

ASSESSMENT REPORT


TITLE PAGE AND SUMMARY

BC Geological Survey
Assessment Report
35182

TYPE OF REPORT [type of survey(s)]: Geochemical, Geophysical and remote aerial survey

TOTAL COST: \$258,939.32

AUTHOR(S)

Acid Rock Drainage / Metal Leaching Assessment	Henry H, Xu P.Eng and John Burton P.Geo Valley Testing Services Ltd.
Misc. Aggregate properties (Density, absorption, soundness LA Abrasion, etc)	L.Hu, M.Sc.E., P.Eng. Golder Associates
Aggregate Quality Testing Program 2014	Henry H. Xu, P.Eng. Valley Testing Services Ltd.
3D aerial Survey and model rendering	Peter Smith, President P.S. Survey
Legal Survey Expansion (incomplete)	Tunbridge & Tunbridge
Mainland Sand and Gravel ULC (compilation of report)	Dani Miller ASCT, Safety and Technical Compliance Manager Signature: 

NOTICE OF WORK PERMIT NUMBER(S) / DATE(S): Q-7-68, Last amended October 25, 2012

YEAR OF WORK: 2014

STATEMENT OF WORK – CASH PAYMENTS EVENT NUMBER(S) / DATE): Event #5525227 October 3, 2014

PROPERTY NAME: Cox Station Quarry (6850 Cox Rd. Abbotsford)

CLAIM NAME(S) (on which the work was done): CHAD #2 – Tenure #326103

COMMODITIES SOUGHT: Construction Aggregates

MINERAL INVENTORY MINEFILE NUMBER(S), IN KNOWN: unknown

MINING DIVISION: New Westminster (Code 13)

NTS/BCGS: 92G.020

LATITUDE: 49°8'3"

LONGITUDE: 122°9'53"

OWNER(S): Mainland Sand and Gravel

MAILING ADDRESS: 9512 194A St. Surrey, BC V4N 4G5

OPERATOR(S): [who paid for the work]: Mainland Sand and Gravel

MAILING ADDRESS: 9512 194A St. Surrey, BC V4N 4G5

PROPERTY GEOLOGY KEYWORDS (lithology, age, stratigraphy, structure, alteration, mineralization, size and attitude): Predominantly (90%) massive granitic varieties, granite to granodiorite. Contains feldspar, quartz, hornblende, magnetite and local dikes / veinlets with andesitic rock. Mohs hardness between 5 and 6. Petrographic examination indicated minor sulfide mineralogy with pyrite identified. Iron oxide mineralogy in the form of magnetite was also identified. ARD / ML potential LOW. SSD 2640 – 2704 kg/m³. Material is generally hard, strong and mildly tough with low porosity.

Exploration Work type	Comment	Days		Totals
All work completed on claim # 381023, with the exception of UAV Survey - UAV Survey should be distributed on a per m2 basis over the following claims 381023, 326103,382071,382073, 382075, 382077, 326102, 313783, 326104				
Personnel (Name)* / Position	Field Days (list actual days)	Days	Rate	Subtotal*
Employees engaged in "east lands development" i.e. opening 26,250m2 of new mine "surface area" for inspection, testing and eventual production. Job descriptions include excavator operator, loader operator, truck driver. No Supervisor time included. Equipment time below "other operations". Rate varies based on % overtime.				
Pay runs October 1 2013 to November 30 PP 30 to 39				
Employee	Hours	Days	Rate	Amount
Block, David	13.75	1.72	43.4974545	598.09
Kirkpatrick, Kervin	4.50	0.56	37.38	168.21
MacDonald, Bill	5.00	0.63	56.07	280.35
Mackenzie, Randy	3.00	0.38	37.71	113.13
Oliver, David	2.50	0.31	37.712	94.28
Parker, Leigh	18.00	2.25	40.0494444	720.89
Schafer, Gerry	55.00	6.88	37.518	2,063.49
Taylor, Neil	8.50	1.06	42.5388235	361.58
Winder, Dave	5.00	0.63	56.07	280.35
Pay Period 40				
Schafer, Gerry	1.00	0.13	37.71	37.71
Pay Period 1 to 24 (2014)				
Addison, Keith	11.50	1.44	38.22	439.53
Belanger, John	19.00	2.38	38.22	726.18
Bikadi, Joseph	76.50	9.56	38.22	2,923.83
Bird, Fred	8.00	1.00	38.22	305.76
Blasetti, Paul	6.25	0.78	38.2208	238.88
Block, David	20.25	2.53	44.3288889	897.66
Buchanan, Robert	1.00	0.13	37.71	37.71
Callaghan, Gordon	114.00	14.25	38.3038596	4,366.64
Carr, Clayton	20.00	2.50	38.1245	762.49
Crayford, Thomas	6.00	0.75	38.22	229.32
Dusenbury, Brian	14.00	1.75	38.22	535.08
Hamilton, Jamie	3.00	0.38	38.22	114.66
Hanna, Dean	1.50	0.19	38.22	57.33
Hardie, Jeff	8.00	1.00	32.49	259.92
Kilpatrick, Kevin	28.00	3.50	38.0925	1,066.59
Kirkpatrick, John	40.00	5.00	38.22	1,528.80
Knuff, Josh	13.75	1.72	38.2203636	525.53
Krutz, Dan	77.00	9.63	38.22	2,942.94
MacDonald, Bill	11.50	1.44	53.286087	612.79
MacKenzie, Randy	18.50	2.31	38.22	707.07
Mather, James	19.00	2.38	44.3210526	842.10
McClelland, Aubrey	19.75	2.47	38.2202532	754.85
Oliver, David	10.25	1.28	38.2214634	391.77
Parker, Leigh	114.00	14.25	40.1242105	4,574.16
Player, Lorne	6.00	0.75	39.8133333	238.88
Rowan, Chris	46.00	5.75	38.22	1,758.12
Schafer, Gerry	35.75	4.47	38.9183217	1,391.33
Smith, Jim	22.50	2.81	38.22	859.95
Svensson, Karl	61.50	7.69	39.0086179	2,399.03
Taylor, Neil	22.00	2.75	45.69	1,005.18
Townley, John	31.50	3.94	38.4587302	1,211.45
Wanek, Glen	6.00	0.75	37.71	226.26
Winder, Dave	24.75	3.09	38.4129293	950.72
				\$40,600.59
				\$40,600.59

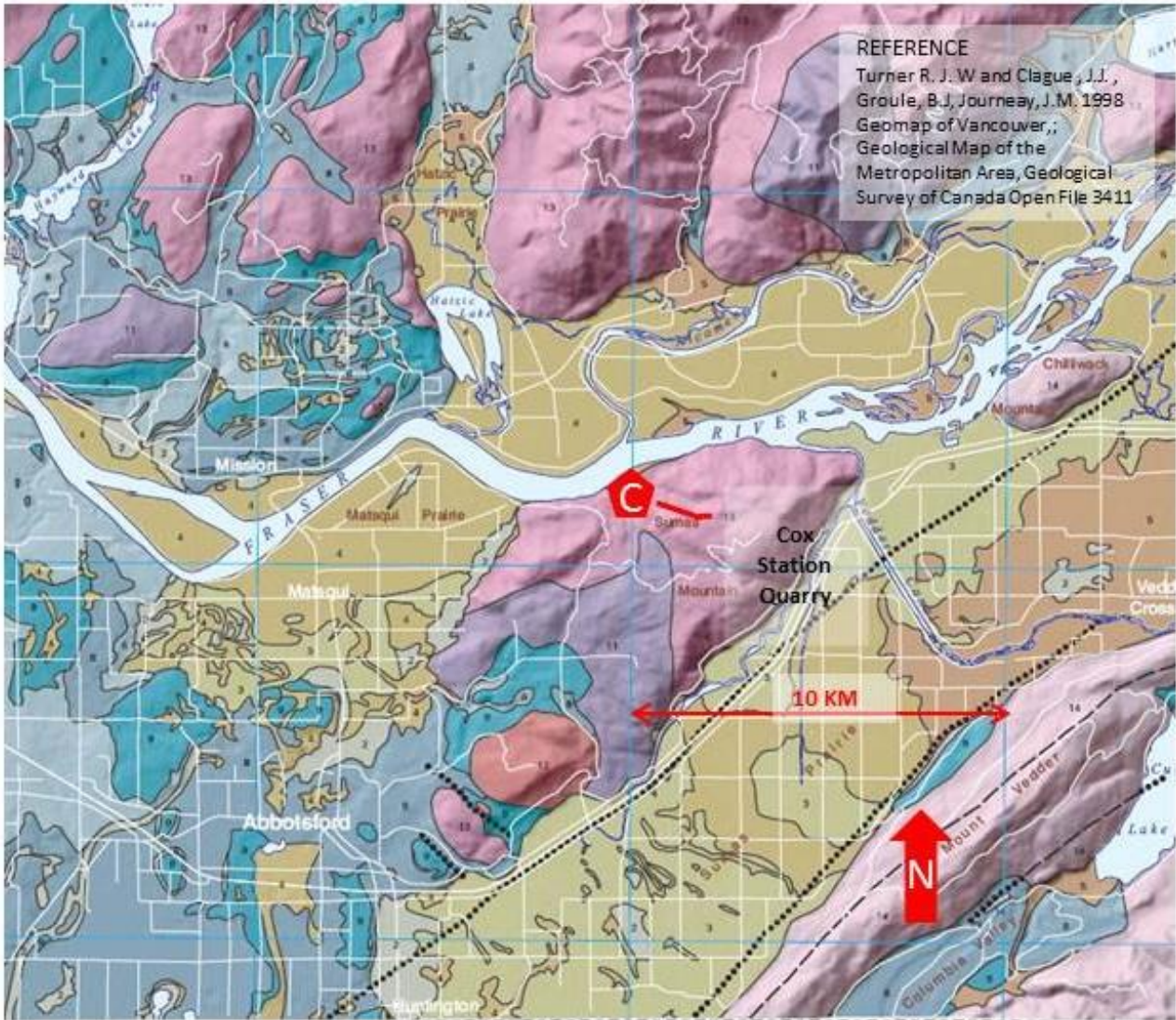
Office Studies		List Personnel (note - Office only, do not include field days)				
Literature search				\$0.00	\$0.00	
Database compilation				\$0.00	\$0.00	
Computer modelling				\$0.00	\$0.00	
Reprocessing of data				\$0.00	\$0.00	
General research				\$0.00	\$0.00	
Report preparation				\$0.00	\$0.00	
					\$0.00	\$0.00
Airborne Exploration Surve		Line Kilometres / Enter total invoiced amount				
Aeromagnetics				\$0.00	\$0.00	
Radiometrics				\$0.00	\$0.00	
Electromagnetics				\$0.00	\$0.00	
Gravity				\$0.00	\$0.00	
Digital terrain modelling				\$0.00	\$0.00	
Other (specify)						
					\$0.00	\$0.00
Remote Sensing		Area in Hectares / Enter total invoiced amount or list personnel				
Aerial photography				\$0.00	\$0.00	
LANDSAT				\$0.00	\$0.00	
Other (specify)				\$0.00	\$0.00	
					\$0.00	\$0.00
Ground Exploration Surveys						
Geological mapping						
Regional (legal survey)	Tie-ins, north boundary of mine site, BCLS contractor				\$672.00	
Reconnaissance	Mark boundary trees for clearing	<i>contractor</i>			\$2,012.50	
Prospect						
Underground						
Trenches	Define by length and width					
					\$2,684.50	\$2,684.50
Ground geophysics		Line Kilometres / Enter total amount invoiced list personnel				
Radiometrics						
Magnetics						
Gravity						
UAV Surveys	490 Ha, 4 surveys / annum	11.2	\$1,080.00		\$12,080.23	
Electromagnetics	<i>Completed by sub contractor</i>					
SP/AP/EP						
IP						
AMT/CSAMT						
Resistivity						
Complex resistivity						
Seismic reflection						
Seismic refraction						
Well logging						
Geophysical interpretation						
Petrophysics						
Other (specify)						
					\$12,080.23	\$12,080.23
Geochemical Surveying		Number of Samples	No.	Rate	Subtotal	
Drill (cuttings, core, etc.)				\$0.00	\$0.00	
Stream sediment				\$0.00	\$0.00	
Soil				\$0.00	\$0.00	
Rock	<i>Durability and reactivity testing</i>		63.0	variable	\$10,897.95	
Water				\$0.00	\$0.00	
Biogeochemistry				\$0.00	\$0.00	
Whole rock				\$0.00	\$0.00	
Petrology				\$0.00	\$0.00	
Other (specify)				\$0.00	\$0.00	
					\$10,897.95	\$10,897.95

Drilling	No. of Holes, Size of Core and Metres	No.	Rate	Subtotal	
Diamond			\$0.00	\$0.00	
Reverse circulation (RC)			\$0.00	\$0.00	
Rotary air blast (RAB)			\$0.00	\$0.00	
Drill & Blast cap rock	2262 M, 6 3/4" holes		aggregated	\$78,478.32	
				\$78,478.32	\$78,478.32
Other Operations	Clarify	No.	Rate	Subtotal	
Trenching	Internal equipment costs for stripping - Rate is averaged, does not include drill costs - included in aggregate drilling cost above.		\$84.33	\$77,307.00	
Bulk sampling			\$0.00	\$0.00	
Underground development			\$0.00	\$0.00	
Other (specify)			\$0.00	\$0.00	
				\$77,307.00	\$77,307.00
Reclamation	Clarify	No.	Rate	Subtotal	
After drilling			\$0.00	\$0.00	
Monitoring			\$0.00	\$0.00	
Other (specify)			\$0.00	\$0.00	
Transportation		No.	Rate	Subtotal	
Airfare			\$0.00	\$0.00	
Taxi			\$0.00	\$0.00	
truck rental			\$0.00	\$0.00	
kilometers			\$0.00	\$0.00	
ATV			\$0.00	\$0.00	
fuel			\$0.00	\$0.00	
Helicopter (hours)			\$0.00	\$0.00	
Fuel (litres/hour)			\$0.00	\$0.00	
Other					
				\$0.00	\$0.00
Accommodation & Food	Rates per day				
Hotel			\$0.00	\$0.00	
Camp			\$0.00	\$0.00	
Meals	day rate or actual costs-specify		\$0.00	\$0.00	
				\$0.00	\$0.00
Miscellaneous					
Contract blasting for access (hydraulic drill)			\$0.00	\$7,414.05	
Professional faller			1s	\$200.00	
				\$7,614.05	\$7,614.05
Equipment Rentals					
Field Gear (Specify)	740 rentals, D8 rentals for stripping		\$0.00	\$26,732.68	
Other (Specify)	lowbedding costs for rentals			\$2,544.00	
				\$29,276.68	\$29,276.68
Freight, rock samples					
			\$0.00	\$0.00	
			\$0.00	\$0.00	
				\$0.00	\$0.00
TOTAL Expenditures					\$258,939.32

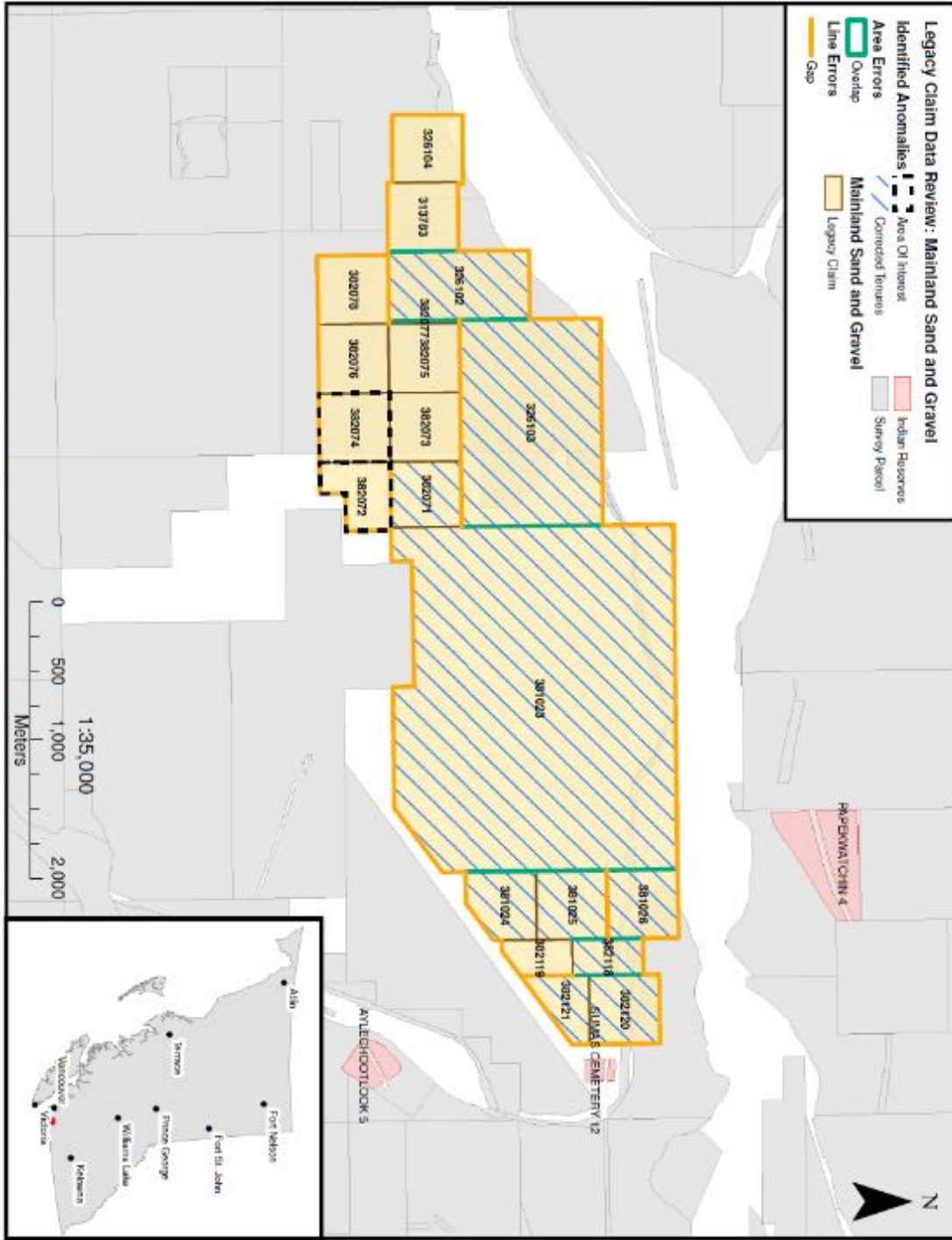
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INDEX MAP

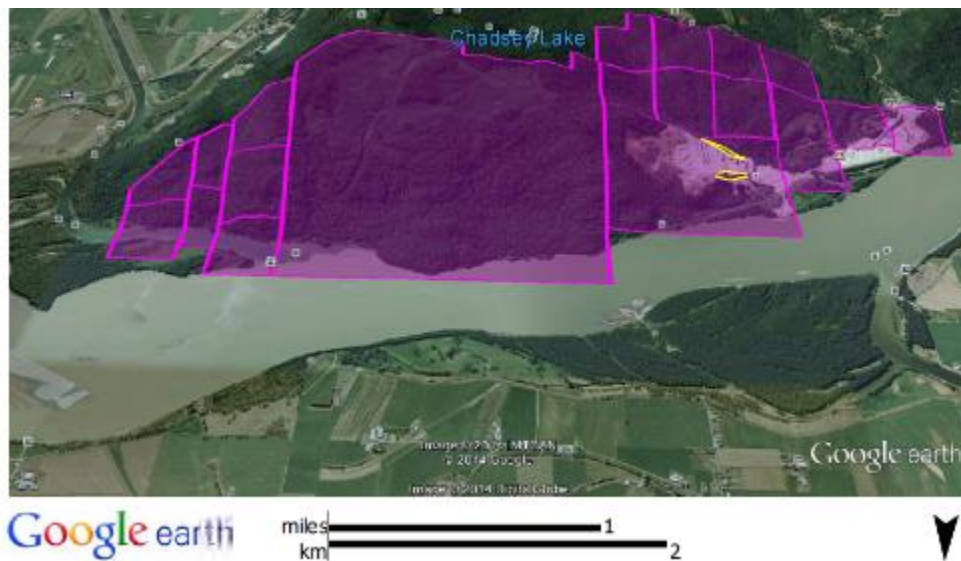


CLAIM MAP

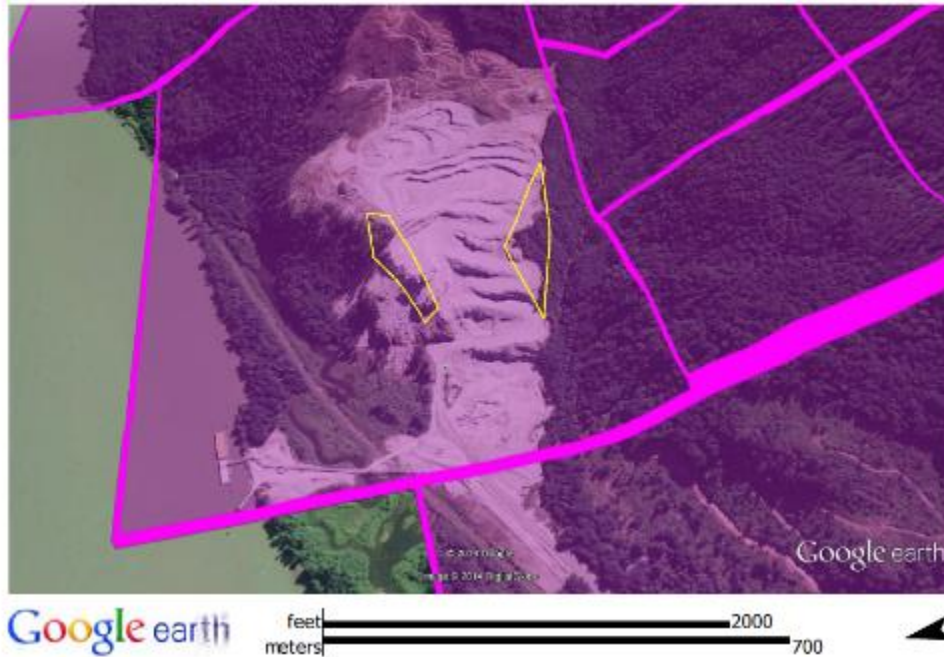


CLAIM LIST

Tenure Number	Claim Name	Owner	Tenure Type	Tenure Sub Type	Map Number	Issue Date	Good To Date	Status	Area (ha)
313783	COX 2	132475 (100%)	Mineral	Claim	092G	1992/oct/08	2024/oct/08	GOOD	25
326102	CHAD #1	132475 (100%)	Mineral	Claim	092G	1994/jun/08	2024/oct/08	GOOD	50
326103	CHAD #2	132475 (100%)	Mineral	Claim	092G	1994/jun/08	2024/oct/08	GOOD	150
326104	COX 1	132475 (100%)	Mineral	Claim	092G	1994/jun/08	2024/oct/08	GOOD	25
381023	MATRIX 1	132475 (100%)	Mineral	Claim	092G	2000/oct/04	2024/oct/08	GOOD	500
381024	MATRIX 2	132475 (100%)	Mineral	Claim	092G	2000/oct/04	2024/oct/08	GOOD	25
381025	MATRIX 3	132475 (100%)	Mineral	Claim	092G	2000/oct/04	2024/oct/08	GOOD	25
381026	MATRIX 4	132475 (100%)	Mineral	Claim	092G	2000/oct/04	2024/oct/08	GOOD	25
382071	MATRIX 5	132475 (100%)	Mineral	Claim	092G	2000/oct/31	2024/oct/08	GOOD	25
382072	MATRIX 6	132475 (100%)	Mineral	Claim	092G	2000/oct/31	2024/oct/08	GOOD	25
382073	MATRIX 7	132475 (100%)	Mineral	Claim	092G	2000/oct/31	2024/oct/08	GOOD	25
382074	MATRIX 8	132475 (100%)	Mineral	Claim	092G	2000/oct/31	2024/oct/08	GOOD	25
382075	MATRIX 9	132475 (100%)	Mineral	Claim	092G	2000/oct/31	2024/oct/08	GOOD	25
382076	MATRIX 10	132475 (100%)	Mineral	Claim	092G	2000/oct/31	2024/oct/08	GOOD	25
382077	MATRIX 11	132475 (100%)	Mineral	Claim	092G	2000/oct/31	2024/oct/08	GOOD	25
382078	MATRIX 12	132475 (100%)	Mineral	Claim	092G	2000/oct/31	2024/oct/08	GOOD	25
382118	MATRIX 13	132475 (100%)	Mineral	Claim	092G	2000/nov/01	2024/oct/08	GOOD	25
382119	MATRIX 14	132475 (100%)	Mineral	Claim	092G	2000/nov/01	2024/oct/08	GOOD	25
382120	MATRIX 15	132475 (100%)	Mineral	Claim	092G	2000/nov/01	2024/oct/08	GOOD	25
382121	MATRIX 16	132475 (100%)	Mineral	Claim	092G	2000/nov/01	2024/oct/08	GOOD	25
								TOTAL ha	1125
Owner 132475 = Mainland Sand & Gravel ULC Incorporation # BC1013422									



Yellow highlighted areas are areas of technical work. Specific sample locations are noted in Technical Reports.



Introduction:

Mainland Sand & Gravel ULC's (MSG) Cox Station Quarry (Cox) is a granite rock quarry located 7 miles upstream of the Abbotsford Mission Bridge on the North Slope of Sumas Mountain in Abbotsford. Cox was first operated as a quarry by CN Rail in the 1950's. MSG began mining on the site in the early 1980's and has since grown its production/sales at Cox to between 2 and 3 million tonnes per year. At that production/mining rate Cox has an estimated 40 – 50 years' worth of reserves remaining.

