Minto Mine Tailings Management Plan

January 19, 2011

Minto Exploration Ltd.

A SUBSIDIARY OF CAPSTONE MINING CORP.

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1 Introduction

Minto Mine's Phase IV Expansion includes within its scope a change to the manner in which tailings are disposed of at the mine: the use of the Dry Stack Tailings Storage Facility (DSTSF) will cease, and the mine will deposit slurry tailings directly into completed open pits.

Beginning when the necessary amendment to the mine's water use license is granted, but provisionally scheduled for April 1, 2012, slurry tailings will be deposited into the completed Main (Area 1) pit. When this pit has reached capacity, in October of 2014, tailings deposition will shift to the completed Area 2 pit, where it will continue until the end of the mine life.

This document is intended to describe the new tailings deposition methodology, the storage capacities of the pits in which tailings will be stored, the means of conveyance and discharge, and the changes to water management and storage. This document supersedes the *2011 Phase IV Tailings Management Plan* prepared by EBA for Minto Explorations Ltd. (MintoEx). EBA's plan is attached as an appendix to this report.

2 Storage Capacities and Spill Elevations

Each pit has a spill elevation – the lowest point in the surrounding topography – that limits its storage capacity. The Main pit has a further constraint that neither slurried tailings nor water can go above the 786m elevation, as shown in Figure 1. This is motivated by the presence of the overburden contact at that elevation, combined with the short distance (130 m) separating the 786m elevation within the pit from the 786m elevation downstream of it near the mill water pond.

In all likelihood, tailings and water can be stored above this elevation, particularly if a low-permeability tailings beach is created along the main ramp; however, the engineering work to demonstrate the viability of this has not yet been performed. In the interest of conservatism, it is assumed for the purpose of this analysis that neither tailings nor water can be allowed to exceed the 786m elevation. Water will be actively managed during the operating phase of the mine's life such that it remains below this level. Further detail on water storage and management is presented in Section 7.

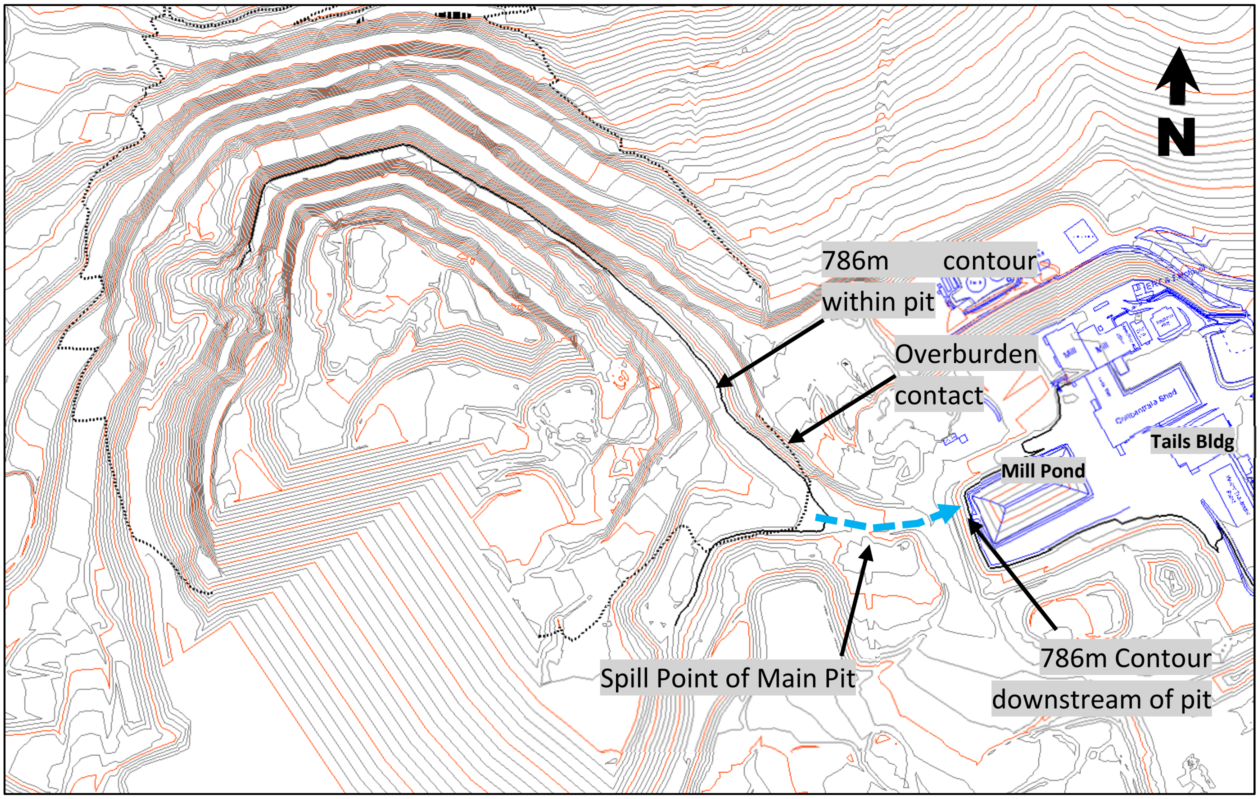


Figure 1: Main pit showing overburden contact, topography, and the 786m elevation limit for water / tailings.

The Area 2 pit does not have such a constraint: while it is surrounded by overburden, the contact is well characterized and dips to the east.

The tailings storage capacities of each pit, as functions of elevation, are shown in Figure 2 and Figure 3. The Main pit's storage curve takes into account the engineered buttress needed to stabilize the south wall.

