AEC

Government of Yukon, Water Resources Branch

Sä Dena Hes Mine, YT
2008 Geotechnical Inspections

Prepared by:

AECOM Canada Ltd.
1479 Buffalo Place, Winnipeg, MB, Canada R3T 1L7
T 204.284.0580 F 204.475.3646 www.aecom.com

Project No.: 2940 039 00 (4.6.1.3)

Date: January, 2009

Statement of Qualifications and Limitations

The attached Report (the "Report") has been prepared by AECOM Canada Ltd. ("Consultant") for the benefit of Government of Yukon ("Client") in accordance with the agreement between Consultant and Client (the "Agreement") for the services described therein, and is subject to the budgetary, time and other constraints and limitations set forth therein.

The information and data contained in the Report, including without limitation the results of any inspections, sampling, testing and analyses and any conclusions or recommendations of Consultant (the "Information"), represent Consultant's professional judgement in light of the knowledge and information available to it at the time of preparation of the Report. Consultant has not updated the Report since the date that the Report was prepared. Further, Consultant has relied upon the accuracy of the information provided to it by Client in order to prepare the Report and Consultant has not independently verified the accuracy of such information, nor was it required to do so. Thus, Consultant shall not be responsible for any events or circumstances that may have occurred since the date on which the Report was prepared which may affect the information contained therein, or for any inaccuracies contained in information that was provided to Consultant by Client.

Consultant makes no guarantees or warranties whatsoever, whether express or implied, with respect to the Report, the Information or any part thereof, and Consultant shall not, by the act of preparing or issuing the Report and the Information, be deemed to have represented that the Report or the Information is accurate, exhaustive, complete or applicable to any specific use other than the agreed upon Scope of Work as defined in the Agreement.

Except as required by law, the Report and the Information are to be treated as confidential and, unless otherwise agreed to by Consultant and Client, may be used and relied upon only by Client and its officers and employees, subject to the foregoing limitations. Consultant accepts no responsibility, and denies any liability whatsoever, to parties other than Client who may obtain access to the Report or the Information for any injury, loss or damage suffered by such parties arising from their use of, reliance upon, or decisions or actions based on the Report or any of the Information unless those parties, prior to using or relying on the Report or the Information, have obtained the express written consent of Consultant and Client to use and rely on the Report and the Information, and signed an Authorized User Agreement in a form provided or agreed to by Consultant.

This Disclaimer is attached to and forms part of the Report.

AECOM
1479 Buffalo Place, Winnipeg, Manitoba R3T 1L7
T 204.284.0580 F 204.475.3646 www.aecom.com

January 8, 2009

Project No. 2940 039 00 (4.6.1.3)

Mr. Glenn Ford
Geotechnical Technologist
Water Resources Branch
Environment
Government of Yukon
419 Range Road
Box 2703, V-310
Whitehorse, YT
Y1A 2C6

Dear Mr. Ford:

Re: Yukon Sites – 2008 Geotechnical Inspections
Sä Dena Hes Mine, YT

AECOM Canada Ltd. is pleased to submit our Final Report for the above referenced project. This report provides the results of our geotechnical inspection and recommendations for follow-up maintenance work.

If you require further information or clarification, please contact Ken Skaftfeld, P.Eng. directly.

Sincerely,

AECOM Canada Ltd.

Ron Typliski, P.Eng.
Vice-President, Manitoba District
Canada West Region
KS/dh

Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	K. Skaftfeld	Nov. 27/08	Draft
2	K. Skaftfeld	Jan. 8/09	Final

Signature Page

Report Prepared By:	Report Reviewed By:
Ken Skaftfeld, P.Eng. Senior Geotechnical Engineer	W. R. Wiesner, P.Eng., (Manitoba) Senior Geotechnical Engineer

Table of Contents

1. Introduction 1
1.1 Terms of Reference and Scope of Work 1
1.2 Background and Site Description 1
2. Review of Background Information 3
3. Geotechnical Inspections 3
3.1 TMA Operation 3
3.2 North Creek Dyke 5
3.3 North Dam 7
3.4 Cofferdam 9
3.5 South Dam 11
3.6 Reclaim Dam 16
3.7 Camp Creek Diversion Channel 19
4. Conclusions and Recommendations 22
4.1 Conclusions 22
4.2 Recommendations 23

Drawings

Drawing 01 Tailings Management Area Site Plan
Drawing 02 North Creek Dyke
Drawing 03 North Dam
Drawing 04 Cofferdam
Drawing 05 South Dam
Drawing 06 Reclaim Dam

Appendices

Appendix A Site Photographs and Video

1. Introduction

1.1 Terms of Reference and Scope of Work

This report summarizes the results of our geotechnical inspection of the tailings dams and associated works at the Sä Dena Hes Mine near Watson Lake in the Yukon Territory. The terms of reference for the inspection were outlined in AECOM's letter to Mr. Glenn Ford of the Government of Yukon Water Resources Branch dated June 25th, 2008. The purpose of the inspection was to i) determine the existing condition and operation of the structures within the Tailings Management Area (TMA) and compare these with previous investigations and dam safety reviews (by others), ii) determine if the structures within the TMA are being operated according to acceptable engineering standards, and iii) identify issues for follow-up and to advise on the adequacy of proposed mitigation measures. In order to achieve these objectives, the program was broken into the following tasks:

1. Review background information provided by the Government of Yukon's Project Manager which included past water licence applications and inspection/dam safety review reports to familiarize ourselves with the TMA structures and associated potential issues.

2. Inspect the TMA structures in the company of the Government of Yukon's Project Manager.

3. Prepare a site inspection report detailing the condition of the TMA structures, changes from the last inspection (based on the background review), required repairs and /or maintenance and other observed issues.

4. Participate, as required, in teleconferences with the owners of the structures and/or their representatives, other government representatives to discuss observations and recommendations, and to assess proposed mitigations.

5. Review the issues noted against proposed mitigations, taken or to be taken, and submit to the Project Manager a follow-up report reviewing the adequacy of mitigations proposed and recommendations regarding any oversight or follow-up work that should be done.

This inspection report is based on a cursory visual inspection and data provided in previous reports by others. Detailed investigations were not carried out and as such, this investigation was not intended to be detailed assessment of their condition.

1.2 Background and Site Description

The Sä Dena Hes Mine is located about 70 km north of the Town of Watson Lake in the Yukon Territory (Figure 01). In 1992, underground lead and zinc mining was terminated after 2 years of operation. The mine site remains under active care and maintenance and in this regard, full-time security and property management is provided by Teck Cominco through on-site personnel until such time as mine operations resume.

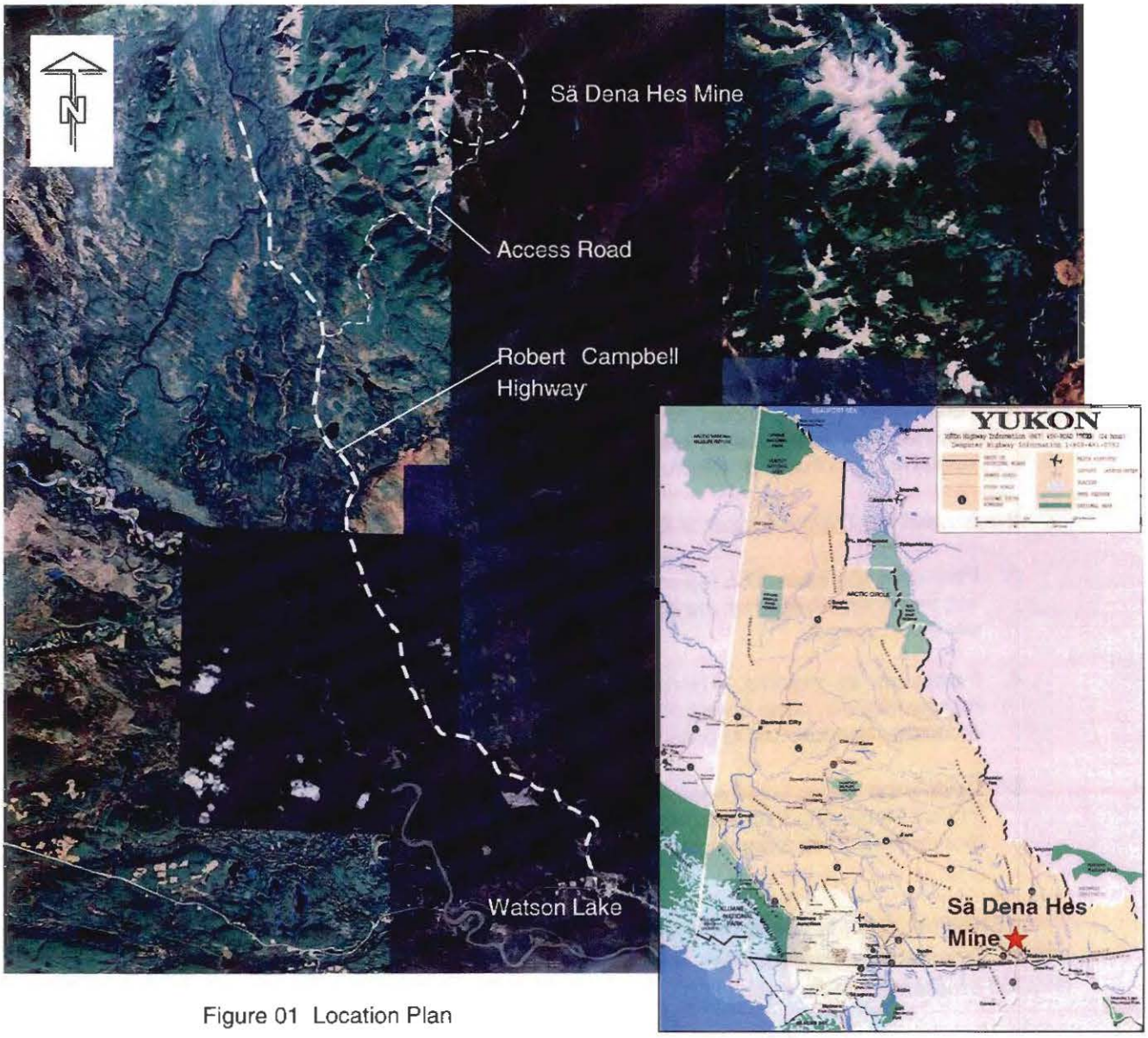


Figure 01 Location Plan

2. Review of Background Information

Background information provided by the Yukon Government Project Manager prior to the inspection included the following:

- Klohn Crippen – Sä Dena Hes Mine – 2003 Dam Safety Review, November 2003.
- SRK Consulting, Operating, Maintenance and Surveillance Manual, Tailings Management Facility Sä Dena Hes, Yukon Territory, December 2004.
- Teck Cominco Metals Ltd., Sä Dena Hes Mine – 2005 Annual Report Yukon Water Licence QZ99-045 Application Number QZ05-070, March 2006.

