Pond Inlet Marine
Infrastructure Project

Nunavut Water Board (NWB)
Annual Report 2018

NWB Licence No. 8BW-PIM1821

Tower Arctic Number:	21807
Document Number:	TA_NWB_8DW-PIM1821_Annual_Report_2018
Submitted From:	Tower Arctic LTD.
Submitted To:	Nunavut Water Board
Date Submitted:	March 31st, 2019
Revision:	0

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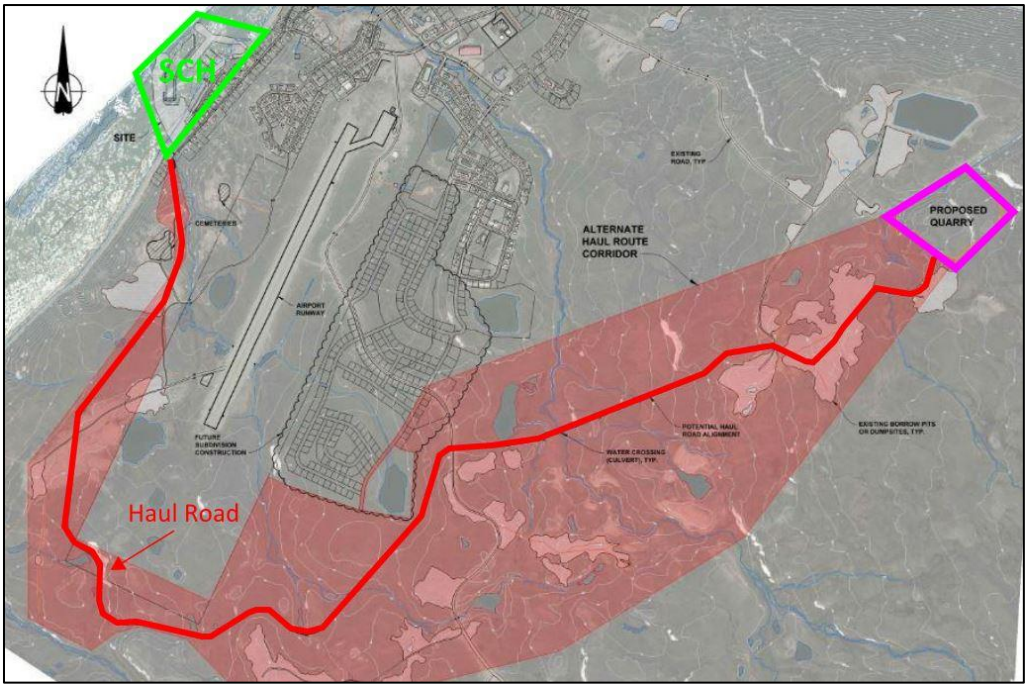
1 Construction Activities and Work Period

In April 2018, Tower Arctic Ltd. (TA) received from the Government of Nunavut (GN) the mandate to build a new Small Craft Harbor (SCH) for the Hamlet of Pond Inlet in the Qikiqtani region of Nunavut.

From August 2018 to November 2018, construction works were carried out for the completion of the haul road and the beginning of the Small Craft Harbor. The main activities realized by TA during season 2018 were; to mobilize the equipment and the workers to Pond Inlet, to develop the quarry, to build the haul road between the quarry and the SCH and finally to begin the fill placement for the West Breakwater. Refer to Figure 1 to see an overview of the project.

FIGURE 1 – PROJECT OVERVIEW, HAMLET OF POND INLET



According to the application form, there were supposed to be approximately 11 culverts installed along the Haul Road. This number was gained from topographic and hydrographic cards during the planning of the project. Once Tower Arctic got on site, TA decided to optimize the alignment of the road, to minimize watercourse crossings and interactions with wetland. Finally, TA only installed 7 culverts alongside the road that TA considered as completed.

Table 1 Shows a list of the construction activities, the start dates and the percentage of completion at the end of the season 2018.

