Photo: *Sample 17-QR-06*

Photo: *TIA Road looking north. Sample location for 17-QR-07*

Photo: *Large basalt boulders with abundant hematite. At curb of TIA road between 17-QR-07 and 17-QR-08 sampling locations*

Photo: *End of TIA road construction at time of monitoring and sampling location for split duplicate pair 17-QR-08 and 17-QR-09*

Photo: *Explosive facility looking northwest. Sampling location of 17-QR-10*

Photo: *Sample 17-QR-10*

Photo: *Pale cream highly altered rock (not sampled)*

Attachment C – Construction Rock Inspection Field Notes and Laboratory Data

Sample ID	Date	Time	Area	Bulk Sample Tag #	Fines Sample Tag #	Coordinates (WG84)			Sampling Comment	Description of Sampling Point	Description of rock types encountered in area*	Sulphides	Fizz	Color of fines	Rinse pH	Rinse EC	SFE?
						Latitude	Longitude	Elevation (m)								uS/cm	
17-QR-01	1-Aug-17	17:05	Airstrip (south apron)	2851	2852	68.155082	-106.617	39	Difficult to sample fines, bulk grain size distribution may not be representative (biased toward coarser fraction)	Center of apron, next to small berm and small rock stockpiles	Dark green basalt (mafic metavolcanic) with hematite veins, some carbonate veins, few samples with K-feldspar veins, some sericite alteration	Mostly <1%, some fragments with euhedral pyrite crystals (1-5%)	Strong	Light pale grey (dark-green on wet samples)	9.2	460	Yes
17-QR-02	3-Aug-17	9:05	Tailings Catchment (West)	2858	2859	68.141671	-106.5886	24		Northeast corner of catchment berm	Mostly basalts with abundant hematite and rare-K-feldspar; rare quartz vein	Mostly none, few fragments with <1%	Strong	Light pale grey	9	560	Yes
17-QR-03	3-Aug-17	9:15	Tailings Catchment (East)	2860	2861	68.141313	-106.5859	27		Southeast corner of catchment berm	Mostly basalts with some hematite, some K-feldspar/carbonate veins; rare vein quartz	None	Moderate	Light pale grey	8.9	410	
17-QR-04	3-Aug-17	10:40	Cyanide Reagant Pad	2862	2863	68.139038	-106.5734	39		Northeast corner of berm	Mostly basalts with some hematite, some K-feldspar/carbonate veins, some carbonate veins, and rare epidote veins; rare vein quartz	None	Strong	Light pale grey	9	410	Yes
17-QR-05	3-Aug-17	11:45	TIA Road	2864	2865	68.122311	-106.5518	41		From pad on the east side of the road, ~450m south og 16-QR-04	Basalts with frequent K-feldspar-carbonate-quartz veins, some hematite (abundant hematite on west side of road), rare epidote veins	Mostly none, some sulphides associated with veins and lesser with hematite (2-4%)	-	Light pale grey	8.9	390	
17-QR-06	3-Aug-17	14:05	TIA Road	2866	2867	68.118688	-106.5468	36		From east side of the road, close to a pad with a container, ~450m south of 17-QR-05	Mostly basalts with frequent K-feldspar-carbonate veins (rare quartz in veins), some hematite, some epidote veins	None	-	Light pale grey	8.8	230	
17-QR-07	3-Aug-17	14:45	TIA Road	2868	2869	68.114335	-106.5419	40		West side of road, ~520m from 17-QR-06	Mostly basalt (green to dark green) with hematite , some K-feldspar-carbonate veins, some carbonate veins, rare epidote veins; rare vein quartz	Mostly none, some basalt with pyrite crystals (1-3%)	Strong	Light brown to pale grey	8.8	390	Yes
17-QR-08	3-Aug-17	15:20	TIA Road	2870	2871	68.110532	-106.5479	29		End of road on pad (southwest corner), ~500m from 17-QR-07	Mostly basalt, abundant hematite (concentrated in last curb of road), some K-feldspar, some to abundant carbonat eveins; rare vein quartz	None	Strong	Brown to light grey	9	280	
17-QR-09	3-Aug-17	15:30	TIA Road	2872	2873	68.110532	-106.5479	29	Duplicate of 17-QR-08	End of road on pad (southwest corner), ~500m from 17-QR-07	Mostly basalt, abundant hematite (concentrated in last curb of road), some K-feldspar, some to abundant carbonat eveins; rare vein quartz	None	Strong	Brown to light grey	9	260	
17-QR-10	3-Aug-17	17:10	Explosive facility pad	2874	2875	68.127471	-106.5522	37		Southwest corner of pad	Mostly basalt with some hematite, abundant carbonate veins, some K-feldspar, some epidote veins; rare vein quartz; rare baked metavolcanics (metasediments?)	Mostly none, some fragments with 2-3% pyrite	Strong	Pale light grey	9.1	150	

* Qualifiers --> Rock types: Mostly (>80% of surveyed rocks), lesser (15-20%). Minerals/features/textures: abundant (>50% of surveyed rocks), frequent (30-50%), some (15-30%), few (5-15%), rare (<5%)

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Description of rock types encountered in area*

Mostly <1%, some fragments with euhedral pyrite crystals (1-5%)

Mostly none, few fragments with <1%

Table 1: ABA Test Results for project HOPE BAY

Maxxam Sample No	Sample ID	Paste pH	CO2	CaCO3 Equiv.	Total S	HCl Extractable Sulphur	Sulphide Sulphur (by diff.)	Acid Generation Potential	Mod. ABA Neutralization Potential	Fizz Rating	Net Neutralization Potential	Neutralization Potential Ratio
	Units	pH Units	wt%	Kg CaCO3/T	wt%	wt%	wt%	Kg CaCO3/T	Kg CaCO3/T	N/A	Kg CaCO3/T	N/A
RV7495	2851	8.54	3.20	72.7	0.15	0.02	0.13	4.1	90.8	STRONG	86.7	22.1
RV7497	2858	8.53	3.89	88.4	0.15	0.02	0.13	4.1	107	STRONG	103	26.1
RV7499	2860	8.70	3.34	75.9	0.16	0.05	0.11	3.4	94.8	STRONG	91.4	27.9
RV7501	2862	8.66	3.60	81.8	0.16	0.04	0.12	3.8	103	STRONG	98.7	27.0
RV7503	2864	8.54	6.19	140.7	0.19	0.03	0.16	5.0	160	STRONG	-feldspar, some epidote, some fragments with 2-3% pyrite	
* Qualifiers --> Rc	DUP-2864	8.62	6.07	138.0	0.18	0.03	0.15	4.7	160	STRONG	155	34.0
RV7507	2866	8.55	5.26	119.6	0.11	0.02	0.09	2.8	139	STRONG	136	49.6
RV7509	2868	8.58	3.65	83.0	0.14	0.02	0.12	3.8	116	STRONG	112	30.5
RV7511	DUP-2868	8.63	4.33	98.4	0.16	0.02	0.14	4.4	124	STRONG	119	28.1
RV7513	2870	8.62	5.07	115.2	0.13	0.02	0.11	3.4	135	STRONG	131	39.6
RV7515	2872	8.68	5.37	122.1	0.12	0.02	0.10	3.1	143	STRONG	140	46.0
RV7517	2874	8.65	5.85	133.0	0.20	0.03	0.17	5.3	150	STRONG	145	28.3
Detection Limits		*N/A*	*0.08*	*1.8*	*0.02*	*0.01*	*0.02*	*0.6*	*0.1*	*N/A*	*0.1*	*0.1*
Maxxam SOP #		*BBY0SOP-*	*LECO*	*BBY WI-00033*	*LECO*	*BBY0SOP-00010*	*BBY WI-00033*	*BBY WI-00033*	*BBY0SOP-00020*	*BBY0SOP-00*	*BBY WI-00033*	*BBY WI-00033*

Notes:

Lawrence, R.W. 1991. Acid Rock Drainage Prediction Manual

References:

Acid Generation Potential = Sulphide Sulphur (by diff.)*31.25

CaCO3 Equivalency = Carbonate Carbon (CO2)*(100/44)*10

Carbonate carbon (CO2; HCl direct method) by Leco.

Fizz Rating - Reference method used is based on NP method.

Net Neutralization Potential = (Modified ABA Neutralization Potential)-(Acid Generation Potential (S-S by diff))

Mod. ABA Neutralization Potential - MEND Acid Rock Drainage Prediction Manual, MEND Project 1.16.1b (pages 6.2-11 to 17), March 1991.

Neutralization Potential Ratio = (Neutralization Potential)/(Acid Generation Potential)

Paste pH - Field and Laboratory Methods Applicable to Overburdens and Minesoils, (EPA 600 / 2-78-054, March 1978).

HCl Extractable Sulphur is based on a modified version of ASTM Method D 2492-02

Sulphide Sulphur = (Total Sulphur)-(Sulphate Sulphur)

Total sulphur, total carbon & carbonate carbon (CO2; HCl direct method) by Leco.

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Description of rock types encountered in area*

Mostly <1%, some fragments with euhedral pyrite crystals (1-5%)
Mostly none, few fragments with <1%

Table 2: ABA QAQC Test Results for project HOPE BAY

	Duplicate QC												
Maxxam Sample No	**Sample ID**	Paste pH Reported	**Paste pH Dup**	CO2 Reported	**CO2 Dup**	Total S Reported	**Total S Dup**	HCl Extractable Sulphur Reported	**HCl Extractable Sulphur Dup**	Mod. ABA Neutralization Potential Reported	**Mod. ABA Neutralization Potential Reported Dup**	Fizz Rating Reported	**Fizz Rating Dup**
	Units	pH Units	pH Units	wt%	wt%	wt%	wt%	wt%	wt%	Kg CaCO3/T	Kg CaCO3/T	N/A	N/A
RV7501 Dup	2862.00			3.60	3.71								
RV7507 Dup	2866.00					0.11	0.12						
RV7513 Dup	2870.00	8.62	8.66							135	137	STRONG	STRONG
RV7517 Dup	2874.00	8.65	8.75					0.03	0.02	150	feldspar, some epido	ne, some fragments with 2-	STRONG

* Qualifiers --> Rock types: Mostly (>80% of surveyed rocks), lesser (15-20%). Minerals/features/textures: abundant (>50% of surveyed rocks), frequent (30-50%), some (15-30%), few (5-15%), rare (<5%)

Reference Material QC				
	Paste pH	CO2	Total S	Mod. ABA Neutralization
Units	pH Units	wt%	wt%	Kg CaCO3/T
Reference Material				
ARD REF MAT GS311-1 (8763456) (2.45 wt%)			2.31	
ARD Spike 2.37% CO2 (8859796) (2.39 wt%)		2.33		
ARD-Paste pH 8.29 (8859855) (8.29 pH Units)	8.32			
KZK-1ModS Slight (8859873) (58.9 Kg CaCO3/T)				58.8
ARD Ref Mat C&S (8763456) (0.16 wt%)			0.17	
ARD Spike 2.37% CO2 (8859796) (2.39 wt%)		2.35		
RS10 STD (8856790) (0.06 % S)				0.07
ARD Ref Mat DBOHC (8856790) (0.27 wt%)				0.29
Blank QC				
Method Blank			<0.02	
Method Blank		<0.08		
Method Blank				-0.3

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Description of rock types encountered in area*

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Page 3 of 6 stly <1%, some fragments with euhedral pyrite crystals (1-5%)