3. Geotechnical Inspections

The geotechnical inspections were carried out on July 18th 2008 by Mr. Ken Skaftfeld, P.Eng. of UMA Engineering in the company of the Government of Yukon's Project Manager, Mr. Glenn Ford and Mr. Brian Currie, Caretaker for the mine. Weather conditions were fair with light rain. All of the major components of the TMA, with the exception of the east and west interceptor ditches, were included in the geotechnical inspections. Photographs and a video were taken during the inspection; these have been included on the compact discs attached to this report in Appendix A. The photo locations and features of note are referenced to GPS waypoints which are shown on the Drawings attached to this report. Their locations are approximate based on the accuracy of the hand held GPS unit.

3.1 TMA Operation

The TMA consists of the following components:

- North Creek Dyke;
- North Dam;
- Cofferdam;
- South Dam;
- Reclaim Dam;
- Camp Creek Diversion; and
- East and West Interceptor Ditches.

The general layout of these components is shown on Figure 02 and Drawing 01.

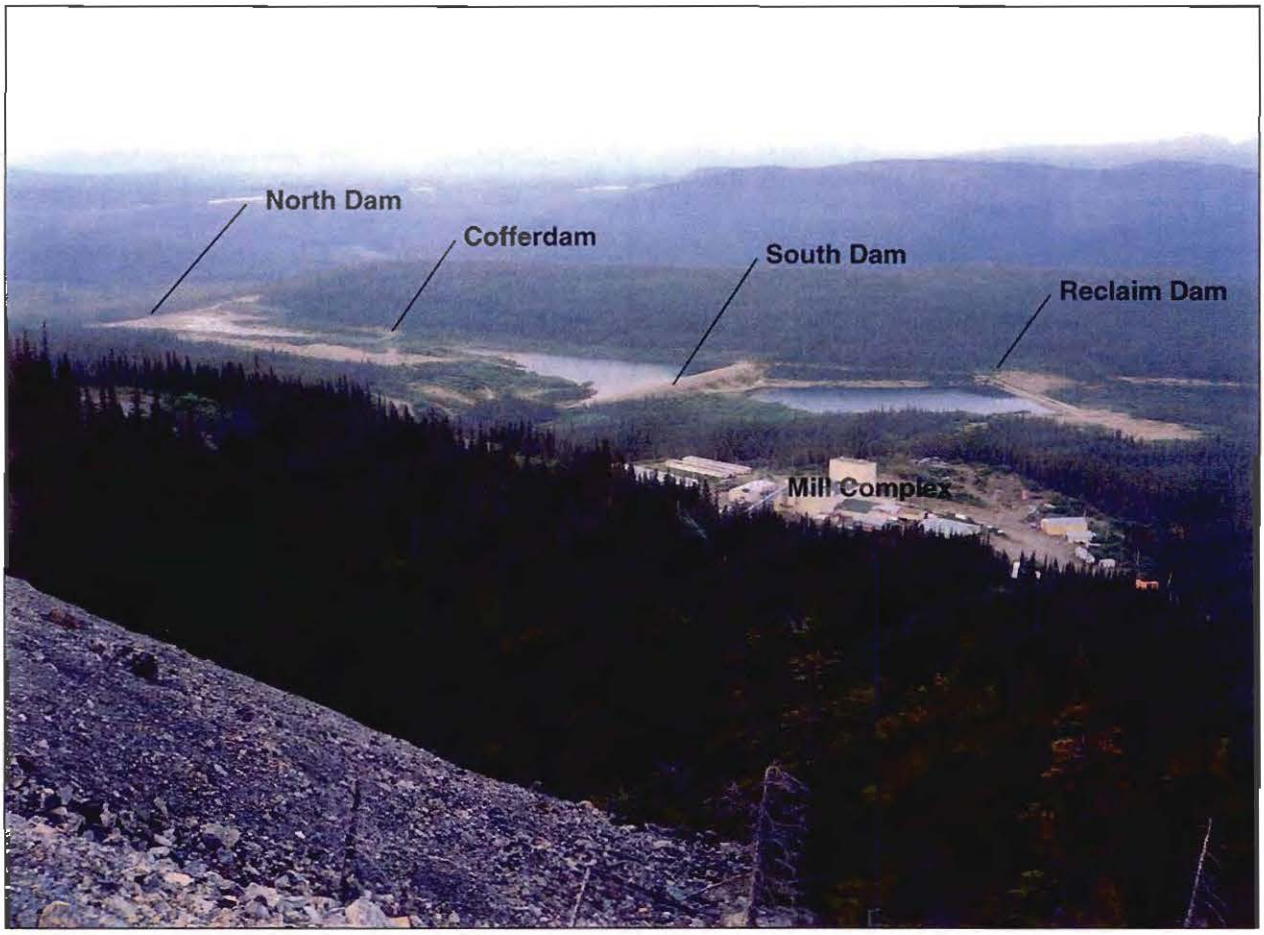


Figure 02 Tailings Management Area Layout (view from 1408 portal)

Sphalerite and galena ore bodies with negligible iron sulphide were processed by conventional flotation methods resulting in carbonate-rich tailings. Because of this mineralization, it is our understanding that acid generation of the tailings will not occur (SRK, 2004). The tailings consist of fine sandy silts with some clay sized particles. About one million m^3 of tailings were deposited from the western end of the North Dam only and the tailings beach formed eastward and southward from this location (SRK, 2004). A decant tower just upstream of the South Dam was intended to be used to decant supernatant from the tailings pond(s) to the reclaim pond. Planned future operations are likely to involve tailings deposition off of both the North Dam and Cofferdam to maintain a barrier between the North Dam and supernatant (SRK, 2004).

Only a small volume of water is contained between the North Dam and Cofferdam in the area referred to in this report as the north pond. Water is impounded upstream of the South Dam in the south pond. Water between the South Dam and Reclaim Dam constitutes the reclaim pond. At the time of our inspection, water was being discharged from the north tailings pond through a gated culvert in the Cofferdam into the south pond. A decant tower in the south pond is no longer operational, having been plugged in 2002 to prevent intermittent discharge following concerns about water quality in the reclaim pond (SRK, 2004). Supernatant water from the south pond was being siphoned over the South Dam into

the reclaim pond. Water from the reclaim pond is discharged into Camp Creek via a siphon system. It is our understanding that the Government of Yukon monitors water quality to confirm that the discharge at the point of compliance downstream of the TMA meets the license limits for the site. The east and west interceptor ditches divert surface water runoff around the TMA.

3.2 North Creek Dyke

The North Creek Dyke, located about 1 km north of the TMA, is an earth fill structure about 50 m long and 5 m high (Drawing 02). The dyke was constructed in 1991 to provide a water supply reservoir for mill operations. A creek flows into the west side of the reservoir which appears to be 0.5 to 1 m deep. The pump station is located on the north side of the reservoir and insulated water lines from the reservoir run along the road to the mill (Figure 03). The crest appears to be in good condition with no visible settlement, cracking or tilting. There is no visible seepage at the toe of the dyke. There is one 600 mm diameter steel outlet pipe and three outlet culverts through the dyke set at a higher elevation to pass larger flow events (Figure 04).

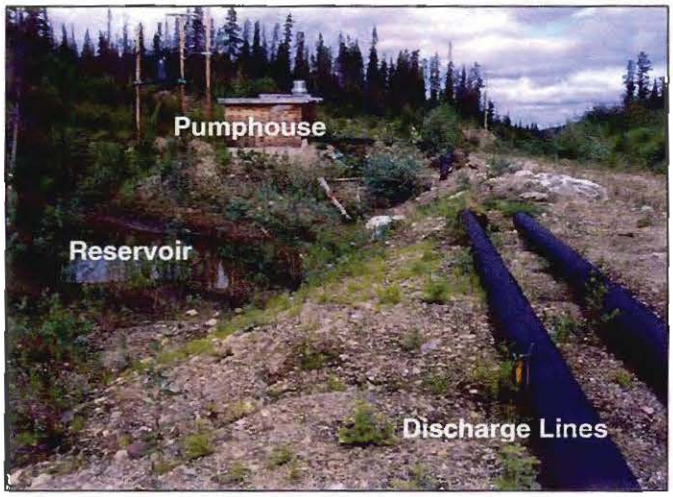


Figure 03 N Creek Dyke Pumphouse & Reservoir

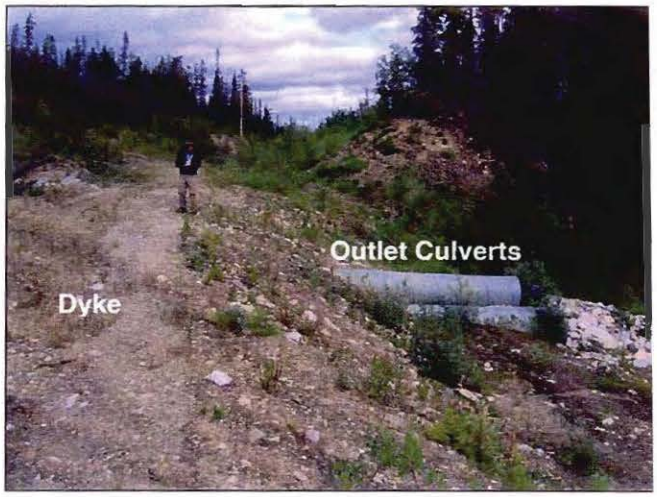


Figure 04 Outlet Culverts Through Dyke

The steel outlet pipe was running about ¾ full at the time of our inspection as seen on Figure 05. Based on an estimated drop in elevation of about 5.5 m from the inlet to outlet ends of the pipe, the flow was estimated to be in the order of 50 L/sec. All reservoir outlets discharge into a lined channel on the downstream face of the dyke. The steel outlet pipe transitions to a 1.2 m diameter corrugated metal pipe (CMP) within the dyke fill. The outlet CMP then discharges onto a spill pad and plunge pool where there are 600 to 1,000 mm diameter rocks (Figure 07). No erosion of the upper or lower spill pads was evident. Channel armouring extends about 10 m beyond the plunge pool.

Sandbags have been added to the armouring around the pipe inlet. The inlet to the pipe is clear and appears stable. Minor erosion gullies were noted on the downstream face of the dyke, however, these

features are somewhat self-armoured with the gravel and cobble size material and vegetation is becoming established in the area of the gullies (Figure 08).