TABLE 1 - CONSTRUCTION COMPONENTS FOR THE PROJECT

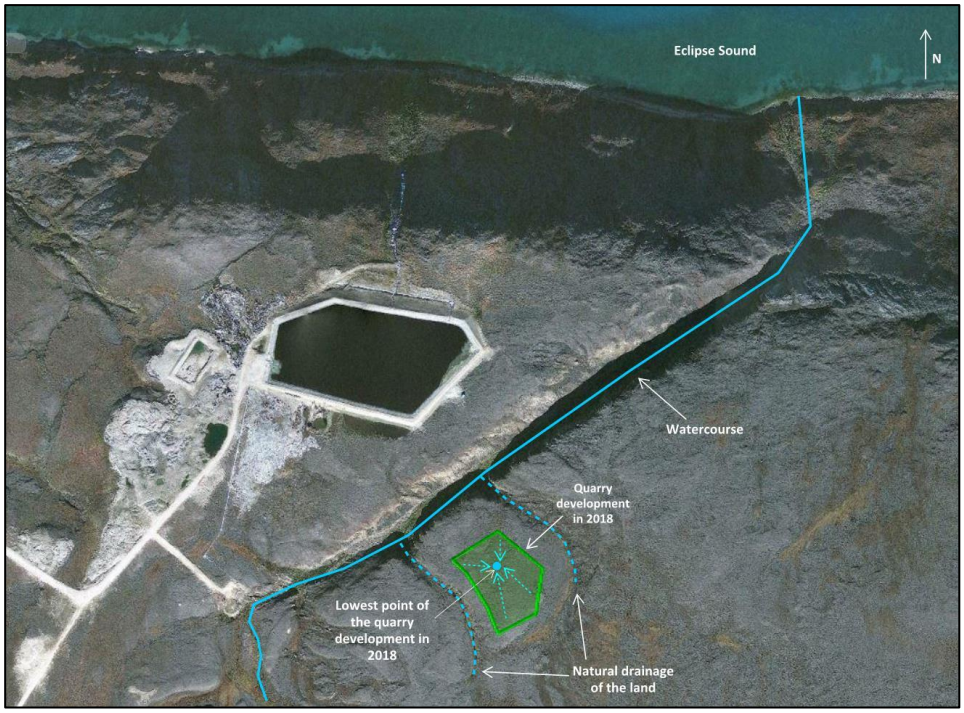
Construction Component	*Date activities started*	*Date activities finished*	*Completion Status*
- **Contractor mobilization**	August 5th 2018	Not finished	± 75%
- **Quarry development**	August 11th 2018	Not finished	± 15%
- **Haul road construction**	August 11th 2018	September 23th 2018	± 100%
- **SCH construction**	September 24th 2018	Not finished	± 20%

1.1 Quarry development

Until the completion of the Small Craft Harbor, the necessary granular material will be produced by the designated quarry for the project. This quarry is located 2,5km east of the hamlet, more than 700m from Eclipse Sound and over 100m from the nearest watercourse. It is to bear in mind that the location of the quarry was part of the client study before the bidding process and that it was mandated to the contractor. The designated land for the establishment of the quarry is flat land with a thin topsoil layer.

Because of the topography of the area, the first step was to create a 20m x 20m open cut to obtain rock faces. By using this method, TA minimized the runoff potential of the quarry, which only was coming from the access ramp. In this manner, the quarry runoff flows to the lowest point of the quarry as it is concave, in comparison with the natural ground level instead of entering in the natural drainage ditches shown on Figure 2.

FIGURE 2 – MAP OF THE QUARRY DEVELOPMENT IN 2018



For 2018 season, a portion of the total volume of rock was blasted and hauled to the SCH or to the stockpile site. The remaining volume of rock will be blasted during both seasons 2019 and 2020. For the remaining quarry operations, TA planned to continue in the same way as in season 2018. TA will enlarge the quarry pit by blasting longer walls while respecting the quarry limits.