Mostly none, few fragments with <1%

Table 3: Aqua Regia Metals Test Results for project HOPE BAY

Maxxam Sample No	Sample ID	Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb
	Units	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm
RV7495	2851	0.6	180	1.8	63	<0.1	56.1	34.2	939	4.95	6.6	0.1	5.8	0.2	23	<0.1	0.2
RV7497	2858	0.4	139	2.2	87	<0.1	62.2	35.4	1150	5.45	4.2	<0.1	5.1	0.2	24	0.2	0.1
RV7499	2860	0.3	145	1.9	84	<0.1	59.0	34.6	1130	5.55	4.8	<0.1	16.1	0.2	18	0.1	0.1
RV7501	2862	0.4	143	1.6	92	<0.1	52.5	37.2	1280	6.74	par, some ae	fragments	27.1	0.2	19	<0.1	<0.1
res/textures: abun	2864	0.3	147	3.4	87	<0.1	61.7	39.2	1360	5.89	4.1	<0.1	4.8	0.1	25	0.2	0.1
RV7505	DUP-2864	0.4	118	3.3	89	<0.1	63.1	38.1	1340	5.88	3.8	<0.1	7.1	0.2	26	0.2	0.2
RV7507	2866	0.3	160	3.6	83	<0.1	67.2	36.3	1220	5.64	3.9	<0.1	7.8	0.4	23	0.1	0.1
RV7509	2868	0.4	144	2.4	72	<0.1	57.9	33.6	1140	5.29	3.9	<0.1	5.2	0.2	21	0.2	<0.1
RV7511	DUP-2868	0.5	133	2.0	76	<0.1	56.8	35.1	1150	5.42	4.6	<0.1	3.8	0.3	24	0.1	<0.1
RV7513	2870	0.3	138	2.2	72	<0.1	75.1	38.5	1210	5.83	6.2	<0.1	4.6	0.2	28	0.1	<0.1
RV7515	2872	0.4	144	1.9	72	<0.1	74.5	37.2	1190	5.54	5.8	<0.1	3.8	0.2	28	<0.1	<0.1
RV7517	2874	0.3	143	3.3	91	<0.1	72.4	41.5	1320	6.09	6.1	<0.1	6.7	0.2	31	0.2	0.1
QAQC Duplicates																	
RV7509 Dup	2868	0.4	144	2.1	73	<0.1	58.8	36.4	1150	5.33	4.1	<0.1	4.9	0.4	22	0.1	0.1
Blanks																	
Method Blank										<0.01							
Method Blank													<0.5				
Method Blank	<0.1	<0.1	<0.1	<1	<0.1	<0.1	<0.1	<1		<0.5	<0.1		<0.1	<1	<0.1	<0.1	
Reference Material																	
REF OREAS45EA (%) (8917343)									22.08								
True Values REF OREAS45EA									**23.51**								
Percent Difference (8917343)									-6.1								
Reference Material																	
REF OREAS45EA PPB (8917354)												57.3					
True Values REF OREAS45EA PPB												**53**					
Percent Difference (8917354)												8.1					
Reference Material																	
REF OREAS45EA PPM (8917370)	1.6	711.1	14.4	32	0.3	379.5	50.3	401		11.7	1.9		10	4	<0.1	0.3	
True Values REF OREAS45EA PPM	**1.39**	**709**	**14.3**	**28.9**	**0.26**	**381**	**52**	**400**		**10.3**	**1.73**		**10.7**	**3.5**	**0.02**	**0.2**	
Percent Difference (8917370)	15.1	0.3	0.7	10.7	15.4	-0.4	-3.3	0.3		13.6	9.8		-6.5	14.3	-100.0	50.0	
Reference Material																	
DS 11 % (8917343)									2.99								
True Values DS 11 %									**3.21**								
Percent Difference (8917343)									-6.8								
Reference Material																	
DS 11 PPB (8917354)												110.5					
True Values DS 11 PPB												**79**					
Percent Difference (8917354)												39.9					
Reference Material																	
DS 11 PPM (8917370)	13.8	150.1	134.7	341	1.5	76	12.4	971		39	2.7		7.7	63	2.3	76	
True Values DS 11 PPM	**13.9**	**156.0**	**138.0**	**345.0**	**1.7**	**81.9**	**14.2**	**1055.0**		**42.8**	**2.6**		**7.7**	**67.3**	**2.4**	**7.2**	
Percent Difference (8917370)	-0.7	-3.8	-2.4	-1.2	-12.3	-7.2	-12.7	-8.0		-8.9	4.2		0.7	-6.4	-3.0	955.6	
Detection Limits	0.1	0.1	0.1	1	0.1	0.1	0.1	1	0.01	0.5	0.1	0.5	0.1	1	0.1	0.1	
Maxxam SOP #	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	

Bi	V	Ca	P	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Hg	Sc	Tl	S	Ga	Se	Te
ppm	ppm	%	%	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm
<0.1	126	3.50	0.032	3	152	2.15	4	0.285	<20	2.62	0.016	0.02	<0.1	<0.01	6.7	<0.1	0.13	7	<0.5	<1
<0.1	131	4.34	0.031	2	167	2.55	4	0.300	<20	3.04	0.020	0.02	<0.1	<0.01	8.1	<0.1	0.13	7	<0.5	<1
<0.1	135	3.86	0.031	3	151	2.21	4	0.307	<20	2.82	0.016	0.02	<0.1	<0.01	7.9	<0.1	0.17	7	0.6	<1
<0.1	179	4.19	0.040	3	123	2.30	11	0.299	<20	3.16	0.017	0.02	<0.1	<0.01	11.7	<0.1	0.12	10	<0.5	<1
<0.1	140	6.06	0.029	2	155	2.88	4	0.272	<20	3.27	0.010	0.03	<0.1	<0.01	9.6	<0.1	0.19	8	<0.5	<1
<0.1	146	5.84	0.028	3	155	2.89	5	0.279	32	3.27	0.013	0.03	<0.1	<0.01	9.6	<0.1	0.18	7	<0.5	<1
<0.1	133	5.35	0.030	3	159	2.53	11	0.247	<20	3.05	0.014	0.04	<0.1	<0.01	9.1	<0.1	0.12	7	<0.5	<1
<0.1	126	4.45	0.027	2	143	2.27	7	0.273	<20	2.82	0.017	0.02	<0.1	<0.01	7.3	<0.1	0.14	7	0.7	<1
<0.1	131	4.59	0.030	3	150	2.29	6	0.284	<20	2.88	0.017	0.03	<0.1	<0.01	7.4	<0.1	0.14	7	<0.5	<1
<0.1	138	5.15	0.031	3	193	2.96	5	0.233	<20	3.32	0.012	0.03	<0.1	<0.01	9.6	<0.1	0.12	8	<0.5	<1
<0.1	131	5.47	0.030	3	190	2.81	4	0.234	<20	3.16	0.012	0.03	<0.1	<0.01	9.1	<0.1	0.12	7	0.6	<1
<0.1	146	5.88	0.030	3	177	2.98	5	0.230	<20	3.41	0.010	0.03	<0.1	<0.01	11.4	<0.1	0.23	8	0.7	<1
<0.1	129	4.51	0.028	3	150	2.26	6	0.286	<20	2.83	0.017	0.03	<0.1	<0.01	7.4	<0.1	0.15	7	<0.5	<1
		<0.01	<0.001			<0.01		<0.001		<0.01	<0.001	<0.01					<0.05			
<0.1	<2			<1	<1		<1		<20				<0.1	<0.01	<0.1	<0.1		<1	<0.5	<0.2
		0.04	0.026			0.09		0.098		3.44	0.021	0.06					<0.05			
		0.036	**0.029**			**0.095**		**0.106**		**3.32**	**0.02**	**0.053**					**0.036**			
		11.1	-10.3			-5.3		-7.5		3.6	5.0	13.2					-100.0			
0.3	308			7	854		144							<0.01	76.8	<0.1		13	1.3	<0.2
0.26	**303**			**6.57**	**849**		**148**							**0.34**	**78**	**0.072**		**11.7**	**0.63**	**0.07**
15.4	1.7			6.5	0.6		-2.7							-100.0	-1.5	-100.0		11.1	106.3	-100.0
		0.99	0.065			0.82		0.088		1.22	0.072	0.4					0.26			
		1.06	**0.070**			**0.85**		**0.098**		**1.13**	**0.069**	**0.40**					**0.28**			
		-6.9	-7.3			-3.5		-9.8		8.1	3.7	0.0					-8.3			
12.4	47			17	55		409						2.1	0.24	2.8	4.8		5	2.2	4
12.2	**50.0**			**18.6**	**61.5**		**417.0**						**2.9**	**0.3**	**3.1**	**4.9**		**4.7**	**1.9**	**4.6**
1.6	-6.0			-8.6	-10.6		-1.9						-27.6	-20.0	-9.7	-2.0		6.4	15.8	-12.3
0.1	2	0.01	0.001	1	1	0.01	1	0.001	20	0.01	0.001	0.01	0.1	0.01	0.1	0.1	0.05	1	0.5	0.2
1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX	1DX

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Description of rock types encountered in area*

Mostly <1%, some fragments with euhedral pyrite crystals (1-5%)

Mostly none, few fragments with <1%

Table 3: MEND SFE Test Results for project HOPE BAY

Maxxam Sample No	Sample ID	Sample Weight	Volume Used	pH	EC	SO4	Acidity to pH4.5	Acidity to pH8.3	Total Alkalinity	Bicarbonate	Carbonate	Hydroxide	Dissolved Chloride	Nitrate-N	Nitrite-N	Total Ammonia	Total Dissolved Solids	Hardness CaCO3	Dissolved Aluminum (Al)
	Units	g	ml	pH Units	uS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
RV7496	2852	250	750	9.51	154.5	15.8	<0.5	<0.5	30	37	<0.5	<0.5	13.7	0.8	<0.05	0.158	74	19.1	0.321
RV7498	2859	250	750	9.13	146.5	19.6	<0.5	<0.5	26	32	<0.5	<0.5	10.1	0.9	<0.05	0.116	82	22.2	0.249
RV7502	2863	250	750	8.00	178.5	29.2	<0.5	<0.5	25	31	<0.5	<0.5	11.7	2.0	<0.05	0.010	100	31.8	0.280
RV7510	2869	250	750	8.45	178.1	26.0	<0.5	<0.5	32	38	<0.5	<0.5	10.9	1.7	<0.05	<0.005	96	40.5	0.258
															Mostly basalt wit Mostly none, some fragments with 2-3% pyrite				
*** Qualifiers --> Rock types: Mostly (>80% of surveyed rocks), lesser (15-20%). Minerals/features/textures: abundant (>50% of surveyed rocks), frequent (30-50%), some (15-30%), few (5-15%), rare (<5%)**																			
Duplicates																			
RV7512	DUP-2869	250	750	8.35	185.6	27.9	<0.5	<0.5	35	43	<0.5	<0.5	11.5	1.8	<0.05	<0.005	100	42.5	0.272
RV7496 Dup	2852																		0.298
RV7512 Dup	DUP-2869						<0.5	<0.5					11.3		<0.05		100		
Blanks																			
Method Blank		0	750	5.81	1.0	<0.5	<0.5	<0.5	0.7	0.8	<0.5	<0.5	<0.5	<0.2	<0.05	<0.005	<10	<0.50	<0.00050
Method Blank																			<0.00050
Method Blank							<0.5	<0.5											
Method Blank									0.8	1.0	<0.5	<0.5							
Method Blank									<0.5	<0.5	<0.5	<0.5							
Method Blank													<0.5						
Method Blank						<0.5													
Method Blank																	<10		
Method Blank																<0.005			
Method Blank															<0.005				
Reference Material																			
MS H2O 10 ppb (8772532) % recovery																			104.27100
Reference Material																			
y 8.3 W-Van (8773040) % recovery								99.9											
Reference Material																			
nity W Soln' B (8773258) % recovery									98.80252										
nity W Soln' B (8773263) % recovery									98.78151										
Reference Material																			
ide W K-Van (8773449) % recovery													106.29000						
Reference Material																			
ate W K-Van (8773450) % recovery						99.50500													
Reference Material																			
S 100 -Van (8774017) % recovery																	100.0		
Reference Material																			
monia-Van (8774430) % recovery																100.00000			
Reference Material																			
e Water-Van (8774941) % recovery															93.10000				
Detection Limits				N/A	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.02	0.005	0.005	10	0.50	0.00050
Maxxam SOP #		BBY0SOP-000	Y0SOP-000	BY0SOP-000	BBY0SOP-00006	Y6SOP-000	BBY6SOP-0003	BBY6SOP-00037	BBY6SOP-00026	BY6SOP-0002	BY6SOP-0002	BY6SOP-0002	BY6SOP-000	BY6SOP-0007	BBY6SOP-00010	Y6SOP-000	Y6SOP-0003	BBY WI-00033	BY7SOP-0000

Notes:

Calculated parameter based on the concentration of Nitrate plus Nitrite(NO2+NO3) minus Nitrite(NO2)

ve.

