
EB1607996-001	D2A	EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	15.3	15.3	0.167	0% - 20%
		EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	4.91	4.92	0.00	0% - 20%
		EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	3060	3070	0.167	0% - 20%
EA037: Ass Field Screening Analysis (QC Lot: 413471)									
EB1607996-001	D2A	EA037: pH (F)	----	0.1	pH Unit	8.3	8.3	0.00	0% - 20%
		EA037: pH (Fox)	----	0.1	pH Unit	6.4	6.4	0.00	0% - 20%

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA033-A: Actual Acidity (QCLot: 413783)								
EA033: pH KCl (23A)	----	----	pH Unit	----	4.8 pH Unit	97.9	70	130
EA033: sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033: Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	15 mole H+ / t	118	70	130
EA033-B: Potential Acidity (QCLot: 413783)								
EA033: acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	<10	----	----	----	----
EA033: Chromium Reducible Sulfur (22B)	----	0.005	% S	<0.005	0.295 % S	86.0	70	130
EA033-C: Acid Neutralising Capacity (QCLot: 413783)								
EA033: Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	<0.01	10 % CaCO3	100	70	130
EA033: acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	<10	----	----	----	----
EA033: sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	<0.01	----	----	----	----

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1607996**	Page	: 1 of 3
Amendment	: **2**		
Client	: **WORLEY PARSONS - INFRASTRUCTURE MWE**	Laboratory	: Environmental Division Brisbane
Contact	: MR ALEX KOCHNIEFF	Contact	: Customer Services EB
Address	: LEVEL 3, 60 ALBERT STREET PO BOX 15081 CITY EAST BRISBANE QLD, AUSTRALIA 4000	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3319 3940	Telephone	: +61-7-3243 7222
Project	: 301310-09537	Date Samples Received	: 23-Mar-2016 12:20
Order number	: ----	Date Analysis Commenced	: 04-Apr-2016
C-O-C number	: ----	Issue Date	: 11-Apr-2016 09:38
Sampler	: ----		
Site	: ----		
Quote number	: ----		
No. of samples received	: 1		
No. of samples analysed	: 1		

NATA Accredited Laboratory 825
Accredited for compliance with ISO/IEC 17025.

NATA WORLD RECOGNISED ACCREDITATION

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

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

Signatories

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

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris		Brisbane Acid Sulphate Soils, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

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

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

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

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

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

- ASS: EA033 (CRS Suite):Retained Acidity not required because pH KCl greater than or equal to 4.5
- This report has been amended following changes made to the client entity as per client request.
- ASS: EA037 (Rapid Field and F(ox) screening): pH F(ox) Reaction Rate: 1 - Slight; 2 - Moderate; 3 - Strong; 4 - Extreme
- ASS: EA033 (CRS Suite): Liming rate is calculated and reported on a dry weight basis assuming use of fine agricultural lime (CaCO3) and using a safety factor of 1.5 to allow for non-homogeneous mixing and poor reactivity of lime. For conversion of Liming Rate from 'kg/t dry weight' to 'kg/m3 in-situ soil', multiply 'reported results' x 'wet bulk density of soil in t/m3'.
- EA037 ASS Field Screening: NATA accreditation does not cover performance of this service.

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)			Client sample ID	D2A	----	----	----	----
			Client sampling date / time	[17-Mar-2016]	----	----	----	----
Compound	CAS Number	LOR	Unit	EB1607996-001	--------	--------	--------	--------
				Result	Result	Result	Result	Result
EA033-A: Actual Acidity								
pH KCl (23A)	----	0.1	pH Unit	**8.8**	----	----	----	----
Titratable Actual Acidity (23F)	----	2	mole H+ / t	<2	----	----	----	----
sulfidic - Titratable Actual Acidity (s-23F)	----	0.02	% pyrite S	<0.02	----	----	----	----
EA033-B: Potential Acidity								
Chromium Reducible Sulfur (22B)	----	0.005	% S	**0.069**	----	----	----	----
acidity - Chromium Reducible Sulfur (a-22B)	----	10	mole H+ / t	**43**	----	----	----	----
EA033-C: Acid Neutralising Capacity								
Acid Neutralising Capacity (19A2)	----	0.01	% CaCO3	**15.3**	----	----	----	----
acidity - Acid Neutralising Capacity (a-19A2)	----	10	mole H+ / t	**3060**	----	----	----	----
sulfidic - Acid Neutralising Capacity (s-19A2)	----	0.01	% pyrite S	**4.91**	----	----	----	----
EA033-E: Acid Base Accounting								
ANC Fineness Factor	----	0.5	-	**1.5**	----	----	----	----
Net Acidity (sulfur units)	----	0.02	% S	<0.02	----	----	----	----
Net Acidity (acidity units)	----	10	mole H+ / t	<10	----	----	----	----
Liming Rate	----	1	kg CaCO3/t	<1	----	----	----	----
Net Acidity excluding ANC (sulfur units)	----	0.02	% S	**0.07**	----	----	----	----
Net Acidity excluding ANC (acidity units)	----	10	mole H+ / t	**43**	----	----	----	----
Liming Rate excluding ANC	----	1	kg CaCO3/t	**3**	----	----	----	----
EA037: Ass Field Screening Analysis								
ø pH (F)	----	0.1	pH Unit	**8.3**	----	----	----	----
ø pH (Fox)	----	0.1	pH Unit	**6.4**	----	----	----	----
ø Reaction Rate	----	1	-	**3**	----	----	----	----

AG1325 V4

Advanced Analytical Australia

CHAIN OF CUSTODY

CLIENT: Advisian	TURNAROUND REQUIREMENTS: ☐ Standard TAT (List due date):	FOR LABORATORY USE ONLY (Circle)	
OFFICE: Level 3, 60 Albert St, Brisbane City, 4000	(Standard TAT may be longer for some tests e.g. Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact?	Yes / No / N/A
PROJECT: Hay Point Beneficial Reuse PROJECT NO: 301310-09537	QUOTE NO.: EN16_0078	Free ice / frozen ice bricks present upon receipt?	Yes / No / N/A
ORDER NUMBER: PURCHASE ORDER NO.:	COUNTRY OF ORIGIN: Australia	Random Sample Temperature on Receipt:	°C
PROJECT MANAGER: Bill Boylson CONTACT PH:	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 5 6 7 OF: 1 2 3 4 5 6 7	Cooler number:	
SAMPLER: Alex Kochnieff SAMPLER MOBILE: 0468 560 301			
COC Emailed to AAA? (YES / NO) EDD FORMAT (or default):			
Email Reports to (will default to PM if no other addresses are listed): alex.kochnieff@advisian.com			
Email Invoice to (will default to PM if no other addresses are listed): PM			