Here are some pictures of the different rock faces and the access ramp of the quarry from 2018:

PICTURE 1 – INITIAL SITE PRIOR TO BLASTING OPERATIONS

PICTURE 2 – SITE OVERVIEW AFTER CLEANING OF THE FIRST BLAST

PICTURE 3 – DEVELOPMENT OF THE QUARRY IN SEPTEMBER 2018 (VIEW FROM THE ACCESS RAMP)

1.2 Haul road construction

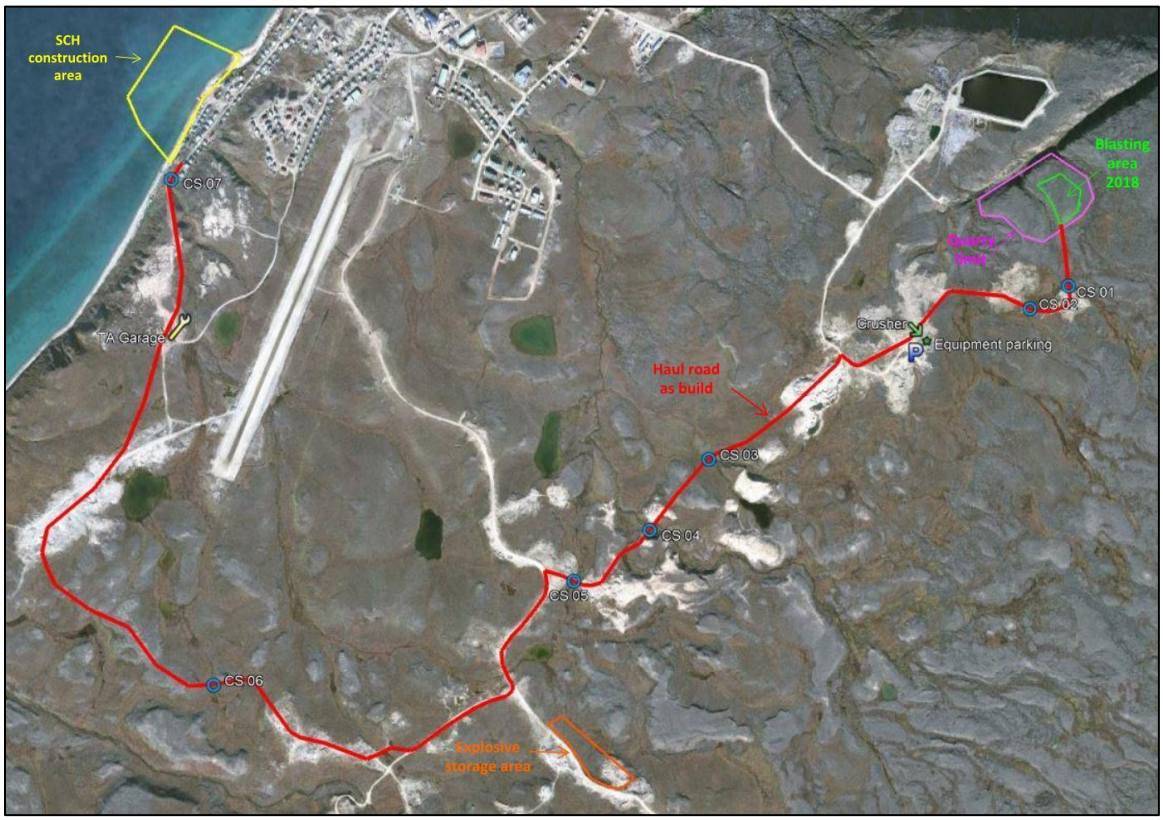
As previously mentioned, the construction of the haul road required the installation of 7 new culverts instead of 11, as planned before. In order to minimize the number of watercourse crossing sites, a field engineer assisted by a surveyor determined the optimal road alignment with as less wetlands as possible while respecting the allowed corridor. The following table presents a summary of the installed culverts during season 2018.

TABLE 2 – CULVERTS SUMMARY

Culvert identification	*X*	*Y*	*Diameter (mm)*
CS01	72°41'25.26"N	77°52'52.44"W	900
CS02	72°41'22.52"N	77°53'8.12"W	900
CS03	72°41'4.32"N	77°55'18.96"W	600
CS04	72°40'55.74"N	77°55'43.05"W	1200
CS05	72°40'49.61"N	77°56'13.95"W	600
CS06	72°40'37.00"N	77°58'40.61"W	600
CS07	72°41'38.15"N	77°58'57.96"W	1200

The diameter of each culvert was chosen accordingly to the size of the watercourse, taking into consideration the potential of the flow increasing during the spring season. In the next figure, all the culverts as mentioned in table 2 are shown on the final haul road alignment.