References:

Hardness = (Calcium*2.497) + (Magnesium*4.118)

Dissolved Antimony (Sb)	Dissolved Arsenic (As)	Dissolved Barium (Ba)	Dissolved Beryllium (Be)	Dissolved Bismuth (Bi)	Dissolved Boron (B)	Dissolved Cesium (Cs)	Dissolved Cadmium (Cd)	Dissolved Calcium (Ca)	Dissolved Chromium (Cr)	Dissolved Cobalt (Co)	Dissolved Copper (Cu)	Dissolved Lanthanum (La)	Dissolved Iron (Fe)	Dissolved Lead (Pb)	Dissolved Lithium (Li)	Dissolved Magnesium (Mg)	Dissolved Manganese (Mn)	Dissolved Phosphorus (P)	Dissolved Molybdenum (Mo)	Dissolved Nickel (Ni)	Dissolved Potassium (K)
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
0.000263	0.00110	0.000746	<0.000010	<0.0000050	0.144	<0.000050	0.0000380	5.72	0.00017	0.000173	0.00409	<0.000050	0.0249	0.0000630	0.00087	1.17	0.00269	0.0122	0.00335	0.000137	2.53
0.000224	0.00137	0.000539	<0.000010	<0.0000050	0.149	<0.000050	<0.0000050	6.67	0.00011	0.0000240	0.000858	<0.000050	0.0031	0.0000140	0.00065	1.34	0.000731	0.0066	0.00353	0.000100	2.58
0.000070	0.00129	0.00259	<0.000010	<0.0000050	0.107	<0.000050	<0.0000050	8.72	0.00010	0.000111	0.00145	<0.000050	0.0662	0.0000600	0.00091	2.43	0.00303	0.0036	0.00448	0.000079	1.83
0.000156	0.000942	0.00190	<0.000010	<0.0000050	0.109	<0.000050	<0.0000050	12.0	<0.00010	0.0000370	0.00204	<0.000050	0.0039	0.0000380	0.00129	2.54	0.00254	0.0081	0.00301	0.000079	1.30
0.000137	0.000941	0.00198	<0.000010	<0.0000050	0.112	<0.000050	<0.0000050	12.5	0.00025	0.0000900	0.00276	<0.000050	0.0859	0.0000550	0.00130	2.73	0.00463	0.0102	0.00302	0.000193	1.39
0.000238	0.00102	0.000684	<0.000010	<0.0000050	0.137	<0.000050	0.0000340	6.15	0.00015	0.000169	0.00395	<0.000050	0.0302	0.0000550	0.00082	1.13	0.00261	0.0110	0.00312	0.000122	2.47
<0.000020	<0.000020	<0.000020	<0.000010	<0.0000050	<0.050	<0.000050	<0.0000050	<0.050	<0.00010	<0.0000050	<0.000050	<0.000050	<0.0010	<0.0000050	<0.00050	<0.050	<0.000050	<0.0020	<0.000050	<0.000020	<0.050
<0.000020	<0.000020	<0.000020	<0.000010	<0.0000050	<0.050	<0.000050	<0.0000050	<0.050	<0.00010	<0.0000050	<0.000050	<0.000050	<0.0010	<0.0000050	<0.00050	<0.050	<0.000050	<0.0020	<0.000050	<0.000020	<0.050
99.60000	99.61000	101.81000	104.50000	97.10000	107.01200	102.90000	97.59000		98.69000	98.01000	98.01000	97.30000	111.03700	100.72000	106.60000		99.74000		96.70000	102.20000	
0.000020	0.000020	0.000020	0.000010	0.0000050	0.050	0.000050	0.0000050	0.050	0.00010	0.0000050	0.000050	0.000050	0.0010	0.0000050	0.00050	0.050	0.000050	0.0020	0.000050	0.000020	0.050
BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-00002	BY7SOP-0000	BY7SOP-00002	BY7SOP-00002	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000

Dissolved Rubidium (Rb)	Dissolved Selenium (Se)	Dissolved Silicon (Si)	Dissolved Silver (Ag)	Dissolved Sodium (Na)	Dissolved Strontium (Sr)	Dissolved Sulphur (S)	Dissolved Tellurium (Te)	Dissolved Thallium (Tl)	Dissolved Thorium (Th)	Dissolved Tin (Sn)	Dissolved Titanium (Ti)	Dissolved Tungsten (W)	Dissolved Uranium (U)	Dissolved Vanadium (V)	Dissolved Zinc (Zn)	Dissolved Zirconium (Zr)	Dissolved Mercury (Hg)	Anion Sum	Cation Sum	Balance %
mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	N/A	N/A	N/A
0.00204	0.000704	1.09	<0.0000050	19.5	0.0132	<10	<0.000020	0.0000030	<0.0000050	<0.00020	<0.00050	0.000067	0.0000090	0.00277	0.00025	<0.00010	<0.000050	1.37	1.34	1.00
0.00168	0.000663	0.99	0.0000080	17.0	0.0164	<10	0.000029	0.0000040	<0.0000050	<0.00020	<0.00050	0.000038	<0.0000020	0.00267	<0.00010	<0.00010	<0.000050	1.29	1.28	0.10
0.00102	0.000561	1.05	0.0000060	18.9	0.0187	<10	0.000027	0.0000030	<0.0000050	<0.00020	0.00114	0.000022	0.0000120	0.00341	0.00019	<0.00010	<0.000050	1.59	1.54	1.60
0.000473	0.000523	0.81	0.0000050	16.4	0.0173	<10	0.000020	0.0000030	<0.0000050	<0.00020	<0.00050	0.000045	0.0000170	0.00143	<0.00010	<0.00010	<0.000050	1.60	1.58	0.50
0.000450	0.000543	0.88	<0.0000050	17.1	0.0186	<10	0.000027	0.0000030	<0.0000050	<0.00020	0.00115	0.000044	0.0000270	0.00152	0.00021	<0.00010	<0.000050	1.74	1.66	2.20
0.00202	0.000748	1.05	<0.0000050	18.9	0.0131	<10	<0.000020	0.0000030	<0.0000050	<0.00020	0.00076	0.000059	0.0000080	0.00271	0.00027	<0.00010	<0.000050			
<0.000050	<0.000040	<0.10	<0.0000050	<0.050	<0.000050	<10	<0.000020	<0.0000020	<0.0000050	<0.00020	<0.00050	<0.000010	<0.0000020	<0.00020	0.00017	<0.00010	<0.000050	0.01	0.00	75.00
<0.000050	<0.000040	<0.10	<0.0000050	<0.050	<0.000050	<10	<0.000020	<0.0000020	<0.0000050	<0.00020	<0.00050	<0.000010	<0.0000020	<0.00020	0.00016	<0.00010	<0.000050			
100.50000	106.09000		105.20000		96.79000		102.10000	98.70000	85.50000	98.00000	103.77000	92.10000	102.94000	98.98000	99.15000	91.60000	95.70000			
0.000050	0.000040	0.10	0.0000050	0.050	0.000050	10	0.000020	0.0000020	0.0000050	0.00020	0.00050	0.000010	0.0000020	0.00020	0.00010	0.00010	0.000050			
BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BY7SOP-0000	BBY7SOP-00002	BBY WI-00033	BBY WI-00033	BBY WI-00033

Maxxam Analytics 4606 Canada Way, Burnaby, BC Canada V5G 1K5 Tel: 604 734 7276 Fax: 604 731 2386 www.maxxam.ca

Client: SRK CONSULTING

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Table 4: Sample List Test Results for project HOPE BAY

Maxxam Sample ID	Client Sample ID	Sample Form	Dry Weight Received (kg)
RV7495	2851	Dry Coarse Rock/Sediment	2.38
RV7496	2852	<2mm Fine/material	0.29
RV7497	2858	Dry Coarse Rock/Sediment	2.21
RV7498	2859	<2mm Fine/material	0.53
* Qualifiers --> Rock types: Mostly (>80%	2860	Dry Coarse Rock/Sediment	1.57
RV7500	2861	<2mm Fine/material	0.49
RV7501	2862	Dry Coarse Rock/Sediment	1.44
RV7502	2863	<2mm Fine/material	0.43
RV7503	2864	Dry Coarse Rock/Sediment	2.00
RV7504	2865	<2mm Fine/material	0.41
RV7505	DUP-2864	Dry Coarse Rock/Sediment	0.00
RV7506	DUP-2865	<2mm Fine/material	0.00
RV7507	2866	Dry Coarse Rock/Sediment	1.45
RV7508	2867	<2mm Fine/material	0.46
RV7509	2868	Dry Coarse Rock/Sediment	1.35
RV7510	2869	<2mm Fine/material	0.52
RV7511	DUP-2868	Dry Coarse Rock/Sediment	0.00
RV7512	DUP-2869	<2mm Fine/material	0.00
RV7513	2870	Dry Coarse Rock/Sediment	1.70
RV7514	2871	<2mm Fine/material	0.43
RV7515	2872	Dry Coarse Rock/Sediment	1.76
RV7516	2873	<2mm Fine/material	0.43
RV7517	2874	Dry Coarse Rock/Sediment	1.91
RV7518	2875	<2mm Fine/material	0.42
		Total Weight	24.32
		Total Samples Received	24

Description of rock types encountered in area*

Mostly <1%, some fragments with euhedral pyrite crystals (1-5%)

Mostly none, few fragments with <1%

Mostly bas: Mostly none, some fragments with 2-3% pyrite

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Table 5: Sample Summary for project HOPE BAY

SRK CONSULTING, HOPE BAY
Page 6 of 6

Date Samples Rec'd by Maxxam: 25 sample were rec'd on 30-Aug-2017.

Sample Prep Conducted by Maxxam: YES

Date of Analysis: September 2017

* Qualifiers --> Rock types: Mostly (>80% of surveyed rocks), lesser (15-20%). Minerals/features/textures: abundant (>50% of surveyed rocks), frequent (30-50%), some (15-30%), few (5-15%), rare (<5%)

Client:	SRK CONSULTING
Client Project Name:	HOPE BAY
Client Project No:	1CT022.016
ARD Project #:	N/A
Maxxam Job No:	B774010
Contact Person:	Eduardo Marquez; Lisa Barazzuol
E-mail Address:	**emarquez@srk.com; lbarazzuol@srk.com**

Data Validated by:	SAID ZEINAB
Position:	Senior Manager, Acid Rock Drainage

Sample Storage

Sample rejects (and selected test residues where applicable) have been archived
Standard archive protocol is archiving for samples for 3 months after testing is complete.
If archiving is required past 3 months a fee will be required.

Description of rock types encountered in area*
Mostly <1%, some fragments with euhedral pyrite crystals (1-5%)
Mostly none, few fragments with <1%
Mostly bas: Mostly none, some fragments with 2-3% pyrite

Appendix B – 2017 Doris Waste Rock, Ore and Infrastructure Seep Monitoring

SRK Consulting (Canada) Inc.
2200–1066 West Hastings Street
Vancouver, BC V6E 3X2

T: +1.604.681.4196
F: +1.604.687.5532
vancouver@srk.com
www.srk.com

Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Jessica Charles, FGS Lisa Barazzuol, PGeo	**Project No:**	1CT022.016
Cc:	Oliver Curran, TMAC	**Date:**	March 21, 2018
Subject:	2017 Geochemical Monitoring of Waste Rock, Doris Mine - FINAL		

1 Introduction

In April 2015, TMAC re-initiated mining at Doris, with placement of waste rock on surface commencing in October 2015. Approximately 146,977 t of waste rock from the Doris underground mine were transferred onto Pad T (shown in Figure 2-1) in 2017. In the same year, approximately 3,060 t of waste rock from surface was placed as backfill in stopes of the Doris Mine. As per the waste rock and ore management plan, all waste rock was designated as mineralized waste rock that will be eventually placed as backfill in the underground mine (TMAC 2016a). Requirements for management and monitoring of waste rock and ore are specified in Water Licence 2AM-DOH1323 Amendment No. 1 (Nunavut Water Board 2016) and the Waste Rock and Ore Management Plan (WROMP, TMAC 2016a and 2016b), which forms part of Licence 2AM-DOH1323 Amendment No. 1.

This memo documents the results of geochemical monitoring of waste rock completed between January and December 2017. Other monitoring activities in the Doris mine area included an annual seep survey along the downgradient toe of the waste rock and ore stockpile area and routine monitoring of the Pollution Collection Pond (PCP). The results of the seepage survey are reported in the accompanying memo (SRK 2018) while results of the routine monitoring program are included in monthly water quality reports prepared by TMAC and submitted to the Nunavut Water Board.

2 Methods

2.1 Geological Inspections

2.1.1 Underground

Protocols for geological inspections are documented in TMAC (2016a). To summarize, geological inspections were conducted by site geologists when monitoring samples were collected and occurred at least once a month for the duration of 2017. Where possible, both the working face and the blasted rock (muck) pile were inspected to identify the rock type, quantity of sulphide and carbonate minerals. The data were recorded in geological inspection logs (Attachment 1).

Figure 2-1: Waste Rock and Ore Stockpile Locations, Doris North

2.1.2 Waste Rock Stockpiles

Eduardo Marquez of SRK completed an inspection of the waste rock stockpile on Pad T in August 2017. A discussion with geologist Kristin Chislett (TMAC) indicated that the only accessible waste rock deposited since the last inspection in June 2016 would be found on the upper bench, which contained over a dozen small waste rock stockpiles along the southern berm. The inspection was thus carried out by walking the perimeter of the upper bench of the pile and examining rock types and the presence of sulphide content. The lower benches were not inspected as they either contained waste rock deposited prior to last inspection or were not accessible. Kristin also indicated that waste rock had been taken underground for backfilling prior to the visit. Moreover, most of the waste rock being produced at the mine remained underground for placement as structural backfill in the stopes.

2.2 Sampling and Sample Preparation

Samples were primarily collected from the blasted rock (muck) from the underground mine by site geologists, however selected samples were collected from the face (Attachment 1). The samples were composited over an individual blast round, typically representing 70 to 95 m^3 of rock.

Samples were collected for total sulphur (S) and total inorganic carbon (TIC) and in some cases acid base accounting (ABA) and elemental analysis. In all cases, samples consisted of a representative mixture of fine and coarse rock fragments from the pile.

The frequency of sample collection, as outlined by the TMAC (2016a) is one sample per 10,000 t of waste rock, which for 2017 equates to a minimum of 15 samples. The numbers of samples collected by TMAC and the associated geochemical tests are summarized in Table 2-1. All of the samples tested were designated and managed as mineralized waste regardless of sulphur content or the mineralized/unmineralized designation noted in Attachment 1. Ore is considered to be mineralized by definition, and therefore geochemical testing was not required. Samples were shipped to Maxxam Laboratories (Maxxam) for preparation and analysis. Analytical instructions were provided by TMAC.