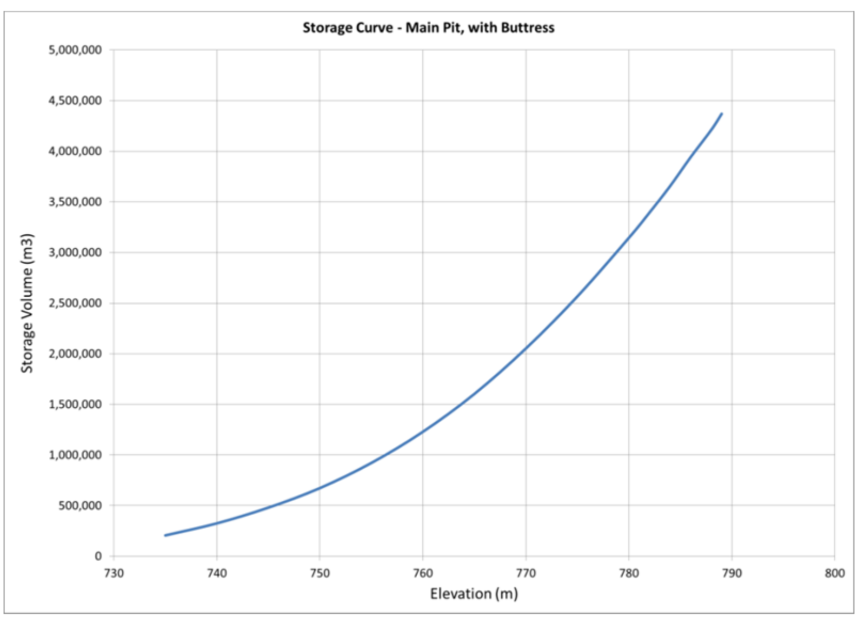


Figure 2: Storage curve for Main pit.

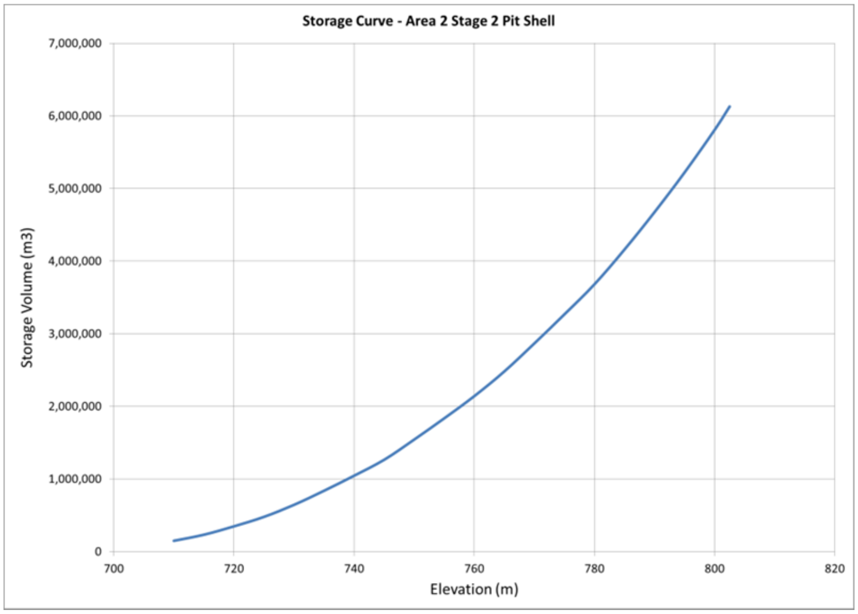


Figure 3: Storage curve for Area 2 pit

	Max Water / Tailings Elevation	Storage Volume at Max Elevation
Main Pit	786.0 m	3,942,000 m^3
Area 2 Pit	802.5 m	6,129,000 m^3

Table 1: Storage volumes for Main and Area 2 pits.

3 Main Pit Water Storage Reserve

Of the Main pit's capacity, 750,000 m^3 will be reserved for the storage of water at all times in the mine life. This contingency storage value corresponds roughly with the mean annual excess runoff for the site, meaning that it could be used to store one year's worth of site runoff under mean precipitation/runoff conditions.

Further detail on water storage and management is presented in Section 7.

Table 2 shows the total capacity available for tailings in each pit. These differ from the volumes presented in Table 1 only by the 750,000 m^3 reserved capacity.

	Storage Volume for Tailings
Main Pit	3,192,000 m^3
Area 2 Pit	6,129,000 m^3
Total	9,321,000 m^3

Table 2: Tailings/water storage volumes for Main and Area 2 pits.

Assuming that slurry tailings deposition may begin on April 1, 2012, 6,992,000 dry metric tonnes (dmt) of tailings, produced from 7,187,000 dmt of mill feed, will be stored in the two pits.

4 Tailings Density

For planning purposes, a density of 1.30 t/m^3 is used. Note that unless otherwise specified, all densities quoted in this analysis are expressed as dry densities in tonnes per cubic meter, dry density being defined as (mass of the solids component of a slurry) / (total volume of slurry).

A recent report prepared by Knight Piesold, entitled *Pre-Feasibility Engineering Review of Minto Mine Tailings Deposition*, suggested that, based on past experience, a density of 1.20 t/m^3 may be more appropriate. It is notable, however, that this value is not based on any test work performed by Knight Piesold on Minto's ore; it is merely representative of the consultant's past experience.

Laboratory tests of settled tailings density, performed by both MintoEx internally and EBA, have yielded results of 1.50 – 1.60 t/m^3. For planning purposes, MintoEx will thus use a density of 1.30 t/m^3, this representing a compromise between lab-scale test work and Knight Piesold's experience at other operations.

Knight Piesold's report also states that, if the desired density cannot be achieved through conventional subaqueous deposition, the use of wick drains would enhance the consolidation of tailings. These are essentially perforated vertical pipes lined with filter cloths: they are sunk into soft tailings and water is pumped from them, thus directly drawing pore water out of in-situ tailings.

A schedule of the 1.30 t/m^3 base case is presented in the following section, and a sensitivity analysis follows in which it is shown that the tailings deposition plan is resilient to changes in achieved density.

5 Scheduling

It is MintoEx's intention to switch to slurry tailings deposition without having to restart the use of the Dry Stack Tailings Storage Facility at a later point in the mine's life. It is thus essential that there be sufficient tailings deposition volume available at every point in the mine's schedule. At a milling rate of 3,860 tonnes per day and assuming a 1.30 t/m^3 dry density for slurry tailings, Figure 4 illustrates that this requirement is satisfied. The mill is currently compliant with the licensed throughput rate of 3,600 tonnes per day; however, an elevated throughput rate was used in order to reflect the increased mill capacity that may be sought through future permitting efforts. Additionally, this adds to the conservatism of the tailings management plan.