FIGURE 3 – LOCATION MAP OF THE CULVERT INSTALLATION SITES ON THE HAUL ROAD



During the mobilization, a pre-construction wildlife survey was completed to determine the presence of animals or fish around the construction site, including on the haul road. None of the watercourses crossed by road where identified as fish habitat. TA used a portion of the existing road which included fording at a specific place. TA decided to install a culvert at this location to avoid watercourse turbidity caused by equipment traffic.

Here are the steps that Tower Arctic followed to install each culvert;

- Positioning of the culvert on the bottom of the watercourse;
- Placement of fine granular material around the culvert to fill the gap between the existing road and the culvert;
- Placement of geotextile on both ends of the culverts to prevent erosion of the fine material;
- Placement of a coarse granular material at both ends top also prevent from erosion

Because of the different nature of the soils that were encountered during the construction of the haul road, some specific measures were implemented to ensure the drainage of the road while preventing sediments from entering in the watercourses.

Between kilometer 2.5 and kilometer 3, TA built drainage ditches on both sides of the road to facilitate the drying. Because the ditches were leading to a watercourse (CS-03), a setup of 3 consecutive settling ponds with geotextile were built between each ditch and the watercourse. The next figure is a sketch of this part of the hauling road followed by photos.

FIGURE 4 – SKETCH OF THE SETTLING PONDS ALONG THE HAUL ROAD

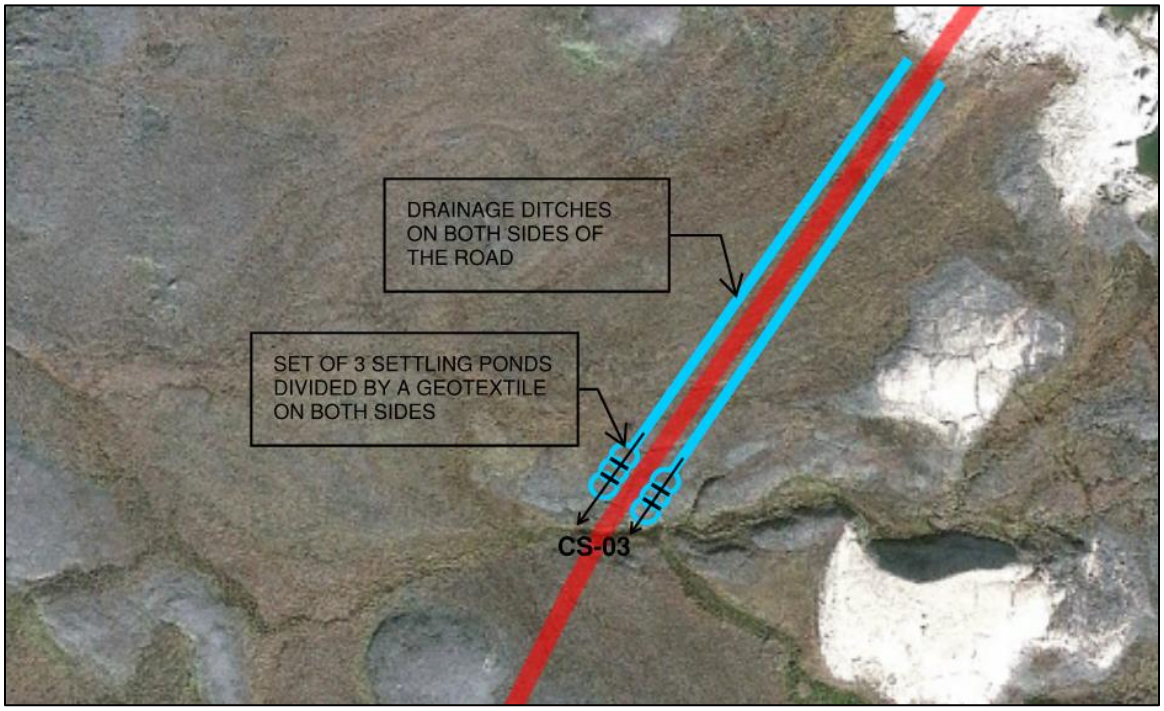


FIGURE 5 – PICTURE OF THE DRAINAGE DITCHES DURING CONSTRUCTION

FIGURE 6 – PICTURE OF SETTLING PONDS RIGHT AFTER CONSTRUCTION