Table 2-1: Waste Rock Monitoring Samples Collected and Associated Test Program

Rock Type[1]	Sulphur & TIC	ABA & Elemental Analysis
11c	1	1
1a	30	8
Total Number of Tests	31	9

Source: \\srk.ad\dfs\na\van\Projects\01_SITES\Hope.Bay\1CT022.016_2017_On-Site_Compliance_Support\!080_Deliverables\2017 Waste Rock\3. Working File\[HopeBay_WRMonitoring_1CT022.027_JC_rev02.xlsx]

Note:

[1] 1a = mafic metavolcanic, 11c = diabase

2.3 Analytical Methods

The following test methods were used in this analysis program:

- Total sulphur analyses were completed using the Leco method.
- TIC was determined by using a Leco furnace to directly measure CO_2 gas evolved from HCl treatment of the sample.
- Modified Sobek NP (MEND 1991).
- Sulphate by HCl leach.
- Elemental concentrations were determined by aqua regia digestion followed by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) analyses. This included determination of major elements (e.g., aluminium, calcium, magnesium, sodium, potassium, iron, sulphur) and trace elements (e.g., arsenic, zinc, copper, cadmium, lead).

Samples collected in Q1 and Q2 were prepared and analyzed at Maxxam in Burnaby, BC, whereas samples collected in Q3 and Q4 were prepared and analyzed by SGS Canada Inc. in Burnaby, BC because Maxxam's data reporting schedule did not meet TMAC's needs.

2.4 Data Interpretation Methods

The ratio of TIC to acid generating potential (AP) provides a measure of the acid rock drainage (ARD) potential of the sample. Samples are classified as non-potentially ARD generating (non-PAG) when TIC/AP ratios are greater than 3, as PAG when ratios are less than 1 and as having an uncertain potential for ARD when ratios are between 1 and 3. For samples with Modified NP, interpretations of ratios of NP to AP were the same as TIC to AP.

3 Results and Discussion

3.1 Geological Inspections

3.1.1 Underground

A summary of the samples collected are provided in Table 2 and include mafic volcanics (1a) and diabase (11c). According to TMAC geologists, in 2017 the Doris underground workings also intersected mafic volcanics (1av and 1p), magnetic diabase (11cm) and late mafic dykes (10b); the overall volume of 10b waste rock was relatively small (<1%). All waste rock placed on Pad T was classified as mineralized.

3.1.2 Waste Rock Stockpiles

The majority of the waste rock inspected was foliated grey mafic metavolcanic (basalt) with carbonate veins and trace to no visible sulphides. Rare K-feldspar was observed in the basalt, occurring within quartz veins. There were also a few truckloads of basalt with pervasive hematite veins. Localized areas of the stockpile areas inspected were rich in quartz veins and pyrite veining (Figure 3-1) and included evidence of pyrite oxidation (rusty brown surfaces on pyrite, see

Figure 3-2). Quartz veins were also visible on the southern slope of the waste rock pile. Minor occurrences (<1%) of pale cream coloured rock, that is altered metavolcanic rock proximal to the contact with the diabase (i.e. low NP basalt), was also observed.

Figure 3-1: Quartz vein along southern berm on the upper bench of Pad T

Figure 3-2: Quartz vein boulder with iron oxide staining

3.2 Laboratory Test Results

Laboratory testing data are provided in Attachments 2 and 3.

3.2.1 Sulphur and TIC

Sulphur and TIC results from Maxxam are available for 31 of the samples. The data are discussed in the context of rock type with the sample distribution as follows: 30 mafic metavolcanics (1a) samples and one diabase (11c) sample. Summaries of the sulphur and TIC data by rock type are provided in Figure 3-3 and Figure 3-4. The data are presented in full in Attachment 2.

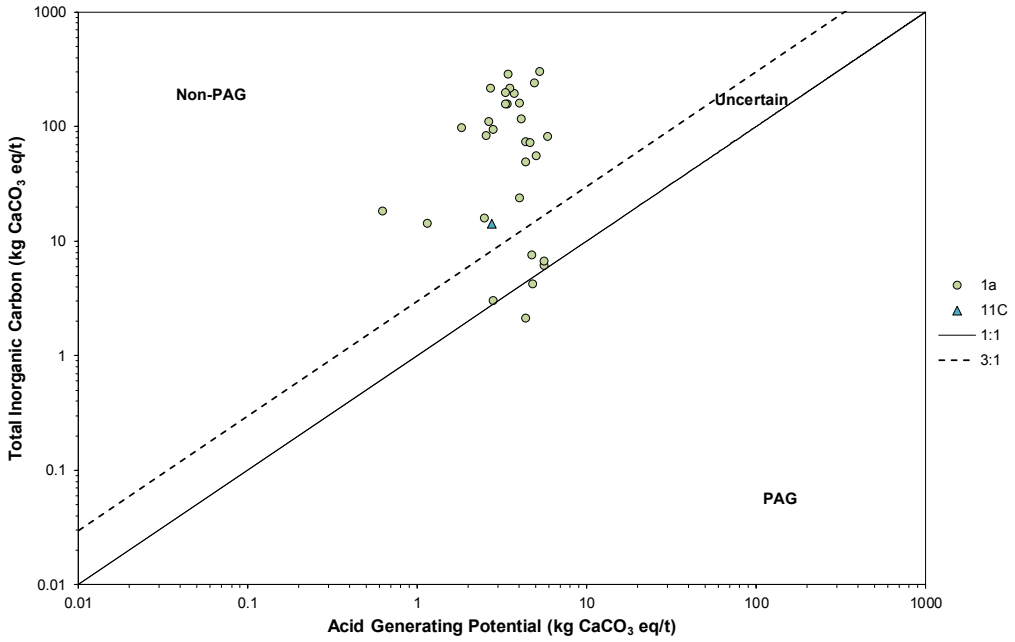
Mafic Metavolcanics (1a)

Sulphur concentrations for samples of 1a were uniformly low ranging from 0.02 to 0.19%, while TIC values ranged from 2.1 to 300 $CaCO_3$ eq/tonne (with median levels of 88 $CaCO_3$ eq/tonne). Approximately 30% of samples (n=9) have a TIC content below 20 kg $CaCO_3$ eq/tonne. TIC levels were lower than expected given typical concentrations observed in basalt from the Doris area (P25 to P75 values between 170 to 340 kg $CaCO_3$ eq/tonne, SRK 2015b). Based on SRK's inspection of the waste rock stockpile (Section 3.1.2), these samples are likely metavolcanics found along the contact with the diabase intrusion that has been altered (or hornfelsed) as a result of heat from the intrusion.

The majority of 1a samples (n=24) were classified as non-PAG. Four samples (13%) were classified as uncertain and two samples (7%) as PAG. The two samples classified as PAG had low levels of TIC (<5 kg $CaCO_3$ eq/tonne) and low levels of total sulphur contents of 0.14% and 0.16%.

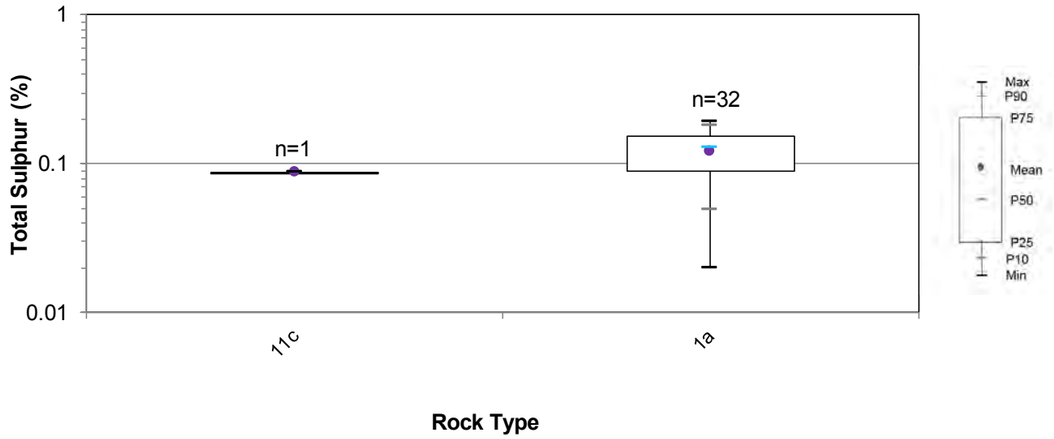
Diabase (11c)

The results show that the 11c sample had a low sulphur (0.09%) and low TIC (14 kg $CaCO_3$ eq/tonne) content. The diabase sample was classified as non-PAG.



\\cdf-fs1.cdf.uk.srk.ad\projects\U7160 Vancouver Geochem Assistance\Project\01_1CT022.027 Hope Bay\2017\Waste Rock\3. Working File\[HopeBay_WRMonitoring_1CT022.027_JC_rev01.xlsx]

Figure 3-3: TIC versus AP for Monitoring Samples



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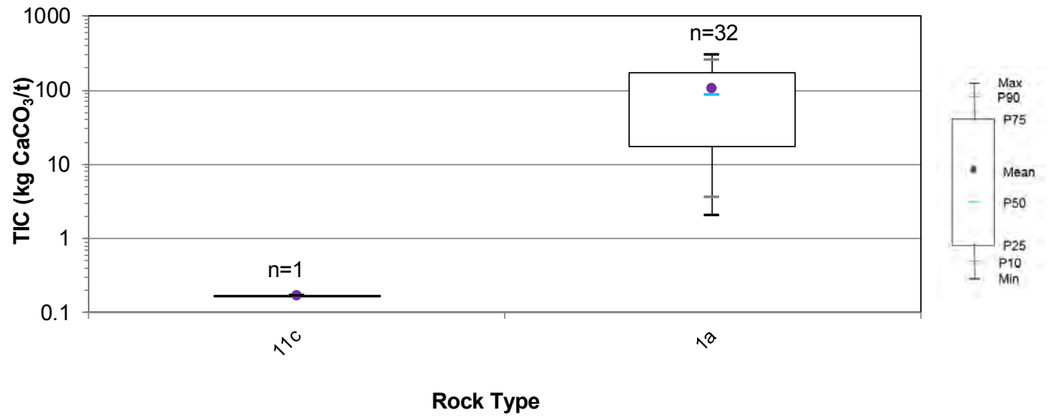

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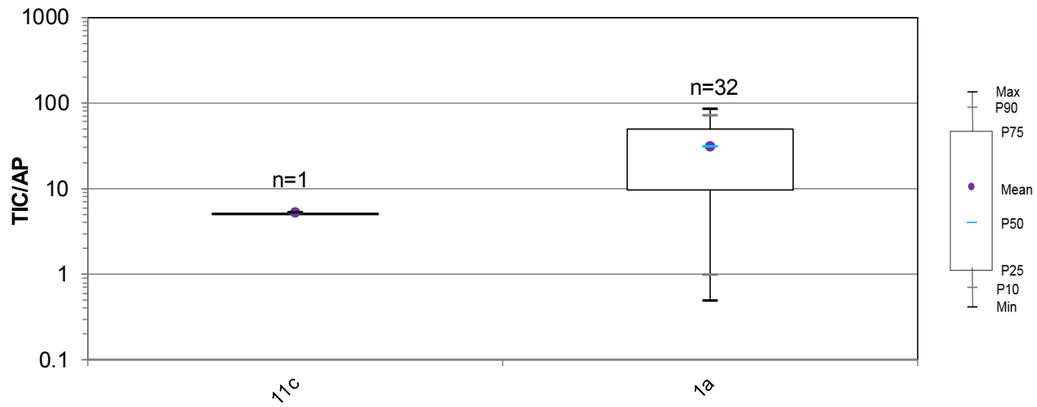

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Figure 3-4: Box and Whisker Plots of S, TIC, and TIC/AP ratios by Rock Type

(These plots are conventional box and whisker graphs, with the upper and lower extremes showing the minimum and maximum values, tick marks outside of the box showing the 5th and 95th percentiles, outer margins of the box showing the 25th and 75th percentiles and central division in the box showing the median value)

3.2.2 ABA Results

Full ABA results are available for nine samples and are presented in Figure 3-5 to Figure 3-7 and Attachment 2.

The results indicate moderately alkaline paste pH, with the paste pH of the 1a material typically (P25 to P75) between 8.2 and 8.9 and a paste pH of 9.2 for the 11c sample.

Total sulphur concentrations are plotted against sulphide sulphur in Figure 3-5. Total sulphur has a generally linear relationship with sulphide sulphur. This indicates the majority of the sulphur is present as sulphide minerals. Accordingly, total sulphur was used to calculate acid potential (AP). A discussion of sulphur levels according to sample type is presented in Section 3.2.1.

Modified NP for the 1a samples is typically (P25 to P75) between 24 to 120 kg $CaCO_3$/t. The one sample of diabase material reported a modified NP value of 31 kg $CaCO_3$/t. For samples with levels of Modified NP up to approximately 60 kg $CaCO_3$/t, levels of NP are generally greater than TIC, suggesting that silicates contributed to the buffering capacity in the tests (Figure 3-6). Above NP levels of 60 kg $CaCO_3$/t, TIC levels tended to be greater than NP, suggesting the occurrence of iron-bearing carbonates which do not contribute to net-neutralization potential as they both produce and consume acid. All samples were classified as non-PAG on the basis of NP/AP (Figure 3-7) owing to higher levels of NP compared to TIC. On the basis of TIC/AP, five of these samples were classified as non-PAG, two as uncertain and one as PAG (Figure 3-3).

