
**Photo: 3.34-5**
Doris-Windy All-Weather Road; Stream Crossing #4; northwest abutment

**Direction:**
North

**Photo: 3.34-6**
Doris-Windy All-Weather Road; Stream Crossing #4; east abutments

**Direction:**
North

## 3.35 Doris-Windy All-Weather Road Quarries (A, B, and D)

General Description

Three rock quarries were established along the route of the Doris-Windy All-Weather Road to facilitate construction.

Observations

At the time of the inspection, none of these quarries was in use, although they may potentially be reopened in the future. Quarry A is being used as a temporary explosives storage area (Photo 3.35-1). Quarry D is being used for core and overburden storage (Photo 3.35-2). There is also a small, HDPE lined bunded area being used as secondary containment for several fuel drums.

Recommendations

Continue to manage the facility in accordance with the approved Quarry Management Plan.


**Photo: 3.35-1**
Doris-Windy All-Weather Road Quarry A

**Direction:**
West


**Photo: 3.35-2**
Doris-Windy All-Weather Road Quarry D

**Direction:**
South

# 4.0 RECOMMENDATIONS

Table 4.2 summarizes the recommendations made in the preceding sections, for the continued safe operation of the various areas inspected at the Doris North Project.

Three priority levels were identified as High, Medium and Low for the recommended action items with a timeframe for implementation proposed below. The differentiation of the level of priority is somewhat arbitrary but can be considered as follows in Table 4.1.

***Table 4.1 Summary of Site Observations for North Dam***

| Priority Level | Definition | Timeframe for Implementation |
|---|---|---|
| High (H) | Refers to items/issues that should be implemented before the mine site enters production, or before the area is put back into use. | Should be implemented within 0 - 1 year. |
| Medium (M) | Refers to items/issues that do not necessarily pose an immediate threat to operations, stability or environmental or health and safety, however, if the item is not addressed in a timely manner, additional deterioration of the situation is anticipated. Delays in addressing the issue may lead to increased costs or an increased likelihood of potential issues in the future. | Should be implemented within 1 - 3 year. |
| Low (L) | Refers to items/issues that are generally flagged that can be dealt with standard care and maintenance undertaken at the Site. | No timeline. |

***Table 4.2 Summary of Recommendations for 2015 Geotechnical Inspection***

| Priority | Area | 2015 Recommendations |
|---|---|---|
| L | Roberts Bay Jetty | The thermistors should be monitored in accordance with the recommended schedule.<br><br>The recommendations with respect to staff inspections and repairs, and staff operational awareness, as well as settlement monitoring made by PND should be implemented (PND 2013). |
| L | Shoreline Laydown Area | It is recommended that the area along the south edge of the main laydown pad be monitored to determine whether water regularly ponds against the main laydown pad. If so, accumulated water should be pumped out during freshet and after significant or prolonged rainfall events. |
| L | 20 ML Roberts Bay Tank Farm Secondary Containment | Pieces of spalled rock should be removed from within the limits of the HDPE liner area. The pieces have sharp edges that can damage the liner, particularly if they are pushed into the liner under the weight of equipment moving within the containment area.<br><br>Sections of exposed liner should be documented and inspected for damage. The gravel cover at wheel and track marks should be measured. Where the gravel is less than the design thickness, the gravel should be scraped back to expose the liner for inspection. The liner should be repaired if required by qualified personnel, and the cover gravel replaced.<br><br>Appropriate snow clearing and water management practices should be maintained to prevent water from building up inside the containment berm that can cause potential erosion of the cover gravel and the raised tank pedestals.<br><br>The construction of the sump should be checked to see if it were designed to allow water to enter from the sides. If so, the sump should be pumped out and monitored to see if water is entering from the sides. The concentration of sediment may be blinding the gravel cover in the immediate vicinity of the sump, and the gravel may need to be replaced with cleaner material at some time.<br><br>Recommendations from inspections carried out by specialists examining the stability of the rock face and rockfall protection system should be implemented<br><br>Only essential traffic should be permitted inside the containment area. |