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Alex Kochnieff			
DATE/TIME: 14/03/16 16:00	DATE/TIME:	DATE/TIME:	DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

	SAMPLE DETAILS MATRIX: Soil(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES: (NB: Suite Codes must be listed to attract suite price. Where Metals are required, specify Total or Dissolved (field filtered) if required.)							Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	ASS - Jarosite	ASS - Chromium Suite	Electrical Conductivity	Sample acid extractable suite	Salinity Chloride	Organic Matter	HOLD	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	G-2	14/03/2016 0:00	S	None	1	1	1	1	1	1	1		
2	C-2 / 0.0-0.1	14/03/2016 0:00	S	None	1	1	1	1	1	1	1		
3	C-2 / 0.25-0.35	14/03/2016 0:00	S	None	1	1							
4	C-2 / 0.5-0.6	14/03/2016 0:00	S	None	1	1	1						
5	C-2 / 0.75-0.85	14/03/2016 0:00	S	None	1	1							
6	C-2 / 0.9-1.0	14/03/2016 0:00	S	None	1	1	1	1	1	1	1		
				TOTAL									

1 2 3 4 5 6

Water Containers Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic; V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; U = Ultra Clean Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles; F = Formaldehyde Preserved Glass

RECEIVED 15 MAR 2016 EC 12

AIG1325

Advanced Analytical Australia **CHAIN OF CUSTODY**

CLIENT: Advisian	**TURNAROUND REQUIREMENTS :** ☐ Standard TAT (List due date):		**FOR LABORATORY USE ONLY (Circle)**
OFFICE: Level 3, 60 Albert St, Brisbane City, 4000	(Standard TAT may be longer for some tests e.g., Ultra Trace Organics) ☐ Non Standard or urgent TAT (List due date):		Custody Seal Intact? Yes / No / N/A
PROJECT: Hay Point Beneficial Reuse **PROJECT NO.**301310-09537	**QUOTE NO.: EN16_007B**	**COC SEQUENCE NUMBER (Circle)**	Free ice / frozen ice bricks present upon receipt? Yes / No / N/A
ORDER NUMBER: **PURCHASE ORDER NO.:**	**COUNTRY OF ORIGIN:** Australia	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Bill Boylson **CONTACT PH:**		OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: Alex Kochnieff **SAMPLER MOBILE:** 0468 660 301	**RELINQUISHED BY:**	**RECEIVED BY:**	**RELINQUISHED BY:** / **RECEIVED BY:**
COC Emailed to AAA? (YES / NO) **EDD FORMAT (or default):**	*Alex Kochnieff*		
Email Reports to (will default to PM if no other addresses are listed): alex.kochnieff@advisian.com	**DATE/TIME:** 16/03/16 16:45	**DATE/TIME:**	**DATE/TIME:** / **DATE/TIME:**
Email Invoice to (will default to PM if no other addresses are listed): PM			

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE *(refer to codes below)*	TOTAL BOTTLES	ASS - pHtpHox	ASS - Chromium Suite	Electrical Conductivity	Salinity (total soluable salts	Salinity Chloride	Organic Matter		HOLD	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
7 1	G-1	16/03/2016 0:00	S	None	2 small bags	1	1	1	1	1	1			
8 2	G-3	16/03/2016 0:00	S	None	2 small bags	1	1	1	1	1	1			
9 3	G-4	16/03/2016 0:00	S	None	2 small bags	1	1	1	1	1	1			
10 4	G-5	16/03/2016 0:00	S	None	1 large bag	1	1	1	1	1	1			
11 5	G-6	16/03/2016 0:00	S	None	1 large bag	1	1	1	1	1	1			
12 6	G-7	16/03/2016 0:00	S	None	1 large bag	1	1	1	1	1	1			
13 7	G-8	16/03/2016 0:00	S	None	1 large bag	1	1	1	1	1	1			
14 8	G-9	16/03/2016 0:00	S	None	1 large bag	1	1	1	1	1	1			
15 9	G-10	16/03/2016 0:00	S	None	1 large bag	1	1	1	1	1	1			
16 10	G-11	16/03/2016 0:00	S	None	2 small bags	1	1	1	1	1	1			
17 11	G-12	16/03/2016 0:00	S	None	1 large bag	1	1	1	1	1	1			
				TOTAL		11	11	11	11	11	11			

RECEIVED 17 MAR 2016 RT 6°C

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

Advanced Analytical Australia

CHAIN OF CUSTODY

A1611325

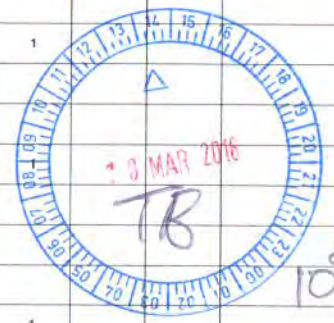
CLIENT: Advisian	**TURNAROUND REQUIREMENTS :** (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☐ Standard TAT (**List due date**):	**FOR LABORATORY USE ONLY (Circle)**
OFFICE: Level 3, 60 Albert St, Brisbane City, 4000		☐ Non Standard or urgent TAT (**List due date**):	Custody Seal Intact? Yes No N/A
PROJECT: Hay Point Beneficial Reuse **PROJECT NO.** 301310-09537	**QUOTE NO.:** EN16_007B	**COC SEQUENCE NUMBER (Circle)**	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER: **PURCHASE ORDER NO.:**	**COUNTRY OF ORIGIN:** Australia	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Bill Boylson **CONTACT PH:**		OF: 1 2 3 4 5 6 7	Other comment:

SAMPLER: Alex Kochnieff	**SAMPLER MOBILE:** 0468 660 301	**RELINQUISHED BY:**	**RECEIVED BY:**	**RELINQUISHED BY:** / **RECEIVED BY:**
COC Emailed to AAA? (YES / NO)	**EDD FORMAT (or default):**	*Alex Kochnieff*		
Email Reports to (will default to PM if no other addresses are listed): alex.kochnieff@advisian.com		DATE/TIME: 18/03/16 08:00	DATE/TIME:	DATE/TIME: / DATE/TIME:
Email Invoice to (will default to PM if no other addresses are listed): PM				