Figure 05 Reservoir Outlets

Figure 06 Discharge From outlet Pipe

Figure 07 Channel Armouring For Upper Culverts

Figure 08 Erosion Gullies on D/S Slope

A second road crossing is located about 75 m downstream of the North Creek Dyke. An earth berm has been constructed across the west ditch, presumably to prevent creek flow from re-routing along the ditch. There is one 1.2 m diameter culvert visible on the upstream side of the road (Figure 09). On the downstream side however, there are two culverts visible (Figure 10). The upper (operational) culvert is 1.2 m diameter. The lower culvert is 600 mm diameter. Rock armouring on the upstream side is up to 1.2 m in diameter and in good condition. The downstream armouring is in good condition although

somewhat sparse around the end of the 1.2 m diameter culvert. About 90 percent of the flow is through the upper culvert.

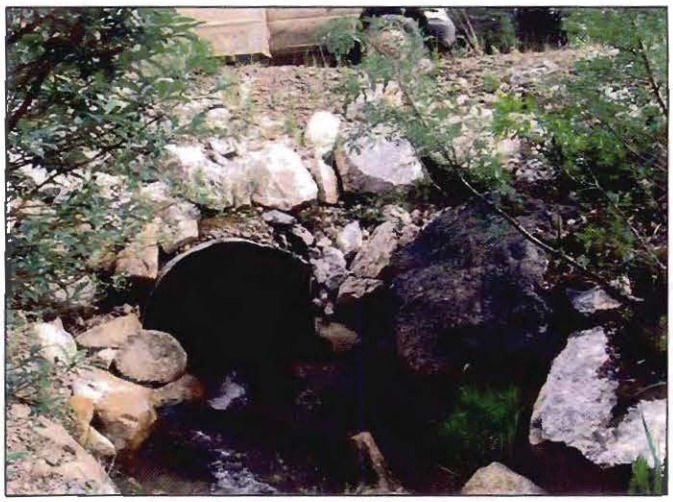


Figure 09 Inlet to Upper Culvert

Figure 10 Culvert Outlets

3.3 North Dam

The North Dam is an earthfill structure approximately 15 m high and 260 m long (Drawing 03). The crest is about 8 m wide with sparse vegetation (Figure 11). The dam crest appears to be in good condition with no visible settlement or cracking. There is a small but noticeable tilt in the crest, in particular along the western half of the dam from about WP 180 to WP 189. Survey shots at WP 199 confirm an elevation difference in the crest of about 0.11 m to the south within this stretch. It is our understanding that the crest was constructed in this fashion to facilitate drainage of surface runoff into the pond (Klohn, 2003). Tailings have been deposited to within about 1 m of the dam crest and a gravel cover has been placed over the tailings in the northwest corner as shown on Figure 12. Erosion channels are developing in the gravel cover. Only a small upstream pond exists towards the east end of the dam where it then extends to the south along the edge of the pond. Erosion gullies are forming on the upstream face of the dam between the edge of the crest and tailings (Figure 13). Rilling of the downstream slope face is considerable, in particular along the lower half of the slope face (Figure 14) where the sand appears damp. There are a number of sand deltas formed at the toe of the dam from surface erosion associated with the rilling (inset on Figure 14). It is possible that the rilling is associated with an expression of the seepage line through the dam.

Figure 11 View E along CL From W Abutment

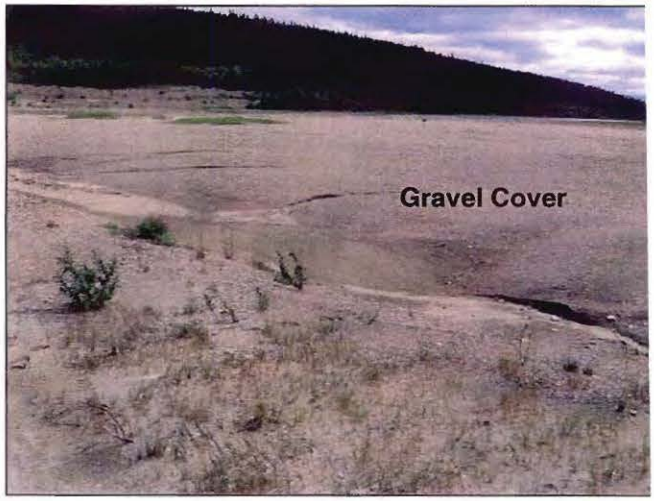


Figure 12 Gravel Cover Over Tailings

Figure 13 Erosion Gullies on U/S Slope at WP 182

Figure 14 Rilling on D/S Slope at WP 184

Seepage along the downstream toe collects in a pond near the middle of the dam (Figure 15). Seepage water could be traced for about 20 m east and 100 m west of the pond as shown on Drawing 03. The water from the pond reports to a pipe weir referred to as MH-02 (Figure 16). Historically, there has been a small flow of water along an 80 m stretch of the downstream toe and in 2003, the measured flow rate ranged from 8 to 52 L/min (SRK, 2004). At the time of the inspection, the flow rate was estimated (not measured) to be in the order of 20 L/min. Vegetation along the drainage paths and in the vicinity of the pond is lush and erosion along the flow paths at the toe of the dam east and west of the pond is minimal.

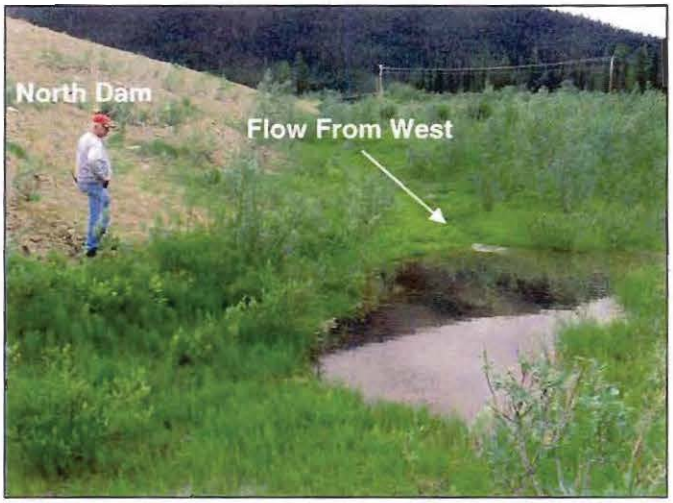


Figure 15 Seepage Pond at D/S Toe

Figure 16 Pipe Weir

There is no spillway or water release structure on the North Dam. Water that accumulates in the tailings pond appears to be directed to the eastern edge of the pond and then to the south where it is released via a gated culvert in the Cofferdam. At the time of the inspection, ponded water was visible along the eastern shoreline of the tailings pond extending to the Cofferdam as seen in Figure 12.

3.4 Cofferdam

The Cofferdam is located in the valley constriction about half-way between the North and South Dams (Drawing 04). The dam is about 100 m long and 2 m high with approximately 2H:1V sideslopes. The dam crest is somewhat uneven with a poorly defined crest with about 1 m of freeboard on the upstream (north) side. Small shrubs are becoming established on the crest and slopes (Figure 17). Water is ponded against the north side of the dam (Figure 18) while the south toe is flanked by wetlands with thick vegetation (Figure 19). Water is discharged through a gated 450 mm diameter culvert. Slumping of the upstream slope at the culvert was observed as seen in Figure 20. The gate on the culvert was almost completely raised and water was flowing at an estimated flow rate of 60 L/min (Figure 21). The bottom 1/4 of the culvert is blocked with sediment and debris. Water discharges into a small pool on the downstream side of the dam as shown on Figure 22.

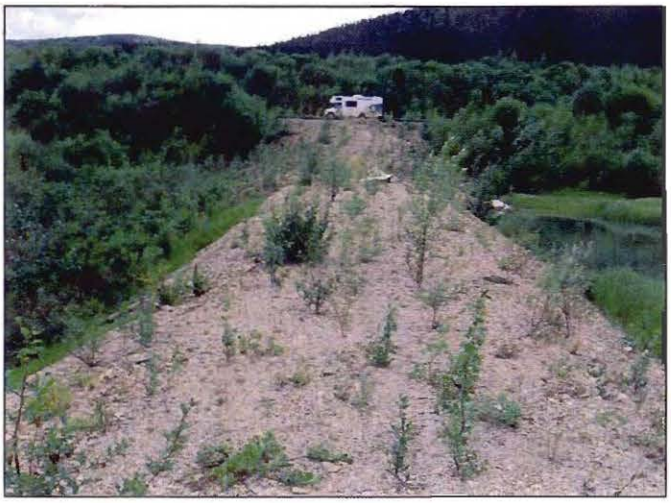


Figure 17 View W Along Cofferdam Crest

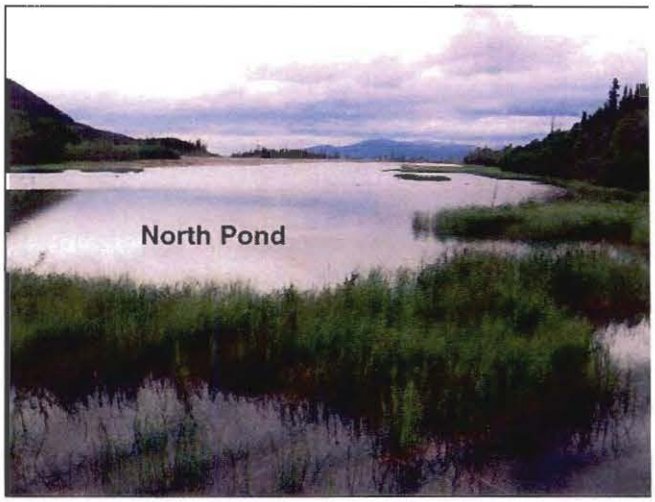


Figure 18 View N at North Pond and North Dam

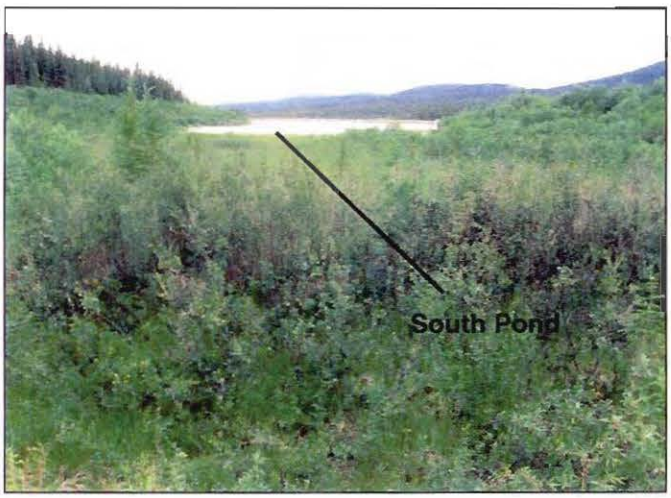


Figure 19 View S at South Pond and South Dam

Figure 20 Slumping of Slope at Culvert

Figure 21 Gated Culvert Inlet

Figure 22 Culvert Outlet

3.5 South Dam

The South Dam is about 400 m long and 18 m high (Drawing 05). The crest appears to be in good condition with no visible settlement, cracking or tilting. As seen on Figure 23, the north half of the dam crest is about 0.6 m lower in elevation than the south half as a result of unfinished dam raise work in 1991 (Teck Cominco, 2003). At the time of the inspection, the minimum freeboard on the upstream side of the dam was in the order of 2 m with the lowest point appearing to be at the emergency spillway located at the west abutment. A toe buttress, about 120 m long, has been constructed on the downstream side of the dam from the east abutment (Figure 24). Small shrubs are becoming established on the upstream and downstream faces of the dam.