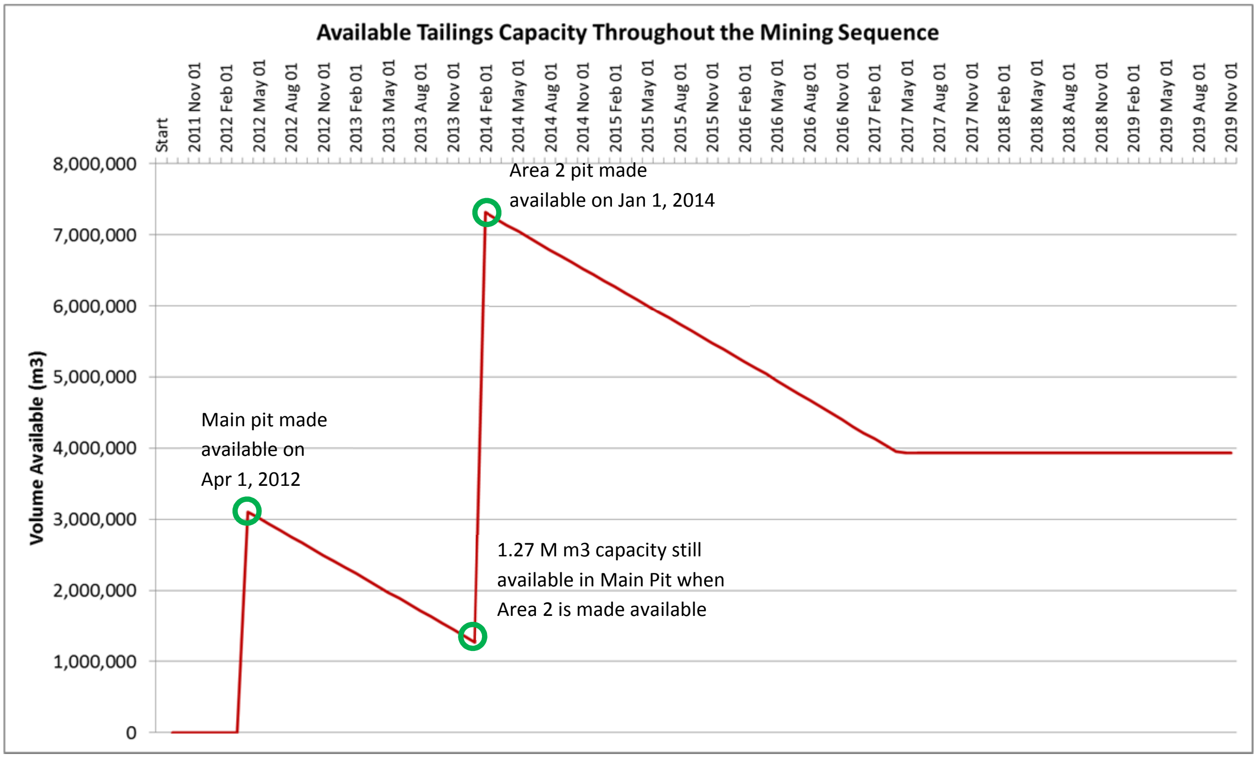
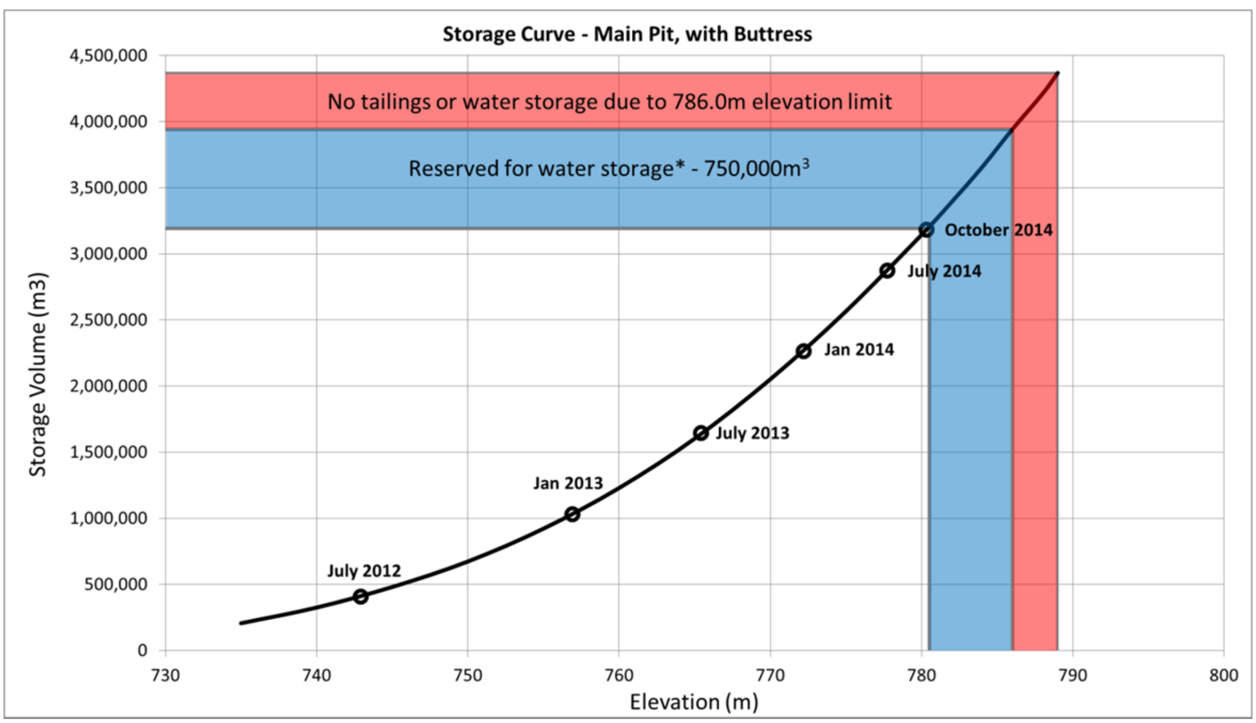


Figure 4: Tailings deposition schedule showing capacity remaining throughout the Phase IV mining sequence.

Approximately 113,000 dry metric tonnes of tailings will be produced per month, requiring 112,000 m^3 of volume. The fill levels of the Main and Area 2 pits are shown in Figure 5 and Figure 6, respectively.



* Due to the natural beach angle formed by tailings discharged from a point, the interface between tailings and water will not be flat at the 780.5 elevation as shown here. For details on tailings discharge methodology, see Section 10.

Figure 5: Fill levels at various points in the mining sequence, superimposed upon the storage curve for the Main pit.

