


**Boral Construction Materials
Materials Technical Services**

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TEST REPORT

CLIENT: P.F. Formation

PROJECT: Quality Control – Annual Full Test of Coarse Sand ex Maroota for 2016

TEST METHOD: i) AS1141 – Methods for Sampling and Testing Aggregates FILE NO: 250/16

ii) RMS – Materials Test Methods Vol. 1 REQUEST NO: 69365

iii) ASTM D7428, 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:		Coarse Sand	
Location:		Maroota Quarry	
Date Sampled:		7.9.16	
Laboratory Sample No:		182603	
Test Method:	Test:	Spec:	Results:
AS1141.11.1*	% Passing A.S. Sieve 9.5mm 6.7mm 4.75mm 2.36mm 1.18mm 600 micron 425 micron 300 micron 150 micron	100*1 - 90-100 60-100 30-100 15-100 - 5- 50 0- 20	 100 99 90 77 58 43 25 5
AS1141.12	Material finer than 75 micron (%)	0- 5	1
AS1141.4	Uncompacted Bulk Density t/m ³ Compacted Bulk Density t/m ³	 Min. 1.2	1.59 1.70
AS1141.5	Particle Density (Dry) t/m ³ Particle Density (SSD) t/m ³ Apparent Particle Density t/m ³ Water Absorption (%)	Min. 2.1 Max. 2.0	2.58 2.60 2.62 0.6
AS1141.24	Sodium Sulphate Soundness (Total Weighted % Loss) Fraction tested : -4.75mm+2.36mm (% Loss) -2.36mm+1.18mm (% Loss) -1.18mm+600 µm (% Loss) -600 µm +300 µm (% Loss)	Max. 6	0.5 0.9 0.4 0.5 0.5

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

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

Page 1 of 2

Kamal Ali



Approved Signatory

Date 11.10.16

Serial No. 150689

ACCREDITED FOR
TECHNICAL
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NATA Accredited Laboratory

Number: 547


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Page 2 of 2**TEST REPORT**

CLIENT: P.F. Formation

PROJECT: Quality Control – Annual Full Test of Coarse Sand ex Maroota for 2016

TEST METHOD: i) AS1141 – Methods for Sampling and Testing Aggregates

FILE NO: 250/16

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REQUEST NO: 69365

iii) ASTM D7428, 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:			Coarse Sand
Location:			Maroota Quarry
Date Sampled:			7.9.16
Laboratory Sample No:			182603
Test Method:	Test:	Spec:	Results:
AS1141.34	Organic impurities other than sugar The colour assessment was made visually using coloured reference glass	Not darker than std.	Pass
AS1141.33	Silt Content (%)		6
RMS T279	Method of Determining Voids Content % Voids The Mean Flow Time (Sec.)		40.9 22.0
ASTM D7428	Micro-Deval Abrasion Test % Loss The % loss of the control aggregate tested closest to the time at which the sample was tested = 18.7		5.5
RMS T262	Moisture Content (%)		7.0
AS1141.25.3	Degradation Factor Fine Aggregate The wash water after using permitted 500ml was:		99 Clear

Sample submitted by client

J. Graham, QC File, File



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Method for Determining Voids Content - Flow Time
RMS T279 - OCT. 2012

CLIENT: P.F. Formation

PROJECT: Quality Control – Annual Full Test of Coarse Sand ex Maroota for 2016

LAB SAMPLE NO: 182603

SAMPLE LOCATION: Maroota Quarry

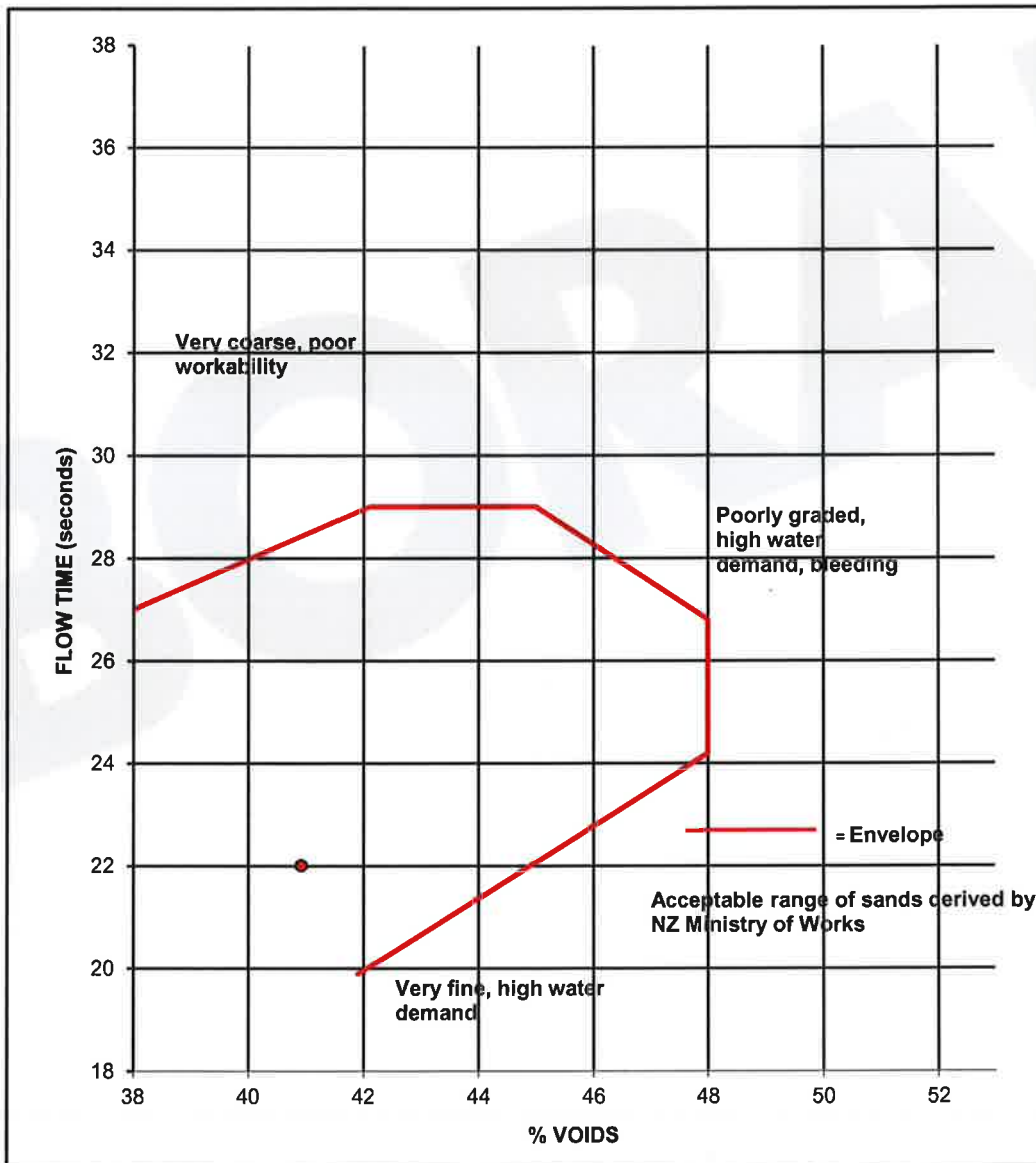
TEST METHOD: RMS – Materials Test Methods Vol. 1

SAMPLE DESCRIPTION: Coarse Sand

FILE NO: 250/16

REQUEST: 69365

DATE SAMPLED: 7.9.16



Sample submitted by client
J. Graham, QC File, File

Kamal Ali
SECTION HEAD - AGGREGATES
10th October 2016



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TEST REPORT

CLIENT: P.F. Formation

FILE NO: 250/16

PROJECT: Quality Control – Annual Full Test of Coarse Sand ex Maroota for 2016

REQUEST NO: 69365

TEST PROCEDURE: Texas Highway Department – Materials and Tests Division –
TEX.402-A, Rev. Sept. 1966

Sample Description:		Coarse Sand
Location:		Maroota Quarry
Date Sampled:		7.9.16
Laboratory Sample No:		182603
Test Method:	Test:	Results:
TEX-402-A	Fineness Modulus of Fine Aggregate	2.46

Sample submitted by client.