Figure 23 View W Along Raised Crest

Figure 24 Toe Buttress at D/S Toe

Seepage was observed along the downstream toe beginning about 20 m east of the west abutment at WP 204 where the dam is in the order of 6 m high immediately downslope from monitoring wells SDW1. Seepage water was clear and estimated to be flowing into a small pond surrounded by lush vegetation at a rate of about 5 L/min (Figure 25). The ground is soft at the toe and to about 2 m up the downstream face. The seepage was traced along the toe for about 35 m to the east to WP 206 where fill material appears to have been pushed out from the toe directing the seepage water to the south. Trace seepage was next observed at the downstream toe about 50 m to the east at WP 207 where the dam is in the order of 10 m high (Figure 26). Seepage water from this location runs into the brush on its way to the reclaim pond. Minor erosion gullies visible on the downstream face at this location are becoming self armoured with the coarser fraction of the earth fill material.

Figure 25 Seepage at D/S Toe near at WP 204

Figure 26 Seepage Area at D/S Toe at WP 207

No water was flowing from the decant tower outlet pipe through the dam (Figure 27). A siphon system consisting of four 100 mm diameter polyethylene pipes over the dam crest at WP 208 (same location as the decant pipe) is used to discharge water from the south pond into the reclaim pond (Figure 28). At the time of our inspection, two of the siphons were operational. Flow rates are measured with a flow meter at the dam crest (inset on Figure 28).

Figure 27 Decant Tower Pipe

Figure 28 Discharge Siphons

The toe buttress is level with no evidence of movement (Figure 29) although erosion gullies have formed on the downslope face as shown on Figure 30. Some slumping of the leading edge of the fill was observed along the edge of the pond. Exposed geotextile can be seen above the buttress in the vicinity of WP 212 in what appears to be the remnants of an old repair (Figure 31). The crest elevation of the buttress drops towards the east abutment where it ties in with an access ramp to the south and an area of gravel and rock fill believed to be one of the drains (Figure 32) installed to improve internal drainage (SRK, 2006). Seepage from a low area just east of the rock fill is visible where it crosses the berm towards the reclaim pond as seen on Figures 33 and 34.

Figure 29 View W at Toe Buttress

Figure 30 Erosion Gullies on D/S Face of Buttress

Figure 31 Exposed Geotextile

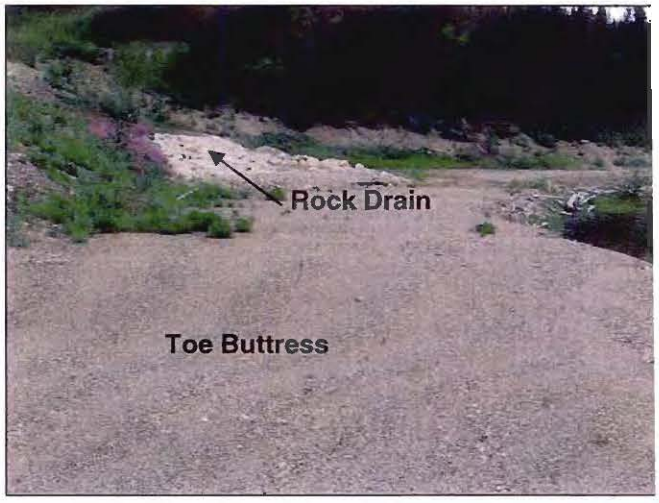


Figure 32 East End of Buttress at Drain

Figure 33 Low Area at E End of Buttress

Figure 34 Seepage From Low Area

Minor erosion gullies are evident on the downstream slope of the South Dam in the area of WP 215 (Figure 35). Wave benches and erosion of the upstream face is evident intermittently along the majority of the dam, in particular east of the decant structure (Figure 36). Similar observations were made in previous inspection reports (Teck Cominco, 2003 & SRK, 2006). Beached driftwood is also visible along the upstream shoreline.

Figure 35 Erosion Gullies on D/S Face

Figure 36 Erosion of U/S Face

Reservoir levels were low enough in the south pond to prevent water from entering into the emergency spillway channel at the west abutment at the time of our inspection (Figure 37). Water puddled in the channel appears to originate from seepage from the natural bank at the northwest corner of the spillway and flows towards the pond. The inlets to the two 900 mm diameter culverts are at least 50% blocked with sediment and debris (Figure 38). There is also some debris and shrubs growing in the discharge channel from the culverts although the culvert ends are not blocked (Figure 39). Minor tension cracking is visible along at the top of the south side of the emergency spillway channel (Figure 40). This was noted previously when concerns were raised with respect to the instabilities of the channel slopes and blockages of the culverts reducing the capacity of the spillway (Klohn, 2003).

Figure 37 Emergency Spillway Channel

Figure 38 Emergency Spillway Culverts (Inlet)

Figure 39 Emergency Spillway Culverts (outlet)

Figure 40 Tension Cracks Along Spillway Chann

3.6 Reclaim Dam

The Reclaim Dam impounds water in the reclaim pond before it is released into Camp Creek diversion channel downstream of the west abutment. It is the most southerly component of the overall TMA (Drawing 06). The crest appears to be in good condition with no visible settlement, cracking or tilting. Saplings and small shrubs are becoming well established on the downstream face as seen on Figure 41. Water is discharged from the reclaim pond into Camp Creek through a siphon system consisting of four 100 mm diameter black polyethylene and one 300 mm diameter Sclairpipe (Figure 42). An emergency spillway is located along the Camp Creek diversion upstream of the road crossing. A rockfill toe buttress was constructed in 1992 and extended to the east abutment in 1994 (SRK, 2006).

Figure 41 View W at Dam and Toe Buttress

Figure 42 Siphons From Reclaim Pond

The rockfill toe buttress appears to be in good condition although a few small voids in the rock were observed (Figure 43). Seepage was observed at the downstream toe along the toe buttress at WP 240 (Drawing 06). It appears however, that seepage at this location originates from higher natural ground to the south where MW RDW-3 is located i.e. seepage does not appear to be through the Dam at this location (Figure 44). At WP 243 however, the seepage water appears to be through the dam where the combined flow from the west reports to a manhole weir at WP 242 (Figure 45). Seepage flow from the east also reports to the manhole weir (Figure 46). The manhole weir is a 1.8 m diameter corrugated metal pipe with a V-notch cut into the side (Figure 47). At the time of the inspection, the flow depth in the V-notch was 70 mm which would equate to a flow rate of approximately 60 L/min (Figure 48).

Figure 43 Void in rock Fill at WP 238

Figure 44 Seepage at Toe at WP 240

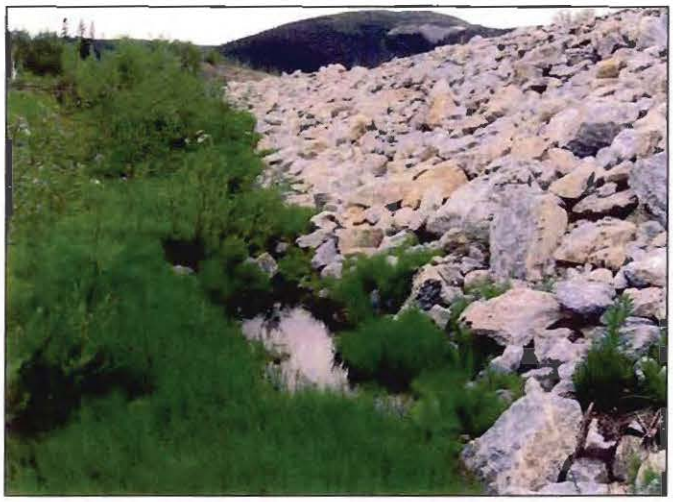


Figure 45 Seepage Flow From W to MH-07

Figure 46 Seepage Flow From E to MH-07

Figure 47 Seepage Flow Entering MH Weir

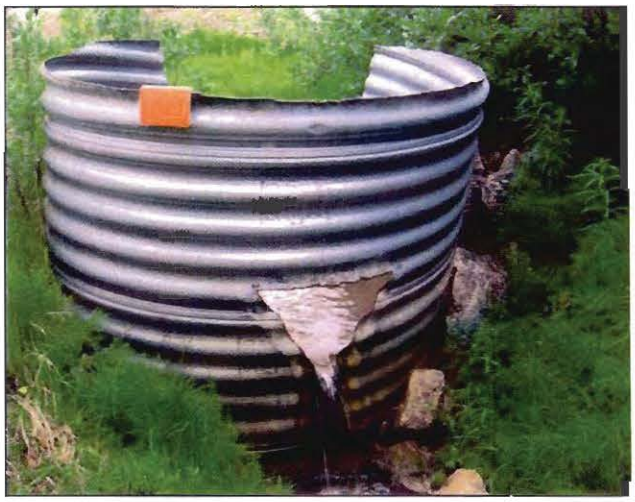


Figure 48 Flow Through V-notch Weir

Subterranean water flow can be heard through the rock fill beginning at the east end of the buttress towards the collection point at MH-07 (Figure 49). There is also some contribution of flow from seepage water originating in an area of soft ground just south of the east abutment (Figure 50). The seepage water appears clear although some fine sand has been deposited in voids in the rock at the toe as seen on the inset on Figure 49.

Figure 49 Subterranean Flow Through Rock Fill

Figure 50 Soft Ground/Seepage at E Abutment

The dam crest is visibly lower at the east abutment where the freeboard reduces from about 1.8 m just west of the east abutment to about 0.9 m at the low point on the dam crest. This low point is connected to a ditch along the east edge of the access road. Based on the design criteria for the dam, the minimum design freeboard was to be 2.5 m (SRK 2004). There is little armouring visible along the upstream side of the dam at the east abutment where driftwood has accumulated (Figure 51). Judging by the elevation at which the driftwood has been beached, it is likely that the reclaim pond has come close to overtopping at the east abutment. Saplings and small shrubs are becoming well established on the downstream face of the dam as seen on Figure 41. Small shrubs and saplings are also becoming established along the upstream face of the dam as seen on Figure 51. Erosion and over-steepening of the upstream face is evident with signs of recent slumping of the slope face at WP 254 (Figure 52)

Figure 51 View W Along U/S Face From WP 251

Figure 52 Slumping of U/S Face at WP 254

3.7 Camp Creek Diversion Channel

The Camp Creek diversion channel diverts creek flow around the tailings impoundments and reclaim pond (Drawing 06). The inspection was limited to a 400 m section of the channel from WP 235 to the spillway exit chute. Two ¼ round corrugated metal pipes (CMPs) have been used to partially line the gradual bends in the channel at the locations shown on Drawing 06 and Figure 53 and 54. The CMPs are held in place by boulders and anchor rods. Some of the anchor rods appear to have become loosened as seen on Figure 54. There is minor slumping of the channel bank behind the CMPs at some locations e.g. from WP 232 to WP 233 (Figure 55). The natural bank on the opposite side of the CMPs is not armoured and has localized sections where the lower bank is over-steepening from erosion resulting in localized slumping of the bank (Figure 56). It appears that the slumping may have caused minor channel restrictions although no large scale bank movements were visible. Vegetation is sparse on the channel slopes but becomes more dense upstream of the last point of inspection (U/S of WP 235).