The majority (approximately ninety-eight percent) of the aggregate produced at Cox is shipped from the quarry via tug and barge. The balance of aggregate produced is shipped by highway truck and/or rail car. Barges loaded at Cox are delivered by tug to either a customer's marine based facility or one of MSG's 4 distribution yards located adjacent to the Fraser River in Langley, Surrey and Richmond (2). Aggregate delivered to the distribution yards is then loaded on to trucks for delivery to various project sites.

The main consumers of Cox aggregate are large construction projects - highways, bridges etc. however, Cox also produces high specification aggregate for applications such as densification stone, artificial playfield bases and asphalt aggregates. Many of the large construction jobs MSG supplies are Ministry of Transport (MOT) projects. MOT recently introduced a technical circular requiring assessment for Acid Rock Drainage / Metal Leaching (ARD/ML) potential.

The mining at Cox continues to proceed in an Eastern direction parallel to the Fraser River (towards the Eastern boundary of the claim). In 2014 both the north and south face were subject to significant new development through daylighting the working benches where previously avoided areas of cap rock existed. A considerable amount of testing was completed to ensure the quality of rock remained

acceptable despite visual indications that lower quality, lower strength material may have existed at the verges (pyrite, staining and calcium seams were observed). In 2014 Cox undertook testing to confirm adherence to the MOT's new requirements for ARD/ML, with a focus on the newly developing area to the north. Cox also adopted new 3D modeling software for quarterly surveying of the site. The 3D models significantly improved the ability for mine managers, engineers, consultants and contractors to better plan roads, benches, calculate volumes, and address property boundary concerns. The quarterly surveys are completed using an unmanned aerial drone and models are available for use within two weeks.

Objective and Scope:

The objective of the 2014 testing program was to confirm to MSG and MSG's customers that as Cox continues its development into new areas of a varied rock formation, the aggregate continues to meet quality requirements for concrete, asphalt, and base aggregates. The tests performed concluded that although some undesirable materials exist near the surface (magnetite, pyrite) they are present only in limited quantity and do not pose a threat to the overall quality of aggregates produced. The remainder of material testing confirmed that the granite, granodiorite and andesitic rocks present are sound, durable and chemically stable for construction aggregates. Ongoing testing will ensure that the weaker cap rock and weathered scree materials do not compromise the overall quality of our production.

The objective of the 2014 3D modelling program was to improve the ability for MSG to plan the development of Cox. The 3D modeling program has allowed MSG to shift the main haul road onto a previously underdeveloped area to the south, opening up the northern face (bluff and scree) for mining.

Geological Setting:

Cox Quarry is located on the north flank of Sumas Mountain, a four peaked 4 Km X 14 km structure rising from Sumas Prairie in the Central Fraser Valley. This region was originally mapped by Roddick and Armstrong in 1956 and 1965. Sumas Mountain is geologically diverse, featuring up thrust metamorphic and sedimentary beds on its southern flank, and intrusive igneous formations in the north. The major structural trend in the region is NE – SW parallel to the overall pattern of the Coast Mountains.

The northern flank of Sumas Mountain features exposed bedrock bluffs. South and west of Wades Creek, considerable deposits of silt, sand and till overlay the bedrock. In localized faults, till depths are over 100m.

The quarry extracts predominantly cretaceous granitic bedrock in the general area of Sumas Peak, the north eastern most peak of the structure. The granite found therein is a part of the Coast Plutonic Complex, a 60 to 200 Km wide rock body which features numerous intrusive events in to pre-existing country rock from mid Jurassic to Mid Cretaceous and in Oligocene to Miocene time. The Granite is orange, very coarsely crystalline (0.5-10mm) with 60-70% orange K-spar, <10% quartz, and 20% mafic minerals (biotite, hornblende) with light green epidote on fracture surfaces. Cox Station granite is partially overlain by Pleistocene Glacial Deposits, including the Vashon and Sumas drifts.*

*D. Huntley PhD, GSC and D. Thopson, P.Geo. 2013 Fraser Valley Geotour, MineralsEd and Natural Resources Canada, Geological survey of Canada

Samples obtained in 2014 indicate the minerals present include Granite, Granodiorite and Andesite. The quarry features several Andesitic dykes, oriented EW and extending vertically for the full extent of the working quarry face (Elevation 11m – 180m).

Discussion:

Cox Quarry extracts between 2,000,000 and 3,000,000 tonnes of material each year for use in the construction industry. Asphalt, Concrete and Ministry of Transportation and Highways customers in particular require material that is hard, durable and free of deleterious materials such as sulfide minerals. The dominant focus of testing at Cox is to insure the ongoing quality of product, and prove the quality of newly exposed areas.

To facilitate testing, and mine expansion, pioneering activities are ongoing on a bench-by-bench basis. In 2014, significant stripping, drilling and blasting occurred on both the north and south flanks. These areas had previously been avoided due to the low production, high risk, and low profitability of pioneering activities. Over 40,000 tonnes of overburden, weathered cap rock and organic soils were removed. Seven pioneering blasts occurred to access previously undisturbed materials. Following the exposure of these materials the annual testing program proceeded to prove out the suitability of the material for Concrete, Asphalt and MoT consumption.

Acid Rock Drainage / Metal Leaching (appendix A) studies were conducted in 2014 on the northern flank, and within the mass of the quarry workings. The cap rock in the northern bluffs shows mild signs of staining and contains trace amounts of pyrite and magnetite. Field survey, static testing and acid-base accounting tests were conducted in accordance with the Ministry of Transportation and Highways Technical Circular T-10/2013. The tests found that although present, the undesirable materials were confined to the cap rock and were not present in sufficient quantity to negatively affect quality.

General Testing (appendix B) occurs on a minimum annual basis. In 2014, general testing was contracted to Golder and Associates, and Valley Testing Services Ltd. Annual testing ensures that as the quarry progresses into new materials, be they in the recently exposed north and south flanks, or deeper in the geological formation, the processed aggregates continue to meet industry requirements for use in concrete, asphalt and highway construction. Testing standards include - Canadian Standards Association (CSA), American Society for Testing and Materials (ASTM) and BC Ministry of Transportation (MoT) requirements. Cox Quarry was tested for:

- Clay Lumps and Friable Particles (ASTM C 142)
- Relative Density (Specific Gravity) and Absorption of Coarse Aggregate (ASTM C127)
- Soundness of Aggregates by use of Magnesium Sulfate (ASTM C88-05)
- Resistance to Degradation of Small Size Coarse Aggregate by Abrasion & Impact in the Los Angeles Machine (ASTM C131)
- Resistance of Coarse Aggregate to the Degradation by Abrasion in the Micro-Deval Apparatus (ASTM D 6928)

- Sand Equivalent Value of soils and Fine Aggregate (ASTM D 2419)
- Uncompacted Void Content of Fine Aggregate (ASTM C1252)
- Bulk Density (Unit Weight) and Voids in Aggregate (ASTM C29)

Cox Quarry material was found compliant with both the MoT and CSA standards for all tests.

Survey activities are ongoing. Survey is required to ensure that, mining is occurring only within the mine boundary, mining footprint is maximized (to the boundary) and planning takes into account access for future mining opportunities. The use of Unmanned Aerial Vehicle (UAV) surveys was introduced in 2014 and has significantly improved planning and layout by providing desktop accessible 3D models which allow for measurements such as elevation, distance, angle and pinpointing of UTM coordinates with a 10 cm accuracy. (Appendix C). A small legal survey was also conducted using a BCLS in 2014 (Tunbridge & Tunbridge). The surveyor staked legal boundaries at the North of the mine site where the quarry workings abut a water lot. These legally registered boundary markers will be useful for tie-in of the north eastern expansion areas.

Pioneering activity was focused on previously avoided north and south flank areas. As the quarry progresses east and into the formation, these flanks constrict the active mining face and sterilize an increasing proportion of the mine site. Pioneering activities in 2014 included the removal of approximately 40,000 tonnes of non-marketable material, and allowed access to an exponentially larger body of mineable material underneath. Seven pioneering blasts were required to extend bench faces towards “daylight” to the north and south of the quarry. Drill and blast logs are included in appendix D.

CONCLUSION

Throughout 2014 a considerable effort and over \$250,000 was put forth to open previously avoided areas along the mines north and south flanks. Focused testing for durability and reactivity has concluded that these areas of the mine meet industry standards for concrete, asphalt and ministry of Transportation and Highways construction. Newly exposed areas of the deposit, particularly those now in production along the north flank appear to be in keeping with historically mined material and are anticipated to continue to produce high quality construction aggregates. New survey techniques, particularly the quarterly use of UAV modelling has allowed for a simplified road design and relocation process which has resulted in the main haulage road being relocated to the south flank, again expanding the working area along the north in the previously avoided material. Going forward, this method of survey will ensure that mining is conducted efficiently for years to come.

STATEMENT OF QUALIFICATIONS

Assembled by: Dani C. Miller, ASCT – Environmental, CPESC two years with Mainland Sand and Gravel, 7 years sand and gravel experience.

Field Supervisor: Mine Manager: Lou Szlovicsak, Shift Boss 35 years + experience at Cox Station Quarry.

Each technical report within this summary report has been signed by the overseeing Professional Engineer on behalf of their Company. The companies selected to perform the assay work each have decades of in house experience and follow ASTM or CSA testing standards. Each laboratory utilized maintains appropriate laboratory accreditation including but not limited to CCIL / CSA and OQM.

APPENDIX A



**Consulting
Engineering**

**Inspection
& Testing**

**Materials
Technology**

**Geoscience
Environmental**

#18 – 3275 McCallum
Road, Abbotsford, BC
V2S 7W8

TF 1.888.855.9733
Tel 604.855.6568
Fax 604.855.7378
www.valleytesting.ca

Branch Offices:

- Burnaby
604-436-9111
- Dawson Creek
(250) 261-6615
- Fort St. John
(250) 261-6615
- Kelowna
(250) 860-9955
- Red Deer (AB)
403-346-1920
- Salmon Arm
(250) 803-0248
- Squamish
(604) 898-1420
- Sunshine Coast
(604) 740-0920
- Surrey
(604) 543-8871
- Victoria
(250) 744-3992
- Whistler
(604) 938-2821



INNOVATIVE QUALITY SOLUTIONS

**Quality Control and Compliance for
Cox Station Quarry,
Abbotsford, BC**

**Acid Rock Drainage/Metal Leaching Assessment
In accordance with:**

Government of BC Technical Circular T-10/2013
"Evaluating the Potential for Acid Rock Drainage and
Metal Leaching at Quarries, Rock Cut Sites and from
Stockpiled Rock or Talus Materials used by the MOTI"

Submitted To:



Mainland Sand & Gravel
SUPPLIERS OF QUALITY CRUSHED STONE PRODUCTS

Submitted By:

Valley Testing Services Ltd.
Abbotsford, BC

March 21, 2014

V-6602



Our Project file:V6602-V1.1

March 21, 2014

Mainland Sand & Gravel Ltd.

9512 – 194A Street
Surrey, B.C.
V4N 4G5

Attention: **Ms. Dani Miller**, Safety & Tech. Compliance Manager

**RE: Summary Report - ARD/ML Testing and Assessment of Rock Samples
Cox Station Quarry, 6850 Cox Road Abbotsford, BC**

1. INTRODUCTION

As requested, Valley Testing Services Ltd. (VTS) has assessed nine rock and aggregate samples for acid rock drainage (ARD) and metal leaching (ML) potential. The samples were obtained by VTS personnel with the assistance of the Client from the above source on January 24th and February 28th, 2014. The assessment of the sample material included mineral identification using petrographic methods, and acid-base accounting (ABA) and metal analysis to determine chemically the potential for ARD/ML. This report summarizes the test results.

2. SAMPLING AND SITE REVIEW

The quarry is currently producing aggregate products for rip-rap, and 75 mm, 40 mm and 25 mm minus crushed gravels. No mining activities were active or currently planned in the west half of the quarry site. A review of the area geology indicates that the quarry is comprised predominantly of massive granitic varieties (granite to granodiorite) and local dike/veinlet andesitic rocks.

The rock and aggregate samples were obtained based on lithology from various locations in the quarry, including a stockpile of processed material on the lower level of the site, and recent blast material from the upper portion of the deposit that was being worked at the time of the site visit. Nine samples were collected to generally evaluate quarry geology for possible acid rock drainage and metal leaching production. Two additional samples were obtained during the second site visit at Corner N# 3 to validate test results from sample CH3-RP-B during the first round testing.

Detailed locations with GPS coordinates are included in Table 1 and marked on Drawings for reference.

While overburden and fractured, weathered rock is present on the site, this material will not be used as part of the production for the current operations according to Client. A visual examination of the active portion of the site and stockpiled production materials that are being evaluated found slight signs of oxidation and sulphide-bearing materials. These appeared localized only, and not widely spread.



Table 1 Summary of Sample Locations and Rock Types

Sample No	Sample ID	Locations	Reference GPS Coordinates	Rock Type and Comments
1	BNH101-A	Bench 101	N: 49°07.899' W:122°10.043' EL. 101 m	Granite
2	BNH101-B	Bench 101, ~10 meter north of sample 101-A	-	Andesite
3	BNH115-A	Bench 115, between Corner No 5 and No 7, ~40 meter south of the GPS location	N: 49°08.026' W:122°09.822' EL. 128 m	Granite to granodiorite Fresh blast material
4	BNH115-B	~15 meter north of sample 115-A	-	Andesite, fresh blast material
5	CR3-RP-A	Corner No 3, sample removed to a stockpile	N: 49°07.986' W:122°10.169' EL. 81 m	Granite
6	CR3-RP-B	Corner No 3, the same stockpile as sample RP-A	-	Andesitic rock
7	AUT75mm-1	Auto sampling from Belt, 75mm minus crush	N: 49°08.029' W:122°10.483' EL. 10 m	A mixture of granitic and andesitic dyke rocks.
8	CR3-RP-3B	~15m from north side end of Corner No 3, quarry face	-	Andesitic dyke, sampled Feb. 28/14
9	CR3-RP-3C	~40 m southeast of sample RP-3B	-	Andesitic dyke, sampled Feb. 28/14

3. METHODOLOGY

3.1 Mineral Identification

Rock fragments from the samples were examined in general accordance with CSA Test Method A23.2-15A-09 *Petrographic examination of aggregates*. Mineralogy within each rock type was identified, as well as the mechanical properties of the material. The purpose of this examination was to identify mineralogy and mechanical properties of the rock types that are known to contribute to ARD/ML in each of the samples.

3.2 ARD/ML Testing

Acid rock drainage forms when sulfide minerals in rocks are exposed to oxidizing conditions in coal and metal mining, highway construction, and other large scale excavations. After being exposed to air and water, oxidation of metal sulfides within the surrounding rock and overburden generates acidity. Colonies of bacteria can greatly accelerate the decomposition of the metal ions. These microbes are known as acidophiles; acidithiobacillus ferro-oxidans is a key contributor to pyrite oxidation.¹



To evaluate the potential of ARD/ML, acid-base accounting (ABA) testing as noted in the **Government of BC Technical Circular T-10/2013** was completed. In addition, the solubility of metals by Aqua Regia Digestion with ICP-MS finish was examined. The digestion is done by using combinations of HNO₃ and HCl. After sample digestion, the solution is analysed by inductively coupled plasma-mass spectrometry (ICP-MS). This testing, referred also to as static testing, gives an indication and supporting information of the materials potential to generate acid and to leach metals into solution. The laboratory analysis was carried out by SGS Canada, Vancouver.

Interpretation of ABA Data

Acid-base accounting is based on the premise that the propensity for a site to produce acid rock drainage can be predicted quantitatively by determining the total amount of acidic and alkaline material a site can potentially produce. The maximum potential acidity (MPA) is calculated using the Total Sulfur value (S%) or the calculated Sulfide value, which is material potentially convertible to sulfuric acid. The neutralization potential (NP) is determined by treating and heating the sample with standardized hydrochloric acid. The net neutralization potential (NNP) is calculated by subtracting the MPA from the NP, resulting in a positive or negative number.

A negative NNP indicates that acid generation is possible; a positive number (in excess of 25 is preferred) indicates the sample is most likely not an acid producer. The NP/MPA ratio is also used to evaluate a sample's acid generating potential. If the ratio is less than 1, the sample could be an acid generator (high potential); if the sample's ratio is greater than 2, the sample is considered to have a low potential of being an acid generator as per Technical Circular T-10/13.

The paste pH test, which accompanies the acid-base accounting test, indicates immediately whether the rock is acid or alkaline. Acid generation may have already begun if the pH is significantly acidic.

The Fizz Rating test is another aspect of the acid-base accounting testing. This test is performed by adding 1 to 2 drops of 25% HCl to a prepared sample. The "fizz" is rated on a scale from 0 to 3; 0 being no reaction, 1 slight reaction, 2 moderate reaction, and 3 strong reaction. There should be a correlation between the NP and the Fizz Rating; for example with a Fizz Rating of 3 we should see a positive NP. With a Fizz Rating of 0, there should be a very low positive or even a negative NP.^{2,5}

In general, sulfide-rich and carbonate-poor materials are expected to have a high potential for acid production. In contrast, alkaline-rich materials (such as limestone), even with significant sulfide mineralogy, often produce alkaline conditions in water.

4. TEST RESULTS AND DISCUSSION

4.1 Mineral Identification

Table 2 summarizes the samples obtained from the quarry, including a brief description of major and accessory minerals observed. Thin sections were not used in the examination.



Table 2 Summary of Sample Rock and Mineral Data

No	Sample ID	Description of Rock Samples
1	BNH101-A	This sample was classified as granite and was coarse grained, massive, containing feldspar (large amount of potassium feldspar or orthoclase), quartz, hornblende, magnetite; no sulfide mineralogy identified. Mohs hardness of >5.5, pinkish pale (salmon) with black speckles.
2	BNH101-B	The sample was composed of fine grained, massive andesitic rocks, containing mainly feldspar, hornblende, olivine, pyroxene, and magnetite. Minor sulfide minerals (pyrite) was noted, Mohs hardness of >5.0, pale to greenish gray.
3	BNH115-A	This sample was classified as granite-granodiorite and was medium to coarse grained, massive, containing feldspar (lesser amounts of orthoclase), quartz, hornblende, and magnetite. No sulfide mineralogy was observed. Mohs hardness of 5.5-6.0, pale gray with black and white speckles.
4	BNH115-B	The sample was composed of fine grained, massive andesitic rocks containing feldspar, hornblende, olivine and pyroxene, magnetite, minor sulfide minerals (pyrite) was noted, Mohs hardness of >5.0, greenish gray.
5	CR3-RP-A	This sample was classified as granite and was coarse grained, massive, containing quartz and feldspar (including some orthoclase), hornblende, magnetite, occasional pyrite mineralization was identified in some particles. Mohs hardness of >5.5, medium red with black speckles.
6	CR3-RP-B	The sample was composed of fine grained, massive andesitic rocks containing feldspar, hornblende, olivine and pyroxene, magnetite; small amount of sulfide minerals (pyrite) was identified as fine grains disseminated in ground mass. Mohs hardness of >5.0, greenish gray (dark).
7	AJT75mm-1	<p>Coarse Portion: This sample material was a processed aggregate and was generally hard, strong, and tough. The porosity of the rock types was generally low. The majority of the sample was composed of granite to granodiorite (approximately 95%), with lesser amounts of volcanic rocks (basalt and andesite). Calcite vein and pyritic mineralogy (<2 %) were noted in some andesitic rock particles. Fracture count was estimated at 100%; minor flat and elongated particles were observed.</p> <p>Fine Portion: This aggregate material is grey to pinkish grey in color, hard, medium tough, and slightly weathered. The predominant rock types are granitic with minor mafic volcanic and are consistent with those classified in the coarse portion of the sample. Mineral grains comprised ~47% of the evaluated sample and primarily consisted of quartz, feldspar (including potassium feldspar), hornblende, magnetite, calcite, and biotite. Rock particles persisted to a size of 630um. There are approximately 1 % weathered particles.</p>



8	CR3-RP-3B	This sample was comprised of fine grained, massive andesitic rocks with minor calcite veins containing feldspar, olivine and pyroxene, magnetite, hornblende. No sulfide minerals were identified. Mohs hardness of >5.5, pale to greenish gray (light).
9	CR3-RP-3C	The sample was comprised of fine grained, massive andesitic rocks containing feldspar, hornblende, higher pyroxene content than sample RP-3B, magnetite, and minor sulfide mineralogy (pyrite), Mohs hardness of >5.5, greenish gray.

The petrographic examination of the rock and aggregate samples did result in minor sulfide mineralogy being identified. The mineral identified was pyrite. Iron oxide mineralogy in the form of magnetite was identified but this form of iron mineralogy is not known to contribute to acid rock drainage. From a mineralogical perspective the risk of ARD/ML is considered LOW.

4.2 ARD/ML Potential

All nine samples were evaluated using acid-base accounting analysis. The results are summarized in Table 3. A certified copy of the analysis completed is attached in Appendix A.

Table 3. Summary of Acid-base Accounting Test Data

Sample ID	S %	MPA tCaCO ₃ / 1000t	NP tCaCO ₃ / 1000t	NNP tCaCO ₃ / 1000t	NP/MPA Ratio	Paste pH	Fizz Rating
BNH101-A	<0.01	<0.3	15.3	15.3	>51.0	8.95	1
BNH101-B	<0.01	<0.3	8.1	8.1	>27.0	8.96	1
BNH115-A	<0.01	<0.3	7.5	7.5	>25.0	8.72	1
BNH115-B	0.02	0.6	24.5	23.9	40.8	8.78	1
CR3-RP-A	<0.01	<0.3	3.6	3.6	>12.0	8.83	0
CR3-RP-B	0.19	5.9	8.0	2.1	1.4	8.71	1
AUT75mm-1	0.07	2.2	13.1	10.9	6.0	8.62	1
CR3-HP-3B	<0.01	<0.3	12.6	12.6	>42.0	8.92	1
CR3-RP-3C	0.02	<0.3	6.5	6.5	21.7	8.89	0

Note: MPA = $-31.25 \times S\%$ or sulfide %, and NNP = NP - MPA

The acid-base accounting test results for the initial seven samples show NNP values ranging from 2.1 to 23.9 tCaCO₃/1000t rock sample. The positive NNP values indicate that the rock material is not likely to be acid producing.



The NP/MPA ratios for the samples range from 6.0 to 51, with the exception of sample CR3-RP-B, indicating these materials have a low potential of generating acid. For sample CR3-RP-B the ratio was 1.4 which, being marginally less than 2, should be considered as an uncertain indication of the materials acid producing potential as noted in TC-T10/2013.

Two additional samples were obtained from Corner № 3 in the vicinity of sample CR3-RP-B. This sampling and testing was completed to validate the results of the initial sample from January 28th. The test results from these two samples indicate that the results from the initial sample was correct and should be considered to reflect a non acid producing condition. Results for samples CR3-RP-3B and 3C clearly show high positive NNP and NP/MPA ratios suggesting the material does not have potential for acid production.

The paste pH values range from 8.62 to 8.99. These pH values show an alkaline condition, and indicate that acid rock generation has not begun. The materials had fizz ratings of 0 to 1, indicating none to slight reaction with hydrochloric acid.

A review of "Metals by Aqua Regia Digestion with ICP-MS finish" indicates that the data, including calcium and sulphur concentration support the above findings in terms of NP and soluble sulphur. Also no elevated metal elements were noted under strong acid digestion (aggressive digestion). The data can be used as benchmark or reference for future expansion and Quality Control. See attached certificate for reference.

Based on the chemical analysis completed, it is our opinion that the material represented by samples № 1 to № 9 are unlikely to have a potential for acid rock generation or metal leaching. The additional testing and evaluation of samples № 8 and № 9 have negated the uncertainty initially noted with respect to sample № 6, and confirmed that the material represented by the samples from Corner № 3 does not present a risk of ARD/ML.

5. CONCLUSIONS AND RECOMMENDATIONS

A review of the petrographic examinations and static testing completed indicates that the sample materials *do not* have a potential of acid rock generation/metal leaching as per TC-T10/2013.

A site review and re-sampling in the vicinity of original sample CR3-RP-B from Corner № 3 was completed. It is our opinion that the additional testing validates the initial result from sample CR3-RP-B and there is no indication of potential for ARD/ML.

If the materials from the source quarry are consistent then no further testing should be necessary for present operations. The material should be monitored on an on-going basis for the amount of sulfide mineralogy. If an increase in sulfide mineralogy is noted then the material should be re-evaluated for acid rock drainage/metal leaching performance. This is applicable for entire site, in particular for Corner № 3.



I trust this report meets your needs. Should you have any questions, please contact the office.

Valley Testing Services Ltd.

Yours truly,

Per:



Henry H. Xu P.Eng.
Civil/Materials Engineer

Reviewed by:

John Burton, P.Geo.
Senior Geological Consultant

References

1. USGS Open-file Report 2005-1148, Acid-rock drainage at Skytop, Center County, Pennsylvania, 2004.
2. US Environmental Protection Agency, Technical Report, Acid Mine Drainage Prediction, Dec 1994.
3. The Environmental Impact of Submarine Tailings Disposal at the Island Copper Mine on Vancouver Island; Moore, Ph.D., Pelletier, and Horne, R.P.Bio.
4. Overview of Acid Mine Drainage Treatment with Chemicals, West Virginia University, Skousen, Hilton, and Faulkner.
5. Laboratory Methods for Acid-Base Accounting, Pennsylvania Department of Environmental Protection, Tim Kania.
6. Guidelines for Metal Leaching and Acid Rock Drainage in British Columbia, Ministry of Energy and Mines, and Ministry of Environment, 1998.
7. Government of BC, Technical Circular T-10/2013.