Kamal Ali
Section Head – Aggregates

28th October 2016

J. Graham, QC File, File



Ref: 2016 182603 Coarse Sand - RMS LLPLPI - A.F.T.
 Page 1 of 1
 Report Template Rev 0 Jan 09 Authorised by A. Mendoza

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TEST REPORT

CLIENT:	P. F. FORMATION	FILE No:	250/16
PROJECT:	Quality Control - Annual Full Test - 2016	REQUEST No:	69365
MATERIAL:	Coarse Sand from Maroota Quarry	DATE SAMPLED:	7.9.16
		DATE TESTED:	23.9.16 to 28.9.16

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. 182603
Test: RMS T108 - Liquid Limit (%) RMS T109 - Plastic Limit (%) and Plasticity Index (%) Sample history Preparation method Method used for moisture content determination	N/A* N/A** NP 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

C. J. Shaw

Date 28.9.16 Serial No. 150690

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Ref: 2016 182603 Coarse Sand - Sand Equivalent - A.F.T.
 Page 1 of 1
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TEST REPORT

CLIENT: P. F. FORMATION
 PROJECT: Quality Control - Annual Full Test - 2016
 MATERIAL: Coarse Sand from Maroota Quarry

FILE No: 250/16
 REQUEST No: 69365
 DATE RECEIVED: 7.9.16
 DATE TESTED: 23.9.16 to 28.9.16

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. 182603
Sand Equivalent	88
Temperature of test solution (°C)	23

Note: Sample provided by client.

JOSHUA GRAHAM, Q. C. FILE, FILE.



Approved Signatory

C. J. Shaw

Date 28.9.16 Serial No. 150691

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FILE No.: 250 / 16

TEST REPORT

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

 PROJECT: Quality Control Annual Full Test of Coarse Sand ex. Maroota for 2016 to AS 2758.1 Specification
 REQUEST No.: 69365
TEST PROCEDURE:

AS 1012.20 – Determination of Chloride and Sulfate in Hardened Concrete and Concrete Aggregates

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.:	182603
Date Sampled:	7.9.16
Sample Description:	Coarse Sand
Field No.:	1

TEST RESULTS:

Chloride as Cl ⁻ (%)	0.002
Sulfate as SO ₃ (%)	0.03
Material Finer than 2 micron (µm) (%)	Not Applicable
Light Particles (%)	Nil
Sugar	Not Detected
Sulfur as S (%)	< 0.02
Methylene Blue Adsorption value (mg/g)	2
Methylene Blue Adsorption value for a Duplicate (mg/g)	2
Average Methylene Blue Adsorption value (mg/g)	2
Organic Matter (%)	0.1
pH (AS)	7.2
pH (RMS)	7.2
Soluble Salts (%)	< 0.3 (Free from Soluble Salts)

Sample submitted by the Client.



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

Approved Signatory

S.Krishnamoorthy

Date 4.10.16.

Serial No.

150692

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Number: 547



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TEST REPORT

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

FILE No: 250 / 16

PROJECT: Quality Control Annual Full Test of Coarse Sand ex. Maroota Quarry for
2016 to AS 2758.1 Specification - Aggregates and Rock for Engineering
Purposes - Part 1: Concrete Aggregates - 7th November 2014

REQUEST No: 69365

TEST METHOD:

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

Laboratory Sample No.: 182603
Date Sampled: 7.9.16
Sample Description: Coarse Sand
Field No.: 1

TEST RESULTS:

CO₂ by Loss on Ignition (%) < 0.1
Calcium Carbonate as CaCO₃ (%) 0.1
Acid Insoluble Residue (%) 100

Sample submitted by the Client.

S. Krishnamoorthy
Analytical Chemist
4th October 2016

Joshua 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.: 250/16

PROJECT: Quality Control Annual Full Test of Coarse Sand ex. Maroota for 2016.