| Priority | Area | 2015 Recommendations |
|---|---|---|
| H | 5 ML Roberts Bay Tank Farm Secondary Containment | Pieces of spalled rock should be removed from within the limits of the secondary containment area. The pieces have sharp edges that can damage the liner, particularly if they are pushed into the liner under the weight of equipment moving within the containment area.<br><br>Sections of exposed liner should be documented and inspected for damage. The gravel cover at wheel and track marks should be measured. Where the gravel is less than the design thickness, the gravel should be scraped back to expose the liner for inspection. The liner should be repaired if required by qualified personnel, and the cover gravel replaced.<br><br>If an extension of the liner limits is required to meet the design capacity of the tank farm, it should be completed before the re-commissioning of the tank.<br><br>Because a portion of the secondary containment facility bears on bedrock and a portion on engineered fill, regular inspections should include an assessment for differential settlement.<br><br>The construction of the sump should be checked to see if it were designed to allow water to enter from the sides. If so, the sump should be pumped out and monitored to see if water is entering from the sides. The concentration of sediment may be blinding the gravel cover in the immediate vicinity of the sump, and the gravel may need to be replaced with cleaner material. |
| L | Roberts Bay Waste Management Area | Continue monitor areas where rock was relocated from the tundra for signs of thermal settlement, and for ponded water along the edges of the thermal pad. |
| L | Quarry #1 Overburden Dump | The perimeter of the sedimentation control berm should be visually monitored to see that is performing as designed, and that there is no sediment transport off of the overburden pile onto the tundra.<br><br>The areas of subsidence are expected to require periodic ongoing maintenance with the placement of additional material. If this area is used for storage at some time in the future, increased maintenance requirements can be expected. |
| M | Airstrip | Areas where rock has been removed from the tundra should be monitored visually for deterioration. Even if the rock was carefully removed a thin layer of sand and gravel generally remains that will affect the vegetation and underlying thermal properties. This could depress the active layer and result in thawing and settlement. |

| Priority | Area | 2015 Recommendations |
|---|---|---|
| | | Although no standing water was observed at the time of the inspection, it is understood that there a maintenance protocol in place whereby standing water is pumped out, and should be implemented whenever necessary.<br><br>The tension cracks observed in the vicinity of the control tower and other nearby structures should be repaired. Generally these structures lie close to the edge of the pad and may experience some movement or damage if the cracks widen and are not repaired. |
| L | Former Wash Bay/Explosives Mixing Plant | If it is proposed to repurpose the building in the future, the tension cracks should be repaired. There is some potential for the cracking to propagate back into the pad and undermine the concrete building pad. |
| L | Upper Reagent Pad AN Storage | If it is proposed to use this area for secondary containment, the liner should be exposed to confirm that it is undamaged. |
| H | Sewage Treatment Plant Outfall | The original pipeline outlet should be monitored in the Spring for thermal settlement. The outlet should be switched to the bedrock outcrop as soon as possible in the Spring. |
| M | Landfarm / Rock Core Storage | Large pieces of stone / rock should be removed from the cells to avoid damage to the HDPE liner. Areas where stone has been (partly) scuffed off the liner should be replaced to provide a full cover thickness. The pothole at the base of the snow pond ramp should be repaired and a diffuser should be used to reduce the impact of the inflow into the pond.<br><br>The area between the rock core storage and the Quarry #2 overburden dump should be kept free of standing water. |
| L | Quarry #2 and Crusher Area | Continue to manage the facility in accordance with the approved Quarry Management Plan. |
| M | Doris North Camp Pads (Pad X, Y, C, E/P, F, G, J/H, Q and Helipad) | Thermal pads are designed with the intent that no permanent heated facilities will be located on top of them. The heat can reduce the insulation properties of the pad and lead to permafrost degradation, and subsequent settlement below the structures. There are several heated structures on-site that should be monitored for settlement.<br><br>The vertical rock face should be inspected periodically particularly after periods of freeze thaw, and loose rock should be scaled. Alternatively, netting and rock bolts could be installed, or barricades installed to prevent access to the base of the wall. |