The majority of the rolling surface of the haul road is built with coarse granular material (75mm minus), produced in the quarry. Prior to the beginning of the project, a geotechnical investigation was made to determine the nature of the rock and its properties. A part of this investigation was to determine the acid rock drainage (ARD) potential for this type of rock. Accordingly to the results available in Appendix 1, there is no potential of ARD with the rock that is present on the quarry site. It is to note that the use of coarse granular material as a rolling surface also helps for sediment and dust control.

2 Environmental compliance

2.1 Environmental monitoring

In 2018, TA implemented a Construction Environmental Management Plan (CEMP) to list all the environmental issues and present the mitigation measures related to those issues. Among the different sections of this document, here are those that apply to the NWB license:

- Spill Prevention and Emergency Response
- Spill Prevention and Response Plan
- Vehicle and Equipment Operators and Use
- Blasting Management and Quarry Development
- Sediment and Erosion Control

The implementation of the CEMP was done by an Environmental Monitor (EM) and its delegates.

2.1.1 Environmental Monitor qualification

The EM for the project in Pond Inlet is Olivier Bédard-Richard. Graduated of « Cégep Sainte-Foy College » in Forest Technology, he has more than 7 years experience in environmental monitoring of different construction projects. Most of the projects in which he participated involved environmental monitoring of very sensitive to sedimentation, erosion and also fish habitat work environments. His experience on the field of major construction work allows him to be proactive in order to deal with the environmental issues accordingly to the construction activities.

2.1.2 Environmental Monitor delegates

For the on-site monitoring of concerns in relation with the NWB license, the field engineer was the environmental monitor delegate.

During the haul road construction and the culvert installation, the on-site engineer has been full time present. When the EM was absent, his delegates had the responsibility to complete the EM's tasks, as mentioned below, but not necessary limited to:

a. Sediment and erosion control
b. Fish habitat monitoring
c. Management and monitoring of contingency measures