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Limitations

Valley Testing Services Ltd. (VTS) prepared the foregoing report for the exclusive use and information of **Mainland Sand & Gravel Ltd.** The information and data were collected and compiled in accordance with the general level of care and skill normally exercised by geoscience and engineering professionals practising under similar circumstances. The testing/investigation was limited to the scope of work specifically addressed in the report. Any use by a third party of the foregoing report, or any reliance upon or decisions made by a third party based upon them is the sole responsibility of such third parties. VTS accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on the foregoing report. All documentation contained in the foregoing report has been prepared in accordance with the requirements in the TC T-04-2013.



Appendix A



A1 Photo- Site Condition and Aggregate Samples



Photo #1 Overview of active quarry face



Photo #2 Newly blasted face materials including a narrow band (dike/vein inside red circle).

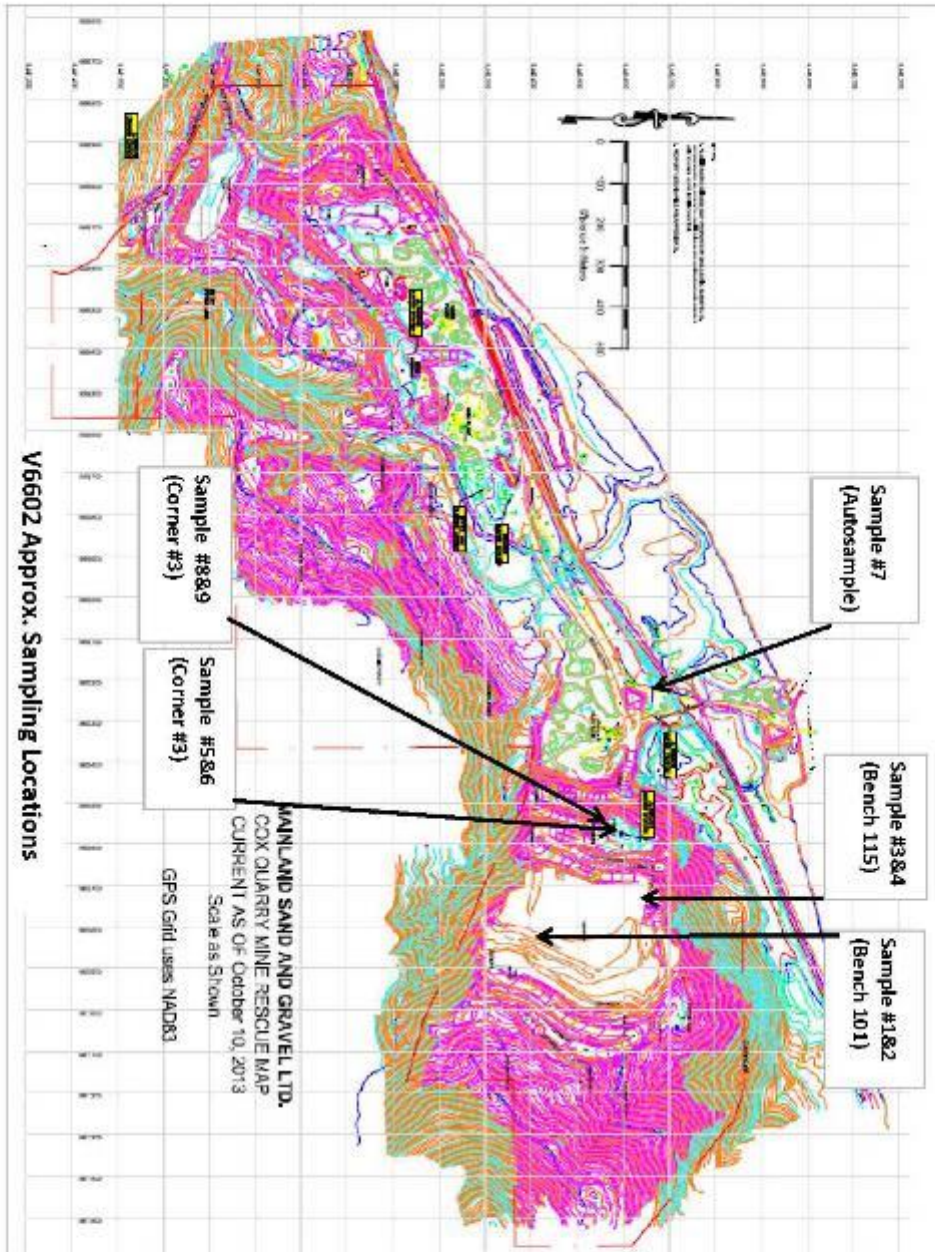


Photo #3 Massive granitic rocks containing k-feldspar (white arrow-top), with andesitic (dike) rocks (red arrows left) prior to further processing.



A2 Sampling Locations

A3 ARD/ML- Test Data/Certificate



CLIENT : Valley Testing Services
 PROJECT : ARD Testing (Project # V6602)
 SGS PROJECT # : 1262
 TEST : Modified Acid-Base Accounting
 Date : February 6, 2014

Sample ID	Paste pH	TIC %	CaCO ₃ NP	Total S %	Si(SO ₄) %	S(S-2) %	Insoluble S %	AP	NP	Net NP	Fizz Test
Method Code	Sobek	CSB02V	Calc. #N/A	CSA06V	CSA07V	CSA08D	Calc. #N/A	Calc. #N/A	Modified	Calc. #N/A	Sobek #N/A
AUT75mm-1	8.62	0.11	9.2	0.07	<0.01	0.07	<0.01	2.2	13.1	10.9	Slight
BNH101-A	8.95	0.13	10.8	<0.01	<0.01	<0.01	<0.01	<0.3	15.3	15.3	Slight
BNH101-B	8.96	0.07	5.6	<0.01	<0.01	<0.01	<0.01	<0.3	8.1	8.1	Slight
BNH115-A	8.72	0.06	5.0	<0.01	<0.01	<0.01	<0.01	<0.3	7.5	7.5	Slight
BNH115-B	8.78	0.25	20.8	0.02	<0.01	0.02	<0.01	0.6	24.5	23.9	Slight
CR3-RP-A	8.63	<0.01	<0.8	<0.01	<0.01	<0.01	<0.01	<0.3	3.6	3.6	None
CR3-RP-B	8.71	0.06	5.0	0.19	<0.01	0.19	<0.01	5.9	8.0	2.1	Slight
Duplicates											
AUT75mm-1	8.66				<0.01	<0.01			11.9		Slight
BNH101-A				0.02		<0.01					
BNH115-A		0.24									
BNH115-B											
QC											
GTS-2A				0.33	4.36						
PD-1						2.6					
RTS-3A											
SY-4		0.91							38.2		Slight
NBM-1									42.0		Slight
Expected Values		0.95		0.35	4.27	2.34					
Tolerance +/-		0.06		0.03	0.30	0.23			4.0		

Note:

AP = Acid potential in tonnes CaCO₃ equivalent per 1000 tonnes of material. AP is determined from the calculated sulphide sulphur content: S(T) - S(SO₄).
 NP = Neutralization potential in tonnes CaCO₃ equivalent per 1000 tonnes of material.

NET NP = NP - AP

Carbonate NP is calculated from TIC originating from carbonate minerals and is expressed in kg CaCO₃/tonne.

Sulphate Sulphur determined by 25% HCl Leach with S by ICP Finish

Sulphide Sulphur determined by Sobek 1:7 Nitric Acid with S by ICP Finish

Insoluble S is acid insoluble S. (Total S - (Sulphate S + Sulphide S)).

CLIENT : Valley Testing Services
 PRODUCT : ARD Testing (Project # V0002)
 SGS PROJECT # : 1282
 TEST : Metals by Aqua Regia Digestion with ICP-AES Finish
 Date : February 6, 2014

Sample ID	Ag	Al	B	Ba	Ca	Ch	Cu	Fe	K	Li	Mg	Mn	Na	Ni	P	S	Sr	Tl
Method Code	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145
LOD	ppm	%	ppm	ppm	%	ppm	ppm	%	%	ppm	%	ppm	%	ppm	ppm	%	ppm	%
ALH75mm-1	<0.01	1.24	58	58	1	54	6.2	1.53	0.07	1	0.57	901	0.05	2.1	0.046	0.03	55.8	0.07
BNH101-A	<0.01	1.49	40	47	1.03	85	2.7	2.9	0.04	3	1.03	751	0.06	1.9	0.069	<0.01	27.8	0.15
BNH101-B	<0.01	0.97	30	49	0.92	105	2.3	1.95	0.07	<1	0.48	568	0.07	2.5	0.044	<0.01	17.2	0.06
BNH115-A	<0.01	0.87	30	50	0.95	104	2.3	1.94	0.06	<1	0.53	316	0.06	2.2	0.047	<0.01	19.3	0.06
BNH115-B	<0.01	1.76	30	33	1.39	82	1.9	3.59	0.07	2	1.20	943	0.06	1.9	0.115	0.02	23.7	0.13
CRS-SP-A	<0.01	0.84	30	64	0.54	128	1.8	1.78	0.06	<1	0.42	384	0.06	2.4	0.045	<0.01	20.6	0.09
CRS-SP-B	<0.01	2.21	40	69	0.83	62	1.1	2.94	0.08	4	2.03	1090	0.05	1.7	0.066	0.23	46.8	0.07
Duplicate	<0.01	0.88	30	65	0.56	105	1.2	1.78	0.06	<1	0.43	384	0.06	2.2	0.044	<0.01	21.4	0.09
QC	2.27	1.85	40	261	0.59	111	2070	4.68	1.44	13	1.23	306	0.06	51	0.066	0.72	6.4	0.2
CH-4	2.18	1.85	RN/A	268	0.61	103.8	2000	4.79	1.45	12.6	1.18	324	0.06	48.57	7.19	0.78	6.98	0.21
Certified Values	10.9	11.55	RN/A	14.3	14.1	12.4	10.1	10.52	11.74	29.84	12.3	11.5	50.3	32.82	27.4	13.4	RN/A	23.3
tolerance (%)																		

V	Zn	Zr	As	Be	Bi	Cd	Ce	Co	Cs	Ga	Ge	Hf	Hg	In	La	Lu	Mo
ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
1	1	0.5	1	0.1	0.02	0.01	0.05	0.1	0.05	0.1	0.1	0.05	0.01	0.02	0.1	0.12	0.05
26	46	4.1	<1	0.3	0.03	0.06	10.5	4.5	0.11	4.6	<0.1	0.18	0.05	<0.02	5.1	0.12	2.56
66	30	8.8	<1	0.3	<0.02	0.02	13.3	8.3	<0.05	7.9	0.2	0.37	<0.01	<0.02	6.7	0.1	1.44
25	51	5.1	<1	0.3	<0.02	0.01	10.7	3.8	<0.05	4.3	<0.1	0.13	<0.01	<0.02	5.5	0.13	3.14
28	19	3.6	<1	0.2	<0.02	0.05	10.5	4.8	<0.05	4.5	<0.1	0.11	0.03	<0.02	5.4	0.12	2.82
56	60	3.3	<1	0.2	<0.02	0.02	11	5.1	<0.05	7	0.1	0.13	<0.01	<0.02	4.8	0.18	2.01
26	27	7.5	<1	0.2	<0.02	0.02	11.3	3.8	<0.05	4.2	<0.1	0.2	<0.01	<0.02	5.6	0.12	2.55
26	108	4.2	<1	0.3	0.02	<0.01	8.19	7.7	0.14	7	<0.1	0.1	<0.01	<0.02	4	0.11	1.27
26	25	7.9	<1	0.2	0.03	0.03	11.8	3.9	<0.05	4.2	<0.1	0.21	<0.01	<0.02	5.8	0.11	2.19
78	211	13.6	7	0.1	0.61	1.14	26.4	22.4	2.81	0.1	0.2	0.27	<0.01	0.12	13.8	0.06	2.63
70.27	160.4	0.0	8.14	0.11	0.51	1.17	26.18	22.6	2.6	0.72	0.21	0.24	RN/A	0.1	14	RN/A	3.05
15.2	11.3	17.7	15.1	241.3	16.7	12.1	10.4	11.1	14.8	12.3	127.4	52.3	RN/A	82.1	11.8	RN/A	14.1

Nb	Pb	Rb	Sb	Sc	Se	Sn	Ta	Tb	Ta	Th	Ti	U	W	Y	Yb
ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145	ICM145
ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
0.05	0.2	0.2	0.05	0.1	1	0.3	0.05	0.02	0.05	0.1	0.02	0.05	0.1	0.05	0.1
1.28	1.9	2.1	0.85	3.8	<1	0.4	0.22	0.24	<0.05	2	<0.02	0.41	0.1	9.05	0.8
0.85	1	0.9	0.93	5.5	<1	0.4	<0.05	0.28	<0.05	0.5	<0.02	0.34	<0.1	8.89	0.7
0.72	1.2	1.7	<0.05	4.6	<1	0.3	<0.05	0.25	<0.05	2.2	<0.02	0.4	<0.1	9.07	0.8
0.72	0.9	1.7	0.23	3.7	<1	0.3	<0.05	0.22	<0.05	2	<0.02	0.34	<0.1	8.45	0.7
0.21	0.8	2.2	0.09	8.9	<1	0.5	<0.05	0.26	<0.05	1.1	<0.02	0.23	<0.1	12.4	1.1
0.73	0.9	1.9	<0.05	3.2	<1	0.3	<0.05	0.23	<0.05	1.8	<0.02	0.39	<0.1	8.09	0.7
0.18	0.6	2.6	<0.05	5.3	<1	0.3	<0.05	0.21	<0.05	1.8	<0.02	0.34	<0.1	8.2	0.7
0.75	0.9	1.8	0.06	5.3	<1	0.3	<0.05	0.25	<0.05	2	<0.02	0.41	<0.1	8.44	0.7
0.46	8.5	67.1	0.59	8.9	2	0.6	<0.05	0.27	0.63	2	0.42	0.3	1.9	6.11	0.4
0.19	8.24	67	0.34	7.99	1.57	0.6	0.3	0.27	0.42	2.2	0.4	0.29	2.15	5.05	RN/A
75	16.1	16.7	47.3	13.1	169.6	154.5	51.7	25.4	35.5	21.2	22.6	52.3	21.6	12.2	RN/A

CLIENT : Valley Testing Services
 PROJECT : ARD Testing (Project # V6602)
 SGS PROJECT # : 1262
 TEST : Modified Acid-Base Accounting
 Date : March 10, 2014

Sample ID	Paste pH	TIC %	CaCO3 NP	Total S %	S(SO4) %	S(S-2) %	Insoluble S %	AP	NP	Net NP	Fizz Test
Method Code	Schak	CSHQ2V	Calc.	CSAQ6V	CSAQ2V	CSAQ8D	Calc.	Calc.	Modified	Calc.	Schak
LOD	0.20	0.01	#N/A	0.01	0.01	0.01	#N/A	#N/A	0.5	#N/A	#N/A
CHS-RP-3B	8.92	0.13	10.8	<0.01	<0.01	<0.01	<0.01	-0.3	12.8	12.8	Sight
CHS-RP-3C	8.99	0.34	3.3	0.02	<0.01	<0.01	0.02	-0.3	6.5	6.5	None
Duplicates											
CTS-TP-3B	8.87	0.13		<0.01	<0.01	<0.01			11.6		Sight
CTS-TP-3C											
QC											
GTS-2A				0.31							
PD-1					4.41						
RTS-3A						2.43					
SY-1		0.81									
NDW-1									38.4		Sight
Expected Values		0.95		0.35	4.27	2.34			42.0		Sight
Tolerance +/-		0.06		0.05	0.93	0.23			4.0		

Note:

AP = Acid potential (mmol CaCO3-equivalents per 100g) based on titration. AP is determined from the acid label on plastic sulphur content (S₂-S₂O₄).
 NP = Neutralization potential (mmol CaCO3-equivalents per 100g) in acid solution.
 NET NP = NP - AP
 Carbonate NP is calculated from TIC originating from carbonate minerals and is expressed in g CaCO3/100g soil.
 Sulphate Sulphur determined by 25% HCl digestion by ICP-MS.
 Sulphide Sulphur determined by Schak 107 Nitric Acid with S by ICP-MS.
 Insoluble S is total inorganic S (Total S - Sulphate S - Sulphide S).

APPENDIX B



CLAY LUMPS AND FRIABLE PARTICLES IN AGGREGATES
ASTM C 142

October 10, 2014
 Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	20 x 25 mm Clear Blend
Source:	Stockpile, Cox Station Quarry


Date sampled: September 26, 2014
Date tested: October 4, 2014

Sampled by: Client
Tested by: VN

Size Fraction (mm)	Mass of Sample (g)	Loss (%)	Original Gradation (%)	Clay Lumps (%)
37.5 x 19	2549.5	0.0	6.1	0.0
19 x 9.5	2175.4	0.0	89.1	0.0
9.5 x 4.75	--	0.0 ⁽¹⁾	4.8	0.0
Percentage Clay Lumps (Weighted Average)				0.0

Note: (1) Fractions comprising less than 5% are considered to have a value equal to the next smaller/larger fraction.

Reported by: S. John, AScT

Reviewed by: 
 L. Hu, M. Sc. E., P.Eng.



Notes: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.
GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



RELATIVE DENSITY (SPECIFIC GRAVITY) AND ABSORPTION OF COARSE AGGREGATE
ASTM C 127

October 14, 2014
 Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	20 mm x 25 mm Clear Blend
Source:	Stockpile, Cox Station Quarry

Date sampled: September 26, 2014
 Date tested: October 6, 2014

Sampled by: RR
 Tested by: VN

Trial No.	Relative Density (Dry Basis)	Relative Density (SSD Basis)	Apparent Relative Density	Absorption (%)
1	2.610	2.631	2.666	0.80
2	2.617	2.637	2.670	0.77
AVERAGE	2.613	2.634	2.668	0.78

Reported by: S. John, AScT

Reviewed by: 
 L. Hu, M. Sc. E., P.Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**STANDARD TEST METHOD FOR
SOUNDNESS OF AGGREGATES BY
USE OF MAGNESIUM SULFATE
ASTM C88-05**

October 14, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	20 mm x 25 mm Clear Blend
Source:	Stockpile, Cox Station Quarry


Date sampled: September 26, 2014
Date tested: October 6 - 11, 2014

Sampled by: RR
Tested by: DC

Sieve Fraction (mm)	Original Grading (%)	Mass/Fraction Before Test (g)	Loss (%)	Weighted Loss (%)
37.5 x 25 25 x 19	6.1	1524.9	1.4	0.1
19 x 12.5 12.5 x 9.5	89.1	1002.5	2.3	2.0
9.5 x 4.75	4.8	---	2.3 ⁽¹⁾	0.1
	100.0		TOTAL	2.2

Notes: (1) Fractions comprising less than 5 % of the sample are assumed to have a loss % value equal to the next larger size fraction.

Reported by: S. John, ASCT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other locations/depths. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada, V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**RESISTANCE TO DEGRADATION OF
SMALL-SIZE COARSE AGGREGATE
BY ABRASION & IMPACT IN THE
LOS ANGELES MACHINE
ASTM C 131**

October 10, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	20 mm x 25 mm Clear Blend
Source:	Stockpile, Cox Station Quarry

Date sampled: September 26, 2014

Sampled by: CM

Date tested: October 8, 2014

Tested by: DCAVN

Grading	B
Number of Revolutions	500
Loss After 500 Revolutions (%)	26.3

Reported by: S. John, AScT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.
GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-8816



**RESISTANCE OF COARSE AGGREGATE
TO DEGRADATION BY ABRASION IN
THE MICRO-DEVAL APPARATUS
ASTM D 6928**

October 10, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	20 mm x 25 mm Clear Blend
Source:	Stockpile, Cox Station Quarry

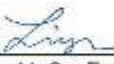
Date sampled: September 26, 2014
Date tested: October 7, 2014

Sampled by: RR
Tested by: DC/VN

Grading	Section 8.2 19 x 16 mm, 16 x 12.5 mm and 12.5 x 9.5 mm Sieve Fractions
Loss at Conclusion of Test (%)	7.2

Validation test: Drain Brothers control aggregate loss was 14.4 %, tested on October 3, 2014. Valid range is between 11.4% and 14.6%

Reported by: S. John, ASCT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods.
This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE
ASTM C 136

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

October 10, 2014
 Project Number: 1405522-2000

ATTENTION: Ms. Dani Miller

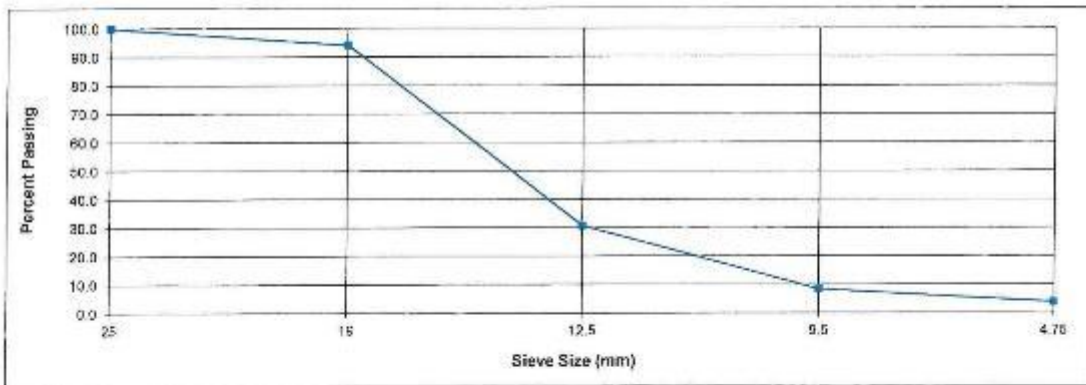
PROJECT: Aggregate Testing

Sample:	20 mm x 25 mm Clear Blend
Source:	Stockpile, Cox Station Quarry

DATE SAMPLED: September 26, 2014
 DATE TESTED: October 4, 2014

SAMPLED BY: RR
 TESTED BY: VN

SIEVE ANALYSIS					MATERIAL SPECIFICATION:	
Sieve Size (mm)	% Retained	% Passing	Individual % Retained (Split values)			
			+ 4.75	- 4.75		
25	0.0	100.0	0.0			
19	5.8	94.1	6.1			
12.5	63.4	30.7	65.9			
9.5	22.2	8.5	23.1			
4.75	4.6	3.8	4.8			
PAN	3.8	0		100.0		
Total	100.0		100.0	100.0		



Reported by: S. John, ASCT

Reviewed by: L. Hu
 L. Hu, M. Sc. E., P. Eng.



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other zones/depths. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6889 Fax: 604-412-6816



CLAY LUMPS AND FRIABLE PARTICLES IN AGGREGATES
ASTM C 142

October 10, 2014
 Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	40 mm Clear
Source:	Stockpile, Cox Station Quarry

Date sampled: September 26, 2014
Date tested: October 4, 2014

Sampled by: Client
Tested by: VN

Size Fraction (mm)	Mass of Sample (g)	Loss (%)	Original Gradation (%)	Clay Lumps (%)
50 x 37.5	3807.0	0.0	8.3	0.0
37.5 x 19	3422.9	0.0	82.3	0.0
19 x 9.5	2411.8	0.0	9.3	0.0
9.5 x 4.75	--	0.0 ⁽¹⁾	0.1	0.0
Percentage Clay Lumps (Weighted Average)				0.0

Note: (1) Fractions comprising less than 5% are considered to have a value equal to the next smaller/larger fraction.

Reported by: S. John, AScT

Reviewed by: 
 L. Hu, M. Sc. E., P.Eng.



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



RELATIVE DENSITY (SPECIFIC GRAVITY) AND ABSORPTION OF COARSE AGGREGATE
ASTM C 127

October 14, 2014
 Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	40 mm Clear
Source:	Stockpile, Cox Station Quarry

Date sampled: September 26, 2014
Date tested: October 6, 2014

Sampled by: CM
Tested by: VN

Trial No.	Relative Density (Dry Basis)	Relative Density (SSD Basis)	Apparent Relative Density	Absorption (%)
1	2.638	2.656	2.687	0.69
2	2.630	2.649	2.681	0.72
AVERAGE	2.634	2.653	2.684	0.71

Reported by: S. John, AScT

Reviewed by: 
 L. Hu, M. Sc. E., P.Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6818



**STANDARD TEST METHOD FOR
SOUNDNESS OF AGGREGATES BY
USE OF MAGNESIUM SULFATE**
ASTM C88-05

October 14, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	40 mm Clear
Source:	Stockpile, Cox Station Quarry

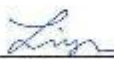
Date sampled: September 26, 2014
Date tested: October 6 - 11, 2014

Sampled by: CM
Tested by: DC

Sieve Fraction (mm)	Original Grading (%)	Mass/Fraction Before Test (g)	Loss (%)	Weighted Loss (%)
63 × 50 50 × 37.5	8.3	2035.7	0.0	0.0
37.5 × 25 25 × 19	82.3	1503.8	0.0	0.0
19 × 12.5 12.5 × 9.5	9.3	1006.0	2.5	0.2
9.5 × 4.75	0.1	---	2.5 ⁽¹⁾	0.0
	100.0		TOTAL	0.2

Notes: (1) Fractions comprising less than 5 % of the sample are assumed to have a loss % value equal to the next larger size fraction.

Reported by: S. John, ASCT

Reviewed by: 
L. Hu, M. Sc. E., P. Eng.