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			**CONTAINER INFORMATION**		**ANALYSIS REQUIRED including SUITES** (NB. Suite Codes must be listed to attract suite price) Where **Metals** are required, specify **Total** (unfiltered bottle required) or **Dissolved** (field filtered bottle required).								**Additional Information**
LAB ID	**SAMPLE ID**	**DATE / TIME**	**MATRIX**	**TYPE & PRESERVATIVE** *(refer to codes below)*	**TOTAL BOTTLES**	ASS - pH/pHox	ASS - Chromium Suite	Electrical Conductivity	Salinity (total soluable salts	Salinity Chloride	Organic Matter		**HOLD**	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	**C-1 / 0.0-0.1**	17/03/2016 0:00	S	None	1 bag	1	1	1	1	1	1			
2	**C-1 / 0.25-0.35**	17/03/2016 0:00	S	None	1 bag	1								
3	**C-1 / 0.5-0.6**	17/03/2016 0:00	S	None	1 bag	1	1							
4	**C-1 / 0.75-0.85**	17/03/2016 0:00	S	None	1 bag	1								
5	**C-1 / 0.9-1.0**	17/03/2016 0:00	S	None	1 bag	1	1	1	1	1	1			
6	**C-4 / 0.0-0.1**	17/03/2016 0:00	S	None	1 bag	1	1	1	1	1	1			
7	**C-4 / 0.25-0.35**	17/03/2016 0:00	S	None	1 bag	1								
8	**C-4 / 0.5-0.6**	17/03/2016 0:00	S	None	1 bag	1	1	1	1	1	1			
9	**C-4 / 0.75-0.85**	17/03/2016 0:00	S	None	1 bag	1								
10	**C-4 / 0.9-1.0**	17/03/2016 0:00	S	None	1 bag	1	1							
11	**C-3 / 0.0-0.1**	17/03/2016 0:00	S	None	1 bag	1	1	1	1	1				
12	**C-3 / 0.25-0.35**	17/03/2016 0:00	S	None	1 bag	1								
13	**C-3 / 0.5-0.6**	17/03/2016 0:00	S	None	1 bag	1	1							
14	**C-3 / 0.75-0.85**	17/03/2016 0:00	S	None	1 bag	1								
15	**C-3 / 0.9-1.0**	17/03/2016 0:00	S	None	1 bag	1	1	1	1	1	1			
16	**D1A**	17/03/2016 0:00	S	None	1 bag	1	1							
					TOTAL	**16**	**10**	**6**	**6**	**6**	**6**			

18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33



Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

SAMPLE RECEIPT NOTIFICATION

Attention : Alex Kochnieff

Client : WorleyParsons Services Pty Ltd
Level 3, 60 Albert Street
Brisbane QLD 4000
Telephone : 07 3036 3433
Facsimile : 07 3221 7791

Project : Sediment Analysis - 301310-09537
Order Number :

Laboratory Reference : A16/1325

Completed Chain of Custody accompanied samples.	**YES**
Samples were received in good condition and correctly preserved for all tests.	**YES**
Samples were received in sufficient time to allow laboratory to meet holding times.	**YES**
Samples were received chilled/chilling (if required).	**YES**

Date samples received : **15, 17&21/03/2016**
Matrix : **Marine Sediment**
No. of samples : **33**
Scheduled reporting date : **7/04/2016**

Client Services Manager : **Trent Biggin**

Telephone : 02 9888 9077
Email : ryan.tombs@advancedanalytical.com.au

Contact your Client Services Manager for all queries and issues regarding this sample batch.

Note: Turnaround time begins at time of receipt at laboratory, surcharges may apply for fast turnaround.

Water samples will be appropriately stored for 1 month from date of receipt of samples.
Soil / Sediment samples will be appropriately stored for 3 months from date of receipt of samples.

COMMENTS:

Advanced Analytical Australia Pty Ltd
ABN 20 105 644 979
11 Julius Avenue
North Ryde NSW 2113 Australia

Ph: + 61 2 9888 9077
Fax: + 61 2 9888 9577
contact@advancedanalytical.com.au
www.advancedanalytical.com.au

12 Ashley Street, Chatswood, NSW 2067
tel: +61 2 9910 6200

email: sydney@envirolab.com.au
envirolab.com.au

Envirolab Services Pty Ltd - Sydney | ABN 37 112 535 645

CERTIFICATE OF ANALYSIS 143449

Client:

Advanced Analytical Aust. Pty Ltd
11 Julius Ave
North Ryde
NSW 2113

Attention: Trent Biggin

Sample log in details:

Your Reference:	**A16/1325**		
No. of samples:	33 soils		
Date samples received / completed instructions received	17/03/16	/	17/03/16

This report replaces R00 due the addition of samples #18-33.

Analysis Details:

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

Report Details:

Date results requested by: / Issue Date:	24/03/16	/	31/03/16
Date of Preliminary Report:	Not Issued		

NATA accreditation number 2901. This document shall not be reproduced except in full.
Accredited for compliance with ISO/IEC 17025. **Tests not covered by NATA are denoted with *.**

Results Approved By:

Jacinta Hurst
Laboratory Manager

sPOCAS field test						
Our Reference:	UNITS	143449-1	143449-2	143449-3	143449-4	143449-5
Your Reference	---------- -	A16/1325/1	A16/1325/2	A16/1325/3	A16/1325/4	A16/1325/5
Sample ID	----------	G-2	C-2	C-2	C-2	C-2
Depth	-	-	0.0-0.1	0.25-0.35	0.5-0.6	0.75-0.85
Date Sampled		14/03/2016	14/03/2016	14/03/2016	14/03/2016	14/03/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/03/2016	21/03/2016	21/03/2016	21/03/2016	21/03/2016
Date analysed	-	21/03/2016	21/03/2016	21/03/2016	21/03/2016	21/03/2016
pH_F (field pH test)*	pH Units	8.7	8.5	8.4	8.5	8.6
pH_{FOX} (field peroxide test)*	pH Units	7.3	7.5	7.7	7.6	7.8
Reaction Rate*	-	Slight	High	High	High	High