Figure 53 View U/S Along Lined Channel From WP 227

Figure 54 View D/S Along Lined Channel From WP 2:

Figure 55 Slumping Behind CMP

Figure 56 Toe Erosion and Slumping

The emergency spillway from the reclaim pond is lined with riprap (Figure 57). The riprap extending along the sides of the channel from the spillway to the culverts at the road crossing is sparse (Figure 58). A staff gauge and water lever recorder located between the downstream end of the CMP channel lining and the emergency spillway read 0.18 m at the time of our inspection (Figure 58). The staff gauge at the culvert entrance at the road read 0.08 m (Figure 59). Erosion gullies have formed on the slope face on the southwest side of the channel for about 30 m upstream of the culverts (Figure 60)

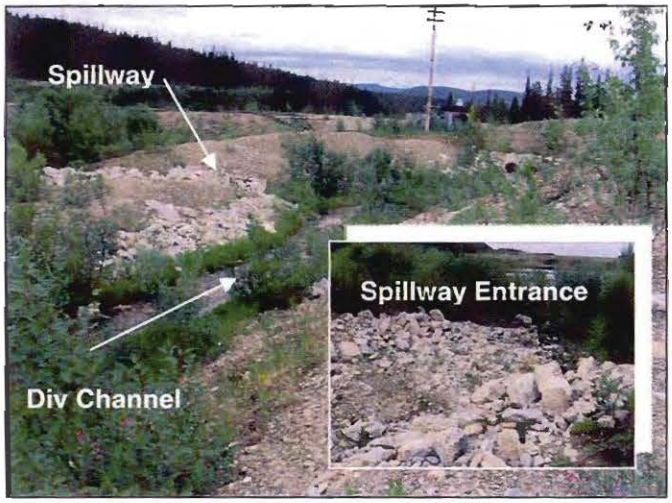


Figure 57 Emergency Spillway

Figure 58 Staff Gauge &WL Recorder

Figure 59 Entrance to Culverts

Figure 60 Erosion Gullies

The channel downstream of the culverts to the spillway chute is well armoured with riprap (Figure 61). The lines from the Siphon system are buried where they cross the road at the pumphouse and then run in the channel as shown on Figure 62.

Figure 61 View U/S at Road Crossing

Figure 62 View D/S Along Channel

4. Conclusions and Recommendations

4.1 Conclusions

The overall components of the TMA appear to be in reasonably good condition but in need of some maintenance. Many, but not all of the observations made in our inspection have been previously noted by others (Klohn Crippen, 2003; SRK, 2004), in particular zones of seepage at downstream toes and erosion gullies on the dam slopes.

With respect to seepage losses through the dams, of particular note are the following:

North Dam: The seepage zone along the downstream toe may be more extensive than previously reported. AECOM's observed seepage along the toe for about 20 m to the east and 100 m west of the seepage pond. Previous reports indicated the seepage along an 80 m zone of the downstream toe. The flow reporting to the pipe weir at the time of the inspection (20 L/min) falls well within the previously reported range of 8 to 52 L/min and is within the design seepage of 35 to 50 L/min (SRK, 2004). Based on this observation, it does not appear that there has been any significant increase in seepage through the North Dam.

South Dam: Seepage and associated soft ground was noted at the downstream toe along the west end of the dam in our inspection. There is no reported seepage in this area in previous reports. There are presently no means to measure seepage flows downstream of the dam to provide data to compare with the design seepage of 35 to 50 L/min for the ultimate configuration (SRK, 2004). Therefore AECOM cannot determine if the current seepage losses fall within an acceptable range.

Reclaim Dam: Seepage along the downstream toe of the Reclaim Dam may be a combination of seepage losses through the dam and some natural groundwater discharge near the west abutment. Previous reports do not appear to have mapped out the extent of the seepage zone although it was noted that seepage is funnelled into the V-notch weir at MH-07. Flow over the weir at the time of our inspection was estimated to be about 60 L/min compared to historical seepage rates of 100 to 200 L/min (SRK, 2004). We were unable to find sufficient background information to confirm that the observed or historical seepage losses fall within the design range for the structure.

With respect to overall slope stability and settlement of the structures, there do not appear to be any significant issues of concern at this time.

Under the current conditions of what we understand to be temporary mine closure, pond water management is still required to protect the existing TMA structures. Current practices differ from the operational management of the TMA however, in that siphon systems are used to maintain safe pond levels. This approach differs from active operation of the TMA when water was decanted from the south pond and pumped from the reclaim pond. Neither the decant tower or reclaim pond pumphouse are currently operational.

4.2 Recommendations

In addition to or consistent with recommendations by others for continued operation and maintenance of the TMA structures during temporary mine closure, AECOM recommends the following:

- It is important that seepage losses continue to be measured, reported and interpreted as part of the overall Operating, Maintenance and Surveillance Program for the mine site. This should be done in conjunction with monitoring of other geotechnical instrumentation at the site. Sufficient information should be obtained to allow comparisons between the observed seepage losses and the design seepage for all three dams. Specifically, this would involve measuring seepage losses at the South Dam and determining the design seepage at the Reclaim Dam.

- Piezometer monitoring should continue and the results compared with piezometric levels established for safe operation of the structures.

- Maintenance of the discharge structures and spillways should be undertaken to reduce the potential for failure. Specifically, it is recommended that:

    - The inlet to the gated culvert at the Cofferdam be cleared of sediment and the slumping of slopes at the inlet repaired.

- The emergency spillway culverts at the west abutment of the South Dam be cleaned of sediment and debris and the channel slopes leading to the culverts be repaired and armoured as required.

- The west abutment of the Reclaim Dam be surveyed and raised as necessary to provide necessary freeboard at this location.

- If not already done so, operational plans for pond operations during temporary mine closure should be developed that recognize the increased monitoring and maintenance associated with managing pond elevations with siphons. Of particular importance would be the long term reliance of this (siphon) system under emergency conditions.

- Measures should be taken to provide a fail-safe seal at the inlet to the south pond decant tower pipe as previously recommended by others (Klohn Crippen, 2003). When the entrance to the tower is under water, a failure of the existing plywood seal could result in the uncontrolled release of a large volume of water that could potentially exceed the storage capacity of the reclaim pond.

- Repair erosion gullies /rills on slopes where necessary.

- Remove shrubs and saplings form all dams.

Sä Dena Hes – Photo Log

Photo #	Date	Description
		North Creek Dyke
916	18-Jul-08	Outlet pipe and culverts from reservoir
917	18-Jul-08	Pumphouse reservoir from WP 171
918	18-Jul-08	Outlet culverts at discharge channel (view from dyke) from WP 171
919	18-Jul-08	Outlet culverts at discharge channel (view from channel) from WP 172
920	18-Jul-08	View of inside of 1.2 m diameter outlet culvert from outlet end
921	18-Jul-08	Outlet culverts at discharge channel (view from channel) from WP 173
922	18-Jul-08	Discharge from outlet pipe from WP 174
923	18-Jul-08	Discharge from outlet pipe from WP 174
924	18-Jul-08	Reservoir water entering outlet pipe
925	18-Jul-08	Minor erosion on D/S dyke slope face at WP 175
926	18-Jul-08	Outlet pipe discharge from dyke
927	18-Jul-08	Culvert crossing D/S of North Creek Dyke (WP 176)
928	18-Jul-08	CI of road at culvert D/S of North Creek Dyke
929	18-Jul-08	Culvert discharge D/S of North creek Dyke at WP 177
930	18-Jul-08	Well casing at TH04-9 at WP 178
		North Dam
931	18-Jul-08	View E from W abutment (WP 179) along dam CL
932	18-Jul-08	View SE from W abutment (WP 179) at gravel cover
933	18-Jul-08	View NE from W abutment (WP 179)
934	18-Jul-08	Erosion gully on U/S edge of crest at WP 180
935	18-Jul-08	Erosion gully on U/S edge of crest at WP 181
936	18-Jul-08	Rilling on D/S slope face at WP 184
937	18-Jul-08	View of seepage pond from WP 186
938	18-Jul-08	View W at rilling on D/S slope face taken from WP 187
939	18-Jul-08	View E at rilling on D/S slope face taken from WP 187
940	18-Jul-08	Upslope edge of rills on D/S slope face at WP 188
941	18-Jul-08	Upslope edge of rills on D/S slope face at WP 188
942	18-Jul-08	View E along N edge of crest from NDW3 at WP 191
943	18-Jul-08	View E along CL of crest from NDW 3 at WP 191
944	18-Jul-08	View E along S edge of crest from NDW 3 at WP 191
945	18-Jul-08	View W along S edge of crest from NDW 3 at WP 191
946	18-Jul-08	View W along CL of crest from NDW 3 at WP 191
947	18-Jul-08	View W along N edge of crest from NDW 3 at WP 191
948	18-Jul-08	Erosion gullies along edge of crest at NDW 3 at WP 191
949	18-Jul-08	View E along D/S toe from NDW4 (WP 192)
950	18-Jul-08	View S at D/S slope from NDW4 (WP 192)
951	18-Jul-08	View W along D/S toe from NDW4 (WP 192)
952	18-Jul-08	View E along D/S toe from seepage pond at WP 194
953	18-Jul-08	View S across seepage pond at D/S toe at WP 194
954	18-Jul-08	View W across seepage pond at D/S toe at WP 194
955	18-Jul-08	View S at outlet pipe from seepage pond at WP 155
956	18-Jul-08	View S at outlet pipe from seepage pond at WP 155
957	18-Jul-08	View W at seepage water drainage channel along D/S toe from WP 196
958	18-Jul-08	Sand delta at D/S toe at WP 196
959	18-Jul-08	View E along seepage water drainage channel along D/S toe from WP 196 (towards seepage pond)
960	18-Jul-08	Start of seepage at D/S toe at WP 197 (view E)
961	18-Jul-08	Sand delta at D/S toe at WP 197
962	18-Jul-08	Rilling on D/S slope face at WP 197
		Cofferdam
964	18-Jul-08	View W from E abutment at WP 201
965	18-Jul-08	View E at E abutment from WP 202
966	18-Jul-08	View N over tailings pond from WP 202
967	18-Jul-08	View W along CL from WP 202
968	18-Jul-08	View S from WP 202
969	18-Jul-08	Inlet to discharge culvert
970	18-Jul-08	Discharge culvert outlet
971	18-Jul-08	Sloughing of N slope at discharge culvert
		South Dam
972	18-Jul-08	Seepage at D/S toe at WP 204
973	18-Jul-08	View W at seepage at D/S toe at WP 205
974	18-Jul-08	View NE at fill at toe at WP 205
975	18-Jul-08	View E at seepage along D/S toe at WP 207
976	18-Jul-08	View W at seepage along D/S toe at WP 207