REQUEST No.: 69365

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

Laboratory Sample No.: 182603
Date Sampled: 07/09/16
Date Received: 09/09/16
Sample Description: Coarse Sand
Field No.: 1

TEST RESULTS

Silicon as SiO₂ (%) 99.0

Sample submitted by the Client.

Nanthini S
Analytical Chemist
23rd September 2016.
J.Graham, Q.C.File, Mat. File, File.


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TEST REPORT

Client: P.F. FORMATION**Address:** 1774 WISEMANS FERRY ROAD MAROOTA, NSW 2756**Date Received:** September 2016**Project:** Quality Control Annual Full Test of Coarse Sand ex Maroota for 2016.**Test Method:** Accelerated Mortar Bar Test for AAR Assessment - RMS T363**File N°:** 250/16**Req N°:** 69365**Date Sampled:** 07/09/2016

LAB SAMPLE N°	SAMPLE DESCRIPTION	LOCATION
182603	Coarse Sand	Maroota Quarry
N/A	Boral GP/SL Cement	Berrima

RESULTS:

Flow: 8% W/C Ratio: 0.37

Age (Days)	Expansion % (Average of 3 specimens)
3	0.001
7	0.010
10	0.018
14	0.025
17	0.040
21	0.070

Aggregate Reactivity Classification:

Mortar Bar Expansion (%) in 1M NaOH (80°C)		Classification
10 days	21 days	
< 0.10*	< 0.10*	Non Reactive
< 0.10*	≥ 0.10*	Slowly Reactive
≥ 0.10*	>> 0.10*	Reactive

*0.15% for naturally occurring Fine Aggregates

Notes: N/A

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



Approved Signatory _____

Safwan Fawal

Date 14/10/2016 Serial No. _____150693

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Number: 547

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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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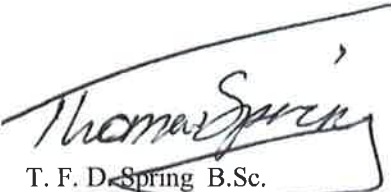
PETROGRAPHIC REPORT ON A COARSE SAND SAMPLE (182603) FROM MAROOTA QUARRY,

prepared for

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

Purchase Order: 5647043
Invoice Number: 00007317
Client Ref: George Calvar

Issued by


T. F. D. Spring B.Sc.
14 October 2016

October, 2016

Bo161005

Page 1 of 6

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Sample Number: 182603 **Date Sampled:** 07/09/2016

Product Type: Coarse Sand **Date Supplied:** 09/09/2016

Sample Source: Ex. Maroota Quarry **Date Recieved:** 22/09/2016

Location: P.F. Formation

Work Requested Petrographic analysis in relation to suitability for use as concrete; 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, (HB 79-2015) entitled *Alkali Aggregate Reaction - Guidelines on Minimising the Risk of Damage to Concrete Structures in Australia*

Identification Medium quartz sand

Description

The sample consisted of about 0.5 kg of pinkish-orange, 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 182603.

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

Sieve Size	Wt % of sample
Coarse (>1.18mm)	24.7%
Medium (>0.3mm)	54.7%
Fine (>0.075mm)	20.0%
Silt (<0.075mm)	0.6%

The minor coarse fraction consists of quartz grains and minor lithic fragments of variably ferruginized sandstone clasts which are difficult to break by hand. There are no apparent deleterious grain coatings; benign secondary iron oxide does occur as occasional coatings on a few sand grains.

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.

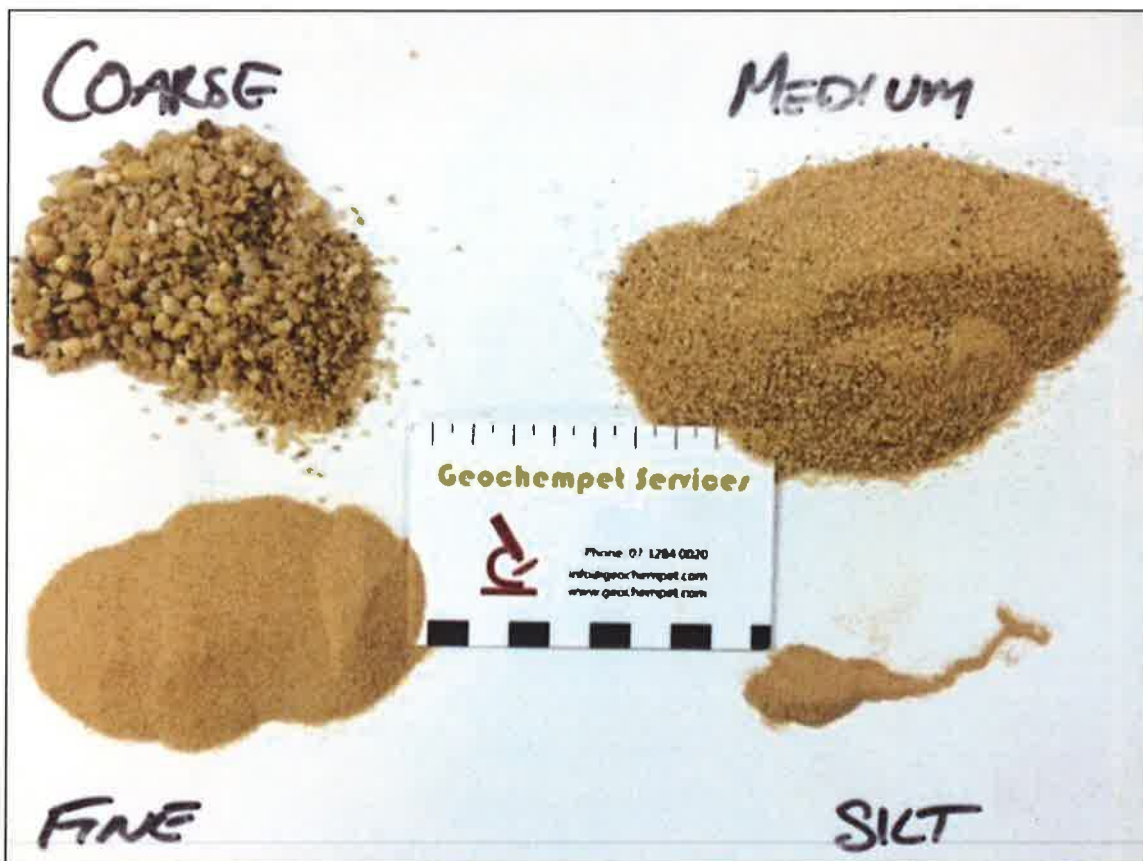


Figure 2: Digital image of sieve fractions as recorded above.

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Figure 3: Digital image of coarse sieve fraction as recorded above. Note the sandstone clasts.

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:

- 77% quartz as single, free, unstrained to mildly strained grains (68%) or as simple composite crystalline aggregates of quartz grains (9%)
- 19% quartz as moderately strained single or more commonly crystalline composite grains
- <1% quartzite (moderately strained)
- 1% feldspar grains (orthoclase)
- <1% heavy mineral grains (including epidote, zircon, haematite/goethite, hornblende and opaque oxide)
- <1% free mica flakes
- <1% lithic clasts of acid volcanics (<1% microcrystalline quartz)
- 2% lithic clasts of quartz sandstone (2% quartz)
- <1% lithic clasts of intermediate volcanics
- <1% ferruginous fragments
- <1% sericitized fragments

- 1% secondary iron coating on free quartz grains

The free silica content (or total quartz plus chert content) of the sand is 98% comprised of 96% free quartz grains or simple crystalline composite grains, and 2% quartz locked within lithic

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fragments of quartzite, iron-cemented clasts and arenite and <1% microcrystalline quartz locked within acid volcanic/tuffaceous clasts.

In thin section, the sand is seen to consist very largely of quartz, comprising 68% quartz as single, free, unstrained to mildly strained grains, 9% quartz as simple composite crystalline aggregates of quartz grains, and 19% quartz as moderately strained single or crystalline composite grains. The grains are confirmed to carry some iron trapped in surface indents, but the amount is very small (apparently 1%).

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

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

Both ferruginous fragments and sericitized clasts amounted to less than 1%.