sPOCAS field test						
Our Reference:	UNITS	143449-6	143449-7	143449-8	143449-9	143449-10
Your Reference	---------- -	A16/1325/6	A16/1325/7	A16/1325/8	A16/1325/9	A16/1325/10
Sample ID	----------	C-2	G-1	G-3	G-4	G-5
Depth		0.9-1.0	-	-	-	-
Date Sampled		14/03/2016	16/03/2016	16/03/2016	16/03/2016	16/03/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/03/2016	21/03/2016	21/03/2016	21/03/2016	21/03/2016
Date analysed	-	21/03/2016	21/03/2016	21/03/2016	21/03/2016	21/03/2016
pH_F (field pH test)*	pH Units	8.7	8.7	8.8	9.2	8.9
pH_{FOX} (field peroxide test)*	pH Units	7.6	6.4	6.5	6.5	6.4
Reaction Rate*	-	High	Slight	Slight	Slight	Slight

sPOCAS field test						
Our Reference:	UNITS	143449-11	143449-12	143449-13	143449-14	143449-15
Your Reference	---------- -	A16/1325/11	A16/1325/12	A16/1325/13	A16/1325/14	A16/1325/15
Sample ID	----------	G-6	G-7	G-8	G-9	G-10
Depth		-	-	-	-	-
Date Sampled		16/03/2016	16/03/2016	16/03/2016	16/03/2016	16/03/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/03/2016	21/03/2016	21/03/2016	21/03/2016	21/03/2016
Date analysed	-	21/03/2016	21/03/2016	21/03/2016	21/03/2016	21/03/2016
pH_F (field pH test)*	pH Units	9.0	9.3	9.3	9.3	9.2
pH_{FOX} (field peroxide test)*	pH Units	6.6	6.5	6.5	6.5	6.5
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test						
Our Reference:	UNITS	143449-16	143449-17	143449-18	143449-19	143449-20
Your Reference	---------- -	A16/1325/16	A16/1325/17	A16/1325/18	A16/1325/19	A16/1325/20
Sample ID	----------	G-11	G-12	C-1	C-1	C-1
Depth		-	-	0.0-0.1	0.25-0.35	0.5-0.6
Date Sampled		16/03/2016	16/03/2016	17/03/2016	17/03/2016	17/03/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	21/03/2016	21/03/2016	29/03/2016	29/03/2016	29/03/2016
Date analysed	-	21/03/2016	21/03/2016	29/03/2016	29/03/2016	29/03/2016
pH_F (field pH test)*	pH Units	9.2	9.2	8.7	9.1	9.2
pH_{FOX} (field peroxide test)*	pH Units	6.5	6.3	7.6	8.2	7.6
Reaction Rate*	-	Slight	Slight	Slight	Slight	Slight

sPOCAS field test						
Our Reference:	UNITS	143449-21	143449-22	143449-23	143449-24	143449-25
Your Reference	---------- -	A16/1325/21	A16/1325/22	A16/1325/23	A16/1325/24	A16/1325/25
Sample ID	----------	C-1	C-1	C-4	C-4	C-4
Depth		0.75-0.85	0.9-1.0	0.0-0.1	0.25-0.35	0.5-0.6
Date Sampled		17/03/2016	17/03/2016	17/03/2016	17/03/2016	17/03/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	29/03/2016	29/03/2016	29/03/2016	29/03/2016	29/03/2016
Date analysed	-	29/03/2016	29/03/2016	29/03/2016	29/03/2016	29/03/2016
pH_F (field pH test)*	pH Units	9.2	9.0	9.0	8.5	9.0
pH_{FOX} (field peroxide test)*	pH Units	8.1	7.9	7.8	7.8	7.7
Reaction Rate*	-	Slight	Slight	High	High	High

sPOCAS field test						
Our Reference:	UNITS	143449-26	143449-27	143449-28	143449-29	143449-30
Your Reference	---------- -	A16/1325/26	A16/1325/27	A16/1325/28	A16/1325/29	A16/1325/30
Sample ID	----------	C-4	C-4	C-3	C-3	C-3
Depth		0.75-0.85	0.9-1.0	0.0-0.1	0.25-0.35	0.5-0.6
Date Sampled		17/03/2016	17/03/2016	17/03/2016	17/03/2016	17/03/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	29/03/2016	29/03/2016	29/03/2016	29/03/2016	29/03/2016
Date analysed	-	29/03/2016	29/03/2016	29/03/2016	29/03/2016	29/03/2016
pH_F (field pH test)*	pH Units	8.6	9.0	9.0	8.6	8.7
pH_{FOX} (field peroxide test)*	pH Units	7.7	7.6	7.6	7.3	7.5
Reaction Rate*	-	High	High	Slight	High	High

sPOCAS field test				
Our Reference:	UNITS	143449-31	143449-32	143449-33
Your Reference	----------	A16/1325/31	A16/1325/32	A16/1325/33
	-			
Sample ID	----------	C-3	C-3	D1A
Depth		0.75-0.85	0.9-1.0	-
Date Sampled		17/03/2016	17/03/2016	17/03/2016
Type of sample		Soil	Soil	Soil
Date prepared	-	29/03/2016	29/03/2016	29/03/2016
Date analysed	-	29/03/2016	29/03/2016	29/03/2016
pH_F (field pH test)*	pH Units	8.7	8.5	8.8
pH_{FOX} (field peroxide test)*	pH Units	7.6	7.4	7.8
Reaction Rate*	-	High	High	High

Client Reference: A16/1325

Chromium Suite						
Our Reference:	UNITS	143449-1	143449-2	143449-4	143449-6	143449-7
Your Reference	---------- -	A16/1325/1	A16/1325/2	A16/1325/4	A16/1325/6	A16/1325/7
Sample ID	----------	G-2	C-2	C-2	C-2	G-1
Depth		-	0.0-0.1	0.5-0.6	0.9-1.0	-
Date Sampled		14/03/2016	14/03/2016	14/03/2016	14/03/2016	16/03/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/03/2016	22/03/2016	22/03/2016	22/03/2016	22/03/2016
Date analysed	-	22/03/2016	22/03/2016	22/03/2016	22/03/2016	22/03/2016
pH $_{kcl}$	pH units	9.1	8.9	9.0	9.0	9.0
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
TAA pH 6.5	moles H^+/t	<5	<5	<5	<5	<5
Chromium Reducible Sulfur	%w/w	0.12	0.22	0.18	0.15	0.20
a-Chromium Reducible Sulfur	moles H^+/t	77	140	110	93	120
S_{KCl}	%w/w S	0.16	0.13	0.039	0.017	0.20
ANC_{BT}	% $CaCO_3$	11	15	18	17	17
s-ANC_{BT}	%w/w S	3.5	4.7	5.6	5.3	5.4
s-Net Acidity	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	<10	<10	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75
a-Net Acidity without ANCE	moles H^+/t	77	140	110	93	120
Liming rate without ANCE	kg $CaCO_3$/t	5.8	10	8.6	7.0	9.3