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other locations/depths. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada, V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**RESISTANCE TO DEGRADATION OF
LARGE-SIZE COARSE AGGREGATE BY
ABRASION & IMPACT IN THE
LOS ANGELES MACHINE
ASTM C 535**

October 10, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 184A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing


Sample:	40 mm Clear
Source:	Stockpile, Cox Station Quarry

Date sampled: September 26, 2014
Date tested: October 8, 2014

Sampled by: CM
Tested by: DC/VN

Grading	3
Number of Revolutions	1000
Loss After 1000 Revolutions (%)	11.9

Reported by: S. John, ASCT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**RESISTANCE OF COARSE AGGREGATE
TO DEGRADATION BY ABRASION IN
THE MICRO-DEVAL APPARATUS
ASTM D 6928**

October 10, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	40 mm Clear
Source:	Stockpile, Cox Station Quarry


Date sampled: September 26, 2014
Date tested: October 8, 2014

Sampled by: CM
Tested by: DC/MN

Grading	Section 8.2 19 x 16 mm, 16 x 12.5 mm and 12.5 x 9.5 mm Sieve Fractions
Loss at Conclusion of Test (%)	5.1

Validation test: Drain Brothers control aggregate loss was 14.4 %, tested on October 3, 2014. Valid range is between 11.4% and 14.8%

Reported by: S. John, AScT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE
ASTM C 136

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

October 10, 2014
 Project Number: 1405522-2000

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	40 mm Clear
Source:	Stockpile, Cox Station Quarry

DATE SAMPLED: September 25, 2014
 DATE TESTED: October 4, 2014

SAMPLED BY: CM
 TESTED BY: VN

SIEVE ANALYSIS					MATERIAL SPECIFICATION:
Sieve Size (mm)	% Retained	% Passing	Individual % Retained (Split values)		
			+ 4.75	- 4.75	
50	0.0	100.0	0.0		
37.5	8.2	91.8	8.3		
25	45.2	46.6	45.7		
19	38.2	10.4	36.6		
12.5	9.0	1.4	9.1		
9.5	0.2	1.2	0.2		
4.75	0.1	1.1	0.1		
PAN	1.1	0		100.0	
Total	100.0		100.0	100.0	



Reported by: S. John, ASCT

Reviewed by: *L. Hu*
 L. Hu, M. Sc. E., P. Eng.



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other zones/depths. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**RESISTANCE OF COARSE AGGREGATE
TO DEGRADATION BY ABRASION IN
THE MICRO-DEVAL APPARATUS
ASTM D 6928**

October 10, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	75 mm Minus Clear
Source:	Belt, Cox Station Quarry

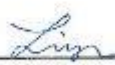
Date sampled: September 29, 2014
Date tested: October 7, 2014

Sampled by: CM
Tested by: DCAVN

Grading	Section 8.2 19 x 16 mm, 16 x 12.5 mm and 12.5 x 9.5 mm Sieve Fractions
Loss at Conclusion of Test (%)	10.4

Validation test: Drain Brothers control aggregate loss was 14.4 %, tested on October 3, 2014. Valid range is between 11.4% and 14.8%

Reported by: S. John, AScT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



Notes: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods.
This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6889 Fax: 604-412-6816



RELATIVE DENSITY (SPECIFIC GRAVITY) AND ABSORPTION OF FINE AGGREGATE
ASTM C 128

October 10, 2014
 Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

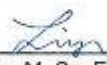
Sample:	Asphalt Sand
Source:	Stockpile, Cox Station Quarry

Date sampled: September 26, 2014
 Date tested: October 3, 2014

Sampled by: CM
 Tested by: DC

Trial No.	Mass (g)	Relative Density (Dry Basis)	Relative Density (SSD Basis)	Apparent Relative Density	Absorption (%)
1	500.6	2.575	2.607	2.661	1.25
2	500.3	2.580	2.610	2.660	1.17
AVERAGE		2.577	2.609	2.660	1.21

Reported by: S. John, ASCT

Reviewed by: 
 L. Hu, M. Sc. E., P.Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-8999 Fax: 604-412-5816



**SOUNDNESS OF AGGREGATE BY
USE OF MAGNESIUM SULFATE**
ASTM C 88

October 15, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	Asphalt Sand
Source:	Stockpile, Cox Station Quarry


Date sampled: September 26, 2014
Date tested: October 6 - 11, 2014

Sampled by: CM
Tested by: DC

Sieve Fraction (mm)	Original Grading % Retained	Mass/Fraction Before Test (g)	Loss (%)	Weighted Loss (%)
4.75 - 2.36	16.3	100.0	15.7	2.6
2.36 - 1.18	20.8	100.0	9.1	1.9
1.18 - 0.600	21.2	100.0	7.0	1.5
0.600 - 0.300	20.0	100.0	3.6	0.7
< 0.300	21.7	---	0.0	0.0
	100.0		TOTAL	6.7

Note: (*) Size fractions < 0.300 mm are assumed to have a loss of 0.0 % as per standard.

Reported by: S. John, AScT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada, V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**RESISTANCE OF FINE AGGREGATE
TO DEGRADATION BY ABRASION IN
THE MICRO-DEVAL APPARATUS
ASTM D 7428**

October 10, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	Asphalt Sand
Source:	Stockpile, Cox Station Quarry

Date sampled: September 26, 2014
Date tested: October 3, 2014

Sampled by: CM
Tested by: DC

Grading	Fines 4.75 x 0.075 mm Sieve Fraction
Loss at Conclusion of Test (%)	11.8

Note: Sultherland Sand control aggregate loss was 17.9 %, tested on October 2, 2014. Valid range is between 15.2% and 18.4%.

Reported by: S. John, AScT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**SAND EQUIVALENT VALUE OF
SOILS AND FINE AGGREGATE**
ASTM D 2419

October 14, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	Asphalt Sand
Source:	Stockpile, Cox Station Quarry

Date sampled: September 26, 2014
Date tested: October 3, 2014

Sampled by: CM
Tested by: DC

TRIAL #	SEDIMENTATION PERIOD (min)	CLAY HEIGHT (inches)	SAND HEIGHT (inches)	SAND EQUIVALENT
1	20.00	5.1	4.5	89
2	20.00	5.1	4.5	89
3	20.00	5.0	4.4	88
AVERAGE				89

Reported by: S. John, ASCT

Reviewed by: 
L. Hu, M. Sc. E., P. Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**UNCOMPACTED VOID CONTENT
OF FINE AGGREGATE
ASTM C1252**

October 14, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	Asphalt Sand
Source:	Stockpile, Cox Station Quarry

Date sampled: September 26, 2014
Date tested: October 7, 2014

Sampled by: CM
Tested by: DC

Procedure	Dry Relative Density (Specific Gravity) of Fine Aggregate (g/cm ³)	Trial	Uncompacted Void Content (%)
A (Standard Graded Sample)	2.577	1	47.1
		2	47.0
		3	46.8
		Average	47.0

Reported by: S. John, ASCT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-8899 Fax: 604-412-8815



SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE
ASTM C 136

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

October 10, 2014
 Project Number: 1405522-2000

ATTENTION: Ms. Dani Miller

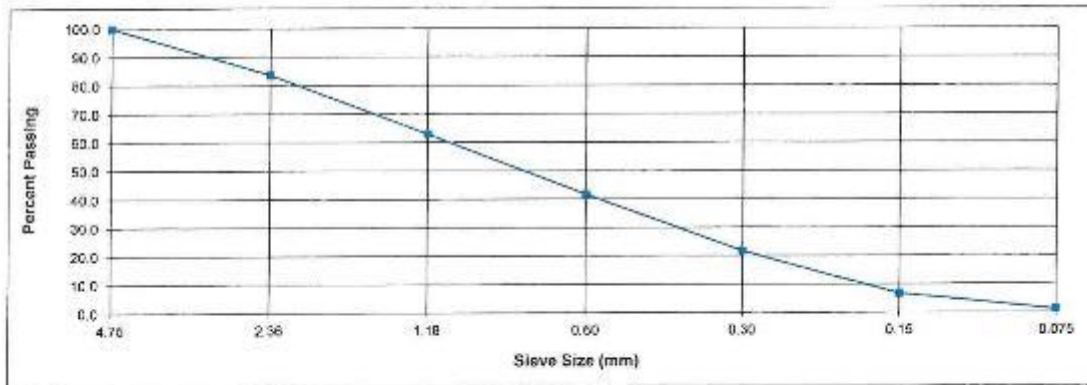
PROJECT: Aggregate Testing

Sample:	Asphalt Sand
Source:	Stockpile, Cox Station Quarry

DATE SAMPLED: September 26, 2014
 DATE TESTED: October 4, 2014

SAMPLED BY: CM
 TESTED BY: VN

Sieve Size (mm)	% Retained	% Passing	Individual % Retained (Split values)		MATERIAL SPECIFICATION:
			+ 4.75	- 4.75	
			4.75	0.0	
2.36	16.3	83.7		16.3	
1.18	20.8	63.0		20.8	
0.60	21.2	41.7		21.2	
0.30	20.0	21.7		20.0	
0.15	14.9	6.8		14.9	
0.075	5.9	1.3		5.5	
PAN	1.3	0		1.3	
Total	100.0			100.0	



Reported by: S. John, ASCT

Reviewed by: *L. Hu*
 L. Hu, M. Sc. E., P.Eng



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GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816




**BULK DENSITY (UNIT WEIGHT)
AND VOIDS IN AGGREGATE**
ASTM C 29

Client:	Mainland Sand & Gravel	Project No.:	1405522
Short Title:	Bulk Density Testing	Phase No.:	1000
Sample ID.:	C1002	Date sampled:	May 15, 2014
COV Item #:	1	Sampled by:	Client
Description:	Fine Aggregate (Clean Sand)	Date tested:	May 20, 2014
Source:	Stockpile, Cox Station Quarry	Tested by:	VN

Trial	Shovelling Loose Procedure	Rodding Compacted Procedure
	Bulk Density (kg/m ³)	Bulk Density (kg/m ³)
#1	1524	1708
#2	1544	1719
#3	1531	1718
Average	1533	1715

Note: Testing was conducted on oven dried materials.

Reported by: D. Clemente

Reviewed by: 
L. Hu, P. Eng.



The test data given herein pertain to the sample provided. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6916



**BULK DENSITY (UNIT WEIGHT)
AND VOIDS IN AGGREGATE**
ASTM C 29

Client:	Mainland Sand & Gravel	Project No.:	1405522
Short Title:	Bulk Density Testing	Phase No.:	1000
Sample ID.:	C3009	Date sampled:	May 15, 2014
COV Item #:	3	Sampled by:	Client
Description:	Clear Crushed Coarse Aggregates	Date tested:	May 20, 2014
Source:	Stockpile, Cox Station Quarry	Tested by:	VN

Trial	Shovelling Loose Procedure	Rodding Compacted Procedure
	Bulk Density (kg/m ³)	Bulk Density (kg/m ³)
#1	1325	1455
#2	1313	1451
#3	1318	1453
Average	1318	1453

Note: Testing was conducted on oven dried materials.

Reported by: D. Clemente

Reviewed by:


L. Hu, P. Eng.



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GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**BULK DENSITY (UNIT WEIGHT)
AND VOIDS IN AGGREGATE**
ASTM C 29

Client:	Mainland Sand & Gravel	Project No:	1405522
Short Title:	Bulk Density Testing	Phase No.:	1000
Sample ID.:	C3012	Date sampled:	May 15, 2014
COV Item #:	3	Sampled by:	Client
Description:	Clear Crushed Coarse Aggregates	Date tested:	May 20, 2014
Source:	Stockpile, Cox Station Quarry	Tested by:	VN

Trial	Shovelling Loose Procedure	Rodding Compacted Procedure
	Bulk Density (kg/m ³)	Bulk Density (kg/m ³)
#1	1330	1475
#2	1324	1469
#3	1327	1473
Average	1327	1472

Note: Testing was conducted on oven dried materials.

Reported by: D. Clemente

Reviewed by: 
L. Hu, P. Eng.



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GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**BULK DENSITY (UNIT WEIGHT)
AND VOIDS IN AGGREGATE**
ASTM C 29

Client:	Mainland Sand & Gravel	Project No:	1405522
Short Title:	Bulk Density Testing	Phase No.:	1000
Sample ID.:	C3920	Date sampled:	May 15, 2014
COV Item #:	3	Sampled by:	Client
Description:	Clear Crushed Coarse Aggregates	Date tested:	May 20, 2014
Source:	Stockpile, Cox Station Quarry	Tested by:	VN

Trial	Shovelling Loose Procedure	Rodding Compacted Procedure
	Bulk Density (kg/m ³)	Bulk Density (kg/m ³)
#1	1351	1492
#2	1331	1493
#3	1340	1491
Average	1341	1492

Note: Testing was conducted on oven dried materials.

Reported by: D. Clemente

Reviewed by: 
L. Hu, P. Eng.



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GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**BULK DENSITY (UNIT WEIGHT)
AND VOIDS IN AGGREGATE**
ASTM C 29

Client:	Mainland Sand & Gravel	Project No:	1405522
Short Title:	Bulk Density Testing	Phase No.:	1000
Sample ID:	Not Provided	Date sampled:	May 15, 2014
COV Item #:	3	Sampled by:	Client
Description:	Clear Crushed Coarse Aggregates	Date tested:	May 20, 2014
Source:	Stockpile, Cox Station Quarry	Tested by:	DC

Trial	Shovelling Loose Procedure	Rodding Compacted Procedure
	Bulk Density (kg/m ³)	Bulk Density (kg/m ³)
#1	1393	1601
#2	1403	1595
#3	1411	1604
Average	1402	1600

Note: Testing was conducted on oven dried materials.

Reported by: D. Clemente

Reviewed by: 
L. Hu, P. Eng.



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GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**BULK DENSITY (UNIT WEIGHT)
AND VOIDS IN AGGREGATE**
ASTM C 29

Client:	Mainland Sand & Gravel	Project No.:	1405522
Short Title:	Bulk Density Testing	Phase No.:	1000
Sample ID.:	C2009	Date sampled:	May 15, 2014
COV Item #:	4	Sampled by:	Client
Description:	9.5mm Crusher Dust for Asphaltic	Date tested:	May 20, 2014
Source:	Stockpile, Cox Station Quarry	Tested by:	DC

Trial	Shovelling Loose Procedure	Rodding Compacted Procedure
	Bulk Density (kg/m ³)	Bulk Density (kg/m ³)
#1	1494	1683
#2	1487	1709
#3	1483	1699
Average	1488	1697

Note: Testing was conducted on oven dried materials.

Reported by: D. Clemente

Reviewed by: 
L. Hu, P. Eng.



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GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-8899 Fax: 604-412-8816




**BULK DENSITY (UNIT WEIGHT)
AND VOIDS IN AGGREGATE**
ASTM C 29

Client:	Mainland Sand & Gravel	Project No:	1405522
Short Title:	Bulk Density Testing	Phase No.:	1000
Sample ID.:	C3040	Date sampled:	May 15, 2014
COV Item #:	5	Sampled by:	Client
Description:	19mm - 37.5mm Clear Crush	Date tested:	May 20, 2014
Source:	Stockpile, Cox Station Quarry	Tested by:	VN

Trial	Shovelling Loose Procedure	Rodding Compacted Procedure
	Bulk Density (kg/m ³)	Bulk Density (kg/m ³)
#1	1378	1551
#2	1371	1559
#3	1374	1562
Average	1374	1557

Note: Testing was conducted on oven dried materials.

Reported by: D. Clemente

Reviewed by: 
L. Hu, P. Eng.



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GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6898 Fax: 604-412-6816



BULK DENSITY (UNIT WEIGHT) AND VOIDS IN AGGREGATE

ASTM C 29


Client:	Mainland Sand & Gravel	Project No:	1405522
Short Title:	Bulk Density Testing	Phase No.:	1000
Sample ID.:	C3020	Date sampled:	May 15, 2014
COV Item #:	14	Sampled by:	Client
Description:	2.36 to 19mm Clear Crushed Coarse Agg	Date tested:	May 20, 2014
Source:	Stockpile, Cox Station Quarry	Tested by:	DC

Trial	Shovelling Loose Procedure	Rodding Compacted Procedure
	Bulk Density (kg/m ³)	Bulk Density (kg/m ³)
#1	1337	1524
#2	1337	1536
#3	1339	1530
Average	1337	1530

Note: Testing was conducted on oven dried materials.

Reported by: D. Clemente

Reviewed by:


L. Hu, P. Eng.



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GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816




**BULK DENSITY (UNIT WEIGHT)
AND VOIDS IN AGGREGATE**
ASTM C 29

Client:	Mainland Sand & Gravel	Project No:	1405522
Short Title:	Bulk Density Testing	Phase No.:	1000
Sample ID.:	C3025	Date sampled:	May 15, 2014
COV Item #:	15	Sampled by:	Client
Description:	2.36 to 25mm Clear Crushed Coarse Agg	Date tested:	May 20, 2014
Source:	Stockpile, Cox Station Quarry	Tested by:	DC

Trial	Shovelling Loose Procedure	Rodding Compacted Procedure
	Bulk Density (kg/m ³)	Bulk Density (kg/m ³)
#1	1341	1536
#2	1338	1538
#3	1344	1534
Average	1341	1536

Note: Testing was conducted on oven dried materials.

Reported by: D. Clemente

Reviewed by: 
L. Hu, P. Eng.



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GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816




**BULK DENSITY (UNIT WEIGHT)
AND VOIDS IN AGGREGATE**
ASTM C 29

Client:	Mainland Sand & Gravel	Project No.:	1405522
Short Title:	Bulk Density Testing	Phase No.:	1000
Sample ID.:	C2019	Date sampled:	May 15, 2014
COV Item #:	9	Sampled by:	Client
Description:	25mm Combined Coarse Aggregate	Date tested:	May 20, 2014
Source:	Stockpile, Cox Station Quarry	Tested by:	DC

Trial	Shovelling Loose Procedure	Rodding Compacted Procedure
	Bulk Density (kg/m ³)	Bulk Density (kg/m ³)
#1	1602	1837
#2	1616	1870
#3	1628	1854
Average	1615	1853

Note: Testing was conducted on oven dried materials.

Reported by: D. Clemente

Reviewed by: 
L. Hu, P. Eng.



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GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6889 Fax: 604-412-6818




**BULK DENSITY (UNIT WEIGHT)
AND VOIDS IN AGGREGATE**
ASTM C 29

Client:	Mainland Sand & Gravel	Project No:	1405522
Short Title:	Bulk Density Testing	Phase No.:	1000
Sample ID.:	C2075	Date sampled:	May 15, 2014
CCV Item #:	13	Sampled by:	Client
Description:	75mm Crushed Tailings	Date tested:	May 20, 2014
Source:	Stockpile, Cox Station Quarry	Tested by:	DC

Trial	Shovelling Loose Procedure	Rodding Compacted Procedure
	Bulk Density (kg/m ³)	Bulk Density (kg/m ³)
#1	1582	1810
#2	1594	1824
#3	1588	1832
Average	1588	1822

Note: Testing was conducted on oven dried materials.

Reported by: D. Clemente

Reviewed by: 
L. Hu, P. Eng.



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GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 804-412-6899 Fax: 804-412-6816




**BULK DENSITY (UNIT WEIGHT)
AND VOIDS IN AGGREGATE**
ASTM C 29

Client:	Mainland Sand & Gravel	Project No:	1405522
Short Title:	Bulk Density Testing	Phase No.:	1000
Sample ID.:	C2012	Date sampled:	May 15, 2014
COV Item #:	17	Sampled by:	Client
Description:	12.5mm Sand Fill	Date tested:	May 20, 2014
Source:	Stockpile, Cox Station Quarry	Tested by:	DC

Trial	Shovelling Loose Procedure	Rodding Compacted Procedure
	Bulk Density (kg/m ³)	Bulk Density (kg/m ³)
#1	1570	1779
#2	1560	1798
#3	1566	1790
Average	1566	1789

Note: Testing was conducted on oven dried materials.

Reported by: D. Clemente

Reviewed by: 
L. Hu, P. Eng.



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GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



BULK DENSITY (UNIT WEIGHT) AND VOIDS IN AGGREGATE

ASTM C 29

Client:	Mainland Sand & Gravel	Project No.:	1405522
Short Title:	Bulk Density Testing	Phase No.:	1000
Sample ID.:	Not provided	Date sampled:	May 15, 2014
COV Item #:	17	Sampled by:	Client
Description:	12.5mm Sand Fill	Date tested:	May 20, 2014
Source:	Stockpile, Cox Station Quarry	Tested by:	DC

Trial	Shovelling Loose Procedure	Rodding Compacted Procedure
	Bulk Density (kg/m ³)	Bulk Density (kg/m ³)
#1	1578	1762
#2	1587	1760
#3	1590	1772
Average	1585	1771

Note: Testing was conducted on oven dried materials.

Reported by: D. Clemente

Reviewed by:


L. Hu, P. Eng.



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GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



CLAY LUMPS AND FRIABLE PARTICLES IN AGGREGATES
ASTM C 142

October 10, 2014
 Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	9 mm Clear Crush
Source:	Belt, Cox Station Quarry

Date sampled: September 26, 2014
Date tested: October 3, 2014

Sampled by: Client
Tested by: VN


Coarse Aggregate Portion (>4.75mm Sieve size)

Size Fraction (mm)	Mass of Sample (g)	Loss (%)	Original Gradation (%)	Clay Lumps (%)
9.5 x 4.75	1410.9	0.0	100.0	0.0
Percentage Clay Lumps (Weighted Average)				0.0

Fine Aggregate Portion (<4.75mm Sieve size)

Size Fraction (mm)	Mass of Sample (g)	Clay Lumps (%)
4.75 x 1.25	115.4	0.1

Reported by: S. John, ASCT

Reviewed by: 
 L. Hu, M. Sc. E., P.Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6898 Fax: 604-412-6816



RELATIVE DENSITY (SPECIFIC GRAVITY) AND ABSORPTION OF COARSE AGGREGATE
ASTM C 127

October 14, 2014
 Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	9 mm Clear Crush
Source:	Belt, Cox Station Quarry

Date sampled: September 26, 2014
Date tested: October 4, 2014

Sampled by: CM
Tested by: VN

Trial No.	Relative Density (Dry Basis)	Relative Density (SSD Basis)	Apparent Relative Density	Absorption (%)
1	2.583	2.616	2.672	1.30
2	2.583	2.619	2.680	1.40
AVERAGE	2.583	2.618	2.676	1.35

Reported by: S. John, ASCT

Reviewed by: 
 L. Hu, M. Sc. E., P.Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**STANDARD TEST METHOD FOR
SOUNDNESS OF AGGREGATES BY
USE OF MAGNESIUM SULFATE**
ASTM C88-05

October 14, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing


Sample:	9 mm Clear Crush
Source:	Belt, Cox Station Quarry

Date sampled: September 26, 2014
Date tested: October 6 - 11, 2014

Sampled by: CM
Tested by: DC

Sieve Fraction (mm)	Original Grading (%)	Mass/Fraction Before Test (g)	Loss (%)	Weighted Loss (%)
9.5 × 4.75	78.3	300.0	10.0	7.8
< 4.75	21.7	100.0	11.9	2.6
	100.0		TOTAL	10.4

Reported by: S. John, AScT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada, V5J 5J2 Tel: 604-412-6898 Fax: 604-412-6816



SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE
ASTM C 136

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

October 10, 2014
 Project Number: 1405522-2000

ATTENTION: Ms Dani Miller

PROJECT: Aggregate Testing

Sample:	9 mm Clear Crush
Source:	Belt, Cox Station Quarry

DATE SAMPLED: September 26, 2014
 DATE TESTED: October 3, 2014

SAMPLED BY: CM
 TESTED BY: VN

Sieve Size (mm)	% Retained	% Passing	Individual % Retained (Split values)		MATERIAL SPECIFICATION:
			+ 4.75	- 4.75	
			9.5	0.0	
4.75	78.3	21.7	100.0		
2.36	20.7	1.0		96.5	
1.18	0.4	0.6		1.7	
0.60	0.2	0.4		1.1	
0.30	0.1	0.2		0.7	
0.15	0.1	0.2		0.3	
0.075	0.0	0.1		0.1	
PAN	0.1	0		0.7	
Total	100.0		100.0	100.0	



Reported by: S. John, ASCT

Reviewed by: *L. Hu*
 L. Hu, M. Sc. E., P.Eng



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other source/depths. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



CLAY LUMPS AND FRIABLE PARTICLES IN AGGREGATES

ASTM C 142

October 10, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	9 mm Minus
Source:	Stockpile, Cox Station Quarry

Date sampled: September 29, 2014
Date tested: October 3, 2014

Sampled by: Client
Tested by: VN

Coarse Portion (>4.75mm Sieve size)

Size Fraction (mm)	Mass of Sample (g)	Loss (%)	Original Gradation (%)	Clay Lumps (%)
19 x 9.5	2019.4	0.0	5.7	0.0
9.5 x 4.75	1244.9	0.1	94.3	0.1
Percentage Clay Lumps (Weighted Average)				0.1

Fine Aggregate Portion (<4.75mm Sieve size)

Size Fraction (mm)	Mass of Sample (g)	Clay Lumps (%)
4.75 x 1.25	129.7	0.2

Reported by: S. John, ASCT

Reviewed by: _____

L. Hu
L. Hu, M. Sc. E., P.Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



RELATIVE DENSITY (SPECIFIC GRAVITY) AND ABSORPTION OF FINE AGGREGATE
ASTM C 128

October 10, 2014
 Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing


Sample:	9 mm Minus
Source:	Stockpile, Cox Station Quarry

Date sampled: September 29, 2014
 Date tested: October 2, 2014

Sampled by: CM
 Tested by: DC

Trial No.	Mass (g)	Relative Density (Dry Basis)	Relative Density (SSD Basis)	Apparent Relative Density	Absorption (%)
1	500.6	2.537	2.588	2.675	2.04
2	500.2	2.547	2.600	2.688	2.06
AVERAGE		2.542	2.594	2.682	2.05

Reported by: S. John, ASCT

Reviewed by: 
 L. Hu, M. Sc. E., P.Eng.



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



SOUNDNESS OF AGGREGATE BY USE OF MAGNESIUM SULFATE ASTM C 88

October 15, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	9 mm Minus
Source:	Stockpile, Cox Station Quarry

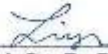
Date sampled: September 26, 2014
Date tested: October 6 - 11, 2014

Sampled by: CM
Tested by: DC

Sieve Fraction (mm)	Original Grading % Retained	Mass/Fraction Before Test (g)	Loss (%)	Weighted Loss (%)
9.5 - 4.75	36.1	301.9	1.2	0.4
4.75 - 2.36	19.4	100.0	4.5	0.9
2.36 - 1.18	15.5	100.0	3.8	0.6
1.18 - 0.600	10.0	100.0	3.3	0.3
0.600 - 0.300	6.9	100.0	2.8	0.2
< 0.300	12.1	---	0.0	0.0
	100.0		TOTAL	2.4

Note: (1) Size fractions < 0.300 mm are assumed to have a loss of 0.0 % as per standard.