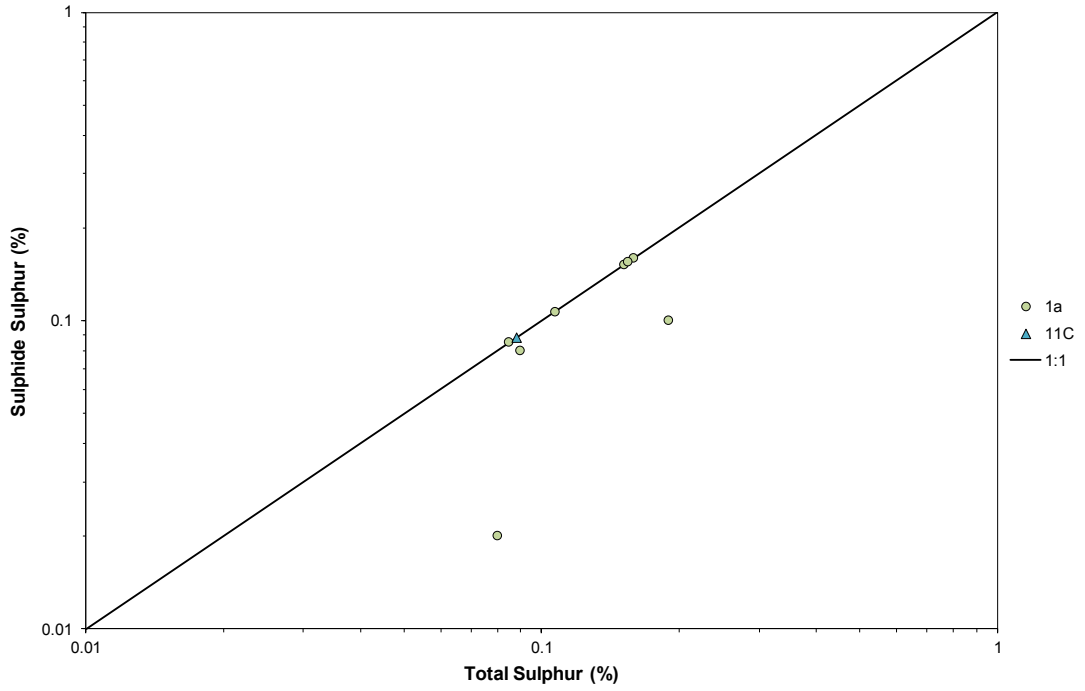

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Figure 3-5: Total Sulphur Plotted against Sulphide Sulphur for ABA Samples

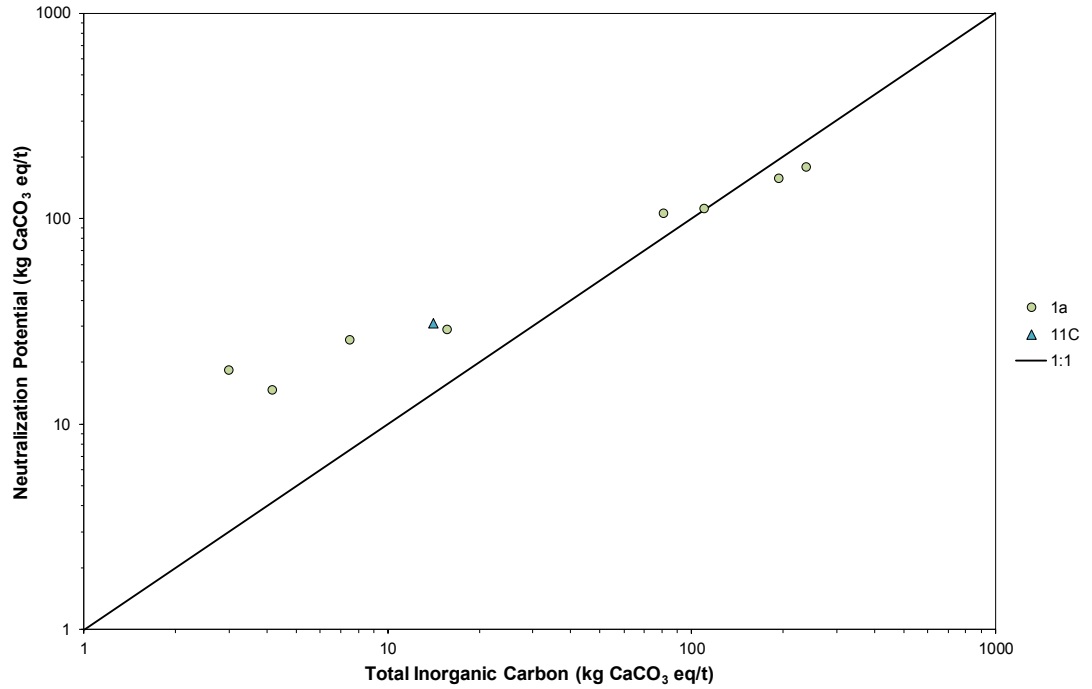

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Figure 3-6: Modified Sobek NP versus TIC for ABA Samples

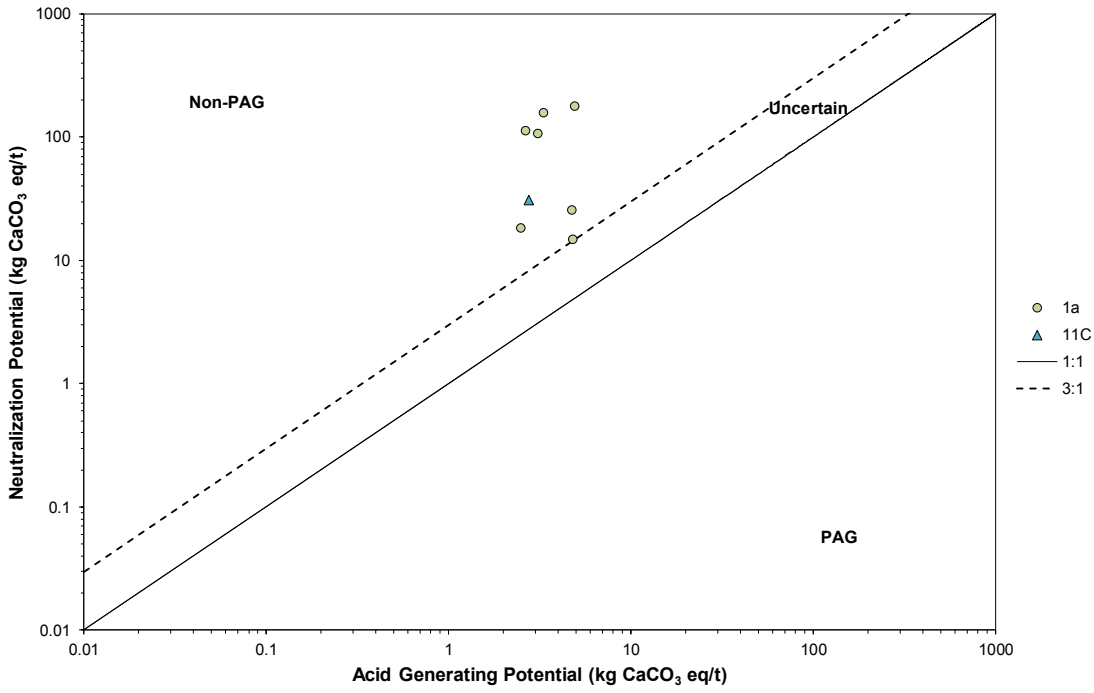

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Figure 3-7: Modified Sobek NP versus AP for ABA Samples

3.2.3 Elemental Analysis

Eight samples of metavolcanics (1a) and one sample of diabase (11c) were submitted for elemental analysis. Results were compared to average crustal abundance for basalt (Price 1997) as an indicator of enrichment and are summarized in Table 3-1 and Table 3-2. The full laboratory results are presented in Attachment 3. Selenium could not be assessed because the screening level was within the range of analytical error.

Results of the elemental analyses indicate that concentrations of trace elements in the mafic metavolcanics (1a) (Table 3-1) and diabase (11c) (Table 3-2) were less than ten times the average crustal abundance for basalt (Price 1997).

Table 3-1: Summary of Elemental Analyses for Basalt (1a)

Parameter	Detection Limit (Q1/2)	Detection Limit (Q3/4)	Unit	P00	P25	Median	P75	P100	10X Average Crustal Abundance* for Basalt
Ag	100	2	ppb	9	16	100	110	230	1100
As	0.5	0.1	ppm	0.3	0.65	0.9	4.2	8.4	20
Au	0.5	0.2	ppb	0.2	0.58	1.6	2.4	3.8	40
Ba	1	0.5	ppm	3	4.5	13	22	45	3300
Ca	0.01	0.01	%	0.81	1.3	2.6	4.2	4.9	76
Cd	0.1	0.01	ppm	0.02	0.058	0.09	0.21	1.5	2.2
Co	0.1	0.1	ppm	23	25	27	30	31	480
Cr	1	0.5	ppm	13	17	18	21	22	1700
Cu	0.1	0.01	ppm	17	32	52	87	220	870
Fe	0.01	0.01	%	4.8	6.1	9.4	9.8	10	86.5
Hg	10	5	ppb	5	5	7.5	10	18	900
Mg	0.01	0.01	%	1.2	1.4	1.7	1.8	2	46
Mn	1	1	ppm	540	710	1200	1600	2100	15000
Mo	0.1	0.01	ppm	0.3	0.41	0.51	0.55	0.7	15
Ni	0.1	0.1	ppm	1.2	1.6	2.5	7	12	1300
P	0.001	0.001	%	0.074	0.085	0.089	0.098	0.11	1
Pb	0.1	0.01	ppm	0.69	0.91	2.8	6.2	37	60
S	0.05	0.02	%	0.06	0.078	0.11	0.15	0.17	0.3
Sb	0.1	0.02	ppm	0.02	0.035	0.07	0.1	0.17	2
Se	0.5	0.1	ppm	0.1	0.3	0.35	0.5	0.5	0.5
Sr	1	0.5	ppm	9	11	15	33	52	4650
U	0.1	0.1	ppm	0.1	0.1	0.1	0.1	0.1	10
V	2	2	ppm	50	66	68	93	130	2500
W	0.1	0.1	ppm	0.1	0.1	0.1	0.1	0.2	7
Zn	1	0.1	ppm	22	94	120	190	600	1050

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Note:

* Numbers highlighted in bold exceed 10 times the average crustal abundance for basaltic rocks from Price (1997)

Statistics based on 8 samples.

Table 3-2: Summary of Elemental Analyses for Diabase (11c)

Parameter	Detection Limit	Unit	Result	10X Average Crustal Abundance* for Basalt
Ag	2	ppb	43	1100
As	0.1	ppm	0.4	20
Au	0.2	ppb	1.6	40
Ba	0.5	ppm	11	3300
Ca	0.01	%	1.5	76
Cd	0.01	ppm	0.01	2.2
Co	0.1	ppm	20	480
Cr	0.5	ppm	59	1700
Cu	0.01	ppm	120	870
Fe	0.01	%	6.2	86.5
Hg	5	ppb	5	900
Mg	0.01	%	3.3	46
Mn	1	ppm	400	15000
Mo	0.01	ppm	0.94	15
Ni	0.1	ppm	38	1300
P	0.001	%	0.062	1
Pb	0.01	ppm	0.69	60
S	0.02	%	0.06	0.3
Sb	0.02	ppm	0.02	2
Se	0.1	ppm	0.1	0.5
Sr	0.5	ppm	26	4650
U	0.1	ppm	0.1	10
V	2	ppm	330	2500
W	0.1	ppm	0.1	7
Zn	0.1	ppm	32	1050

Source: \\cdf-fs1.cdf.uk.srk.ad\projects\U7160 Vancouver Geochem Assistance\Project\01_1CT022.027 Hope Bay\2017\Waste Rock\3. Working File\[HopeBay_WRMonitoring_1CT022.027_JC_rev02.xlsx]

Note:

* Numbers highlighted in bold exceed 10 times the average crustal abundance for basaltic rocks from Price (1997)

4 Summary and Conclusions

Mining at Doris in 2017 has resulted in the placement of approximately 146,977 t of waste rock on Pad T, all of which was managed as mineralized waste rock. The balance of waste rock produced in 2017 remained underground and was placed as structural backfill in the underground stopes. In 2017, 3,060 t of waste rock from the surface waste rock stockpile was placed as backfill in stopes of the Doris mine.

A total of 31 waste rock samples were collected as part of the waste rock geochemical monitoring program with one sample geologically identified as diabase (11c) and the others as mafic metavolcanics (1a). According to TMAC geologists, waste rock geologically classified as late mafic dyke (10b) was also intersected in 2017 though the overall volume of mafic dyke waste rock was relatively small (<1%).

Sulfur concentrations for the mafic metavolcanics samples (1a) were uniformly low, ranging from 0.02 to 0.19% and with median levels of 0.13%. TIC ranged from 2.1 to 300 kg $CaCO_3$ eq/tonne, with 30% of samples having TIC levels less than 30 kg $CaCO_3$ eq/tonne. TIC levels are lower than expected given typical concentrations observed in basalt from the Doris area (P25 to P75 values between 167 to 339 kg $CaCO_3$ eq/tonne, SRK 2015b). Based on SRK's inspection of the waste rock stockpile, these samples are likely metavolcanics found along the contact with the diabase intrusion that has been altered (or hornfelsed) as a result of heat from the intrusion.

On the basis of TIC/AP, the majority of basalt samples were classified as non-PAG with two samples classified as having an uncertain potential for ARD and four samples as PAG. ARD classifications by TIC/AP are more conservative than NP/AP owing to higher levels of NP. Trace element analyses on the solids indicated that concentrations of trace elements in mafic 1a 11c materials were less than ten times the average crustal abundance for basalt.

A long-term assessment of the anticipated geochemical behaviour of the waste rock in the stockpile on Pad T with respect to acid rock drainage and metal leaching (ARD/ML) is not possible for the reasons described as follows:

- The higher incidence of mafic metavolcanics (1a) with lower TIC content. Based on kinetic test work (SRK 2015b), the risk for metal leaching from this material is expected to be low.
- Volumes of the waste rock according to rock type, specifically for the low TIC mafic metavolcanics materials cited above, are not documented.

The geochemical behaviour of the waste rock is monitored through the annual seep survey along the downgradient toe of the waste rock and ore stockpile area and routine monitoring of the Pollution Control Pond (PCP). The results of the seepage survey are reported in the accompanying memo (SRK 2018) while results of the routine monitoring program are included in monthly water quality reports prepared by TMAC and submitted to the Nunavut Water Board. All waste rock on surface will be placed underground at closure.

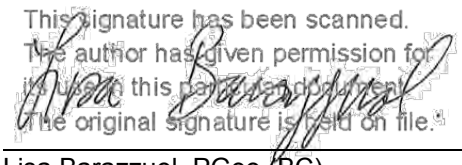
Kind regards,

SRK Consulting (UK) Ltd.

Jessica Charles, FGS
Consultant

Reviewed by

SRK Consulting (Canada) Ltd.



Lisa Barazzuol, PGeo (BC)
Senior Consultant

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Price, W.A. 1997. DRAFT Guidelines and Recommended Methods for the Prediction of Metal Leaching and Acid Rock Drainage at Minesites in British Columbia. BC Ministry of Employment and Investment, Energy and Minerals Division. 151pp

SRK 2015a. Hope Bay Project – Doris North Waste Rock and Ore Management Plan – Revision 2. Report prepared for TMAC Resources Inc. by SRK Consulting, April 2015.

SRK 2015b. Static Testing and Mineralogical Characterization of Waste Rock and Ore from the Doris Deposit, Hope Bay. Report prepared for TMAC Resources by SRK Consulting, June 2012.

TMAC 2016a. Waste Rock and Ore Management Plan, Hope Bay Project, Nunavut. Report prepared for the Nunavut Water Board by TMAC Resources, August 2016.

TMAC 2016b. Waste Rock and Ore Management Plan, Hope Bay Project, Nunavut. Addendum prepared for the Nunavut Water Board by TMAC Resources, September 2016.

Attachment 1 – Geological Inspection Logs

WASTE ROCK SAMPLES

			SAMPLE LOCATION								GEOLOGIC DESCRIPTION			
SAMPLE #	GEOLOGIST	DATE SAMPLED	LEVEL	STN/GP#	X	Y	Z	MINING ZONE	ANALYSIS	MINERALIZED/NOT MINERALIZED	ROCK TYPE	SULPHIDE %	CARBONATE %	DESCRIPTION
R828364	AG	16-Jan-17	BTD	Muck pile from DS Blast on jan 16, 2017	433702.915	7559518.921	-119	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		
R828365	KC	10-Feb-17	BTD	Feb 10 DS blast face	433730.8	7559610.4	-137	Any zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828366	KC	10-Feb-17	BTD	Corner of DB3	433720.3	7559563.2	-130	Any zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828367	AG	2-Mar-17	BTD	Muck pile from DS Blast on Mar 2, 2017	433752.925	7559708.941	-147	Any zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828368	KC	22-Mar-17	BTD	corner of vent access	433767	7559746	-155	Basalt and buffer zone	Total Sulphur and TIC	Mineralized	1a	<1		Minor Fe staining
R828369	KC	29-Mar-17	BTD	BTD face Mar 30	433774	7559787	-159	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		Minor Fe staining
R828370	AG	16-Apr-17	BTD	Muck pile from DS Blast on Apr 16, 2017	433805.009	7559858.28	-168	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828371	KC	5/7/2017	4825LA	Stn 2505+13.5	433826	7559743	-165	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828372	KC	5/7/2017	BTD	7/May face	433829	755802	-181	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828373	KC	5/7/2017	4820	7/May face	433759	755845	-170	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		Fe Staining
R828374	AG	5/23/2017	4820 EXP	Muck pile from DS Blast on May 23, 2017	433767.009	7559889.473	-177	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		
R828375	AG	5/23/2017	BTD	Muck pile from NS Blast onMay 25, 2017	433815.601	7559671.988	-189	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828376	AG	5/25/2017	4825LA	Face as of May 25, 2017	433872.257	7559730.395	-170	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		Fe Staining
R828377	KC	6/15/2017	4795 RMK	Right corner of remuck	433833	7559743.7	-192	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		
R828378	KC	6/15/2017	BTD	June 15 face	433786	7559713	-197	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828379	AG	13-Jul-17	BTD	Muck pile from DS Blast on July 13, 2017	433821.62	7559799.973	-213	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828380	KC	2-Aug-17	4885 RMK	RMK	433747	7559338.7	-109	Diabase	ABA test	Not Mineralized	11C	<1		
R828381	KC	2-Aug-17	BTD	Face BTd	433829	7559750.1	-221	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828382	KC	2-Aug-17	4994 SB	Safety Bay	433586	7559100	-46	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		
R828383	KC	13-Sep-17	DCO	DCO SB	433584	7558994	-62	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828384	KC	13-Sep-17	DCO	DCO station 9407	433581	7559041	-55	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828385	KC	13-Sep-17	BTD	SB	433782	7559729	-235	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828386	KC	13-Sep-17	BTD	ECO	433800	7559712	-230	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828387	KC	18-Oct-17	BTD	RMK	433842	7559789	-248	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		Hematite staining pervasive
R828388	KC	20-Oct-17	DCO	RMK	433572	7558940	-69	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		
R828389	AG	14-Nov-17	BTD	muck pile from Nov 14 blast	433839.992	7559731.854	-253	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		Minor Hematite staining
R828390	KC	3-Dec-17	BTD	Dec 3 face	433812	7559710	-263	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	1		Minor Hematite staining
R828391	KC	3-Dec-17	4765 Acc	end of access	433909.6	7559718	-229	Alteration zone	ABA test	Not Mineralized	1a	<1		
R828392	KC	4-Dec-17	DCO	ECO	433582	755809	-87	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		
R828393	AP	24-Dec-17	DCO	Muck pile from Dec 23, NS blast	433591.891	7558721.666	-98	Basalt and buffer zone	ABA test	Not Mineralized	1a	<1		
R828394	AP	24-Dec-17	BTD	Muck pile from Dec 23, NS blast	433774.894	7559732.136	-265	Basalt and buffer zone	Total Sulphur and TIC	Not Mineralized	1a	<1		

Attachment 2 – Laboratory Results – Full ABA

			Paste pH	S(T)	S(SO4)	S(S-2)	AP	AP from S(T)	CO2	TIC	TIC	Mod NP	Net NP	Fizz Test	TIC/AP	NP/AP
			Std. Units	%S	%S	%S	kg CaCO3/t	kg CaCO3/t	wt%	%C	kg CaCO3/t	kg CaCO3/t	kg CaCO3/t	-		-
SAMPLE #	ROCK TYPE	LOD Q1-2	#N/A	0.02	0.01	0.02	0.6		0.08		1.8	0.1	0.1	#N/A		0.1
		LOD Q3-4	0.20	0.005	0.01	#N/A	#N/A			0.01	#N/A	0.5	#N/A	#N/A		#N/A
R828364	1a	Maxxam	8.99	0.090	0.010	0.080	2.50	2.81	0.13	0.04	3.00	18.3	15.8	SLIGHT	1.1	7.32
R828365	1a	Maxxam	#N/A	0.18	#N/A	#N/A	#N/A	5.63	0.27	0.07	6.10	#N/A	#N/A	#N/A	1.1	#N/A
R828366	1a	Maxxam	#N/A	0.14	#N/A	#N/A	#N/A	4.38	0.090	0.02	2.10	#N/A	#N/A	#N/A	0.5	#N/A
R828367	1a	Maxxam	#N/A	0.14	#N/A	#N/A	#N/A	4.38	2.14	0.58	48.6	#N/A	#N/A	#N/A	11.1	#N/A
R828368	1a	Maxxam	#N/A	0.13	#N/A	#N/A	#N/A	4.06	1.04	0.28	23.6	#N/A	#N/A	#N/A	5.8	#N/A
R828369	1a	Maxxam	8.38	0.080	0.090	< 0.020	0	2.50	0.69	0.19	15.7	28.8	28.8	MODERATE	6.3	#N/A
R828370	1a	Maxxam	#N/A	0.12	#N/A	#N/A	#N/A	3.75	8.52	2.33	194	#N/A	#N/A	#N/A	51.6	#N/A
R828371	1a	Maxxam	#N/A	0.090	#N/A	#N/A	#N/A	2.81	4.09	1.12	93.0	#N/A	#N/A	#N/A	33.1	#N/A
R828372	1a	Maxxam	#N/A	0.11	#N/A	#N/A	#N/A	3.44	6.91	1.89	157	#N/A	#N/A	#N/A	45.7	#N/A
R828373	1a	Maxxam	#N/A	0.14	#N/A	#N/A	#N/A	4.38	3.23	0.88	73.4	#N/A	#N/A	#N/A	16.8	#N/A
R828374	1a	Maxxam	8.98	0.19	0.090	0.10	3.10	5.94	3.58	0.98	81.4	106	103	MODERATE	13.7	34.2
R828375	1a	Maxxam	#N/A	0.13	#N/A	#N/A	#N/A	4.06	6.96	1.90	158	#N/A	#N/A	#N/A	38.9	#N/A
R828376	1a	Maxxam	#N/A	< 0.020	#N/A	#N/A	#N/A	0.63	0.80	0.22	18.2	#N/A	#N/A	#N/A	29.1	#N/A
R828377	1a	SGS	8.09	0.16	< 0.010	0.16	4.97	4.97	#N/A	2.88	240	171	172	MODERATE	48.3	34
R828378	1a	SGS	#N/A	0.082	#N/A	#N/A	#N/A	2.56	#N/A	1.00	83.3	#N/A	#N/A	#N/A	32.5	#N/A
R828379	1a	SGS	#N/A	0.11	#N/A	#N/A	#N/A	3.34	#N/A	1.89	158	#N/A	#N/A	#N/A	47.1	#N/A
R828380	11C	SGS	9.23	0.088	< 0.010	0.088	2.75	2.75	#N/A	0.17	14.2	31.0	28.3	None	5.2	11
R828381	1a	SGS	#N/A	0.17	#N/A	#N/A	#N/A	5.31	#N/A	3.61	301	#N/A	#N/A	#N/A	56.6	#N/A
R828382	1a	SGS	8.91	0.15	< 0.010	0.15	4.75	4.75	#N/A	0.090	7.50	25.6	20.9	None	1.6	5
R828383	1a	SGS	#N/A	0.037	#N/A	#N/A	#N/A	1.16	#N/A	0.17	14.2	#N/A	#N/A	#N/A	12.3	#N/A
R828384	1a	SGS	#N/A	0.18	#N/A	#N/A	#N/A	5.63	#N/A	0.080	6.67	#N/A	#N/A	#N/A	1.2	#N/A
R828385	1a	SGS	#N/A	0.11	#N/A	#N/A	#N/A	3.53	#N/A	2.59	216	#N/A	#N/A	#N/A	61.1	#N/A
R828386	1a	SGS	#N/A	0.059	#N/A	#N/A	#N/A	1.84	#N/A	1.17	97.5	#N/A	#N/A	#N/A	52.9	#N/A
R828387	1a	SGS	#N/A	0.13	#N/A	#N/A	#N/A	4.16	#N/A	1.40	117	#N/A	#N/A	#N/A	28.1	#N/A
R828388	1a	SGS	7.86	0.085	< 0.010	0.085	2.66	2.66	#N/A	1.32	110	111	108	Moderate	41.4	42
R828389	1a	SGS	#N/A	0.15	#N/A	#N/A	#N/A	4.69	#N/A	0.86	71.7	#N/A	#N/A	#N/A	15.3	#N/A
R828390	1a	SGS	#N/A	0.16	#N/A	#N/A	#N/A	5.09	#N/A	0.66	55.0	#N/A	#N/A	#N/A	10.8	#N/A
R828391	1a	SGS	8.88	0.16	< 0.010	0.16	4.84	4.84	#N/A	0.050	4.17	14.6	9.76	None	0.9	3
R828392	1a	SGS	#N/A	0.087	#N/A	#N/A	#N/A	2.72	#N/A	2.60	217	#N/A	#N/A	#N/A	79.7	#N/A
R828393	1a	SGS	8.24	0.11	< 0.010	0.11	3.34	3.34	#N/A	2.34	195	157	153	Moderate	58.3	47
R828394	1a	SGS	#N/A	0.11	#N/A	#N/A	#N/A	3.47	#N/A	3.42	285	#N/A	#N/A	#N/A	82.2	#N/A

Attachment 3 – Laboratory Results – Multi Element Analysis

			Mo	Cu	Pb	Zn	Ag	Ni	Co	Mn	Fe	As	U	Au	Th	Sr	Cd	Sb	Bi	V	Ca
			ppm	ppm	ppm	ppm	ppb	ppm	ppm	ppm	%	ppm	ppm	ppb	ppm	ppm	ppm	ppm	ppm	ppm	%
SAMPLE #	ROCK TYPE	LOD Q1-2	0.1	0.1	0.1	1	100	0.1	0.1	1	0.01	0.5	0.1	0.5	0.1	1	0.1	0.1	0.1	2	0.01
		LOD Q3-4	0.01	0.01	0.01	0.1	2	0.1	0.1	1	0.01	0.1	0.1	0.2	0.1	0.5	0.01	0.02	0.02	2	0.01
R828364	1a	Maxxam	0.30	78.4	7.10	22.0	< 100	2.60	24.4	535	6.14	0.80	0.10	2.40	0.70	9.00	< 0.10	< 0.10	< 0.10	66.0	0.81
R828369	1a	Maxxam	0.50	22.1	1.40	139	< 100	2.40	30.5	1470	9.75	< 0.50	0.10	2.50	0.60	11.0	< 0.10	< 0.10	< 0.10	68.0	1.37
R828374	1a	Maxxam	0.30	113	5.90	596	< 100	11.3	30.4	1220	9.21	0.70	< 0.10	3.80	0.40	51.0	1.50	< 0.10	< 0.10	126	3.78
R828377	1a	SGS	0.54	60.4	0.69	128	9.00	12.2	30.5	2092	10.4	4.10	< 0.10	< 0.20	0.20	19.1	0.060	0.040	0.030	112	4.87
R828380	11C	SGS	0.94	119	0.69	31.7	43.0	38.0	20.1	403	6.21	0.40	0.10	1.60	0.40	26.4	< 0.010	< 0.020	0.11	328	1.45
R828382	1a	SGS	0.59	215	4.16	37.2	137	5.50	25.8	566	4.77	8.40	< 0.10	1.20	0.50	11.4	0.050	0.040	0.070	50.0	1.39
R828388	1a	SGS	0.70	34.8	0.94	113	17.0	1.30	28.3	1112	9.82	1.00	< 0.10	< 0.20	0.40	26.4	0.020	0.020	0.10	86.0	4.07
R828391	1a	SGS	0.51	43.2	37.0	337	228	1.70	23.3	761	6.14	4.50	< 0.10	0.70	0.80	10.3	0.54	0.17	0.11	66.0	0.90
R828393	1a	SGS	0.44	17.4	0.81	114	11.0	1.20	26.4	1921	9.65	0.30	< 0.10	2.00	0.30	52.3	0.080	< 0.020	0.020	68.0	4.61

			P	La	Cr	Mg	Ba	Ti	B	Al	Na	K	W	Sc	Tl	S	Hg	Se	Te	Ga
			%	ppm	ppm	%	ppm	%	ppm	%	%	%	ppm	ppm	ppm	%	ppb	ppm	ppm	ppm
SAMPLE #	ROCK TYPE	LOD Q1-2	0.001	1	1	0.01	1	0.001	20	0.01	0.001	0.01	0.1	0.1	0.1	0.05	10	0.5	0.2	1
		LOD Q3-4	0.001	0.5	0.5	0.01	0.5	0.001	20	0.01	0.001	0.01	0.1	0.1	0.02	0.02	5	0.1	0.02	0.1
R828364	1a	Maxxam	0.11	7.00	22.0	1.15	26.0	0.28	< 20.0	1.47	0.10	0.10	< 0.10	5.30	< 0.10	0.070	< 10.0	< 0.50	< 0.20	16.0
R828369	1a	Maxxam	0.10	5.00	18.0	1.73	20.0	0.34	< 20.0	2.57	0.11	0.13	0.10	6.80	< 0.10	0.060	< 10.0	< 0.50	< 0.20	16.0
R828374	1a	Maxxam	0.080	4.00	22.0	1.75	3.00	0.11	< 20.0	3.20	0.066	0.020	< 0.10	24.8	< 0.10	0.17	< 10.0	< 0.50	< 0.20	17.0
R828377	1a	SGS	0.074	2.50	20.9	2.02	5.20	0.0050	< 20.0	3.23	0.027	0.060	< 0.10	17.6	< 0.020	0.13	< 5.00	0.30	< 0.020	11.7
R828380	11C	SGS	0.062	6.10	58.6	3.28	11.3	0.21	< 20.0	3.11	0.32	0.12	< 0.10	12.4	0.030	0.060	< 5.00	0.10	< 0.020	12.1
R828382	1a	SGS	0.090	5.00	17.7	1.28	20.4	0.23	< 20.0	1.45	0.21	0.10	< 0.10	8.90	0.12	0.15	< 5.00	0.30	< 0.020	9.70
R828388	1a	SGS	0.087	5.00	18.9	1.50	3.80	0.092	< 20.0	3.32	0.036	0.010	< 0.10	20.7	< 0.020	0.080	< 5.00	0.30	< 0.020	16.6
R828391	1a	SGS	0.096	6.40	13.2	1.77	44.7	0.26	< 20.0	2.03	0.13	0.17	0.20	7.00	0.060	0.15	18.0	0.40	< 0.020	14.1
R828393	1a	SGS	0.088	3.70	13.7	1.60	4.70	0.0070	< 20.0	3.05	0.013	0.020	< 0.10	21.6	< 0.020	0.090	< 5.00	0.10	< 0.020	14.6

Appendix C – 2017 Hope Bay Quarry and Construction Rock Monitoring

SRK Consulting (Canada) Inc.
2200–1066 West Hastings Street
Vancouver, BC V6E 3X2

T: +1.604.681.4196
F: +1.604.687.5532
vancouver@srk.com
www.srk.com

Memo

To:	Shelley Potter, TMAC	**Client:**	TMAC Resources Inc.
From:	Marie-Christine Noel Lisa Barazzuol	**Project No:**	1CT022.016
Cc:	Oliver Curran, TMAC	**Date:**	March 26, 2018
Subject:	2017 Doris Waste Rock, Ore and Infrastructure Seep Monitoring		

1 Introduction

As part of the verification, monitoring and management plans for the Hope Bay Project (the Project), TMAC monitors seepage downstream of the Doris North infrastructure, pads, roads, and waste rock. The 2017 seepage program was completed by TMAC in accordance with conditions outlined in Part D "Conditions applying to Construction and Operations" Item 20 of Water Licence 2AM-DOH1323 Amendment No. 1 (Nunavut Water Board 2016), Quarry Management and Monitoring Plan (TMAC 2017) and the Waste Rock and Ore Management Plan, Hope Bay Project, Nunavut (TMAC 2016).

This memo presents the results of the 2017 freshet seep survey and complies with Item 21 of the Water Licence cited above. It includes seepage monitoring of the Doris waste rock stockpiles and infrastructure constructed at Doris between fall of 2016 to mid-2017 using Quarry 2 rock, including:

- Tailings Impoundment Area (TIA) access road between Quarry 3 and southern end of TIA,
- Tailings catchment basin,
- Airstrip expansion, and
- Temporary explosives berm by the North Dam.

2 Methods

2.1 Seep Survey and Sample Collection

TMAC conducted the waste rock and construction (quarry) rock seep survey between June 15 and June 18, 2017 in the areas outlined in Section 1. Seep survey locations were established opportunistically by walking the toes of the waste rock stockpile, infrastructure, roadways, and berms (Attachment A). Additionally, three reference points in the tundra, not subject to mine influences, were sampled. The samples used as reference points were collected at approximately the same points as the 2010-2016 seep surveys (in the vicinity of the Doris-Windy Road, Attachment A)

Seeps were observed in all inspected areas except the temporary explosives berm. A total of 12 seepage sites and 3 reference sites were established. Of the twelve seepage sites, seven sites were in along the TIA Access Road, three were in the waste rock influenced area, and two were at the airstrip.

Field measurements were taken at all locations where water was observed flowing into and out of construction rock material including seeps where precipitation runoff and snowmelt came into contact with rock along the roadways, building pads and berms. Electrical conductivity (EC), pH, temperature, oxidation-reduction potential (ORP), and flow rates (where possible) were measured at each of these locations at the time of monitoring.

As per the water licence, a minimum of 10% of the total sample set, including any sites with elevated conductivity, were submitted to a laboratory for an extended analytical suite. A total of 15 samples was collected and analyzed. In addition, one duplicate sample and one field blank were collected and submitted for laboratory analysis, and one travel blank was included in sample shipments as part of SRK's quality assurance/quality control (QA/QC) program.

TMAC submitted 18 samples (including a duplicate and field and travel blanks) to ALS Environmental Labs in Vancouver, BC where they were analyzed for pH, conductivity, sulphate, acidity, alkalinity, chloride, fluoride, nitrate, nitrite, phosphorus, ammonia, total dissolved solids (TDS), total suspended solids (TSS) and low level dissolved metals including mercury and selenium. All samples were filtered and preserved in the field, as required.

2.2 Quality Assurance

QA/QC review of all data was conducted by SRK and deemed overall acceptable.

Ion balances ranged from -10.7 to 9.9% for the seep samples. One sample exceeded SRK's criteria of ±10% (17-TLA-02) with an ion balance of -10.7%. As the sample had very low concentrations of ions (electrical conductivity <µS/cm) this was deemed acceptable. All other samples complied with SRK's criteria.

Field blank parameters were below detection limits indicating that appropriate field filtration and sampling methods were employed. The field duplicate results were within ±7% relative percent difference (RPD) for all parameters with measured concentrations above ten times the detection limit.

Laboratory and field values of pH and electric conductivity (EC) were compared, as well as total dissolved solids (TDS) and lab conductivity. Conductivity values were near parity for all samples. Values of pH were slightly higher in the lab than in the field for all samples. For all samples, TDS demonstrated a strong positive correlation with lab conductivity.

3 Results and Discussion

Attachment A presents maps of the seepage sample locations and the as-built alignment of the airstrip, TIA access road and Pad T. A complete set of field observations and measurements is provided in Attachment B. Attachment C contains the laboratory water chemistry results.

3.1 Field Measurements

The maps in Attachment A present electric conductivity and pH measured in the field. The field data are summarized as follows (Table 1):

- pH was neutral to slightly alkaline.
- The samples collected within the Waste Rock Influenced Area (17-DC-01, 17-DC-02, 17-DC-03) had the highest levels of conductivity (3350 to 3860 µS/cm).
- Median conductivity concentrations of the seepage samples collected along the TIA access road were 86 µS/cm while the median conductivity concentrations of the samples collected along the airstrip was 390 µS/cm.
- Median concentrations for the reference samples were 93 µS/cm. The reference points were measured as representative of conditions outside the influence of construction and mining operations.

Table 1: Mean Values for Field Conductivity and pH Measurements

Site Area	No. of Samples	Conductivity (µS/cm)	pH
		Median	
Waste Rock Influenced Area	3	3600	7.8
TIA Access Road	7	86	7.7
Airstrip	2	390	7.9
Reference Points	3	93	7.7

Source: \\van-svr0\projects\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\C_Seep_Surveys\June2017%20Seepage%20Survey\4.%20Working%20file\2017_DorisSeep_CompiledData_Rev00_AMD.xlsx

3.2 Laboratory Data

A summary of water quality analyses for the 2017 seep samples is presented in Table 2. All parameters were compared to the CCME water quality guidelines for the protection of aquatic life to screen for elevated parameters (dissolved). Comparisons to these criteria were used solely for screening purposes and are not directly applicable because the seep locations do not support aquatic life.

3.2.1 Windy Road Area (Reference)

Consistent with previous years, three reference samples were taken in the Windy Road area and submitted for laboratory analysis (Table 2). The lab pH values ranged from 7.4 to 7.7, while lab electric conductivity was measured between 52 and 120 µS/cm. Parameter concentrations were below the screening criteria.

3.2.2 Waste Rock Influenced Area

Three samples from the Waste Rock Influenced Area (WRIA) in the Doris Camp were submitted for laboratory analysis (Table 2). DC-01 and DC-02 were sampled immediately downstream of the toe of the stockpile on Pad I that is composed of TMAC ore placed on top of waste rock from 2011 and 2012. Accordingly, seepage from DC-01 and DC-02 are considered contact water (undiluted) from this stockpile.

The lab pH values ranged from 7.6 to 7.8, and lab electric conductivity ranged from 3,100 to 3,500 µS/cm. All samples had elevated ammonia, chloride and nitrate concentrations compared to the screening criteria. Ammonia concentrations ranged from 4 to 6 times above the screening criteria and nitrate concentrations were 13 to 17 higher. One sample (17-DC-03) had copper concentrations that were twice the screening criteria while the other two samples were 50 times higher. Two samples (17-DC-01 and 17-DC-02) had iron and selenium concentrations two times and four times greater than the screening criteria, respectively. One sample (17-DC-01) had arsenic concentrations 50% greater than the screening criteria.

