APPENDIX C

AS BUILT AND INFRASTRUCTURE MONITORING REPORTS

APPENDIX C.1

CONSTRUCTION SUMMARY REPORT

BAFFINLAND IRON MINES CORPORATION

MARY RIVER PROJECT

Construction Summary Report
Mine Site Waste Rock Facility Expansion and Drainage System
Construction of West Ditch and East Ditch phase 2021
December 2021

PERMIT TO PRACTICE
BAFFINLAND IRON MINES CORPORATION
Signature
Date 16MAR2022
PERMIT NUMBER: P 712
NT/NU Association of Professional Engineers and Geoscientists

REGISTERED PROFESSIONAL ENGINEER
A.A. NAJEY
LICENSEE
NT/NU

Date	Rev.	Prepared By
2021-11-28	0	Abid A Najey, P.Eng.

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Name and Operator of the Mine:	**Baffinland Iron Mines - Mary River Project** **Baffinland Iron Mines Corporation**
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1. FACILITY DESCRIPTION

1.1 PURPOSE

Baffinland Iron Mines Corporation (Baffinland) operates an iron mine at the Mary River Project (the Project) in the North Baffin Region of Nunavut. Ore is mined from Deposit 1, crushed on site, and hauled to Milne Port (approximately 100 km from site) where it is stockpiled and shipped off-site for processing. Waste rock from the open pit is disposed of at the Waste Rock Facility (WRF) which is located to the north of the open pit. The location of the facility is provided in Appendix B.

Waste rock produced from the open pit mining operation is managed at the WRF, which consists of a waste rock stockpile, a sedimentation pond (WRF Pond), and perimeter ditches. The WRF was designed to intercept, convey and treat contact water before discharging to the environment. The WRF Pond Expansion project includes the WRF Pond, West Ditch and East Ditch. This report focuses on the West Ditch and East Ditch areas that were constructed in 2021 (Phase 2021).

The WRF Pond Expansion project started in June 2019. The purpose of the project is to intercept and direct the runoff generated over the area of the Proposed WRF footprint (around 503 000 m^2), as shown in drawing (G-200) in Appendix A, to the retention pond which is located to the north of the Existing Waste Rock Facility.

The interception system includes the West Ditch and East Ditch. The West Ditch has a total length of 1081 m and extends along the west side of the Existing Waste Rock Facility to intercept runoff flows in the west direction. The East Ditch has a total length of 1066 m and extends along the east side of the Existing Waste Rock Facility to intercept runoff flows in the east direction. The two ditches were constructed in two stages, in the year 2020 West Ditch station (0+000 to 0+450) and East Ditch station (0+000 to 0+680) were constructed, while the remainder of this expansion was constructed in 2021. The 2021 construction period includes the construction of East Ditch station (0+683.3 to 1+066.51) and the West Ditch station (0+450 to 1+081.49), as shown on Figure-1.

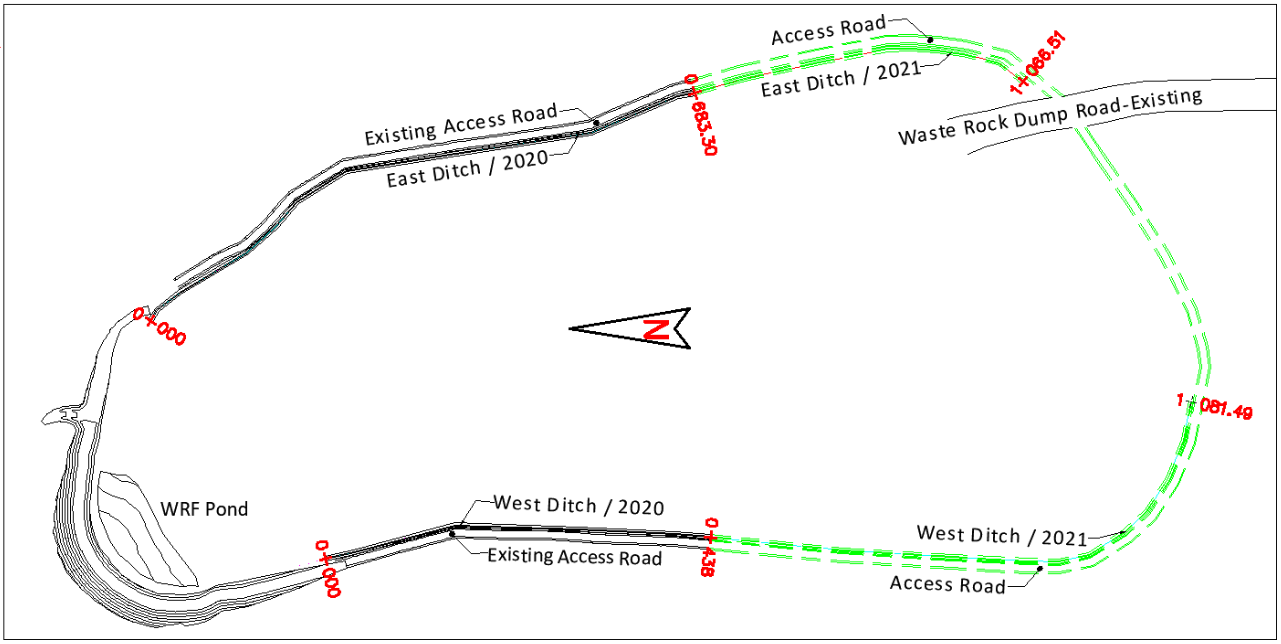


Figure 1 – West/East Ditch 2020/2021 construction phases.

1.2 DESIGN BASIS

In general, the WRF Pond and the WRF Expansion Drainage System have been designed in accordance with:

- the recommendations provided by the Canadian Dam Association (CDA) per Golder Associates Ltd. (Golder) WRF Pond Expansion Drainage System report (Appendix A).
- Canadian Dam Association Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams (CDA 2014);
- Canadian Dam Association's Dam Safety Guidelines (CDA 2007); and
- The provisions of Type 'A' Water License No. 2AM-MRY1325 Amendment No. 1.

The design of the WRF Expansion Drainage System is provided on the Golder Issued for Construction (IFC) drawings (Appendix A).

The ditches as shown in the drawings have trapezoidal cross section with 1.0m bottom width, 1.0m depth and 4.42m upper width. The side slopes are 2 horizontal to 1 vertical. The bottom and slopes are covered with a layer of 300 mm thickness of D_{50}=200mm riprap. The layer of riprap provides protection against erosion that may occur during the melting season or heavy rainfall.

The slope of the ditch vertical alignment was designed based on the topographic survey data, taking into account the potential for erosion and sediment transport. Based on the topography and design criteria set by Golder the minimum and maximum redesigned slopes of the West Ditch are 1.35% and 2.39% respectively. The East Ditch redesigned minimum and maximum slopes are 1.24% and 5% respectively.

To divert the clean runoff from entering into the ditch, a diversion berm was designed by Golder. The berm extends along and beyond the two ditches with a height equal to 1m above the upper edge of the ditch, the width of crest is 1m with side slopes 2 horizontal to 1 vertical.

1.3 GENERAL SCOPE OF WORK

The WRF Expansion West and East ditches involved the following scope of work:

- Construct the Diversion Berm which acts as an access road extending along the two ditches for accessing the WRF facility, construct the East Ditch station (0+683.3) to (1+066.51) and the West Ditch station (0+450) to (1+081.49);
- Layout the horizontal alignment of the West/ East ditches by using GPS device and timber stakes, according to the design lines and elevations;
- Excavate the West/East ditches to the permafrost level according to the design cross section, see Figure-2;
- Install check dams to intercept and prevent eroded sediment from migrating into the WRF Pond;
- Rip and excavate the West/East ditch to design level and shape the side slopes according to the cross section;
- Install non-woven geotextile fabric in West/East ditches and on the diversion berm side slope next to the ditches;

- Place 300 mm layer of D_{50} =200 mm riprap on the bottom and side slopes of the West/East ditches;
- Install a culvert for the existing 200 mm (8 in) high density polyethylene (HDPE) dewatering pipeline through the Diversion Berm; and
- Monitor the quality of construction work, and carry out As-built surveys;

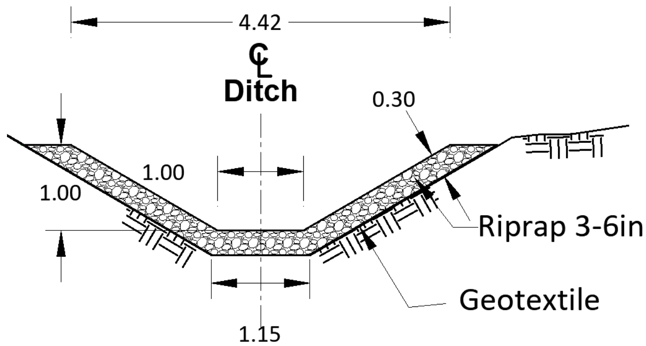


Figure 2 - Ditch typical cross section.

1.4 LOCATION AND BASE ELEVATIONS

East Ditch starts at elevation 580.14m above sea level and ends at elevation 624.11m.
The West Ditch starts at elevation 577.76 m above sea level and ends at elevation 608.23m.

Table-1 Elevations and coordinates of principle points/ ditch centerline.

Location	Northing	Easting	Elev. (m)
East Ditch Station (0+000)/ Construction 2020	7916744.05	563143.03	580.14
East Ditch Station (0+683)/ Construction 2020	7916131.77	563399.26	604.34
East Ditch Station (1+066.51)/ Construction 2021	7915763.26	563411.18	624.11
West Ditch Station (0+000)/ Construction 2020	7916595.27	562863.22	577.76
West Ditch Station (0+438))/ Construction 2020	7916104.64	562898.88	585.51
West Ditch Station (1+081.49)/ Construction 2021	7915561.68	563046.34	608.23
Pipe Culvert	7915781.62	563425.87	607.33

Table-2 Elevations, coordinates and slopes of East Ditch.

Station	N (m)	E (m)	Riprap Elev.	Slope
0+683.3	7916131.77	563399.26	604.34	4.90%
0+700	7916115.69	563403.82	605.15	
0+725	7916091.67	563410.64	606.38	
0+750	7916067.47	563416.92	607.60	
0+775	7916043.03	563422.16	608.83	
0+800	7916018.58	563427.41	610.05	
0+825	7915994.14	563432.65	611.28	
0+850	7915969.61	563437.54	612.50	
0+875	7915945.11	563442.4	613.73	
0+900	7915920.57	563447.26	614.95	
0+925	7915895.68	563448.79	616.33	5.50%
0+950	7915870.73	563447.58	617.70	
0+975	7915845.91	563444.76	619.08	
1+000	7915821.36	563440.23	620.45	
1+025	7915797.08	563434.26	621.83	
1+050	7915776.16	563421.52	623.20	
1+066.51	7915763.26	563411.18	624.11	

Table-3 Elevations, coordinates and slopes of West Ditch.

Station	N (m)	E (m)	Riprap Elev.	Slope
0+438	7916114.39	562900	585.51	1.20%
0+450	7916102.55	562898.88	585.66	
0+475	7916077.68	562896.36	585.96	
0+500	7916052.81	562893.84	586.26	
0+525	7916027.93	562891.36	586.56	
0+550	7916003.06	562888.99	586.86	
0+575	7915978.16	562886.62	587.16	
0+600	7915953.24	562884.68	587.46	
0+625	7915928.29	562883.16	587.76	
0+650	7915903.35	562881.63	588.06	
0+675	7915878.38	562880.11	588.36	
0+700	7915853.43	562878.58	589.06	2.80%
0+725	7915828.47	562877.12	589.76	
0+750	7915803.51	562875.7	590.46	
0+775	7915778.55	562874.37	591.59	4.50%
0+800	7915753.57	562873.24	592.71	
0+825	7915728.58	562872.91	593.84	
0+850	7915704	562876.91	595.09	5%
0+875	7915680.83	562885.23	596.34	
0+900	7915659.78	562898.71	597.59	
0+925	7915640.04	562913.88	598.84	
0+950	7915622.12	562931.28	600.34	6%
0+975	7915606.45	562950.75	601.84	
1+000	7915592.22	562971.19	603.34	
1+025	7915580.49	562993.26	604.84	
1+050	7915570.92	563016.24	606.34	
1+075	7915563.59	563040.13	607.84	
1+81.49	7915561.68	563046.34	608.23	

2. CONSTRUCTION OF WEST AND EAST DITCHES

The materials used for constructing the West and East Ditches are as specified in Golder WRF Pond Expansion Drainage System Report (Appendix A) and listed below:

- 500 mm minus rockfill (Run of Quarry (ROQ))
- D_{50}=200 mm clear riprap
- Layfield LP7 non-woven geotextile

All riprap was hauled to the construction site using the newly constructed access roads. During the 2021 construction period the two access roads (Diversion Berms) were extended beyond the upstream ends of the two ditches. The ROQ was placed directly on the ground within the predetermined lines followed by spreading, leveling and compacting using a CAT D8 Dozer.

The access roads are intended to:

- Provide a access to the WRF Treatment Plant;
- Provide access for construction of the West/East Ditch;
- Allow maintenance of the Waste Rock Facility ditches;
- Act as the facility diversion berm to direct non-contact water around the facility

The West and East Ditches alignments were laid out, and the upper edges of the slopes were marked on the ground to avoid any extra excavation and land disturbance. Excavation was carried out by 374 CAT excavator, and started from the end of the ditch constructed in 2020 in the upstream direction to the last station. Excavated material from the ditches was placed on the outside edge of the Diversion Berm, leveled and compacted to add extra width to the berm.

As the excavation was completed in the melting season, the contractor was directed to install sediment barriers in a number of locations to better control and remove the sediment that builds up upstream of the barriers. Additionally, geotextile cover was used to cover the excavated slopes in the areas where cohesionless soil was observed. This technique was quite effective in protecting the side slope from being eroded by the runoff generated during and after severe storms. Various sizes of boulders were encountered during the excavation. All boulders were extracted and relocated away from the ditch boundary. Boulder holes were filled with a suitable material to restore the uniform trapezoidal shape of the ditch.

