Government of Yukon, Water Resources Branch

Minto Mine, YT
Water Storage Pond Dam
Geotechnical Inspections

Prepared by:

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Project Number:

60160522 (402.19.2.1)

Date:

February 2011

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February 17, 2011

Mr. Glenn Ford
Geotechnical Technologist
Yukon Environment
Government of Yukon
Box 2703, V-310
Room 310, 300 Main Street
Whitehorse, YT
Y1A 2C6

Dear Mr. Ford:

Project No: 60160522 (402.19.2.1)
Regarding: Minto Mine – 2010 Geotechnical Inspection

AECOM Canada Ltd. (AECOM) is pleased to submit our report for the above referenced project. If you require further information or clarification, please do not hesitate to contact the undersigned.

Sincerely,

AECOM Canada Ltd.

Tom Wingrove, P.Eng.
Executive Vice-President,
Deputy Operations Director,
North America, Environment

KT:dh
Encl.

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Revision Log

Revision #	Revised By	Date	Issue / Revision Description
1	February 17, 2011	K. Thiessen	Final

AECOM Signatures

PROFESSIONAL
YUKON
KENDALL THIESSEN
TERRITORY
17/02/2011
ENGINEER

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Geotechnical Engineering Specialist

PERMIT TO PRACTICE
Signature
Date 17/02/11
PERMIT NUMBER: PP066
Association of Professional Engineers of Yukon

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1. Introduction

1.1 Terms of Reference and Scope of Work

This report summarizes the results of our geotechnical inspection of the water storage pond dam at the Minto Mine 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 May 31, 2010. The purpose of the inspection was to i) evaluate the existing condition of the facilities comprising the Main Water Dam, ii) confirm that they are being operated according to acceptable engineering practice and iii) and identify any issues for follow-up. In order to achieve these objectives, the program was broken into the following tasks:

1. Review background information provided by the GY Project Manager including: water license; design documents; past inspection reports; licensee annual and monthly reports; and incident reports, in order to become familiar with the structures and potential issues,
2. Visit the mine site and inspect the facilities in the company of the GY Project Manager,
3. Prepare a site visit report for the site detailing condition of the facilities, changes from the last inspection (based on the file review), required repairs and/or maintenance and other observed issues. If considered appropriate, assess the risks posed by the facilities and provide recommendations regarding the need for and frequency of follow-up site inspections.
4. Participate, as required, in teleconferences with the owners of the structures and/or their representatives and 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. There has been no attempt made to corroborate or further analyze information or conclusions presented in past reports. This report does not constitute a dam safety review, as defined by the Canadian Dam Safety Guidelines.

2. Review of Background Information

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

- Minto Explorations Ltd. – 2007 Annual Water License Report and 2007 Annual Quartz Mining License Report, July, 2007.
- Minto Explorations Ltd. – 2008 Annual Water License Report and 2008 Annual Quartz Mining License Report, May, 2009.
- Access Consulting Group. – QLM-0001 - Minto Project, 2008-09 Annual report, July 31, 2009.
- EBA Engineering Consultants Ltd. – Construction Quality Assurance Manual, August, 1997.

- Access Consulting Group - Detailed Decommissioning and Reclamation Plan, Minto Project, Yukon Territory, June 2007.
- Access Consulting Group - Detailed Decommissioning and Reclamation Plan, Revision 2, September 2009.
- EBA Engineering Consultants Ltd. – First Filling Inspection and Initial Seepage Rate Assessment, March 26, 2008.
- EBA Engineering Consultants Ltd. – Water Storage Pond Dam – 2008/2009 Annual Review, August 30, 2009.

3. Site Description and Background

The Minto Mine site is situated in the Yukon Territory about 240 km northwest of Whitehorse on the west side of the Yukon River (Figure 01). The mine site can be accessed via a gravel road from the west side of the river which is crossed in ice free months using a barge. Upon freeze-up, an ice bridge is used to cross the river. Copper ore deposits are mined using conventional open pit truck and loader operations and are processed in an on-site mill with waste disposal of rock overburden and tailings on site.

