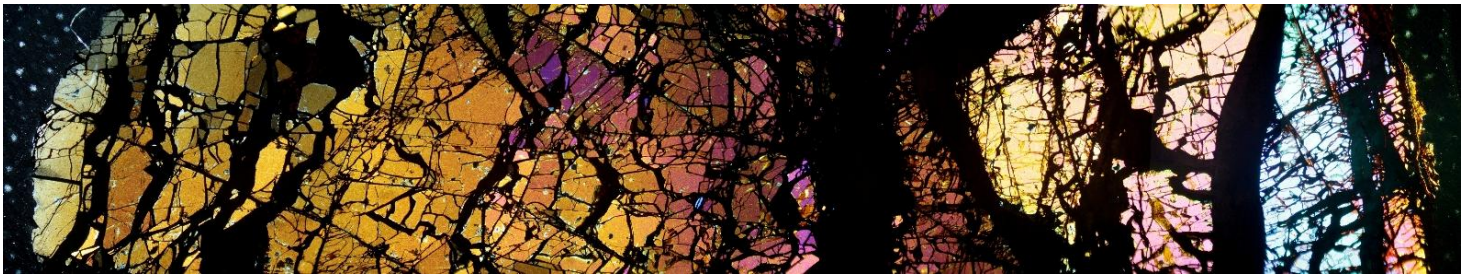

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PETROGRAPHIC REPORT ON A COARSE SAND SAMPLE (B90978) FROM BURDERKIN TRANSPORT

Prepared For

SOIL ENGINEERING SERVICES
GARBUTT

Purchase Order: 7940
Invoice Number: 00007532
Client Ref:

Issued by H M Spring

H.M. Spring B.Sc.
21 March 2017

GEOCHEMPET SERVICES BRISBANE

Sample Number: B90978 **Date** : 02/03/17

Product Type: Coarse Sand **Date Received**: 06/03/17

Sample Source: Burdekin Transport **Project:** TS19341

Work Requested Petrographic analysis in relation to use as concrete sand; 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 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 and of Queensland Main Roads Test Method Q188 Determination of the Quartz Content of Sand (Petrological Assessment)

Identification Quartzofeldspathic and lithic medium to coarse sand of mainly granitoid derivation

Description

The sample consisted of about 10kg of moderate yellowish brown, clean sand. Clasts vary from subangular to subrounded and rounded.

Figure 1: Digital image of supplied Coarse Sand.

In a crude test of a small dry subsample the following results were recorded;

Sieve Size	Wt % of sample
Coarse (>1.18mm)	46.9%
Medium (>0.3mm)	51.1%
Fine (>0.075mm)	1.9%
Silt (<0.075mm)	0.1%

The coarse fraction ranges from 1 mm up to about 8mm in size and includes obvious examples of worn rock fragments in addition to quartz and feldspar grains. There are no apparent deleterious grain coatings.

When a sub-sample was swirled in water, the suspended fraction settled lightly, leaving a slight turbidity and no argillaceous scum. This suggests the presence of very minor silts and clays in the sample.