Comments and Interpretations

The supplied coarse sand sample (labelled 182603) from the Maroota Quarry is considered to be fairly clean quartz sand which may be described broadly for engineering purposes as medium quartz sand.

The **free silica content** (or **total quartz content** as defined in the Queensland Department of Main Roads Test Method **Q188**) of the sand is **about 98%**, comprised of 96% free quartz grains or simple crystalline composite grains, and 2% quartz locked within lithic fragments of quartzite, clay cemented quartz grains and arenite and <1% of 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**.

The sand as a whole is predicted to have **potential for mild or slow deleterious alkali-silica reactivity in concrete**. It carries about 19% 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.

Guidance can be obtained from 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*.

Free Silica Content

The free silica content is about 98%.

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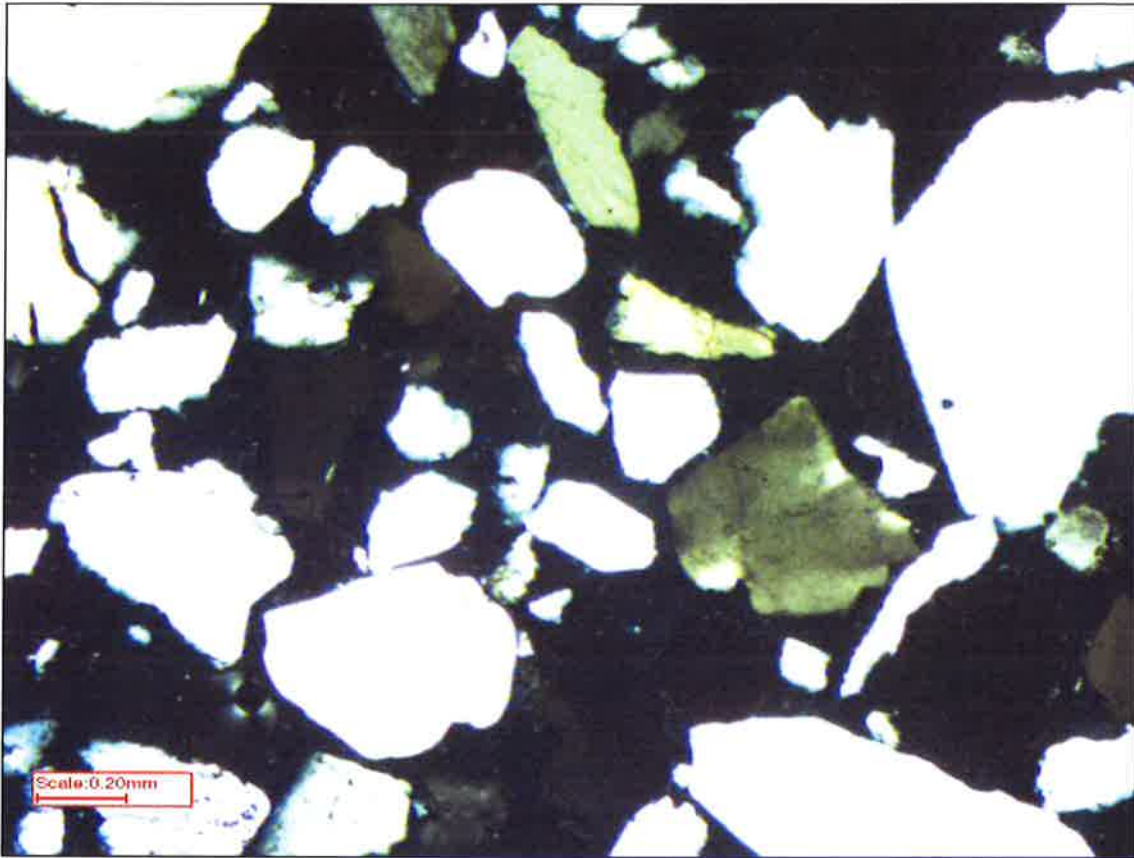


Figure 4: Micrograph of supplied sand sample 182603, taken at low magnification under transmitted cross polarised light. Image shows a typical view of the sample, dominated by sub-rounded quartz showing a range of straining extinctions.