Figure 01 Location Plan

The general mine site layout is illustrated on the figures in Appendix A (Access 2008). The mining operation generally consists of:

- An open pit and associated haul roads,
- Camp area,
- Mill and ancillary facilities,
- Waste rock and overburden dumps,

- Dry stack tailings storage facility,
- Water storage pond and dam, and
- Diversion ditches and structures.

4. Geotechnical Inspection

The geotechnical inspection was carried out on July 23rd 2010 by Mr. Ken Skaftfeld of AECOM in the company of the Government of Yukon's Project Manager, Mr. Glenn Ford. This inspection focussed on the water storage pond (WSP) dam located along Minto Creek about 1 km downstream of the Mill Site although cursory inspections were also made at the surface water sumps at km 0.5 and 1.5 and the Minto Creek channel downstream of the dam. Photographs and a video were taken during the inspection; these have been included on the DVD attached to this report in Appendix B. The photo locations and features of note are referenced to GPS waypoints shown on Drawing 01. Their locations are approximate based on the accuracy of the hand held GPS unit. All references in this report to the right and left hand sides of the dam and channel, etc. are from the perspective of viewing in a down stream direction. The general layout of the WSP dam and access road is shown on Drawing 01. Additional site plans and cross sections taken from reports by others are included in Appendix A for reference.

The WSP dam was substantially completed in April 2007 and currently retains water from mill processes, various site operations, the diversion of surface water and dewatering of the Minto Mine's Phase 1 pit (Minto Explorations, 2009). A seepage collection building (pumphouse) is located immediately downstream of the stilling basin. Water from this location is pumped back to the WSP via a reclaim line. A trapezoidal flume (Monitoring Station W3), located about 300 m downstream of the dam, is used to monitor discharge from the WSP and is the point of final compliance for surface water quality. At the time of the inspection, the water level was about 1.57 m below the invert of the spillway, compared with a target of 1.5 m (personal communication, J. Reske).

The dam is a zoned earth fill structure constructed with a core, graded downstream filters, upstream and downstream rock fill shells and a downstream rock fill toe berm (EBA 2009). The crest is at about elevation 719.3 m, or about 25 m above the natural valley floor. A spillway channel lined with 600mm diameter rock fill extends from the dam crest to a stilling basin at the downstream toe. The overburden below the core was excavated and the surface dressed with shotcrete after a grout curtain was installed in 1998 along the dam centerline. A grout blanket and grout curtain extension to the upstream edge of the core were installed in 2006 to mitigate seepage at the right abutment as a result of permafrost degradation (EBA 2008). Geotechnical instrumentation consisting of piezometers and ground temperature cables have since been installed to assess the current extent of permafrost thaw.

It was initially expected that the water in the pond could be directly discharged over the dam spillway into Minto Creek once having met the Water Use License effluent criteria. A pump previously installed at the toe of the dam at monitoring Station WL17 was used to pump non-compliant seepage water via a reclaim line to the WSP. After significant rainfall in the summer of 2008, the pumping capacity at WL17 was exceeded and water overtopped the spillway. Three 150mm diameter siphons were subsequently installed over the spillway crest to discharge water in compliance with Amendment 4 to the Water Use License (WUL) issued by the Yukon Water Board (Minto Explorations, 2009). These siphons remain in place although were not in operation at the time of the site visit. Based on this operational experience, a water treatment plant was constructed in 2009 and will remain operational until the WUL discharge criteria can be met (Minto explorations, 2009). Treated water from the WTP is pumped over the dam through a polyethylene diameter discharge pipe. Two additional lines discharge clean surface water from the sumps at km 0.5 and 1.5 to points downstream of the flume. It is now envisioned that the dam will remain in place to provide a retention pond for settlement of suspended solids contained in turbid site run-off and allow monitoring and treatment of water, as required, prior to discharge.

4.1 Dam Crest

The dam crest is about 10 m wide and 100 m long with coarse rock fill at surface. Sand has been spread in some areas presumably for vehicle and equipment access. The crest is in good condition with no visible settlement, tilting or erosion as seen in Figures 02 and 03. Visible (shallow) depressions are believed to be from preparation of drill pads used to install geotechnical instrumentation near the right abutment as seen in Figure 03. Logs visible on the crest on the right hand side of the spillway in Figure 03 have been pulled from the pond at the inlet to the spillway. Upstream and downstream slopes are in good condition as are the right abutment contacts with the natural soil (Figure 04). No seepage was observed at the downstream abutment immediately downslope of the crest. The natural shoreline upstream of the right abutment appears relatively stable with some slumping of the thin vegetative cover also evident in previous inspection photographs (Figure 05).