3.2.3 TIA Access Road Area

Seven samples from the TIA access road area (including the tailings catchment basin) were submitted for laboratory analysis (Table 2). Lab pH ranged from 7.5 to 8, and lab electric conductivity ranged from 64 to 240 µS/cm. Three samples (17-CB-01, 17-TLA-04, and 17-TLA-05) had copper concentrations that exceeded but the same order of magnitude as the screening criteria (higher by a maximum of 60%).

3.2.4 Airstrip Area

Two samples from the Airstrip area were submitted for laboratory analysis (Table 2). Lab pH for the samples was 8.2 and 8.1 and lab electric conductivity of 560 and 230. The copper concentration for both samples exceeded the screening criteria by a factor of approximately 4. All other parameters were below the screening criteria. In general, 17-AIRSTR-01 had higher concentrations than 17-AIRSTR-02. Sulphate concentrations for both samples were low (≤12 mg/L).

Table 2: Summary of Laboratory Results of 2017 Seep Samples.

Area	Sample ID	Field pH	Lab pH	Field EC	Lab EC	ORP	Total Hardness	TDS	Total Ammonia	Cl	NO3	SO4	Al	As	Cd	Cu	Fe	Pb	Hg	Ni	Se	Tl	Zn
		s.u.	s.u.	µS/cm	µS/cm	mV	mg $CaCO_3$/L	mg/L	mg N/L	mg/L	mg N/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	CCME Guideline*	*6.5-9*	*6.5-9*	-	-	-	-	-	*4***	*120 mg/L*	*3 mg N/L*	-	*0.1*	*0.005*	*0.0041****	*0.004****	*0.3*	*0.007****	*0.000026*	*0.15****	*0.001*	*0.0008*	*0.03*
Reference (Windy Road)	17-REF-01	7	7.4	53	52	110	22	57	<0.0050	3.2	<0.0050	<0.30	0.049	0.00018	<0.0000050	0.00086	0.15	<0.000050	<0.0000050	0.0023	<0.000050	<0.000010	0.0033
	17-REF-02	7.7	7.5	120	120	100	31	80	<0.0050	18	<0.0050	3.3	0.021	<0.00010	<0.0000050	0.00068	0.043	<0.000050	<0.0000050	0.00099	<0.000050	<0.000010	0.0011
	17-REF-03	7.7	7.7	93	93	61	35	65	<0.0050	6.3	<0.0050	2.5	0.018	<0.00010	<0.0000050	0.0012	0.043	<0.000050	<0.0000050	<0.00050	<0.000050	<0.000010	0.0041
Waste Rock Influenced Area	17-DC-01	7.8	7.7	3600	3500	210	750	2300	**22**	**920**	**48**	180	0.0072	**0.0074**	0.000065	**2.1**	**0.63**	<0.00010	0.000007	0.069	**0.0038**	0.000069	<0.0020
	17-DC-02	7.9	7.6	3900	3600	200	790	2400	**23**	**970**	**51**	170	0.0059	0.0033	0.00012	**2.2**	**0.55**	<0.00010	<0.0000050	0.08	**0.0039**	0.000062	<0.0020
	17-DC-03	7.8	7.8	3400	3100	170	920	1900	**15**	**900**	**40**	35	0.0068	0.0016	0.00013	**0.008**	<0.020	<0.00010	<0.0000050	0.0031	0.00082	0.000048	<0.0020
TIA Access Road	17-CB-01a	8.2	8	240	220	150	89	140	0.005	14	0.28	7.3	0.014	0.00018	<0.0000050	**0.0053**	0.016	<0.000050	<0.0000050	0.00067	0.00011	<0.000010	0.0016
	17-TLA-01	8	7.5	63	79	160	25	56	0.12	3	0.0058	<0.30	0.081	0.00014	5.6E-06	0.0024	0.069	0.000063	<0.0000050	0.0022	<0.000050	<0.000010	0.0037
	17-TLA-02	7.5	7.5	66	64	170	30	71	0.018	3.8	0.009	<0.30	0.074	0.00015	<0.0000050	0.0026	0.091	<0.000050	<0.0000050	0.0034	<0.000050	<0.000010	0.0029
	17-TLA-03	7.3	7.6	86	81	170	35	75	0.05	4.6	0.0096	<0.30	0.064	0.00022	<0.0000050	0.0029	0.063	<0.000050	0.000005	0.0033	<0.000050	<0.000010	0.0027
	17-TLA-04	7.5	8	260	240	160	110	180	0.13	13	1.7	4.1	0.071	0.00068	0.000011	**0.0067**	0.07	0.000059	<0.0000050	0.0022	0.000088	<0.000010	0.0021
	17-TLA-05	7.7	7.6	99	96	110	43	92	0.024	6.2	<0.0050	<0.30	0.085	0.00026	<0.0000050	**0.0041**	0.061	<0.000050	0.0000053	0.004	0.000053	<0.000010	0.0025
	17-TLA-06	8.5	7.7	81	84	99	33	52	0.084	3.5	0.018	1.2	0.021	0.00013	<0.0000050	0.002	0.016	<0.000050	<0.0000050	<0.00050	<0.000050	<0.000010	<0.0010
Airstrip	17-AIRSTR-01	7.6	8.2	560	510	150	230	320	0.66	34	0.016	12	0.017	0.0035	0.000027	**0.017**	0.049	<0.000050	<0.0000050	0.0042	0.00023	<0.000010	<0.0010
	17-AIRSTR-02	8.2	8.1	230	220	110	92	140	0.12	8.7	0.094	6.5	0.022	0.0022	<0.0000050	**0.014**	0.037	<0.000050	<0.0000050	0.0012	0.00015	<0.000010	<0.0010

Source: \\van-svr0\projects\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\C_Seep_Surveys\June2017%20Seepage%20Survey\4.%20Working%20file\2017_DorisSeep_CompiledData_Rev00_AMD.xlsx

Notes:

(1) *Comparisons to CCME water quality guidelines for the protection of aquatic life are intended for screening purposes and are not directly applicable because the seepage sites do not support aquatic life.

(2) Values in bold indicates value exceeds respective water quality guideline for the parameter.

(3) **Guideline for ammonia is pH and temperature dependent. Seepage waters had an average temperature of 3.6ºC at time of sampling and an average pH of 7.8. This guideline value is approximate.

(4) ***Guideline calculated based on the average hardness of the seepage samples of 195 mg CaCO3 mg/L

3.3 Comparison to Previous Surveys

Table 3 presents a comparison of samples collected in 2017 from the waste rock influenced and reference areas with historical seepage samples collected from the same area (refer to maps in Attachment A). The historical data are presented as 5th, 50th, and 95th percentile statistics, with concentrations below the detection limit assumed to be equal to the detection limit.

3.3.1 Windy Road Area (Reference)

Reference samples collected in 2017 had concentrations generally consistent with the historical dataset.

3.3.2 Waste Rock Influenced Area

Consistent with previous years, seepage results indicated flushing of salts from drilling brines (chloride) and explosives residues (ammonia and nitrate) from the waste rock stockpile. Sulphate concentrations were within historical ranges. Copper, iron and nickel for the stockpile seepage samples (17-DC-01 and 17-DC-02) were higher than historic monitoring data, however this could be due to the fact that these samples represent true contact (undiluted) water and the presence of ore within the stockpile. All other parameters were consistent with the historical dataset.

Table 3: Comparison of Water Quality Results to Range of Observed Data for Waste Rock Influenced Area and Reference Sites

Area	Samples	Sample ID	Lab pH	Lab EC	Total Hardness	TDS	Total Ammonia	Cl	NO3	SO4	Al	As	Cd	Cu	Fe	Pb	Hg	Ni	Se	Tl	Zn
			s.u.	µS/cm	mg CaCO3/L	mg/L	mg N/L	mg/L	mg N/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
		CCME guideline*	*6.5-9*	-	-	-	*4***	*120 mg/L*	*3 mg N/L*	-	*0.1*	*0.005*	*0.0041****	*0.004****	*0.3*	*0.007****	*0.000026*	*0.15****	*0.001*	*0.0008*	*0.03*
Reference (Windy Road)	2017 Samples	17-REF-01	7.4	52	22	57	<0.0050	3.2	<0.0050	<0.30	0.049	0.00018	<0.0000050	0.00086	0.15	<0.000050	<0.0000050	0.0023	<0.000050	<0.000010	0.0033
		17-REF-02	7.5	120	31	80	<0.0050	18	<0.0050	3.3	0.021	<0.00010	<0.0000050	0.00068	0.043	<0.000050	<0.0000050	0.00099	<0.000050	<0.000010	0.0011
		17-REF-03	7.7	93	35	65	<0.0050	6.3	<0.0050	2.5	0.018	<0.00010	<0.0000050	0.0012	0.043	<0.000050	<0.0000050	<0.00050	<0.000050	<0.000010	0.0041
Reference (Windy Road) 2011-2016	2011 to 2016 Statistics	P05	7.2	53	17	33	0.005	3.7	0.005	0.3	0.0059	0.0001	0.000005	0.00084	0.025	0.00005	0.000005	0.0005	0.00005	0.00001	0.0014
		P50	7.5	75	23	57	0.0056	6.3	0.005	0.77	0.019	0.00011	0.00001	0.0012	0.043	0.00005	0.00001	0.00092	0.0001	0.00001	0.0033
		P95	8	200	76	120	0.015	28	0.005	3.9	0.051	0.00021	0.00005	0.0019	0.19	0.00005	0.00001	0.0026	0.001	0.0001	0.0046
		n	19	15	19	19	16	19	19	19	19	19	19	19	19	19	15	19	19	19	19
Waste Rock Influenced Area	2017 Samples	17-DC-01	7.7	3500	750	2300	22	920	48	180	0.0072	0.0074	0.000065	2.1	0.63	<0.00010	0.000007	0.069	0.0038	0.000069	<0.0020
		17-DC-02	7.6	3600	790	2400	23	970	51	170	0.0059	0.0033	0.00012	2.2	0.55	<0.00010	<0.0000050	0.08	0.0039	0.000062	<0.0020
		17-DC-03	7.8	3100	920	1900	15	900	40	35	0.0068	0.0016	0.00013	0.008	<0.020	<0.00010	<0.0000050	0.0031	0.00082	0.000048	<0.0020
Waste Rock Influenced Area 2011-2016	2011 to 2016 Statistics	P05	7.6	420	130	230	0.29	58	1.9	11	0.007	0.00061	0.0000071	0.0028	0.01	0.00005	0.000005	0.00059	0.00025	0.00001	0.0011
		P50	7.9	2400	820	2200	16	840	43	39	0.012	0.0014	0.000034	0.0064	0.03	0.000064	0.00001	0.0018	0.0014	0.000077	0.0025
		P95	8.1	8500	2500	7100	67	2500	140	140	0.032	0.0043	0.00032	0.014	0.065	0.00025	0.00001	0.0066	0.01	0.001	0.03
		n	20	14	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20	20

Source: van-svr0\projects\01_SITES\Hope.Bay\1CH008.023_Geochem_Monitoring\C_Seep_Surveys\June2017%20Seepage%20Survey\4.%20Working%20file\2017_DorisSeep_CompiledData_Rev01_AMD.xlsx

Notes:

(1) All metal concentrations are dissolved

4 Conclusions and Recommendations

The scope of the 2017 Hope Bay seep monitoring survey included infrastructure constructed from quarry rock between fall 2016 and mid-2017 (airstrip expansion, tailings catchment basin, temporary explosives berm by the North dam, the TIA access road between Quarry 3 and the southern end of the TIA) and areas downstream of waste rock stockpiles, including seepage collected from the toe of the stockpiles. All infrastructure surveyed was constructed from rock sourced from Quarry 2. Seepage samples were observed and sampled in all areas except downstream of the temporary explosives berm.

The results of the 2017 sampling program indicate that there are no major issues with respect to metal leaching and acid rock drainage in seepage associated with infrastructure at Hope Bay. Compared with seeps from infrastructure areas, and consistent with previous years, seepage from areas impacted by waste rock had elevated levels of chloride, nitrate and ammonia. Chloride levels are attributed to flushing of drilling brines and nitrate and ammonia levels to blasting residues from the waste rock.

The waste rock toe seepage samples were elevated in arsenic, copper, iron, nickel and selenium concentrations compared to screening criteria and/or historical data. The elevated concentrations may be due to the sample type (undiluted contact water) and the presence of ore in the stockpile that historically contained waste rock only.

Continued monitoring will establish trends in parameter concentrations. The majority of this seepage is captured in the water management system implemented at Doris and directed to the TIA.

Regards,
SRK Consulting (Canada) Inc.

Marie-Christine Noel
Consultant

Reviewed by

Lisa Barazzuol, PGeo (BC)
Senior Consultant

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The opinions expressed in this report have been based on the information available to SRK at the time of preparation. SRK has exercised all due care in reviewing information supplied by others for use on this project. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information, except to the extent that SRK was hired to verify the data.

5 References

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Attachment A – Maps of 2017 Sampling Locations