

6 March 2017

The Director
Williamtown Sand Syndicate Pty Ltd.
PO Box 898
Newcastle NSW 2300

Attention: Mr Darren Williams

Dear Darren,

**RE: PRELIMINARY RESOURCE ASSESSMENT
PROPOSED SAND EXTRACTION – CABBAGE TREE ROAD, WILLIAMTOWN**

Please find enclosed our Preliminary Resource Assessment report for the proposed Sand Extraction Site located off Cabbage Tree Road, Williamtown.

The report includes a desktop study of existing geotechnical report and testing results already conducted for the site. It provides a summary of the potential quarry resource, including test results, descriptions and discussion of the engineering properties of the sand encountered during previous drilling investigations performed within the resource, and provides a preliminary assessment of the suitability of the resource for uses in the glass making, concrete, asphalt, sealing, road building and construction industry.

If you have any questions regarding this report, please do not hesitate to contact Alan Cullen or the undersigned.

For and on behalf of Qualtest Laboratory (NSW) Pty Ltd



Jason Lee
Principal Geotechnical Engineer



Alan Cullen
Principal Geotechnician

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1.0 Introduction

Qualtest Laboratory NSW Pty Ltd (Qualtest) is pleased to present this report on behalf of Williamtown Sand Syndicate Pty Ltd for the proposed Cabbage Tree Road sand extraction pit, to be located off Cabbage Tree Road, Williamtown.

The report includes a desktop study of existing testing results already conducted for the site. It provides a summary of the potential sand resource, including test results, descriptions and discussion of the engineering properties of sand types encountered during previous drilling investigations performed within the resource, and provides a preliminary assessment of the suitability of the resource for use in the glass making, concrete, asphalt, sealing, road building and construction industry.

2.0 Scope of Work

The scope of work has included a review of the existing test results previously supplied, along with eight new samples collected by the client from the resource and surrounding local supply locations, along with laboratory test results previously conducted.

TABLE 2.1 – SUMMARY OF PREVIOUS INVESTIGATIONS AND TESTING CARRIED OUT

| Report Reference | Contents |
|--|---|
| RCA Australia (RCA) Preliminary Geotechnical & Groundwater Investigation, Proposed Sand Extraction, Cabbage Tree Road, Williamtown Ref: RCA ref10059-201/2, 21 October 2015. | Geotechnical and Groundwater Investigation to provide geotechnical data for input into characterisation of resource along with groundwater levels and background groundwater quality for preparation of an EIS. Included borehole logs BH1 to BH12; |
| Geochempet Services (Geochempet) Petrographic Reports, November & December 2016 and Sietronics Pty Ltd. | Copies of test results from Petrographic Analysis of 2 samples and combined report using X-Ray Fluorescence data received from Sietronics Pty Ltd was prepared. |
| Qualtest Laboratory (NSW) Pty Ltd (Qualtest) Laboratory test reports for testing conducted by Qualtest and other specialist testing laboratories listed below in January 2016. Qualtest February 2018, 8 samples of sand from existing resources and surrounding locations. | Laboratory testing of samples retrieved from the boreholes, including: Clay & Fine Silt, Particle Size Distribution, Bulk Density, Particle Density and Water Absorption, Material Finer than 75µm, Organic Impurities. Particle Size Distribution testing. |

3.0 Potential Resource

3.1 Geological Setting

Reference to the Statewide Geology GIS data base and the Port Stephens 1:100,000 Geology sheet 9232, copyright to the Department of Industry and Investment (Minerals and Petroleum), indicates that the site is situated within the Tea Gardens and Shoal Bay aeolian sand landscapes associated with the Coastal Back Barrier System consisting of the following geological units either present on or near the site.

- Pleistocene Beach –(Qpbw) Comprising of Beach ridge swale and dune - deflation hollow: consisting of Marine Sand, indurated sand, organic mud, peat. This is shown as sub-cropping within the main deposit consisting of; -
- Pleistocene Dune –(Qpbd) – Comprising of Marine sand, and indurated sand. Shown as sub-cropping over the remainder of the site.
- These are the same geological units found at Tanilba Bay where Sibelco Australia are currently producing from.

3.2 Site Description

The site is located to the North of Cabbage Tree Road, Williamtown, between about 2.7km and 4.3km to the west of the intersection of Cabbage Tree Road and Nelson Bay Road.

Existing development in the vicinity of the site included residences along Cabbage Tree Road at the southern side of the site, together with residencies along Barrie Close to the west of the site. Newcastle Airport is located about 3-4km north-east of the site.

Topographically, the site and adjacent surrounding area comprises sand sheets and low undulating sand dunes on the coastal plain. The areas planned for extraction generally comprise of low undulating sand dunes.

Based on the plans provided, the existing ground surface elevations across the areas from which sand extraction is proposed are variable and range up to 8-9m AHD in proposed Extraction Area 1, 15m AHD in proposed Extraction Area 2, and up to 23m AHD in proposed Extraction Area 3.

Flatter low-lying areas with existing ground surface elevations typically in the order of 2-4m AHD are present to the north and south of proposed Extraction Area 1, between proposed Extraction Area 2 and Area 3, and to the south-east of proposed Extraction Area 3.

4.0 Discussion of Results

4.1 RCA Report – ref 10059-201/2, 21 October 2015

The subsurface profiles encountered in the boreholes performed by RCA at the site comprised of sands and sands with a trace of silt, of various colours. Some layers or lenses of indurated (weakly cemented) sand and silty sand were encountered at some locations.

The particle size distribution samples performed indicate that the majority of the sand tested from across the various proposed extraction zones was generally within the following gradation bands.

TABLE 4.1 – PARTICLE SIZE DISTRIBUTION TEST RESULTS

| Area | Borehole No | Depth (m) | Particle Size Distribution Silt & clay >0.075mm | Particle Size Distribution | Particle Size Distribution | Particle Size Distribution |
|-------------------|-------------|---------------|--|------------------------------------|--------------------------------------|--------------------------------------|
| | | | | Fine grained Sand 0.075 -0.21m* | Medium Grained Sand 0.21 – 0.60mm | Coarse grained Sand 0.60 – 2.36mm |
| Extraction Area 1 | BH 5 | 1.5 - 1.95m | 2 | 65 | 24 | 9 |
| | BH 8 | 3.0 - 3.45m | 2 | 27 | 70 | 1 |
| Extraction Area 2 | BH 1 | 6.0 - 6.45m | 3 | 28 | 66 | 3 |
| | BH 10 | 4.0 - 4.45m | 5 | 36 | 57 | 2 |
| Extraction Area 3 | BH 3 | 1.5 - 1.95m | 2 | 20 | 76 | 2 |
| | BH 9 | 1.0 - 1.45m | 2 | 19 | 77 | 2 |
| | BH 9 | 4.0 - 4.45m | 0 | 15 | 82 | 3 |
| | BH 9 | 8.5 - 8.95m | 1 | 19 | 78 | 2 |
| | BH 9 | 13.0 - 13.45m | 0 | 11 | 85 | 4 |

* The percent passing the AS1289 3.6.1 300µm test sieve from the RCA PSD's has been used for the calculation.

The grading curves from the particle size distribution testing were relatively similar and generally indicated that the sands at the site were fine to medium grained or medium grained.

4.2 Geochempet and Sietronics

Qualtest performed sampling from Extraction Area 1 and 2 in November 2016, and had two samples assessed by Geochempet for Petrographic analysis. The samples are believed to have originated from depths between 0.0m and 2.0m below the surface within the Area 2 extraction zone.

Further samples were also sent to Sietronics Pty Ltd who assessed the mineralogical footprint using X-Ray Fluorescence techniques. Geochempet later sent sub-samples of the two sands for further analysis to better quantify their chemical and mineralogical fingerprints, after removal of the coarse and ultra-fine fractions from the samples.

A sub-sample of each supplied sand samples was pulped in a non-steel crucible and then digested in acids to dissolve SiO₂, and the residue is fused for ICPAES analysis of impurities using ME-PKG85 method by ALS Chemex.

Additionally, cobalt, copper, manganese, nickel, vanadium and zinc were determined using method ME-ICP61. Loss of ignition at 1000C was determined by method OA-GRA05. The following results were obtained for ME-PKG85 and are (in weight percent).

TABLE 4.2.1 – CHEMICAL COMPOSITION TEST RESULTS

| Oxide WT.% | Sample S02 | Sample S04 |
|--------------------------------|------------|------------|
| SiO ₂ | 99.2% | 99.2% |
| Fe ₂ O ₃ | 0.09% | 0.084% |
| Al ₂ O ₃ | 0.273% | 0.218% |
| TiO ₂ | 0.18% | 0.208% |
| Cr ₂ O ₃ | 17ppm | 18ppm |
| Loss on ignition | 0.17% | 0.18% |

Note: The results of ME-ICP61 are (in ppm).

TABLE 4.2.2 – TRACE ELEMENT COMPOSITION TEST RESULTS

| Trace Element | Sample S02 | Sample S04 |
|---------------|------------|------------|
| Co | <1 | <1 |
| Cu | 2 | 1 |
| Mn | 9 | 10 |
| Ni | <1 | <1 |
| V | 4 | 3 |
| Zn | 2 | 3 |

Note: The results of ME-ICP61 are (in ppm).

The Geochempet summary of these results is that they compare favourably with silica sand supplied for manufacture of glass in the Newcastle area.

4.3 Qualtest Results (2016)

Qualtest performed four exploratory boreholes with Extraction Areas 1 & 2 in November 2016. Qualtest recovered samples to perform preliminary resource assessment with regards to suitability of the deposit for use within the construction and manufacturing industries.

Four boreholes were excavated by hand auger to 2.0m below the surface. The recovered samples are believed to have originated from depths between 0.0m and 2.0m below the surface from within Extraction Zone Areas 1 & 2.

The following testing was undertaken to make a preliminary assessment of the suitability of the sand for use within the construction and manufacturing industries. Results are shown below in Table 4.3.1.

TABLE 4.3.1 – PHYSICAL PROPERTY TEST RESULTS

| Description | Method | Sample S01 | Sample S02 | Sample S03 | Sample S04 | AS2758 - Uncrushed Fine Aggregate Specification |
|---|--------------------------|------------|------------|------------|------------|---|
| Uncompacted Bulk Density (t/m ³) | AS1141.4 | - | 1.54 | - | 1.49 | - |
| Compacted Bulk Density (t/m ³) | | - | 1.65 | - | 1.64 | - |
| Apparent Particle Density (t/m ³) | AS1141.5 | - | 2.63 | - | 2.64 | >2.1 |
| Particle Density Dry (t/m ³) | | - | 2.62 | - | 2.61 | >2.1 |
| Particle Density SSD (t/m ³) | | - | 2.62 | - | 2.62 | >2.1 |
| Water Absorption (%) | | - | 0.1 | - | 0.5 | 0- 2% |
| Particle Size Distribution | | | | | | |
| 9.5mm | AS1289.11.1- unwashed | 100 | 100 | 100 | 100 | 100 |
| 6.7mm | | 100 | 100 | 100 | 100 | - |
| 4.75mm | | 100 | 100 | 100 | 100 | 90 - 100 |
| 2.36mm | | 100 | 100 | 100 | 100 | 60 - 100 |
| 1.18mm | | 100 | 100 | 98 | 100 | 30 - 100 |
| 600 µm | | 99 | 99 | 77 | 99 | 15 - 100 |
| 425 µm | | 90 | 89 | 23 | 92 | - |
| 300 µm | | 33 | 43 | 0 | 43 | 5 - 50 |
| 150 µm | | 1 | 0 | 0 | 2 | 0 - 20 |
| 75 µm | | 0 | 0 | 0 | 0 | 0 - 5 |
| % finer 75 µm | AS1141.12 | - | 0 | - | 0 | 0 - 5 |
| Clay & Fine silt (%) | AS1141.33 | 5 | 1 | 2 | 1 | - |

In February 2018 Qualtest were asked to perform particle size distribution testing of sand samples recovered from the proposed development, and from some locations immediately surrounding the proposed development. Results of the particle size distribution tests are summarised in the table below, with sample locations referenced as provided by client.

TABLE 4.3.2 – PARTICLE SIZE DISTRIBUTION TEST RESULTS

| AS sieve size (mm) | S01 CTR Front Dune | S02 CTR Front surface | S03 CTR Back Minus 0.5m | S04 TB South pit | S05 TB Old pit south east wall | S06 TB ½ hill -0.5m north | S07 TB pit floor - 0.2m North | S08 Stockton beach sand |
|--------------------|-----------------------------|--------------------------------|-------------------------------------|------------------------|---|------------------------------------|---|----------------------------------|
| 2.36mm | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| 1.18mm | 100 | 100 | 99 | 100 | 100 | 100 | 100 | 100 |
| 600 µm | 99 | 100 | 96 | 100 | 100 | 99 | 99 | 100 |
| 425 µm | 89 | 92 | 79 | 99 | 98 | 97 | 97 | 76 |
| 300 µm | 18 | 37 | 31 | 67 | 68 | 47 | 62 | 19 |
| 150 µm | 1 | 2 | 3 | 2 | 2 | 4 | 6 | 1 |
| 75 µm | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 |

Note: CTR – Cabbage Tree Road Development, TB – Tanilba Bay, S – Stockton Beach

Analysis of the Cabbage Tree Road and Tanilba Bay sample results (along with visual observations), confirm that they are both composed of sub angular to sub rounded, siliceous, fine quartz grains, and minor other robust mineral grains and lithic fragments, which confirms they are of similar geological origins as outlined in the Reference to the State-wide Geology GIS data base and the Port Stephens 1:100,000 Quaternary Geology sheet 9232.I.

5.0 Summary

5.1 Glass

Glassmaking needs consistent correctly sized and low iron silica sand. Glass manufactures usually classify silica sand into separate groups on the basis of the chemical and physical properties. Since the impurities of silica sand in different deposits around the region are dependent on numerous geological factors, glass manufactures have set specifications to each source of approved material, and in general, manufacturers are concerned mostly about consistency of the approved material on a day to day basis.

Minerals such as chromite, picotite, ilmenite, leucosene, kyanite and zircon are minerals on which strict limits are placed for glass making sands. Because of their refractory nature, such minerals either do not melt or only partially melt, which results in stones or feathers in finished glass. These create stress concentration points which lead to potential fracture.

Glass manufacture can generally be broken into two main glass grades, flat glass and container glass with some other more specialised grades.

An example of typical Sand chemical content requirements are outlined in Table 5.1 below.

TABLE 5.1 – EXAMPLE OF TYPICAL GLASS GRADE SPECIFICATION REQUIREMENTS & CTR RESULTS

| Compound | GENERAL SPECIFICATION REQUIREMENTS | | Cabbage Tree Road Test Results |
|---------------------------------------|------------------------------------|-----------------|-----------------------------------|
| | Flat Glass | Container Glass | |
| SiO₂ | ≥99.5% | ≥99.5% | 99.2% |
| Fe₂O₃ | ≤0.04% | ≤0.03% | 0.09% |
| Al₂O₃ | ≤0.3% | ≤0.03% | 0.273% |
| TiO₂ | ≤0.1% | ≤10 ppm | 0.18% |
| Cr₂O₃ | ≤2 ppm | - | 17ppm |
| CO₃O₄ | ≤2 ppm | - | <1ppm |
| MnO₂ | ≤20 ppm | - | 9ppm |
| CaO-MgO | - | ±0.1% | - |
| ZrO₂ | - | ≤0.01% | - |
| Na₂O-K₂O | - | ±0.1% | - |
| Moisture | - | ≤0.1% | - |

These results indicate that the sand recovered from Cabbage Tree Road proposed extraction pit is of similar geological origins, and is mineralogical and physically very similar in size and shape to the sand samples collected from Tanilba Bay. Both locations based on the quaternary maps published (Port Stephens 1:100,000 Geology sheet 9232, copyright to the Department of Industry and Investment), are from the same geological units.

The particle size distributions are very similar and predominantly fall between the 600 µm and the 150 µm graduation size. Both samples demonstrated minor organics which can be removed during processing, and both had low LOI results when tested at 1,000 Degrees Celsius. Both samples tested from the Cabbage Tree Road development indicate a silica content of 99.2%, with low iron and alumina content, along with little other impurities. Whilst they do not fully meet the generally accepted specification requirements for Flat Glass, they may be suitable for container or coloured glass, dependant on individual specification requirements.

5.2 Concrete Sand

The following tests were performed to determine the material characteristics of recovered samples from the deposit, and were targeted to give a preliminary broad coverage of general requirements:

- Bulk Density;
- Particle Density and Water Absorption;
- Particle Size Distribution;
- Percent Passing 75 µm / Clay & Fine Silt Content;
- Petrographic Analysis / Alkali Reactivity.

The tests performed give a preliminary assessment of the characteristics of the sand for use in the concrete and asphalt industries.

5.2.1 Bulk Density

Bulk Density is defined as the mass of particles divided by the total volume they occupy. The total volume includes particle volume, inter-particle void volume and internal pore volume.

5.2.2 Particle Density and Water Absorption

The Particle Density and Water Absorption Test is universally accepted within the Australian Construction Industry as the definitive measure of fine & coarse aggregate density and water absorption. It is used to determine these properties for both coarse grained aggregate and natural and manufactured sands.

The Particle Density test produces results similar to Specific Gravity (Apparent Particle Density), but also takes into account the voids that may be present in the material being tested. At the same time, the amount of water that is held within those voids is calculated and reported as the Water Absorption of the material. The definition of the four reportable parameters which are calculated is set out below:

Apparent Density: The dry mass of particles divided by their volume, with the volume including only the impermeable voids.

Particle Density – Dry: The dry mass of particles divided by their volume, with the volume including both permeable and impermeable voids.

Particle Density - Saturated Surface Dry (SSD): The SSD mass of particles divided by their volume, with the volume including both permeable and impermeable voids.

Water Absorption: The ratio expressed as a percentage, of the mass of water held in the permeable voids of the particles brought to SSD condition following soaking under water for 24 hours, to the oven dried mass of the material.

The test properties listed above provide key design parameters for concrete and asphalt mixes.

Both results obtained demonstrate the low absorption characteristics of the recovered samples with both samples assessed returning results well below the acceptable limits of 2.5% and 3% required by AS2758 for concrete and AS3152 for asphalt.

5.2.3 Particle Size Distribution

Particle Size Distribution (PSD), or grading, is one of the most influential and commonly reported characteristics of an aggregate. Grading influences concrete durability, road base compatibility, porosity, workability, cement and water requirements, strength and shrinkage. However, it is the total aggregate grading in the mix that is critical to the mix performance. The grading of an individual component is not critical to the mix performance and an unsuitable grading can be improved by blending with other components. In this case the individual grading is not critical but once the blend is established, the consistency of individual components is critical to the production of a consistent product.

The particle size distributions performed on all samples from the Cabbage Tree Road site indicate that they comply with the AS2758 requirements for use as fine aggregate in concrete production and AS3152 in Asphalt.

5.2.4 Percent Passing 75 µm / Clay & Fine Silt Content

The percentage passing 75 micron is calculated as the loss on washing expressed as a percentage of the original sample mass.

The 75 micron fraction size is used in Australia as a near approximation to the 60 micron size limit that in geological terms, marks the boundary between fine Sand and Silt.

In natural aggregates, the total passing 75 micron will include the silt and clay fractions and will be composed of silt and clay minerals. In many specifications including AS 2758.1, the percentage passing 75 micron has been specified as a control over clay and silt fines that may cause water and cement demand, shrinkage, cracking, and control the permeability of some materials.

Percentage passing results provided in Table 4.3.1 and 4.3.2 give indicative values that may be expected from material won from this source. In the quarry production environment, this can be improved by either appropriate screening, dust extraction systems or by washing of the end product.

5.2.5 Petrographic Analysis / Alkali Reactivity

In most concrete, aggregates are more or less chemically inert. However, some aggregates react with the alkali hydroxides in concrete, causing expansion and cracking over a period of many years. This alkali-aggregate reaction has two forms: Alkali-Silica Reaction (ASR) and Alkali-Carbonate Reaction (ACR).

Alkali-Silica Reaction (ASR) is of more concern as aggregates containing reactive silica materials are more common. In ASR, aggregates containing certain forms of silica will react with alkali hydroxide in concrete to form a gel that swells as it adsorbs water from the surrounding cement paste or the environment. These gels can induce enough expansive pressure to damage concrete.

Alkali-silica reaction can be controlled using certain supplementary cementitious materials. In proper proportions, silica fume, fly ash, and ground granulated blast-furnace slag have significantly reduced or eliminated expansion due to alkali-silica reactivity. In addition, lithium compounds have been used to reduce ASR.

Although potentially reactive aggregates exist throughout Australia, alkali-silica reaction distress in concrete is not that common because of the measures taken to control it. It is also important to note that not all ASR gel reactions produce destructive swelling.

Based on the petrographic analysis undertaken by Geochempet, it is understood the sand as a whole is predicted to have **potential for mild or slow deleterious alkali-silica reactivity in concrete**. It carries about 2% of cherty or finely microcrystalline quartz and 21% of moderately stained quartz and 1% heavily strained quartz.

Being composed of sub angular to sub rounded, siliceous, fine quartz grains, minor other robust mineral grains and lithic fragments, the sand is interpreted to be **physically suitable for use as sand in concrete**. This however should be confirmed with performance of RMS T363 on further recovered samples or during routine quality assurance testing of the resource.

In summary, the recovered sand samples tested from the Cabbage Tree Road proposed extraction pit broadly meet the requirements of AS2758 and AS3152 for both use as fine aggregate in the production of Concrete and Asphalt, subject to conformance with routine quality assurance testing protocols.

5.3 General Fill Sand

Whilst the sand from the above resource has not been formally tested for compliance with the normal test requirements required for use as General Fill, it is observed that based on the particle size distributions performed and the gradational percentages returned, the material will likely be non-plastic in terms of plasticity. The material is likely to exceed the California Bearing Ratio requirement of 15% based on the particle size distributions performed. However due to the single sized nature of the material it is likely going to prove difficult to compact without significant moisture conditioning and compaction techniques.

6.0 Limitations

The findings presented in the report and used as the basis for recommendations presented herein were obtained using normal, industry accepted geotechnical design practices and standards. To our knowledge, they represent a reasonable interpretation of the general conditions of the site.

The extent of testing associated with this assessment is limited to discrete borehole locations. It should be noted that subsurface conditions between and away from the borehole locations may be different to those observed during the field work and used as the basis of the recommendations contained in this report.

If subsurface conditions encountered during bulk excavation or quarry operations differ from those given in this report, further advice should be sought without delay.

Data and opinions contained within the report may not be used in other contexts or for any other purposes without prior review and agreement by Qualtest. If this report is reproduced, it must be in full.

If you have any further questions regarding this report, please do not hesitate to contact Alan Cullen or the undersigned.

For and on behalf of Qualtest Laboratory (NSW) Pty Ltd



Jason Lee
Principal Geotechnical Engineer



Alan Cullen
Principal Geotechnician

APPENDIX A:

Material Photographs &

Results of Qualtest Laboratory Testing (2018)

S01 – Cabbage Tree Road – “Front Dune”

Site Photograph 1A: Before Washing



Site Photograph 1B: After Washing



Report No: MAT:NEW18W-0370--S01

Issue No: 1

Material Test Report

Client: Williamtown Sand Syndicate
PO Box 898
Newcastle NSW

Principal:

Project No.: NEW16P-0199
Project Name: Cabbage Tree Road Sand Quarry Assesment



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



Approved Signatory: Adam Dwyer
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 19/02/2018

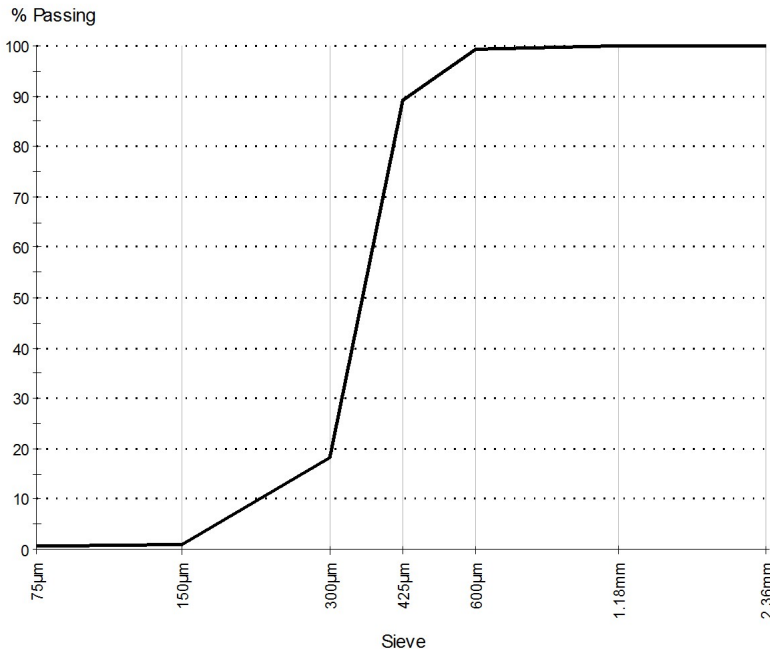
Sample Details

Sample ID: NEW18W-0370--S01
Sampling Method: Sampled by Client
Date Sampled: 12/02/2018
Source: Cabbage Tree Road
Material: Sand
Specification: No Specification
Project Location: Williamtown, NSW
Sample Location: Front - Dune

Other Test Results

| Description | Method | Result | Limits |
|-------------|--------|--------|--------|
|-------------|--------|--------|--------|

Particle Size Distribution



Method: AS 1289.3.6.1

Drying by: Oven

Note: Sample Washed

| Sieve Size | % Passing | Limits |
|------------|-----------|--------|
| 2.36mm | 100 | |
| 1.18mm | 100 | |
| 600µm | 99 | |
| 425µm | 89 | |
| 300µm | 18 | |
| 150µm | 1 | |
| 75µm | 1 | |

Comments

N/A

S02 – Cabbage Tree Road – “Front Dune Surface”

Site Photograph 2A: Before Washing



Site Photograph 2B: After Washing



Report No: MAT:NEW18W-0370--S02
Issue No: 1

Material Test Report

Client: Williamtown Sand Syndicate
 PO Box 898
 Newcastle NSW

Principal:

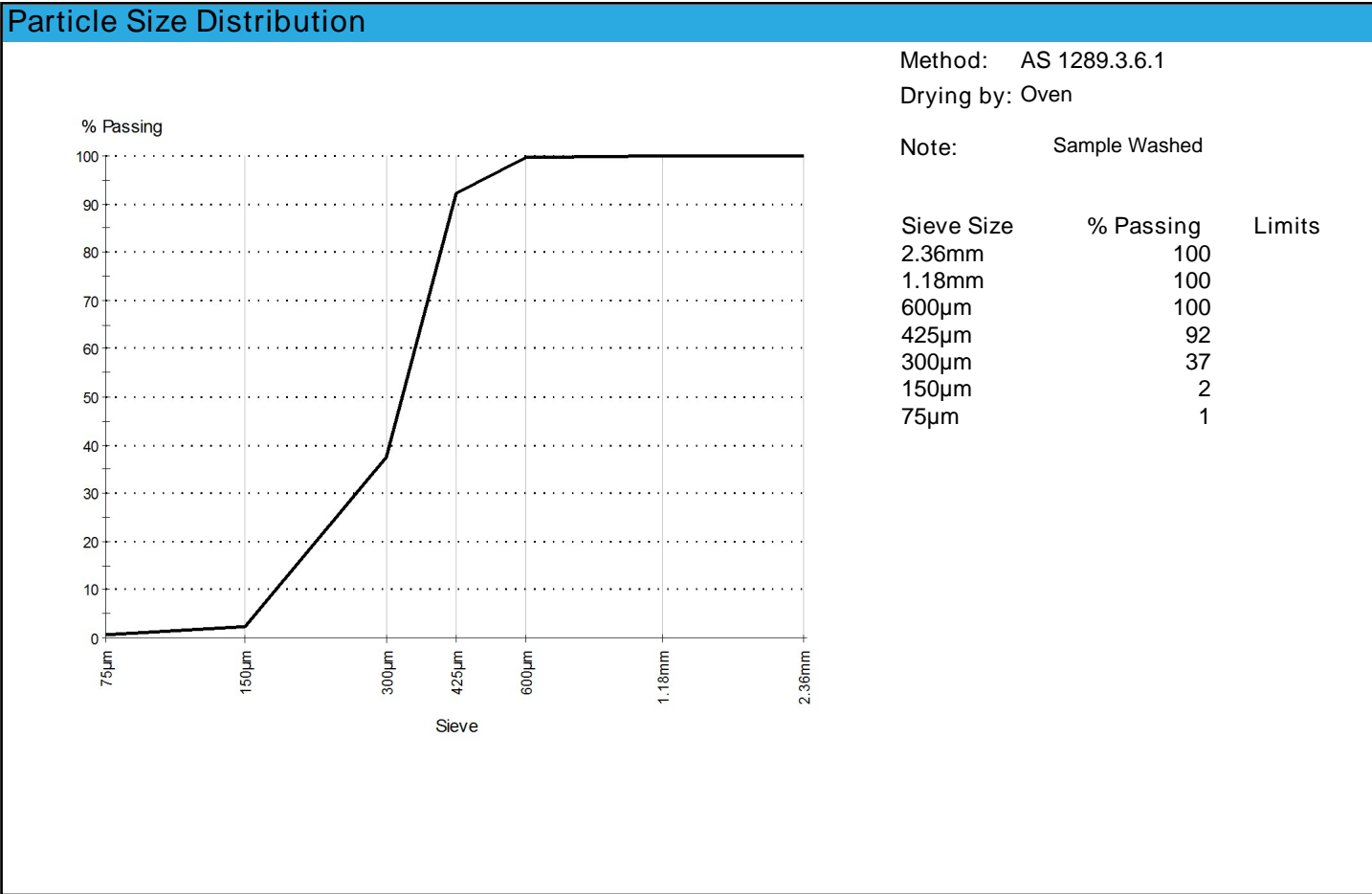
Project No.: NEW16P-0199
Project Name: Cabbage Tree Road Sand Quarry Assesment



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 The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards

(Signature)
 Approved Signatory: Adam Dwyer
 (Senior Geotechnician)
 NATA Accredited Laboratory Number: 18686
 Date of Issue: 19/02/2018

| Sample Details | | Other Test Results | | | |
|-------------------|-------------------|--------------------|--------|--------|--------|
| | | Description | Method | Result | Limits |
| Sample ID: | NEW18W-0370--S02 | | | | |
| Sampling Method: | Sampled by Client | | | | |
| Date Sampled: | 12/02/2018 | | | | |
| Source: | Cabbage Tree Road | | | | |
| Material: | Sand | | | | |
| Specification: | No Specification | | | | |
| Project Location: | Williamtown, NSW | | | | |
| Sample Location: | Front - Surface | | | | |



Comments

N/A

S03 – Cabbage Tree Road – “Back Dune 0.5m Deep”

Site Photograph 3A: Before Washing



Site Photograph 3B: After Washing




Report No: MAT:NEW18W-0370--S03
Issue No: 1

Material Test Report

Client: Williamtown Sand Syndicate
 PO Box 898
 Newcastle NSW

Principal:

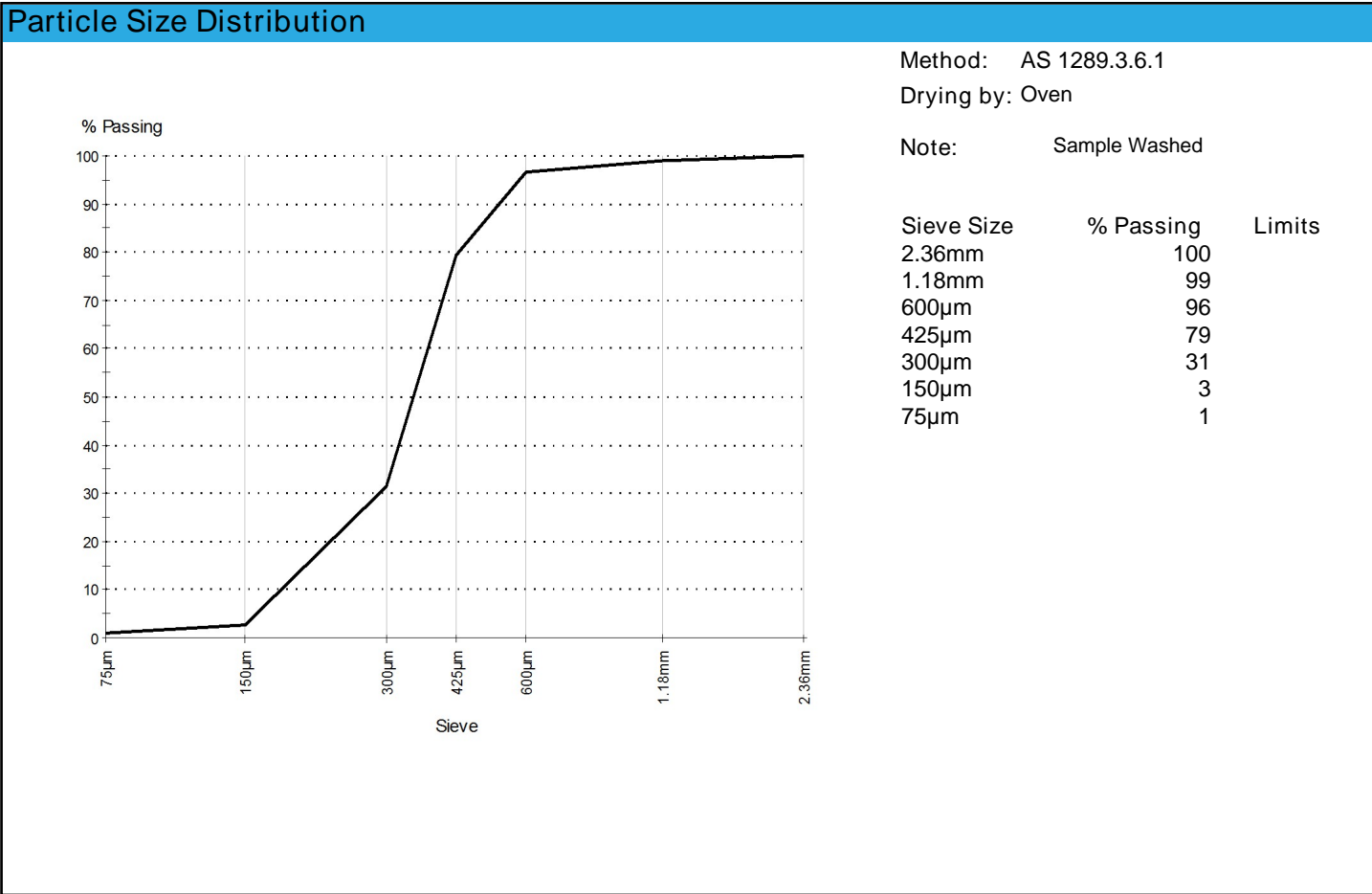
Project No.: NEW16P-0199
Project Name: Cabbage Tree Road Sand Quarry Assesment



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

(Signature)
 Approved Signatory: Adam Dwyer
 (Senior Geotechnician)
 NATA Accredited Laboratory Number: 18686
 Date of Issue: 19/02/2018

| Sample Details | | Other Test Results | | | |
|-------------------|-------------------|--------------------|--------|--------|--------|
| | | Description | Method | Result | Limits |
| Sample ID: | NEW18W-0370--S03 | | | | |
| Sampling Method: | Sampled by Client | | | | |
| Date Sampled: | 12/02/2018 | | | | |
| Source: | Cabbage Tree Road | | | | |
| Material: | Sand | | | | |
| Specification: | No Specification | | | | |
| Project Location: | Williamtown, NSW | | | | |
| Sample Location: | Back - 0.5m Deep | | | | |



Comments
 N/A

S04 – Tanilba Bay – “Pit South”

Site Photograph 4A: Before Washing



Site Photograph 4B: After Washing



Report No: MAT:NEW18W-0370--S04

Issue No: 1

Material Test Report

Client: Williamtown Sand Syndicate
PO Box 898
Newcastle NSW

Principal:

Project No.: NEW16P-0199
Project Name: Cabbage Tree Road Sand Quarry Assesment



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

AD
Approved Signatory: Adam Dwyer
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 19/02/2018

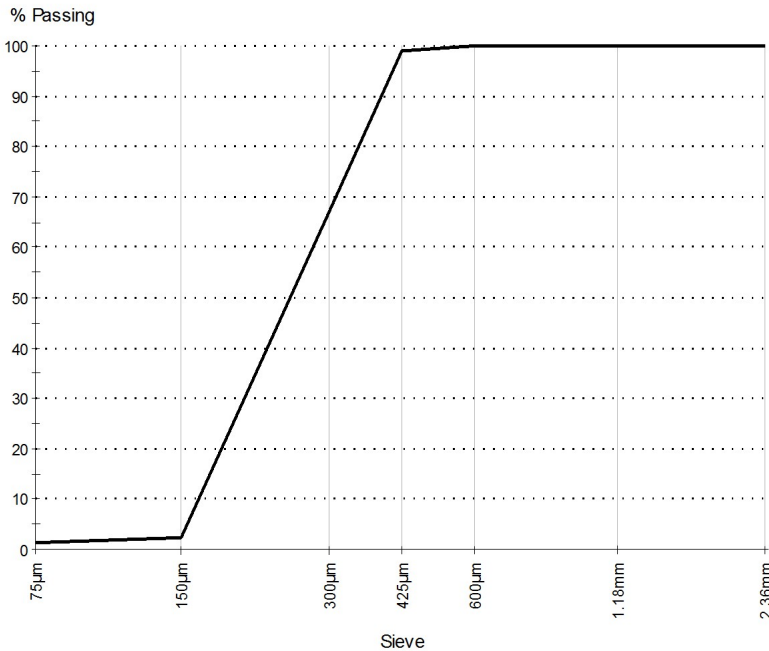
Sample Details

Sample ID: NEW18W-0370--S04
Sampling Method: Sampled by Client
Date Sampled: 12/02/2018
Source: Tanilba Bay
Material: Sand
Specification: No Specification
Project Location: Williamtown, NSW
Sample Location: South Pit

Other Test Results

| Description | Method | Result | Limits |
|-------------|--------|--------|--------|
|-------------|--------|--------|--------|

Particle Size Distribution



Method: AS 1289.3.6.1

Drying by: Oven

Note: Sample Washed

| Sieve Size | % Passing | Limits |
|------------|-----------|--------|
| 2.36mm | 100 | |
| 1.18mm | 100 | |
| 600µm | 100 | |
| 425µm | 99 | |
| 300µm | 67 | |
| 150µm | 2 | |
| 75µm | 1 | |

Comments

N/A

S05 – Tanilba Bay – “Old Pit Southeast wall”

Site Photograph 5A: Before Washing



Site Photograph 5B: After Washing



Report No: MAT:NEW18W-0370--S05
Issue No: 1

Material Test Report

Client: Williamtown Sand Syndicate
 PO Box 898
 Newcastle NSW

Principal:

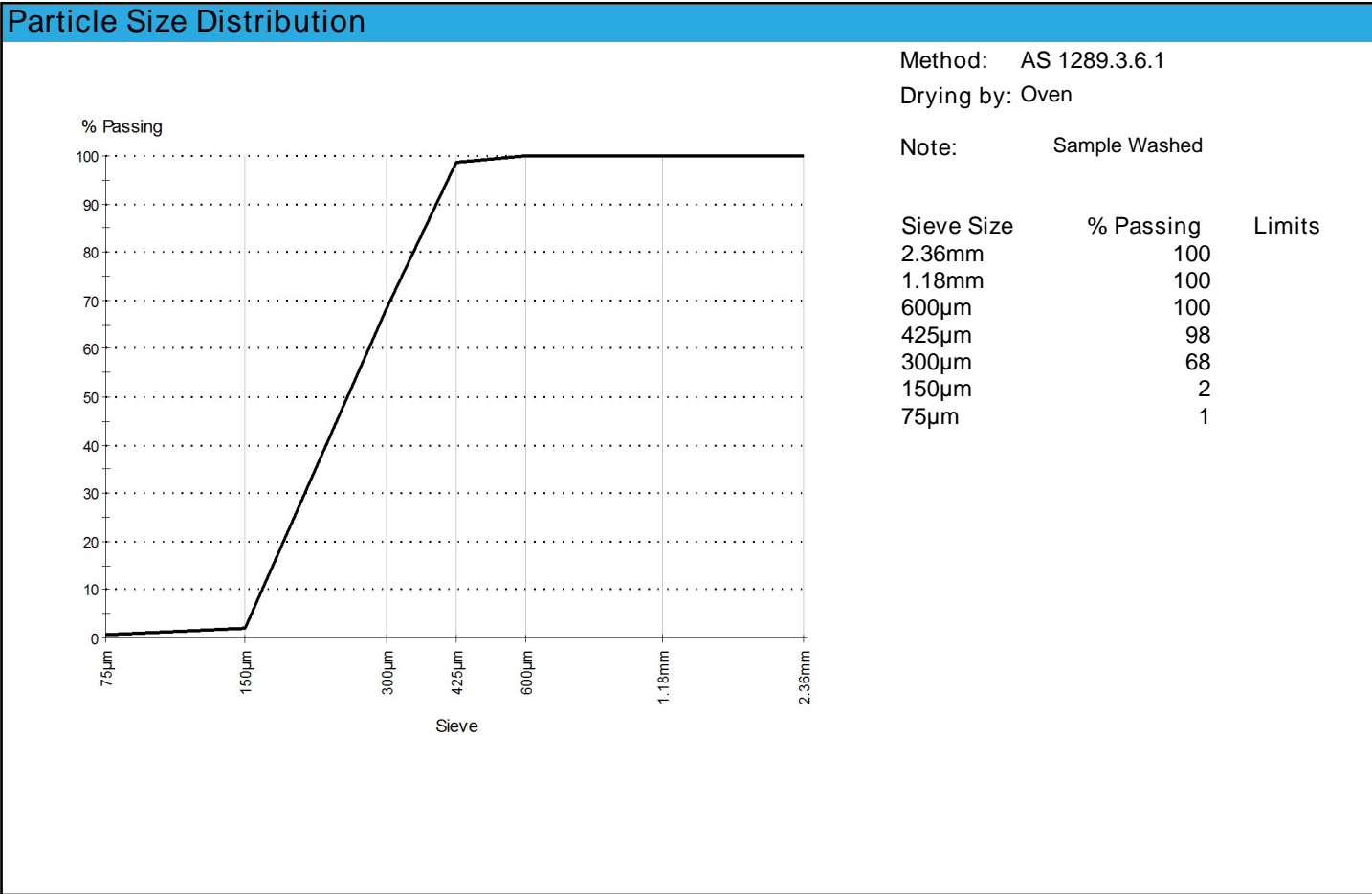
Project No.: NEW16P-0199
Project Name: Cabbage Tree Road Sand Quarry Assesment



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

(Signature)
 Approved Signatory: Adam Dwyer
 (Senior Geotechnician)
 NATA Accredited Laboratory Number: 18686
 Date of Issue: 19/02/2018

| Sample Details | | Other Test Results | | | |
|-------------------|---------------------------|--------------------|--------|--------|--------|
| | | Description | Method | Result | Limits |
| Sample ID: | NEW18W-0370--S05 | | | | |
| Sampling Method: | Sampled by Client | | | | |
| Date Sampled: | 12/02/2018 | | | | |
| Source: | Tanilba Bay | | | | |
| Material: | Sand | | | | |
| Specification: | No Specification | | | | |
| Project Location: | Williamtown, NSW | | | | |
| Sample Location: | Old Pit - South East Wall | | | | |



Comments
 N/A

S06 – Tanilba Bay – “Half Hill 0.5m North”

Site Photograph 6A: Before Washing



Site Photograph 6B: After Washing



Report No: MAT:NEW18W-0370--S06
Issue No: 1

Material Test Report

Client: Williamtown Sand Syndicate
 PO Box 898
 Newcastle NSW

Principal:

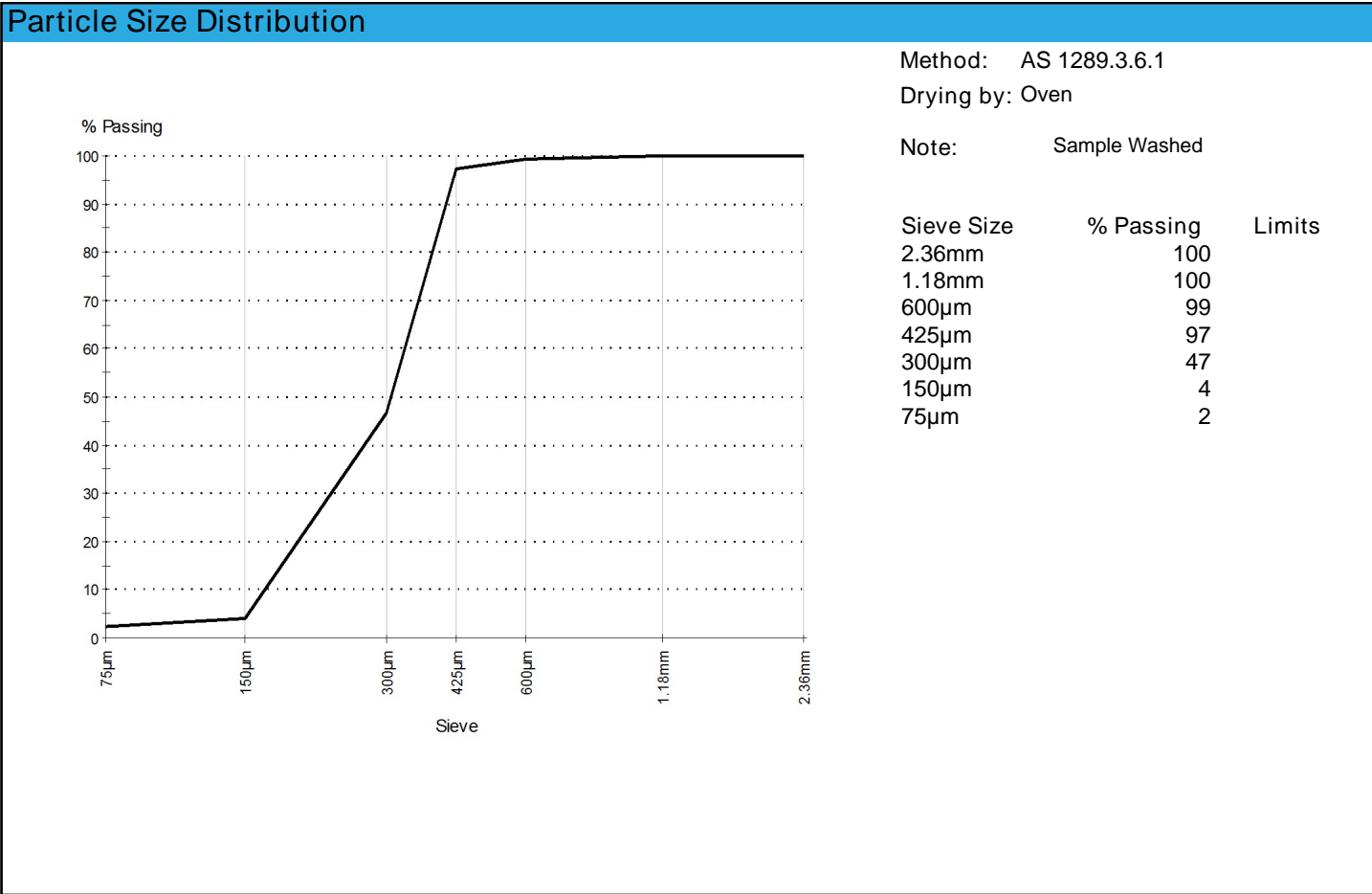
Project No.: NEW16P-0199
Project Name: Cabbage Tree Road Sand Quarry Assesment



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(Signature)
 Approved Signatory: Adam Dwyer
 (Senior Geotechnician)
 NATA Accredited Laboratory Number: 18686
 Date of Issue: 19/02/2018

| Sample Details | | Other Test Results | | | |
|-------------------|-----------------------|--------------------|--------|--------|--------|
| | | Description | Method | Result | Limits |
| Sample ID: | NEW18W-0370--S06 | | | | |
| Sampling Method: | Sampled by Client | | | | |
| Date Sampled: | 12/02/2018 | | | | |
| Source: | Tanilba Bay | | | | |
| Material: | Sand | | | | |
| Specification: | No Specification | | | | |
| Project Location: | Williamtown, NSW | | | | |
| Sample Location: | 1/2 Hill - 0.5m North | | | | |



Comments
 N/A

S07 – Tanilba Bay – “Pit Floor 0.2m North”

Site Photograph 7A: Before washing



Site Photograph 7B: After Washing



Report No: MAT:NEW18W-0370--S07

Issue No: 1

Material Test Report

Client: Williamtown Sand Syndicate
PO Box 898
Newcastle NSW

Principal:

Project No.: NEW16P-0199
Project Name: Cabbage Tree Road Sand Quarry Assesment



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The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards

AD
Approved Signatory: Adam Dwyer
(Senior Geotechnician)
NATA Accredited Laboratory Number: 18686
Date of Issue: 19/02/2018

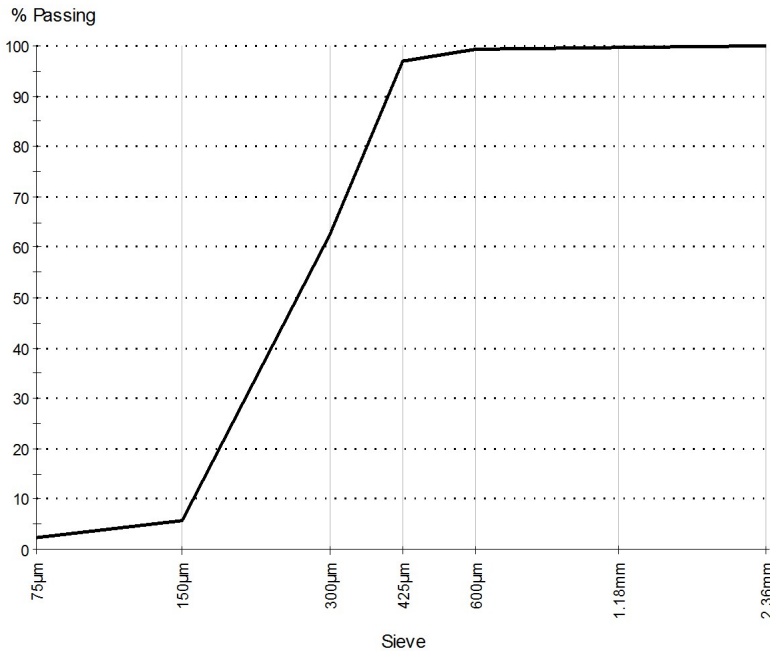
Sample Details

Sample ID: NEW18W-0370--S07
Sampling Method: Sampled by Client
Date Sampled: 12/02/2018
Source: Tanilba Bay
Material: Sand
Specification: No Specification
Project Location: Williamtown, NSW
Sample Location: Pit Floor - 0.2m North

Other Test Results

| Description | Method | Result | Limits |
|-------------|--------|--------|--------|
|-------------|--------|--------|--------|