| Priority | Area | 2015 Recommendations |
|---|---|---|
| M | ML Doris North Camp Tank Farm - Pad R | Long term stabilization measures have been designed for the rock faces to prevent damage to the tanks and the HDPE liner. These should be implemented as the site moves out of Care and Maintenance. |
| L | Power Generation Station - Pad B | The monitoring of the settlement points should continue regularly. A review of the foundation system should be undertaken to determine where the footings lie in proximity to the slope and what they bear on. A structural assessment of the stacks should also be undertaken. |
| H | Waste Rock Pile – Pad I | Once production resumes and if Pad I is used to store more waste rock, it will need to be managed in accordance with the Waste Rock Management Plan.<br><br>The stability of the waste rock pile along the south edge should be assessed, or the waste rock be removed from the edge of the pad. This are should be barricaded off until an assessment confirms the pile is stable. |
| H | Pollution Control and Sedimentation Ponds | Pollution Control Pond<br>The stability of the south edge of the Pollution Control Pond and the waste rock stockpile should be assessed. Continue to regularly regular monitor of the temperature at the downstream side of the pond.<br><br>Sedimentation Control Pond<br>It should be confirmed that the cuts in the HDPE liner lie above the elevation of the overflow pipelines. The overlap between the two sections of liner at the north end of the berm that separates the two ponds should be sealed. |
| M | Sumps #1 and #2 | A previous recommendation to backfill a low area around Sump#1 should be implemented to prevent standing water and further degradation of the permafrost. |
| H | Doris Primary Vent Raise Pad | The rock wall is in close proximity to the vent raise. Previous recommendations with respect to the installation of appropriate barricades and signage should be implemented to keep people and equipment at a safe distance from the wall.<br><br>The sump and cut-off trench should be completed to divert surface runoff from the bedrock into the raise. |
| H | Doris North Dam | If not already implemented, a regular program should be carried out for the depressions across the upstream and downstream faces.<br><br>As previously recommended, sampling and testing of the seepage water along the toe should be carried out to characterize the seepage water to eliminate seepage from under the dam as a source.<br><br>A regular maintenance program for the thermosyphons should be developed and implemented. |

| Priority | Area | 2015 Recommendations |
|---|---|---|
| M | All-Weather Roads (Doris Site) | Former roadside turnout areas should be monitored for signs of thermal settlement. Areas where water regularly ponds against the road toe should be documented and checked during freshet and after significant precipitation. Standing water should be pumped from these areas.<br><br>It has been recommended that a buttress be constructed along the toe of the Secondary Road where there was a previous instability, although this has not been implemented. With construction activities, and as the mine goes into production, this road is expected to see increased traffic. It is recommended that toe berm should be constructed. Until it is in place, the slope should be monitored for signs of movement. |
| M | Doris Creek Bridge | The thermistors should continue to monitor permafrost conditions at the bridge abutments. The gabions should be monitored to see if there is ongoing deformation. |
| M | Doris-Windy All-Weather Road | Former roadside turnout areas should be visually monitored for signs of thermal settlement. |
| M | Doris-Windy All-Weather Road Stream Crossings | Rock fill should be placed at locations where standing water is notes against the thermal bridge abutment pads to provide insulation and stabilize potential deterioration of the permafrost.<br><br>In earlier geotechnical inspections it was noted that the web of the I-beam, on top of the fourth pile from the northwest corner of the arch culvert at stream crossing #1, was buckled, but that there had been no change since first noticed in 2012. Some damage to the bridge section was also noted at stream crossing #3. If notable changes are observed in subsequent inspections, a structural assessments should be undertaken. |
| L | Doris-Windy All-Weather Road Quarries (A, B, and D) | Continue to manage the facility in accordance with the approved Quarry Management Plan. |
| | Frozen Core Plant Pad | Not Inspected |

## 5.0 CLOSING REMARKS

This report has been prepared by Ms. Jane Doucette, P. Eng. and reviewed by Mr. Andy Small, P. Eng. from Amec Foster Wheeler.

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Respectfully submitted,

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