Client Reference: A16/1325

Chromium Suite						
Our Reference:	UNITS	143449-8	143449-9	143449-10	143449-11	143449-12
Your Reference	---------- -	A16/1325/8	A16/1325/9	A16/1325/10	A16/1325/11	A16/1325/12
Sample ID	----------	G-3	G-4	G-5	G-6	G-7
Depth		-	-	-	-	-
Date Sampled		16/03/2016	16/03/2016	16/03/2016	16/03/2016	16/03/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/03/2016	22/03/2016	22/03/2016	22/03/2016	22/03/2016
Date analysed	-	22/03/2016	22/03/2016	22/03/2016	22/03/2016	22/03/2016
pH $_{kcl}$	pH units	9.1	9.4	9.2	9.4	9.6
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
TAA pH 6.5	moles H^+/t	<5	<5	<5	<5	<5
Chromium Reducible Sulfur	%w/w	0.14	0.01	0.12	<0.005	0.03
a-Chromium Reducible Sulfur	moles H^+/t	89	7	77	<3	21
S_{KCl}	%w/w S	0.16	0.072	0.16	0.094	0.037
ANC_{BT}	% $CaCO_3$	16	11	17	16	7.0
s-ANC_{BT}	%w/w S	5.1	3.4	5.6	5.3	2.2
s-Net Acidity	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	<10	<10	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75
a-Net Acidity without ANCE	moles H^+/t	89	<10	77	<10	21
Liming rate without ANCE	kg $CaCO_3$/t	6.7	<0.75	5.8	<0.75	1.6

Chromium Suite						
Our Reference:	UNITS	143449-13	143449-14	143449-15	143449-16	143449-17
Your Reference	---------- -	A16/1325/13	A16/1325/14	A16/1325/15	A16/1325/16	A16/1325/17
Sample ID	----------	G-8	G-9	G-10	G-11	G-12
Depth		-	-	-	-	-
Date Sampled		16/03/2016	16/03/2016	16/03/2016	16/03/2016	16/03/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	22/03/2016	22/03/2016	22/03/2016	22/03/2016	22/03/2016
Date analysed	-	22/03/2016	22/03/2016	22/03/2016	22/03/2016	22/03/2016
pH $_{kcl}$	pH units	9.6	9.7	9.6	9.8	9.8
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
TAA pH 6.5	moles H^+/t	<5	<5	<5	<5	<5
Chromium Reducible Sulfur	%w/w	0.02	0.01	<0.005	0.006	0.01
a-Chromium Reducible Sulfur	moles H^+/t	13	9	<3	4	7
S_{KCl}	%w/w S	0.058	0.048	0.040	0.032	0.025
ANC_{BT}	% $CaCO_3$	8.3	6.9	11	7.5	3.5
s-ANC_{BT}	%w/w S	2.7	2.2	3.5	2.4	1.1
s-Net Acidity	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	<10	<10	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75
a-Net Acidity without ANCE	moles H^+/t	13	<10	<10	<10	<10
Liming rate without ANCE	kg $CaCO_3$/t	0.94	<0.75	<0.75	<0.75	<0.75

Chromium Suite						
Our Reference:	UNITS	143449-18	143449-20	143449-22	143449-23	143449-25
Your Reference	---------- -	A16/1325/18	A16/1325/20	A16/1325/22	A16/1325/23	A16/1325/25
Sample ID	----------	C-1	C-1	C-1	C-4	C-4
Depth		0.0-0.1	0.5-0.6	0.9-1.0	0.0-0.1	0.5-0.6
Date Sampled		17/03/2016	17/03/2016	17/03/2016	17/03/2016	17/03/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/03/2016	23/03/2016	23/03/2016	23/03/2016	23/03/2016
Date analysed	-	30/03/2016	30/03/2016	30/03/2016	30/03/2016	30/03/2016
pH $_{kcl}$	pH units	9.3	9.6	9.4	9.1	9.0
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
TAA pH 6.5	moles H^+/t	<5	<5	<5	<5	<5
Chromium Reducible Sulfur	%w/w	0.05	0.02	0.04	0.11	0.16
a-Chromium Reducible Sulfur	moles H^+/t	30	10	24	67	98
S_{KCl}	%w/w S	0.11	0.049	0.090	0.096	0.080
ANC_{BT}	% $CaCO_3$	5.0	2.6	3.8	16	17
s-ANC_{BT}	%w/w S	1.6	0.84	1.2	5.2	5.5
s-Net Acidity	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	<10	<10	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75
a-Net Acidity without ANCE	moles H^+/t	30	10	24	67	98
Liming rate without ANCE	kg $CaCO_3$/t	2.3	0.75	1.8	5.1	7.4

Chromium Suite						
Our Reference:	UNITS	143449-27	143449-28	143449-30	143449-32	143449-33
Your Reference	---------- -	A16/1325/27	A16/1325/28	A16/1325/30	A16/1325/32	A16/1325/33
Sample ID	----------	C-4	C-3	C-3	C-3	D1A
Depth		0.9-1.0	0.0-0.1	0.5-0.6	0.9-1.0	-
Date Sampled		17/03/2016	17/03/2016	17/03/2016	17/03/2016	17/03/2016
Type of sample		Soil	Soil	Soil	Soil	Soil
Date prepared	-	23/03/2016	23/03/2016	23/03/2016	23/03/2016	23/03/2016
Date analysed	-	30/03/2016	30/03/2016	30/03/2016	30/03/2016	30/03/2016
pH $_{kcl}$	pH units	8.9	9.3	8.7	8.9	8.9
s-TAA pH 6.5	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
TAA pH 6.5	moles H^+/t	<5	<5	<5	<5	<5
Chromium Reducible Sulfur	%w/w	0.29	0.06	0.19	0.23	0.33
a-Chromium Reducible Sulfur	moles H^+/t	180	38	120	140	210
S_{KCl}	%w/w S	0.091	0.12	0.078	0.12	0.11
ANC_{BT}	% $CaCO_3$	16	11	9.3	16	15
s-ANC_{BT}	%w/w S	5.0	3.5	3.0	5.2	5.0
s-Net Acidity	%w/w S	<0.01	<0.01	<0.01	<0.01	<0.01
a-Net Acidity	moles H^+/t	<10	<10	<10	<10	<10
Liming rate	kg $CaCO_3$/t	<0.75	<0.75	<0.75	<0.75	<0.75
a-Net Acidity without ANCE	moles H^+/t	180	38	120	140	210
Liming rate without ANCE	kg $CaCO_3$/t	14	2.9	8.9	11	16

Method ID	Methodology Summary
Inorg-063	pH- measured using pH meter and electrode. Soil is oxidised with Hydrogen Peroxide or extracted with water. Based on section H, Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004. To ensure accurate results these tests are recommended to be done in the field as pH may change with time thus these results may not be representative of true field conditions.
Inorg-068	Chromium Reducible Sulfur - Hydrogen Sulfide is quantified by iodometric titration after distillation to determine potential acidity. Based on Acid Sulfate Soils Laboratory Methods Guidelines, Version 2.1 - June 2004.