Reported by: S. John, AScT

Reviewed by: 
L. Hu, M. Sc. E., P. Eng.



Notice: The test data given herein pertain to the samples provided, and may not be applicable to material from other locations/d Depths. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada, V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**RESISTANCE TO DEGRADATION OF
SMALL-SIZE COARSE AGGREGATE
BY ABRASION & IMPACT IN THE
LOS ANGELES MACHINE
ASTM C 131**

October 10, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	9 mm Minus
Source:	Stockpile, Cox Station Quarry

Date sampled: September 29, 2014
Date tested: October 8, 2014

Sampled by: CM
Tested by: DC/VN

Grading	C
Number of Revolutions	500
Loss After 500 Revolutions (%)	25.4

Reported by: S. John, ASCT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**RESISTANCE OF FINE AGGREGATE
TO DEGRADATION BY ABRASION IN
THE MICRO-DEVAL APPARATUS
ASTM D 7428**

October 10, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	9 mm Minus
Source:	Stockpile, Cox Station Quarry

Date sampled: September 29, 2014
Date tested: October 3, 2014

Sampled by: CM
Tested by: DC/OA

Grading	Fines 4.75 x 0.075 mm Sieve Fraction
Loss at Conclusion of Test (%)	9.5

Note: Sutherland Sand control aggregate loss was 17.9 %, tested on October 2, 2014. Valid range is between 15.2% and 18.4%.

Reported by: S. John, ASCT

Reviewed by:
L. Hu, M. Sc. E., P.Eng.



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



**SAND EQUIVALENT VALUE OF
SOILS AND FINE AGGREGATE**
ASTM D 2419

October 14, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing


Sample:	9 mm Minus
Source:	Stockpile, Cox Station Quarry

Date sampled: September 29, 2014
Date tested: October 3, 2014

Sampled by: CM
Tested by: DC

TRIAL #	SEDIMENTATION PERIOD (min)	CLAY HEIGHT (inches)	SAND HEIGHT (inches)	SAND EQUIVALENT
1	20.00	5.5	4.2	77
2	20.00	5.5	4.2	77
3	20.00	5.3	4.3	82
AVERAGE				79

Reported by: S. John, ASCT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

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**UNCOMPACTED VOID CONTENT
OF FINE AGGREGATE
ASTM C1252**

October 14, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing


Sample:	9 mm Minus
Source:	Stockpile, Cox Station Quarry

Date sampled: September 29, 2014
Date tested: October 7, 2014

Sampled by: CM
Tested by: DC

Procedure	Dry Relative Density (Specific Gravity) of Fine Aggregate (g/cm ³)	Trial	Uncompacted Void Content (%)
A (Standard Graded Sample)	2.542	1	47.4
		2	47.5
		3	47.2
		Average	47.4

Reported by: S. John, ASCT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



Note: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.
GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE
ASTM C 136

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

October 10, 2014
 Project Number: 1405522-2000

ATTENTION: Ms. Dani Miller

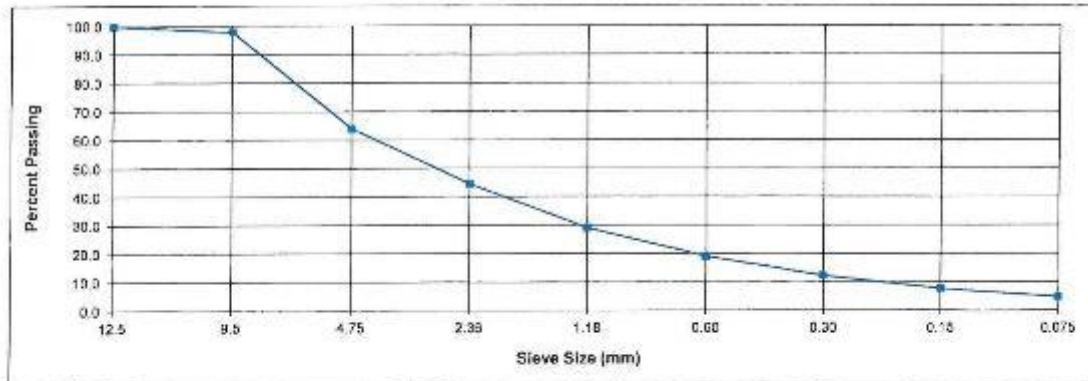
PROJECT: Aggregate Testing

Sample:	9 mm Minus
Source:	Stockpile, Cox Station Quarry

DATE SAMPLED: September 29, 2014
 DATE TESTED: October 1, 2014

SAMPLED BY: CM
 TESTED BY: VN

Sieve Size (mm)	% Retained	% Passing	Individual % Retained (Split values)		MATERIAL SPECIFICATION:
			+ 4.75	- 4.75	
			12.5	0.0	
9.5	2.0	98.0	5.7		
4.75	34.1	63.9	94.3		
2.36	19.4	44.5		30.3	
1.18	15.5	29.1		24.2	
0.60	10.0	19.1		15.6	
0.30	6.8	12.3		10.7	
0.15	4.5	7.7		7.1	
0.075	2.9	4.8		4.5	
PAN	4.8	0		7.5	
Total	100.0		100.0	100.0	



Reported by: S. John, AS&T

Reviewed by: *L. Hu*
 L. Hu, M. Sc. E., P.Eng.



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other zones/deposits. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LIMITED, 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-8899 Fax: 604-412-8816



CLAY LUMPS AND FRIABLE PARTICLES IN AGGREGATES

ASTM C 142

October 10, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	12 x 20 mm Clear Blend
Source:	Stockpile, Cox Station Quarry

Date sampled: September 29, 2014
Date tested: October 3, 2014

Sampled by: Client
Tested by: VN

Size Fraction (mm)	Mass of Sample (g)	Loss (%)	Original Gradation (%)	Clay Lumps (%)
19 x 9.5	2470.1	0.0	51.7	0.0
9.5 x 4.75	1117.0	0.0	49.0	0.0
Percentage Clay Lumps (Weighted Average)				0.0

Reported by: S. John, ASCT

Reviewed by: _____

L. Hu
L. Hu, M. Sc. E., P.Eng.



Notice: The test data given here in pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6898 Fax: 604-412-6818



RELATIVE DENSITY (SPECIFIC GRAVITY) AND ABSORPTION OF COARSE AGGREGATE
ASTM C 127

October 14, 2014
 Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing


Sample:	12 mm x 20 mm Clear Blend
Source:	Stockpile, Cox Station Quarry

Date sampled: September 29, 2014
Date tested: October 4, 2014

Sampled by: CM
Tested by: VN

Trial No.	Relative Density (Dry Basis)	Relative Density (SSD Basis)	Apparent Relative Density	Absorption (%)
1	2.604	2.632	2.678	1.05
2	2.595	2.625	2.675	1.14
AVERAGE	2.600	2.628	2.676	1.10

Reported by: S. John, ASCT

Reviewed by: 
 L. Hu, M. Sc. E., P.Eng.



Notes: The test data given herein pertain to the sample referenced, and may not be applicable to material from other zones/depths. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6818



**STANDARD TEST METHOD FOR
SOUNDNESS OF AGGREGATES BY
USE OF MAGNESIUM SULFATE**
ASTM C88-05

October 14, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing


Sample:	12 mm x 20 mm Clear Blend
Source:	Stockpile, Cox Station Quarry

Date sampled: September 29, 2014
Date tested: October 6 - 11, 2014

Sampled by: CM
Tested by: DC

Sieve Fraction (mm)	Original Grading (%)	Mass/Fraction Before Test (g)	Loss (%)	Weighted Loss (%)
19 x 12.5 12.5 x 9.5	51.0	1005.9	5.7	2.9
9.5 x 4.75	49.0	300.1	5.4	2.6
	100.0		TOTAL	5.5

Reported by: S. John, ASCT

Reviewed by: 
L. Hu, M. Sc. E., P. Eng.



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other locations/depths. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada, V5J 5J2 Tel: 604-412-8899 Fax: 604-412-8816



**RESISTANCE TO DEGRADATION OF
SMALL-SIZE COARSE AGGREGATE
BY ABRASION & IMPACT IN THE
LOS ANGELES MACHINE
ASTM C 131**

October 10, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing


Sample:	12 mm x 20 mm Clear Blend
Source:	Stockpile, Cox Station Quarry

Date sampled: September 29, 2014
Date tested: October 8, 2014

Sampled by: CM
Tested by: DC/VN

Grading	B
Number of Revolutions	500
Loss After 500 Revolutions (%)	29.0

Reported by: S. John, AScT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



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GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 804-412-6899 Fax: 604-412-6816



**RESISTANCE OF COARSE AGGREGATE
TO DEGRADATION BY ABRASION IN
THE MICRO-DEVAL APPARATUS
ASTM D 6928**

October 10, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	12 mm x 20 mm Clear Blend
Source:	Stockpile, Cox Station Quarry

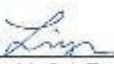
Date sampled: September 29, 2014
Date tested: October 7, 2014

Sampled by: CM
Tested by: DCVN

Grading	Section 8.2 19 x 16 mm, 16 x 12.5 mm and 12.5 x 9.5 mm Sieve Fractions
Loss at Conclusion of Test (%)	11.4

Validation test: Drain Brothers control aggregate loss was 14.4 %, tested on October 3, 2014. Valid range is between 11.4% and 14.8%

Reported by: S. John, ASCT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



Notice: The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816



SIEVE ANALYSIS OF FINE AND COARSE AGGREGATE
ASTM C 136

MAINLAND SAND & GRAVEL
 9512 - 194A Street
 Surrey, BC, V4N 4G5

October 10, 2014
 Project Number: 1405522-2000

ATTENTION: Ms. Dani Miller

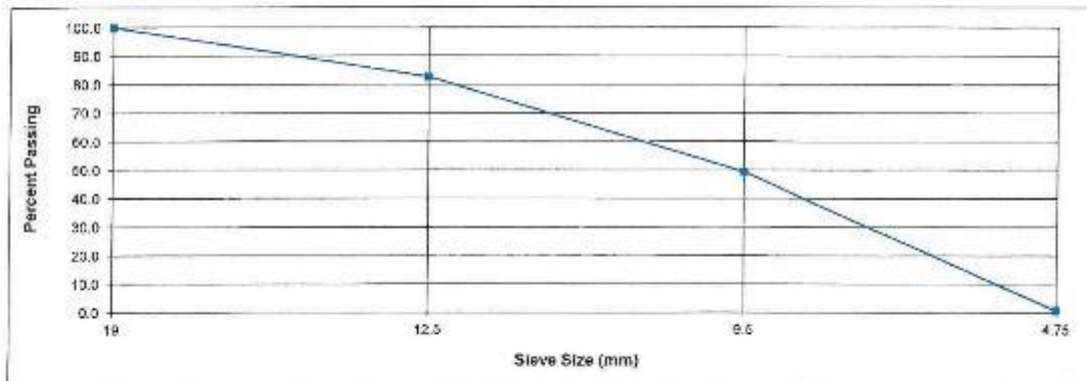
PROJECT: Aggregate Testing

Sample:	12 mm x 20 mm Clear Blend
Source:	Stockpile, Cox Station Quarry

DATE SAMPLED: September 29, 2014
 DATE TESTED: October 3, 2014

SAMPLED BY: CM
 TESTED BY: VN

Sieve Size (mm)	% Retained	% Passing	Individual % Retained (Split values)		MATERIAL SPECIFICATION:
			+ 4.75	- 4.75	
			19	0.0	
12.5	17.3	82.7	17.4		
9.5	33.4	49.3	33.6		
4.75	48.6	0.7	49.0		
PAN	0.7	0		100.0	
Total	100.0		100.0	100.0	



Reported by: S. John, ASCT

Reviewed by: *L. Hu*
 L. Hu, M. Sc. E., P.Eng.



Note: The test data given herein pertain to the sample provided, and may not be applicable to material from other sources. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

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**RESISTANCE OF COARSE AGGREGATE
TO DEGRADATION BY ABRASION IN
THE MICRO-DEVAL APPARATUS
ASTM D 6928**

October 10, 2014
Project Number: 1405522-2000

MAINLAND SAND & GRAVEL
9512 - 194A Street
Surrey, BC, V4N 4G5

ATTENTION: Ms. Dani Miller

PROJECT: Aggregate Testing

Sample:	19 mm Minus Road Base
Source:	Belt, Cox Station Quarry

Date sampled: September 29, 2014
Date tested: October 7, 2014

Sampled by: CM
Tested by: DCMN

Grading	Section 8.2 19 x 16 mm, 16 x 12.5 mm and 12.5 x 9.5 mm Sieve Fractions
Loss at Conclusion of Test (%)	11.4

Validation test: Drain Brothers control aggregate loss was 14.4 %, tested on October 3, 2014. Valid range is between 11.4% and 14.8%

Reported by: S. John, ASCT

Reviewed by: 
L. Hu, M. Sc. E., P.Eng.



Notice. The test data given herein pertain to the sample provided, and may not be applicable to material from other production zones/periods. This report constitutes a testing service only. Interpretation of the data given here may be provided upon request.

GOLDER ASSOCIATES LTD., 300 - 3811 North Fraser Way, Burnaby, BC, Canada V5J 5J2 Tel: 604-412-6899 Fax: 604-412-6816

**SUMMARY REPORT
AGGREGATE QUALITY TESTING PROGRAM (2014)
Cox Station Quarry, BC**

Prepared for:

Mr. David Rubuliak, BBA



Mainland Sand & Gravel
SUPPLIERS OF QUALITY CRUSHED STONE PRODUCTS

9512 – 191A Street
Surrey, B.C.
V4N 4G5

Prepared by:



CCIL/CSA Certified & OQM Certified Company

Valley Testing Services Ltd.
#18 – 3275 McCallum Road
Abbotsford, B.C. V2S 7W8
www.valleytesting.ca

Project No. V6595A
February 07, 2014





Materials Testing & Engineering Services
 CCIL/CSA and QQM Certified Company
Innovative Quality Solutions

February 07, 2014
 Aggregate Quality Testing
 Project No. V6595A

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Appendices

- Appendix A1 Photographs
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Materials Testing & Engineering Services
CCIL/CSA and QM Certified Company
Innovative Quality Solutions

February 07, 2014
Aggregate Quality Testing
Project No. V6595A

I. INTRODUCTION

On January 20, 2013 and January 28 Valley Testing Services Ltd. received three (3) aggregate samples of 75 mm minus, 40mm Clear Crush and 25 mm minus crushed aggregates from Cox Station Quarry, located in Abbotsford, BC (see photo below). All samples were extracted from stockpiles of the Quarry by the Client.

These samples were tested to determine the suitability of aggregates for use as concrete/asphalt aggregates, in accordance with CSA and BC Ministry of Transportation (MoT) requirements. This report summarizes the testing results.



Aero View of Cox Station Quarry

1



Materials Testing & Engineering Services
 CCIL/CSA and QM Certified Company
Innovative Quality Solutions

February 07, 2014
 Aggregate Quality Testing
 Project No. V6595A

II. TESTING RESULTS

1.0 Relative Density and Absorption of Coarse and Fine Aggregate (ASTM C127, C128)

This test method covers determination of the average density of a quantity of coarse & fine aggregate particles, the relative density and the absorption of the aggregates.

Test results are included in the attached appendices. The average test results are summarized below.

Aggregate Type	Bulk Relative Density (SSD) (kg/m ³)	Absorption (%)
75 mm minus (coarse portion)	2640	0.84
75 mm minus (fine portion)	2565	1.97
40 mm Clear Crush	2704	0.55

2.0 Flat and Elongated Particles in Coarse Aggregate (ASTM D4791)

This Test Method outlines the procedures for determination of flat and elongated particles in coarse aggregate.

75 mm Crushed Aggregate (1:3 Ratio)

Test Scope	% by mass
Percentage of Flat & Elongated Particles	46.92
MMCD Specifications for Upper & Lower Course	10.0

The results indicate that the material is above upper limit of MMCD specification requirements for Upper & Lower Courses.

3.0 Micro-Deval Test (ASTM D6928 & ASTM D7428))

This test method covers a procedure for testing resistance of aggregates to abrasion using Micro-Deval apparatus. It furnishes information which is helpful in judging the suitability of coarse and fine aggregate subject to weathering and abrasive action when adequate information is not available. The test results are shown in the appendices and are summarized below.

Coarse Aggregate (Composite sample 19 mm – 9.5 mm) (ASTM D6928)

Sample:	Coarse Aggregate
Total Sample Weight, (g)	1500.0
Finished weight, (g)	1437.9
Degradation (%)	4.1
CSA A23.2-23A Table 12 and MoT	17 max
MoT Section 502 Table 502B	18 max

2



Materials Testing & Engineering Services
 CCIL/CSA and QQM Certified Company
Innovative Quality Solutions

February 07, 2014
 Aggregate Quality Testing
 Project No. V6595A

The materials meet CSA and MoT Specifications for Coarse aggregate.

75 mm Crushed Aggregate (Fine Portion) (ASTM D7428)

Sample:	Fine Aggregate:
Total Sample Weight, (g)	500.0
Finished weight, (g)	447.0
Degradation (%)	10.6
CSA A23.2-23A Table 12	20 max

The materials meets CSA requirement for fine aggregates.

4.0 Soundness of Aggregate by using of Magnesium Sulfate (ASTM C88)

This test method determines the aggregates resistance to disintegration using a standard solution of Magnesium Sulfate. It provides helpful information in judging the soundness of aggregate subjected to weathering action. The test results are shown in the appendices and are summarized below.

75 mm Crushed Aggregate (Coarse Portion)

Sample:	Weight % Loss
75 mm Crushed Aggregate (Coarse Portion)	9.5
MoT Specified Maximum Loss (%) Section 211 Table 211-E	12.0
CSA A23.2-9A (Table 12) for Concrete exposed to freezing and thawing-other exposure conditions	12.0 18.0

The material meets CSA and MoT Specifications for Concrete aggregates.

75 mm Crushed Aggregate (Fine Portion)

Sample:	Weight % Loss
75 mm Crushed Aggregate (Fine Portion)	15.7
CSA A23.2-9A (Table 12) and MoT Table (211E) for Fine Aggregates	16.0 max

The material meets CSA and MoT Specifications for Concrete aggregates.

5.0 Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine (ASTM C535 & ASTM C131)

This test method measures the resistance to degradation of aggregates (smaller than 40 mm or 37.5 mm) using Los Angeles abrasion machine. It is the degradation of mineral aggregates of standard grading resulting from a combination of actions, including abrasion, impact, and grinding in a rotating steel drum containing a specified number of steel spheres. The test results are shown in the appendices and are summarized below.

8



Materials Testing & Engineering Services
 CCL-CSA and QM Certified Company
Innovative Quality Solutions

February 07, 2014
 Aggregate Quality Testing
 Project No. V6595A

75 mm Crushed Aggregate (ASTM C535)

Product	Grading	Original Mass (g)	Mass After Test (g)	Loss (g)	Percent Loss (%)
Coarse Aggregate	2	10024.1	8296.4	1727.7	17.2
CSA for Concrete Paving / Other Concrete (max loss)					35/50
MoT for Portland Cement Concrete (max loss)					35
MMCD for Upper Course (max loss)					25

The material meets CSA and MoT Specifications for Concrete aggregates.

75 mm Crushed Aggregate (Small Size) (ASTM C131)

Product	Grading	Original Mass (g)	Mass After Test (g)	Loss (g)	Percent Loss (%)
Coarse Aggregate	B	5010.5	3751.9	1258.6	25.1
CSA for Concrete Paving / Other Concrete (max loss)					35/50
MoT for Portland Cement Concrete (max loss)					35
MMCD for Upper Course (max loss)					25

The material meets CSA and MoT Specifications for Concrete aggregates.

6.0 Clay Lumps and Friable Particles in Aggregate (ASTM C 142)

This test method sets out the procedure for determination of Clay Lumps and Friable Particles in aggregate:

25 mm Crushed Aggregate (Coarse Portion)

Test Scope	% by mass
Clay Lumps and Friable Particles	0.04
CSA for Concrete A23.1-09 Table 12 Coarse Aggregate	0.25/0.5

The material meets MoT and CSA requirements for concrete aggregates.

25 mm Crushed Aggregate (Fine Portion)

Test Scope	% by mass
Clay Lumps and Friable Particles	0.4
CSA for Concrete A23.1-09 Table 12 Coarse Aggregate	1.0

The material meets MoT and CSA requirement for concrete aggregates.



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7.0 Low Density granular material in aggregate (ASTM C123)

This test method sets out the procedure for determination of the appropriate percentage of low-density granular pieces in aggregate by means of sink-float separation in a heavy liquid of suitable relative density.

25 mm Crushed Aggregate

Test Scope	% by mass
Percentage of Low-Density Particles	0.0
CSA for Concrete A23.1-09 Table 12 Coarse Aggregate	0.5 / 1.0

The material meets CSA and MoT requirement for concrete aggregate.

25 mm Crushed Aggregate (Fine Portion)

Test Scope	% by mass
Percentage of Low-Density Particles	0.1
CSA for Concrete A23.1-09 Table 12 Coarse Aggregate	0.5

The material meets CSA and MoT requirement for concrete aggregate.

8.0 Un-compacted Void Content of Fine Aggregate (ASTM C1252)

This test method covers the determination of the loose compacted void content of a sample of fine aggregate.

Mass of Measure (g)	Mass of Fine Aggregate (g)	Bulk Specific Gravity (kg/m ³)	Un-compacted Void Content (%)
186.5	137.6	2516	45.3
MoT specifications for regular mixes and for Super Pave Mixes > 45%			

The material meets MoT requirement for regular mixes and Super-Pave mixes.

9.0 Sand Equivalent (ASTM D2419)

This test method indicates the presence or absence of plastic fines in aggregate mixes. A small amount of non-plastic fines generally has no detrimental effect and may be even desirable for aggregates to be used for paving. The test results are shown in the appendices and are summarized below:

Test Scope	%
Sand Equivalent	43.3



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Note. Sand Equivalent test is normally completed on a mixture of fine aggregates for the purpose of mixture design. Typical minimum values range 40 to 45%.

10.0 Durability Index (ASTM D4374)

This test method covers the determination of durability index of an aggregate. The calculated durability index is a value indicating the relative resistance of an aggregate to production of detrimental cycle clay-like fines when subjected to the prescribed mechanical methods of degradation. The test results are shown in the appendices and are summarized below:

Trial 1		Trial 2	
Procedure A (coarse)		Procedure B (fine)	
Durability Index Dc	81.3	Durability Index Df	90.5

Typical MOT requirement for Durability Index is min. 60%.

11.0 Freeze & Thaw (CSA A23.2-24A)

This test method covers testing of coarse aggregate to determine their resistance to disintegration by repeated freezing and thawing in sodium chloride solution. The test results are shown in the appendices and are summarized below:

Test Scope	% by mass
Freeze & Thaw	4.2
CSA for Concrete A23.1-09 Table 12 Coarse Aggregate	6.0

The material meets MOT and CSA requirement for concrete aggregates.

12.0 Plastic Index (ASTM D-4318)

This test method covers determination of natural moisture content in soils and the Atterberg Limits (Liquid Limit) and the moisture range in which the soil remains in plastic state while passing from the semi-solid to the liquid state. The material was found non plastic.

13.0 Petrographic Testing (CSA A23.2-15A)

75 mm Crushed Aggregate-Coarse Portion:

The examination was performed on coarse portion of the aggregate sample. The material has been assigned a grade of "Good" with a **PN number of 117**. The sample material was generally found to be hard, strong, and mildly tough. The porosity of the rock types was generally low. The majority of the sample was composed of granite (to granodiorite, in total approximately 95%), and lesser volcanic igneous rocks (basalt and andesite). Fracture count was 100% and some flat or elongated particles were observed. The material was washed to aid in identification and was generally free from coatings and organic matter.

6



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75 mm Crushed Aggregate -Fine Portion:

This portion sample is ranged on sieves [5mm to 84um]. The material has been assigned a grade of "Good". The portion of material used for this examination is gray to pinkish gray in color. The aggregate ranges from hard, medium tough in general. The predominant rock types predominantly consist of granite family rocks, and volcanic igneous rocks (Andesite with minor amount of Basaltic and Dacite rocks). Mineral grains comprised ~46.5% of the evaluated sample and primarily consisted of quartz, feldspar (including alkali-feldspar), hornblende, magnetite and calcite, biotite. Rock particles persisted to a size of 630um. There are about 0.8% weathered particles. The material was washed to aid in identification.

III. COMMENTS AND CLOSURE

The aggregate test results indicate that the samples of 75 mm, 40 mm and 25 mm minus Coarse Aggregates generally complies with BC MoT and CSA requirements for concrete and asphalt production except for Flats & Elongated particles.

We trust this report meets your requirement. If there are any questions or concerns, please do not hesitate to contact the undersigned at your convenience.

Yours truly,

VALLEY TESTING SERVICES LTD.

Per;

Jaime Rivero, Sr. Tech.
 Laboratory Supervisor

Uri Lipshitz, AS&T
 Sr. Paving Consultant

Reviewed by

Henry H. Xu, P.Eng.
 Civil/Materials Engineer



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APPENDIX A



Materials Testing & Engineering Services
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Appendix A1



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Photos of Aggregate Samples for Visual Reference



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**Appendix A2 Test Reports &
Appendix A3 VTS Profile**

APPENDIX C

Unmanned Aerial Vehicle (UAV) Surveys 2014.