Fig 02 View N Across Spillway at Dam Crest

Fig 03 Dam Crest S of Spillway

Fig 04 Right Upstream Abutment at Valley Slope

Fig 05 Right Upstream Shoreline

The water treatment plant is located on the left upstream abutment where the reclaim line from the pumphouse and discharge lines from the water treatment plant and surface water sumps at km 0.5 and 1.5 cross (Figure 06). A large diameter pipe also crosses the crest but terminates a short distance on the downstream side. The source of this pipe is not known although it does not appear to have operated. Minor erosion gullies about 300 mm deep were noted at the downstream left abutment as seen in Figure 07. The access road slope to the pond between the water treatment plant and Pump Station is oversteepened as seen in Figures 08 and 09.

Fig 06 Pipes Crossing Left D/S Abutment

Fig 07 Erosion Gullies on Left D/S Abutment

Fig 08 View of Pump Station From WTP

Fig 09 Oversteepened Slope Along Access Rd

4.2 Spillway

The spillway is located in the middle of the dam with the entrance set about 3 m below the crest. The channel is about 12 m wide and armoured with large diameter rock. A log boom is in place upstream of the entrance to the spillway as shown in Figure 10. A timber cut-off wall across the entrance channel and embedded into the dam core, maintains an operating level in the pond at about 716.3 m (Figure 11). The channel slopes on the dam crest are steep although the rock fill underlying the sand may be flatter. The spillway channel on the downstream face of the dam slopes at about 4H:1V and is well armoured with large diameter rock fill. An upslope view of the spillway channel can be seen in Figure 12.

Fig 10 Entrance to Spillway

Fig 11 Timber Cut-off Wall

Fig 12 Spillway Channel on Downstream Slope From Left Abutment

A stilling basin and seepage collection pumphouse were constructed at the downstream end of the spillway in 2007. Water is pumped from a sump in the pumphouse building back over the WSP dam. At the time of the inspection, the pump has been removed for maintenance. Although there was no water in the stilling basin, water was flowing through gravel layers about a metre below the pumphouse pad. A significant portion of this water appears to be from the discharge line from the water treatment plant as seen in Figures 13 and 14.

Fig 13 Energy Dissipater at D/S End of Stilling Basin

Fig 14 Flow Through Gravel D/S of Pumphouse

Water was ponded at the downstream toe of the rock fill on the right abutment (Fig 15). The small pond drains along a narrow channel into the stilling basin rock fill at an estimated flow rate of about 5 l/sec (Fig 16). The seepage water was clear with no turbidity or visible suspended solids. A portion of the water visible in the gravel beneath the west side of the pumphouse likely originates at the pond. Based on previous observations, it is the opinion of EBA Engineering that the area of ponded water is the result of seepage through the right abutment and seepage through the filter materials along the base of the downstream shell (EBA, 2009). There was no sight or sound of seepage on the spillway channel at the location previously reported by EBA Engineering (EBA 2009).

Fig 15 Pond at D/S Toe of Right Abutment

Fig 16 Pond Draining Into Rock Fill

4.3 Monitoring Station W3

The flow rate through the flume at Monitoring Station W3, located about 300 m downstream of the dam was 60 l/sec at a flow depth of 1.2 feet (Figure 17 and 18). This flow however, includes the water being discharged from the water treatment plant at the time of the inspection. It is our understanding that flow rates are typically in the order of 5 l/sec. at this location (Minto Explorations, 2009).

Fig 17 Flume at Monitoring Station W3

Fig 18 Staff Gauge in Flume (L/s on rhs, ft on lhs)

4.4 Access Road

Water from the catchment sumps at km 0.5 and 1.5 along the access road is discharged into Minto Creek downstream of the WSP dam. It is our understanding that these facilities are only used to contain and direct clean water during the spring freshet into Minto Creek downstream of Monitoring Station W3. By diverting this water, the contribution of surface runoff along the access road can be separated from the overall WSP water balance. Although not in service at the time of our inspection, they appeared to be in good condition with sufficient armouring (Figure 19). The discharge point downstream of W3 is shown in Figure 20.

A washout occurred at the time of the inspection at WP 106 along the pipe bench on the south side of the access pond adjacent to the WSP (Figure 21). The washout resulted from a leak at the valve on a pipe from the mill site to either the pumphouse to the WSP. The washout was reported to Mine Site Staff and repairs were implemented immediately. The washout was minor and posed no risk to the pipe bench or access road. A view of the main dam from the access road at WP 107 is shown in Figure 22.

Fig 19 Catchment Sump at km 1.5

Fig 20 Discharge From Catchment Sump

Fig 21 Washout at WP 106

Fig 22 View E at WSP Dam From WP 107

5. Conclusions and Recommendations

The overall condition of the WSP dam and associated structures is considered to be good. The engineer of record (EBA Engineering) is familiar with the background on dam construction, performance monitoring and maintenance to date. AECOM has had an opportunity to review and are in agreement with EBA's recommendations for follow-up work presented in their 2008 and 2009 Annual Inspection reports. Consistent with or in addition to these, AECOM recommended the following at a meeting at Minto's Mine Office immediately after the site inspection:

1. The sources and rates of seepage through the dam should be further investigated. Flows at Monitoring Station W3 were originally a combination of groundwater discharge and dam seepage until July 5, 2007, when MEL installed a recirculation pump at the toe of the dam to route seepage water through the dam back into the WSP. After this point in time, flows at W3 were believed to be solely groundwater discharge (ACCESS, 2008). In addition to measures proposed by EBA in their 2009 Annual Report (appended to the 2008-09 Annual Report, ACCESS 2009), a weir should be installed to measure flow rates from the pond on the right downstream abutment. Weekly monitoring of the weir flow rate and WSP pond level should also be undertaken. This will assist in separating the seepage through the dam into water passing through the filter and that believed to be seeping through a zone of thawed permafrost on the right abutment.

2. The seepage data should be reviewed in conjunction with the results of geotechnical instrumentation monitoring to determine if seepage rates are increasing and determine the timing for any necessary remedial works, most likely to include the extension of the grout curtain on the right abutment.

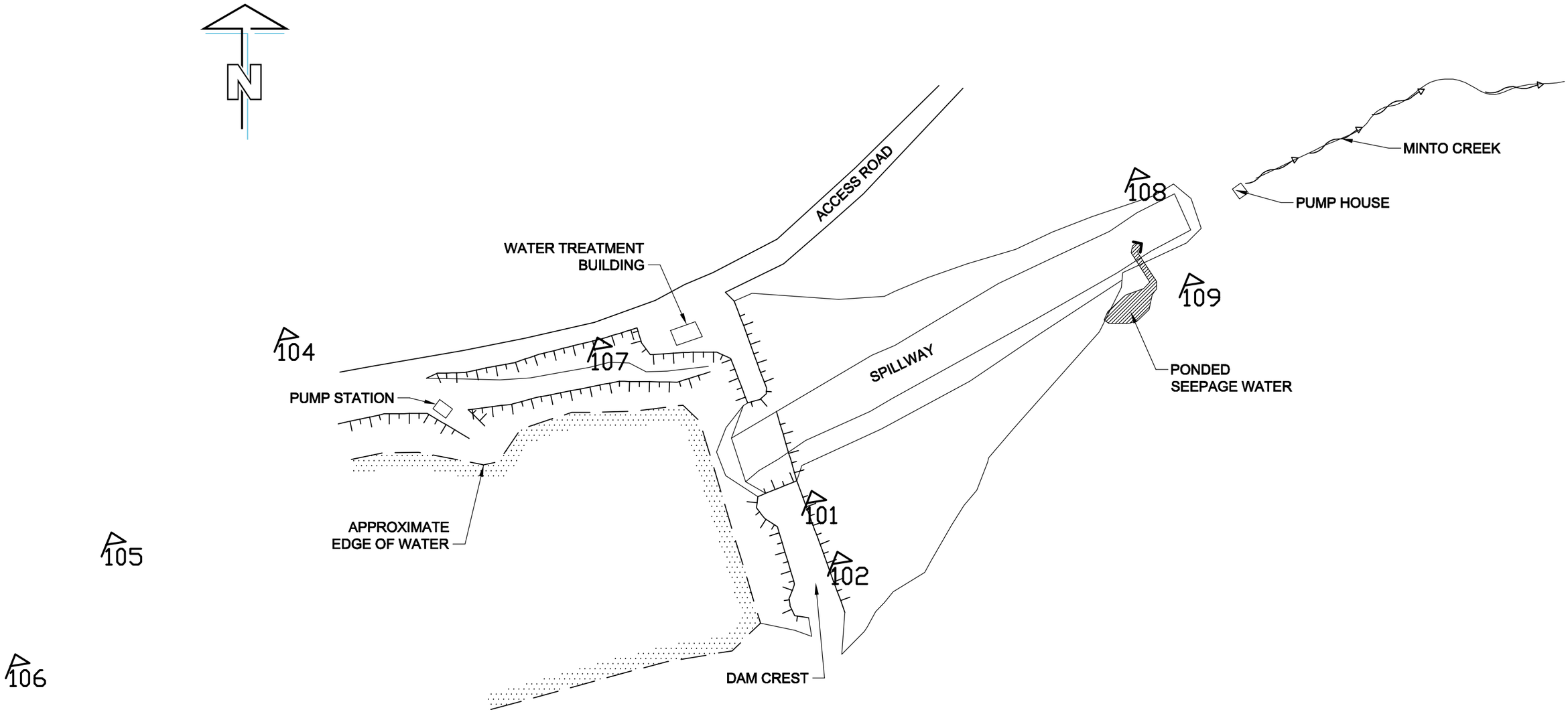
3. Any floating debris at the boom in front of the spillway entrance and debris (logs) piled up on the dam crest should be removed.

4. The steep bank between the pipe bench and the access road between the water treatment plant and pump station should be stabilized to prevent possible loss of the main access road into the mine site.

5. Erosion gullies on the upstream and downstream slopes near the dam crest on the left abutment should be repaired.

Drawings,

Drawing 01 - TSF Site Plan



SITE PLAN

0 12.5 25 m SCALE 1:1250

AECOM

Yukon Government
Minto Mine Dam

Site Plan

Drawing - 01

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

PLOT: 11/02/04 1:52:31 PM

Saved By: cloustonc

ISS/REV: 0A
AECOM FILE NAME: 60160522-01-B-F01-R0X.dwg

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Appendix A

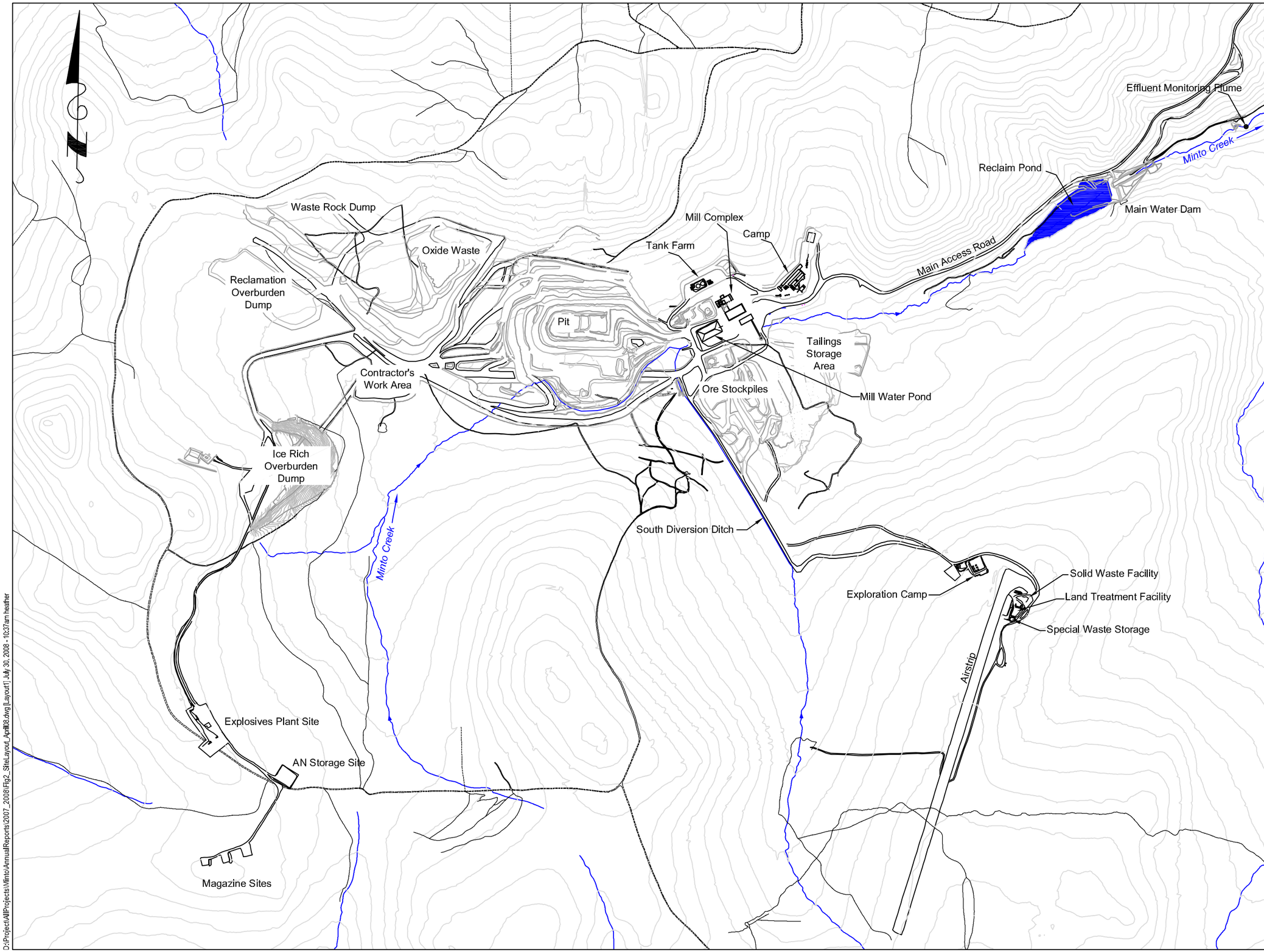
Figures for Reference

List of Figures:

Access Consulting Group, 2008, Minto Mine Project, 2007-2008 Annual Report: General Site Layout

EBA Engineering Consultants Ltd. 2008. Minto Mining Project, 2008 Annual Inspection: Site Plan–Water Retention Dam.

EBA Engineering Consultants Ltd., 2009. Water storage pond dam, Minto Mine: Spillway section showing construction materials.



Minto Mine Project

2007 - 2008 Annual Report

MINTO EXPLORATIONS Ltd.
A Subsidiary of Sherwood Copper Corp.

Legend:

- Access Road
- Exploration Road
- Contour
- Water Course
- Water Body

UTM Zone 8 NAD83
NTS Sheet 115I11
Basedata obtained from Minto Mine March 2008

Figure 2

General Site Layout - April 2008

Scale:

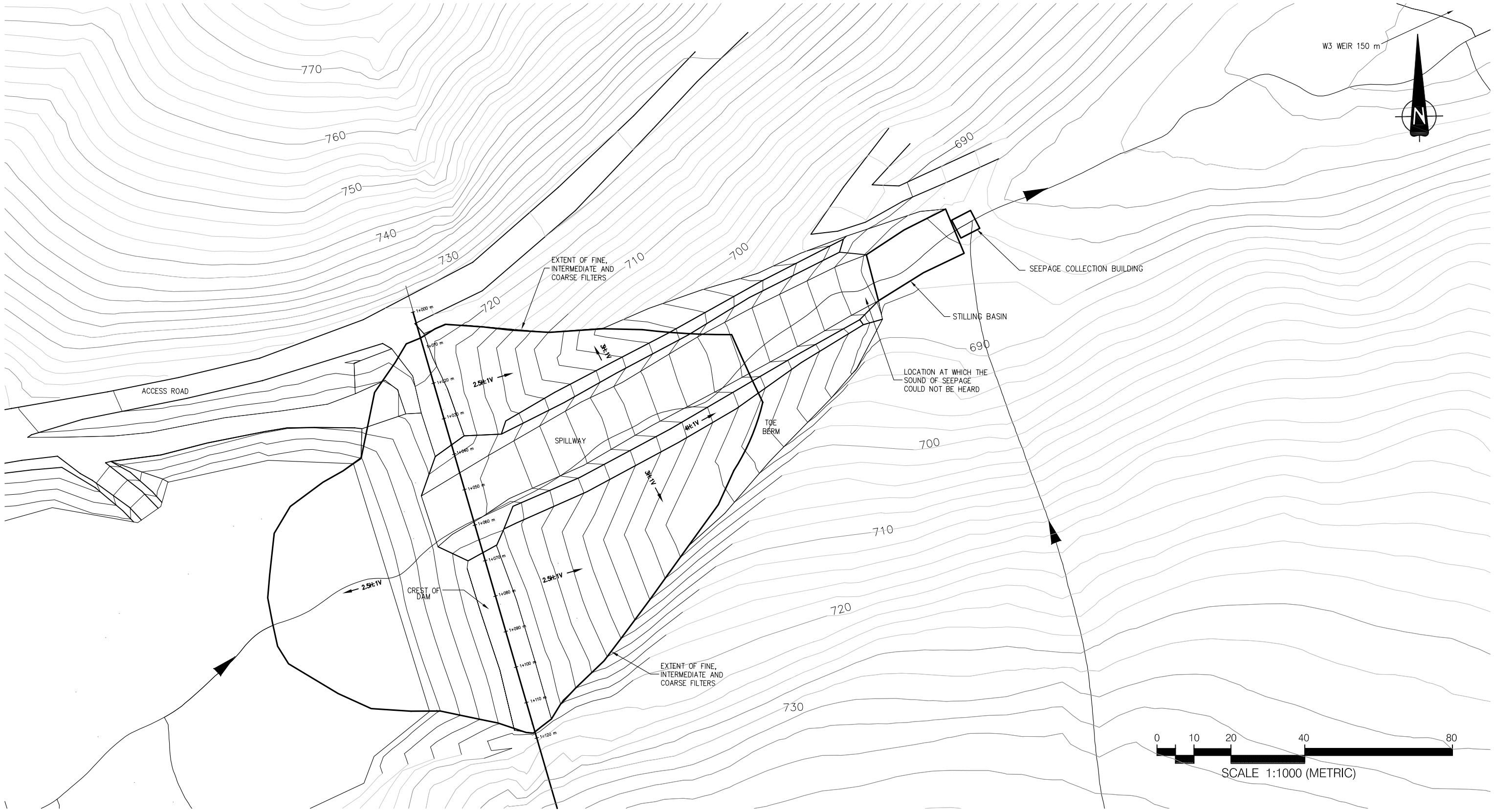
0 50 100 200 300 400 500 m

ACCESS CONSULTING GROUP

Drawn by: HD	Checked by: SVB

Date: July 2008

D:\Project\AllProjects\Minto\AnnualReports\2007_2008\Fig2_SiteLayout_April08.dwg [Layout1], July 30, 2008 - 10:37am heather



CLIENT

Minto Explorations Ltd.

MINTO MINING PROJECT
MINTO MINE, YUKON

SITE PLAN - WATER RETENTION DAM
2008 ANNUAL INSPECTION

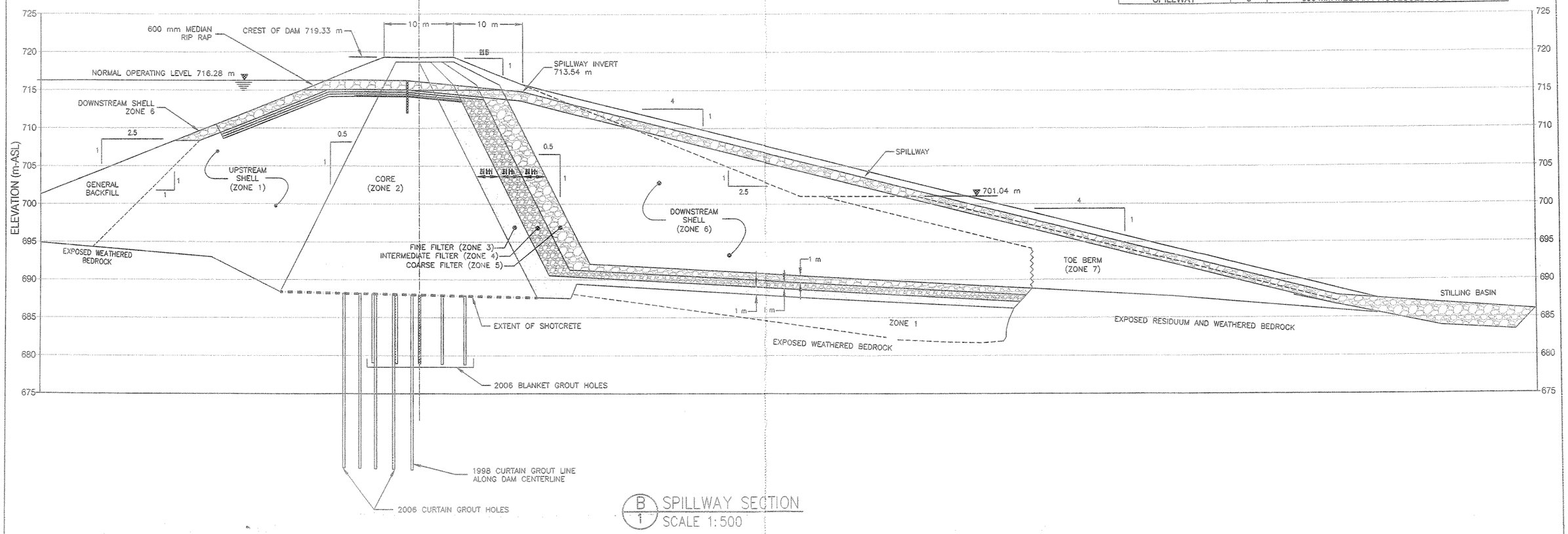
EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
W14101068.002	JSB	CPC	0
OFFICE	DATE		
WHSE	January 14, 2009		

Figure 1

\\eba.local\corp\Whitehorse\Data\0201\drawings\Minto\Minto Mine Site\2005-2006 Drawings\1200173_2006_Tailings_Dam_Const_Drawings\1200173_F1_2008Insp.dwg [FIGURE 1] August 30, 2009 - 6:50:26 pm (BY: CHAD COWAN)

MATERIALS	ZONE	COMPOSITION
UPSTREAM SHELL	1	75 mm MINUS UNSCREENED RESIDUUM
CORE	2	25 mm MINUS SCREENED RESIDUUM
FINE FILTER	3	16 mm MINUS CRUSHED ALLUVIAL SAND AND GRAVEL
INTERMEDIATE FILTER	4	12.5 mm TO 50 mm CRUSHED ALLUVIAL GRAVEL
COARSE FILTER	5	50 mm TO 150 mm SCREENED ALLUVIAL GRAVEL
DOWNSTREAM SHELL	6	150 mm TO 600 mm PROCESSED ROCK FILL
TOE BERM	7	600 mm TO 1500 mm PROCESSED ROCK FILL
SPILLWAY	8	600 mm MEDIAN PROCESSED ROCK FILL



B/1 SPILLWAY SECTION
SCALE 1:500

NOTE:
BASE DRAWING OBTAINED FROM DRAFT OMS MANUAL SUBMITTED FOR REVIEW APRIL 2008.

0 25
Scale: 1: 500 (metres)

CLIENT
MINTO EXPLORATIONS LTD.

WATER STORAGE POND DAM
MINTO MINE, YT

SPILLWAY SECTION
SHOWING CONSTRUCTION MATERIALS

ISSUED FOR REVIEW

EBA Engineering Consultants Ltd.

PROJECT NO.	DWN	CKD	REV
W14101068.002	KJT	JPB	0
OFFICE	DATE		
EBA-WHSE	October 27, 2009		

Figure 5

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Minto Mine
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Minto Mine
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