Client Reference: A16/1325

QUALITY CONTROL sPOCAS field test	UNITS	PQL	METHOD	Blank
Date prepared	-			[NT]
Date analysed	-			[NT]
pH_F (field pH test)*	pH Units		Inorg-063	[NT]
pH_{FOX} (field peroxide test)*	pH Units		Inorg-063	[NT]

QUALITY CONTROL Chromium Suite	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base II Duplicate II %RPD	Spike Sm#	Spike % Recovery
Date prepared	-			22/03/2016	143449-1	22/03/2016 || 22/03/2016	LCS-1	22/03/2016
Date analysed	-			22/03/2016	143449-1	22/03/2016 || 22/03/2016	LCS-1	22/03/2016
pH_{kcl}	pH units		Inorg-068	[NT]	143449-1	9.1 || 9.2 || RPD: 1	LCS-1	102%
s-TAA pH 6.5	%w/w S	0.01	Inorg-068	<0.01	143449-1	<0.01 || <0.01	[NR]	[NR]
TAA pH 6.5	moles H^+/t	5	Inorg-068	<5	143449-1	<5 || <5	LCS-1	91%
Chromium Reducible Sulfur	%w/w	0.005	Inorg-068	<0.005	143449-1	0.12 || 0.13 || RPD: 8	LCS-1	128%
a-Chromium Reducible Sulfur	moles H^+/t	3	Inorg-068	<3	143449-1	77 || 81 || RPD: 5	[NR]	[NR]
S_{HCl}	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NR]	[NR]
S_{KCl}	%w/w S	0.005	Inorg-068	<0.005	143449-1	0.16 || 0.16 || RPD: 0	[NR]	[NR]
S_{NAS}	%w/w S	0.005	Inorg-068	<0.005	[NT]	[NT]	[NR]	[NR]
ANC_{BT}	% $CaCO_3$	0.05	Inorg-068	<0.05	143449-1	11 || 11 || RPD: 0	[NR]	[NR]
s-ANC_{BT}	%w/w S	0.05	Inorg-068	<0.05	143449-1	3.5 || 3.5 || RPD: 0	[NR]	[NR]
s-Net Acidity	%w/w S	0.01	Inorg-068	<0.01	143449-1	<0.01 || <0.01	[NR]	[NR]
a-Net Acidity	moles H^+/t	10	Inorg-068	<10	143449-1	<10 || <10	[NR]	[NR]
Liming rate	kg $CaCO_3$/t	0.75	Inorg-068	<0.75	143449-1	<0.75 || <0.75	[NR]	[NR]
a-Net Acidity without ANCE	moles H^+/t	10	Inorg-068	<10	143449-1	77 || 81 || RPD: 5	[NR]	[NR]
Liming rate without ANCE	kg $CaCO_3$/t	0.75	Inorg-068	<0.75	143449-1	5.8 || 6.1 || RPD: 5	[NR]	[NR]

QUALITY CONTROL Chromium Suite	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
Date prepared	-	143449-16	22/03/2016 || 22/03/2016	LCS-2	23/03/2016
Date analysed	-	143449-16	22/03/2016 || 22/03/2016	LCS-2	30/03/2016
pH_{kcl}	pH units	143449-16	9.8 || 9.8 || RPD: 0	LCS-2	102%
s-TAA pH 6.5	%w/w S	143449-16	<0.01 || <0.01	[NR]	[NR]

QUALITY CONTROL Chromium Suite	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD	Spike Sm#	Spike % Recovery
TAA pH 6.5	moles H^+/t	143449-16	<5 || <5	LCS-2	88%
Chromium Reducible Sulfur	%w/w	143449-16	0.006 || 0.01 || RPD: 50	LCS-2	124%
a-Chromium Reducible Sulfur	moles H^+/t	143449-16	4 || 8 || RPD: 67	[NR]	[NR]
S_{KCl}	%w/w S	143449-16	0.032 || 0.033 || RPD: 3	[NR]	[NR]
ANC_{BT}	% $CaCO_3$	143449-16	7.5 || 7.5 || RPD: 0	[NR]	[NR]
s-ANC_{BT}	%w/w S	143449-16	2.4 || 2.4 || RPD: 0	[NR]	[NR]
s-Net Acidity	%w/w S	143449-16	<0.01 || <0.01	[NR]	[NR]
a-Net Acidity	moles H^+/t	143449-16	<10 || <10	[NR]	[NR]
Liming rate	kg $CaCO_3$/t	143449-16	<0.75 || <0.75	[NR]	[NR]
a-Net Acidity without ANCE	moles H^+/t	143449-16	<10 || <10	[NR]	[NR]
Liming rate without ANCE	kg $CaCO_3$/t	143449-16	<0.75 || <0.75	[NR]	[NR]

QUALITY CONTROL Chromium Suite	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Date prepared	-	143449-18	23/03/2016 || 23/03/2016
Date analysed	-	143449-18	30/03/2016 || 30/03/2016
pH_{kcl}	pH units	143449-18	9.3 || 9.3 || RPD: 0
s-TAA pH 6.5	%w/w S	143449-18	<0.01 || <0.01
TAA pH 6.5	moles H^+/t	143449-18	<5 || <5
Chromium Reducible Sulfur	%w/w	143449-18	0.05 || 0.05 || RPD: 0
a-Chromium Reducible Sulfur	moles H^+/t	143449-18	30 || 30 || RPD: 0
S_{HCl}	%w/w S	[NT]	[NT]
S_{KCl}	%w/w S	143449-18	0.11 || 0.11 || RPD: 0
S_{NAS}	%w/w S	[NT]	[NT]
ANC_{BT}	% $CaCO_3$	143449-18	5.0 || 5.3 || RPD: 6
s-ANC_{BT}	%w/w S	143449-18	1.6 || 1.7 || RPD: 6
s-Net Acidity	%w/w S	143449-18	<0.01 || <0.01
a-Net Acidity	moles H^+/t	143449-18	<10 || <10
Liming rate	kg $CaCO_3$/t	143449-18	<0.75 || <0.75
a-Net Acidity without ANCE	moles H^+/t	143449-18	30 || 30 || RPD: 0

QUALITY CONTROL Chromium Suite	UNITS	Dup. Sm#	Duplicate Base + Duplicate + %RPD
Liming rate without ANCE	kg $CaCO_3$ /t	143449-18	2.3 || 2.2 || RPD: 4

Report Comments:

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

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

Quality Control Definitions

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

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

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

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

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

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however, were analysed at a frequency to meet or exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD and matrix spike recoveries for the batch were within the laboratory acceptance criteria.
Filters, swabs, wipes, tubes and badges will not have duplicate data as the whole sample is generally extracted during sample extraction.
Spikes for Physical and Aggregate Tests are not applicable.
For VOCs in water samples, three vials are required for duplicate or spike analysis.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spikes, LCS and Surrogate recoveries: Generally 70-130% for inorganics/metals; 60-140% for organics (+/-50% surrogates) and 10-140% for labile SVOCs (including labile surrogates), ultra trace organics and speciated phenols is acceptable.

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

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

Where sampling dates are not provided, Envirolab are not in a position to comment on the validity of the analysis where recommended technical holding times may have been breached.

REPORT OF ANALYSIS

Laboratory Reference: A16/1325 [R00]

Client: WorleyParsons Services Pty Ltd
Level 3, 60 Albert Street
Brisbane QLD 4000

Contact: Alex Kochnieff

Project: Sediment Analysis - 301310-09537
Sample Type: Marine Sediment
No. of Samples: 33
Date Received: 15, 17 & 18/03/2016
Date Completed: 5/04/2016

Laboratory Contact Details:

Client Services Manager: Trent Biggin
Technical Enquiries: Andrew Bradbury
Telephone: +61 7 3268 1228
Fax: +61 7 3268 1238
Email: brisbane@advancedanalytical.com.au
andrew.bradbury@advancedanalytical.com.au

Attached Results Approved By:

Rama Nimmagadda
Technical Manager

Comments:
All samples tested as submitted by client.
All attached results have been checked and approved for release.
This is the Final Report and supersedes any reports previously issued with this reference number.

Advanced Analytical Australia Pty Ltd
ABN 20 105 644 979
11 Julius Avenue
North Ryde NSW 2113 Australia

Ph: + 61 2 9888 9077
Fax: + 61 2 9888 9577
contact@advancedanalytical.com.au
www.advancedanalytical.com.au

Batch Number: A16/1325 [R00]
Project Reference: Sediment Analysis - 301310-09537

Laboratory Reference:	-	-	**/1**	**/2**	**/3**	**/4**
Client Reference:	-	-	**G-2**	**C-2 / 0.0-0.1**	**C-2 / 0.25-0.35**	**C-2 / 0.5-0.6**
Analysis Description	- **Method**	- **Units**				
Subcontract Sediment Analysis						
Organic Matter	SUB	%	2	2	[NA]	[NA]
Salinity (Total Soluble Salts)	SUB	mg/Kg	37,200	37,300	[NA]	[NA]
Chloride^	SUB	mg/kg	22,300	22,600	[NA]	[NA]
Conductivity^	SUB	µS/cm	11400	11500	[NA]	[NA]
Chromium Reducible Suite^	SUB		See Comments	See Comments	[NA]	See Comments
pHf (field pH test)^	SUB	pH units	Comments	Comments	Comments	Comments
pHfox (field peroxide test)^	SUB	pH units	Comments	Comments	Comments	Comments

Laboratory Reference:	-	-	**/5**	**/6**	**/7**	**/8**
Client Reference:	-	-	**C-2 / 0.75-0.85**	**C-2 / 0.9-1.0**	**G-1**	**G-3**
Analysis Description	- **Method**	- **Units**				
Subcontract Sediment Analysis						
Organic Matter	SUB	%	[NA]	2	2	2
Salinity (Total Soluble Salts)	SUB	mg/Kg	[NA]	37,000	50,600	37,200
Chloride^	SUB	mg/kg	[NA]	22,200	31,800	22,700
Conductivity^	SUB	µS/cm	[NA]	11400	15600	11500
Chromium Reducible Suite^	SUB		[NA]	See Comments	See Comments	See Comments
pHf (field pH test)^	SUB	pH units	Comments	Comments	Comments	Comments
pHfox (field peroxide test)^	SUB	pH units	Comments	Comments	Comments	Comments

Advanced Analytical Australia Pty Ltd
ABN 20 105 644 979
11 Julius Avenue
North Ryde NSW 2113 Australia
Ph: + 61 2 9888 9077
Fax: + 61 2 9888 9577
contact@advancedanalytical.com.au
www.advancedanalytical.com.au

Batch Number: A16/1325 [R00]
Project Reference: Sediment Analysis - 301310-09537

Laboratory Reference:	-	-	**/9**	**/10**	**/11**	**/12**
Client Reference:	-	-	**G-4**	**G-5**	**G-6**	**G-7**
Analysis Description	- **Method**	- **Units**				
Subcontract Sediment Analysis						
Organic Matter	SUB	%	1	2	1	0
Salinity (Total Soluble Salts)	SUB	mg/Kg	18,500	31,700	17,200	11,200
Chloride^	SUB	mg/kg	9,880	17,900	9,480	5,240
Conductivity^	SUB	µS/cm	5690	9750	5290	3450
Chromium Reducible Suite^	SUB		See Comments	See Comments	See Comments	See Comments
pHf (field pH test)^	SUB	pH units	Comments	Comments	Comments	Comments
pHfox (field peroxide test)^	SUB	pH units	Comments	Comments	Comments	Comments

Laboratory Reference:	-	-	**/13**	**/14**	**/15**	**/16**
Client Reference:	-	-	**G-8**	**G-9**	**G-10**	**G-11**
Analysis Description	- **Method**	- **Units**				
Subcontract Sediment Analysis						
Organic Matter	SUB	%	0	0	0	0
Salinity (Total Soluble Salts)	SUB	mg/Kg	12,500	11,200	13,000	10,400
Chloride^	SUB	mg/kg	6,180	4,940	6,750	5,530
Conductivity^	SUB	µS/cm	3850	3450	4010	3190
Chromium Reducible Suite^	SUB		See Comments	See Comments	See Comments	See Comments
pHf (field pH test)^	SUB	pH units	Comments	Comments	Comments	Comments
pHfox (field peroxide test)^	SUB	pH units	Comments	Comments	Comments	Comments

