



Soft sand and Silica sand Study

Final Report - Appendix A

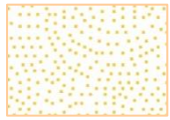
Sampling Site Details and Testing Results

To be used in conjunction with the Final Report (Cuesta QA Ref C/SDNPA008)

10th June 2015

Cuesta Consulting Limited

Key to detailed location maps for individual sites



Folkestone Formation outcrop



South Downs National Park



Active Quarry



Inactive Quarry



Dormant Quarry



Closed Quarry



Proposed Site

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BGS Resource Mapping:

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QA Ref C/SDNPA009

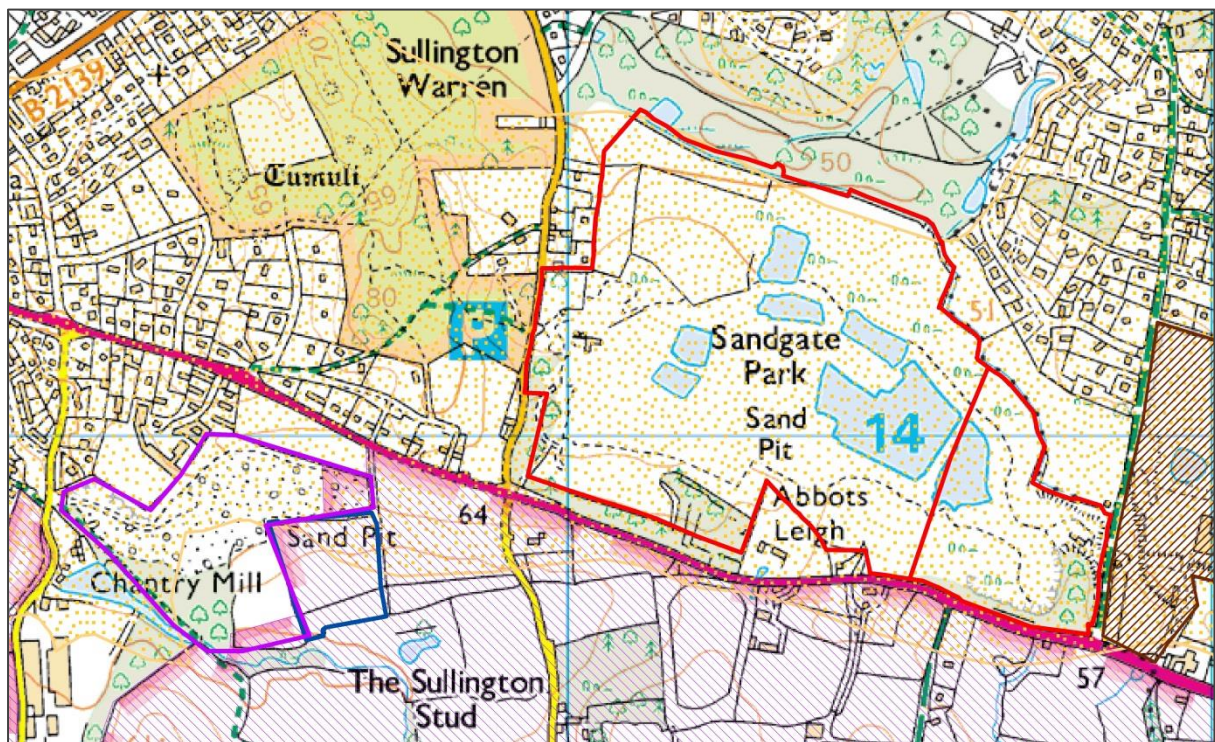
Date: 10th June 2015

Status: Final

Samples SASS1 to SASS3 - Sandgate Park Quarry

Site location map

Red outline = current planning permissions; purple = inactive permission; blue = proposed extension



Site photographs



SASS1 - Sandgate Park Quarry

In-situ sample of upper horizon from current working face

Sampled by Cuesta Consulting Ltd. 05/03/2015

Photomicrograph



Shape analysis:

Colour under Microscope	Other Observations	Roundness	Sphericity
Golden yellow and translucent white, coated in red 'silt'	A range of grain sizes observed a few at around 1mm but the majority smaller. Larger grains have red stained 'pock marks' or indentations. Grains coated in very fine grained red 'silt' - like material. Groups of grains 'stick together' before use of pestle. Some grains of low sphericity, some of high sphericity but generally medium sphericity. Occasional sub-angular grains.	Sub-Rounded to Rounded	Medium Sphericity

Chemical Analysis:

SiO₂	TiO₂	Al₂O₃	Fe₂O₃t	Mn₃O₄	MgO	CaO	Na₂O	K₂O	P₂O₅	SO₃	Cr₂O₃	SrO
%	%	%	%	%	%	%	%	%	%	%	%	%
98.54	0.04	0.43	0.22	<0.01	<0.05	<0.01	<0.05	0.01	<0.01	<0.1	<0.01	<0.01
ZrO₂	BaO	NiO	CuO	ZnO	PbO	V₂O₅	HfO₂	F	Cl	LOI	Total	
%	%	%	%	%	%	%	%	%	%	%	%	
<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.36	99.6	

Important note: the above analysis was carried out without prior washing to remove fines (<63 microns), which accounted for 2% (by mass) of the overall sample. As a consequence, the proportions of impurities are likely to be somewhat higher, and the percentage of silica somewhat lower, than would be expected from a pre-washed sample

SASS2 - Sandgate Park Quarry

In-situ sample of lower horizon at side of haul road

Sampled by Cuesta Consulting Ltd. 05/03/2015

Photomicrograph



Shape analysis:

Colour under Microscope	Other Observations	Roundness	Sphericity
Golden yellow and translucent white	A range of grain sizes observed a few at around 1mm but the majority smaller. Very occasional larger grains have iron stained 'pock marks' or indentations. Groups of grains 'stick together' before use of pestle. Some grains of low sphericity, some of high sphericity but generally medium sphericity. More occasional sub-angular grains.	Sub-Rounded to Rounded	Medium Sphericity

Chemical Analysis:

SiO₂	TiO₂	Al₂O₃	Fe₂O₃t	Mn₃O₄	MgO	CaO	Na₂O	K₂O	P₂O₅	SO₃	Cr₂O₃	SrO
%	%	%	%	%	%	%	%	%	%	%	%	%
98.19	0.03	0.47	0.15	<0.01	<0.05	<0.01	<0.05	0.02	<0.01	<0.1	<0.01	<0.01
ZrO₂	BaO	NiO	CuO	ZnO	PbO	V₂O₅	HfO₂	F	Cl	LOI	Total	
%	%	%	%	%	%	%	%	%	%	%	%	
<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.44	99.3	

Important note: the above analysis was carried out without prior washing to remove fines (<63 microns), which accounted for 3% (by mass) of the overall sample. As a consequence, the proportions of impurities are likely to be somewhat higher, and the percentage of silica somewhat lower, than would be expected from a pre-washed sample

SASS3 - Sandgate Park Quarry

Disturbed sample from blended and washed sand stockpile

Sampled by Cuesta Consulting Ltd. 05/03/2015

Photomicrograph



Shape analysis:

Colour under Microscope	Other Observations	Roundness	Sphericity
Clear (like fine glass) translucent white with some golden yellow grains with red staining	A range of grain sizes observed a few at around 1mm but the majority smaller. Some grains of low sphericity, some of high sphericity but generally medium sphericity. More occasional sub-angular grains. About half the grains clear like glass.	Sub-Rounded to Rounded	Medium Sphericity

Chemical Analysis:

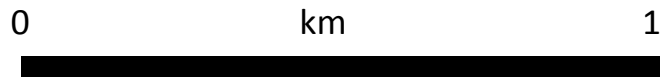
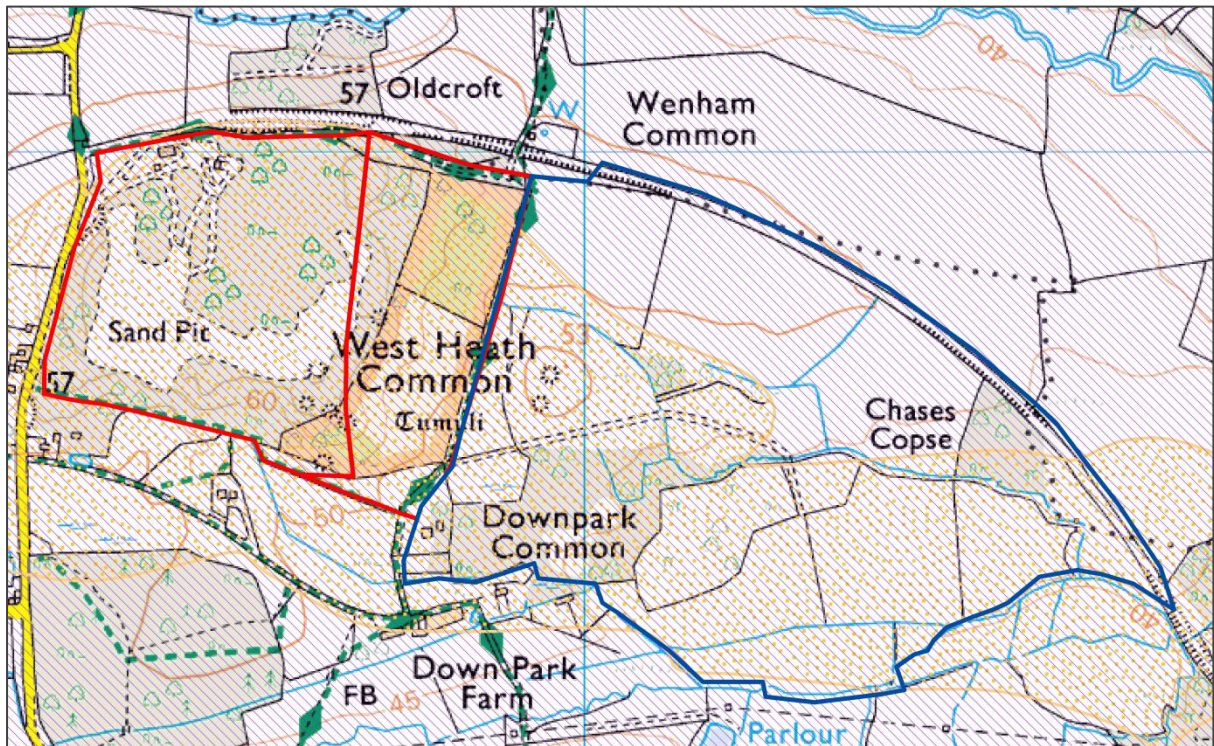
SiO₂	TiO₂	Al₂O₃	Fe₂O₃t	Mn₃O₄	MgO	CaO	Na₂O	K₂O	P₂O₅	SO₃	Cr₂O₃	SrO
%	%	%	%	%	%	%	%	%	%	%	%	%
98.69	0.03	0.10	0.09	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.1	<0.01	<0.01
ZrO₂	BaO	NiO	CuO	ZnO	PbO	V₂O₅	HfO₂	F	Cl	LOI	Total	
%	%	%	%	%	%	%	%	%	%	%	%	
<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.23	99.14	

Important note: the above analysis was carried out on washed material from the quarry stockpile, with the proportion of fines (<63 microns) having been reduced to only 1% (by mass). The proportions of impurities are therefore likely to be comparable with those expected from a pre-washed laboratory sample.

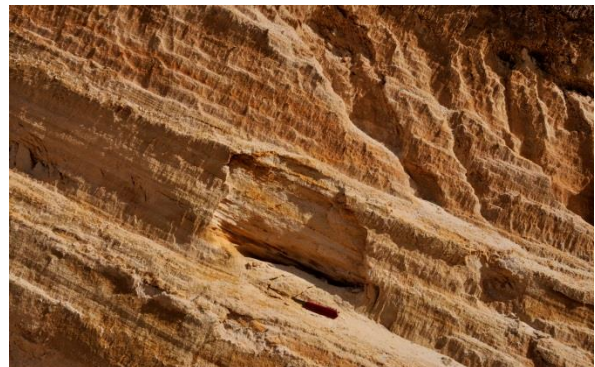
Samples SASS4 to SASS6 - West Heath Common Quarry

Site location map

Red outline = current planning permission; blue = proposed extension



Site photographs



SASS4 - West Heath Common Quarry

In-situ sample of “White Sand” from northern end of original quarry

Sampled by Cuesta Consulting Ltd. 05/03/2015

Photomicrograph



Shape analysis:

Colour under Microscope	Other Observations	Roundness	Sphericity
Clear (like fine glass) translucent white with very occasional golden yellow grains with red staining	A range of grain sizes observed a few at around 1mm but the majority smaller. The majority of the grains are clear like fine glass. Grains vary in shape some are almost well rounded, others sub-angular.	Sub-Angular to Rounded	Medium to High Sphericity

Chemical Analysis:

SiO₂	TiO₂	Al₂O₃	Fe₂O₃t	Mn₃O₄	MgO	CaO	Na₂O	K₂O	P₂O₅	SO₃	Cr₂O₃	SrO
%	%	%	%	%	%	%	%	%	%	%	%	%
98.19	0.05	0.27	0.35	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.1	<0.01	<0.01
ZrO₂	BaO	NiO	CuO	ZnO	PbO	V₂O₅	HfO₂	F	Cl	LOI	Total	
%	%	%	%	%	%	%	%	%	%	%	%	
<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.37	99.23	

Important note: the above analysis was carried out without prior washing to remove fines (<63 microns), though these accounted for only 1% (by mass) of the overall sample. As a consequence, the proportions of impurities are likely to be comparable with those expected from a pre-washed laboratory sample.

SASS4a - West Heath Common Quarry

In-situ mixed sample of black, brown and pink horizons from eastern side of current workings

Sampled by Cuesta Consulting Ltd. 05/03/2015

Photomicrograph



Shape analysis:

Colour under Microscope	Other Observations	Roundness	Sphericity
Clear (like fine glass) translucent white and light grey sand grains coated in grey 'silt'	No coarse sand grain sizes observed. Grains all very similar in size. Groups of grains 'stick together' before use of pestle. Despite the colour of the sand being almost black, the sand grains themselves are clear to light grey in colour but coated in darker grey fine grained 'silt' like material.	Sub-Angular to Sub-Rounded	Medium to High Sphericity

Chemical Analysis:

SiO₂	TiO₂	Al₂O₃	Fe₂O₃t	Mn₃O₄	MgO	CaO	Na₂O	K₂O	P₂O₅	SO₃	Cr₂O₃	SrO
%	%	%	%	%	%	%	%	%	%	%	%	%
96.76	0.12	0.60	0.32	<0.01	<0.05	<0.01	<0.05	0.03	<0.01	<0.1	<0.01	<0.01
ZrO₂	BaO	NiO	CuO	ZnO	PbO	V₂O₅	HfO₂	F	Cl	LOI	Total	
%	%	%	%	%	%	%	%	%	%	%	%	
0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	1.29	99.14	

Important note: the above analysis was carried out without prior washing to remove fines (<63 microns), which accounted for 2% (by mass) of the overall sample. As a consequence, the proportions of impurities are likely to be somewhat higher, and the percentage of silica somewhat lower, than would be expected from a pre-washed sample

SASS5 - West Heath Common Quarry

Disturbed 'as dug' sample of yellowish sand from current workings (excavated below water from side of lagoon)

Sampled by Cuesta Consulting Ltd. 05/03/2015

Photomicrograph



Shape analysis:

Colour under Microscope	Other Observations	Roundness	Sphericity
Golden yellow and translucent white with some clear (like fine glass) and some orange grains	A range of grain sizes observed with occasional larger than 1mm size grain. Very occasional black 'silt'- like material coating the grains.	Sub-Angular to Sub-Rounded	Medium to High Sphericity

Chemical Analysis:

SiO₂	TiO₂	Al₂O₃	Fe₂O₃t	Mn₃O₄	MgO	CaO	Na₂O	K₂O	P₂O₅	SO₃	Cr₂O₃	SrO
%	%	%	%	%	%	%	%	%	%	%	%	%
98.31	0.07	0.33	0.28	<0.01	<0.05	<0.01	<0.05	0.02	<0.01	<0.1	<0.01	<0.01
ZrO₂	BaO	NiO	CuO	ZnO	PbO	V₂O₅	HfO₂	F	Cl	LOI	Total	
%	%	%	%	%	%	%	%	%	%	%	%	
<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.39	99.4	

Important note: the above analysis was carried out without prior washing to remove fines (<63 microns), though these accounted for only 1% (by mass) of the overall sample. As a consequence, the proportions of impurities are likely to be comparable with those expected from a pre-washed laboratory sample.

SASS6 - West Heath Common Quarry

Disturbed 'as dug' sample of mostly pink sand from eastern side of current workings (excavated dry).

Sampled by Cuesta Consulting Ltd. 05/03/2015

Photomicrograph



Shape analysis:

Colour under Microscope	Other Observations	Roundness	Sphericity
Clear (like fine glass) translucent white and light grey	No coarse sand grain sizes observed. Grains all very similar in size. Some parts of the sand form hard compact lumps that break up with the pestle. Occasional orange stained grains. Occasional fine 'silt' - like coating on the grains. Occasional Angular grains.	Sub-Angular to Sub-Rounded	Medium to High Sphericity

Chemical Analysis:

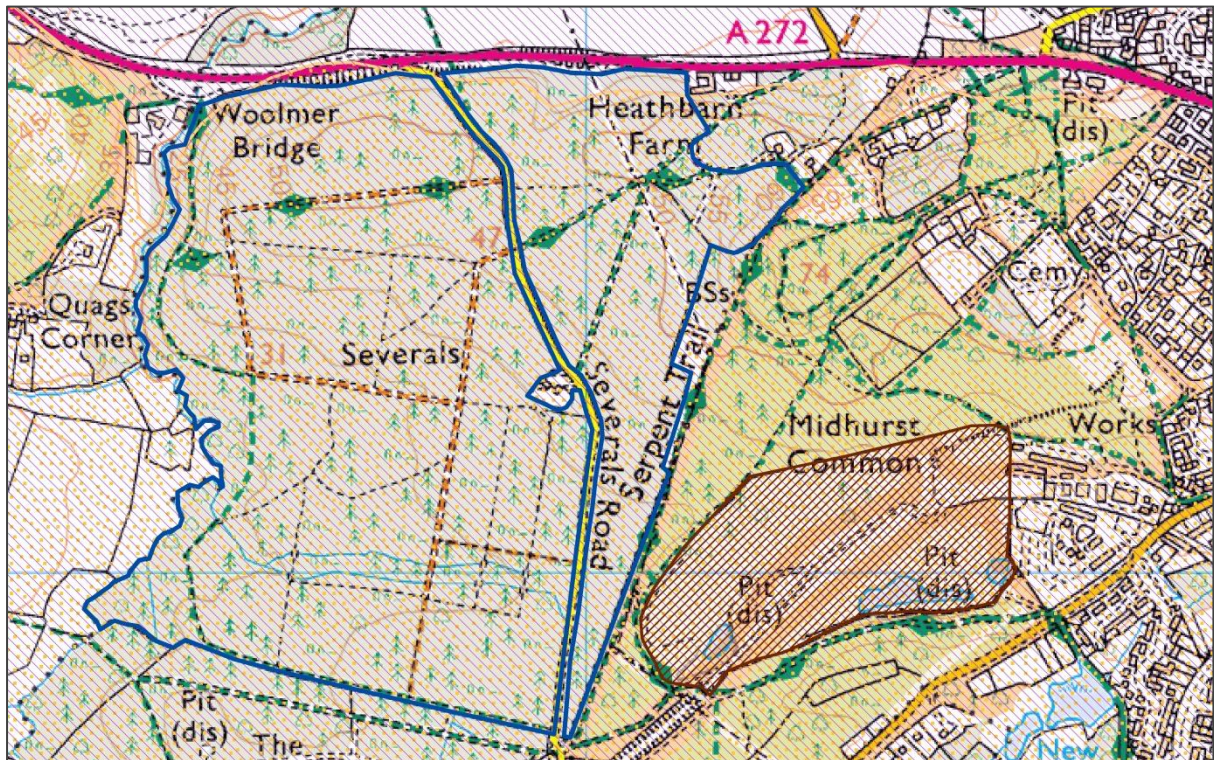
SiO₂	TiO₂	Al₂O₃	Fe₂O₃t	Mn₃O₄	MgO	CaO	Na₂O	K₂O	P₂O₅	SO₃	Cr₂O₃	SrO
%	%	%	%	%	%	%	%	%	%	%	%	%
97.79	0.11	0.66	0.18	<0.01	<0.05	<0.01	<0.05	0.03	<0.01	<0.1	<0.01	<0.01
ZrO₂	BaO	NiO	CuO	ZnO	PbO	V₂O₅	HfO₂	F	Cl	LOI	Total	
%	%	%	%	%	%	%	%	%	%	%	%	
0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.58	99.37	

Important note: the above analysis was carried out without prior washing to remove fines (<63 microns), which accounted for 2% (by mass) of the overall sample. As a consequence, the proportions of impurities are likely to be somewhat higher, and the percentage of silica somewhat lower, than would be expected from a pre-washed sample

Samples SASS7 to SASS8 - Midhurst Common Quarry (disused)

Site location map

Blue outline = Proposed sites, 'Severais West & Severais East; Brown = disused quarry



0 km 1

Site photographs



SASS7 - Midhurst Common Quarry

In-situ sample of yellowish sand from base of quarry - above thin clay drape

Sampled by Cuesta Consulting Ltd. 05/03/2015

Photomicrograph



Shape analysis:

Colour under Microscope	Other Observations	Roundness	Sphericity
Clear (like fine glass) translucent white and some light orange	No coarse sand grain sizes observed. Grains all very similar in size. Occasional light grey or orange 'silt' like material coating some grains	Sub-Angular to Sub-Rounded	Medium to High Sphericity

Chemical Analysis:

SiO₂	TiO₂	Al₂O₃	Fe₂O₃t	Mn₃O₄	MgO	CaO	Na₂O	K₂O	P₂O₅	SO₃	Cr₂O₃	SrO
%	%	%	%	%	%	%	%	%	%	%	%	%
97.52	0.07	1.03	0.20	<0.01	<0.05	<0.01	<0.05	0.06	<0.01	<0.1	<0.01	<0.01
ZrO₂	BaO	NiO	CuO	ZnO	PbO	V₂O₅	HfO₂	F	Cl	LOI	Total	
%	%	%	%	%	%	%	%	%	%	%	%	
<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.63	99.51	

Important note: the above analysis was carried out without prior washing to remove fines (<63 microns), which accounted for 4% (by mass) of the overall sample. As a consequence, the proportions of impurities are likely to be somewhat higher, and the percentage of silica somewhat lower, than would be expected from a pre-washed sample.

SASS8 - Midhurst Common Quarry

In-situ sample of yellowish-orange sand from base of quarry - below thin clay drape.

Sampled by Cuesta Consulting Ltd. 05/03/2015

Photomicrograph



Shape analysis:

Colour under Microscope	Other Observations	Roundness	Sphericity
Clear (like fine glass) translucent white and light grey	No coarse sand grain sizes observed. Grains all very similar in size. Occasional light grey 'silt' like material coating some grains	Sub-Angular to Sub-Rounded	Medium to High Sphericity

Chemical Analysis:

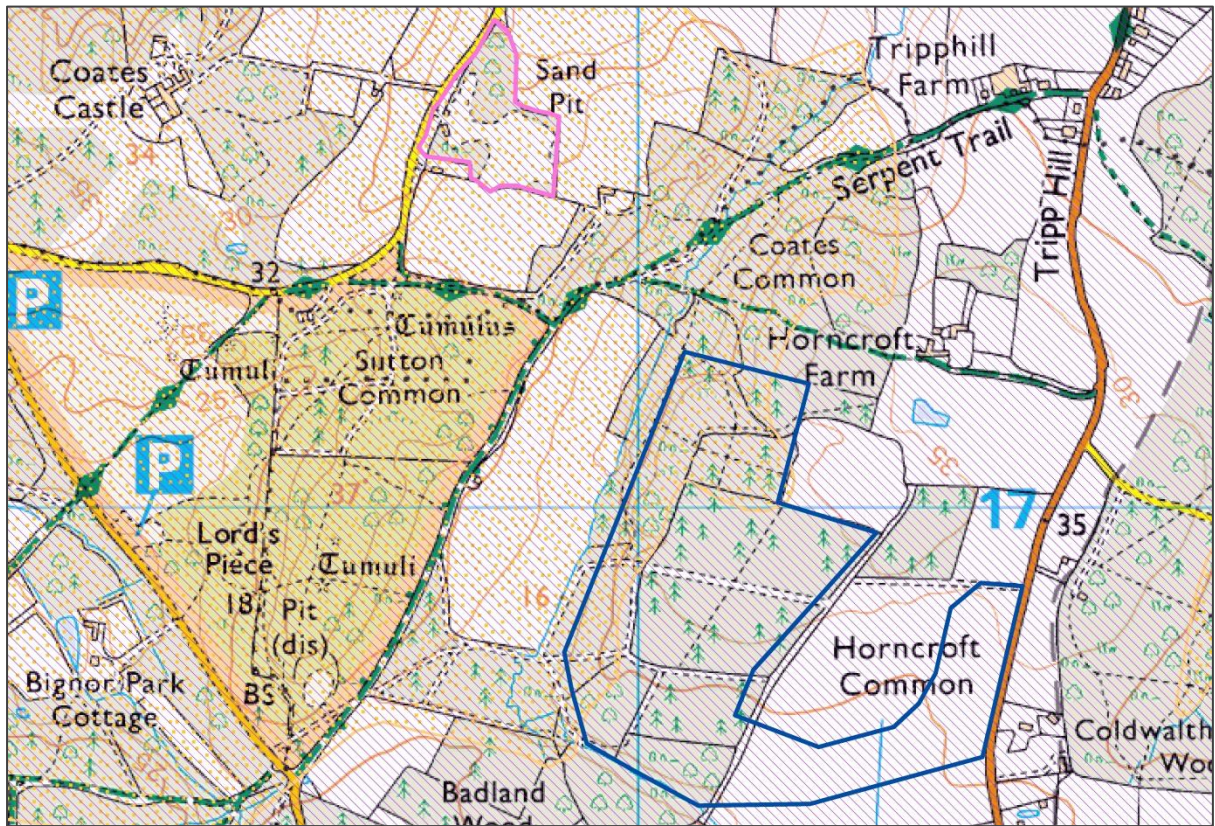
SiO₂	TiO₂	Al₂O₃	Fe₂O₃t	Mn₃O₄	MgO	CaO	Na₂O	K₂O	P₂O₅	SO₃	Cr₂O₃	SrO
%	%	%	%	%	%	%	%	%	%	%	%	%
98.52	0.10	0.40	0.19	<0.01	<0.05	<0.01	<0.05	0.02	<0.01	<0.1	<0.01	<0.01
ZrO₂	BaO	NiO	CuO	ZnO	PbO	V₂O₅	HfO₂	F	Cl	LOI	Total	
%	%	%	%	%	%	%	%	%	%	%	%	
<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.36	99.59	

Important note: the above analysis was carried out without prior washing to remove fines (<63 microns), which accounted for 3% (by mass) of the overall sample. As a consequence, the proportions of impurities are likely to be somewhat higher, and the percentage of silica somewhat lower, than would be expected from a pre-washed sample

Samples SASS9 to SASS10 - Coates Pit Quarry (dormant)

Site location map

Pink outline = Coates Pit Quarry; blue outline = proposed Horncroft site



0 km 1

Site photographs

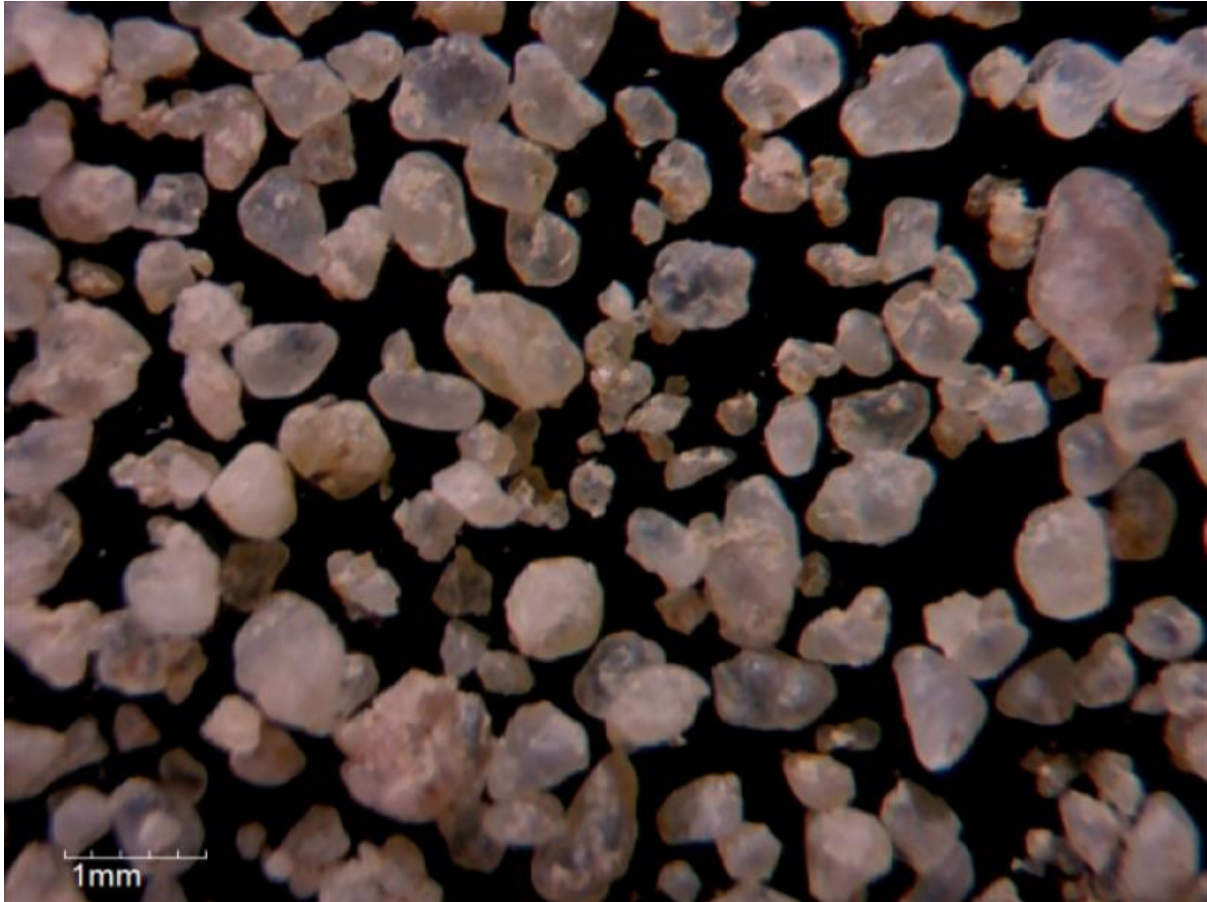


SASS9 - Coates Pit Quarry

In-situ sample from lower part of quarry face in NE corner

Sampled by Cuesta Consulting Ltd. 05/03/2015

Photomicrograph



Shape analysis:

Colour under Microscope	Other Observations	Roundness	Sphericity
Golden Yellow and translucent white	No coarse sand grain sizes observed. Dark orange staining on some grains. Occasional light orange 'silt' - like material coating some grains	Sub Rounded	Medium to High Sphericity

Chemical Analysis:

SiO₂	TiO₂	Al₂O₃	Fe₂O₃t	Mn₃O₄	MgO	CaO	Na₂O	K₂O	P₂O₅	SO₃	Cr₂O₃	SrO
%	%	%	%	%	%	%	%	%	%	%	%	%
97.77	0.04	0.59	0.42	<0.01	<0.05	<0.01	<0.05	0.02	0.01	<0.1	<0.01	<0.01
ZrO₂	BaO	NiO	CuO	ZnO	PbO	V₂O₅	HfO₂	F	Cl	LOI	Total	
%	%	%	%	%	%	%	%	%	%	%	%	
<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.46	99.31	

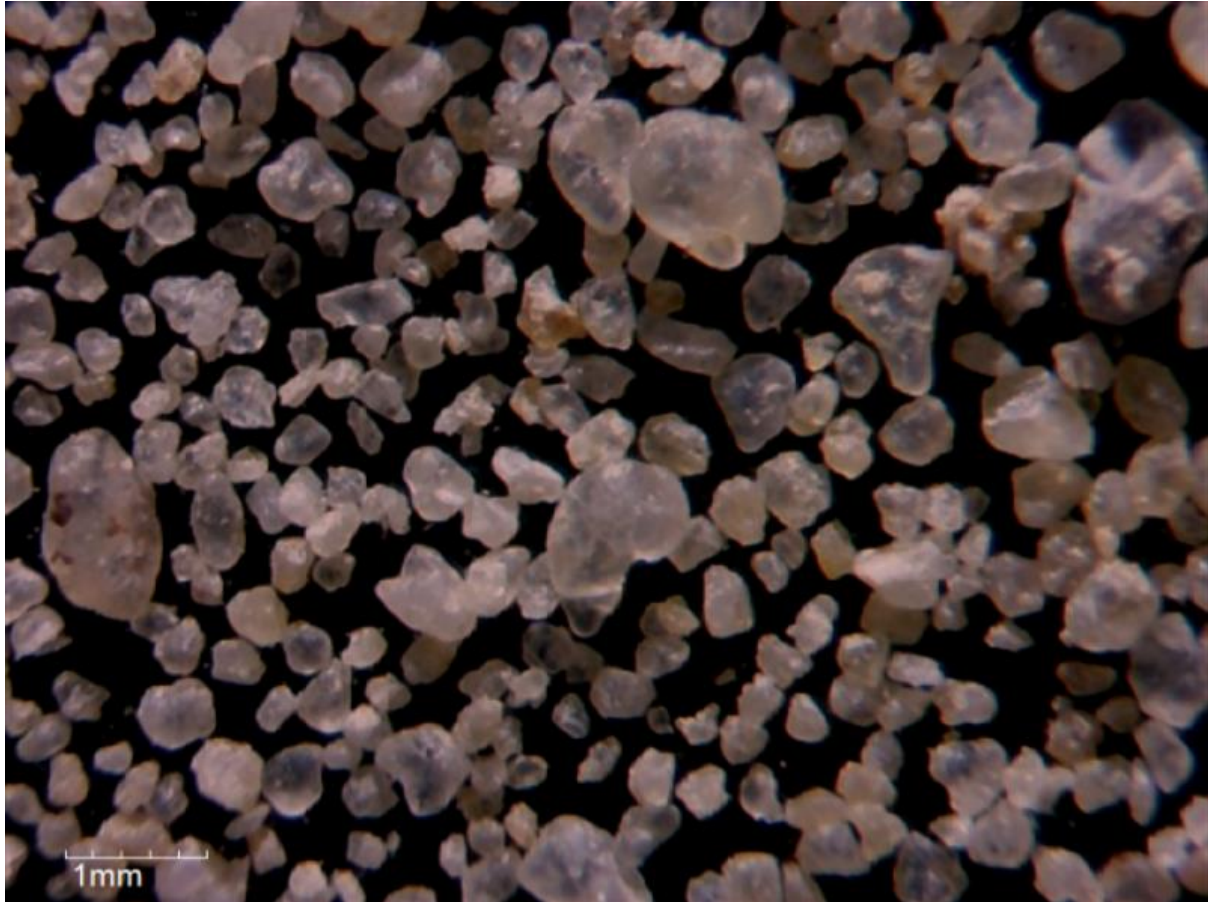
Important note: the above analysis was carried out without prior washing to remove fines (<63 microns), which accounted for 2% (by mass) of the overall sample. As a consequence, the proportions of impurities are likely to be somewhat higher, and the percentage of silica somewhat lower, than would be expected from a pre-washed sample

SASS10, - Coates Pit Quarry

In-situ sample from higher part of quarry face in S side of quarry.

Sampled by Cuesta Consulting Ltd. 05/03/2015

Photomicrograph



Shape analysis:

Colour under Microscope	Other Observations	Roundness	Sphericity
Golden yellow and translucent white	A range of sand grain sizes observed some more than 1mm but the majority smaller. Dark orange staining on some grains. Occasional light orange 'silt' - like material coating some grains	Sub Rounded	Medium to High Sphericity

Chemical Analysis:

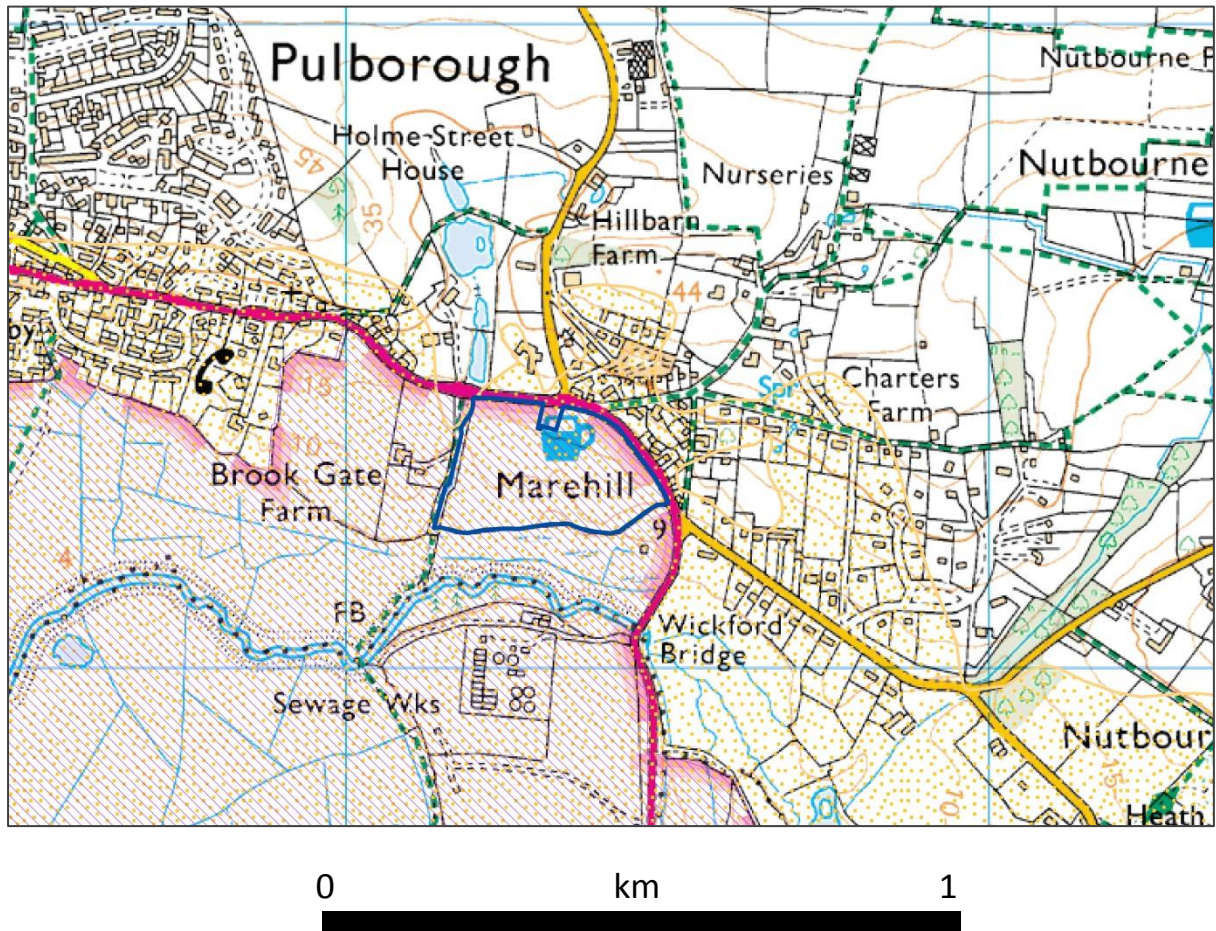
SiO₂	TiO₂	Al₂O₃	Fe₂O₃t	Mn₃O₄	MgO	CaO	Na₂O	K₂O	P₂O₅	SO₃	Cr₂O₃	SrO
%	%	%	%	%	%	%	%	%	%	%	%	%
98.3	0.04	0.65	0.34	<0.01	<0.05	<0.01	<0.05	0.02	<0.01	<0.1	<0.01	<0.01
ZrO₂	BaO	NiO	CuO	ZnO	PbO	V₂O₅	HfO₂	F	Cl	LOI	Total	
%	%	%	%	%	%	%	%	%	%	%	%	
<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.34	99.69	

Important note: the above analysis was carried out without prior washing to remove fines (<63 microns), which accounted for 3% (by mass) of the overall sample. As a consequence, the proportions of impurities are likely to be somewhat higher, and the percentage of silica somewhat lower, than would be expected from a pre-washed sample.

Sample SASS12 - Wickford Bridge Proposed Site

Site location map

Blue outline = Proposed site - Wickford Bridge



Site photograph



SASS12, - Wickford Bridge

Disturbed near-surface sample of sandy soil, from molehills in SE part of site.

Sampled by Cuesta Consulting Ltd. 06/03/2015

Photomicrograph



Shape analysis:

Colour under Microscope	Other Observations	Roundness	Sphericity
Yellow and white grains heavily coated in light brown 'silt' particles	No coarse sand grain sizes observed. Grains heavily coated in fine grained light brown 'silt' - like material. Small roots present.	Sub-Angular to Sub-Rounded	Medium to High Sphericity

Chemical Analysis:

SiO₂	TiO₂	Al₂O₃	Fe₂O₃t	Mn₃O₄	MgO	CaO	Na₂O	K₂O	P₂O₅	SO₃	Cr₂O₃	SrO
%	%	%	%	%	%	%	%	%	%	%	%	%
93.40	0.18	2.07	0.86	0.01	<0.05	0.03	<0.05	0.17	0.05	<0.1	<0.01	<0.01
ZrO₂	BaO	NiO	CuO	ZnO	PbO	V₂O₅	HfO₂	F	Cl	LOI	Total	
%	%	%	%	%	%	%	%	%	%	%	%	
0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	2.38	99.17	

Important note: the above analysis was carried out on a near-surface soil sample, without prior washing to remove fines (<63 microns), which accounted for a relatively high proportion (12% by mass) of this particular sample. As a consequence, the proportions of impurities are likely to be significantly higher, and the percentage of silica significantly lower, than would be expected from a pre-washed sample of the underlying mineral deposit.

Samples SASS14 to SASS15 - Kingsley Quarry

Site location map

Red outline = Current planning permission



0 km 1

Site photographs



SASS14, - Kingsley Quarry

Disturbed sample of yellowish sand from current workings (excavated by suction dredging and washed).

Sampled by Cuesta Consulting Ltd. 06/03/2015

Photomicrograph



Shape analysis:

Colour under Microscope	Other Observations	Roundness	Sphericity
Yellow orange and clear (like fine glass) translucent white	No coarse sand grain sizes observed. Occasional brown grain present. Grains very 'clean'.	Sub-Angular to Sub-Rounded	High Sphericity

Chemical Analysis:

SiO₂	TiO₂	Al₂O₃	Fe₂O₃t	Mn₃O₄	MgO	CaO	Na₂O	K₂O	P₂O₅	SO₃	Cr₂O₃	SrO
%	%	%	%	%	%	%	%	%	%	%	%	%
98.92	0.05	0.20	0.75	<0.01	<0.05	<0.01	<0.05	0.05	0.02	<0.1	<0.01	<0.01
ZrO₂	BaO	NiO	CuO	ZnO	PbO	V₂O₅	HfO₂	F	Cl	LOI	Total	
%	%	%	%	%	%	%	%	%	%	%	%	
<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.3	100.29	

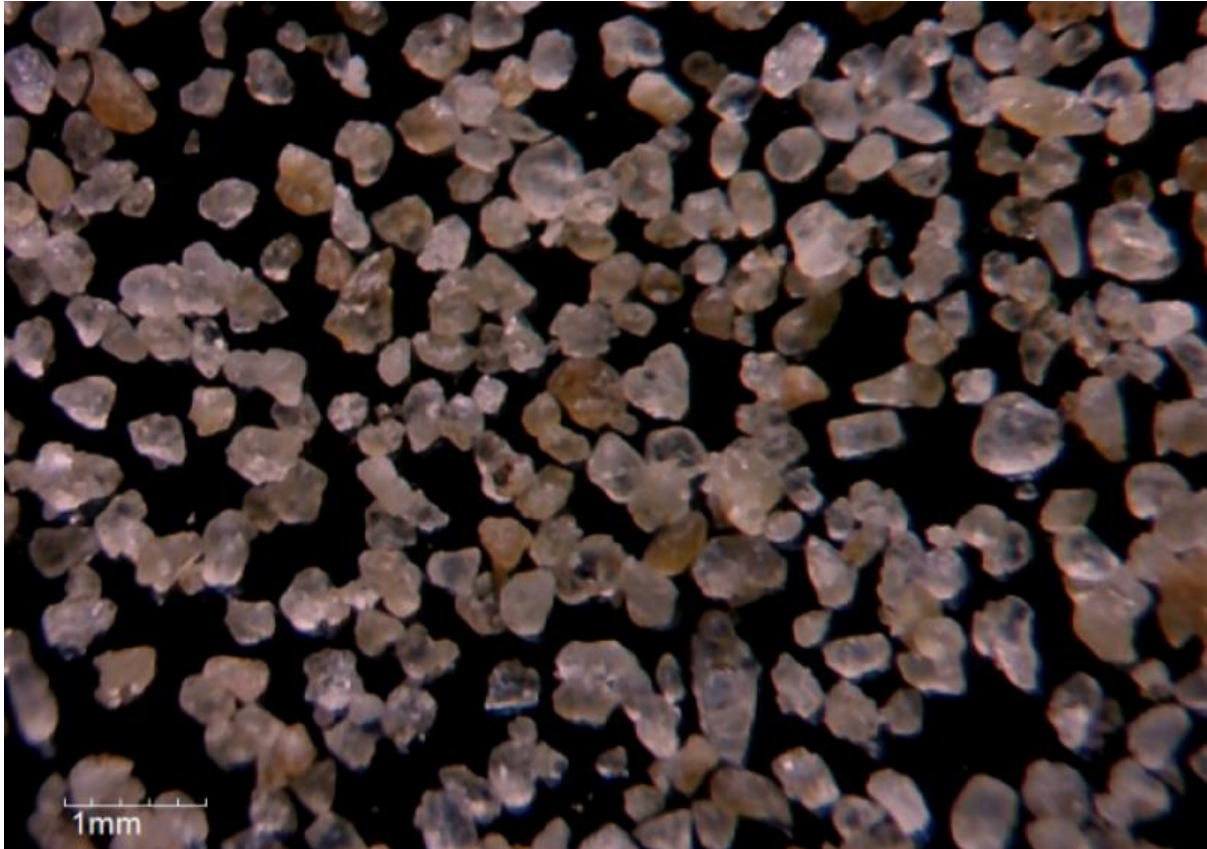
Important note: the above analysis was carried out on washed material from the quarry stockpile, with the proportion of fines (<63 microns) having been reduced to only 1% (by mass). The proportions of impurities are therefore likely to be comparable with those expected from a pre-washed laboratory sample.

SASS15, - Kingsley Quarry

In-situ sample of yellowish sand from southern edge of current workings (above water level).

Sampled by Cuesta Consulting Ltd. 06/03/2015

Photomicrograph



Shape analysis:

Colour under Microscope	Other Observations	Roundness	Sphericity
Yellow orange and clear (like fine glass) translucent white	No coarse sand grain sizes observed. Occasional brown grain present. Some dark orange staining on some grains.	Sub-Angular to Sub-Rounded	Medium to High Sphericity

Chemical Analysis:

SiO₂	TiO₂	Al₂O₃	Fe₂O₃t	Mn₃O₄	MgO	CaO	Na₂O	K₂O	P₂O₅	SO₃	Cr₂O₃	SrO
%	%	%	%	%	%	%	%	%	%	%	%	%
97.69	0.06	0.41	0.43	<0.01	<0.05	<0.01	<0.05	0.12	0.01	<0.1	<0.01	<0.01
ZrO₂	BaO	NiO	CuO	ZnO	PbO	V₂O₅	HfO₂	F	Cl	LOI	Total	
%	%	%	%	%	%	%	%	%	%	%	%	
<0.02	<0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	0.36	99.08	

Important note: the above analysis was carried out without prior washing to remove fines (<63 microns), though these accounted for only 1% (by mass) of the overall sample. As a consequence, the proportions of impurities are likely to be comparable with those expected from a pre-washed laboratory sample.