Sä Dena Hes – Photo Log

Photo #	Date	Description
977	18-Jul-08	Outlet end of discharge culvert at WP 208
978	18-Jul-08	View E at tD/S toe berm from WP 208
979	18-Jul-08	Discharge syphons at WP 208
980	18-Jul-08	View W at toe berm from WP 210
981	18-Jul-08	View N at toe berm and dam from WP 210
982	18-Jul-08	View E at toe berm and pond from WP 210
983	18-Jul-08	View S across pond towards Reclaim Dam from WP 210
984	18-Jul-08	Erosion gullies on berm at WP 210
985	18-Jul-08	View W at erosion gullies on berm at WP 210
986	18-Jul-08	Exposed geotextile at WP 210
987	18-Jul-08	Exposed geotextile at WP 210
988	18-Jul-08	View W along top of berm from WP 212
989	18-Jul-08	View S across pond from WP 212
990	18-Jul-08	View E along top of berm from WP 212
991	18-Jul-08	View W at seepage at E end of berm at WP 213
992	18-Jul-08	View N at gravel and rock fill in seepage area at WP 213
993	18-Jul-08	View NE at gravel and rock fill in seepage area at WP 213
994	18-Jul-08	View E at rock fill and exposed geotextile at WP 213
995	18-Jul-08	Eroison gullies on U/S slope face at WP 215
996	18-Jul-08	View W at U/S erosion from WP 217
997	18-Jul-08	View E at U/S erosion from WP 218
998	18-Jul-08	View W at U/S erosion from WP 218
999	18-Jul-08	View N at decant tower from WP 218
1000	18-Jul-08	View W along lower crest CL at WP 218
1001	18-Jul-08	View E along lower crest CL at WP 218
1002	18-Jul-08	View E along upper crest CL at WP 218
1003	18-Jul-08	View W along upper crest CL at WP 218
1004	18-Jul-08	View W along S edge of upper crest at WP 218
1005	18-Jul-08	View S from WP 218
1006	18-Jul-08	View SE at toe berm from WP 218
1007	18-Jul-08	View E along S edge of upper crest at WP 218
1008	18-Jul-08	Syphon flow meter
1009	18-Jul-08	Seepage into ditch at WP 219
1010	18-Jul-08	Blocked culverts at emergency spillway (WP 219)
1011	18-Jul-08	Outlet from emergency spillway culverts
1012	18-Jul-08	Motor home crossing low spot on dyke at emergency spillway
1013	18-Jul-08	Tension cracks on S side of channel at emergency spillway
		Reclaim Dam
1014	18-Jul-08	View SE at spillway exit chute
1015	18-Jul-08	View U/S at end of spillway channel
1016	18-Jul-08	View U/S along spillway channel
1017	18-Jul-08	View SE at spillway exit chute
1018	18-Jul-08	Outlet of spillway culverts at WP (WP 223)
1019	18-Jul-08	Staff gauge at spillway outlet culverts
1020	18-Jul-08	Erosion gullies on RHS of emergency spillway channel about 30 m U/S of culverts (WP 225)
1021	18-Jul-08	View N across spillway channel from WP 226
1022	18-Jul-08	View U/S along spillway channel and staff gauge from WP 226
1023	18-Jul-08	View D/S along spillway channel from WP 226
1024	18-Jul-08	D/S end of CMP half section in spillway channel at WP 227
1025	18-Jul-08	D/S end of CMP half section in spillway channel at WP 227
1026	18-Jul-08	View D/S along spillway channel from WP 227
1027	18-Jul-08	Half round CMP, view U/S from WP 228
1028	18-Jul-08	View NE at emergency spillway channel inlet at WP 229
1029	18-Jul-08	Armouring on banks of emergency spillway inlet at WP 229
1030	18-Jul-08	Slumping behind 1/2 round CMP at WP 232
1031	18-Jul-08	View D/S along spillway channel from U/S end of 1/2 round CMP from WP 233
1032	18-Jul-08	RHS bank at WP 233
1033	18-Jul-08	View D/S along channel from D/S end of second 1/2 round CMP from WP 234
1034	18-Jul-08	View U/S along channel from D/S end of second 1/2 round CMP from WP 234
1035	18-Jul-08	View D/S along channel from U/S end of second 1/2 round CMP from WP 235
1036	18-Jul-08	View U/S along channel from U/S end of second 1/2 round CMP from WP 235
1037	18-Jul-08	Slumping of RH bank
1038	18-Jul-08	Inlet ends of spillway channel outlet culverts (from WP 236)
1039	18-Jul-08	RH bank along road beside spillway channel from WP 236

Sä Dena Hes – Photo Log

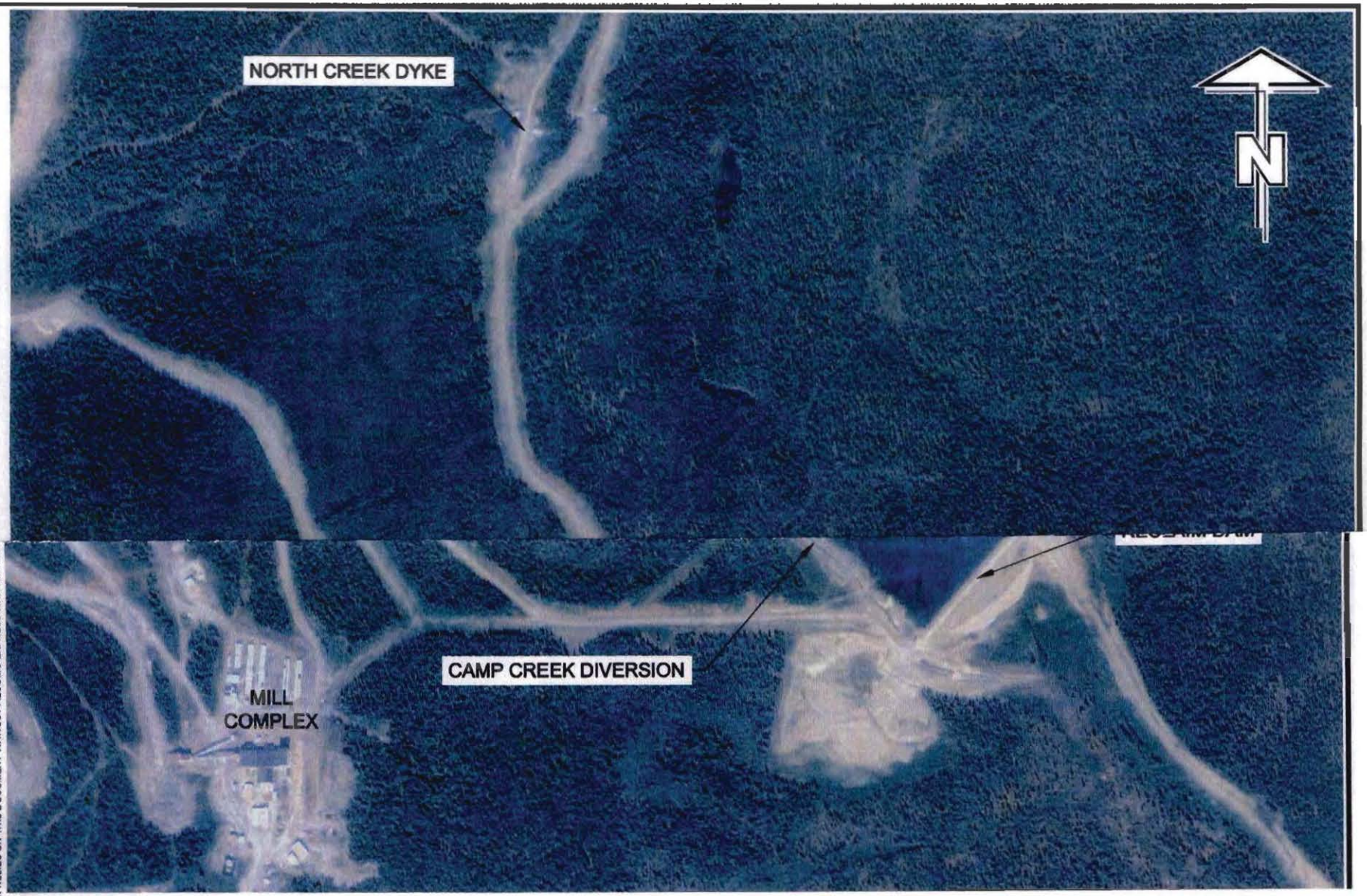
Photo #	Date	Description
1040	18-Jul-08	W end of rock fill toe berm from WP 237
1041	18-Jul-08	Void in rock fill at WP 238
1042	18-Jul-08	Seepage along toe of berm (view W) at WP 240
1043	18-Jul-08	MH-07 Discharge Sump at WP 242
1044	18-Jul-08	View W at seepage along toe of berm from WP 242
1045	18-Jul-08	Seepage from tor berm to MH sump from WP 242
1046	18-Jul-08	V- notch outlet from MH-07
1047	18-Jul-08	Inlet notch to MH-07
1048	18-Jul-08	Seepage at toe of berm at WP 243, 244
1049	18-Jul-08	Subterranean flow in rock fill at WP 245 (view W)
1050	18-Jul-08	E end of rock fill from WP 245
1051	18-Jul-08	Seeapge water entering rock fill near WP 245
1052	18-Jul-08	View of MH-07 from WP 246
1053	18-Jul-08	Sand in seepage water at WP 247
1054	18-Jul-08	View W along CL of dam from E abutment at WP 248
1055	18-Jul-08	View SW from E abutment at WP 248
1056	18-Jul-08	View W across pond from E abutment at WP 248
1057	18-Jul-08	View N from WP 248
1058	18-Jul-08	View SW at toe berm from WP 249
1059	18-Jul-08	View W along U/S slope showing driftwood and minor erosionat WP 251
1060	18-Jul-08	View E along U/S slope showing driftwood and minor erosionat WP 251
1061	18-Jul-08	View E along CL of dam from WP 254
1062	18-Jul-08	View W along CL of dam from WP 254
1063	18-Jul-08	View W along U/S slope from WP 254
1064	18-Jul-08	View E along U/S slope from WP 254
1065	18-Jul-08	Slumping of U/S slope at WP 254
1066	18-Jul-08	View E along D/S slope from WP 254
1067	18-Jul-08	View W along D/S slope from WP 254
1068	18-Jul-08	View D/S along spillway channel from road crossing
		Miscellaneous
1070	18-Jul-08	View of TMA from 1408 Portal
1071	18-Jul-08	View of TMA from 1408 Portal
1072	18-Jul-08	View of TMA from 1408 Portal
P104706	18-Jul-08	View of TMA from 1408 Portal
P104707	18-Jul-08	View of TMA from 1408 Portal
P104708	18-Jul-08	View of TMA from 1408 Portal
P104709	18-Jul-08	View of TMA from 1408 Portal
1030	18-Jul-08	View N along North Creek Dyke
1031	18-Jul-08	View N at North Creek Pumphouse and lines
1032	18-Jul-08	View S across tailings from North Dam
1033	18-Jul-08	View E along North Dam CL
1034	18-Jul-08	Monitoring well in tailings
1035	18-Jul-08	Monitoring well in tailings
1036	18-Jul-08	Monitoring well in tailings
1037	18-Jul-08	D/S Slope at North Dam
1038	18-Jul-08	D/S Slope at North Dam