Immediately after shaping the ditch cross section to the design lines and elevations, a non-woven geotextile was placed such that complete contact between the side slope surface and the geotextile was achieved. A 300 mm thick layer of riprap size D_{50}=200 mm was placed and arranged to minimize the voids between rocks. To ensure better protection of the diversion berm side slope the geotextile and riprap layer were extended to the upper edge which exceeds the design limits.

3. CONSTRUCTION ACTIVITY SUMMARY

The following sequence of construction occurred at the WRF Pond Expansion West and East Ditches:

1) Constructed West Diversion Berm (phase 2021) – Started April 12, 2021, Completed May 21, 2021
   a) Laid out West Diversion Berm centerline on the ground by offsetting the West Ditch centerline by 8.5 m, and marked the left/right boundaries.
   b) Cleared snow, stripped organic and deleterious materials at the berm's base.
   c) Placed ROQ material, levelled and compacted to elevation of 1 m above existing ground.
   d) Shaped the side slopes and dressed the surface.

2) Constructed West Ditch (phase 2021) – Started June 26, 2021, Completed July 28, 2021
   a) Staked out bottom ditch stations from 0+450 to 1+081.49 and marked upper width.
   b) Excavated the ditch and removed boulders.
   c) Installed check dams and silt fencing.
   d) Shaped ditch bottom and side slopes to the design contours and elevations.
   e) Placed non-woven geotextile.
   f) Placed D_{50}=200 mm clear riprap.

3) Removed snow and ice to expose natural ground along the East Ditch started June 29, 2021.

4) Constructed East Ditch (phase 2021) – Started August 2, 2021, Completed September 15, 2021
   a) Staked out bottom ditch stations from 0+683.30 to 1+066.51 and marked upper width.
   b) Excavated the ditch and removed boulders.
   c) Installed check dams and excavated temporary diversion ditch.
   d) Shaped ditch bottom and side slopes to the design contours and elevations.
   e) Placed non-woven geotextile.
   f) Place D_{50}=200 mm clear riprap.

5) Construct East Diversion Berm (phase 2021) – Started August 5, 2021, Completed August 17, 2021
   a) Laid out East Diversion Berm centerline on the ground by offsetting the East Ditch centerline by 8.5 m, and marked the left/right boundaries.
   b) Cleared snow, stripped organic and deleterious materials at the berm's base.
   c) Placed ROQ material, levelled and compacted to elevation of 1 m above existing ground.
   d) Installed pipe culvert through berm for existing HDPE dewatering pipeline protection.
   e) Shaped the side slopes and dressed the surface.

In summary, construction activities for the West and East ditches (phase 2021) began April 12, 2021 and were completed by September 15, 2021.

4. CONSTRUCTION QUALITY CONTROL

4.1 SCOPE

Construction Quality Control (CQC) refers to measures implemented by Baffinland and its Contractors to verify that materials used in construction and their workmanship meet the requirements of the Issued for Construction (IFC) drawings, design criteria, and specifications. The CQC actions included, but were not limited to: verifying the suitability of construction material properties with field testing and/or visual inspection, documenting testing procedures and results, and documenting construction activities including verification of design geometry through survey and maintaining photographic records.
The CQC activities carried out by Baffinland are described below.

4.2 VISUAL INSPECTIONS AND DOCUMENTATION OF CONSTRUCTION ACTIVITIES

Baffinland Engineer(s) maintained daily field representation where they provided the Contractor with directions related to safety, construction planning, equipment management, QA/QC assurance and conformance to design review.

- Review plans and specifications;
- Document activities and take photographic records,
- Contractor staff performance evaluation;
- Visual inspection;
- Material inspection;
- Elevation and positioning verification;
- Survey device accuracy check; and
- Baffinland policy and procedure adherence.

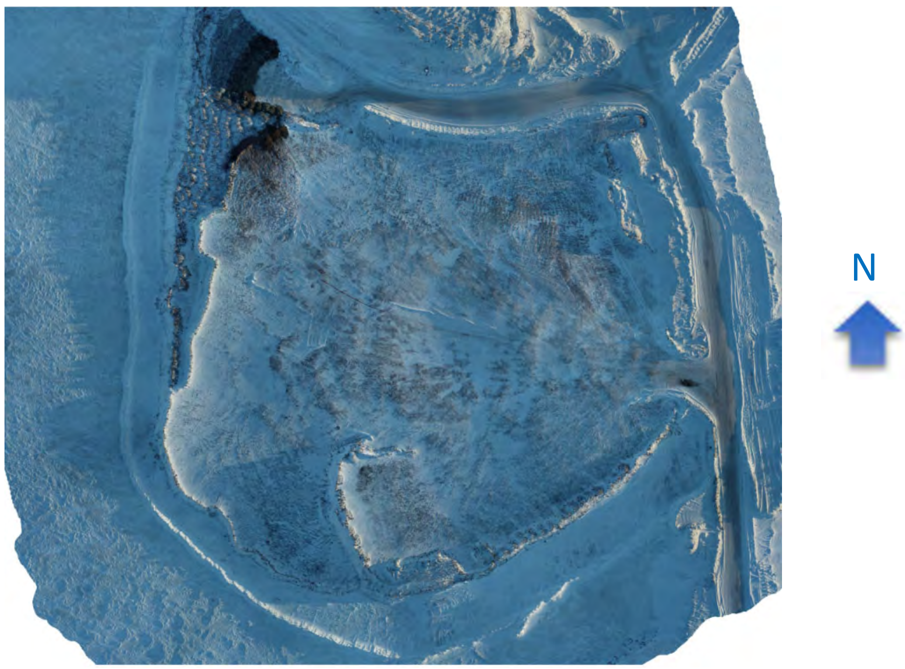
Through the entire period of construction, the daily visual inspection was conducted by a Baffinland Engineer to ensure that all design and specification requirements were applied. Pre-selected points at strategic locations and randomly selected points were surveyed and compared to design elevations and coordinates. Survey data was recorded and documented, see as-built documentation for final survey elevations (Tables 4 and 5).

Prior to their use in construction. All materials were visually verified for suitability and conformity to specifications, and unsuitable materials were rejected. Technicians and operators were closely monitored for performance evaluation and correction of poor construction practices or productivity improvement. Survey data was collected using aerial drone scans, and compared to the data obtained from conventional GPS field survey devices. The Contractor was requested to place suitable barriers to control sediment transport and to separate the clean runoff from contact water. All water in the construction area (contact water) was diverted to the existing WRF sedimentation pond for treatment, and all clean runoff water was diverted around the construction areas and WRF.

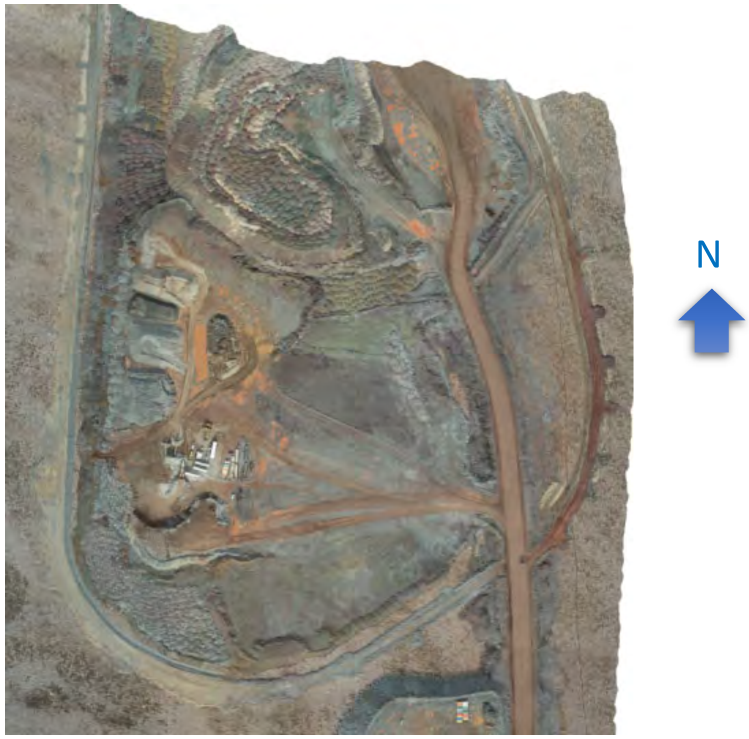
The Contractor was requested to provide a Daily Construction Progress Report (see Appendix F) in which the below activities were described:

- Daily activities completed;
- Planned activities for next day;
- Contractor remarks;
- Completed quantities;
- Manpower and equipment information; and
- Project photos.

5. PHOTOGRAPHIC RECORDS



Photograph 1- Drone Photo of Area Prior to Construction, April 9, 2021.



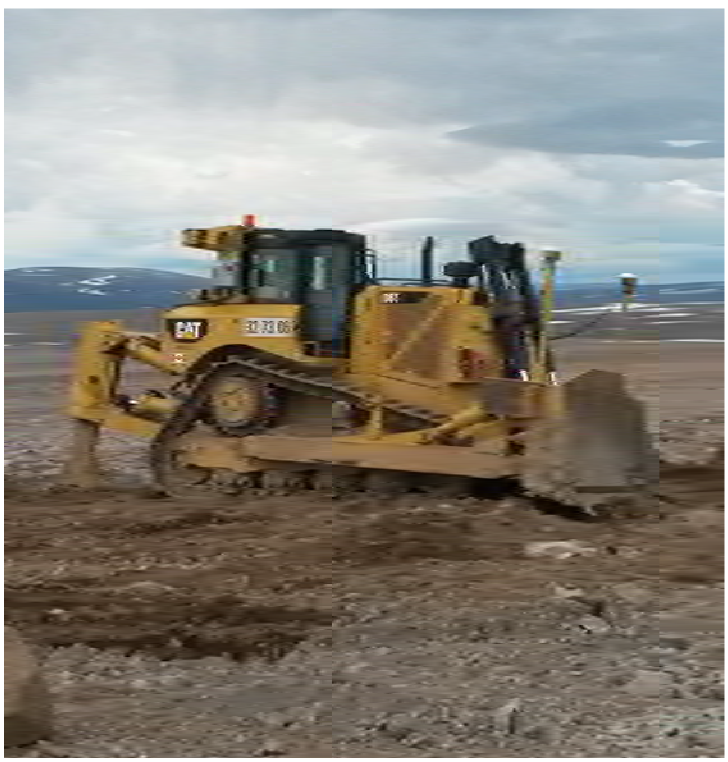
Photograph 2- Drone Photo of Construction Area, August 21, 2021.

Photograph 3- West Ditch placement of stakes and survey marks, June 26, 2021.

Photograph 4- West Ditch excavation began at station 0+438, June 27, 2021.

Photograph 5- West Ditch excavation along ditch alignment, June 28 2021.

Photograph 6- West Ditch construction of check dam, June 28, 2021.



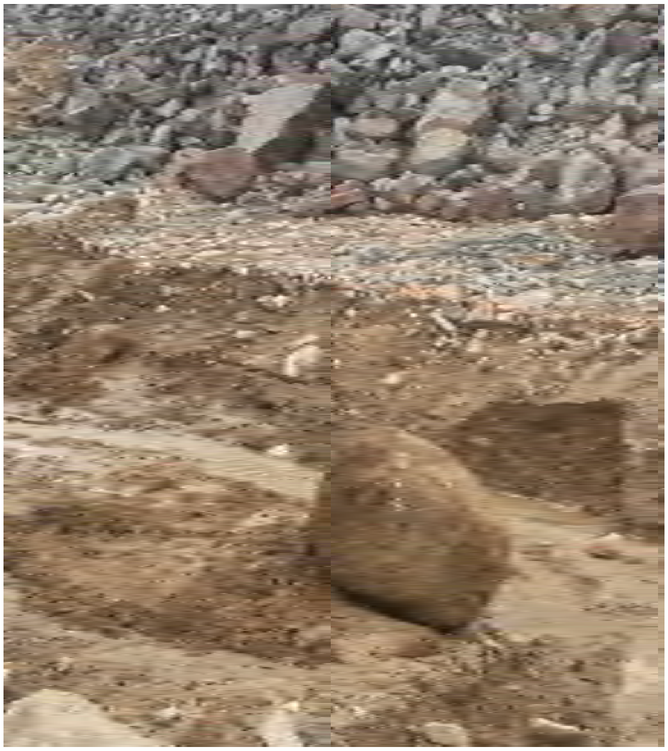
Photograph 7- West Ditch excavated material leveled by D8 Dozer, June 29 2021.

Photograph 8- East Ditch snow removal and temporary ditch construction, June 29, 2021.

Photograph 9- West Ditch excavation in soft soil, July 1, 2021.

Photograph 10- West Ditch bottom elevation check, July 2, 2021.

Photograph 11- West Ditch geotextile installation, July 26, 2021.



Photograph 12- West Ditch boulder removal, July, 2 2021.

Photograph 13- West Ditch riprap layer for erosion protection, July 28, 2021.

Photograph 14 – West Ditch Completion, August 6, 2021.

Photograph 15- East Ditch excavation close to limits of excavation, August 6, 2021.

Photograph 16- East Ditch Excavation, August 8, 2021.

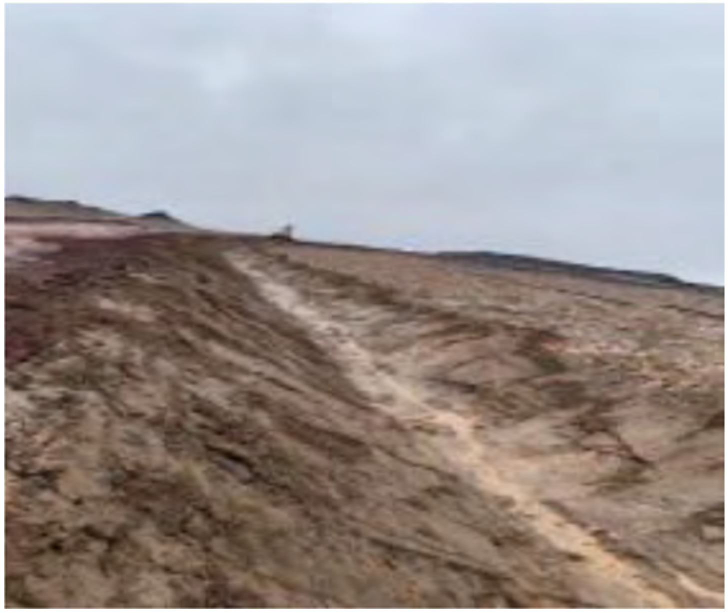
Photograph 16- East Ditch pipe culvert installation for protection of existing HDPE pipeline, August 8, 2021.