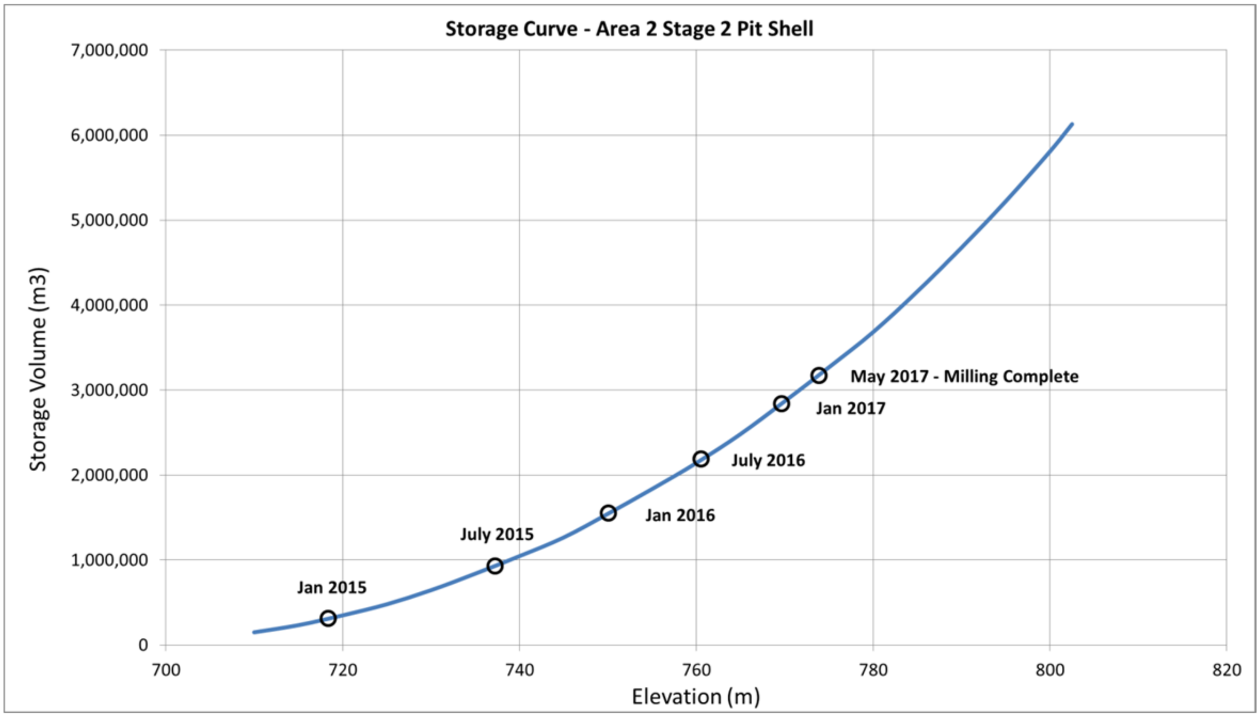


Figure 6: Fill levels at various points in the mining sequence, superimposed upon the storage curve for the Area 2 pit.

6 Sensitivity Analysis: Tailings Density

A cursory analysis shows that the combined volume of the Main and Area 2 pits is well in excess of that required for 6,992,000 dmt of tailings, even at densities as low as 1.10 t/m^3:

Dry Density of Tailings	% Solids by Weight*	Volume Required	Surplus Volume relative to 9,321,000 m^3 capacity
1.10	64.9%	6,356,364	2,964,636
1.15	66.7%	6,080,000	3,241,000
1.20	68.4%	5,826,667	3,494,333
1.25	69.9%	5,593,600	3,727,400
1.30	71.5%	5,378,462	3,942,538

*for fully saturated slurry with solid particle specific gravity of 2.70

Table 3: overall tailings volume requirements for various tailings densities.

To ensure that the requirement for adequate volume is satisfied at all points throughout the mine life, the schedule is re-run for a density of 1.10 t/m^3; Figure 7 shows the results of this analysis.

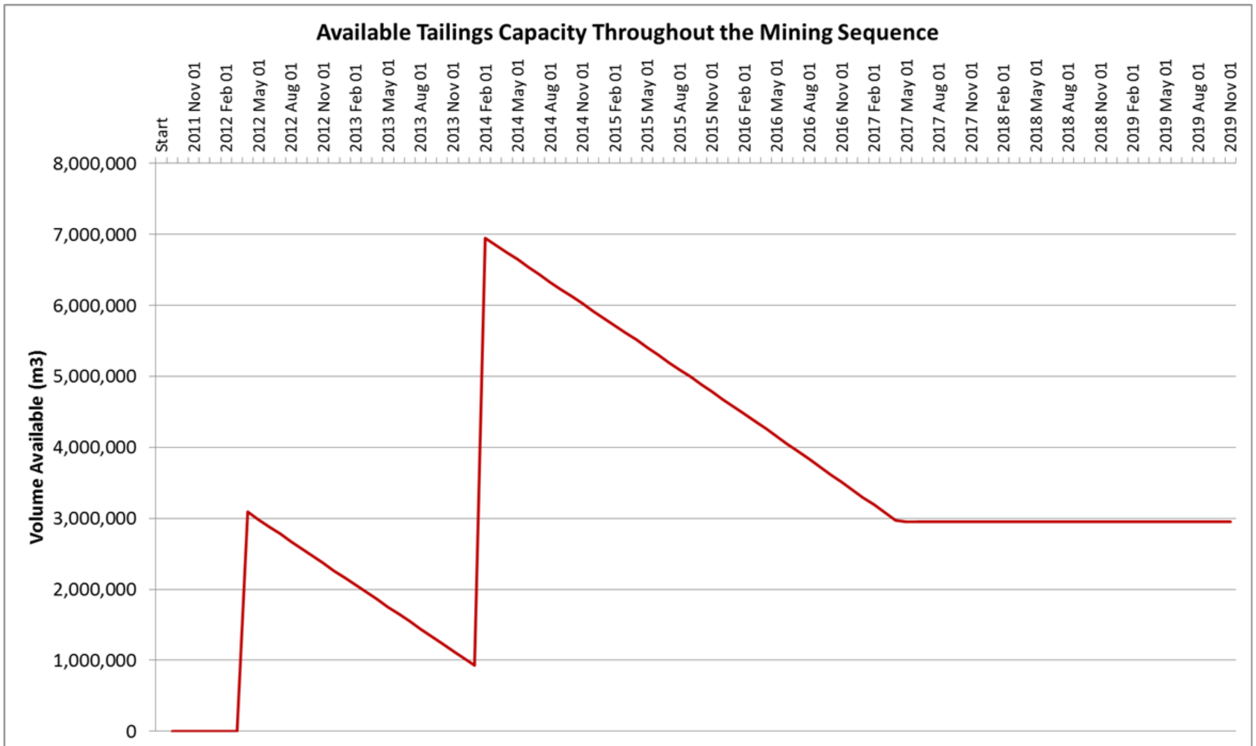


Figure 7: Schedule of available tailings capacity for the worst-case tailings density of 1.10 t/m^3.

The above figure demonstrates that the tailings plan is resilient to variations in achieved density: even at 1.10 t/m^3, the main pit has 1.0 Mm^3 available when the mining of Area 2 pit is finished.

MintoEx may nonetheless opt for enhanced consolidation using wick drains if its plans for future expansion would benefit from a higher tailings density.

7 Water Storage

As noted in Section 3, 750,000 m^3 of the Main pit's capacity will be reserved for the storage of water at all times in the mine life, this corresponding roughly with the mean annual excess runoff for the site. Figure 8 shows the volume reporting to the Main pit – that is, volume from catchments at Minto that are either impacted or cannot be discharged directly off site – as a function of precipitation.[1]

[1] Memorandum CCL-MC8, Clearwater Consultants Ltd., May 30 / 2011.

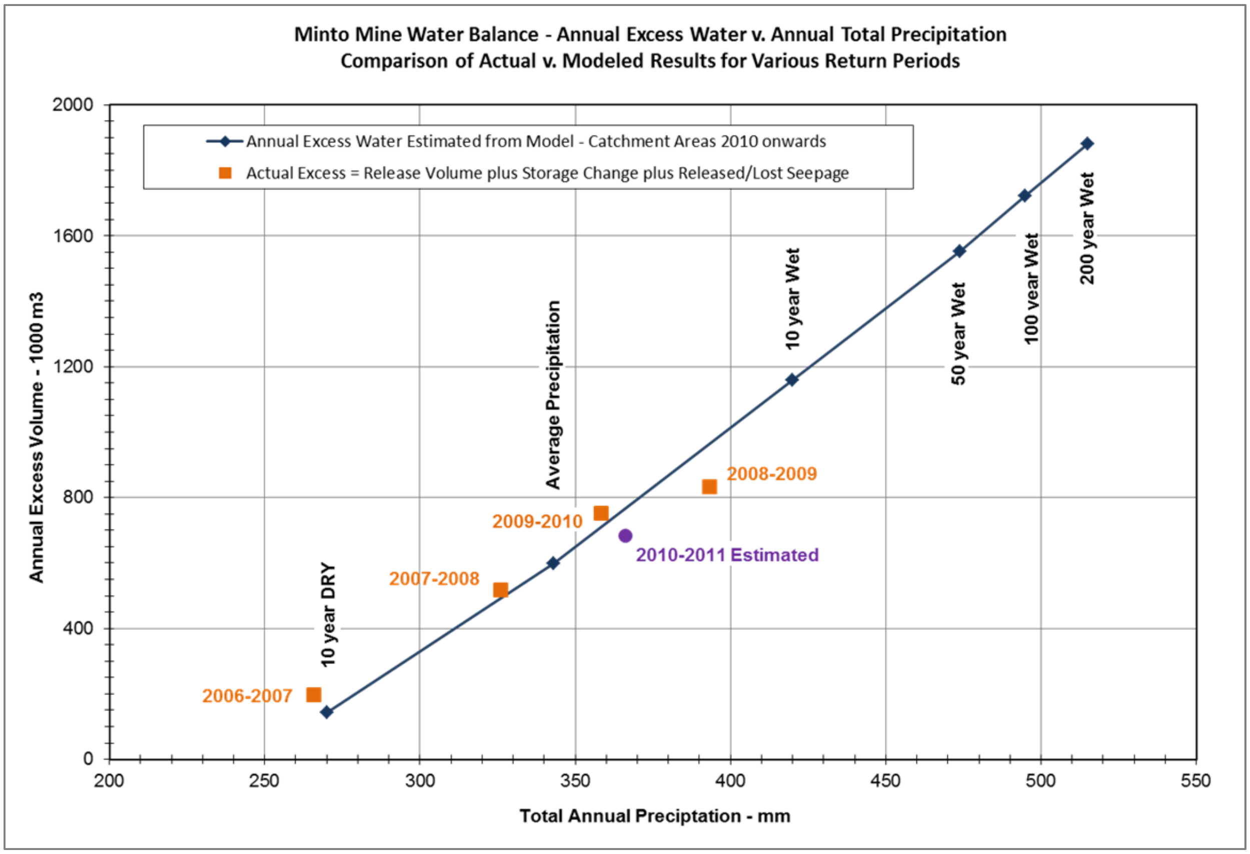


Figure 8: Annual runoff water from impacted catchments.

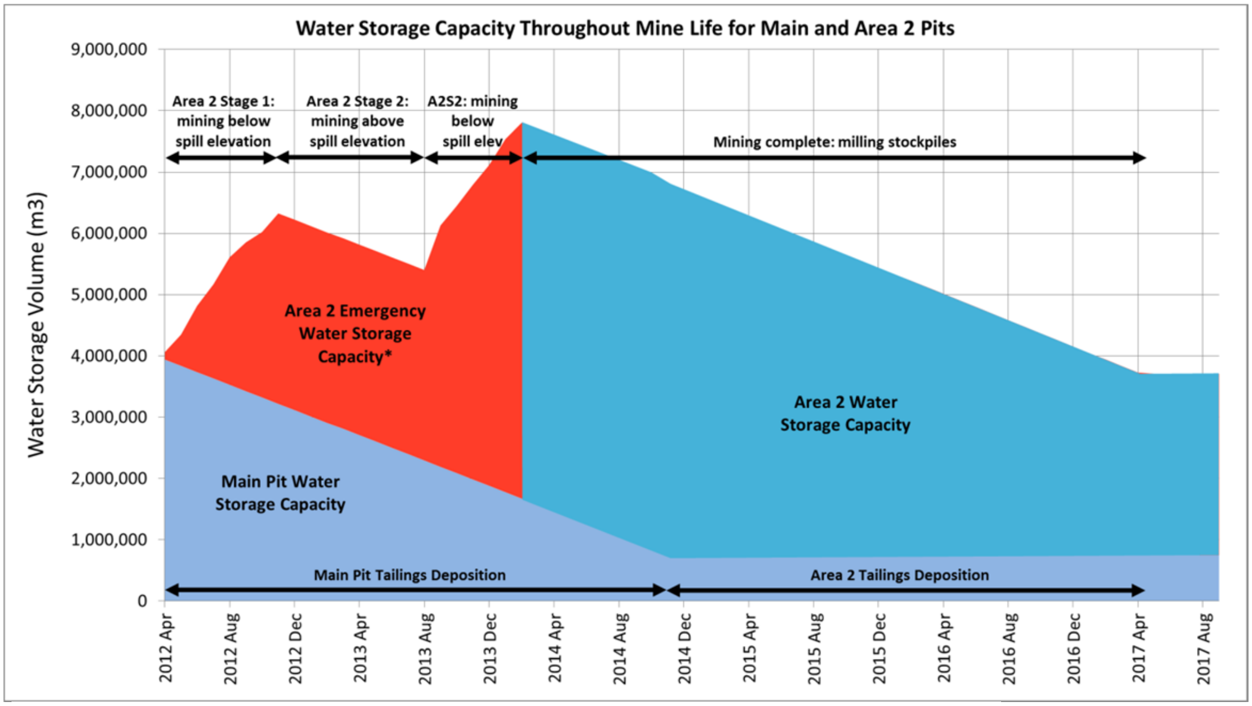
Tailings will be deposited into the Main pit from April 2012 through October 2014. The pit will start with 3,942,000 m^3 of capacity, which will be steadily depleted by the deposition of tailings until, at the end of this period, the Main pit will be left with 750,000 m^3 in capacity.