Particle Size Distribution



Method: AS 1289.3.6.1

Drying by: Oven

Note: Sample Washed

| Sieve Size | % Passing | Limits |
|------------|-----------|--------|
| 2.36mm | 100 | |
| 1.18mm | 100 | |
| 600µm | 99 | |
| 425µm | 97 | |
| 300µm | 62 | |
| 150µm | 6 | |
| 75µm | 2 | |

Comments

N/A

S08 – “Stockton Beach Sand”

Site Photograph 8A: Before Washing



Site Photograph 8B: After Washing




Report No: MAT:NEW18W-0370--S08
Issue No: 1

Material Test Report

Client: Williamtown Sand Syndicate
 PO Box 898
 Newcastle NSW

Principal:

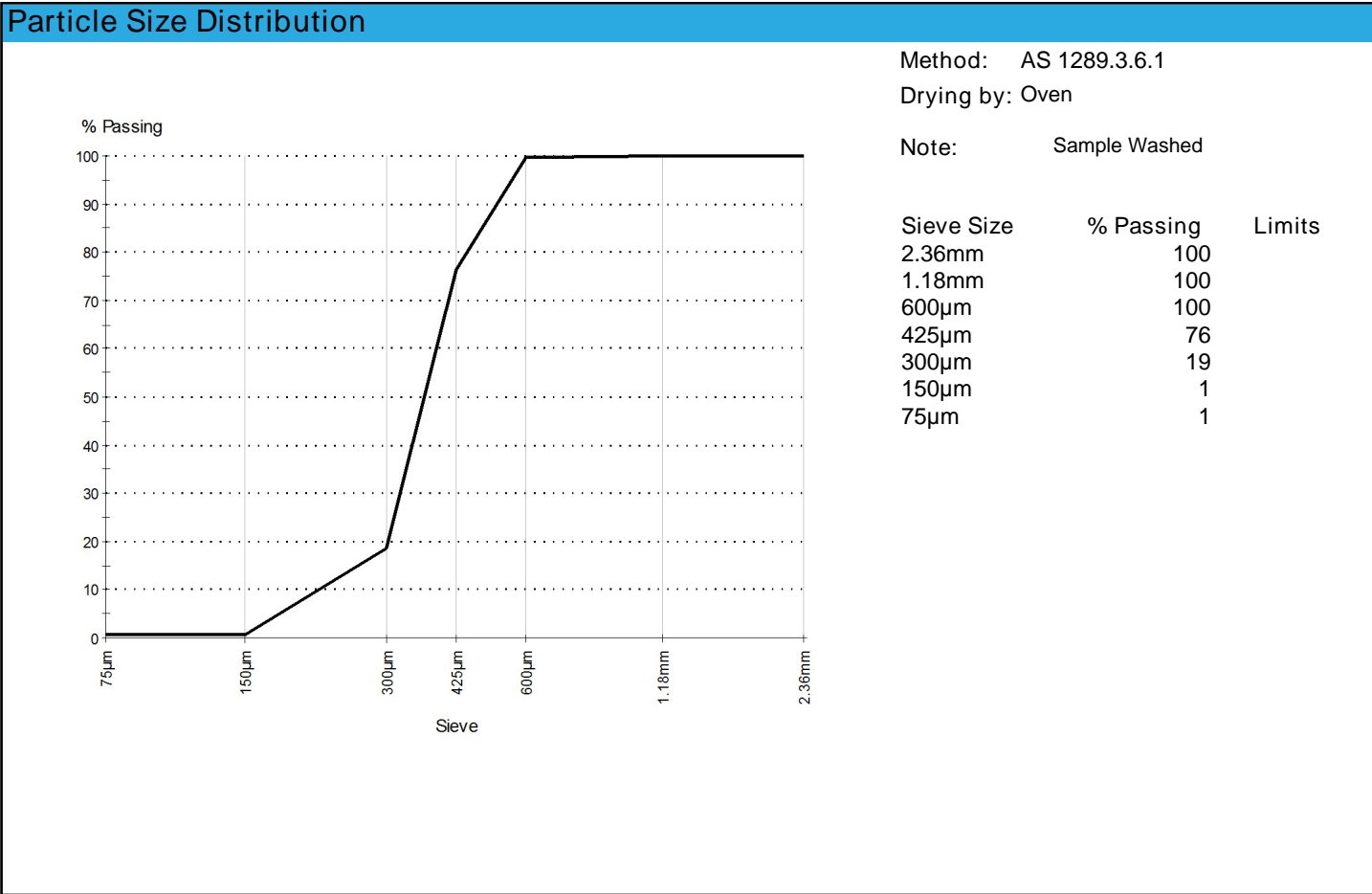
Project No.: NEW16P-0199
Project Name: Cabbage Tree Road Sand Quarry Assesment



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

(Signature)
 Approved Signatory: Adam Dwyer
 (Senior Geotechnician)
 NATA Accredited Laboratory Number: 18686
 Date of Issue: 19/02/2018

| Sample Details | | Other Test Results | | | |
|-------------------|-----------------------|--------------------|--------|--------|--------|
| | | Description | Method | Result | Limits |
| Sample ID: | NEW18W-0370--S08 | | | | |
| Sampling Method: | Sampled by Client | | | | |
| Date Sampled: | 12/02/2018 | | | | |
| Source: | Stockton Beach | | | | |
| Material: | Sand | | | | |
| Specification: | No Specification | | | | |
| Project Location: | Williamtown, NSW | | | | |
| Sample Location: | Stockton - Beach Sand | | | | |



Comments

N/A

APPENDIX B:

Additional Laboratory Testing (2016)

Material Test Report

Report No: MAT:NEW16W-3428--S01

Issue No: 2

This report replaces all previous issues of report no 'MAT:NEW16W-3428--S01'.

Client: Williamtown Sand Syndicate
 PO Box 898
 Newcastle NSW

Principal:

Project No.: NEW16P-0199
 Project Name: Cabbage Tree Road Sand Quarry Assesment



Accredited for compliance with ISO/IEC 17025
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 to Australian/national standards

Dane Cullen
 Approved Signatory: Dane Cullen
 (Senior Geotechnician)
 NATA Accredited Laboratory Number: 18686
 Date of Issue: 30/11/2016

Sample Details

| | |
|-------------------|--------------------------|
| Sample ID: | NEW16W-3428--S01 |
| Sampling Method: | AS1289.1.2.1 cl 6.5 |
| Date Sampled: | 11/11/2016 |
| Source: | On-Site |
| Material: | Sand |
| Specification: | Uncrushed Fine Aggregate |
| Project Location: | Williamtown, NSW |
| Sample Location: | BH1 - (0.0 - 2.0m) |

Particle Size Distribution

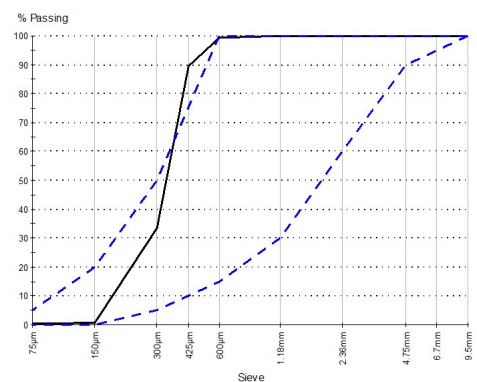
Method: AS 1141.11.1
 Drying by: Oven
 Note: Sample Not Washed

| Sieve Size | % Passing | Limits |
|------------|-----------|----------|
| 9.5mm | 100 | 100 |
| 6.7mm | 100 | |
| 4.75mm | 100 | 90 - 100 |
| 2.36mm | 100 | 60 - 100 |
| 1.18mm | 100 | 30 - 100 |
| 600µm | 99 | 15 - 100 |
| 425µm | 90 | |
| 300µm | 33 | 5 - 50 |
| 150µm | 1 | 0 - 20 |
| 75µm | 0 | 0 - 5 |

Other Test Results

| Description | Method | Result | Limits |
|------------------------|------------|--------|--------|
| Clay and Fine Silt (%) | AS 1141.33 | 5 | |

Chart



Comments

N/A

Report No: MAT:NEW16W-3428--S02

Issue No: 1

Material Test Report

Client: Williamtown Sand Syndicate
 PO Box 898
 Newcastle NSW

Principal:

Project No.: NEW16P-0199
 Project Name: Cabbage Tree Road Sand Quarry Assesment



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 The results of the tests, calibrations and/or
 measurements included in this document are traceable
 to Australian/national standards

Dane Cullen
 Approved Signatory: Dane Cullen
 (Senior Geotechnician)
 NATA Accredited Laboratory Number: 18686
 Date of Issue: 30/11/2016

Sample Details

Sample ID: NEW16W-3428--S02
 Sampling Method: AS1289.1.2.1 cl 6.5
 Date Sampled: 11/11/2016
 Source: On-Site
 Material: Sand
 Specification: Uncrushed Fine Aggregate
 Project Location: Williamtown, NSW
 Sample Location: BH2 - (0.0 - 2.0m)

Particle Size Distribution

Method: AS 1141.11.1

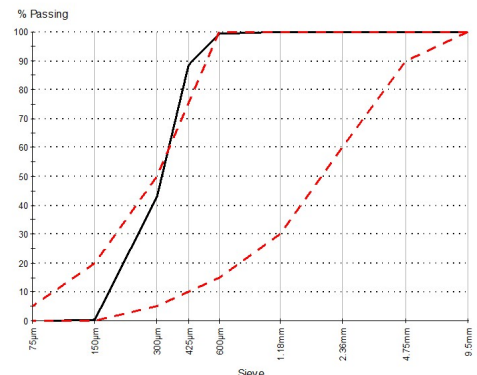
Note: Sample Not Washed

| Sieve Size | % Passing | Limits |
|------------|-----------|----------|
| 9.5mm | 100 | 100 |
| 4.75mm | 100 | 90 - 100 |
| 2.36mm | 100 | 60 - 100 |
| 1.18mm | 100 | 30 - 100 |
| 600µm | 99 | 15 - 100 |
| 425µm | 89 | |
| 300µm | 43 | 5 - 50 |
| 150µm | 0 | 0 - 20 |
| 75µm | 0 | 0 - 5 |

Other Test Results

| Description | Method | Result | Limits |
|----------------------------------|------------|-------------|--------|
| Finer 75µm (%) | AS 1141.12 | | 0 - 5 |
| Clay and Fine Silt (%) | AS 1141.33 | 1 | |
| Uncompacted Bulk Density (t/m³) | AS 1141.4 | 1.54 | |
| Compacted Bulk Density (t/m³) | | 1.65 | |
| Aggregate Moisture Condition | | As Received | |
| Nominal Size Of Sample (mm) | | 1 | |
| Apparent Particle Density (t/m³) | AS 1141.5 | 2.63 | |
| Particle Density Dry (t/m³) | | 2.62 | |
| Particle Density SSD (t/m³) | | 2.62 | |
| Water Absorption (%) | | 0.1 | |

Chart



Comments

N/A

Report No: MAT:NEW16W-3428--S03
Issue No: 1


Material Test Report

Client: Williamtown Sand Syndicate
 PO Box 898
 Newcastle NSW

Principal:

Project No.: NEW16P-0199
Project Name: Cabbage Tree Road Sand Quarry Assesment

Accredited for compliance with ISO/IEC 17025
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 to Australian/national standards



Dane Cullen
 Approved Signatory: Dane Cullen
 (Senior Geotechnician)
 NATA Accredited Laboratory Number: 18686
 Date of Issue: 30/11/2016

Sample Details

Sample ID: NEW16W-3428--S03
Sampling Method: AS1289.1.2.1 cl 6.5
Date Sampled: 11/11/2016
Source: On-Site
Material: Sand
Specification: Uncrushed Fine Aggregate
Project Location: Williamtown, NSW
Sample Location: BH3 - (0.0 - 2.0m)

Particle Size Distribution

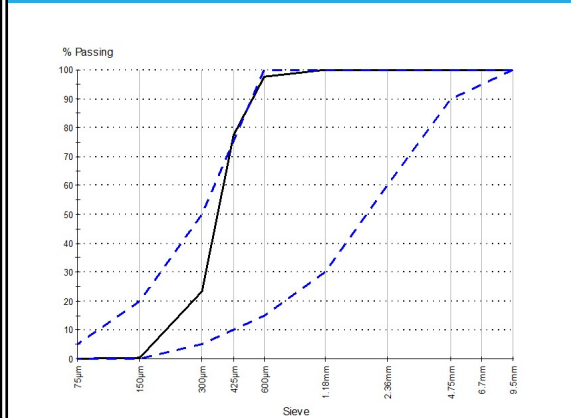
Method: AS 1141.11.1
Drying by: Oven
Note: Sample Not Washed

| Sieve Size | % Passing | Limits |
|------------|-----------|----------|
| 9.5mm | 100 | 100 |
| 6.7mm | 100 | |
| 4.75mm | 100 | 90 – 100 |
| 2.36mm | 100 | 60 – 100 |
| 1.18mm | 100 | 30 – 100 |
| 600µm | 98 | 15 – 100 |
| 425µm | 77 | |
| 300µm | 23 | 5 – 50 |
| 150µm | 0 | 0 – 20 |
| 75µm | 0 | 0 – 5 |