Sä Dena Hes – Video Log

Video Clip	DESCRIPTION	Date
	North Creek Dyke	
MOV 05D	North Creek Dyke	July 18, 2008
MOV 05E	Centerline of Road at Culvert Crossing, Waypoint 171	July 18, 2008
MOV 05F	Centerline of Road at Culvert Crossing, Waypoint 171	July 18, 2008
MOV 060	North Creek Dyke, Armouring for Steel Outlet Pipe	July 18, 2008
MOV 061	North Creek Dike, Armouring for Steel Outlet Pipe	July 18, 2008
MOV 062	Plunge Pool D/s of North Creek Dyke	July 18, 2008
MOV 063	Downstream Side, North Creek Dyke	July 18, 2008
MOV 064	Creek North of North Creek Dyke	July 18, 2008
MOV 065	Downstream of Culvert Crossing the Road	July 18, 2008
MOV 066	Gravel Berm North Side of Creek Channel at Culvert Crossing	July 18, 2008
	North Dam	
MOV 067	West Abutment, North Dam, Waypoint 179	July 18, 2008
MOV 068	Upstream Edge of North Dam Crest, Waypoint 180	July 18, 2008
MOV 069	Downstream Face of North Dam	July 18, 2008
MOV 06A	Downstream Face of North Dam	July 18, 2008
MOV 06B	Centerline North Dam, MW's NDW2A, 2B, 2C, Waypoint 190	July 18, 2008
MOV 06C	Centerline North Dam	July 18, 2008
MOV 06E	Riiiing on D/S Face of North Dam, Waypoint 190	July 18, 2008
MOV 06F	Upstream Edge of North Dam Crest	July 18, 2008
MOV 070	MW NDW4A, Waypoint 192	July 18, 2008
MOV 072	Toe of North Dam, Seepage Pond	July 18, 2008
MOV 073	End of Seepage Pond, Waypoint 195	July 18, 2008
MOV 074	Downstream Toe of North Dam, Waypoint 196	July 18, 2008
MOV 075	Downstream Toe of North Dam, Waypoint 197, Start of Seepage	July 18, 2008
	Cofferdam	
MOV 076	West Abutment @ Cofferdam Between East and West Dams	July 18, 2008
	South Dam	
MOV 077	South Dam, West Abutment, Waypoint 205, MW GSDW1A, 1B	July 18, 2008
MOV 078	Seepage at Toe of South Dam	July 18, 2008
MOV 079	South Dam, Waypoint 207 Start of Seepage	July 18, 2008
MOV 07C	South Dam, Outlet of Discharge Pipe from Decant Tower, Waypoint 208	July 18, 2008
MOV 07D	Stabilizing Berm, South Dam	July 18, 2008
MOV 07E	Stabilizing Berm, South Dam, Trace Seepage	July 18, 2008
MOV 07F	Stabilizing Berm, South Dam, Trace Seepage	July 18, 2008
MOV 080	Stabilizing Berm, South Dam, Waypoint 212	July 18, 2008
MOV 081	East Abutment, Waypoint 216	July 18, 2008
MOV 082	Centerline Lower Dam Crest, Waypoint 218	July 18, 2008
MOV 083	West Abutment, South Dam, Channel from Pond	July 18, 2008
MOV 084	Outlet Ends of West Abutment Culverts	July 18, 2008
	Reclaim Dam and Diversion Channel	
MOV 085	Reclaim Pond Dam at Discharge Culvert	July 18, 2008
MOV 086	Inlet to Discharge Culverts	July 18, 2008
MOV 087	Erosion Gullies Upstream of Discharge Culverts at Reclaim Dam	July 18, 2008
MOV 088	Upstream Flow Monitoring Station, Spillway Channel	July 18, 2008
MOV 089	Upstream End of Corrugated Pipe Gully Section, Spillway Channel	July 18, 2008
MOV 08A	2nd Armoured Section, Spillway Channel, Waypoint 236	July 18, 2008
MOV 08B	Upstream of 2nd Armoured Section	July 18, 2008
MOV 08C	Downstream Side of Reclaim Pond Dam, Waypoint 237	July 18, 2008
MOV 08D	Downstream Side of Reclaim Pond Dam, Waypoint 237	July 18, 2008
MOV 08E	Riprap Buttress, Seepage Area, Waypoint 240	July 18, 2008

Sä Dena Hes – Video Log

Video Clip	DESCRIPTION	Date
MOV 08F	V Notch Weir, Seepage Area, Waypoint 262	July 18, 2008
MOV 090	Riprap Buttress, Seepage Area	July 18, 2008
MOV 091	East End of Toe Berm at Rock Drain	July 18, 2008
MOV 092	Downstream Toe Berm	July 18, 2008
MOV 093	Upstream Edge of Reclaim Dam at Pond	July 18, 2008
	View of TMA From 1408 Portal	
MOV 094	Bird's Eye View of TMA	July 18, 2008
MOV 095	Bird's Eye View of TMA	July 18, 2008



B SIZE 11" x 17" (279.4mm x 431.8mm)

THIS DOCUMENT IS PROTECTED BY COPYRIGHT LAW AND MAY NOT BE USED, REPR
MODIFIES, OR RELIES ON THIS DOCUMENT WITHOUT AECOM'S EXPRESS WRITTEN CONS
NO RESPONSIBILITY, AND DENIES ANY LIABILITY WHATSOEVER, TO ANY PARTY THAT USES, REPRODUCES

ISS/REV: A
UMA FILE NAME: 2940-039-00_01-B-F001_RX.dwg

AECOM

0 75 150 225 m SCALE 1:7500

Gartner Lee Limited
Yukon Sites
2008 Geotechnical Inspections

Sä Dena Hes Mine Site
Tailings Management Area Site Plan
Drawing - 01

ISS/REV: A
UMA FILE NAME: 2940-039-00_01-B-F002_RX.dwg Saved By: hadfieldm PLOT: 08/11/28 11:09:33 AM A SIZE 8.5" x 11" (215.9mm x 279.4mm)

THIS DOCUMENT IS PROTECTED BY COPYRIGHT LAW AND MAY NOT BE USED, REPRODUCED OR MODIFIED IN ANY MANNER OR FOR ANY PURPOSE EXCEPT WITH THE WRITTEN PERMISSION OF UMA ENGINEERING LTD. DOING BUSINESS AS AECOM ("AECOM") OR A PARTY TO WHICH ITS COPYRIGHT HAS BEEN ASSIGNED. AECOM ACCEPTS NO RESPONSIBILITY, AND DENIES ANY LIABILITY WHATSOEVER, TO ANY PARTY THAT USES, REPRODUCES, MODIFIES, OR RELIES ON THIS DOCUMENT WITHOUT AECOM'S EXPRESS WRITTEN CONSENT.

HAND HELD GPS WAYPOINT

0 20 40 60 m SCALE 1:2000

IMAGE SOURCE: GOOGLE EARTH

AECOM

Gartner Lee Limited
Yukon Sites
2008 Geotechnical Inspections

Sä Dena Hes Mine Site
North Creek Dyke
Drawing - 02

ISS/REV: A
UMA FILE NAME: 2940-039-00_01-B-F003_RX.dwg Saved By: hadfieldm PLOT: 08/11/28 11:22:50 AM A SIZE 8.5" x 11" (215.9mm x 279.4mm)

THIS DOCUMENT IS PROTECTED BY COPYRIGHT LAW AND MAY NOT BE USED, REPRODUCED OR MODIFIED IN ANY MANNER OR FOR ANY PURPOSE EXCEPT WITH THE WRITTEN PERMISSION OF UMA ENGINEERING LTD. DOING BUSINESS AS AECOM ("AECOM") OR A PARTY TO WHICH ITS COPYRIGHT HAS BEEN ASSIGNED. AECOM ACCEPTS NO RESPONSIBILITY, AND DENIES ANY LIABILITY WHATSOEVER, TO ANY PARTY THAT USES, REPRODUCES, MODIFIES, OR RELIES ON THIS DOCUMENT WITHOUT AECOM'S EXPRESS WRITTEN CONSENT.

HAND HELD GPS WAYPOINT

0 20 40 60 m SCALE 1:2000

IMAGE SOURCE: GOOGLE EARTH

AECOM

Gartner Lee Limited
Yukon Sites
2008 Geotechnical Inspections

Sä Dena Hes Mine Site
North Dam
Drawing - 03

ISS/REV: A
UMA FILE NAME: 2940-039-00_01-B-F004_RX.dwg Saved By: hadfieldm PLOT: 08/11/28 11:26:59 AM A SIZE 8.5" x 11" (215.9mm x 279.4mm)

THIS DOCUMENT IS PROTECTED BY COPYRIGHT LAW AND MAY NOT BE USED, REPRODUCED OR MODIFIED IN ANY MANNER OR FOR ANY PURPOSE EXCEPT WITH THE WRITTEN PERMISSION OF UMA ENGINEERING LTD. DOING BUSINESS AS AECOM ("AECOM") OR A PARTY TO WHICH ITS COPYRIGHT HAS BEEN ASSIGNED. AECOM ACCEPTS NO RESPONSIBILITY, AND DENIES ANY LIABILITY WHATSOEVER, TO ANY PARTY THAT USES, REPRODUCES, MODIFIES, OR RELIES ON THIS DOCUMENT WITHOUT AECOM'S EXPRESS WRITTEN CONSENT.