Photograph 18- East Ditch excavation in soft soil, August 10, 2021.

Photograph 19- East Ditch boulder removal during construction, August 10, 2021.

Photograph 20- East Ditch placement of rockfill for Diversion Berm August 14, 2021.

Photograph 21- East Ditch side slope excavation, August 15, 2021.



Photograph 22- East Ditch side slopes finished to design level August 16, 2021.

Photograph 23- East Ditch placement of non-woven geotextile, August 26, 2021.

Photograph 24- East Ditch riprap cover of 280 mm thickness, August 27, 2021.

6. AS-BUILT DRAWINGS

As-Built survey data was collected by using GPS and Drone surveys. Coordinates, elevations and images were treated and presented in the form of tables, lines and images in order to simplify the engineering information.

As-built drawings and coordinates are presented in Appendix E.

Figure-25 includes a recent drone image taken after the construction which clearly shows the real changes on the ground compared to the design drawings. The development of the WRF can be clearly seen in the image where the West and East Diversion Berms extend to intercept and direct the runoff to the two ditches.

Tables 4 and 5 provide design and as-built elevations of the ditch centerline at the top of the 0.3 m riprap thickness for the East and West ditches, respectively.

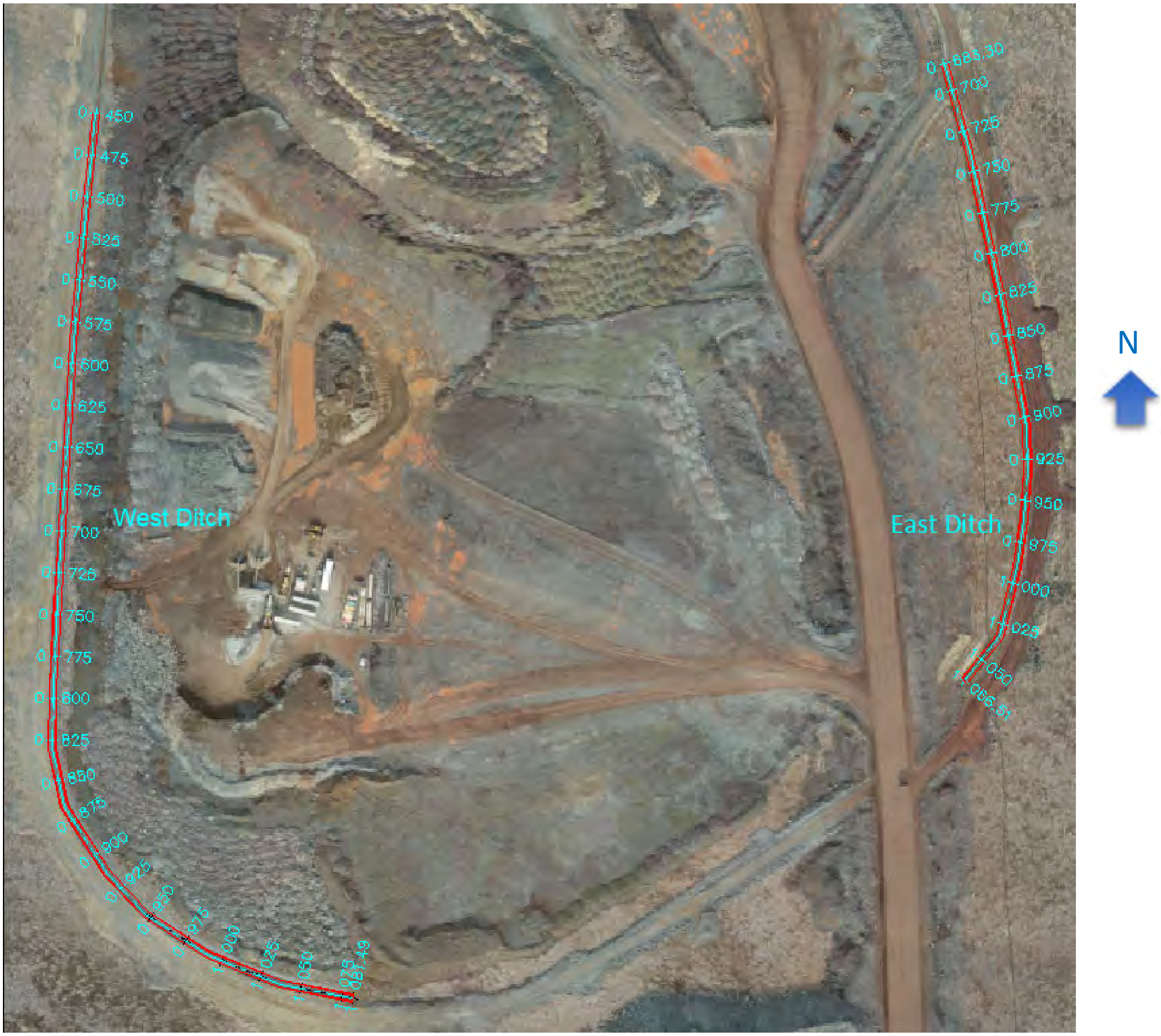
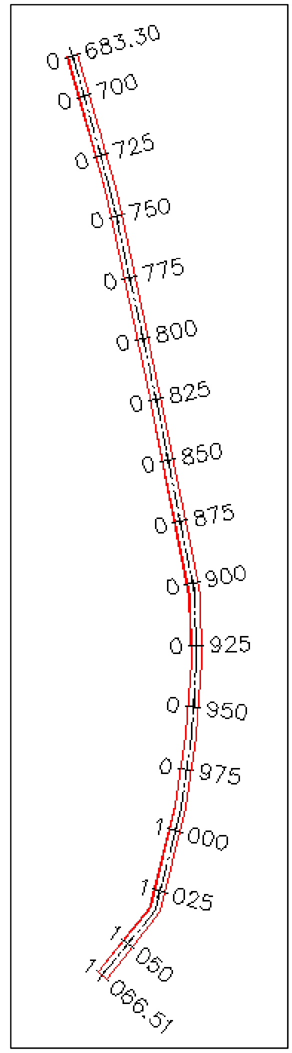


Figure 3- Photograph after completion of West and East Ditches with As-Built Overlay (see As-Built Drawing in Appendix E).

Table 4- East Ditch Riprap design and as-Built elevations.

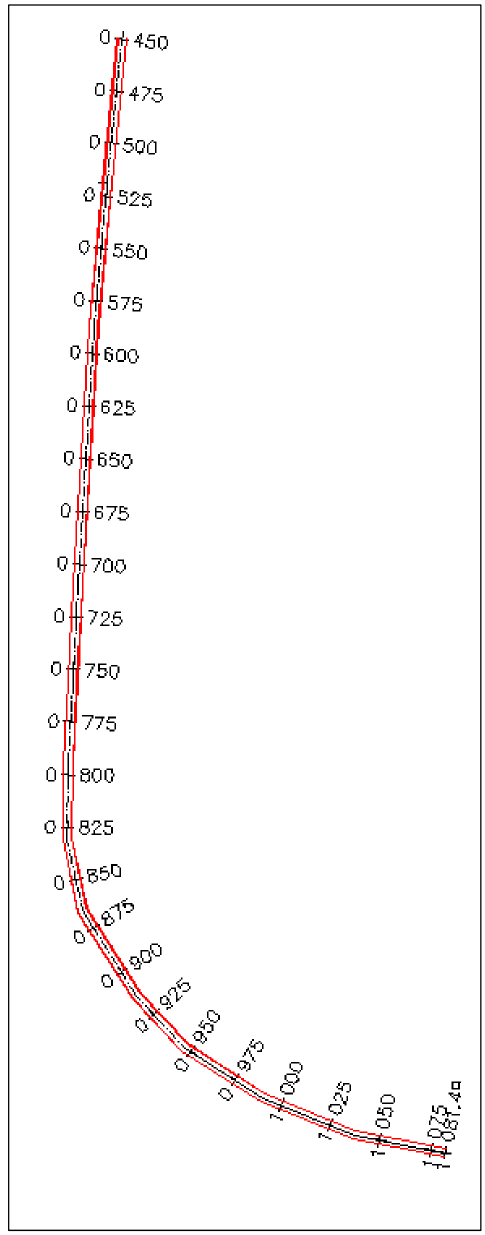
Station	N (m)	E (m)	Riprap Design Elev.	Riprap As-Built Elev. (m)	Slope
0+683.3	7916132	563399.3	604.34	604.28	4.90%
0+700	7916116	563403.8	605.15	605.21	
0+725	7916092	563410.6	606.38	606.44	
0+750	7916067	563416.9	607.60	607.89	
0+775	7916043	563422.2	608.83	608.74	
0+800	7916019	563427.4	610.05	610.10	
0+825	7915994	563432.7	611.28	611.30	
0+850	7915970	563437.5	612.50	612.52	
0+875	7915945	563442.4	613.73	613.65	
0+900	7915921	563447.3	614.95	615.03	
0+925	7915896	563448.8	616.33	616.46	5.50%
0+950	7915871	563447.6	617.70	617.80	
0+975	7915846	563444.8	619.08	618.97	
1+000	7915821	563440.2	620.45	620.81	
1+025	7915797	563434.3	621.83	621.93	
1+050	7915776	563421.5	623.20	623.19	
1+066.51	7915763	563411.2	624.11	624.25	



East Ditch Horizontal Alignment

Table 5- West Ditch Riprap finished and as-Built elevations

Station	N (m)	E (m)	Riprap Design Elev.	Riprap As-Built Elev. (m)	Slope
0+438	7916114	562900	585.51	585.57	1.20%
0+450	7916103	562898.9	585.66	585.70	
0+475	7916078	562896.4	585.96	585.88	
0+500	7916053	562893.8	586.26	586.27	
0+525	7916028	562891.4	586.56	586.53	
0+550	7916003	562889	586.86	586.99	
0+575	7915978	562886.6	587.16	587.11	
0+600	7915953	562884.7	587.46	587.43	
0+625	7915928	562883.2	587.76	587.64	
0+650	7915903	562881.6	588.06	587.98	
0+675	7915878	562880.1	588.36	588.35	
0+700	7915853	562878.6	589.06	589.13	2.80%
0+725	7915828	562877.1	589.76	589.99	
0+750	7915804	562875.7	590.46	590.87	
0+775	7915779	562874.4	591.59	591.72	4.50%
0+800	7915754	562873.2	592.71	592.76	
0+825	7915729	562872.9	593.84	593.89	
0+850	7915704	562876.9	595.09	594.90	5%
0+875	7915681	562885.2	596.34	596.39	
0+900	7915660	562898.7	597.59	597.59	
0+925	7915640	562913.9	598.84	599.06	
0+950	7915622	562931.3	600.34	600.39	6%
0+975	7915606	562950.8	601.84	602.02	
1+000	7915592	562971.2	603.34	603.76	
1+025	7915580	562993.3	604.84	605.13	
1+050	7915571	563016.2	606.34	606.79	
1+075	7915564	563040.1	607.84	608.66	



West Ditch Horizontal Alignment

1+81.49	7915562	563046.3	608.23		

7. FIELD DECISIONS & DEVIATIONS

1- As mentioned in the Construction Summary Report for the 2020 phase of this work, the Diversion Berm was modified from the original design. In drawing C-130 produced by Golder (Appendix A), the crest width of the berm was designed to be 1 m, with side slopes 2 m horizontal to 1 m vertical. Baffinland's Engineer increased the total width of the Diversion Berm, for both ditches, from 1 m to 8 m while maintaining the slope of the side slopes (see Figure 24). This modification was necessary to provide construction equipment with stable access during the summer construction period. After construction, the berm will provide the maintenance team with year-round access to the WRF Pond and West and East Ditches. The two diversion berms form a ring road that runs around the Waste Rock Facility with a total length greater than 2.5km.

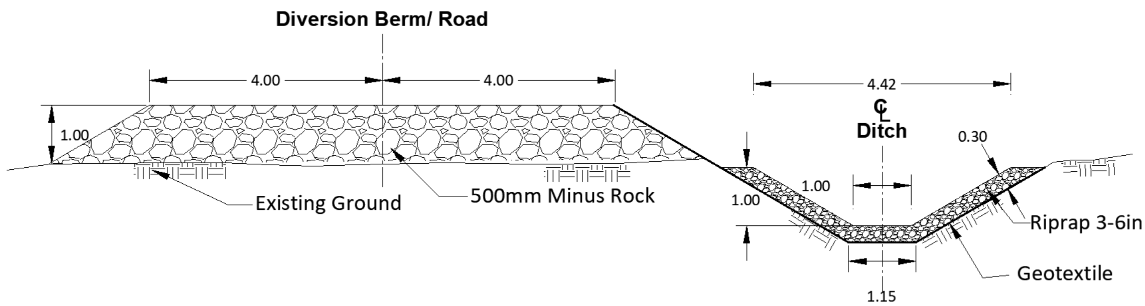


Figure 4 - Ditch and modified Diversion Berm typical cross section.

2- Baffinland's Engineer has modified the alignment of the West Ditch from station (0+947) to (1+081.49) as shown in Figure 25 and in Appendix D. The amount of shifting from IFC drawing number G-200 produced by Golder is 0 m (zero) at (D33) station (0+947) to around 14 m at (D36) station (1+081.49). This modification was deemed necessary based on site observations and engineering judgement. With this modification, the West Ditch is within the limit of minimum 3m buffer from the waste rock and better oriented to capture the contact water runoff flows to be directed to the WRF Sediment Pond.