Mining in Area 2 will finish by February of 2014, at which time the entire pit becomes available for water and/or tailings storage; however, deposition will not actually move to Area 2 until the Main pit is filled in October.

February 2014 thus represents a minimum for the water storage available at site: Area 2 is not yet ready to accept water while the Main Pit is only eight months from being filled. At this point, 1,670,000 m^3 is available, corresponding approximately to a 20-year wet year for annual runoff. It should be noted that the low-point for water storage capacity occurs in February; i.e., before freshet. By April of 2014, the Area 2 pit is complete.

Even before the Area 2 pit is completed, it can be made available for water storage in an emergency situation, though this would require that mining activities move elsewhere or cease. This emergency storage capacity is theoretically sufficient to handle a 200-year wet runoff year.

These data, combined with the storage curves for the pits and the tailings deposition schedule, can be used to plot a graph of water storage capacity available to the mine as a function of time: this is presented in Figure 9.



* Emergency storage capacity would involve flooding the Area 2 pit before mining is complete.

Figure 9: Water storage capacity throughout the mine life for both pits, combined.

8 Water Management

Once the Main pit has reached its storage limit for tailings, water will be managed such that the 750,000 m^3 capacity will be available each spring before freshet begins. This will be accomplished by means of water treatment and discharge off-site, as per the licensed water management plan with the changes proposed in Amendment 8 to the mine's Water Use License. The site's water treatment will draw water from the Main pit and discharge at a rate of approximately 5,000 m^3/d.

Treatment will start in April of each year, while runoff water from the site reports the Main pit via the water conveyance network. Some of the 750,000 m^3 capacity will be used up during spring and summer. Treatment will continue until winter conditions make discharge infeasible; typically early October.

9 Tailings Line

Minto's current circuit runs flotation tailings from the mill building to the tailings building, where this stream is run through a thickener. This produces slurry having approximately 60% solids by weight.

To filter material for the DSTSF, the thickener underflow is currently routed to a bank of filter presses. This setup will be modified such that the thickener underflow will be directed instead to a tailings line. Filter press operation will cease and the presses will be decommissioned.

Routing for the tailings line is currently being finalized. The major design criterion is that, after a short uphill segment where it exits the tailings building, along which the line will gain approximately 9m of elevation over a 175m run, the line must maintain a continuous negative gradient of at least 2.0% toward the pit.

The line itself will be HDPE with a diameter of 8”. Heat tracing will not be installed, as the slurry exiting the tailings thickener underflow measures approximately 28°C, which is warm enough that icing of the line is not expected to be an issue under operating conditions. When the mill shuts down, the line will be flushed with water sourced from an existing stock tank within the tailings filtration building. The pump used for flushing the line will be equipped with a diesel-powered backup generator to guard against the possibility of tailings line damage during power outages. When flushing is complete, most of the water from the line will drain freely toward the pit, while a small quantity from the 175m of pipe sloping toward the tailings building will drain back into it.

10 Tailings Discharge Points

EBA has prepared a Tailings Management Plan for Phase IV that details the tailings deposition methodology for the Main pit. Briefly, the report shows that the solids component of the tailings will form an angle of 4° from the point of discharge; thus, six discharge points around the circumference of the pit were initially planned in order to achieve the best possible fill. However, in order to ensure that 750,000 m^3 remains in the pit for water storage, points 4, 5, and 6 will not be used.

Discharge points are shown in Figure 10.