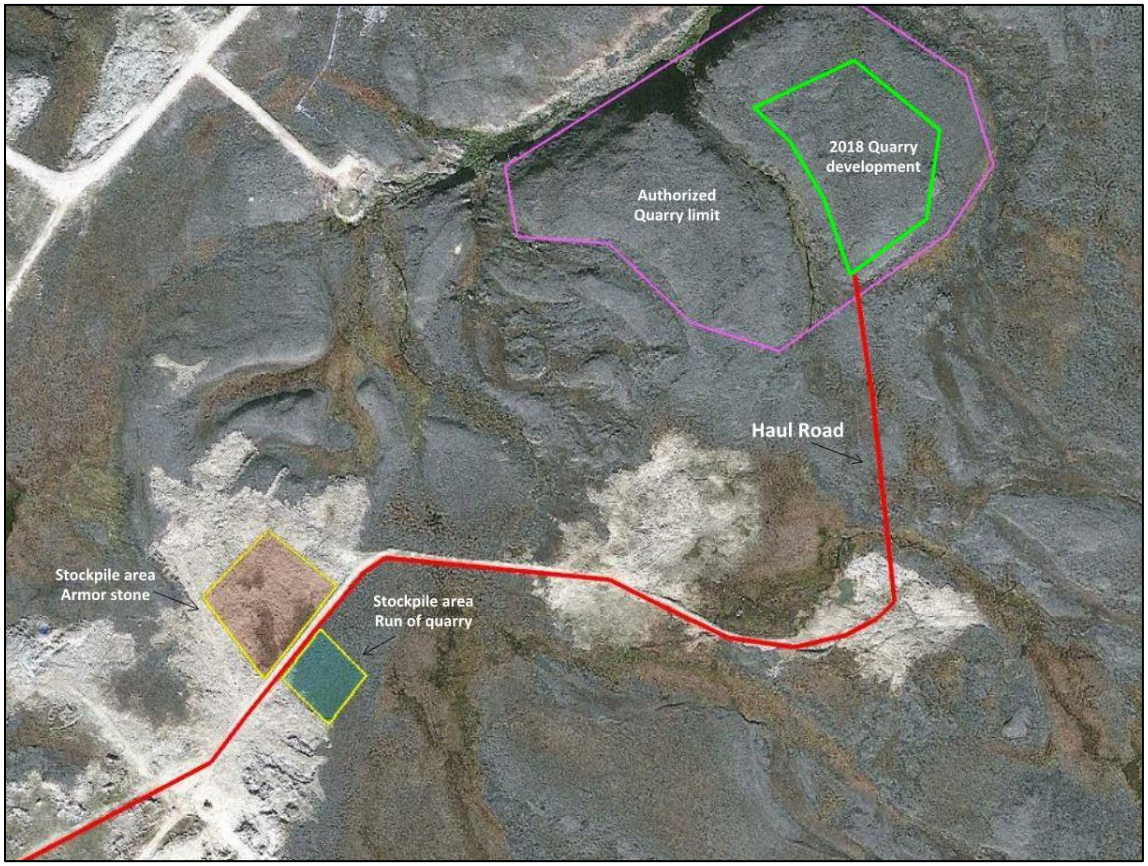
2.1.3 Environmental reports

The main concern about culvert installations in area's, where the surface and the topsoil are permanently frozen, is the increase of volume of the watercourses during the spring season and during heavy rain fall. For this reason, and according to the norms prescribed in the NWB license document, TA created a culvert inspection document, available in Appendix 2.

2.2 Sediment and Erosion Control for Stockpiles

To minimize potential erosion and sedimentation of the stockpiles, all the aggregates were accumulated near the quarry site on flat land without any watercourse at its proximity. Refer to the Figure 5 to locate the stockpiles area.

FIGURE 5 – LOCATION OF THE STOCKPILES AREA



2.3 Haul Road and Culverts Inspection for Next Seasons

Even if TA built every culvert accordingly to standards, a seasonal inspection will be executed by the field engineer at the beginning of seasons 2019 and 2020 (around June-July) to ensure that the culverts are still functional and in place.

Because of the projected traffic on the haul road to transport the material between the quarry site and the construction site, a weekly follow up will take place and maintenance if required.