Other Test Results

| Description | Method | Result | Limits |
|------------------------|------------|--------|--------|
| Clay and Fine Silt (%) | AS 1141.33 | 2 | |

Chart



Comments

N/A

Report No: MAT:NEW16W-3428--S04

Issue No: 1

Material Test Report

Client: Williamtown Sand Syndicate
 PO Box 898
 Newcastle NSW

Principal:

Project No.: NEW16P-0199
 Project Name: Cabbage Tree Road Sand Quarry Assesment



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 measurements included in this document are traceable
 to Australian/national standards

Dane Cullen
 Approved Signatory: Dane Cullen
 (Senior Geotechnician)
 NATA Accredited Laboratory Number: 18686
 Date of Issue: 30/11/2016

Sample Details

Sample ID: NEW16W-3428--S04
 Sampling Method: AS1289.1.2.1 cl 6.5
 Date Sampled: 11/11/2016
 Source: On-Site
 Material: Sand
 Specification: Uncrushed Fine Aggregate
 Project Location: Williamtown, NSW
 Sample Location: BH4 - (0.0 - 2.0m)

Particle Size Distribution

Method: AS 1141.11.1
 Drying by: Oven

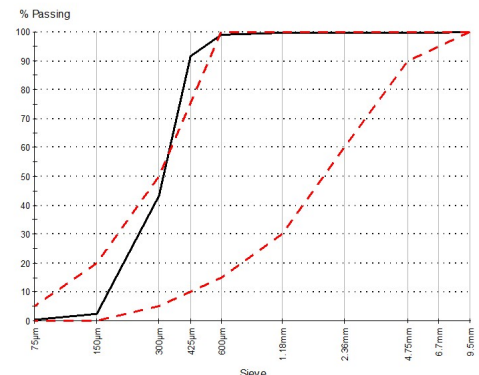
Note: Sample Not Washed

| Sieve Size | % Passing | Limits |
|------------|-----------|----------|
| 9.5mm | 100 | 100 |
| 6.7mm | 100 | |
| 4.75mm | 100 | 90 - 100 |
| 2.36mm | 100 | 60 - 100 |
| 1.18mm | 100 | 30 - 100 |
| 600µm | 99 | 15 - 100 |
| 425µm | 92 | |
| 300µm | 43 | 5 - 50 |
| 150µm | 2 | 0 - 20 |
| 75µm | 0 | 0 - 5 |

Other Test Results

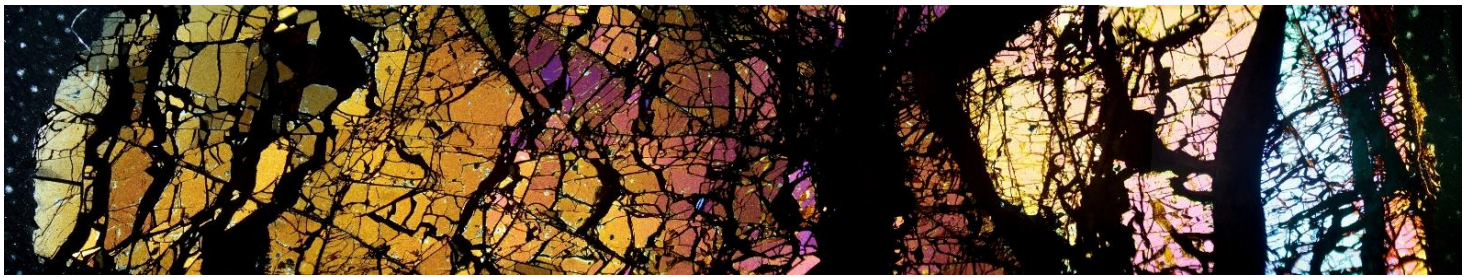
| Description | Method | Result | Limits |
|---|------------|-------------|--------|
| Finer 75µm (%) | AS 1141.12 | 0 | 0 - 5 |
| Clay and Fine Silt (%) | AS 1141.33 | 1 | |
| Uncompacted Bulk Density (t/m ³) | AS 1141.4 | 1.49 | |
| Compacted Bulk Density (t/m ³) | | 1.64 | |
| Aggregate Moisture Condition | | As Received | |
| Nominal Size Of Sample (mm) | | 1 | |
| Apparent Particle Density (t/m ³) | AS 1141.5 | 2.64 | |
| Particle Density Dry (t/m ³) | | 2.61 | |
| Particle Density SSD (t/m ³) | | 2.62 | |
| Water Absorption (%) | | 0.5 | |

Chart



Comments

N/A

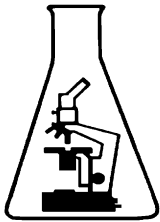


Geochempet Services

ABN 980 6945 3445

PETROLOGICAL and GEOCHEMICAL CONSULTANTS

Principals: K.E. Spring B.Sc.(Hons), MAppSc and H.M. Spring B.Sc.



5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

GEOCHEMICAL TESTING RESULTS ON TWO SAND SAMPLES (NEW16W-3428-S02, NEW16W-3428-S04) FROM CABBAGE TREE ROAD SAND QUARRY

prepared for

**QUALTEST LABORATORY (NSW) PTY LTD
WARABROOK, NSW**

Purchase Order: QTPO16-0263

Invoice Number: 00007426

Client Ref: Dane Cullen

Issued by

K. E. Spring B.Sc.(Hons), MAppSc
12 December 2016

DECEMBER, 2016

Q1161201xrf

Page 1

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GEOCHEMPET SERVICES, BRISBANE

GEOCHEMICAL TESTING RESULTS ON TWO SAND SAMPLES (NEW16W-3428-S02, NEW16W-3428-S04) FROM CABBAGE TREE ROAD SAND QUARRY

Work Requested

Geochemical testing on two sand samples

Method

After discussions with Dane Cullen at Qualtest, the two sands were submitted to ALS on 09/12/16 with coarse and ultrafine fractions removed. A sub-sample of each supplied sand sample was pulped in a non-steel crucible and then digested in acids to dissolve SiO₂ and the residue is fused for ICPAES analysis of impurities using ME-PKG85 method by ALS Chemex. Additionally, cobalt, copper, manganese, nickel, vanadium and zinc was determined using method ME-ICP61. Loss of ignition at 1000C was determined by method OA-GRA05.

Results

The results for ME-PKG85 are (in weight percent):

| | S02 | S04 |
|--------------------------------|------------|------------|
| SiO ₂ | 99.2% | 99.2% |
| Fe ₂ O ₃ | 0.09% | 0.084% |
| Al ₂ O ₃ | 0.273% | 0.218% |
| TiO ₂ | 0.18% | 0.208% |
| Cr ₂ O ₃ | 17ppm | 18ppm |
| Loss on ignition | 0.17% | 0.18% |

The results for ME-ICP61 are (in ppm):

| | S02 | S04 |
|----|------------|------------|
| Co | <1 | <1 |
| Cu | 2 | 1 |
| Mn | 9 | 10 |
| Ni | <1 | <1 |
| V | 4 | 3 |
| Zn | 2 | 3 |

These results seem to be comparable favourably with silica sand supplied for manufacture of glass sand in the Newcastle area.

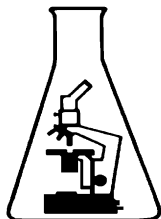
GEOCHEMPET SERVICES, BRISBANE

Geochempet Services

ABN 980 6945 3445

PETROLOGICAL and GEOCHEMICAL CONSULTANTS

Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.



5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

**PETROGRAPHIC REPORT
ON A SAND SAMPLE (NEW16W-3428-S02)
FROM CABBAGE CREEK ROAD SAND QUARRY**

prepared for

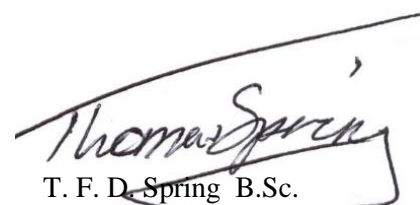
**QUALTEST PTY LTD
WARABROOK NSW**

Purchase Order: QTPO16-0263

Invoice Number: 00007399

Client Ref: Dane Cullen

Issued by


T. F. D. Spring B.Sc.
6 December 2016

December, 2016

Qu161201

Page 1 of 6

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GEOCHEMPET SERVICES, BRISBANE

Sample Label: NEW16W-3428-S02 **Date Sampled:** 11/11/2016
Sample Type: Sand **Date Supplied:** 16/11/2016
Sample Source: Cabbage Tree Road Sand Quarry **Date Received:** 21/11/2016
Bore Hole: BH1 **Depth:** 0.0 – 2.0 m
Project No.: NEW16P-0190
Work Order No.: NEW16W-3428

Work Requested Petrographic assessment of suitability for use as concrete sand and glass manufacturing, petrographic assessment of potential for alkali-silica reactivity

Methods Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete*, the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*, the AS1141 Standard Guide for the *Method for sampling and testing aggregates*, of the content of the 1996 joint publication of the Cement and Concrete Association of Australia and Standards Australia, entitled (HB 79-2015) *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia* and of Queensland Main Roads Test Method Q188 *Determination of the Quartz Content of Sand (Petrological Assessment)*

Identification Medium to fine quartz sand

Description

The sample consisted of about 5 kg of brown sand, composed largely of subangular to less commonly subrounded quartz.



Figure 1. Digital image of sub-sample of supplied sand

GEOCHEMPET SERVICES, BRISBANE

In a crude, dry sieving test of small subsample the following results were tabulated;

| Sieve Size | Wt % of sample |
|------------------|----------------|
| Coarse (>1.18mm) | <0.1% |
| Medium (>0.3mm) | 73.4% |
| Fine (>0.075mm) | 26.5% |
| Silt (<0.075mm) | 0.1% |

The coarse fraction consisted entirely of plant matter.

When a subsample was swirled with water in a glass beaker, there was a light suspension of material indicating the presence of minor clay and silt.

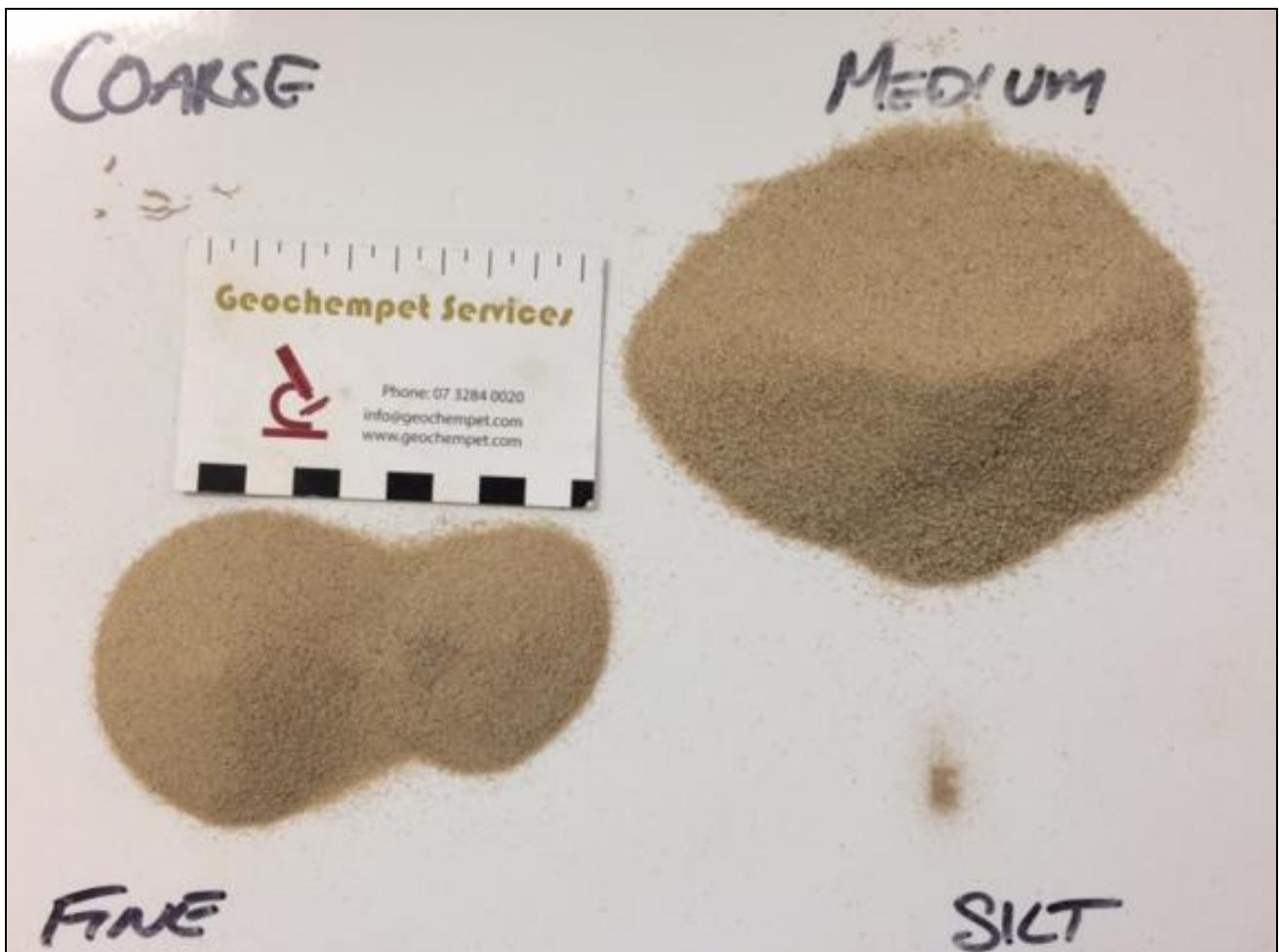


Figure 2. Digital image of sieve fractions

GEOCHEMPET SERVICES, BRISBANE



Figure 3: Image of the coarse fraction showing plant fragments

A thin section was prepared for microscopic examination in transmitted polarized light. A count of 100 widely spaced points falling within sectioned sand clasts gave the following composition:

- 73% quartz as unstrained and mildly strained free grains (67%) and simple composite grains (6%)
- 19% quartz as moderately strained free and composite grains
- 2% quartzite
- 2% chert
- 1% vein quartz
- 1% feldspar
- 1% other mineral grains (opaque oxides, tourmaline, zircon and rutile)
- 1% lithic clasts of acid volcanics/tuff (<1% microcrystalline quartz)
- <1% lithic clasts of intermediate volcanics

In thin section, the most common fragments are seen to be unstrained or faintly strained, simple grains of quartz (67%); other quartz fragments are of unstrained but polycrystalline style (6%), are moderately strained single or crystalline composite grains (19%) and quartzite composed of moderately strained quartz grains (2%). Other siliceous clast include 1% of vein quartz and 2% chert

Other free mineral grains amounting to about 1% comprised of opaque oxides, tourmaline, zircon and rutile.

Feldspar grains of plagioclase and orthoclase amount to 1%.

Lithic clasts of acid volcanics amount to 1% (<1% microcrystalline quartz). Intermediate volcanic clasts present at <1%.

A major element XRF analysis on the sand sample was undertaken by Sietronics Pty Ltd, Canberra using a Philips PW2400 XRF with Rh-end window tube and SUPERQ software.

GEOCHEMPET SERVICES, BRISBANE

The following results (in oxide wt%) were produced:

| | |
|--------------------------------|-------|
| SiO ₂ | <98.0 |
| TiO ₂ | 0.29 |
| Al ₂ O ₃ | 0.23 |
| Fe ₂ O ₃ | 0.15 |
| MgO | 0.05 |
| CaO | 0.03 |
| LOI | 0.4 |

All other elements analysed are below the detection limit of the equipment.

Comments and Interpretations

This supplied sand sample (Labelled NEW16W-3428-S02) from Cabbage Creek Road Sand Quarry may be described for engineering purposes as fine to medium quartz sand.

The **free silica content** (or total quartz) of the sand is **97%**, most of which is present as free grains or simple crystalline composite grains of quartz (92%), with 3% lithic clasts of quartzite and vein quartz and 2% microcrystalline quartz in acid volcanics and chert.

Being composed of subangular to subrounded, siliceous, fine quartz grains, minor other robust mineral grains and lithic fragments, the sand is interpreted to be **physically suitable for use as sand in concrete**.

The sand as a whole is predicted to have **potential for mild or slow deleterious alkali-silica reactivity in concrete**. It carries about 2% of cherty or finely microcrystalline quartz and 21% of moderately stained quartz and 1% heavily strained quartz.

Thus, sand of the type represented in the supplied sample is interpreted to be **suitable for use in concrete** provided that appropriate precautions are taken in mix and engineering design to take account of its perceived potential for mild or slow deleterious alkali-silica reactivity.

Guidance on how to deal with the perceived mild to slow potential for deleterious alkali-silica reactivity may be found in the 1996 joint publication of the *Cement and Concrete Association of Australia* and *Standards Australia*, entitled *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*.

It is noted also that the sand has good potential for use in the manufacture of glass. Sands suitable for glass manufacture are described as having silica content (i.e. a SiO₂ content) of 98 to 99.8% (>98% for this sand sample), and the amount and nature of the impurities is important, particularly coloured elements. Alumina should be less than 1% (0.23% for this sand sample) and iron oxide should be quite low (0.15% for this sand sample - around 0.2% is usually acceptable for coloured glass). Sand for glass manufacture should be of even grain size, generally less than 20 mesh (i.e. less than about 0.85 mm) and coarser than 100 mesh (i.e. coarser than about 0.15 mm). It seems that sand equivalent to the supplied sample from Cabbage Tree Road could be used to generate a product meeting these specifications but further analysis and processing is required to determine suitability for glass manufacture production.

Free Silica Content

The free silica content is about 97%.

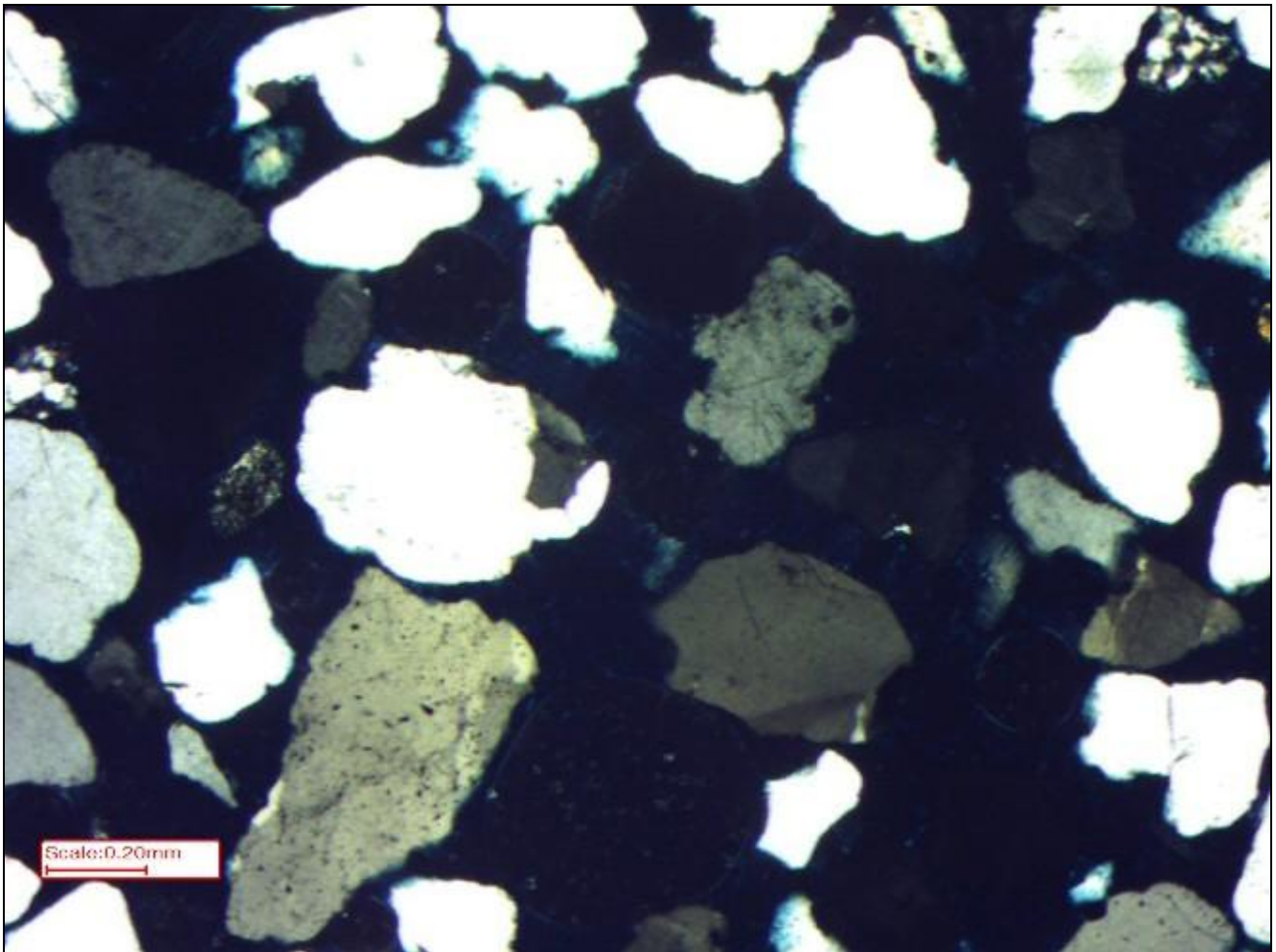


Figure 4. Microscopic image of slide from concrete sand – bland sand sample. Image is dominated by sub-rounded quartz grains with a small number of other lithic clast including acid-volcanic clasts and chert clasts.

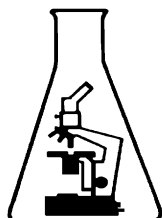
GEOCHEMPET SERVICES, BRISBANE

Geochempet Services

ABN 980 6945 3445

PETROLOGICAL and GEOCHEMICAL CONSULTANTS

Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.



5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

**PETROGRAPHIC REPORT
ON A SAND SAMPLE (NEW16W-3428-S04)
FROM CABBAGE CREEK ROAD SAND QUARRY**

prepared for

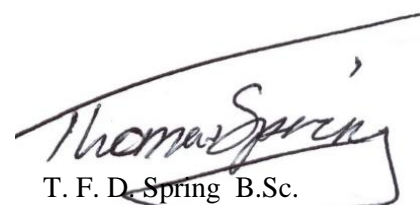
**QUALTEST PTY LTD
WARABROOK NSW**

Purchase Order: QTPO16-0263

Invoice Number: 00007399

Client Ref: Dane Cullen

Issued by


T. F. D. Spring B.Sc.
6 December 2016

December, 2016

Qu161202

Page 1 of 6

The material contained within this report may not be quoted other than in full. Extracts may be used only with expressed prior written approval of Geochempet Services.

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Sample Label: NEW16W-3428-S04 **Date Sampled:** 11/11/2016
Sample Type: Sand **Date Supplied:** 16/11/2016
Sample Source: Cabbage Tree Road Sand Quarry **Date Received:** 21/11/2016
Bore Hole: BH4 **Depth:** 0.0 – 2.0 m
Project No.: NEW16P-0190
Work Order No.: NEW16W-3428

Work Requested Petrographic assessment of suitability for use as concrete sand and glass manufacturing, petrographic assessment of potential for alkali-silica reactivity

Methods Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete*, the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*, the AS1141 Standard Guide for the *Method for sampling and testing aggregates*, of the content of the 1996 joint publication of the Cement and Concrete Association of Australia and Standards Australia, entitled (HB 79-2015) *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia* and of Queensland Main Roads Test Method Q188 *Determination of the Quartz Content of Sand (Petrological Assessment)*

Identification Medium to fine quartz sand

Description

The sample consisted of about 5 kg of brown sand, composed largely of subangular to less commonly subrounded quartz.



Figure 1. Digital image of sub-sample of supplied sand

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In a crude, dry sieving test of small subsample the following results were tabulated;

| Sieve Size | Wt % of sample |
|------------------|----------------|
| Coarse (>1.18mm) | 0.1% |
| Medium (>0.3mm) | 70.3% |
| Fine (>0.075mm) | 29.6% |
| Silt (<0.075mm) | 0.0% |

The coarse fraction consisted of a mixture of plant material and charcoal.

When a subsample was swirled with water in a glass beaker, there was a light suspension of material indicating the presence of minor clay and silt.

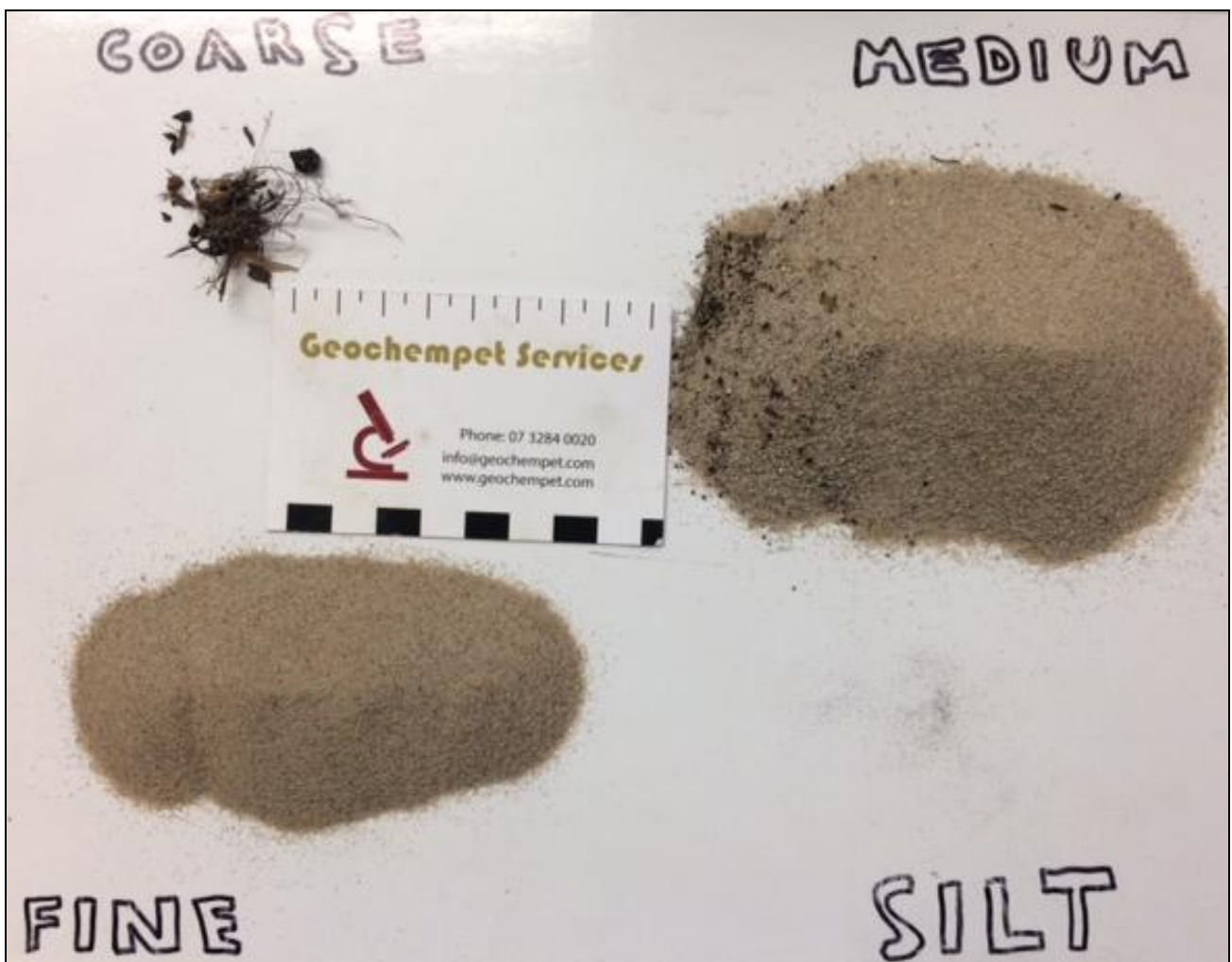


Figure 2. Digital image of sieve fractions

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Figure 3: Image of the coarse fraction showing plant fragments and charcoal.

A thin section was prepared for microscopic examination in transmitted polarized light. A count of 100 widely spaced points falling within sectioned sand clasts gave the following composition:

80% quartz as unstrained and mildly strained free grains (70%) and simple composite grains (10%)

15% quartz as moderately strained free and composite grains

2% quartzite

<1% chert

<1% vein quartz

1% feldspar

1% other mineral grains (opaque oxides, tourmaline, zircon and rutile)

<1% lithic clasts of acid volcanics/tuff (<1% microcrystalline quartz)

<1% lithic clasts of intermediate volcanics

1% plant and charcoal matter

In thin section, the most common fragments are seen to be unstrained or faintly strained, simple grains of quartz (70%); other quartz fragments are of unstrained but polycrystalline style (10%), are moderately strained single or crystalline composite grains (15%) and quartzite composed of moderately strained quartz grains (2%). Other siliceous clast include <1% of vein quartz and chert

Other free mineral grains amounting to about 1% comprised of opaque oxides, tourmaline, zircon and rutile.

Feldspar grains of plagioclase and orthoclase amount to 1%.

Lithic clasts of acid volcanics amount to <1% (<1% microcrystalline quartz). Intermediate volcanic clasts present at <1%.

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Plant matter and charcoal amounted to about 1%.

A major element XRF analysis on the sand sample was undertaken by Sietronics Pty Ltd, Canberra using a Philips PW2400 XRF with Rh-end window tube and SUPERQ software.

The following results (in oxide wt%) were produced:

| | |
|--------------------------------|-------|
| SiO ₂ | <98.0 |
| TiO ₂ | 0.22 |
| Al ₂ O ₃ | 0.25 |
| Fe ₂ O ₃ | 0.1 |
| MgO | 0.03 |
| CaO | 0.02 |
| MnO | 0.01 |
| P ₂ O ₅ | 0.01 |
| LOI | 0.6 |

All other elements analysed are below the detection limit of the equipment.

Comments and Interpretations

This supplied sand sample (Labelled NEW16W-3428-S04) from Cabbage Creek Road Sand Quarry may be described for engineering purposes as fine to medium quartz sand.

The **free silica content** (or total quartz) of the sand is **97%**, most of which is present as free grains or simple crystalline composite grains of quartz (95%), with 2% lithic clasts of quartzite and vein quartz and <1% microcrystalline quartz in acid volcanics and chert.

Being composed of subangular to subrounded, siliceous, fine quartz grains, minor other robust mineral grains and lithic fragments, the sand is interpreted to be **physically suitable for use as sand in concrete**.

The sand as a whole is predicted to have **potential for mild or slow deleterious alkali-silica reactivity in concrete**. It carries about <1% of cherty or finely microcrystalline quartz and 17% of moderately stained quartz and <1% heavily strained quartz.

Thus, sand of the type represented in the supplied sample is interpreted to be **suitable for use in concrete** provided that appropriate precautions are taken in mix and engineering design to take account of its perceived potential for mild or slow deleterious alkali-silica reactivity.

Guidance on how to deal with the perceived mild to slow potential for deleterious alkali-silica reactivity may be found in the 1996 joint publication of the *Cement and Concrete Association of Australia* and *Standards Australia*, entitled *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*.

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sample), and the amount and nature of the impurities is important, particularly coloured elements. Alumina should be less than 1% (0.25% for this sand sample) and iron oxide should be quite low (0.1% for this sand sample - around 0.2% is usually acceptable for coloured glass). Sand for glass manufacture should be of even grainsize, generally less than 20 mesh (i.e. less than about 0.85 mm) and coarser than 100 mesh (i.e. coarser than about 0.15 mm). It seems that sand equivalent to the supplied sample from Cabbage Tree Road could be used to generate a product meeting these specifications but further analysis and processing is required to determine suitability for glass manufacture production.

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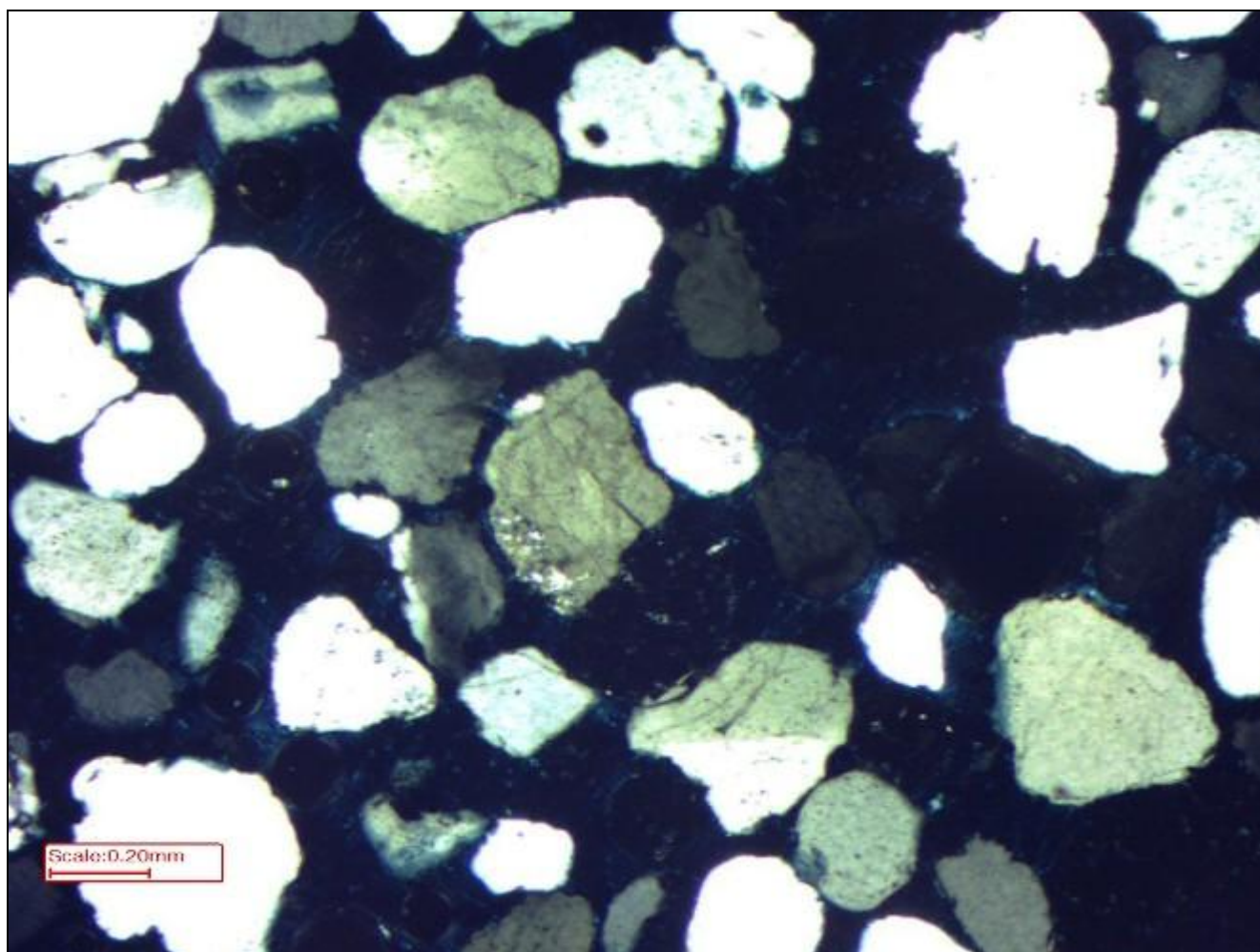


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11 Cheney Place Mitchell ACT 2911 | PO Box 695 Mitchell ACT 2911

☎ (02) 6246 9299 📠 (02) 6241 5771 📧 spl@sietronics.com.au

🌐 www.sietronicslabservices.com.au

Qualtest Laboratory (NSW) Pty Ltd
8 Ironbark Close
WARABROOK, NSW 2304

Attention: Mr. Dane Cullen

Wednesday, 30 November 2016

Report Number LS1758

X-Ray Fluorescence Analysis

Introduction:

Four (4) samples were submitted for elemental analysis using X-ray fluorescence (XRF).

Sampling & Preparation:

The samples were pulverised in a tungsten carbide (WC) grinding head using a standard ring mill prior to preparation of 40mm fused beads for major element analysis.

Analytical Method:

The XRF data was produced using a Philips PW2400 XRF with Rh-end window tube and SUPERQ software.

Results:

See tables below.

Reference:

Norrish K and Hutton J.T. 1969. *An accurate X-ray spectrographic method for the analysis of a wide range of geological samples*, Geo Geochimica et Cosmochimica Acta, 33, PP 431-453.

Tim Black

Sietronics Pty Limited - Canberra Office

E: tim.black@sietronics.com.au

P: (02) 6246 9299

W: www.sietronicslabservices.com.au

Please note: If samples are required to be returned or held for a long period of time please contact Sietronics Pty Ltd as soon as possible. All samples are discarded one (1) month after report is issued.

Major Element XRF Analysis

| OXIDE WT.% | Dry basis | | | |
|---------------|--------------------|-------------------|-------------------|-------------------|
| | SPL Ref: LS1758-01 | LS1758-02 | LS1758-03 | LS1758-04 |
| Sample ID: | BH1 (0.0-2.0m) | BH2 (0.0-2.0m) | BH3 (0.0-2.0m) | BH4 (0.0-2.0m) |
| SiO2 | >98.0 | >98.0 | >98.0 | >98.0 |
| TiO2 | 0.29 | 0.2 | 0.14 | 0.22 |
| Al2O3 | 0.23 | 0.38 | 0.23 | 0.25 |
| Fe2O3 | 0.15 | 0.11 | 0.11 | 0.1 |
| MnO | BLD | BLD | BLD | 0.01 |
| MgO | 0.05 | 0.06 | 0.01 | 0.03 |
| CaO | 0.03 | 0.03 | 0.01 | 0.02 |
| Na2O | BLD | 0.01 | BLD | BLD |
| K2O | BLD | 0.01 | 0.01 | BLD |
| P2O5 | BLD | 0.01 | 0.01 | 0.01 |
| SO3 | BLD | BLD | BLD | BLD |
| L.O.I. | 0.4 | 0.35 | 0.71 | 0.6 |

LOI = Loss on Ignition at 1,050°C.

BLD = Below Level of Detection