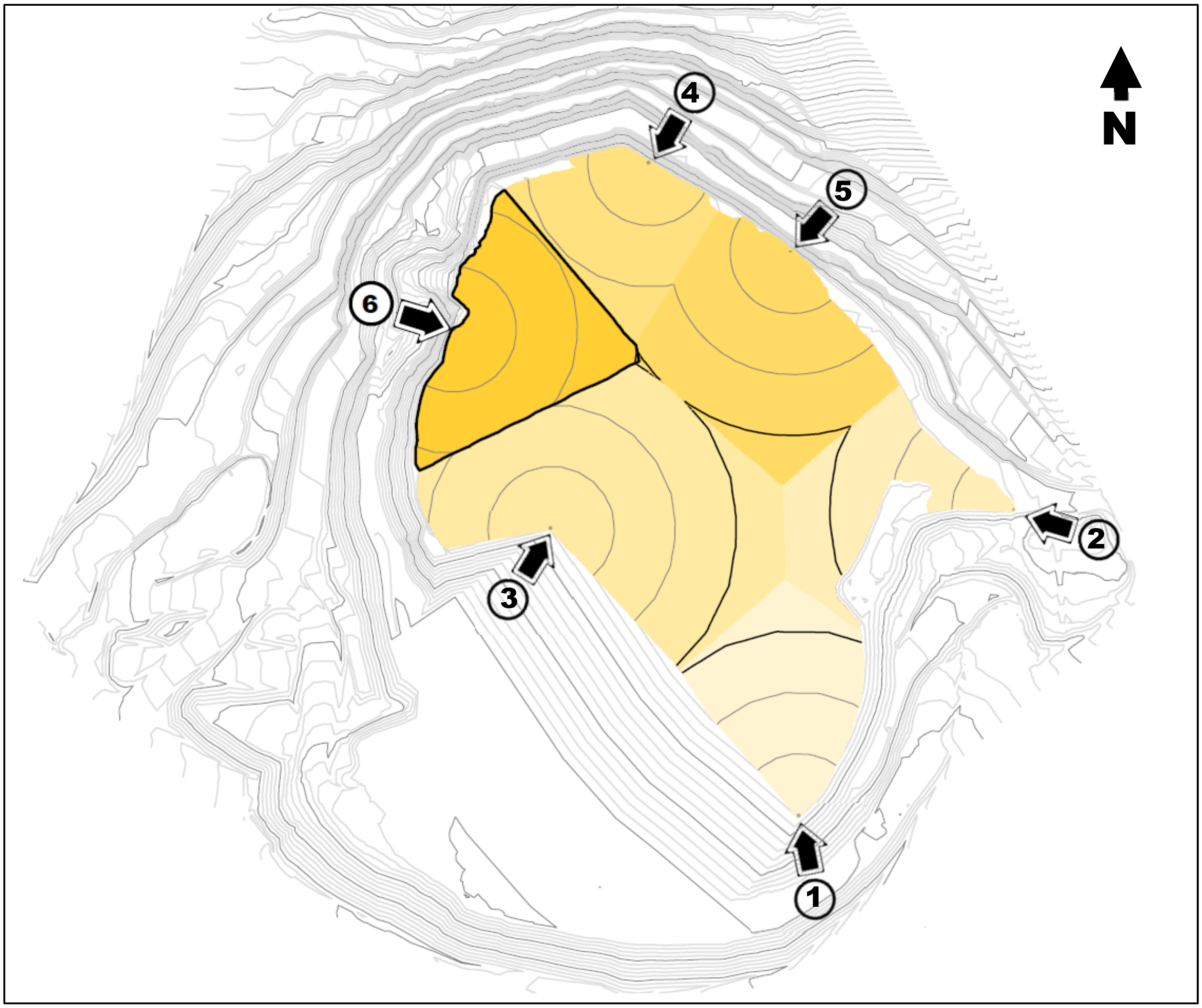


Figure 10: Tailings discharge points around Main pit (figure reproduced from EBA's Phase IV Tailings Management Plan).

Table 4 shows the volume in the pit after each discharge point has reached its limit. All discharge points are located at the 786.0m elevation.

Discharge Point	Total Volume Placed	Incremental Volume
1	2.29 Mm^3	
2	2.56 Mm^3	270,000 m^3
3	3.13 Mm^3	570,000 m^3

Table 4: Volume placed into the Main pit from each of three remaining proposed discharge points.

Tailings deposition will be subaqeous; that is, the tailings line will run beneath the water level in the pit and discharge there. This is necessary to ensure that ice is not entrained in the tailings deposit during winter months, reducing its overall density. To enable easy modification of line length as the water level rises, the last 50m of piping will be comprised of 12m and 6m segments joined by Victaulic couplings. The remainder of the line will be fused.

The precise beach angle of the tailings is not presently known; there is no definitive model that predicts tailings slope angles as a function of particle size distribution, flow rate, and discharge density. EBA's use of a 4° angle is believed to be conservative, representing an upper bound. The mine will conduct a bathymetric survey after one year of tailings placement, and at least on a yearly basis thereafter, to determine both beach angle and achieved density.

11 Reclaim Water

As per the water balance in table B-2 of EBA's *Tailings Management Plan,* the mill will require 120 m^3/h of water from the Main pit. The mine's water treatment plant, when operating at its maximum throughput, will treat a further 250 m^3/h.

This demand for water will necessitate the creation of a new reclaim water system from the Main pit. This will consist of a reclaim water line, running parallel to the tailings line and conveying water from the pit back to the mill, and a reclaim barge, which will float on the tailings deposit's supernatant water and house the pumping equipment necessary to feed the line.

In the past, water has been pumped from the pit using an electric pump powered by a diesel generator: this solution is not well suited to the continuous water demands of the mill; thus, the site's power grid will be extended to the reclaim barge.

Power will be carried via a cable running alongside the reclaim water line. The system will consist of a 4160V transmission cable from the mill to a 300KVA step-down transformer adjacent to the reclaim barge. This solution was chosen over a direct 600V feed due to the considerable length (approximately 435 m) of the run; the thickness of the cable required for direct 600V transmission would have posed handling challenges.

The pumping system will be comprised of two vertical turbine pumps, one in operation and one standing by during winter (water treatment plant not operating), and both operating during summer months. The pumps will be equipped with variable frequency drives to provide control over flow rate.

The reclaim line will be 8" HDPE DR11 pipe, insulated but not heat traced. As with the tailings line, it will have a continuous gradient to ensure it drains when pumping is stopped.

During winter months, small pumps or agitators will operate continuously to prevent the formation of ice around the reclaim barge. The exact design will depend on the vendor chosen to fabricate the barge; the design has not been finalized at the time of writing.

The barge will be located at point (2) while discharging at point (1), then relocated to point (3) when the discharge point advances to (2).

12 Area 2 Pit

The Main pit will reach its storage limit in October of 2014, at which time slurry tailings deposition will be switched to the Area 2 pit, the mining of which will have finished by January 2014.

Detailed design has not yet been undertaken for a tailings discharge system to Area 2. There is a minimal elevation difference between the point at which the line exits the tailings building (800.2 m) and the lowest point along the crest of Area 2 (approximately 802m elevation). Discharge into Area 2 will be from a single point, as there will be ample capacity remaining in Area 2 pit after the completion of Phase IV milling, obviating the need to maximize fill factor.

A potential routing of the tailings line is shown below in Figure 11. In contrast to the setup in the Main pit, a continuous negative profile cannot be maintained along the entire line; heat tracing or insulation may be necessary.