- Conducted by PS Surveys <http://pssurveys.ca> ; Peter Smith 778-389-0724
- Using SenseFly Ebee UAV for precise professional aerial mapping.
- Collect aerial photography 3cm- 5cm precision.
- With its 16 MP camera capable of 1.5 cm/pixel.
- These images are transformed into orthomosaics (maps) and 3D elevation models with relative accuracy of down to 3 cm / 5 cm.

Objective: Work planning including north and southmost rim extensions.

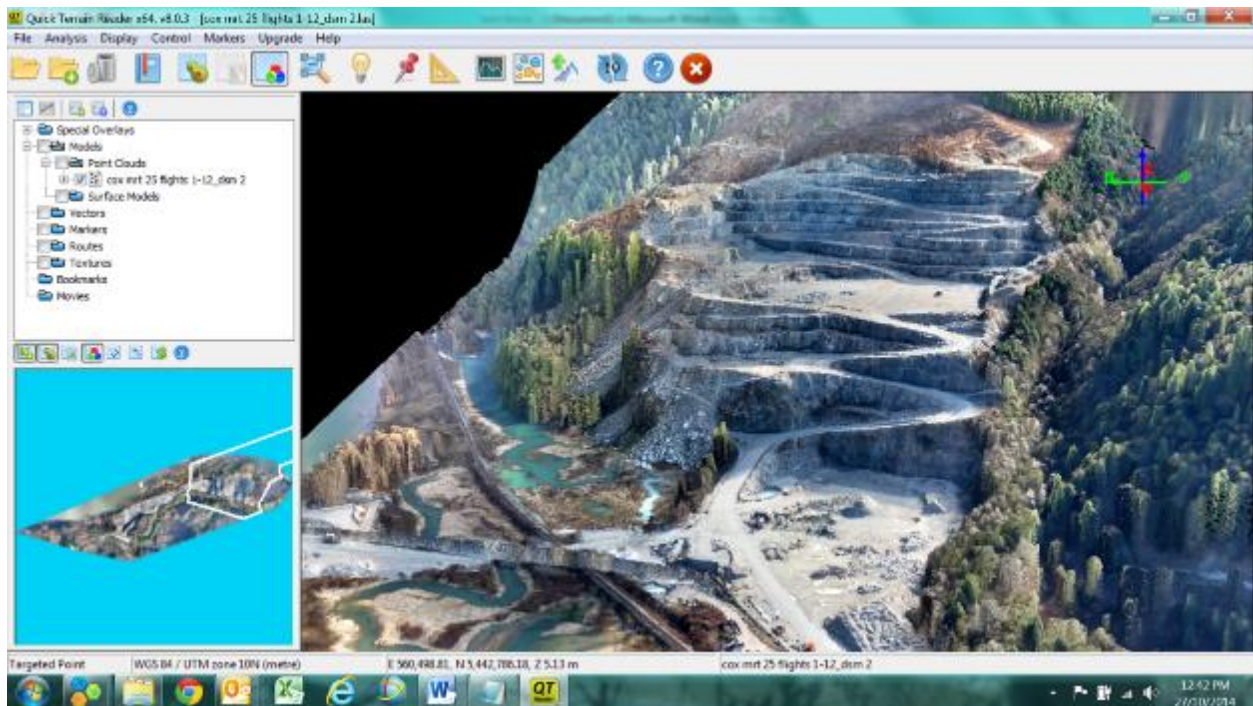
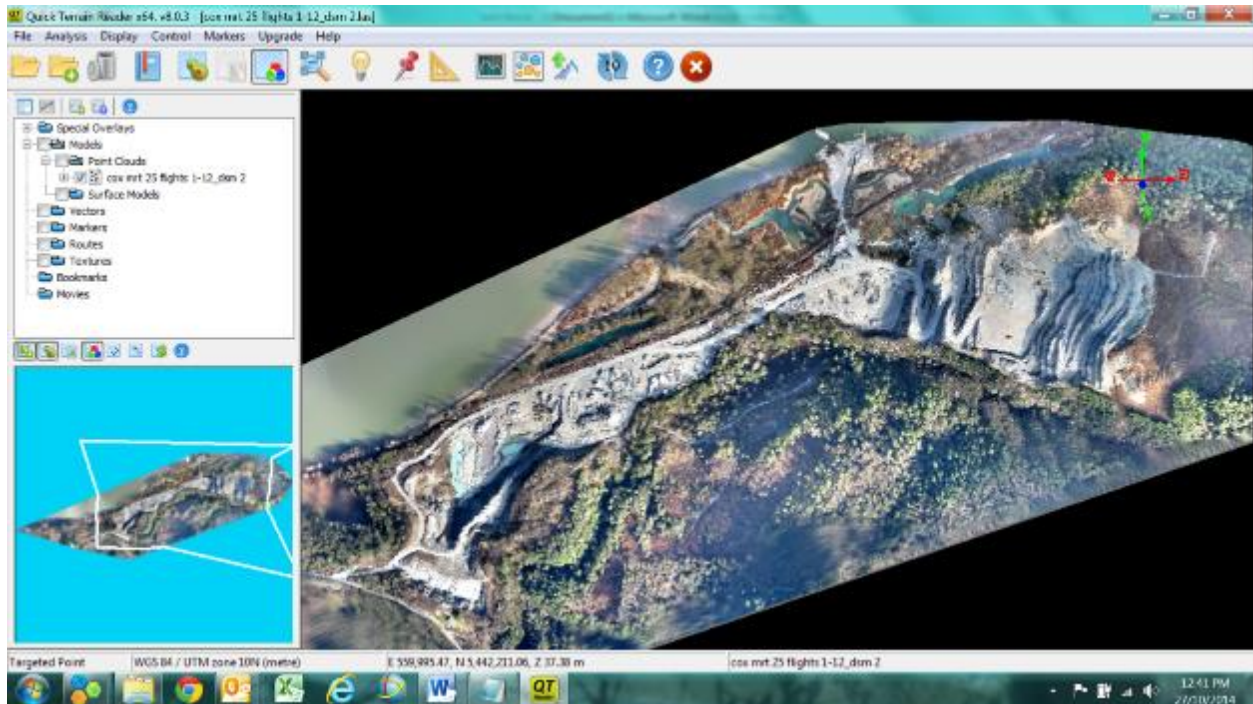
Examples: See screen shots below. Later examples include property lines overlain on model.

Instrumentation: SenseFly Ebee UAV and postflight terra 3D EB, coupled with ground controls.

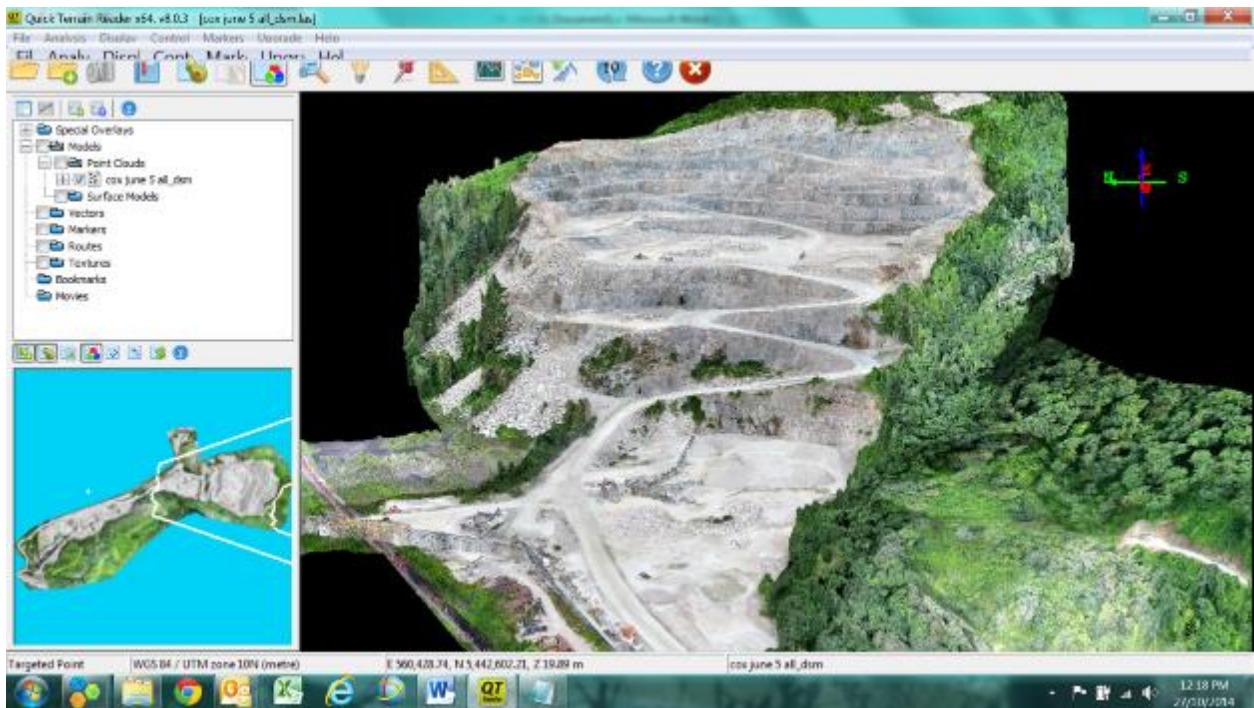
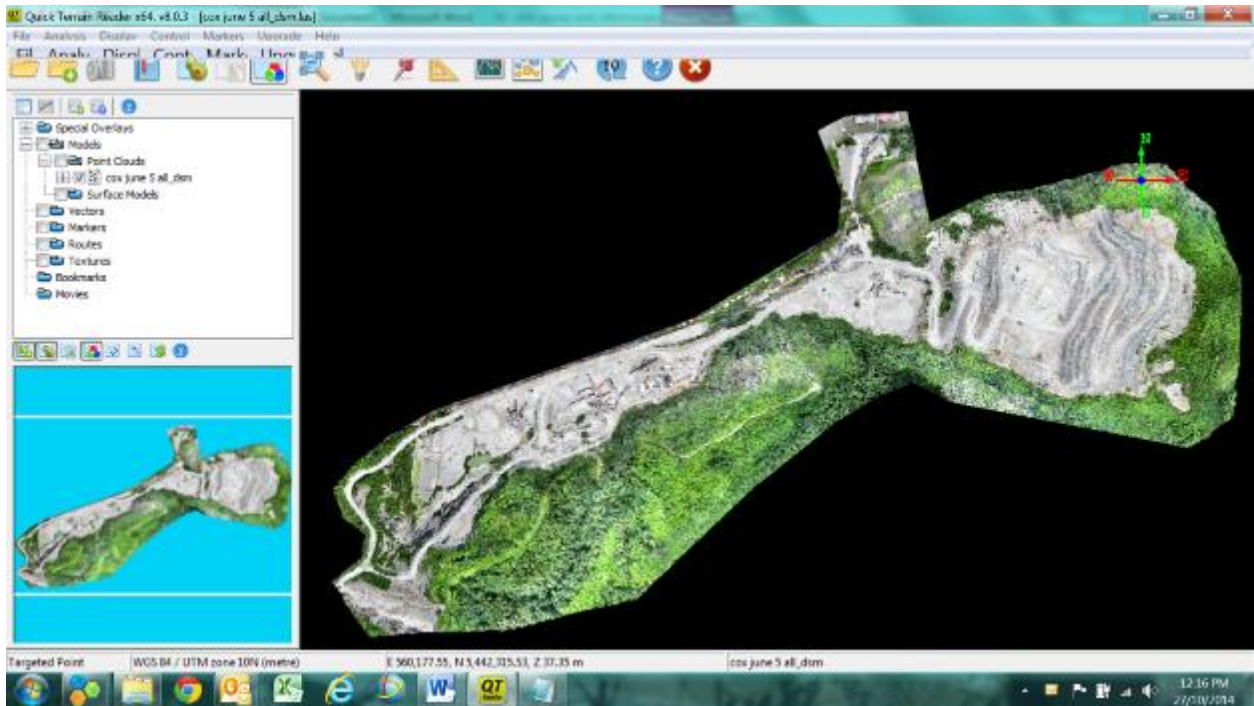
Results: Three successful 3D models were created, and utilized day-to-day by the Mine Manager and Shift Bosses to direct work including exploration and expansion along the northern and southern flanks. Notable work included re-routing of haul road to parallel south property Line (shown in October screen shot) utilizing grade and run information from UAV only, no ground survey required. This allowed more working access to the targeted north face where reclamation of usable scree and removal of natural cliff face is occurring.

Notes: Average file size 8GB per survey, four surveys annually. Too large for CDROM, Dropbox (or similar) services. October 27, 2014 request to Mineral.Titles@gov.bc.ca for alternate file transfer protocol unresolved at the time of this report. Subsequently, screen shots have been added below.

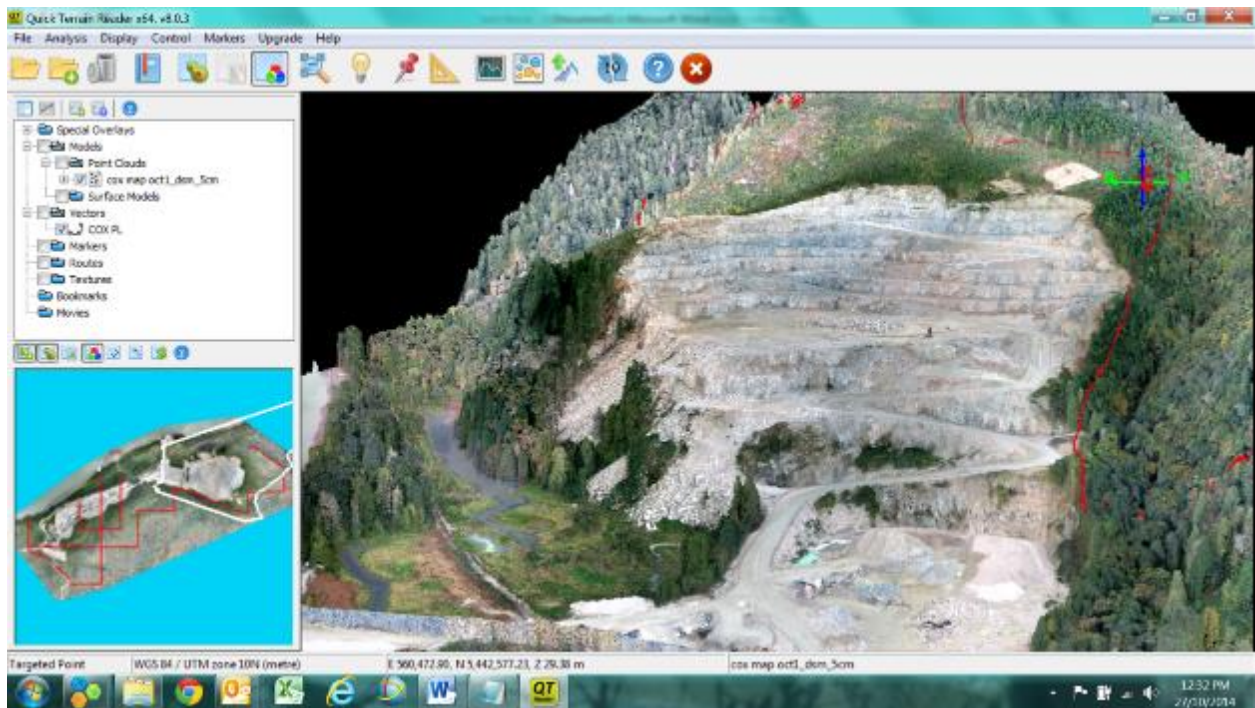
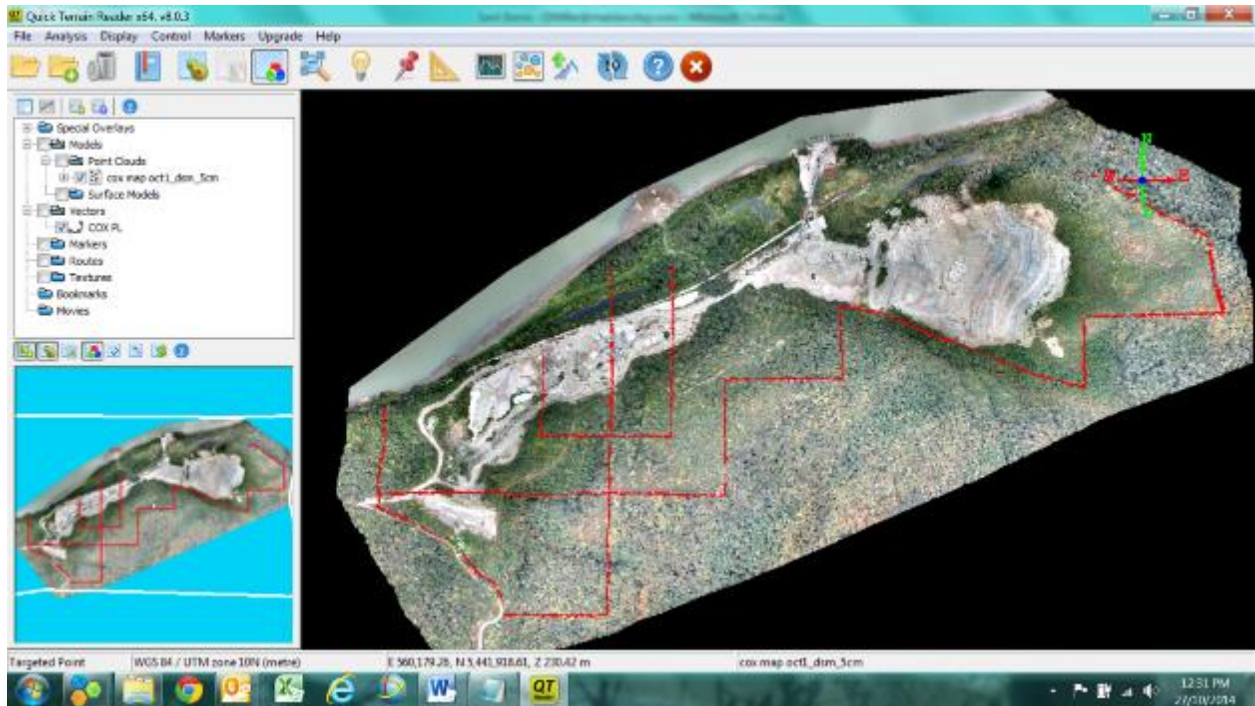
Mar 31, 2014



June 5, 2014



Oct 1, 2014



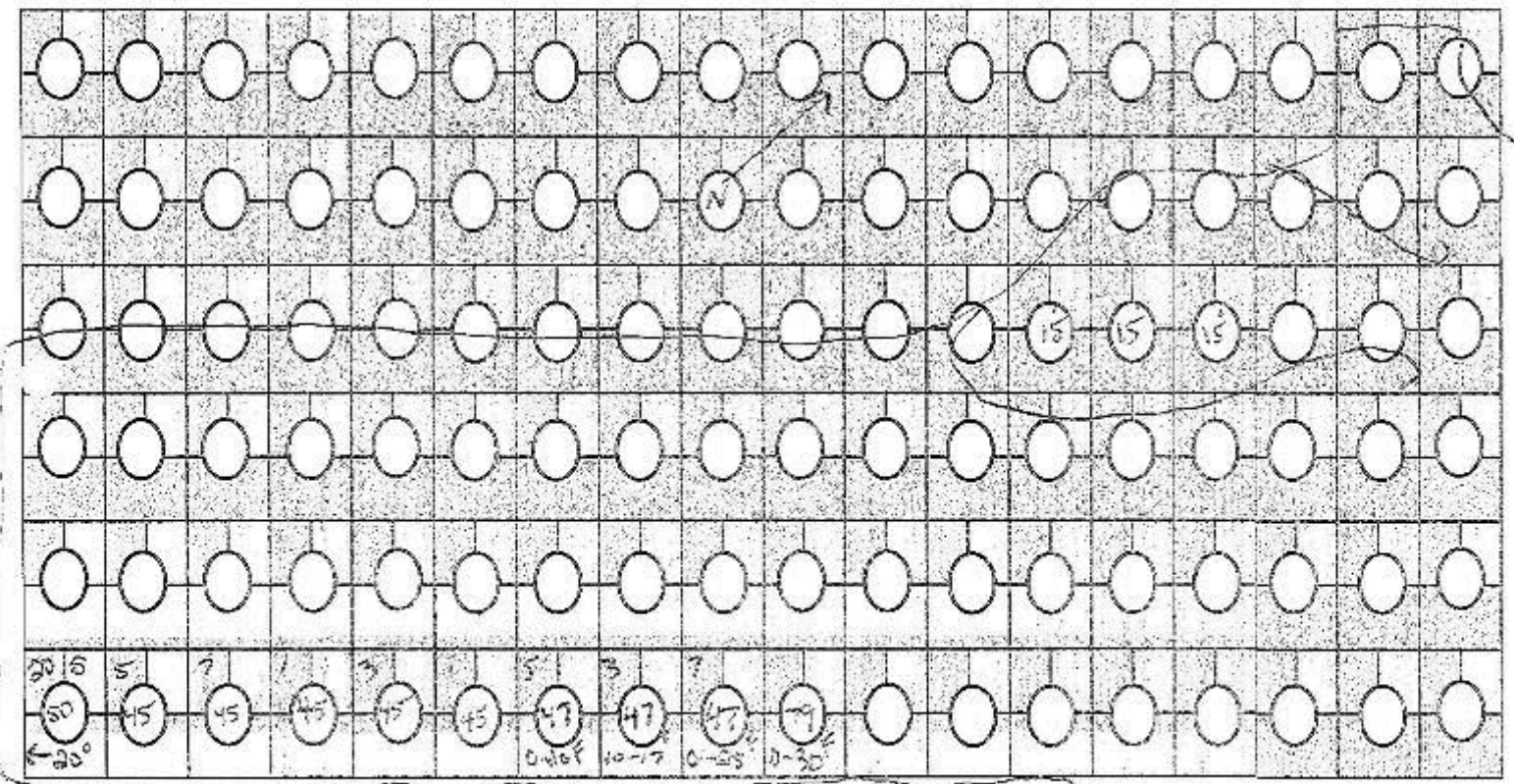
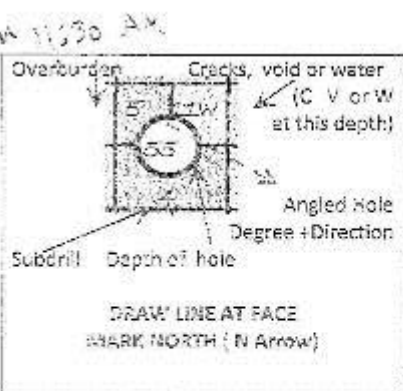
APPENDIX D

BLAST LOG: COX Permit # 007-60 Manager: L. Szlachetka Exp. Supplier: Westcon Explosives (Australia) Blaster: Shawn Szlachetka Cert #: 42409	Blast # 2014-09-29 Date: Sept 29-14 Time: 9:00 Weather: 12°C Ceiling: FOGGY Wind: NSW/Speed: /	Hole Status: 13 # Holes Loaded: 13 # Holes Abandoned: / # Liners: / # Holes Downed: /	Collars: Mar FT Stemming Used: Cuttings Free Face: (X) n	Explosive Used: ANFO KG: 1610 KG EMULSION KG: / BAGS ANFO: / CHUBS: 3 OTHER: /	# Boosters: 13 Delays: 17x / 42x / 100x /	Detonators: 9m: 3 12m: / 15m: 10	Detonation Method (circle): Electric (X) Wireless Safety fuse
	Tonnes of rock (ss x ms) = Face to Back(M) X side to side(M) X Depth of hole (M) X 2.6 (tonnes per M ³) = Tonnes						
	Latitude: 49°08.058 Longitude: 118°10.004 Blast Map: Show / North / Tie Ins / Plan view / Cross Section / Faults Blast Math: # holes = 13 Delay between rows = / Delay between holes = 0.5 Sum of delays first to last hole = 22 Closest Structure: Ponds/Plows Seismo Location: Seismo to blast (Meters): Recorded 1PS/min/s Con dB						
	Post Blast COMMENTS - (Circle if yes, X if no if yes, Describe) Misfire Premature Detonation Fly Rock On Site Damage Off Site Damage Public Complaint OTHER: outer edge removal 15' holes not much movement VERY minimal rock over bank SIGNATURE: [Signature]						

DRILLING LOG- COX		Ideal	Actual
Spacing		12'	
Burden			
Depth		15-45'	
Subdrill		5'	
Material - SG			
Free Face	YES or NO		
Elevation	15		Metres

Driller:
 Finish Drilling Date: ✓
 Notes: (Faults, seams etc.)
 outer edge removal
 medium hard