Advanced Analytical Australia Pty Ltd
ABN 20 105 644 979
11 Julius Avenue
North Ryde NSW 2113 Australia

Ph: + 61 2 9888 9077
Fax: + 61 2 9888 9577
contact@advancedanalytical.com.au
www.advancedanalytical.com.au

Batch Number: A16/1325 [R00]
Project Reference: Sediment Analysis - 301310-09537

Laboratory Reference:	-	-	**/17**	**/18**	**/19**	**/20**
Client Reference:	-	-	**G-12**	**C-1 / 0.0-0.1**	**C-1 / 0.25-0.35**	**C-1 / 0.5-0.6**
Analysis Description	- **Method**	- **Units**				
Subcontract Sediment Analysis						
Organic Matter	SUB	%	0	1	[NA]	[NA]
Salinity (Total Soluble Salts)	SUB	mg/Kg	9,490	16,800	[NA]	[NA]
Chloride^	SUB	mg/kg	4,990	7,900	[NA]	[NA]
Conductivity^	SUB	µS/cm	2920	5170	[NA]	[NA]
Chromium Reducible Suite^	SUB		See Comments	See Comments	See Comments	See Comments
pHf (field pH test)^	SUB	pH units	Comments	Comments	Comments	Comments
pHfox (field peroxide test)^	SUB	pH units	Comments	Comments	Comments	Comments

Laboratory Reference:	-	-	**/21**	**/22**	**/23**	**/24**
Client Reference:	-	-	**C-1 / 0.75-0.85**	**C-1 / 0.9-1.0**	**C-4 / 0.0-0.1**	**C-4 / 0.25-0.35**
Analysis Description	- **Method**	- **Units**				
Subcontract Sediment Analysis						
Organic Matter	SUB	%	[NA]	0	2	[NA]
Salinity (Total Soluble Salts)	SUB	mg/Kg	[NA]	11,400	28,100	[NA]
Chloride^	SUB	mg/kg	[NA]	5,250	13,700	[NA]
Conductivity^	SUB	µS/cm	[NA]	3510	8650	[NA]
Chromium Reducible Suite^	SUB		See Comments	See Comments	See Comments	See Comments
pHf (field pH test)^	SUB	pH units	Comments	Comments	Comments	Comments
pHfox (field peroxide test)^	SUB	pH units	Comments	Comments	Comments	Comments

Advanced Analytical Australia Pty Ltd
ABN 20 105 644 979
11 Julius Avenue
North Ryde NSW 2113 Australia
Ph: + 61 2 9888 9077
Fax: + 61 2 9888 9577
contact@advancedanalytical.com.au
www.advancedanalytical.com.au

Batch Number: A16/1325 [R00]
Project Reference: Sediment Analysis - 301310-09537

Laboratory Reference: **Client Reference:** **Analysis Description**	- - **Method**	- - **Units**	**/25** **C-4 / 0.5-0.6**	**/26** **C-4 / 0.75-0.85**	**/27** **C-4 / 0.9-1.0**	**/28** **C-3 / 0.0-0.1**
Subcontract Sediment Analysis						
Organic Matter	SUB	%	2	[NA]	[NA]	1
Salinity (Total Soluble Salts)	SUB	mg/Kg	36,600	[NA]	[NA]	14,800
Chloride^	SUB	mg/kg	21,700	[NA]	[NA]	7,000
Conductivity^	SUB	µS/cm	11300	[NA]	[NA]	4550
Chromium Reducible Suite^	SUB		See Comments	See Comments	See Comments	See Comments
pHf (field pH test)^	SUB	pH units	Comments	Comments	Comments	Comments
pHfox (field peroxide test)^	SUB	pH units	Comments	Comments	Comments	Comments

Laboratory Reference: **Client Reference:** **Analysis Description**	- - **Method**	- - **Units**	**/29** **C-3 / 0.25-0.35**	**/30** **C-3 / 0.5-0.6**	**/31** **C-3 / 0.75-0.85**	**/32** **C-3 / 0.9-1.0**
Subcontract Sediment Analysis						
Organic Matter	SUB	%	[NA]	[NA]	[NA]	2
Salinity (Total Soluble Salts)	SUB	mg/Kg	[NA]	[NA]	[NA]	29,400
Chloride^	SUB	mg/kg	[NA]	[NA]	[NA]	15,400
Conductivity^	SUB	µS/cm	[NA]	[NA]	[NA]	9050
Chromium Reducible Suite^	SUB		See Comments	See Comments	See Comments	See Comments
pHf (field pH test)^	SUB	pH units	Comments	Comments	Comments	Comments
pHfox (field peroxide test)^	SUB	pH units	Comments	Comments	Comments	Comments

Advanced Analytical Australia Pty Ltd
ABN 20 105 644 979
11 Julius Avenue
North Ryde NSW 2113 Australia

Ph: + 61 2 9888 9077
Fax: + 61 2 9888 9577
contact@advancedanalytical.com.au
www.advancedanalytical.com.au

Batch Number: A16/1325 [R00]
Project Reference: Sediment Analysis - 301310-09537

Laboratory Reference: **Client Reference:** **Analysis Description**	- - - **Method**	- - - **Units**	**/33** **D1A**
Subcontract Sediment Analysis			
Chromium Reducible Suite^	SUB		See Comments
pHf (field pH test)^	SUB	pH units	Comments
pHfox (field peroxide test)^	SUB	pH units	Comments

Method	Method Description
SUB	Subcontracted Analysis

Result Comments

[<] Less than
[INS] Insufficient sample for this test
[NA] Test not required

Acid Sulfate Soil analysis was subcontracted to Envirolab Services (NATA Number 2901); reference Envirolab certificate number 143449.

Analysis was subcontracted to Sydney Analytical Laboratories (NATA Number 1884); reference SAL report number SAL25867B.

Advanced Analytical Australia Pty Ltd
ABN 20 105 644 979
11 Julius Avenue
North Ryde NSW 2113 Australia

Ph: + 61 2 9888 9077
Fax: + 61 2 9888 9577
contact@advancedanalytical.com.au
www.advancedanalytical.com.au