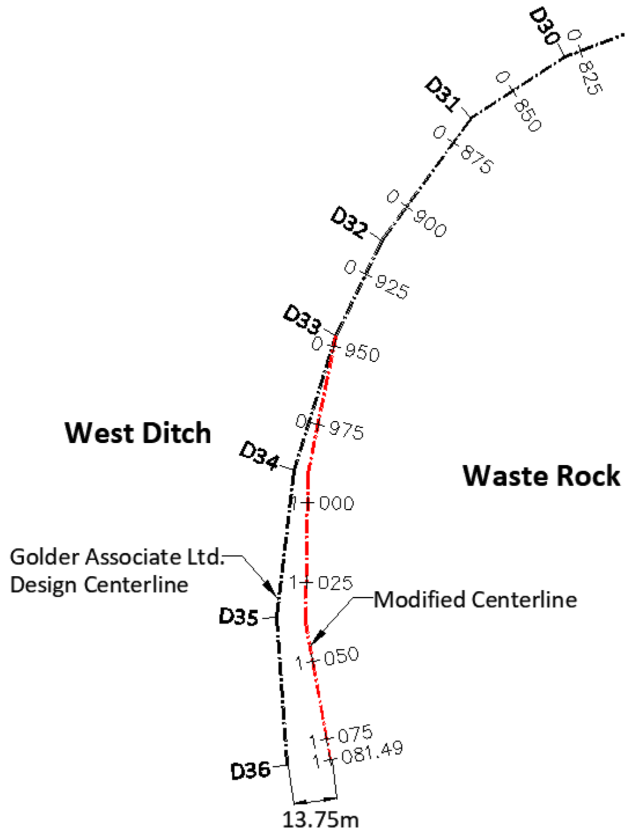


Figure 5 – West Ditch alignment modification.

3- Golder designed the vertical alignment for the West Ditch based on available topographic survey data. Elevations with coordinates of setout points from D19 to D36 were included in drawing G-200 in Appendix A. The design elevations for the top surface of the riprap are shown in Table 6. Graphical representation of the design elevation along with recent survey data for the existing ground clearly shows that the proposed grade is higher than it should be. As designed the minimum ditch depth could not be achieved. The profile in Figure 26 was scaled 10 times greater in the vertical direction to show the difference in elevations. For example, in station (0+850) the finished grade line of the ditch bottom is only 0.28 m beneath the existing surface ground.

Table 6 – West Ditch vertical alignment coordinates and elevation as per Golder design

WEST DITCH POINTS SETOUT TABLE			
POINT No.	EASTING (m)	NORTHING (m)	ELEVATION (m)
D19	562875.20	7916546.74	579.300
D20	562880.21	7916525.74	579.483
D21	562900.92	7916448.04	580.169
D22	562913.04	7916402.12	581.357
D23	562908.71	7916259.07	583.664
D24	562904.21	7916159.03	585.297
D25	562891.98	7916034.34	587.065
D26	562885.47	7915966.03	587.688
D27	562877.94	7915842.89	589.702
D28	562875.38	7915797.80	591.359
D29	562873.31	7915758.26	592.935
D30	562872.84	7915723.34	594.457
D31	562880.10	7915688.84	596.063
D32	562905.87	7915648.59	598.634
D33	562928.75	7915624.15	600.563
D34	562963.06	7915596.53	603.188
D35	563004.45	7915574.53	605.913
D36	563046.32	7915561.67	608.795

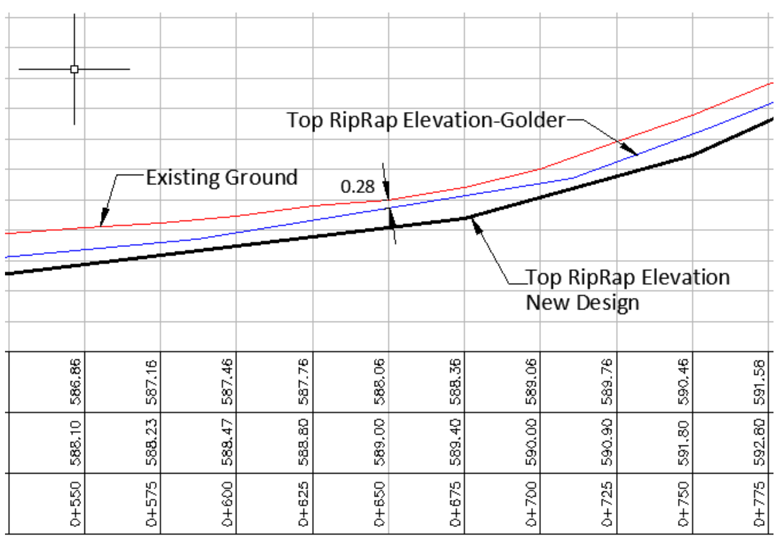


Figure 6 – West Ditch Golder grade line close to existing ground.

The problem of placing the finished grade line close to surface exists in the East Ditch as well. Table-7 includes Setout coordinates and elevations for points D1 to D18. In Figure-27 station (1+000) the finished grade line is 0.76 m beneath the existing ground surface.

Table 7 – East Ditch vertical alignment coordinates and elevation as per Golder Associates Ltd.

EAST DITCH POINTS SETOUT TABLE			
POINT No.	EASTING (m)	NORTHING (m)	ELEVATION (m)
D1	563143.03	7916744.05	579.300
D2	563155.21	7916736.76	579.985
D3	563177.93	7916711.89	581.400
D4	563220.33	7916635.24	583.122
D5	563248.84	7916603.40	584.504
D6	563276.56	7916579.64	585.386
D7	563311.08	7916524.10	586.118
D8	563334.50	7916379.54	592.006
D9	563354.66	7916248.35	598.661
D10	563396.03	7916151.18	603.586
D11	563415.08	7916076.07	607.237
D12	563433.09	7915992.12	611.678
D13	563448.27	7915915.51	615.518
D14	563448.97	7915889.46	616.934
D15	563446.77	7915859.54	618.658
D16	563442.57	7915830.80	620.182
D17	563432.50	7915789.89	622.592
D18	563411.19	7915763.25	624.315

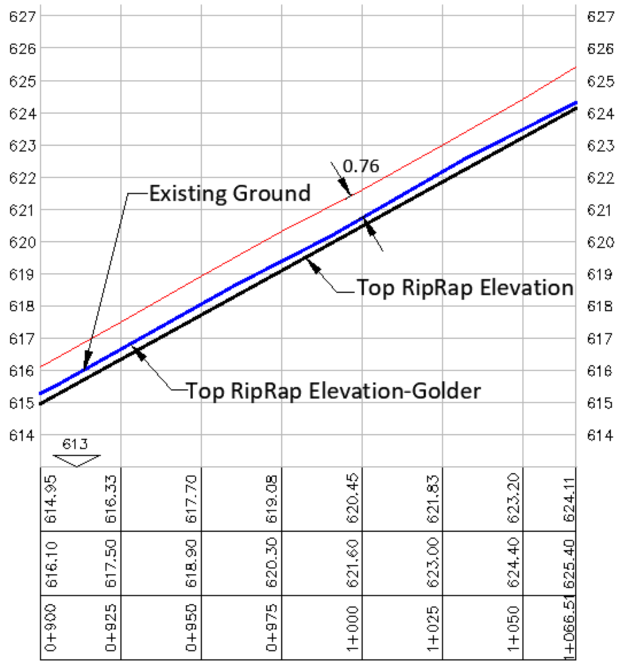


Figure 7 – East Ditch Golder grade line close to existing ground.

Baffinland's Engineer has modified the design to meet the dimensions of the typical ditch cross section prepared by Golder. The new design, provided in Appendix C1-C3, maintained the original horizontal alignment without changing the coordinates of the setout points. A new design was proposed after studying the topographic survey data collected by drone, and the available hydrological information. The new design focused on creating longitudinal slopes that can provide a flow velocity that will avoid hydrodynamic scour and sediment transport. This is considered an extra precaution in addition to the erosion and sediment control provided by the geotextile and riprap in the ditches. The new design reduced the number of longitudinal slopes and change points in both ditches. In the West Ditch alignment the number of slopes was reduced from 12 to 5, in the East Ditch it was reduced from 8 slopes to 2.

8. PERFORMANCE EVALUATION

The construction of the East and West Ditches during the 2020 phase was successful as the ditches conveyed water to the WRF Pond without an uncontrolled release to the environment. During the 2021 phase, the same construction methodology and practices were used, and many heavy rain events occurred during construction and post-construction. The new 2021 phase ditches have successfully conveyed all contact water to the WRF Pond without any uncontrolled releases to the environment, and the berms have successfully diverted non-contact runoff water around the WRF.

During the 2022 freshet Baffinland's engineering team will continue to monitor the performance and effectiveness of the drainage system in intercepting and channeling runoff to the WRF Pond.

9. VIBRATION MONITORING AND QUARRY ACTIVITY

No vibration monitoring was conducted during the construction of the Mine Site Waste Rock Pond Expansion and Drainage System as it was not deemed necessary based on the scope of activities required for construction.

Control for quarrying activity was conducted as per Baffinland's specific management plans:

- BAF-PH1-830-P16-0004 : Borrow Pit and Quarry Management Plan

10. ENVIRONMENTAL MONITORING

Environmental monitoring during the construction of the West and East Ditches Phase 2021 was conducted as per the Environmental Protection Plan (EPP), (BAF-PH1-830-P16-0008). In addition to the EPP, all construction follows the requirements of the Environmental Health and Safety Management Framework (BAF-PH1-830-STD-0001).

The Baffinland on-site Environmental management team was responsible for environmental monitoring at all sites during construction and following-up with the construction team(s) if there were any reported environmental incidents or non-conformances.

The West and East Ditches Phase 2021 construction was also required to follow the requirements of the Surface Water and Aquatic Ecosystems Management Plan (BAF-PH1-830-P16-0026). This management plan outlines the best management practices implemented to limit the potential for adverse impacts to receiving waters, aquatic ecosystems, fish and fish habitat during construction. In addition, this plan details the systems in place to mitigate and manage drainage and runoff at the building sites, address point and non-point discharges to surface waters and assess those discharges on water quality and quantity relative to their receiving water systems. The Spill Contingency Plan (BAF-PH1-830-P16-0036) in conjunction with the Emergency Response Plan (BAF-PH1-830-P16-0007) provides guidance and instructions for first responders and Baffinland Management in the event of a spill or other emergency such as fire or accident.

The risks to the water quality in the respective rivers and streams as a result of construction of the Mine Site Waste Rock Pond Expansion and Drainage System would originate from the following sources based on construction methodology:

- Spills from equipment
- Increase in sediment load in the water

There were no recorded spills from equipment used at the construction site. During the period of construction, water quality monitoring conducted at station MS-08 under the Type “A” Water License 2AM-MRY1325 indicated total suspended solids (TSS) and other parameter at levels below the applicable Water License criteria. The results for water quality monitoring were provided in monthly reports submitted to the Nunavut Water Board and other stakeholders. In consideration of the above, the environmental mitigation strategies were effective in maintaining runoffwater quality.

11. UNANTICIPATED OBSERVATIONS

The site conditions and topographic survey data collected by drone identified that the grade lines for the bottom of the two ditches were too close to the existing ground surface. The design finished elevations prepared by Golder (Drawing G-200 in Appendix A) failed to provide the required cross section as per the design. Elevations for West Ditch station (0+ 438) to (1+081.49) and East Ditch station (0+ 683.3) to (1+066.51) were re-designed by Baffinland Engineer Abid A Najey, P.Eng. The new design meets the criteria previously set by Golder (see Appendix A). As re-designed, the two ditches completely intercepted the runoff flows from the Waste Rock Facility, and conveyed them to the WRF Pond. In the year of construction 2021, no water ponding or sediment build-up in the ditch bottoms was observed, which meets the intent of the original Golder design.

12. SURFACE MONITORING

Not conducted. All water reported to the WRF water management structures.

13. REQUIRED MAINTENANCE

No major issues were observed during the construction period of the two ditches. Since commencing construction work, the future maintenance plan was considered as an important part of the project. The Baffinland engineering team upgraded the Diversion Berm proposed by Golder to a wide access road that extends along both ditches to provide all-season access. This access will facilitate and accelerate the process of maintenance in the event of a major storm event. As part of the maintenance plan, periodically and after major storm events, visual inspections will be conducted to identify potential damage in the drainage system and to prepare a plan for rapid remediation. During major storm events the Baffinland engineering team will conduct visual observations to evaluate the efficacy of the drainage system and to draw lessons that could improve the efficiency of similar projects in the future. The Baffinland MineOps technical services team will be responsible for reviewing the ditch system for damage and correct issues after every major storm / freshet event.

14. ADAPTIVE MANAGEMENT

For discussion of adaptive management principles and practices applied during the Construction Phase of the Project and their overall effectiveness please refer to the 2021 Annual Report to the Nunavut Impact Review Board. An example of adaptive management utilized on this project would be when it was discovered that the IFC ditch construction elevations were actually at existing surface grade in some areas of the design. To address this issue, additional evaluation of the flow rates into the two ditches was conducted, and the vertical alignments were modified accordingly to meet the design intent and field conditions.