Start Drilling Date: 2012 6:30
 Blast Log #: 2014-08-29-37

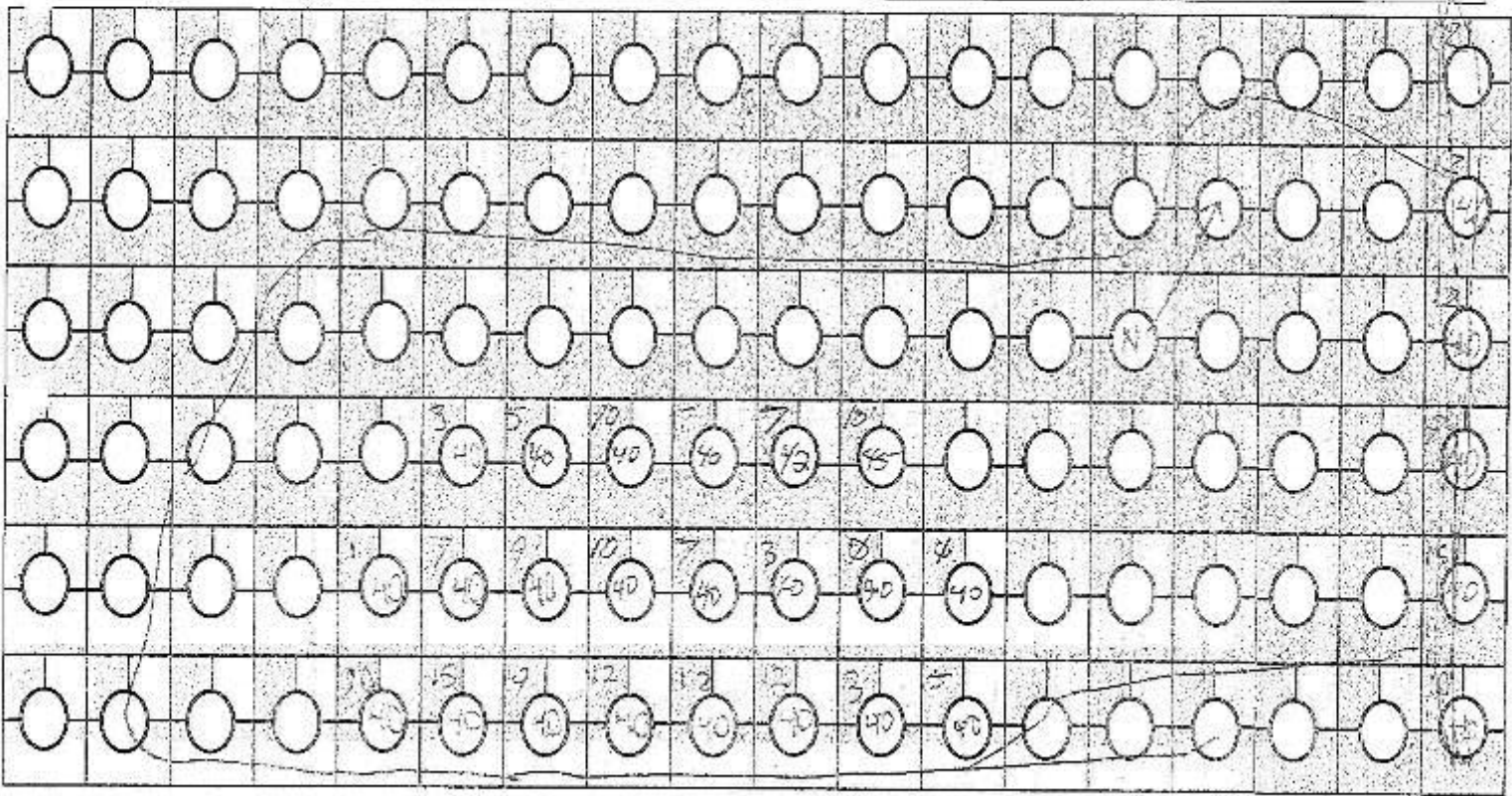
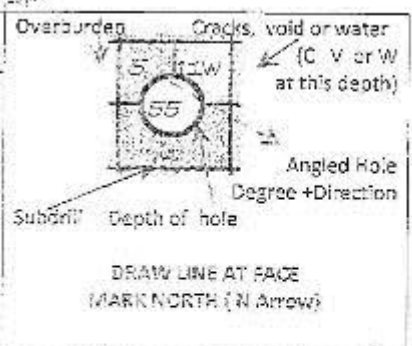


BLAST LOG: COX Permit # 027-60 Manager: L. Szalaykare Exp. Supplier: Western Explosives (Austin) Blaster: Shawn Szechtin Cert #: 42403	Blast # <u>201408129</u> (www-URL) <u>80</u>	Date: <u>Nov 29, 14</u>	Time: _____	Weather: <u>20°C</u> (Precip/Temp)	Ceiling: <u>Cloudy</u>	Wind: _____ (MSW/Speed)
	Hole Status: <u>21</u> # Holes Loaded: _____ # Holes Abandoned: <u>1</u> # Timers: _____ # Holes Disturbed: _____	Collars: <u>none</u> # Collars: <u>18</u> Stemming Used: <u>cuttings</u> Free Face: <u>0</u> n	Explosive Used: <u>3119 kg</u> ANFO (kg): _____ EMULSION (kg): _____ BAGS ANFO: _____ CHUSS: _____ OTHER: _____	# Boosters: <u>21</u> Delays: _____ 17x _____ 42x _____ 100x <u>2</u>	Detonators: _____ 9m _____ 17m _____ 18m <u>21</u>	Detonation Method (circle): Electric _____ <u>Wireless</u> Safety fuse _____
Tonnes of rock: (sa x ms) = Face to Back(M) X side to side(M) X Depth of hole (M) X 2.6 (tonnes per M³) = Tonnes						
Latitude: <u>N 49° 08.065</u> Longitude: <u>W 122° 09.976</u> Blast Map: <input type="checkbox"/> Show <input checked="" type="checkbox"/> North <input checked="" type="checkbox"/> Tie Ins <input checked="" type="checkbox"/> Plan view <input checked="" type="checkbox"/> Cross Section <input checked="" type="checkbox"/> Faults Blast Math: # holes = <u>21</u> Delay between rows = <u>125</u> Delay between holes = <u>25</u> Sum of delays first to last hole = <u>400 ms</u>						
Closest Structure: _____ (By hole #) _____ Seismo Location: _____ Seismo to blast (Meters): _____ Recorded ips/mm/s: _____ Con dB: _____	Post Blast COMMENTS — (Circle Yes, X No If Yes, Describe) Misfire Premature Detonation Fly Rock On Site Damage Off Site Damage Public Complaint OTHER: _____					
c:\users\dmilic\desktop\msg blast log cox v8 jan 27 2014.docx						SIGNATURE: _____

DRILLING LOG- COX	
Idea:	Actual:
Spacing	14'
Burden	14'
Depth	35'
Subdrill	5'
Material - SG	
Free Face	YES or NO
Elevation	128 Metres

Driller: *pg 51*
 Finish Drilling Date: *28 9.00*
 Notes: (Faults, seams etc.)
out edge removal North wall

Start Drilling Date: *Aug 27/14*
 Blast Log #: *2014-08129-80*

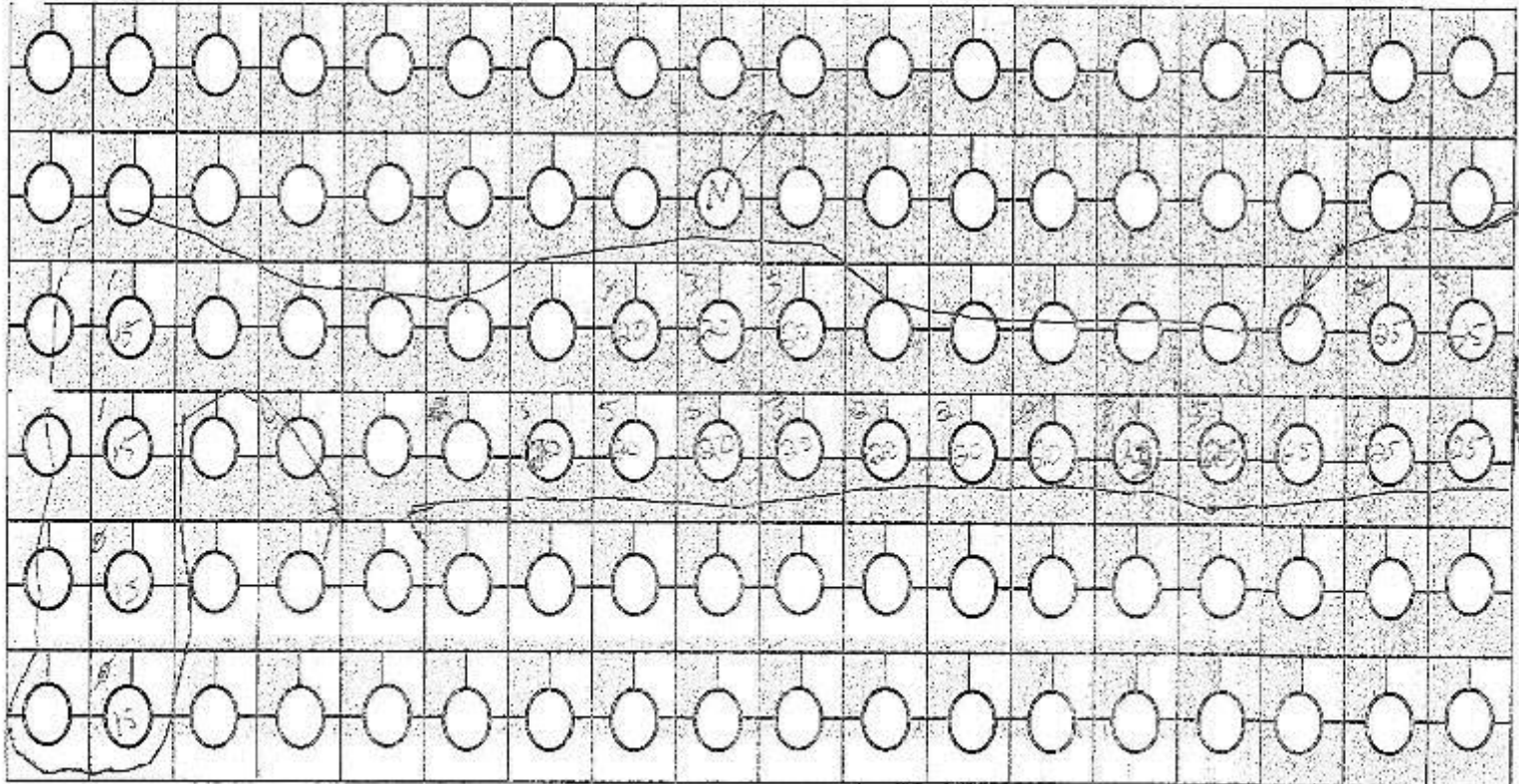
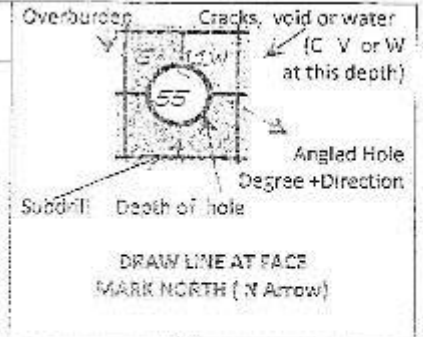


BLAST LOG: COX		Blast # <u>2014-09-26</u>	Date: <u>Aug 26-14</u>	Time: <u>8:30</u>	Weather: <u>27C</u>	Clouds: <u>clear</u>	Wind: <u>E</u>
Permit # <u>A-7-08</u>	Manager: <u>L. SZ. GUYON</u>	Hole Status: <u>52</u>	Collars: <u>Mar</u>	Explosive Used: <u>ANFO EG</u>	# Boosters: <u>52</u>	Detonators: <u>52</u>	Detonation Method (circle): <u>Wireless</u>
Exp. Supplier: <u>Weston</u>	Explosives: <u>Anstina</u>	# Holes Abandoned: <u>0</u>	Stemming Used: <u>Cuttings</u>	EMULSION EG: _____	Delays: _____	12m <u>100</u>	Electric
Blaster: <u>Shawn Szoszk</u>	Cert #: <u>40403</u>	# Liners: _____	Free Face: <u>0</u>	SAGS ANFO: _____	27x _____	15m <u>100</u>	<u>Wireless</u>
		# Holes Downgraded: _____		CHUBS: <u>4</u>	42x <u>2</u>		Safety fuse
				OTHER: _____	100x <u>4</u>		
Tonnes of rock: (kg x vol) = Face to Back (M) X side to side (M) X Depth of hole (M) X 2.5 (tonnes per M ³) = Tonnes							
Latitude: <u>N 49° 08.058</u>							
Longitude: <u>W 122° 09.974</u>							
Blast Map: <u>Show</u>							
<u>North</u>							
<u>Tie ins</u>							
<u>Plan view</u>							
<u>Cross Section</u>							
<u>Fractures</u>							
Blast Math: # holes = <u>52</u>							
Delay between rows = <u>42-100</u>							
Delay between holes = <u>25</u>							
Sum of delays first to last hole = <u>1275</u>							
Closest Structure: _____							
Seismo Location: _____							
Seismo to blast (Meters): _____							
Recorded us/m/s: _____							
Con dB: _____							
Post Blast COMMENTS - (Circle if yes, X if no, if yes, describe)	Misfire	Premature Detonation	Fly Rock	On Site Damage	Off Site Damage	Public Complaint	
OTHER: <u>2-18m used for tie-in</u>							
<u>Charn fell off of diesel pump for ANFO mix</u>							
<u>not sure how many holes were loaded no diesel</u>							
<u>good break/movement</u>							
<u>many holes were loaded no diesel</u>							
Signature: _____							

DRILLING LOG- COX		
	ideal	Actual
Spacing	14'	
Burden	14'	
Depth	15-25'	
Subdrill	<input checked="" type="checkbox"/>	
Material + SG		
Free Face	YES or NO	
Elevation	128	Metres

Driller:
 Finish Drilling Date: Aug 25-14
 Start Drilling Date: Aug 25-14
 Blast Log #: 2014-08-26 78

Notes: (Faults, seams etc.)
 Outer edge removal North
 medium rock

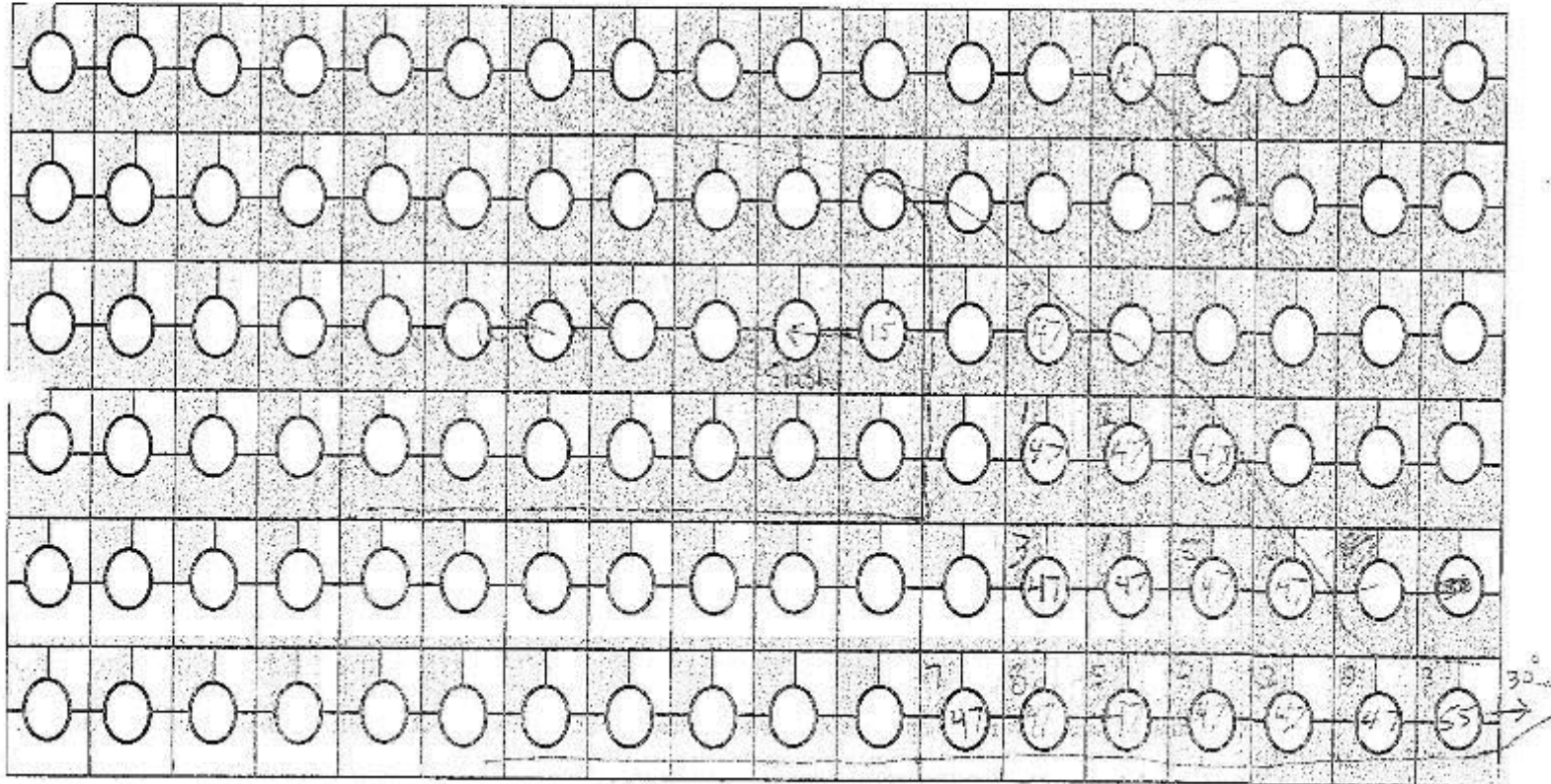
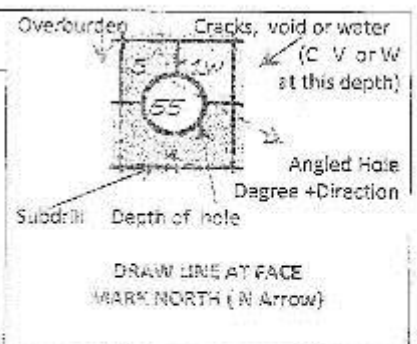


BLAST LOG: COX Permit # 02-7-09 Manager: G. Scoullas Exp. Supplier: Western Explosives (kg): Blaster: Shawn Scoullas Cert #: A2409	Blast # <u>2014-08-19</u> (YYYY-MM)	Date: <u>Aug 19 2014</u>	Time: <u>10:15</u>	Weather: <u>22°C</u> (Precip/Temps)	Ceiling: <u>Cloudy</u> (Clouds)	Wind: <u> </u> (MSW/speed)
	Hole Status: <u>44</u> # Holes Loaded: <u>44</u> # Holes Abandoned: <u> </u> # Lines: <u>7</u> # Holes Devalued: <u>0</u> (M-2000 Index)	Collars: <u>M or E</u> Stemming Used: <u>Cutting</u> Free Face: <u>Y n</u>	Explosive Used: ANFO: <u> </u> EMULSION: <u> </u> BASTAKFO: <u> </u> CHUS: <u>3</u> OTHER: <u> </u>	# Boosters: <u>34</u> Delays: 17x <u> </u> 42x <u>5</u> 100x <u>2</u>	Detonators: 5m: <u> </u> 12m: <u>1</u> 18m: <u>43</u>	Detonation Method (circle): Electric <input type="checkbox"/> Wireless <input checked="" type="checkbox"/> Safety fuse <input type="checkbox"/>
Tonnes of rock: (SxM) x Face to Back (M) X side to side (M) X Depth of hole (M) X 2.6 (tonnes per M³) = Tonnes						
Latitude: _____ Longitude: _____ Blast Map → Show → > North > Tie Ins > Plan view > Cross Section > Faults Blast Math: # holes <u>44/16</u> Delay between rows = <u>92/100</u> Delay between holes = <u>25</u> Sum of delays first to last hole = <u>254ms</u> = <u>325</u> Closest Structure: Particle Plant Seismo Location: Seismo to blast (Meters): Recorded LPS/m/s: Con dB	<p> B-115 haul Road Free Face N 79° 07.933' W 129° 09.728' B-101 </p>					
Post Blast COMMENTS - (Circle if yes, X if no if yes, Describe) Misfire Premature Detonation <u>Fly Rock</u> On Site Damage Off Site Damage Public Complaint OTHER: <u>good break/movement</u>						
c:\users\dmliter\desktop\msblast log.xls v3 Jan 27 2014.docx						SIGNATURE:

DRILLING LOG- COX		
	Ideal	Actual
Spacing	34'	1-5'
Burden	14'	
Depth	42'	
Subdrill	5'	
Material + SG		
Free Face	YES or NO	
Elevation	115	Metres

Driller: SS ¹⁰⁰⁰ PS
 Start Drilling Date: Aug 13 - 14
 Finish Drilling Date: Aug 14 1976
 Blast Log #: 2014, 208, 19-76

Notes: (Faults, seams etc.)
 medium rock
 water edge removal



#5 faulty Austin Det !!! - this was Austin #3!

BLAST LOG: COX Permit # G-7-07 Manager: L. Solomson Exp. Supplier: Western Explosives (Austin) Blaster: Shawn S. Sorensen Cert #: 42403	Blast # Do: 08-14 (Year-Week) 75	Date: Aug 14-14	Time: 11:10	Weather: 20°C (Precip/Temp)	Ceiling: cloudy	Wind: / (NSEW/speed)
	Hole Status: # Holes Loaded: 52 # Holes Abandoned: / # Liners: / # Holes Downwards: /	Collars: M or E 15-18 Stemming Used: Cutting/dirt Free Face: y/n 80%	Explosive Used: ANFO KG: 7850 EMULSION KG: BAGS ANFO: CHUBS: OTHER:	# Boosters: 52 Delays: 27x 42x / 200x 8	Detonators: 0m 0.2m 32 0.3m 28	Detonation Method (circle): Electric Wireless Safety fuse
Tonnes of rock: (se x no) = Face to Back (M) X side to side (M) X Depth of hole (M) X 2.6 (tonnes per M ³) = Tonnes						
Latitude: N49°05.084E Longitude: W122°04.954 Blast Map: → Show → > North > Ties Ins > Plan view > Cross Section > Faults Blast Math: # holes = Delay between rows = 100 Delay between holes = 25-30 Sum of delays first to last hole = 905 Closest Structure: Parallel Power Seismo Location: Seismo to blast (Meters): Recorded LPS/mm/s: Con dB						
Post Blast COMMENTS - (Circle if yes, X if no if yes, Describe) Misfire Premature Detonation Fly Rock On Site Damage Off Site Damage Public Complaint OTHER: 25 production holes 22 - outer edge flattening/pioneering very good break/movement / no rock over the bank Faulty clip c:\users\sdmiller\desktop\nsp_blast_log_cox_v2_jan_27_2014.docx SIGNATURE: <i>[Signature]</i>						

How long will Mainland make there Blaster use a faulty production?