HAND HELD GPS WAYPOINT

0 20 40 60 m SCALE 1:2000

IMAGE SOURCE: GOOGLE EARTH

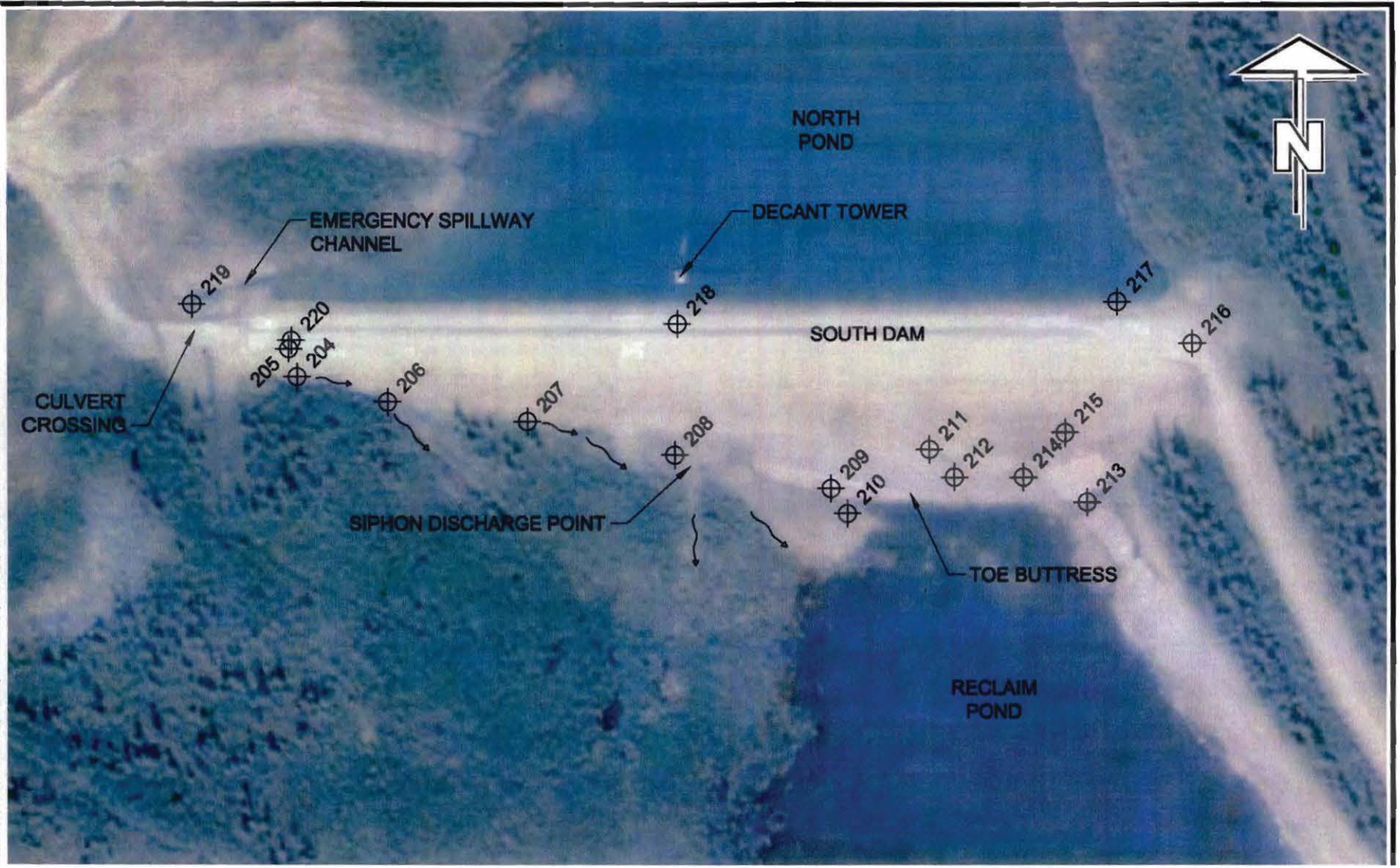
AECOM

Gartner Lee Limited
Yukon Sites
2008 Geotechnical Inspections

Sä Dena Hes Mine Site
Cofferdam
Drawing - 04

ISS/REV: A
UMA FILE NAME: 2940-039-00_01-B-F005_RX.dwg Saved By: hadfieldm PLOT: 09/01/07 11:42:36 AM A SIZE 8.5" x 11" (215.9mm x 279.4mm)

THIS DOCUMENT IS PROTECTED BY COPYRIGHT LAW AND MAY NOT BE USED, REPRODUCED OR MODIFIED IN ANY MANNER OR FOR ANY PURPOSE EXCEPT WITH THE WRITTEN PERMISSION OF UMA ENGINEERING LTD. DOING BUSINESS AS AECOM ("AECOM") OR A PARTY TO WHICH ITS COPYRIGHT HAS BEEN ASSIGNED. AECOM ACCEPTS NO RESPONSIBILITY, AND DENIES ANY LIABILITY WHATSOEVER, TO ANY PARTY THAT USES, REPRODUCES, MODIFIES, OR RELIES ON THIS DOCUMENT WITHOUT AECOM'S EXPRESS WRITTEN CONSENT.



0 20 40 60 m SCALE 1:2000

IMAGE SOURCE: GOOGLE EARTH

⊕ HAND HELD GPS WAYPOINT

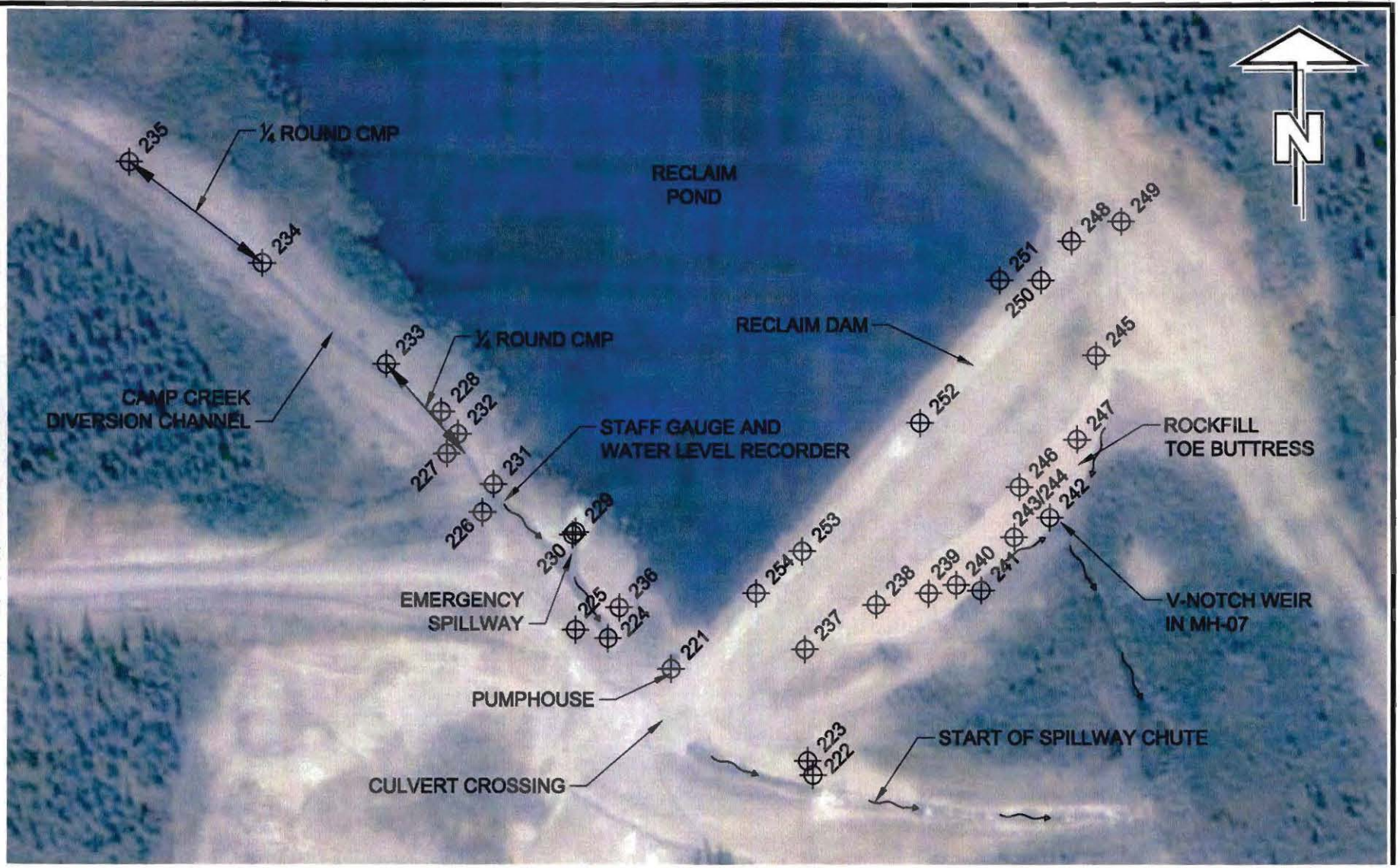
AECOM

Gartner Lee Limited
Yukon Sites
2008 Geotechnical Inspections

Sä Dena Hes Mine Site
South Dam
Drawing - 05

ISS/REV: A
UMA FILE NAME: 2940-039-00_01-B-F006_RX.dwg Saved By: hadfieldm PLOT: 08/11/28 11:32:10 AM A SIZE 8.5" x 11" (215.9mm x 279.4mm)

THIS DOCUMENT IS PROTECTED BY COPYRIGHT LAW AND MAY NOT BE USED, REPRODUCED OR MODIFIED IN ANY MANNER, OR FOR ANY PURPOSE EXCEPT WITH THE WRITTEN PERMISSION OF UMA ENGINEERING LTD. DOING BUSINESS AS AECOM ("AECOM"), OR A PARTY TO WHICH ITS COPYRIGHT HAS BEEN ASSIGNED. AECOM ACCEPTS NO RESPONSIBILITY, AND DENIES ANY LIABILITY WHATSOEVER, TO ANY PARTY THAT USES, REPRODUCES, MODIFIES, OR RELIES ON THIS DOCUMENT WITHOUT AECOM'S EXPRESS WRITTEN CONSENT.



HAND HELD GPS WAYPOINT

0 20 40 60 m SCALE 1:2000

IMAGE SOURCE: GOOGLE EARTH

AECOM

Gartner Lee Limited
Yukon Sites
2008 Geotechnical Inspections

Sä Dena Hes Mine Site
Reclaim Dam
Drawing - 06

WATERPROOF
WL7
LEVEL
281
00005548
+GF+ SIGNET

CRUISECANADA.com
1-800-RV-RENT