Type 'A' Water License 2AM-MRY1325 Requirements and Concordance Table:

Schedule D Item No.	Minimum Information Requirement	Corresponding Section of this Report
a	Description of all infrastructure and facilities designed to contain, withhold, divert or retain Water and/or Waste	Section 1
b	A summary of construction activities including photographic records, before, during and after construction of the facilities and infrastructure designed to contain, withhold, divert or retain Water and /or Waste	Section 3 Section 5
c	As-built drawings and design for facilities and infrastructure, in item (a) of this schedule, designed and constructed to contain, withhold, divert or retain Water and/or Waste	Appendix C1,C2,C3,D,E
d	Documentation of field decisions that deviate from the original plans and any data used to support or develop facilities and infrastructure to withhold, divert or retain Water and /or Waste	Section 7
e	A comparison of measured versus predicted performance of infrastructure and facilities	Section 8
f	Any blast vibration monitoring and control for quarrying activity carried out in close proximity to fish bearing waters	Section 9
g	Monitoring conducted for sediment and explosives residue release from construction areas	Section 10
h	Monitoring undertaken in accordance with Part D of the License during construction phase of the project	Section 10
i	Details confirming that the requirements of the CCME guidance document entitled "Aboveground Storage Tank Systems for Petroleum and Allied Petroleum Products (2003)" have been met by the Licensee	N/A
j	Data collected from instrumentation used to monitor earthworks and the interpretation of that data	N/A
k	A discussion of any unanticipated observations including changes in risk and mitigation measures implemented to reduce risk during construction	Section 11
l	An overview of any method including frequency used to monitor deformations, seepage and geothermal responses	N/A

Commercial Lease Q13C301 Lease Operations Guide Concordance Table:

Schedule D Item No.	Minimum Information Requirement	Corresponding Section of this Report
1	The name and contact information of the person and company responsible for completing the construction, construction monitoring and preparing the As-Built Report.	Page 4
2	The name and contact information of the Baffinland representative(s) that QIA can contact should it have any questions or comments regarding the As-Built Report.	Page 1,4
3	An introduction to the infrastructure or facilities including but not limited to the construction background, concept and construction history.	Section 1
4	Construction records including As-Built drawings signed and stamped by a professional engineer detailing surveys, planar and cross sections that illustrate all designed components. This should be provided in PDF format, and if requested in native file (e,g. CAD, .dxf, etc.).	Appendix F,C1,C2,C3,D,E
5	Detailed description of any deviations from the For-Construction Design. Deviations that should be noted include, but are not limited to; changes in design and construction materials, construction methodology or monitoring.	Section 7
6	Observed performance of the construction including a comparison to predicted performance. Recommendations for performance monitoring based on observations during construction if applicable.	Section 8
7	A description and list of instrumentation installed, if applicable, and results of construction monitoring and post construction monitoring, including all environmental data. Recommendations for additional performance or environmental monitoring based on observations and monitoring results, if applicable.	N/A
8	A summary of quality assurance testing results, if applicable, and comparison of these results to construction/design requirements to ensure performance of the infrastructure or facilities.	Section 4
9	A summary of adaptive management principles and practices related to environmental management and monitoring applied during the relevant phases of the Project and their overall effectiveness.	Section 14
10	Photographic records before, during and after construction of the facilities or infrastructure	Section 5
11	Map(s) to illustrate the completed construction in relation to Lease boundaries, and water bodies. The minimum distance from completed or modified facilities and infrastructure to the surveyed boundary of the Property, surveyed boundary of the Impact Area, and the ordinary high water mark should be provided.	Appendix B

APPENDIX A
IFC Drawings & Report - Golder Associates Ltd.

APPENDIX B
Map of WRF Pond Expansion and Drainage System Phase 2021

APPENDIX C1
East and West Ditches Plan and Profile

APPENDIX C2
West Ditch Plan and Profile (1)

APPENDIX C3
West Ditch Plan and Profile (2)

APPENDIX D
West Ditch Horizontal Alignment Modification

APPENDIX F
Daily Work Progress Reports

APPENDIX G
Geotextile Material Data Sheet

REPORT

WRF Pond Expansion Drainage System

Submitted to:

Cody Gagne, Mine Superintendant

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Distribution List

Baffinland Iron Mines Corporation- Electronic Copy

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APPENDICES

1.0 INTRODUCTION

Golder Associates (Golder) has been retained by Baffinland Iron Mines Corporation (BIM) to provide input into the design and operation of the Waste Rock Facility (WRF) at its Mary River Project. The Mary River Project is an operational iron mine on Baffin Island in Canada's Nunavut territory. Ore is mined from the open pit, crushed onsite, and hauled to the Milne Port (approximately 100 km from site) where it is stockpiled and shipped off-site for processing. Waste rock from the open pit is disposed of at the WRF which is located to the north of the open pit.

Golder recently carried out a review of the proposed WRF expansion considering waste rock production through the year 2022 (Golder 2018a). Expansion of the WRF pond is required to collect and manage the runoff generated over the expanded WRF footprint. This report provides the detailed design for the WRF Pond expansion drainage system.

2.0 BACKGROUND

Waste rock produced from the open pit mining operation is managed at the WRF. The WRF currently consists of a waste rock stockpile, a sedimentation pond (referred to herein as the "WRF Pond"), and perimeter ditches. Surface runoff and seepage from the WRF is currently collected in ditches and directed to the WRF Pond. Containment for the WRF Pond is provided by a berm (referred to herein at the "WRF Pond Berm") in conjunction with natural topography. The WRF Pond utilizes a geomembrane as the low permeability element. The existing WRF Pond was constructed from September 2015 to May 2016.

The WRF Pond was originally designed as a sedimentation pond. Once clarified, the collected flow was intended to be discharged directly to the environment without treatment. BIM recently identified that the WRF is potentially generating acid rock drainage (ARD). BIM is currently constructing a water treatment system (WTS) to treat and discharge the impacted water collected at the WRF Pond. While actions are currently being undertaken to reduce the future potential for continued ARD, at this time, forward planning of the WRF expansion considers that the requirement to collect and treat ARD may continue in the near-term.

It is noted that seepage out of the existing WRF Pond Berm has been identified. An inspection was carried out in September 2017 to identify the seepage source (Hatch 2017). No damage to the existing WRF Pond geomembrane was noted during the inspection, and the source of seepage was not conclusively determined. A more detailed inspection of the WRF Pond will be carried out at the time of the proposed expansion, and any required repair or remediation carried out.

3.0 SITE CONDITIONS

The following sections provide a discussion on the site conditions.

3.1 Geotechnical

Two boreholes, located approximately 2 km from the WRF, were drilled during a 2016 investigation (KPC 2006). The results of the investigation identified that the foundation conditions likely consist of 6.5 - 13.5 m of glacial till underlain by bedrock. The groundwater table was not record at the time of the investigation. The glacial till was typically a sand and gravel with some silt, though the composition varied with depth and by borehole. Refer to Appendix A for the relevant borehole logs.

It has been assumed that the site conditions from Appendix A are applicable to the WRF Pond. This assumption will be reviewed at the time of construction.

3.2 Climate and Hydrology

The project is located in the North Baffin Region of Baffin Island. Based on regional data collected by Knight Piesold (2012), the mean annual precipitation ranges from 200 mm to 400 mm and the mean annual temperature is approximately -15°C. The monthly average temperatures are mostly above freezing between June and August.

Golder carried out a hydrological study (Golder 2018b) to support the design of water collection and water treatment facilities based on local hydrometric and meteorological data collected on-site. The hydrometric station H07 with 11 available years of record, was selected as the most representative for the hydrological conditions around the WRF. A statistical analysis was carried out to estimate runoff for the return periods from 2 to 100 years and durations ranging between 1-day to 105-days.

Table 1 provides a summary of the estimated runoff values generated for various durations and return periods. As the return periods were assessed based on actual measured stream-flow data at station H07, the values in Table 1 account for varying hydrological events (i.e., including both rainfall events and freshet flows).

Table 1: Estimated Runoff (mm) by Return Period and Event Duration

Return Period (Years)	Flood Event Duration (Days)																	
	1	2	3	4	5	6	7	8	9	10	15	20	30	45	60	75	90	105
2	21	38	52	66	79	92	105	117	129	140	186	217	264	309	327	348	359	362
5	26	47	63	82	98	114	129	143	157	169	229	265	326	369	397	425	438	440
10	32	57	74	96	114	131	146	161	175	188	258	298	358	398	430	463	476	478
25	41	73	94	119	140	157	171	185	199	211	294	342	392	425	464	501	514	515
50	50	90	116	141	163	180	192	204	216	228	321	376	414	442	484	524	538	538
100	61	113	146	168	190	206	215	223	234	244	349	410	433	457	502	544	558	558

Golder (2018) recommended to apply a safety factor of 1.2 to the values presented in Table 1 due to the limitations of the study (e.g., data extrapolated from 11 years of data and runoff calculated from natural ground).

The short-term rainfall intensity-duration-frequency curves recommended by Knight Piesold (2012) for the Mary River Project site and established in the civil design criteria (Hatch 2013) are based on rainfall data from the Environment Canada Clyde River (ID 2400800) and Pond Inlet Airport (ID 2403201) climate Stations. The intensity-duration-frequency values in Table 2 present rainfall statistics for durations between 5 minutes and 24 hours for return periods between 2 years and 200 years.

Table 2: Short-term intensity-duration-frequency values for various return periods (KPC, 2012)

Duration	Return Periods								
	2-yr	5-yr	10-yr	15-yr	20-yr	25-yr	50-yr	100-yr	200-yr
5 min	0.8	1.0	1.2	1.3	1.3	1.4	1.5	1.7	1.8
10 min	1.2	1.5	1.7	1.9	2.0	2.1	2.3	2.5	2.7
15 min	1.5	1.9	2.2	2.4	2.5	2.6	2.9	3.1	3.4
30 min	2.5	3.1	3.6	3.9	4.1	4.3	4.8	5.2	5.7
1 hr	4.0	5.2	6.1	6.6	7.0	7.3	8.1	9.0	9.9
2 hr	6.0	7.7	9.1	9.9	10.5	10.9	12.2	13.5	14.8
6 hr	11.9	16.3	19.8	21.8	23.2	24.3	27.6	30.8	34.1
12 hr	15.9	21.8	26.4	29.1	30.9	32.4	36.7	41.1	45.4
24 hr	24.8	34.0	41.3	45.4	48.3	50.6	57.4	64.2	71.0

Local precipitation records from the meteorological station installed at the Mary River Mine site are only available for the last four years. The local records were compared against regional records for coastal sites operated by Environment and Climate Change Canada (Pond Inlet and Clyde River climate stations). A reliable correlation between the precipitation data on the coastal sites and the Mary River Mine site meteorological data was not observed. Additionally, given the short period of concurrent (or near-concurrent) rainfall data available and the rarity of high-intensity events, a statistically acceptable relationship between elevation and extreme rainfall could not be developed at this time. The rainfall intensity-duration-frequency statistics presented in the Hatch (2013) design criteria report and developed by Knight Piesold (2012) are considered valid. No update is recommended at this time, however, as the length of rainfall record at the Mary River climate station increases, it is recommended that the new data be used to verify every two or three years the adequacy of the rainfall intensity-duration-frequency statistics used for design.

4.0 PROPOSED SCOPE OF WORK

The WRF Expansion involves the following scope of work:

- Raise the WRF Pond Berm to crest elevation 579.7 meters above sea level (masl);
- Excavate the East Ditch;
- Excavate the West Ditch; and,
- Line the WRF Pond with a geomembrane.

Raising of the WRF Pond Berm will generally involve:

- Stripping of organic and deleterious materials over the expanded footprint;

- Placing fill materials in the berm and compacting layer by layer;
- Construction of the emergency spillway;
- Placing of the geomembrane bedding materials; and,
- Installation of the geomembrane.

BIM has observed seepage from the existing WRF Pond Berm. The existing geomembrane condition will be examined, and an attempt will be made to identify the source of the seepage. The existing geomembrane will be repaired, if possible, or replaced.

The East and West Ditches will be excavated to an approximate 1.0 m depth through the existing ground. Riprap will be provided, as necessary, to reduce observed erosion.

5.0 DESIGN BASIS

The following sections describe the WRF Pond expansion design basis. Refer to Appendix B for the Issued for Construction (IFC) drawings.

5.1 General

The WRF Pond expansion has been designed in accordance with the recommendations provided by the Canadian Dam Association (CDA). Applicable documents include:

- Canadian Dam Association Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams (CDA 2014); and,
- Canadian Dam Association's Dam Safety Guidelines, (CDA 2007).

As well, the design is in accordance with provisions of Water Licence No. 2AM-MRY1325-Amendment No.1.

5.2 Dam Classification

The CDA recommends a dam classification system based on the consequence of failure. The dam classification is a measure of the greatest incremental losses that could result from the uncontrolled release of water or stored contents behind a dam, due to failure of the dam or its appurtenances based on the worst-case but realistic failure condition. Incremental losses are defined as losses from dam failures which are above and beyond those which may be expected to occur under the same natural conditions (e.g. flood, earthquake, or other event) with the dam in place, but without failure of the dam. The dam classification guidelines from the CDA are reproduced in Figure 1 below.

Dam class	Population at risk	Incremental Losses		
		Loss of life	Environmental and cultural values	Infrastructure and economics
Low	None	0	Minimal short-term No long term loss	Low economic losses; area contains limited infrastructure or services
Significant	Temporary only	Unspecified	No significant loss or deterioration of fish or wildlife habitat Loss of marginal habitat only Restoration or compensation in kind highly possible	Losses to recreational facilities, seasonal workplaces, and infrequently used transportation routes
High	Permanent	10 or fewer	Significant loss or deterioration of *important* fish or wildlife habitat Restoration or compensation in kind is highly possible	High economic losses affecting infrastructure, public transportation, and commercial facilities
Very high	Permanent	100 or fewer	Significant loss or deterioration of *critical* fish or wildlife habitat Restoration or compensation in kind possible but impractical	Very high economic losses affecting important infrastructure or services (e.g., highway, industrial facility, storage facilities, for dangerous substances)
Extreme	Permanent	More than 100	Major loss of *critical* fish or wildlife habitat Restoration or compensation in kind impossible	Extreme losses affecting critical infrastructure or services, (e.g., hospital, major industrial complex, major storage facilities for dangerous substances
See Table 2-1 in the CDA 2007 Guidelines for notes related to population at risk and implications of loss of life.				

Figure 1: Dam Classification (CDA 2014)

It is expected that a failure of the WRF Pond Berm and release of the contained water would have low impact. There is no potential for loss of life resulting from a dam failure, except for employees that may be working immediately downstream of the berm at the time of failure. Given the relatively low volume of water contained (~50,000 m^3), and that the retained flows will be continuously treated and discharged to the environment (i.e. the WRF Pond will be continuously drawn down), the uncontrolled release of the retained water does not pose significant or long-term environmental losses. The WRF Pond hazard classification is therefore considered “Low”.