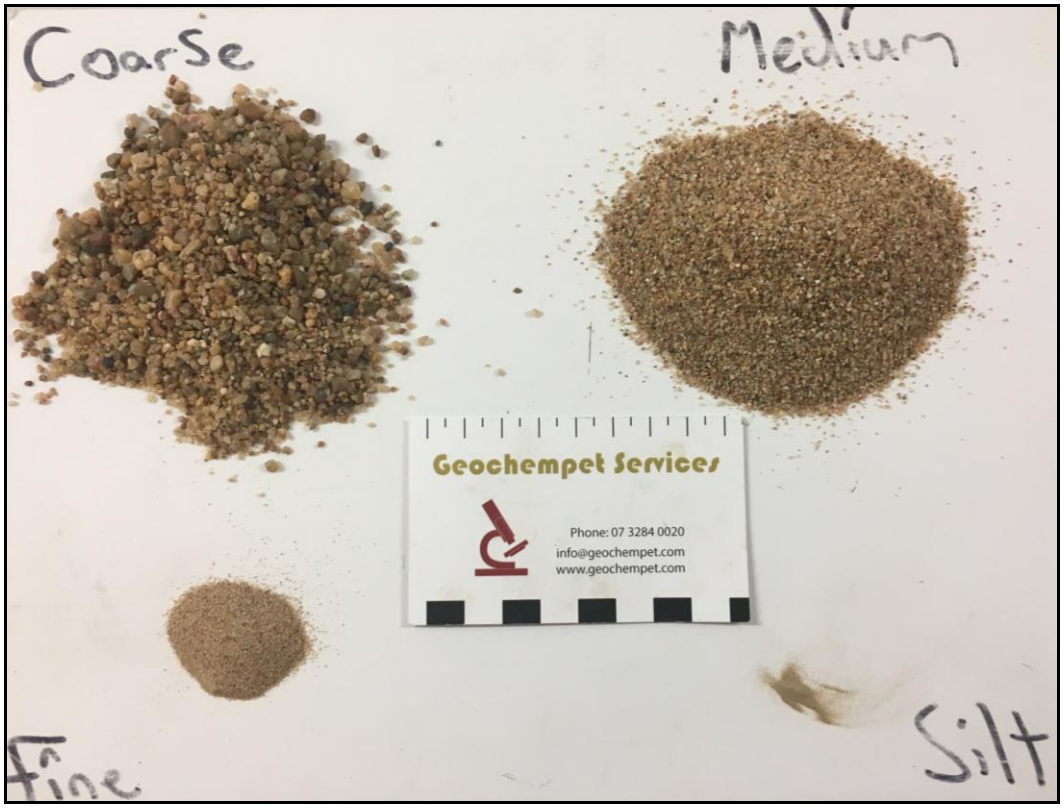

Figure 2: Digital image of sieve fraction as recorded above.

Figure 3: Image of the coarse fraction composed of granite and quartz

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 (volume % of clast types) for the sand:

19%	quartz as single mildly strained grains (10%) or as crystalline composite aggregates of similar quartz (9%)
15%	quartz as moderately strained single grains and simple composite fragments (<1% heavily strained)
5%	lithic clasts of quartzite (moderately strained)
1%	lithic clast of jasper
<1%	lithic fragments of vein quartz (heavily strained)
12%	feldspar grains (6% orthoclase and 6% plagioclase)
<1%	other free mineral grains (including epidote, opaque oxide and hornblende)
33%	lithic clasts of granitoid rock (composed of 18% quartz and 11% other minerals; 11% moderately strained quartz)
1%	lithic clasts of epidotized rock fragments
3%	lithic clasts of acid volcanic/tuffaceous rock (1% microcrystalline quartz)
2%	lithic clasts of intermediate volcanic/tuffaceous rock
1%	lithic clasts of basalt

3% lithic clasts of arenite (2% quartz)
1% lithic clasts of micaceous quartz arenite (1% quartz)
2% lithic clasts of ferricrete
2% argillized fragments

A simultaneous determination of free silica content (or total quartz content as defined in the Queensland Department of Main Roads Test Method Q188) indicated about 62%, comprising about 34% free grains or crystalline composite grains of quartz, 26% quartz locked within lithic clasts of granitoid style, arenite, clay cemented grains, vein quartz and quartzite and 2% of finely crystalline quartz locked within lithic fragments of jasper and acid volcanic/tuffaceous lithic clasts.

Quartz occurring as single, unstrained to mildly strained grains amounts to 10%, quartz as crystalline composites of several mildly strained grains also amounts to 9% and moderately strained single or crystalline composite grains of quartz amount to an additional 15%. Lithic clasts of moderately strained quartzite amount to 4% with a further <1% locked within clast of jasper and <1% as heavily strained vein quartz.

Feldspar grains amount to 12%. They comprise 6% orthoclase and 6% plagioclase.

Other free mineral grains amount to <1%: they include epidote, hornblende and opaque oxide.

Lithic clasts of slightly to moderately weathered (limonite-pigmented) granitoid rock amount to 33%: they are composed of medium-grained crystalline aggregates of two or more of the minerals orthoclase, plagioclase, quartz, hornblende and minor other minerals. Other lithic clasts comprise acid volcanic and/or tuffaceous rock (finely quartzofeldspathic), ferruginous arenite, intermediate volcanic/tuffaceous rock, quartz-epidote rock, micaceous quartz arenite and ferruginous clasts.
Argillized fragments most likely after feldspar amount to 2%

Comments and Interpretations

The supplied Coarse Sand sample (B90978) is considered to consist of clean, quartzofeldspathic and lithic medium to coarse sand. The sand is interpreted to consist of fragments derived by erosion and transportation from a mainly granitoid source area.

The **free silica content** (or total **quartz content** as defined in the Queensland Department of Main Roads Test Method Q188) of the sand is 62%, comprising about 34% free grains or crystalline composite grains of quartz, 26% quartz locked within lithic clasts of granitoid style, arenite, clay cemented grains, vein quartz and quartzite and 2% of finely crystalline quartz locked within lithic fragments of jasper and acid volcanic/tuffaceous lithic clasts.

Being composed mostly of hard, strong mineral and rock fragments, the sand is predicted to be **physically suitable for use as concrete sand**. The presence of variably weather feldspar and argillized fragments may give rise to slightly enhanced water demand.

In relation to potential for alkali-silica reactivity in concrete it is noted that the sand carries about 31% of moderately strained quartz and <1% heavily strained quartz (as free grains and crystalline composite grains and within quartzite clasts) and 2% of finely microcrystalline quartz (within chert

and acid volcanic/tuffaceous rock). Thus, the sand is predicted to have **potential for mild or slow alkali-silica reactivity in concrete**.

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 appropriate precautions 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 62%

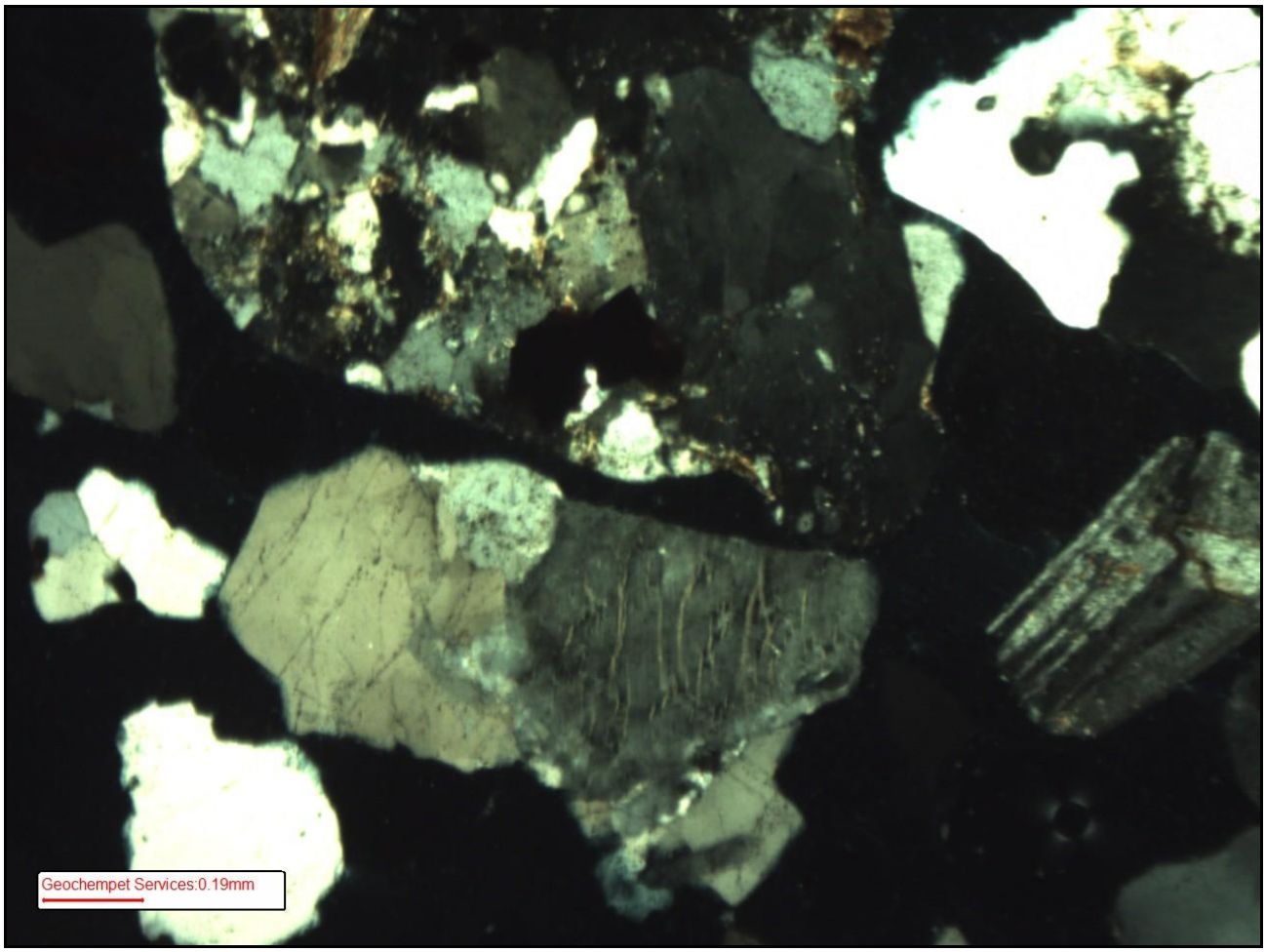

Figure 4: Photo-micrograph taken at low magnification with transmitted cross polarised light. Image shows the typical mineral assemblage observed throughout the slide with a mixture of free grains of feldspar and quartz as well as lithic clasts of granite.