BLAST LOG: COX Permit # 02-7-08 Manager: L. Sidorowicz Exp. Supplier: Wascana Explosives (A/B/C/K): Blaster: Skowron, Sidorowicz Cert #: 42409	Blast # <u>2014-07-108</u> (any other) <u>63</u>	Date: <u>July 8-17</u>	Time: <u>8:15 AM</u>	Weather: (Precip/Temp) <u>20°C</u>	Ceiling: <u>Clear</u>	Wind: (Dir/Speed) <u>E</u>	
	Hole Status: # Holes Loaded <u>12</u>	Collars: <u>M or IT</u> <u>12-14"</u>	Explosive Used: ANFO KG: <u>6370 KG</u> EMULSION KG: <u>5017 KG WASCAN</u> BARS ANFO: <u>2 Shots</u> CHUSS: _____ OTHER: _____	# Boosters: <u>12</u> Delays: _____ 17x _____ 42x _____ 100x <u>3</u>	Detonators: 9m _____ 17m _____ 15m <u>12</u>	Detonation Method (circle): Electric _____ <u>Wireless</u> Safety fuse _____	
	# Holes Abandoned <input checked="" type="checkbox"/>	Stemming Used: <u>Optimal</u>	Free Face: <input checked="" type="checkbox"/> n	Tonnes of rock: (sg x Ma) = Face to Back(M) _____ X side to side(M) _____ X Depth of hole (M) _____ X 2.6 (tonnes per M ³) = _____ Tonnes			
	# Lines _____ # Holes Dewatered <input checked="" type="checkbox"/>	Latitude: <u>N 49° 08.063'</u> Longitude: <u>W 120° 09.996'</u> Blast Map <input checked="" type="checkbox"/> Show <input type="checkbox"/> North <input type="checkbox"/> Ties to <input type="checkbox"/> Plan view <input type="checkbox"/> Cross Section <input type="checkbox"/> Faults Blast Math: # holes = <u>12</u> Delay between rows = <u>100</u> Delay between holes = <u>25</u> Sum of delays first to last hole = <u>350</u> Closest Structure: <u>Workshop Blower</u> Seismo Location: _____ Seismo to blast (Meters): _____ Recorded ups/mm/s: _____ Con dB: _____					

Post Blast COMMENTS - (Circle if yes, X if no if yes, describe) Misfire Premature Detonation Fly Rock On Site Damage Off Site Damage Public Complaint
 OTHER: outer edge shot nothing went over the edge/good break

SIGNATURE:

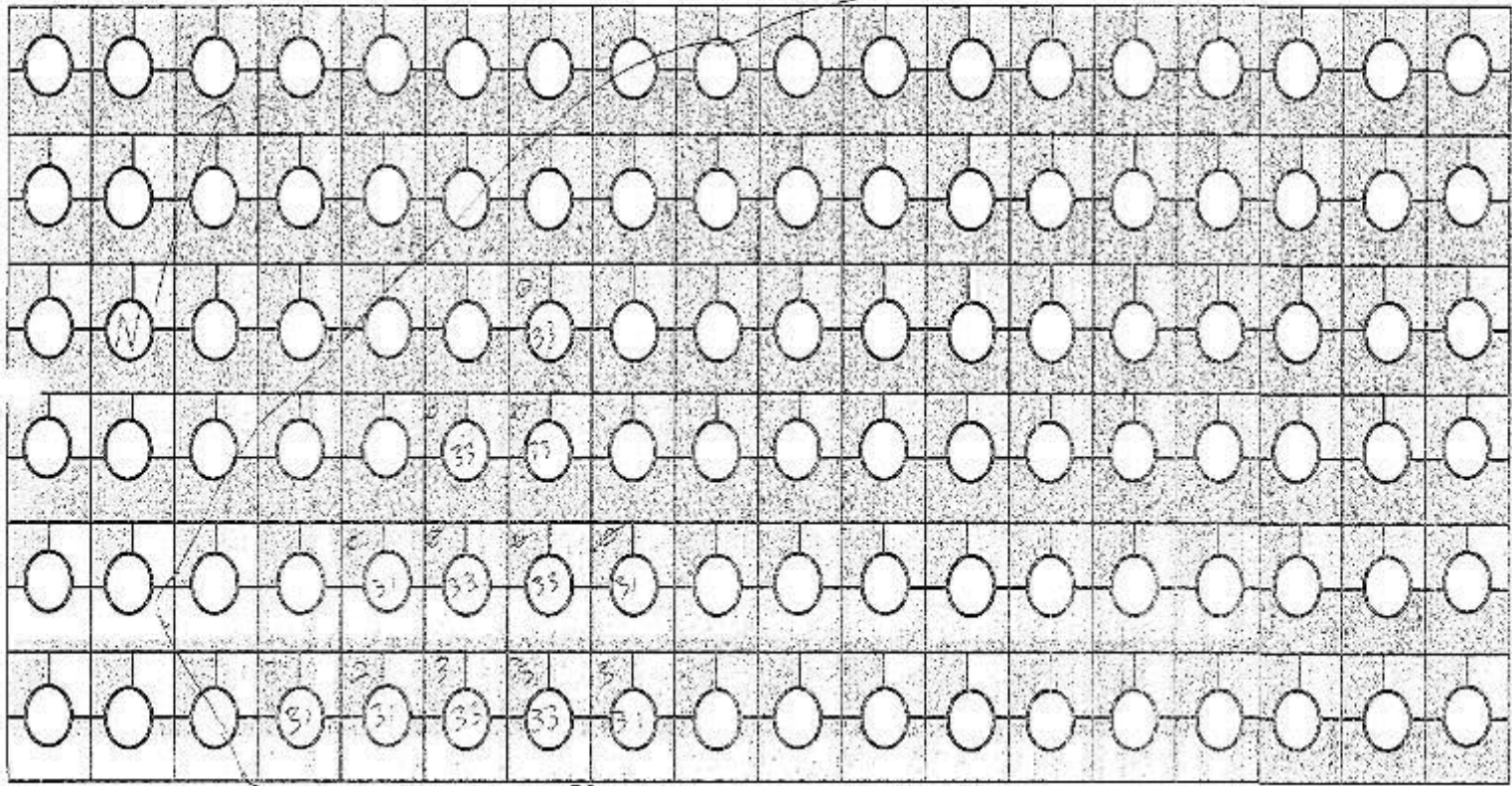
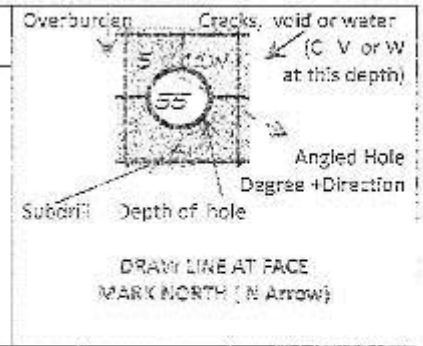
c:\users\dmiller\desktop\msp_blast_log_cox_v3_jun 27 2014.docx

DRILLING LOG- COX	
Ideal	Actual
Spacing	Varies
Burden	Varies
Depth	
Subdrill	27-33
Material + SG	
Free Face	(YES) or NO
Elevation	35 M Metres

Driller: SS
 Finish Drilling Date: July 7 1998
 Start Drilling Date: July 7 1998
 Blast Log #: 204-07-09-63

Notes: (Faults, seams etc.)
 North ridge
 Pioneering

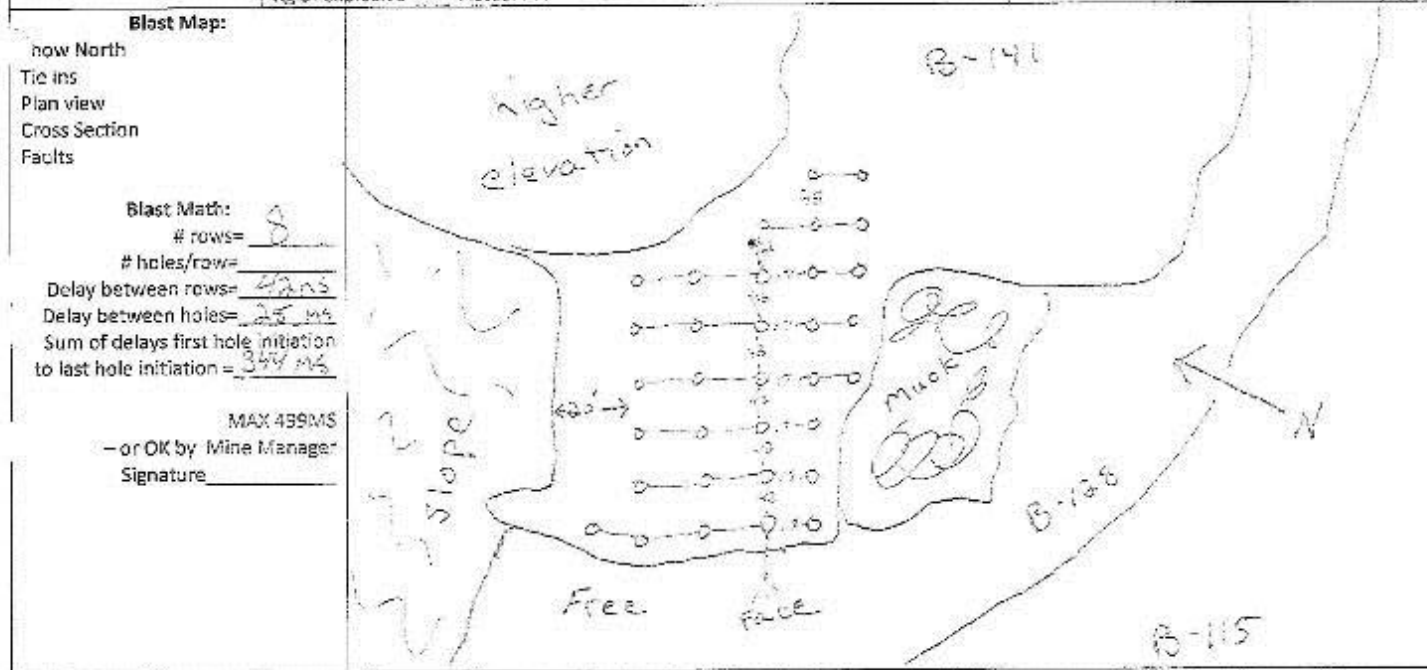
8:00



BLAST LOG: COX		Blast # <u>3014-06</u>	Date: <u>Jun 19 2014</u>	Time: <u>10:00</u>	Weather: <u>0°C</u>	Celling: <u>400</u>	Wind: <u>E</u>	
Mine # <u>COX</u>	Permit #	Blaster: <u>Shawn Szostak</u>	Cart #: <u>42409</u>	Manager:	Exp. Supplier: <u>Western</u>			
Explosive Used: <u>ANFO</u>	Booster Used: <u>11</u>	Detonation Method: <u>EPEC cap</u>		Shock Tube Used: <u>Western</u>				
Delays: <u>1-42ms</u>	Eze Dets: <u>11-60'</u>	Stemming (material used): <u>cuttings</u>		Free Face w/in: <u>4'</u>				
# holes loaded: <u>11</u>	# holes abandoned: <u>0</u>	# Liners: <u>11</u>		# Holes dewatered: <u>0</u>				
Tonnes of rock: (SG x Ms)	Powder Factor = Tonnes of rock / Kg of explosive	MAX PF: MIN PF: Actual PF:	Closest Structure:	Seismo Location:	Distance (M)	Recorded IPS/m/s	Con dB	
<p>Blast Map:</p> <p>How North Tie ins Plan view Cross Section Faults</p> <p>Blast Math: # rows = <u>2</u> # holes/row = <u>3-15</u> Delay between rows = <u>50</u> Delay between holes = <u>25</u> Sum of delays first hole initiation to last hole initiation = <u>310</u></p> <p>MAX 499MS - or OK by Mine Manager Signature _____</p>								
Post Blast -- (Circle if yes, X if no if yes, Describe)		Misfire	Premature Detonation	Fly Rock	On Site Damage	Off Site Damage	Public Complaint	Other

good break/movement

BLAST LOG: COX Mine # Permit #	Blast # <u>2014-07</u>	Date: <u>Jan 18 2014</u>	Time: <u>11:00</u>	Weather: <u>0°C</u> (Frost/Temps)	Colling: <u>Fog</u>	Wind: <u>E</u> (NSLW/speed)
	Blaster: <u>Shawn Stewart</u>	Manager:	Exp. Supplier: <u>Western</u>			
Explosive Used: (Type and kg) <u>ANFO</u>	Booster Used: <u>33</u> (Brand and #)	Detonation Method: <u>elec cap</u>		Shock Tube Used: (Brand and #) <u>100'</u>		
Delays: <u>5-17/2-40</u>	Size Dets: <u>33</u> (Brand and length)	Stemming (material used) <u>cuttings</u>		Free Face y/n <u>y</u> (if n describe)		
# holes loaded: <u>33</u>	# holes abandoned:	# Liners:		# holes dewatered:		
Tonnes of rock: (est x wt)	Powder Factor = Tonnes of rock Kg of explosive	MAX PF: MIN PF: Actual PF:	Closest Structure:	Seismo Location:	Distance (M)	Recorded US/mms Con dB



Post Blast -	Misfire	Premature Detonation	Fly Rock	On Site Damage	Off Site Damage	Public Complaint	Other
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(Circle if yes, X if no
If yes, Describe)

left 20' buffer from slope so nothing goes over the edge good break/movement

Signature: _____

APPENDIX E

East Land Development Costs October 2013 to September 4 2014							
Costs by Month	Sub Equip Hire	Drill & blast internal	Equipment Rental	Equipment Use Internal	Wages & Benefits	Fees - Consulting	Totals
13-Oct			6,860.49	3,464.00	1,618.76	1,319.50	13,262.75
13-Nov			9,398.73	7,656.00	2,977.69		20,032.42
13-Dec				222.00	68.36		290.36
14-Jan		592.16		7,040.00	3,297.48	6,709.50	17,639.14
14-Feb				2,841.00	1,488.73	2,859.15	7,188.88
14-Mar				560.00	209.54	2,157.75	2,927.29
14-Apr					-	13,543.95	13,543.95
14-May				5,066.00	3,376.08	1,270.50	9,712.58
14-Jun				15,167.00	6,984.03	2,581.95	24,732.98
14-Jul	2,544.00	15,113.32	10,473.46	25,091.00	5,660.51	603.75	59,486.04
14-Aug	200.00	61,660.52		10,200.00	14,919.41	2,030.70	89,010.63
14-Sep		1,112.31			-		1,112.31
Totals	2,744.00	78,478.31	26,732.68	77,307.00	40,600.59	33,076.75	258,939.33

Sub Equipment Hire					Subtotal by Month
Date	Document #	Supplier	Description	Amount	
31-Jul	112558	Northside Transport	Move D400 trucks Jamieson to Cox	672.00	
31-Jul	112557	Northside Transport	Move D400 trucks Jamieson to Cox	672.00	
31-Jul	85103	Verrault Lowbed	Move D8 from Jamieson to Cox	1,200.00	2,544.00
31-Aug	18-Aug-14	Paul's Tree Service	Remove 3 trees	200.00	200.00
Totals				2,744.00	2,744.00

Blast #	Date	No of Holes	Drilling Hrs (reg)	Drilling Hrs (OT)	Total Drilling Hours	Drill time per foot per hour	Drilling total in feet	Blasting Hours (reg)	Helpers Hrs (Reg)	Excavator Time (Reg)	Drill and Labour Cost	Excavator Cost	Chubs	Airfo Kg	Airfo Cost	Gas Bags	Gas Bag Costs	Liners	Liners Cost	Boosters	Boosters Cost	18 m Dual Delay	12 m Dual Delay	9 m Dual Delay	Dual Delay Cost	Quick Relay	Quick Relay Cost	Dewatering Cost W/Exp	Delivery Cost W/Exp	Total Delivery Cost	Total Cost
2014-01-19-06	18-Jan	11									\$0.00	\$0.00		\$0	\$0.00		\$0.00	11	\$139.70	11	\$68.75				\$109.95	1	\$4.95	0.00		\$0.00	\$322.86
2014-01-18-07	18-Jan	33									\$0.00	\$0.00		\$0	\$0.00		\$0.00													\$0.00	\$269.30
2014-07-08-43	08-Jul	12	6.5	0	7	55	360	2	2	1.5	\$1,876.12	\$168.00	0.00	1,600	\$1,408	0	\$0.00	0	\$0.00	12	\$75.00	12	0	0	\$141.48	3	\$14.55	1.50	1.50	\$390.00	\$4,073.15
2014-07-08-54	08-Jul	24	18.5	0.5	19	69	1320	4	2	0	\$5,012.26	\$0.00	0.00	4,890	\$4,303	4	\$25.00	18	\$112.50	24	\$150.00	24	0	0	\$282.96	5	\$24.25	3.00	5.00	\$1,130.00	\$11,040.17
2014-08-14-75	14-Aug	50	26	4	30	61	1838	6	4.5	1.5	\$8,112.46	\$168.00	0.00	7,250	\$6,380	0	\$0.00	50	\$312.50	28	\$22.00	22	0	\$549.24	6	\$29.10	0.00	5.00	\$875.00	\$16,426.30	
2014-08-19-76	19-Aug	44	26	7.5	34	55	1848	6	6	0	\$9,064.53	\$0.00	3.00	8,710	\$7,755	11	\$68.75	7	\$43.75	44	\$325.00	43	1	0	\$516.93	7	\$33.95	4.50	6.50	\$1,520.00	\$19,277.71
2014-08-26-78	26-Aug	52	26	1	27	39	1040	2	2	1	\$6,960.33	\$112.00	4.00	7,050	\$6,324	0	\$0.00	0	\$0.00	52	\$325.00	33	21	0	\$598.23	6	\$29.10	0.00	6.50	\$1,137.50	\$15,486.16
2014-08-29-80	29-Aug	21	24	1	25	29	735	5	3	1	\$6,656.35	\$112.00	0.00	3,119	\$2,745	0	\$0.00	0	\$0.00	21	\$131.25	21	0	0	\$247.59	2	\$9.70	0.00	3.25	\$568.75	\$10,470.36
2014-09-29-87	29-Sep	13									\$0.00	\$0.00	0.00	1,010	\$889	0	\$0.00		\$0.00	13	\$81.25	10	0	3	\$142.26		\$0.00		\$0.00	\$0.00	\$1,112.31
		260			14				5		\$37,682.05	\$560.00		33,629	\$29,804		\$93.75		\$295.95		\$1,625.00				\$2,588.25		\$208.55		\$5,621.25	\$78,478.32	

Note: Yellow highlighted blasts missing information on labour costs thus, labour costs not included.

Equipment rental					(See below)		
Date	Document #	Supplier	Description	Amount	Fuel not included in Rentals	Total including fuel	Subtotal per Month
Oct 13	930025148	Finning	Rental of 740 truck	5,129.26	1,731.23	6,860.49	6,860.49
Nov 13	930026050	Finning	Partial Month 740 rental	7,012.53	2,386.20	9,398.73	9,398.73
Jul 13	WF13552	Great West equip	Service	1,727.36		1,727.36	
Jul 13	WF13553	Great West equip	Service	1,719.10		1,719.10	
Jul 13	302-26137	Delta Aggregates	Cat D8 Rental	7,027.00		7,027.00	10,473.46
Totals				22,615.25	4,117.43	26,732.68	26,732.68
					Surcharge		
	Extra Costs for Fuel		Use about 25 litres per hour	1,525.39	205.84		
	Extra Costs for Fuel		Use about 25 litres per hour	2,102.49	283.71		
			Total fuel	3,627.88			
			Surcharge .04	489.55	489.55		
			Extra cost for fuel	4,117.43			

Internal Equipment Rental By Month							
Date	Unit #	Description	Hours	Rate/Hr	Total \$	Monnthly Sub Total	
Oct 13	204	D5 Cat	26.00	56.00	1,456.00		
	351	Komatsu WA900	4.00	182.00	728.00		
	907	Cat 775D	5.00	110.00	550.00		
	915	Cat 740	2.00	90.00	180.00		
	919	Cat 775D	5.00	110.00	550.00	3,464.00	
Nov 13	350	Volvo 350F	2.00	139.00	278.00		
	411	Cat 345	59.00	112.00	6,608.00		
	914	Cat 775D	7.00	110.00	770.00	7,656.00	
Dec 13	411	Cat 345	1.00	112.00	112.00		
	902	Cat 775D	1.00	110.00	110.00	222.00	
Jan-14	313	Cat 992C	1.00	182.00	182.00		
	333	Cat 980	14.00	79.00	1,106.00		
	411	Cat 345	16.00	112.00	1,792.00		
	902	Cat 775D	11.00	110.00	1,210.00		
	917	Cat 775F	9.00	110.00	990.00		
	918	Cat 775F	6.00	110.00	660.00		
	919	Cat 775G	10.00	110.00	1,100.00	7,040.00	
Feb-14	313	Cat 992C	3.00	182.00	546.00		
	333	Cat 980	1.00	79.00	79.00		
	351	Komatsu WA900	3.00	182.00	546.00		
	411	Cat 345	10.00	112.00	1,120.00		
	902	Cat 775D	3.00	110.00	330.00		
Mar-14	907	Cat 775D	2.00	110.00	220.00	2,841.00	
	411	Cat 345	3.00	112.00	336.00		
	412	380d Volvo	2.00	112.00	224.00	560.00	
May-14	411	Cat 345	3.00	112.00	336.00		
	909	Cat 740	6.00	90.00	540.00		
	915	Cat 740	5.00	90.00	450.00		
	917	Cat 775F	10.00	110.00	1,100.00		
	918	Cat 775F	15.00	110.00	1,650.00		
	919	Cat 775G	3.00	110.00	330.00		
	920	Cat 775G	6.00	110.00	660.00	5,066.00	
Jun-14	335	Cat 980	5.00	79.00	395.00		
	349	Komatsu WA600	14.00	139.00	1,946.00		
	350	Volvo 350F	10.00	139.00	1,390.00		
	351	Komatsu WA900	1.00	182.00	182.00		
	411	Cat 345	37.00	112.00	4,144.00		
	902	Cat 775D	14.00	110.00	1,540.00		
	909	Cat 740	20.00	90.00	1,800.00		
	914	Cat 775D	7.00	110.00	770.00		
	915	Cat 740	26.00	90.00	2,340.00		
	918	Cat 775F	5.00	110.00	550.00		
	920	Cat 775G	1.00	110.00	110.00	15,167.00	
	Jul-14	204	Cat D5	37.00	56.00	2,072.00	
		349	Komatsu WA600	6.00	139.00	834.00	
350		Volvo 350F	20.00	139.00	2,780.00		
351		Komatsu WA900	5.00	182.00	910.00		
411		Cat 345	50.00	112.00	5,600.00		
902		Cat 775D	10.50	110.00	1,155.00		
909		Cat 740	37.00	90.00	3,330.00		
910		Cat 775D	7.00	110.00	770.00		
915		Cat 740	40.00	90.00	3,600.00		
917		Cat 775 F	6.00	110.00	660.00		
918		Cat 775F	9.00	110.00	990.00		
919		Cat 775G	6.00	110.00	660.00		
920		Cat 775G	9.00	110.00	990.00		
	Unreconciled				740.00	25,091.00	
Aug-14	339	Cat 980	7.00	79.00	553.00		
	350	Volvo 350F	9.00	139.00	1,251.00		
	909	Cat 740	29.00	90.00	2,610.00		
	915	Cat 740	17.00	90.00	1,530.00		
	411	Cat 345	38.00	112.00	4,256.00	10,200.00	
				77,307.00	77,307.00		

Wages and Benefits By Month			
Record wages and costs by Month			
	Canpay	Payroll per GL	Payroll no benefit burden
	Pay Periods		
13-Oct	30-33	2,086.55	1618.762
13-Nov	34-39	3,838.18	2977.691
13-Dec	40 & 1	88.12	68.3642
			0
14-Jan	2-4	4,250.38	3297.479
14-Feb	5-7	1,918.94	1488.729
14-Mar	8-9	270.09	209.538
14-Apr			0
14-May		4,351.69	3376.076
14-Jun		9,002.27	6984.033
14-Jul		7,296.28	5660.512
14-Aug		19,230.80	14919.41
			0
		52,333.30	40600.59
Note -Payroll includes wage			
		0.78	

Fees - Consulting							
cost	desc.	Date	Document #	Supplier	Description	Amount	Total by group
2	geophysical airborne	02/28/14	451-2013	PS Surveys	Aerial survey w 3 d model	2,030.70	
2	geophysical airborne	04/01/14	475-2013	PS Surveys	Ground control / Aerial survey	6,129.90	
2	geophysical airborne	06/02/14	464-2013	PS Surveys	Aerial survey w 3 d model	1,888.95	
2	geophysical airborne	08/11/14	470-2013	PS Surveys	Aerial survey w 3 d model	2,030.70	12,080.25
3	geological mapping	Oct-13	521-2013ADJ	PS Surveys	Mark trees with blue flagging for tree clearing	1,319.50	
3	geological mapping	06/30/14	10032	Beck & associates	Borehole Planning	693.00	2,012.50
4	legal survey	01/08/14	F-509	Tunbridge & Tunbridge	Professional Time plan and title research	299.25	
4	legal survey	02/13/14	E-855 P7	Tunbridge & Tunbridge	BCLS professional time to revise sketches plus letter & email	372.75	672.00
5	geochemical rock	01/31/14	17604	Valley Testing Services	Petrographic, freeze thaw, sand equiv, micro deval etc.	6,410.25	
5	geochemical rock	02/28/14	17716	Valley Testing Services	ARD ML Primary	455.70	
5	geochemical rock	03/31/14	17856	Valley Testing Services	Bulk densities	451.50	
5	geochemical rock	03/31/14	17766	Valley Testing Services	ARD ML Addendum	1,380.75	
5	geochemical rock	03/31/14	17859	Valley Testing Services	Proctor density	325.50	
5	geochemical rock	05/23/14	615652	Golder Associates	Bulk densities	1,270.50	
5	geochemical rock	07/31/14	18157	Valley Testing Services	Sand Equiv, Soundness, SG & Absorption	603.75	10,897.95
6	Prep - Road	04/04/14	140401	Sierra Drilling & Blasting	Boulder removal north face	5,944.05	
6	Prep - Road	04/28/14	140406	Sierra Drilling & Blasting	Boulder removal north face	1,470.00	7,414.05
						33,076.75	

Wages and Benefits					
Personnel (Name)* / Field Days (list actual days)	Days	Rate	Subtotal*		
Pay runs October 1 2013 to November 30 PP 30 to 39					
Employee	Hours	Days		Amount	
Block, David	13.75	1.72	43.50	598.09	
Kirkpatrick, Kervin	4.50	0.56	37.38	168.21	
MacDonald, Bill	5.00	0.63	56.07	280.35	
Mackenzie, Randy	3.00	0.38	37.71	113.13	
Oliver, David	2.50	0.31	37.71	94.28	
Parker, Leigh	18.00	2.25	40.05	720.89	
Schafer, Gerry	55.00	6.88	37.52	2,063.49	
Taylor, Neil	8.50	1.06	42.54	361.58	
Winder, Dave	5.00	0.63	56.07	280.35	
Pay Period 40					
Schafer, Gerry	1.00	0.13	37.71	37.71	
Pay Period 1 to 24 (2014)					
Addison, Keith	11.50	1.44	38.22	439.53	
Belanger, John	19.00	2.38	38.22	726.18	
Bikadi, Joseph	76.50	9.56	38.22	2,923.83	
Bird, Fred	8.00	1.00	38.22	305.76	
Blasetti, Paul	6.25	0.78	38.22	238.88	
Block, David	20.25	2.53	44.33	897.66	
Buchanan, Robert	1.00	0.13	37.71	37.71	
Callaghan, Gordon	114.00	14.25	38.30	4,366.64	
Carr, Clayton	20.00	2.50	38.12	762.49	
Crayford, Thomas	6.00	0.75	38.22	229.32	
Dusenbury, Brian	14.00	1.75	38.22	535.08	
Hamilton, Jamie	3.00	0.38	38.22	114.66	
Hanna, Dean	1.50	0.19	38.22	57.33	
Hardie, Jeff	8.00	1.00	32.49	259.92	
Kilpatrick, Kevin	28.00	3.50	38.09	1,066.59	
Kirkpatrick, John	40.00	5.00	38.22	1,528.80	
Knuff, Josh	13.75	1.72	38.22	525.53	
Krutz, Dan	77.00	9.63	38.22	2,942.94	
MacDonald, Bill	11.50	1.44	53.29	612.79	
MacKenzie, Randy	18.50	2.31	38.22	707.07	
Mather, James	19.00	2.38	44.32	842.10	
McClelland, Aubrey	19.75	2.47	38.22	754.85	
Oliver, David	10.25	1.28	38.22	391.77	
Parker, Leigh	114.00	14.25	40.12	4,574.16	
Player, Lorne	6.00	0.75	39.81	238.88	
Rowan, Chris	46.00	5.75	38.22	1,758.12	
Schafer, Gerry	35.75	4.47	38.92	1,391.33	
Smith, Jim	22.50	2.81	38.22	859.95	
Svensson, Karl	61.50	7.69	39.01	2,399.03	
Taylor, Neil	22.00	2.75	45.69	1,005.18	
Townley, John	31.50	3.94	38.46	1,211.45	
Wanek, Glen	6.00	0.75	37.71	226.26	
Winder, Dave	24.75	3.09	38.41	950.72	
Total Wage cost					40,600.59