5.3 Environmental Design Flood

The Environmental Design Flood (EDF) is defined as the most severe flood that is to be managed without release of untreated water to the environment. The existing WRF Pond is designed to manage (i.e., to contain) the 1:10 year 24 hr event. For the expanded WRF, the EDF has been selected as the 1:10 year 15-day event. The use of a longer duration, more severe design event is proposed as a result of the requirement for the WRF Pond to temporarily function as a treatment pond. The 1:10 year 24-hr design event used for the original pond design was selected based on the expectation that the WRF Pond would solely act as a sedimentation pond.

The CDA specifies for the EDF to be determined on a site-specific basis, though return periods of 1:50 to 1:200 years are identified as typical (CDA 2007). These higher return periods are considered appropriate for Life of Mine structures that have typical service lives of >30 years, and often for perpetuity. Given the expected temporary nature of the proposed WRF Pond expansion (a new Life of Mine sedimentation pond, or additional expansion of the existing WRF pond, will be required to manage expansion of the WRF beyond the 585,000 m^2 footprint), the use of a 1:100 year return period event is not justified. The WRF Pond design criteria will be reviewed and revised if necessary, prior to expansion of the WRF beyond the proposed 585,000 m^2 footprint.

5.4 Flood Routing

The Inflow Design Flood (IDF) is defined as the most severe inflow flood for which a dam is designed. While the WRF Pond has been sized to store the EDF, it is proposed that the IDF be safely conveyed through the emergency spillway and discharged to the environment.

The IDF is selected on the basis of the Dam Classification and the consequence of failure of the structures. Based on the dam classification of “Low”, the IDF recommended by the CDA is a storm event with a 1:100 year return period. Consistent with the previously developed civil design criteria (Hatch 2013), the IDF adopted for the WRF Pond expansion is the 1:200 year 24-hr event (71 mm of rainfall over 24 hours). The WRF Pond spillway has been sized to pass this flow. It was conservatively assumed that there will be no remaining storage capacity within the WRF Pond at the onset of the IDF occurrence.

5.5 Freeboard Requirements

The WRF Pond is designed to maintain a minimum freeboard requirement to reduce potential for overtopping of the berm during the IDF, or as a result of wave action. The CDA guidelines recommend a minimum freeboard of 95% of the waves caused by the most critical wind at the maximum design pond elevation (CDA 2007). A frequency analysis was performed for the hourly wind velocity from Pond Inlet A climate station (1976 – 2017). The data from 2009 to 2012 were removed from the analysis due to more than half of their data missing from the record. Table 3 presents the wind velocity associated with various return periods.

Table 3: Frequency analysis of the wind velocity measured at the Pond Inlet A Climate Station

Return Period	Wind Velocity (m/s)	95% Confidence Interval (m/s)
5	20.1	21.2 – 21.2
10	22.5	22.9 – 22.9
50	24.0	20.8 – 27.1
100	25.0	21.1 – 29.2
500	27.4	21.6 – 34.4
1,000	28.4	21.7 – 36.9

The maximum windspeed recorded at the Mary River Mine site meteorological data from 2013 – 2017 was 28.4 m/s.

Assuming the maximum fetch of 250 m across the pond, the 1,000 year wind velocity (upper value of the 95% confidence interval) and a pond depth of 5.3 m, the significant wave height is estimated to be 0.51 m.

5.6 WRF Pond Capacity

The existing WRF Pond has a design capacity of approximately 9,000 m^3 at the maximum operating water level (MOWL) of 575.8 masl. The existing berm has a crest elevation of 577.0 masl and the geomembrane installed to elevation 575.8 masl. The emergency spillway is set at elevation 576.0 masl. The WRF Pond is currently sized to retain the 1:10 year 24 hour storm event (Hatch 2013). The existing pond has a surface area of approximately 9,900 m^2 at a water elevation of 575.8 masl.

Figure 2 provides the volume of inflow to the WRF pond less treatment for the 1:10 year event with varying durations. The runoff values are those from Table 1 applied to a catchment area of 585,000 m^2. The predicted pond inflow considers a water treatment rate of 280 m^3/h.

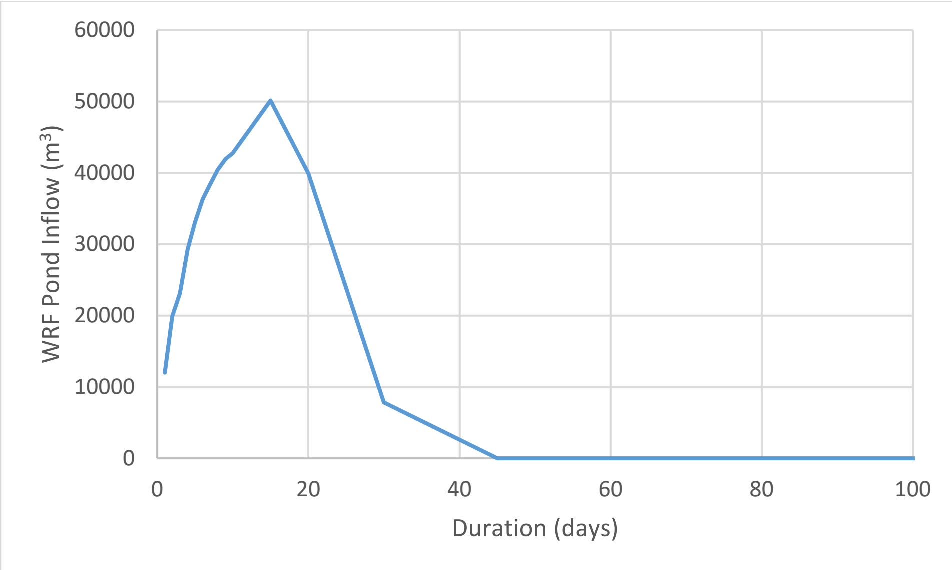

Figure 2: Predicted WRF Pond Inflow

The maximum WRF Pond inflow of 50,130 m^3 is predicted to occur for the 15 day event (the EDF), and is the design capacity for the current expansion. The predicted inflow for the 1:10 year 24 hour event (current design criteria) is 12,000 m^3. Where the WRF Pond capacity is 0 m^3, the rate of treatment of 280 m^3/h is predicted to exceed the rate of pond inflow.

Figure 3 below provides the struck level curve for the proposed expanded WRF Pond.

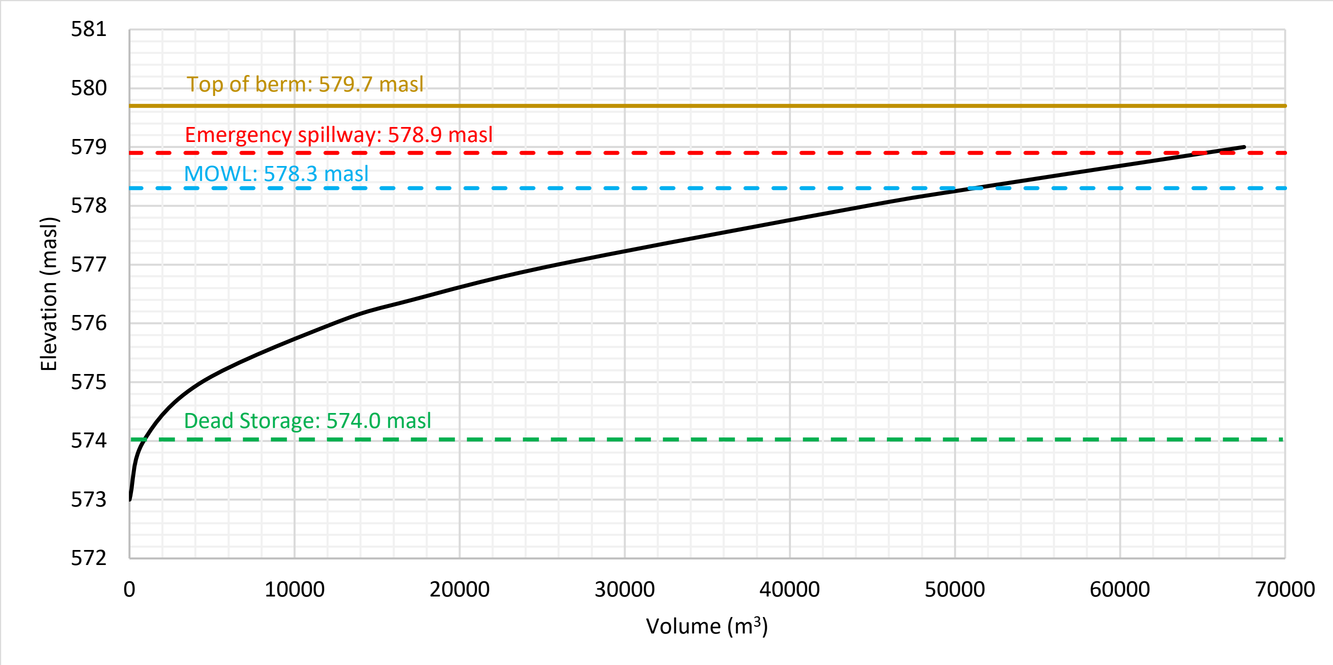

Figure 3: Proposed WRF Pond Struck Level Curve

The WRF Pond capacity at the MOWL (elevation 578.3 masl) will be approximately 51,000 m^3. To accommodate uncertainties in the hydrological data a minimum factor of safety of 1.2 has been applied to the pond capacity (Golder, 2018). The geomembrane is therefore proposed to be installed to elevation 579.3 masl, corresponding to a total storage volume of 65,000 m^3 (27% increase in volume over the 51,000 m^3 design capacity) at the spillway invert of 578.9 masl, and providing 0.2 m of additional freeboard above the IDF water level of 579.1 (see Section 5.8). The WRF Pond surface area at elevation 579.3 masl is approximately 25,000 m^2 (15,000 m^2 increase over the existing condition).

Inflow into the WRF Pond will be treated and discharged to the environment on a continuous basis. The water treatment system (WTS) intake will be located at the deepest section of the WRF Pond to minimize the dead storage volume. The dead storage volume below elevation 574.0 m is 900 m^3.

5.7 WRF Pond Berm Stability

The WRF Pond Berm is designed to be stable under the expected loading conditions, including: rapid drawdown of the pond, surcharge in the pond water level, wind and wave action, and seismic loading.

The following minimum Factors of Safety (FOS) for the WRF Pond Berm slopes have been adopted (CDA 2007):

- End of Construction: 1.3
- Long-term steady state: 1.5
- Seismic loading: 1.0

Based on the dam classification of “Low”, the design earthquake recommended by the CDA is the 1:100 year return event. The Peak Ground Acceleration (PGA) based on the 2015 National Building Code and determined by Earthquakes Canada is 0.019g for the 1:100 year return period.

The WRF Pond Berm is a homogeneous rockfill berm with a geomembrane installed on the upstream slope as the low permeability element. Refer to Appendix B for the detailed design. Table 4 below provides a summary of the material strength parameters input into the slope stability model. Refer to Section 5.7.2 for further discussion on the material strength parameters.

Table 4: Material Strength Parameters

Material	Unit Weight (kN/m^3)	Friction Angle (º)	Cohesion (kPa)
Rock Fill	20	40	0
Till	20	34	0
Bedrock	Impenetrable		

5.7.1 Stability Analysis Results

The WRF Pond Berm slope stability was analyzed using Slope/W 2018 version 9.0.4.15639 developed by GEO-SLOPE International Ltd. This software uses the limit equilibrium method for the stability analysis. The Morgenstern-Price method was used where the interslice shear forces were represented with a half-sine function.

The FOS, defined as the ratio of the forces tending to resist failure over the forces tending to cause failure, was computed for a series of potential failure surfaces. A range of potential slip surfaces were analysed:

- Static loading conditions for the upstream and downstream face; and,
- Seismic loading conditions for the upstream and downstream face.

For each loading condition, the lowest FOS was determined for the slip surface within the berm slope, and also for a deep-seated foundation failure. The slip surface was analyzed using both the grid and radius and entry/exit definition methods.

The Hynes-Griffin and Franklin (1984) procedure was used for the pseudo-static analysis. This procedure recommends that horizontal acceleration input into the stability analysis be half the predicted bedrock PGA. Based on this method, a horizontal acceleration of 0.0095 g, which is half the PGA of 0.019g for a 1:100 year event, was input into the stability analysis model.

The results of the stability analysis are provided as Figure 4 below.

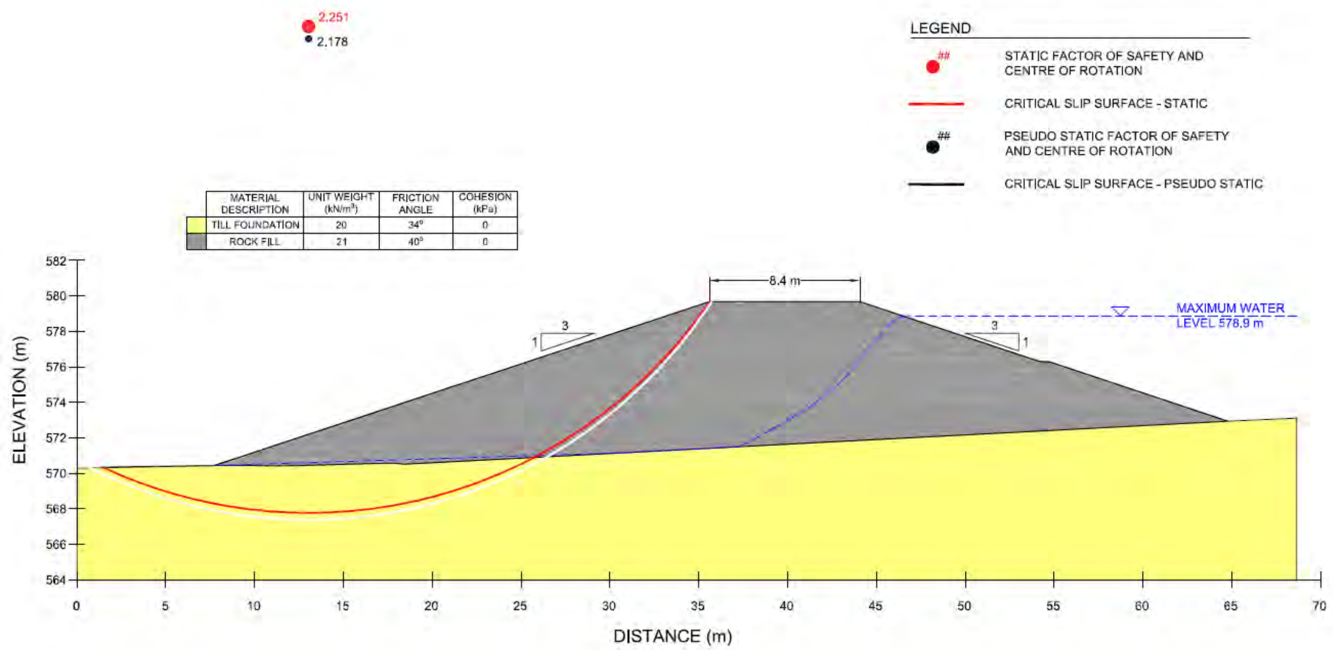

Figure 4: WRF Pond Berm Stability Analysis Results

The minimum FOS for the static and pseudo-static condition is 2.25 and 2.18, respectively. These FOS exceed the minimum requirements specified under Section 5.7.