APPENDIX 1

ARD Laboratory Results

Maxxam

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

Client: WORLEYPARSONS CANADA SERVICES

Table 1: ABA Test Results for project POND INLET

Maxxam Sample No	Sample ID	Paste pH	Paste EC	Rinse pH (on <2mm)	Rinse EC (on <2mm)	CO2	CaCO3 Equiv.	Total S	HCl Extractable Sulphur	HNO3 Extractable Sulphur	Non Extractable Sulphur (by diff.)	Acid Generation Potential	Mod. ABA Neutralization Potential	Fizz Rating	Net Neutralization Potential	Neutralization Potential Ratio
	Units	pH Units	uS/cm	pH Units	uS/cm	wt%	Kg CaCO3/T	wt%	wt%	wt%	wt%	Kg CaCO3/T	Kg CaCO3/T	N/A	Kg CaCO3/T	N/A
RK9703	PIQ17-01-ARD-001	8.89	354	8.89	398	<0.08	<1.8	0.05	0.01	0.04	<0.02	1.3	15.8	NONE	14.5	12.2
RK9704	PIQ17-01-ARD-002	9.16	272	9.15	202	0.11	2.5	0.04	<0.01	0.03	<0.02	0.9	5.80	NONE	4.90	6.4
RK9705	PIQ17-01-ARD-003	9.52	296	9.43	258	<0.08	<1.8	<0.02	0.03	0.02	<0.02	0.6	4.80	NONE	4.20	8.0
RK9706	PIQ17-01-ARD-004	9.47	366	9.40	300	0.10	2.3	0.03	0.01	0.02	<0.02	0.6	7.50	NONE	6.90	12.5
RK9707	PIQ17-01-ARD-005	9.53	306	9.66	256	<0.08	<1.8	0.03	0.08	0.01	<0.02	0.3	5.00	NONE	4.70	16.7
RK9708	PIQ17-01-ARD-006	9.68	333	9.83	264	0.08	1.8	0.08	0.01	0.06	<0.02	1.9	6.50	NONE	4.60	3.4
RK9709	PIQ17-01-ARD-007	9.58	358	9.74	319	<0.08	<1.8	0.28	0.04	0.08	0.16	2.5	5.30	NONE	2.80	2.1
RK9710	PIQ17-01-ARD-008	9.78	313	9.95	268	<0.08	<1.8	<0.02	<0.01	0.01	<0.02	0.3	5.00	NONE	4.70	16.7
RK9711	PIQ17-02-ARD-001	8.87	418	8.96	411	<0.08	<1.8	0.05	0.02	0.03	<0.02	0.9	9.00	NONE	8.10	10.0
RK9712	PIQ17-02-ARD-002	9.23	275	9.38	236	<0.08	<1.8	0.03	0.01	0.02	<0.02	0.6	6.50	NONE	5.90	10.8
RK9713	PIQ17-02-ARD-003	9.29	272	9.32	270	<0.08	<1.8	0.03	0.01	0.02	<0.02	0.6	9.30	NONE	8.70	15.5
RK9714	PIQ17-02-ARD-004	9.41	325	9.73	243	0.13	3.0	0.10	0.01	0.04	0.05	1.3	8.00	NONE	6.70	6.2
Detection Limits		*N/A*	*1*	*N/A*	*0.5*	*0.08*	*1.8*	*0.02*	*0.01*	*0.01*	*0.02*	*0.3*	*0.1*	*N/A*	*0.1*	*0.1*
Maxxam SOP #		*BBY0SOP-00*	*BBY0SOP-00*	*BBY0SOP-00012*	*BBY0SOP-00029*	*LECO*	*BBY WI-00033*	*LECO*	*BBY0SOP-00010*	*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 = HNO3 Extractable Sulphide Sulphur*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.
Non Extractable Sulphur = (Total Sulphur)-(HCl Extractable Sulphate Sulphur)-(HNO3 Extractable Sulphide Sulphur)
Net Neutralization Potential = (Modified ABA Neutralization Potential)-(Acid Generation Potential (HNO3 Extr))
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 EC - based on Field and Laboratory Methods Applicable to Overburdens and Minesoils, (EPA 600 / 2-78-054, March 1978).
Paste pH - Field and Laboratory Methods Applicable to Overburdens and Minesoils, (EPA 600 / 2-78-054, March 1978).
Rinse EC (on <2mm) - Based on Rinse pH Procedure, MEND PREDICTION MANUAL, (MEND Report 1.20.1, December 2009).
Rinse pH (on <2mm) - MEND PREDICTION MANUAL, (MEND Report 1.20.1, December 2009).
HCl Extractable Sulphur is based on a modified version of ASTM Method D 2492-02
HCl Extractable Sulphur and HNO3 Extractable Sulphur is based on a modified version of ASTM Method D 2492-02
Total sulphur, total carbon & carbonate carbon (CO2; HCl direct method) by Leco.

APPENDIX 2

Culverts Visual Inspection Form

Culverts Visual Inspection Report

Date: _____ Inspector name: _____

Temperature: _____ Location/Contract: _____

Inspection Type: (Spring inspection, Weekly inspection, End of the year inspection): _____

Inspection Item:	CS-01	CS-02	CS-03	CS-04	CS-05	CS-06	CS-07
Water Flow Issue							
Structural Issue							
Sediment Issue							
Embankment Issue							
Corrective action required (Y/N) **If there is any action required please refer to the next section**							

Culvert identification number: _____ Immediate correction needed (YES/NO): _____
Superintendant was made aware (YES/NO): _____
Problem description/corrective action:

Culvert identification number: _____ Immediate correction needed (YES/NO): _____
Superintendant was made aware (YES/NO): _____
Problem description/corrective action:

Culvert identification number: _____ Immediate correction needed (YES/NO): _____
Superintendant was made aware (YES/NO): _____
Problem description/corrective action:

Culvert identification number: _____ Immediate correction needed (YES/NO): _____
Superintendant was made aware (YES/NO): _____
Problem description/corrective action: