


**Boral Construction Materials
 Materials Technical Services**

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TEST REPORT

CLIENT: P.F. FORMATION

PROJECT: Quality Control – Annual Full Test of Fine Washed Sand ex Maroota for 2018

TEST PROCEDURE: i) AS1141 – Methods for Sampling and Testing Aggregates FILE No: 250/18

ii) RMS - Materials Test Methods Vol. 1

REQUEST No: 77949

 iii) ASTM 7428-15, Standard Test Method for Resistance of Fine Aggregate to Degradation by Abrasion
 in the Micro-Deval Apparatus

 SPECIFICATION: AS2758.1- Concrete Aggregates – Date: 7th November 2014

Sample Description:		Fine Washed Sand	
Location:		Maroota Quarry	
Laboratory Sample No:		203604	
Date Sampled:		11.4.18	
Test Method:	Test:	Spec	Results:
*AS1141.11.1	% Passing A.S. Sieve		
	9.5mm	100**	
	6.7 mm	-	
	4.75 mm	90-100	100
	2.36 mm	60-100	98
	1.18 mm	30-100	93
	600 micron	15-100	78
	425 micron	-	57
	300 micron	5-50	33
	150 micron	0-20	10
AS1141.12	Material finer than 75 micron (%)	0-5	2
AS1141.5	Particle Density (DRY) (t/m ³)	Min 2.1	2.51
	Particle Density (SSD) (t/m ³)		2.53
	Apparent Particle Density (t/m ³)		2.57
	Water Absorption (%)	Max. 2.0	0.8
AS1141.4	Uncompacted Bulk Density (t/m ³)		1.43
	Compacted Bulk Density (t/m ³)	Min 1.2	1.58
AS1141.24	Sodium Sulphate Soundness		
	Total Weighted (% Loss)	Max. 6	1.0
	Fraction tested:		
	1.18mm+600 µm (%Loss)		2.2
	-600 µm +300µm (% Loss)		0.6
AS1141.33	Silt Content (%)		8
AS1141.34	Organic impurities other than sugar	Not darker than	Pass
	The colour assessment was made visually using coloured reference glass	std.	
RMS T262	Moisture Content (%)		7.2

*Sample washed over 75 micron sieve as per AS1141.11.1 Clause 5.6.

Page 1 of 2

** As per Coarse Aggregate – Recommended Gradings (Table B2), AS2758.1



Approved Signatory

Kamal Ali

Date

8.5.18

Serial No.

168350

NATA Accredited Laboratory

Accredited for compliance with ISO/IEC 17025

Number: 547


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Page 2 of 2

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SPECIFICATION: AS2758.1- Concrete Aggregates – Date: 7th November 2014

Sample Description:			Fine Washed Sand
Location:			Maroota Quarry
Laboratory Sample No:			203604
Date Sampled:			11.4.18
Test Method:	Test:	Spec	Results:
AS1141.25.3	Degradation Factor – Fine Aggregate The wash water after using permitted 500ml was:		46 Clear
RMS T279	Method of Determining Voids Content and Flow Time % of Voids The Mean Flow Time (sec.)		44.7 23.6
ASTM D7428*1	Micro-Deval Abrasion Test % Loss The % loss of the control agg. tested closest to the time at which the sample was tested = 18.8		5.6

Sample Submitted by Client.

*1 Sample tested without preparing standard grading as per ASTM D7428 Clause 8 Note 2

J. Graham, QC File, File



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Method for Determining Voids Content - Flow Time

RMS T279

CLIENT: P.F. FORMATION

FILE NO: 250/18

PROJECT: Quality Control – Annual Full Test of Fine Washed Sandex Maroota for 2018

LAB SAMPLE NO: 203604

REQUEST: 77949

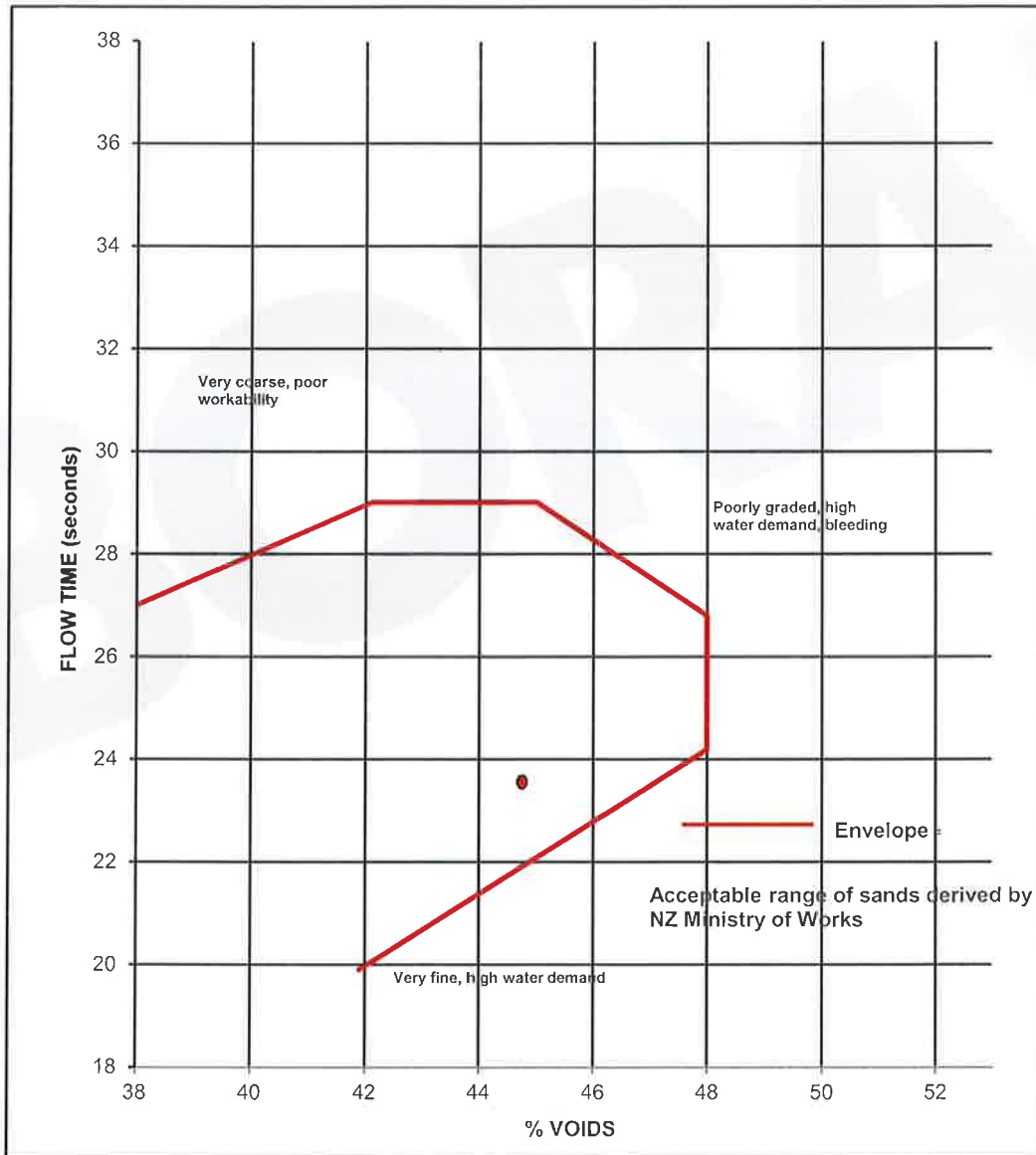
SPECIFICATION: AS2758.1- Concrete Agg. – Date: 7th Nov. 2014

LOCATION : Maroota Quarry

TEST METHOD: RMS – Materials Test Methods Vol.1

DATE SAMPLED: 11.4.18

SAMPLE DESCRIPTION: Fine Washed Sand



Material sampled by client.

Kamal Ali 
SECTION HEAD – AGGREGATES
2nd May 2018
J. Graham, QC File, File



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TEST REPORT

CLIENT: P.F. FORMATION

FILE No: 250/18


PROJECT: Quality Control – Annual Full Test of Fine Washed Sand ex Maroota for 2018

REQUEST No: 77949

TEST PROCEDURE: Texas Highway Department – Materials and Tests Division – TEX.402-A, Rev. Aug. 1999

Sample Description:		Fine Washed Sand
Location:		Maroota Quarry
Laboratory Sample No:		203604
Date Sampled:		11.4.18
Test Method:	Test:	Results:
TEX-402-A	Fineness Modulus of Fine Aggregate	1.88

Sample submitted by client.

Kamal Ali 
SECTION HEAD – AGGREGATES
30th April 2018

J. Graham, QC File, File



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TEST REPORT

CLIENT: P.F. FORMATION

FILE No: 250/18

PROJECT: Quality Control – Annual Full Test of Fine Washed Sand ex Maroota for 2018

REQUEST No: 77949

TEST PROCEDURE: AASHTO T 304 – Uncompacted Void Content of Fine Aggregate (Method A)

Sample Identification	Field Sample Number	Laboratory Sample Number	Bulk Dry Specific Gravity (t/m ³)	Uncompacted Voids Content (%)
Fine Washed Sand ex Maroota Quarry– 11/4/2018	1	203604	2.51	43.1

Material sampled by client

J. Graham, QC File, File

Kamal Ali



Approved Signatory 

Date 8-5-18 Serial No. 168351

Accredited for compliance with ISO/IEC 17025

NATA Accredited Laboratory

Number: 547



Ref: 2018 203604 Fine Washed Sand Sand Equivalent AS PI - AFT
Page 1 of 1
 Report Template Rev 0 Jan 09 Authorised by A. Mendoza

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TEST REPORT

CLIENT: P. F. FORMATION
 PROJECT: Quality Control - Annual Full Test - 2018
 MATERIAL: Fine Washed Sand from Maroota Quarry

FILE No: 250/18
 REQUEST No: 77949
 DATE SAMPLED: 11.4.18
 DATE TESTED: 18.4.17 to 26.4.17

Test Method AS1289.3.7.1	Results
Determination of the Sand Equivalent of a soil using a power-operated shaker	Field Sample No. 1 Laboratory Sample No. 203604
Sand Equivalent	66
Temperature of test solution (°C)	25

Test Methods RMS T108 and T109	Results
Determination of the Liquid Limit (refers to AS1289.3.1.1), Plastic Limit (refers to AS1289.2.1), and Plasticity Index of Road Materials.	Field Sample No. 1 Laboratory Sample No. 203604
Test: RMS T108 - Liquid Limit (%) RMS T109 - Plastic Limit (%) and Plasticity Index (%)	N/A* N/A** NP
Sample history Preparation method Method used for moisture content determination	OD DS N/App
<p>N/A* - Test is not applicable due to continual slippage in bowl. Liquid Limit could not be obtained. NP - Non-plastic. N/A** - Unable to roll, plastic limit could not be obtained. N/App. - Not Applicable. Sample history:- NS = Natural state, AD = Air dried, OD = Oven dried at 50°C, UN = Unknown, AR = As received Preparation method:- WS = Wet sieved, DS = Dry sieved, AR = As received</p>	

Note: Sample provided by client.

JOSHUA GRAHAM, Q. C. FILE, FILE.



Approved Signatory _____
 Date 3-5-18 Serial No. 168352

Artemio Mendoza


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TEST REPORT

CLIENT: P.F. Formation FILE No: 250 / 18
 1774 Wisemans Ferry Road Maroota NSW 2756
 PROJECT: Quality Control Annual Full Test of Fine Washed Sand ex. Maroota for 2018 to AS 2758.1 REQUEST No: 77949
 Specification

TEST PROCEDURE:

AS 1012.20.1 – Determination of Chloride and Sulfate in Hardened Concrete and Aggregates – Nitric Acid Extraction Method

AS 1141.12 – Percent Passing 75 micron

AS 1141.13 – Material Finer than 2 micron

AS 1141.31 – Determination of Light Particles

AS 1141.35 – Detection of Sugar

AS 1141.36 – Sulfur in Metallurgical Slag, Crushed Rock or Other Pavement Materials

RMS T659 – Methylene Blue Adsorption value of Road Construction Material

AS 1289.4.1.1 – Organic Matter content

AS 1289.4.3.1 – Determination of the pH value of a Soil

RMS T123 – Determination of the pH value of a Soil

RMS T264 – Soluble Salts in Sand

Laboratory Sample No.: 203604

Date Sampled: 11.04.18

Sample Description: Fine Washed Sand

Field No.: 1

TEST RESULTS:Chloride as Cl⁻ (%) 0.002Sulfate as SO₃ (%) 0.03

Percent Passing 75micron (µm) (%) 2

Material Finer than 2 micron (µm) (%) Not Applicable

Light Particles (%) 0

Sugar Not Detected

Sulfur as S (%) 0.02

Methylene Blue Adsorption value (mg/g) 3

Methylene Blue Adsorption value for a Duplicate (mg/g) 3

Average Methylene Blue Adsorption value (mg/g) 3

Deleterious Fines Index (DFI) + 6

Organic Matter (%) 0

pH (AS) 6.4

pH (RMS) 6.4

Soluble Salts (%) < 0.3 (Free from Soluble Salts)

Sample submitted by the Client.

+ Note: DFI = (MBV mg/g) X (Material finer than 75µm %)

DFI Calculation is not part of RMS T659 or AS1141.12 and not covered by our laboratory's current scope of accreditation.

Joshua Graham, Q.C.File, Mat.File, File.

Approved Signatory  KAMAL ALI FRANK GRIMA

Date 28-5-18 Serial No. 168353

NATA Accredited Laboratory

Number: 547



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TEST REPORT

CLIENT: P.F. Formation
1774 Wisemans Ferry Road Maroota NSW 2756

FILE No: 250 / 18

PROJECT: Quality Control Annual Full Test of Fine Washed Sand ex. Maroota for
2018 to AS 2758.1 & ITP PF Fine Sand - 10AFQ01 - Maroota Quarry -
19/09/2017 Specifications

REQUEST No: 77949

TEST METHOD:

AS 2350.2 Clause 5.5 - Loss on Ignition (Modified)
Tex- 612 - J - Acid Insoluble Residue For Fine Aggregate

Laboratory Sample No.: 203604
Date Sampled: 11.4.18
Sample Description: Fine Washed Sand
Field No.: 1

TEST RESULTS:

CO₂ by Loss on Ignition (%) 0.1
Calcium Carbonate as CaCO₃ (%) 0.2
Acid Insoluble Residue (%) 99

Sample submitted by the Client.

S.Krishnamoorthy
Analytical Chemist
27th April 2018

J.Graham, Q.C.File, Mat.File, File.



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TEST REPORT

CLIENT: P.F.FORMATION
1774 Wisemans Ferry Road Maroota, N.S.W. 2756

FILE No: 250 / 18

PROJECT: Annual Full Test of Fine Washed Sand from Maroota for 2018.

REQUEST No: 77949

TEST PROCEDURE:

AS 1012.20.2 - Determination of Water-Soluble Chloride in Aggregates and Hardened Concrete

Laboratory Sample No.: 203604
Date Sampled: 11.04.18
Date Received: 18.04.18
Sample Description: Fine Washed Sand

Field No.: 1

TEST RESULTS:

Chloride as Cl⁻ (%) 0.002

Sample submitted by the Client.

FRANK GRIMA
Analytical Chemist
28th May, 2018

J.Graham, Q.C.File, Mat.File, File.



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TEST REPORT

CLIENT: P.F.FORMATION
1774 Wisemans Ferry Road, Maroota, NSW 2756.

FILE No.: 250/18

PROJECT: Quality Control Annual Full Test of Fine Washed sand ex Maroota for 2018. REQUEST No.: 77949

**TEST PROCEDURE: Boral Chemical Method 2 – Determination of metal oxides by
Lithium Meta Borate Fusion and analysed using ICP**

Laboratory Sample No.: 203604
Date Sampled: 11/04/18
Date Received: 18/04/18
Sample Description: Fine washed
sand
Field No.: 1

TEST RESULTS

Silicon as SiO₂ (%) 97.2

Sample submitted by the Client.

Nanthini S
Analytical Chemist
25th May 2018.

J.Graham, Q.C.File, Mat.File, File.



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Test Report

Client:	P. F. FORMATION	File No:	250/18
Address:	1774 Wisemans Ferry Road Maroota, NSW 2756	Req. No:	77949
Date Received:	April 2018	Date Sampled:	11/04/2018
Project:	Quality Control Annual Full Test of Fine Washed Sand ex Maroota for 2018.		
Test Method:	Accelerated Mortar Bar Test for AAR Assessment - RMS T363		

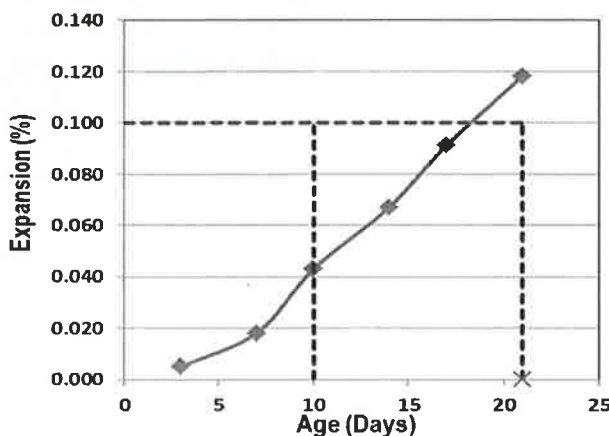
Lab Sample No	Sample Description	Location
203604	Fine Washed Sand	Marrota Quarry
N/A	Boral GP / SL Cement	Berrima

Results:

Flow (%): 12

W/C Ratio: 0.48

Age (Days)	Expansion (%) Avg. of 3 specimens
3	0.005
7	0.018
10	0.043
14	0.067
17	0.091
21	0.118



Mortar Bar Expansion (E) % Duration of Specimens in 1mol/L NaOH at 80°C		RMS T363 Aggregate Reactivity Classification
10 Days	21 Days	
< 0.1*	< 0.1*	Non-Reactive
< 0.1*	≥ 0.1*	Slowly Reactive
≥ 0.1*	>> 0.1*	Reactive

* 0.15% for naturally occurring fine aggregates

Notes: N/A

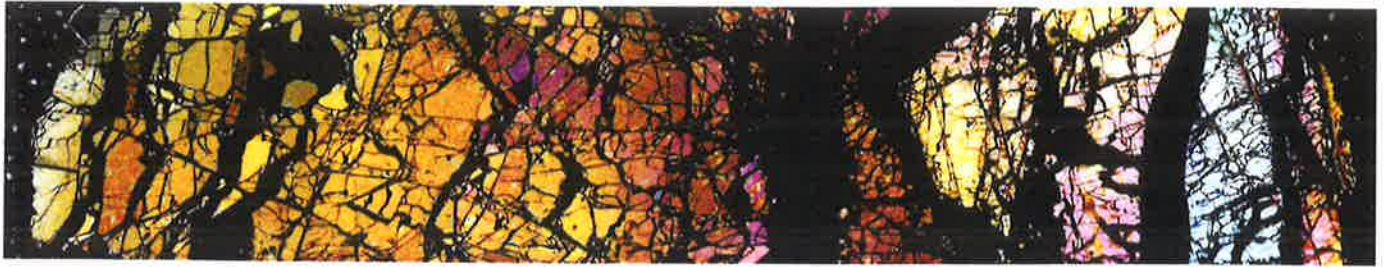
Joshua Graham, Q. C. File, Mat. File, File



Approved Signatory Safwan Fawal

Date 25/05/2018 Serial No. 168354

NATA Accredited Laboratory



Geochempet Services

ABN 980 6945 3445

PETROLOGICAL and GEOCHEMICAL CONSULTANTS

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



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PETROGRAPHIC REPORT ON A FINE WASHED SAND SAMPLE (203604) FROM MAROOTA QUARRY

prepared for

**BORAL RESOURCES (NSW) PTY LTD
MATERIALS TECHNICAL SERVICES**

Purchase Order: 5897405

Invoice Number: 00008177

Client Ref:

Issued by

C. A. Nix BAppSc MEngSc
18 May 2018

MAY, 2018

Bo180507

Page 1 of 6

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GEOCHEMPET SERVICES, BRISBANE

Sample Number: 203604 **Date Sampled:** 11/04/2018

Product Type: Fine Washed Sand **Date Supplied:** 18/04/2018

Sample Source: Ex. Maroota Quarry **Date Received:** 30/04/2018

Location: P.F. Formation

Work Requested Petrographic analysis in relation to suitability for use as concrete sand and as a fine component in asphalt; petrographic assessment of potential for alkali-silica reactivity

Methods Account taken of ASTM C 295 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 2015 joint publication of the Cement and Concrete Association of Australia and Standards Australia, (HB 79-2015) entitled *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*

Identification Medium to fine quartz sand

Description

The sample consisted of about 0.5 kg of very light yellowish-grey, clean sand, composed of water-worn, sub-rounded and sub-angular quartz grains and minor lithic fragments.



Figure 1: Digital image of sub-sample from supplied sample 203604.

GEOCHEMPET SERVICES, BRISBANE

In a crude, dry sieving test of small subsample these results were tabulated:

Sieve Size	Wt % of sample
Coarse (>1.18mm)	8.7%
Medium (>0.3mm)	64.8%
Fine (>0.075mm)	25.8%
Silt (<0.075mm)	0.7%

The coarse fraction consists of quartz grains and minor lithic fragments of quartzite and sandstone clasts which are difficult to break by hand, with trace plant material. There are no apparent deleterious grain coatings.

When a subsample was swirled in water, a very light grey persistent turbidity was noted, suggesting the presence of minor silt and clay in the sample.

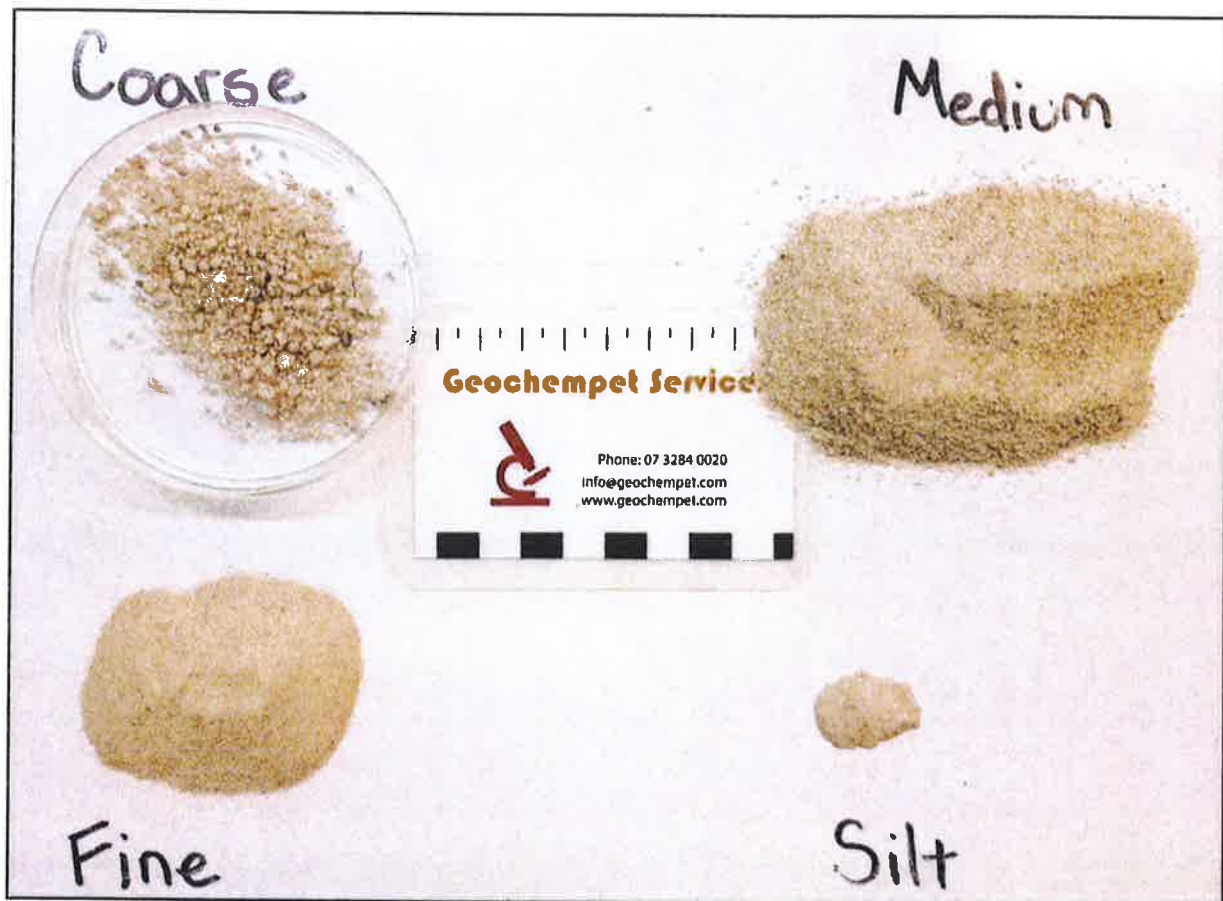


Figure 2: Digital image of sieve fractions as recorded above.

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Figure 3: Digital image of coarse sieve fraction as recorded above.

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

- 69% quartz as single, free, unstrained to mildly strained grains (59%) or as simple composite crystalline aggregates of quartz grains (10%)
- 12% quartz as moderately strained single or more commonly crystalline composite grains
- 10% quartzite (4% moderately strained)
- 2% feldspar grains (orthoclase)
- <1% heavy mineral grains (including epidote, zircon, haematite/goethite, hornblende and opaque oxide)
- <1% free mica flakes

- 2% lithic clasts of acid volcanics (1% microcrystalline quartz)
- 2% lithic clasts of quartz sandstone (2% quartz)
- <1% lithic clasts of intermediate volcanics
- <1% lithic clasts of meta-pelite/slate
- <1% ferruginous fragments
- <1% sericitized fragments
- 2% clay cemented quartz grains (1% quartz)

GEOCHEMPET SERVICES, BRISBANE

1% clay coating on free quartz grains
trace Plant matter

The free silica content (or total quartz plus chert content) of the sand is 95% comprised of 81% free quartz grains or simple crystalline composite grains, and 13% quartz locked within lithic fragments of quartzite, clay cemented clasts and arenite and a further 1% microcrystalline quartz locked within acid volcanic/tuffaceous clasts.

In thin section, the sand is seen to consist very largely of quartz, comprising 59% quartz as single, free, unstrained to mildly strained grains, 10% quartz as simple composite crystalline aggregates of quartz grains, and 12% quartz as moderately strained single or crystalline composite grains. The grains are confirmed to carry some clay trapped in surface indents, but the amount is small (apparently 1%). Other siliceous fragments include 10% quartzite.

Variable weathered sericitized and kaolinized feldspar grains amount to about 2%. Small heavy mineral grains are conspicuous and amount to <1%, comprising epidote, zircon, haematite/goethite, hornblende and opaque oxide.

Lithic clasts amount to 4% of the sample and consist of 2% acid volcanic/tuffaceous fragments (<1% finely crystalline quartz in groundmass), 2% quartz sandstone (consisting of quartz and subordinate feldspars suspended in a clay matrix), <1% intermediate volcanics and a further <1% meta-pelite/slate.

Ferruginous fragments (probably after feldspars) amounts to about <1% of the sand sample. Sericitized clasts amounted to <1% along with a trace of plant rootlets.

Clay cemented quartz grains were also noted making up about 2%.

Comments and Interpretations

The supplied fine washed sand sample (labelled 203604) from the Maroota Quarry is considered to be fairly clean quartz sand which may be described broadly for engineering purposes as medium to fine quartz sand.

The **free silica content** (or **total quartz content**) of the sand is **about 95%**, comprised of 81% free quartz grains or simple crystalline composite grains, and 13% quartz locked within lithic fragments of quartzite, clay cemented clasts and arenite and a further 1% microcrystalline quartz locked within acid volcanic/tuffaceous clasts.

Being composed largely of sub-rounded and sub-angular grains of quartz, the sand is interpreted to be **physically suitable for use as concrete sand**. It does carry some hard to remove clay coatings and clay-cemented quartz grains but the amount is considered to be insufficient to contribute significantly to water demand.

The sand as a whole is predicted to have **potential for mild or slow deleterious alkali-silica reactivity in concrete**. It carries about 16% of moderately stained quartz (as free grains or simple composite grains, and in quartzite), and <1% microcrystalline quartz in lithic clasts of acid volcanic/tuffaceous rock.

GEOCHEMPET SERVICES, BRISBANE

Guidance can be obtained from the 2015 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*.

In short, sand equivalent to the supplied sample is predicted to be **suitable for use as concrete sand and as a fine component in asphalt**, subject to bitumen stripping and polishing tests.

Free Silica Content

The free silica content is about 95%.

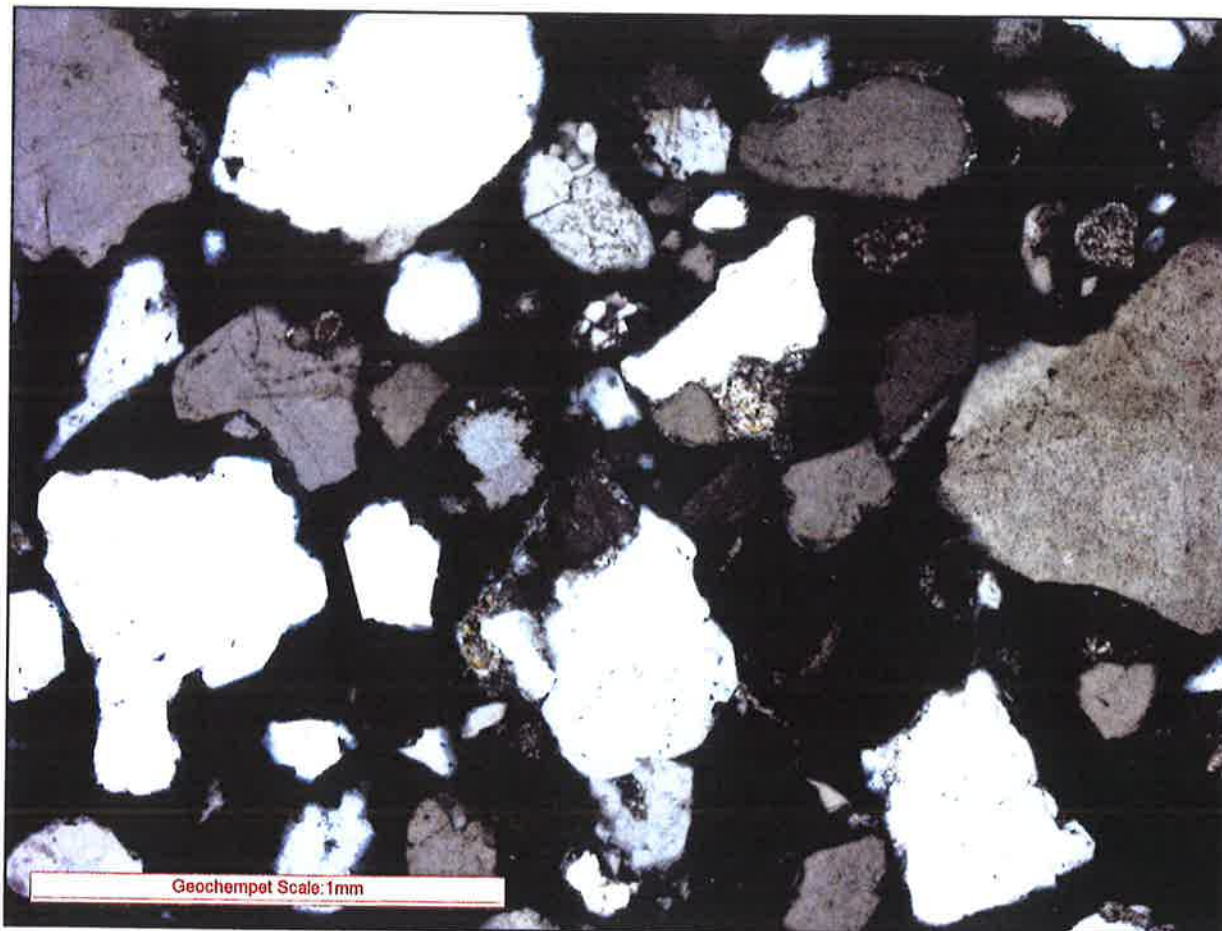


Figure 4: Microscopic image of supplied sand sample, taken at low magnification under transmitted cross polarised light. Image shows a typical view of the sample, dominated by sub-rounded quartz showing a range of extinctions, along with arenite fragments.