Rapid draw down of the WRF Pond is not expected to have significant impact on the WRF Pond berm stability. At a treatment rate of 280 m^3/hr the maximum WRF Pond drawdown rate varies from 0.13 – 0.33 m/hr depending on the pond elevation. It is expected that the rockfill WRF Pond Berm will drain at a similar rate.

5.7.2 Limitations

The material strength parameters and foundation conditions input into the slope stability model are assumed based on professional judgement. No laboratory testing has been carried out to verify the strength parameters.

The foundation conditions have been assumed based on the results of the two boreholes located approximately 2.0 km from the WRF Pond (KPC 2006). No additional information is available on the foundation conditions at the WRF Pond Berm. It is recommended that test pitting be carried out along the WRF Pond Berm expanded foundation, prior to construction of the berm, if ground conditions permit. The foundation conditions should then be verified against the material strength parameters assumed in Table 4. The presence of weak foundation materials may require removal or result in the requirement to flatten or buttress the WRF Pond Berm downstream slope. The presence of continuous layers of ground ice within the foundation may also result in creep of the WRF Pond Berm slopes. If test pitting is not feasible due to frozen ground conditions, it is recommended that survey monitoring pins be installed along the WRF Pond Berm downstream slope.

5.8 WRF Pond Emergency Spillway

The WRF Pond emergency spillway will be located at the north east abutment of the WRF Pond Berm. The spillway has been sized to safely pass the 200-yr 24-hr IDF. Refer to Section 5.4 for discussion on the IDF selection and definition. The Hydrologic Engineering Centre Hydrologic Modelling System (HEC-HMS) software

(USACE 2013) was used for the flood routing. Losses along the flow path upstream of the WRF Pond were simulated using the SCS Curve Number (CN). A CN of 97 was assumed for the waste rock (based on recommended CN values for prepared ground). The CN value for waste rock accounts for direct runoff plus interflow (i.e., flow which infiltrates into the waste rock but later reports as toe seepage); however the lag effects associated with the interflow are ignored, making this value more conservative.

The spillway design elements include the following:

- Total drainage area of 585,000 m^2;
- Invert elevation of 578.9 m (0.8 m below the WRF Pond Berm crest);
- Base width of 5.0 m with 10H:1V side slopes at the berm crest for truck trafficability;
- The spillway channel will be approximately 50 m long;
- The spillway channel will have a slope of 12% (i.e. 8.5H:1V);
- The spillway channel will be protected with riprap.

Refer to Drawing C-200 (Appendix B), for the spillway detailed design.

The spillway peak discharge for the 200-yr 24-hr storm event is predicted to be 1.35 m^3/s. The maximum water surface elevation above the spillway invert under the design storm event conditions would be 579.11 m, which is 0.59 m below the berm crest elevation, thus satisfying the freeboard requirements of 0.51 m described in Section 5.5. An overflow spillway channel will be constructed on the downstream face of the WRF Pond Berm with adequate riprap (400 mm riprap, minimum D_{50} of 200 mm) to withstand the design peak flow velocity of 2.0 m/s. The spillway channel will have a bottom width of 5 m, a total depth of 0.5 m (including a 0.3 m freeboard) and will transition from 10H:1V side slopes at the berm crest into 2H:1V side slopes at the outlet. The spillway channel will have a 5 m long energy dissipation area at the toe.

The riprap placed within the spillway invert will be covered by a 200 mm thick sacrificial layer of granular to permit vehicle access through the spillway. This granular wearing layer is expected to washout during activation of the spillway, and would subsequently have to be replaced to restore vehicle access.

5.9 Diversion Ditches

The WRF design includes the design of contact water collection ditches surrounding the facility. As shown on Drawing G-200 (Appendix B), two perimeter ditches are proposed, one on either side of the WRF. It has been assumed that the ditches will generally drain north, discharging the collected runoff into the WRF Pond.

The following design criteria have been established for the ditches:

- Ditches convey the 1:25 year (Hatch 2013) 10-min event with an intensity of 12.4 mm/hr (based on the time of concentration calculated for each ditch) including 0.3 m of freeboard;
- Flood events up to the 1:100 year storm event would be fully contained within the ditches, but ditch erosion would likely require ditch maintenance works after such an event;

- Provide riprap erosion protection for sections of the ditch with velocities greater than 1.5 m/s (Hatch 2013). Riprap to be extended a minimum of 3.0 m into sections where riprap is not required to create a stilling basin;
  - Riprap may not be placed at the time of ditch excavation. The requirement for riprap will be assessed by BIM based on site observations and performance monitoring.
- Reduce potential for collection of non-contact runoff;
- Trapezoidal channel with a base width of 1.0 m and minimum depth of 1.0 m; and,
- Side slopes of 2H:1V or flatter as required by ground conditions.

Spoil from the ditch excavation will be utilized to construct a berm on the outside of the ditch (the side opposite from the WRF) to reduce potential for collection of non-contact water. The geometry of the clean water diversion berm shown on Drawing C-130 (Appendix B) may be modified in the field, at the time of construction, based on the material conditions.

The peak flow rates were calculated for the ditches using the Rational Method and assuming a runoff coefficient of 0.9 for the catchments draining to the ditches (0.26 km^2 and 0.27 km^2 for the west and east ditch respectively). The calculated peak flows are 0.82 m^3/s and 0.86 m^3/s for the west and east ditches respectively. The hydraulic capacity of the ditch was determined using Manning's Equation. The ditches will be protected with riprap at locations where the flow velocity exceeds 1.5 m/s.

Table 5 below provides the location, slope, water depth, the flow velocity and the riprap requirements under the design storm event. The minimum riprap thickness shall be twice the riprap D_{50} value. The requirement for riprap will be assessed by BIM based on site observations and performance monitoring.

Table 5: Collection Ditch Design Parameters

	Upstream Station	Downstream Station	Slope (%)	Flow Depth (m)	Flow Velocity (m/s)	Minimum Riprap D_{50} (mm)
West Ditch	0+000	0+022	0.08%	0.7	0.5	Not required
	0+022	0+102	1.5%	0.4	1.3	Not required
	0+102	0+150	2.5%	0.3	1.6	200
	0+150	0+293	1.6%	0.4	1.4	Not required
	0+293	0+393	1.6%	0.4	1.4	Not required
	0+393	0+518	1.4%	0.4	1.3	Not required
	0+518	0+587	0.9%	0.4	1.1	Not required
	0+587	0+710	1.6%	0.4	1.4	Not required
	0+710	0+755	3.7%	0.3	1.8	200
	0+755	0+795	4.0%	0.3	1.9	200
	0+795	0+830	4.4%	0.3	2.0	200
	0+830	0+865	4.5%	0.3	2.0	200
	0+865	0+913	5.4%	0.3	2.1	300
	0+913	0+946	5.7%	0.3	2.2	300

	Upstream Station	Downstream Station	Slope (%)	Flow Depth (m)	Flow Velocity (m/s)	Minimum Riprap D_{50} (mm)
	0+946	0+990	5.9%	0.2	2.2	300
	0+990	1+037	5.8%	0.3	2.2	300
	1+037	1+081	6.6%	0.2	2.3	300
East Ditch	0+000	0+014	6.6%	0.2	1.5	300
	0+014	0+048	4.1%			CSP Culvert Riprap to be provided at outlet
	0+048	0+135	2.0%	0.3	1.5	Not required
	0+135	0+178	3.2%	0.3	1.8	200
	0+178	0+215	2.4%	0.3	1.6	200
	0+215	0+280	1.1%	0.4	1.2	Not required
	0+280	0+427	4.0%	0.3	1.9	200
	0+427	0+559	5.0%	0.3	2.1	300
	0+559	0+665	4.7%	0.3	2.0	300
	0+665	0+742	4.7%	0.3	2.0	300
	0+742	0+828	5.2%	0.3	2.1	300
	0+828	0+906	4.9%	0.3	2.1	300
	0+906	0+932	5.4%	0.3	2.2	300
	0+932	0+962	5.8%	0.3	2.2	300
	0+962	0+991	5.3%	0.3	2.1	300
	0+991	1+034	5.7%	0.3	2.2	300
	1+034	1+068	5.1%	0.3	2.1	300

5.9.1 Culvert Crossing

A culvert will be installed in the East Ditch between station 0+014 and 0+048 to accommodate a proposed road to access the water treatment system pad. The Federal Highway Administration (FHWA) HY-8 software (FHWA 2012) was used for sizing the culvert based on a peak flow of 0.86 m^3/s.

The following assumptions were considered in the model:

- The culverts were assumed to be located at the bottom of the cross-sections and installed on the grade provided in Table 5.
- The culvert “roughness” (i.e. Manning’s n value) corresponds to that of corrugated steel pipe (CSP).
- The culverts are free of debris.

Considering a slope of 4%, one circular CSP culvert of 900 mm of diameter is recommended to convey the 0.86 m^3/s peak flow at this intersection.

6.0 CONSTRUCTION

6.1 Construction and Operating Considerations

The construction considerations related to the WRF Pond include the following:

- Test pitting to be carried out along the footprint of the expanded WRF Pond Berm prior to any fill placement, if ground conditions permit. The requirement for survey monitoring pins installed along the WRF Pond Berm downstream slope will be considered if ground conditions do not permit test pit excavation.
- The pond shall be completely drained and the condition of the existing geomembrane inspected prior to construction of the WRF Pond expansion;
- Sedimentation and erosion mitigation measures, as required, shall be in place before commencing construction;
- A temporary water management plan shall be developed and implemented prior to construction;
- All materials shall be placed in horizontal lifts with a nominal compacted thickness of 1.0 m or less;
- Each lift shall be compacted by dozer tracking across the entire width of the lift;
- Culverts should be placed on a 0.3 m thick layer of prepared sand and gravel foundation;
- The minimum depth of cover to be provided over any culvert at a road crossing should be determined to withstand heavy load from traffic using the road;
- Culverts should be extended at least 1.5 m from the embankment at the inlet and the outlet to avoid blockage from any falling debris from the road; and,
- An as-built survey shall be collected to document all construction activities.

The operating conditions related to the WRF Pond include:

- Inflow into the WRF Pond will be continuously treated and discharged to the environment. The water level will be maintained at the lowest practical level.
- The WRF Pond water level must not be drawn down from above elevation 575.8 m when ice is present due to the potential for ice to damage the geomembrane on the upstream slope at the elevation 575.8 m bench.
- The WTS feed pump will be located on the WRF Pond Berm crest at approximate station 0+300, at the deepest location of the WRF Pond to reduce the dead storage volume.
- The WTS Feed pump discharge line will be routed along the upstream edge of the WRF Pond Berm crest.

6.2 Construction Materials

The following sections provide the gradation for the proposed fill materials.

6.2.1 500 mm minus Rock Fill

Rock fill for the WRF Pond Berm construction shall be obtained from an approved construction material source, as required under Water Licence No. 2AM-MRY1325-Amendment No.1. The material shall be well graded within the limits defined in Table 6 below.

Table 6: 500 mm Minus Rock Fill Gradation

Sieve (mm)	% Passing by Weight	
	Lower	Upper
500	100	100
150	100	50
75	40	20
37.5	23	15
19	15	8
4.75	5	0
2	5	0
0.075	5	0

6.2.2 Intermediate Bedding Material

The Intermediate Bedding Material shall be placed be placed as a transition material between the geomembrane bedding layer and the underlying rock fill. The bedding material shall be produced from an approved construction material source as required under Water Licence No. 2AM-MRY1325-Amendment No.1. The material shall be well graded within the limits defined in Table 7 below.

Table 7: Intermediate Bedding Material Gradation

Sieve (mm)	% Passing by Weight	
	Lower	Upper
32	100	100
19	100	85
13.2	100	70
9.5	100	50
4.75	70	30
1.18	40	10
0.3	22	5
0.075	8	0

6.2.3 Fine Bedding Material

The Fine Bedding Material shall be placed be placed as a transition material between the geomembrane and underlying Intermediate Bedding Material. The fine bedding material shall be produced from an approved construction material source as required under Water Licence No. 2AM-MRY1325-Amendment No.1. The material requirements are defined as follows:

- The material shall be well graded;
- The maximum particle size shall be 2.0 mm.
- The fines content (% passing the #200 sieve) shall not exceed 5%.

Alternatively, the fine bedding material can be replaced by a non-woven geotextile.

6.2.4 Riprap

Riprap shall be placed as erosion protection at the emergency spillway and the within the East and West Diversion Ditches in the reaches noted in Table 5. Riprap within the spillway channel shall be sourced from an approved construction material source as required under Water Licence No. 2AM-MRY1325-Amendment No.1. Riprap placed within the East and West Diversion Ditches can be produced from waste rock. The requirement for Riprap within the East and West Diversion Ditches will be assessed by BIM based on performance monitoring (i.e., the riprap may not be placed at the time of ditch excavation).

The riprap requirements are defined as follows:

- The material shall be well graded;
- The maximum riprap particle gradation shall not exceed 2 times the specified D_{50} value;
- The fines content (% passing the #200 sieve) shall not exceed 5%

Signature Page

Golder Associates Ltd.

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Ken De Vos, P.Geo.
Principal, Project Director

Ken Bocking, P.Eng.
Principal

BA/KB/ba

https://golderassociates.sharepoint.com/sites/22103g/technical work/phase 2000/2003 pond upgrade/1790951_design brief/1790951-2000-doc028_bimwasterockfacilitypondupgrade_15jun2018.docx

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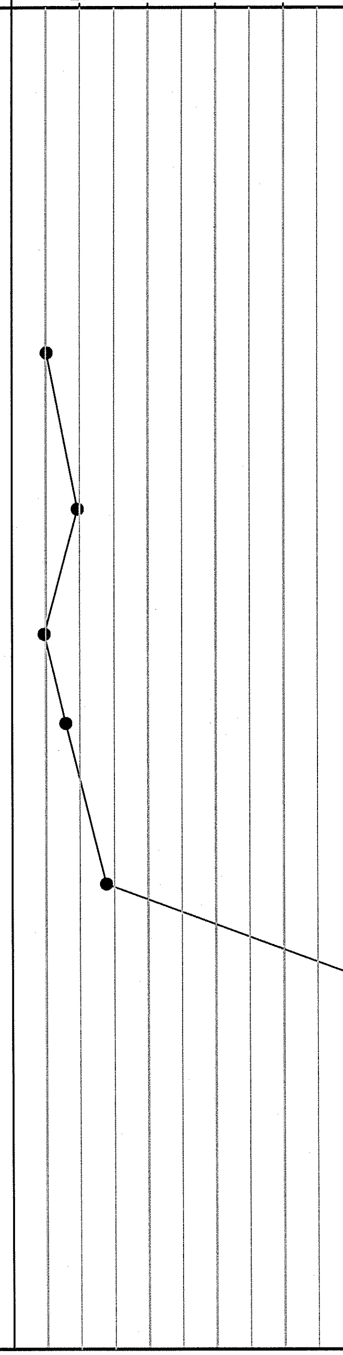
APPENDIX A

Historical Borehole Logs

Project:	Mary River Project	Drill Hole No.	**MWD 003**	PAGE	1 of 3
Drilling Co:	Boart Longyear	In Situ Sampler:	HQ Core Barrel	Date Started:	4 Jul 06
Drilling Method:	Rotary Coring - Longyear Fly 38	Elevation:	519 m	Date Completed:	5 Jul 06
Location:	Mary River, Baffin Island	Total Depth:	31.6 m	Logged by:	RLV/RBK/ACK
Coordinates:	7,915,196 N , 564,290 E	Inclination:	-90	Reviewed by:	KEH

DEPTH (m)	ELEVATION (m)	GRAPHIC LOG	DESCRIPTION OF MATERIALS	RUN RECOVERY (%)	FROZEN SOIL DESCRIPTION	SAMPLE RECOVERY (%)	SAMPLES	SAMPLE NO.	BLOW COUNT/ RQD (%)	SPT 'N' VALUE/ RMR	FIELD VANE SHEAR STRENGTH Remould (▲) Peak (△) / SPT TEST DATA 'N' VALUES Uncorrected (✕) Corrected (□) / PL MC LL (20 40 60 80)	INSTRUMENTATION DEPTHS (m)	INSTRUMENTATION DETAILS
	518.0		**2 - TILL** (0 to 13.5) Reddish brown, well graded sand and gravel with trace silt and cobble and boulder fragments (up to 10cm dia). Poor fines (sand and silt) recovery in areas was due to thawing and washing of soil matrix by drilling fluid.										
2				39	Nbe Vx								
	516.0		Frozen soils were recovered below 3.0m depth and were typically well bonded with and without excess ice with some ice and soil stratification and 5cm to 10cm massive ice lenses. Total visible ice within the stratum was less than 2 percent.										
4							▮	1					
	514.0		Sample 1 (3.7m to 4.0m) - Well graded silty sand with some gravel.										
			Sample 2 (5.4m to 5.8m) - Gap graded sand and gravel with trace silt.				▮	2					
6				100	Nbe Vx								
	512.0		Sample 3 (6.8m to 7.2m) - Poorly graded gravelly sand with trace silt.				▮	3					
8			Sample 4 (7.9m to 8.1m) - Poorly graded sand with trace gravel and trace silt.				▮	4					
	510.0			100	Nbn. Vs								
10			Sample 5 (9.6m to 10.0m) - Well graded, ice rich, gravelly sand with some silt.				▮	5					
	508.0		Sample 6 (11.0m to 11.4m) - Poorly graded, ice rich, gravelly sand with some silt.				▮	6					
12				65	Nbn								
	506.0												
14			**5B - HIGHLY FRACTURED GNEISS** (13.5 to 22) Dark gneissic bedrock with white specks. Highly fractured with extensive weathering.										



FROZEN SOIL DESCRIPTIONS:

- Nf - POORLY BONDED
- Nbn - WELL BONDED, NO EXCESS ICE
- Nbe - WELL BONDED, EXCESS ICE
- Vx - INDIVIDUAL ICE INCLUSIONS
- Vc - ICE COATINGS ON PARTICLES
- Vr - RANDOM OR IRREGULARLY ORIENTED ICE FORMATIONS
- Vs - STRATIFIED OR DISTINCTLY ORIENTED ICE FORMATIONS
- I+C - ICE WITH SOIL INCLUSIONS
- ICE - ICE WITHOUT SOIL INCLUSIONS

SAMPLE SYMBOL:

AUGER · SPLITSPOON · THERMISTOR · CORE · SHELBY TUBE

Baffinland
Mary River Project

Knight Piésold
CONSULTING

Project No.	Ref. No.	Rev.
NB102-00181/3	2	0

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Project: Mary River Project | Drill Hole No. **MWD 003**
Drilling Co: Boart Longyear | In Situ Sampler: HQ Core Barrel | Date Started: 4 Jul 06
Drilling Method: Rotary Coring - Longyear Fly 38 | Elevation: 519 m | Date Completed: 5 Jul 06
Location: Mary River, Baffin Island | Total Depth: 31.6 m | Logged by: RLV/RBK/ACK
Coordinates: 7,915,196 N , 564,290 E | Inclination: -90 | Reviewed by: KEH

DEPTH (m)	ELEVATION (m)	DESCRIPTION OF MATERIALS	RUN RECOVERY (%)	FROZEN SOIL DESCRIPTION	SAMPLE RECOVERY (%)	SAMPLES	SAMPLE NO.	BLOW COUNT/ RQD (%)	SPT 'N' VALUE/ RMR	FIELD VANE SHEAR STRENGTH Remould (▲) Peak (△) / SPT TEST DATA 'N' VALUES Uncorrected (×) Corrected (□) / PL MC LL 20 40 60 80	INSTRUMENTATION DEPTHS (m)	INSTRUMENTATION DETAILS
			87	Nbn I+S								
16												
	502.0											
18			92	Nbn								
	500.0											
20												
	498.0		89	N/R				*33*				
22		**6B - GNEISSIC BEDROCK** (22 to 31.6) Dark blueish grey gneissic bedrock with white specks. Strong and hard with some fracturing.										
	496.0											
24			99	N/R				*93*				
	494.0											
26												
	492.0		86	N/R				*73*				
28												
	490.0											

FROZEN SOIL DESCRIPTIONS:
- Nf - POORLY BONDED
- Nbn - WELL BONDED, NO EXCESS ICE
- Nbe - WELL BONDED, EXCESS ICE
- Vx - INDIVIDUAL ICE INCLUSIONS
- Vc - ICE COATINGS ON PARTICLES
- Vr - RANDOM OR IRREGULARLY ORIENTED ICE FORMATIONS
- Vs - STRATIFIED OR DISTINCTLY ORIENTED ICE FORMATIONS
- I+C - ICE WITH SOIL INCLUSIONS
- ICE - ICE WITHOUT SOIL INCLUSIONS

SAMPLE SYMBOL: AUGER, SPLITSPOON, THERMISTOR, CORE, SHELBY TUBE

Baffinland
Mary River Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
NB102-00181/3	2	0

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Project:	Mary River Project	Drill Hole No.	**MWD 003**	
Drilling Co:	Boart Longyear	In Situ Sampler:	HQ Core Barrel	Date Started: 4 Jul 06
Drilling Method:	Rotary Coring - Longyear Fly 38	Elevation:	519 m	Date Completed: 5 Jul 06
Location:	Mary River, Baffin Island	Total Depth:	31.6 m	Logged by: RLV/RBK/ACK
Coordinates:	7,915,196 N , 564,290 E	Inclination:	-90	Reviewed by: KEH

DEPTH (m)	ELEVATION (m)	GRAPHIC LOG	DESCRIPTION OF MATERIALS	RUN RECOVERY (%)	FROZEN SOIL DESCRIPTION	SAMPLE RECOVERY (%)	SAMPLES	SAMPLE NO.	BLOW COUNT/ *RQD (%)*	SPT 'N' VALUE/ *RMR*	FIELD VANE SHEAR STRENGTH Remould (▲) Peak (△) / SPT TEST DATA 'N' VALUES Uncorrected (✕) Corrected (□) / PL MC LL 20 40 60 80	INSTRUMENTATION DEPTHS (m)	INSTRUMENTATION DETAILS
	488.0			69	N/R				*50*				
32			End of Drillhole: 31.6 m										
	486.0												
34													
	484.0												
36													
	482.0												
38													
	480.0												
40													
	478.0												
42													
	476.0												
44													

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SAMPLE SYMBOL:

AUGER, SPLITSPOON, THERMISTOR, CORE, SHELBY TUBE

Baffinland
Mary River Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
NB102-00181/3	2	0

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Project: Mary River Project	Drill Hole No. MWD 004	PAGE 1 of 2
Drilling Co: Boart Longyear	In Situ Sampler: HQ Core Barrel	Date Started: 30 Jun 06
Drilling Method: Rotary Coring - Longyear Fly 38	Elevation: 473 m	Date Completed: 3 Jul 06
Location: Mary River, Baffin Island	Total Depth: 31.6 m	Logged by: RLV/ACK
Coordinates: 7,915,488 N , 564,716 E	Inclination: -90	Reviewed by: KEH

DEPTH (m)	ELEVATION (m)	GRAPHIC LOG	DESCRIPTION OF MATERIALS	RUN RECOVERY (%)	FROZEN SOIL DESCRIPTION	SAMPLE RECOVERY (%)	SAMPLES	SAMPLE NO.	BLOW COUNT/ *RQD (%)*	SPT 'N' VALUE/ *RMR*	FIELD VANE SHEAR STRENGTH Remould (▲) Peak (△); SPT TEST DATA 'N' VALUES Uncorrected (×) Corrected (□); PL MC LL; 20 40 60 80	INSTRUMENTATION DEPTHS (m)	INSTRUMENTATION DETAILS
	472.0		**2 - TILL** (0 to 6.5) Reddish brown, well graded sand and gravel with trace silt and cobble and boulder fragments (up to 10cm dia). Low recovery of fines (sand and silt) due to thawing and washing of soil matrix by drilling fluid. Frozen soils were recovered below 0.4m depth and were typically well bonded soils with some ice and soil stratification and a 5cm massive ice lens. Total visible ice within the stratum was less the 2 percent total visible ice.										
2				42	Nbn								
	470.0												
4													
	468.0												
6				86	Nbn Vx								
	466.0		**5B - HIGHLY FRACTURED GNEISS** (6.5 to 12.5) Dark gneissic bedrock with white specks. Highly fractured with extensive weathering.										
8													
	464.0			96	N/R				*40*				
10													
	462.0												
12				98	N/R				*56*				
	460.0		**6B - GNEISSIC BEDROCK** (12.5 to 31.6) Dark blue gneissic bedrock with white specks. Strong and hard with reduced fracturing with depth.										
14													
	458.0			98	N/R				*66*				

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SAMPLE SYMBOL:

AUGER · SPLITSPOON · THERMISTOR · CORE · SHELBY TUBE

Baffinland
Mary River Project

Knight Piésold CONSULTING

Project No.	Ref. No.	Rev.
NB102-00181/3	2	0

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Project: Mary River Project	Drill Hole No. **MWD 004**	PAGE 2 of 2	
Drilling Co: Boart Longyear	In Situ Sampler: HQ Core Barrel	Date Started: 30 Jun 06	
Drilling Method: Rotary Coring - Longyear Fly 38	Elevation: 473 m	Date Completed: 3 Jul 06	
Location: Mary River, Baffin Island	Total Depth: 31.6 m	Logged by: RLV/ACK	
Coordinates: 7,915,488 N , 564,716 E	Inclination: -90	Reviewed by: KEH	

FIELD VANE SHEAR STRENGTH Remould (▲) Peak (△); SPT TEST DATA 'N' VALUES Uncorrected (✕) Corrected (□); PL MC LL; 20 40 60 80

DEPTH (m)	ELEVATION (m)	GRAPHIC LOG	DESCRIPTION OF MATERIALS	RUN RECOVERY (%)	FROZEN SOIL DESCRIPTION	SAMPLE RECOVERY (%)	SAMPLES	SAMPLE NO.	BLOW COUNT/ RQD (%)	SPT 'N' VALUE/ RMR	INSTRUMENTATION DEPTHS (m)	INSTRUMENTATION DETAILS
	456.0											
18				99	N/R				***83***			
	454.0											
20												
	452.0			97	N/R				***78***			
22												
	450.0											
24				100	N/R				***80***			
	448.0											
26												
	446.0			100	N/R				***80***			
28												
	444.0											
30				100	N/R				***66***			
	442.0											
			End of Drillhole: 31.6 m									

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SAMPLE SYMBOL: AUGER, SPLITSPOON, THERMISTOR, CORE, SHELBY TUBE

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