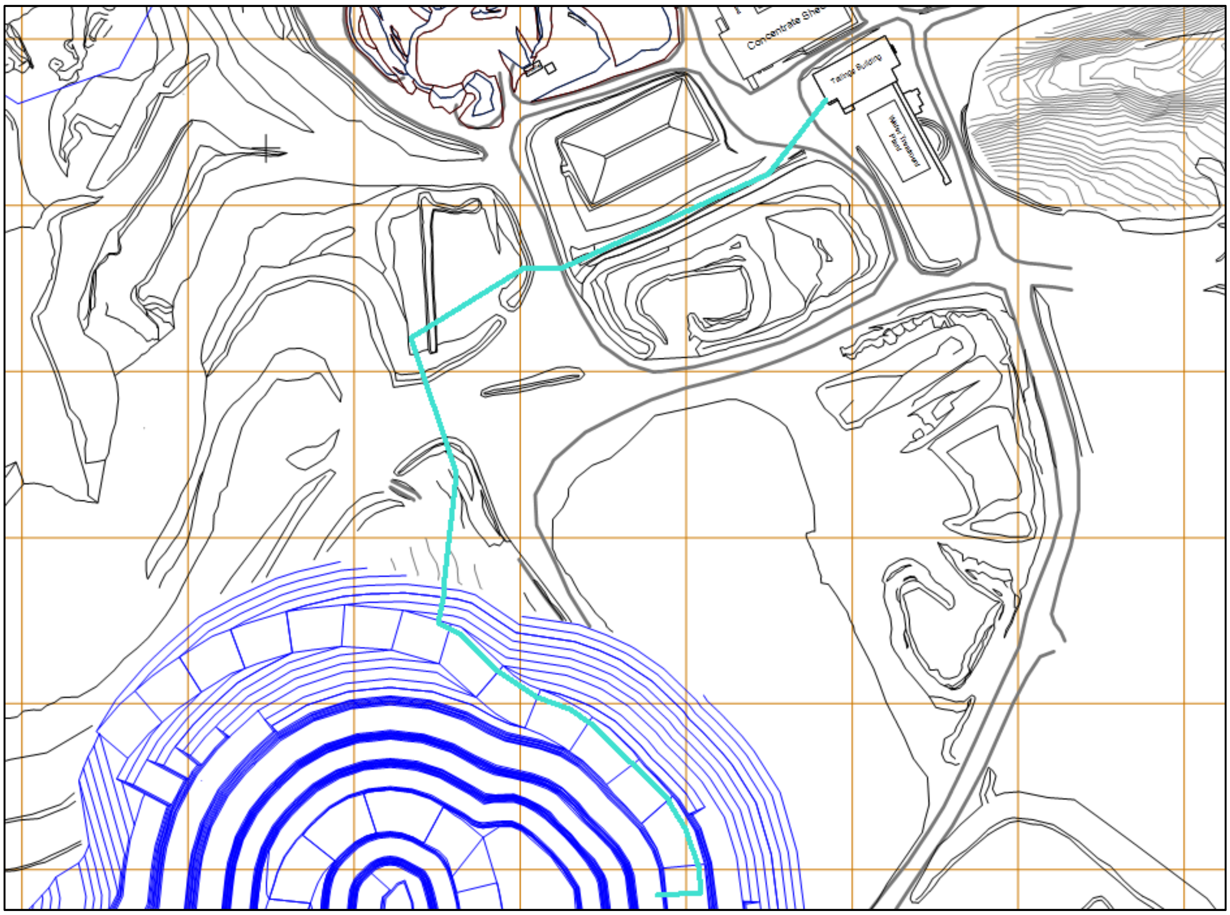


Figure 11: Potential tailings line route to Area 2 pit.

The line will pass underneath a haul road, and will run down the main spiral ramp of the Area 2 pit to a depth of approximately 772m, which represents the ultimate elevation of tailings in that pit.

Appendix A
2011 Phase IV Tailings Management Plan

By EBA Engineering Consultants Ltd.

MINTO EXPLORATIONS LTD.

2011 PHASE IV TAILINGS MANAGEMENT PLAN MINTO MINE, YUKON

REPORT

AUGUST 2011
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1.0 INTRODUCTION

Minto Explorations Ltd. (Minto) is proposing the Phase IV Expansion at the Minto Mine site, located north of Carmacks, Yukon Territory. The expansion includes the development of the Area 2 Open Pit, Area 118 Open Pit, the development of the Area 2/118 underground mine, as well as waste management and related activities. Minto requested that EBA, a Tetra Tech Company (EBA), prepare a tailings management plan for the expansion of existing waste disposal facilities as part of the Phase IV development. The following areas shown in Figure 1 are designated for tailings disposal as part of this Phase IV Tailings Management Plan:

1. The Dry Stack Tailings Storage Facility (DSTSF)
2. Area 1 Open Pit
3. Area 2 Open Pit

This document describes the proposed methods for the management of tailings solids and process water originating from the Minto mining operations. Waste management is discussed in a separate document: "Phase IV Waste Management Plan, Minto Mine, YT".

2.0 PROPERTY DESCRIPTION AND BACKGROUND INFORMATION

2.1 General

Site: Minto Mine

Location: Whitehorse Mining District, Yukon Territory

Coordinates: NAD 83, UTM Zone 8, 6945147N, 385443E

Water Licence: QZ96-006, Type A

Status: Operating

2.2 Location and Access

The Minto Mine is approximately 240 km northwest of Whitehorse and is accessed either by land via the North Klondike Highway and Minto Access Road or by air. Access by land requires crossing the Yukon River, which is accomplished by barge in summer and ice road in winter. The site is inaccessible by land for periods in the spring and fall when neither the ice road nor barge is available.

2.3 Topography and Vegetation

The Minto Mine property lies in the Dawson Range, part of the Klondike Plateau, which is an uplifted surface dissected by erosion. Topography in the area consists of rounded rolling hills and ridges with relief of up to 600 m (2,000 ft.). The highest elevation on the property is 975 m (3,200 ft.) above sea level, compared to elevations of 460 m (1,500 ft.) along the Yukon River. Bedrock exposures are limited except on hillcrests and ridges.

The colluvium overburden is primarily sand formed by decomposing granitic bedrock. The overburden layer is prevalent and provides a well-drained, sound foundation for buildings and roads on south-facing locations. The north-facing slopes are mostly frozen with permafrost. Vegetation is subarctic boreal forest composed largely of spruce and poplars on the well-drained south-facing slopes, while moss and alder or 'buck brush' prevails in the permafrost zones. The area has been impacted by several wild fires, the last of which was in 1995. Many of the burnt trees have blown down and the burnt areas are being naturally recovered by pine and alder.

2.4 Geology

The Minto Project is found in the eastern margin of the Yukon-Tanana Composite Terrain, which is comprised of several metamorphic assemblages and batholiths. It is broadly contemporaneous with the Omineca Belt in nearby British Columbia.

The Minto Property and surrounding area are underlain by plutonic rocks of the Granite Mountain Batholith (Early Mesozoic Age). They vary in composition from quartz diorite and granodiorite to quartz monzonite. The batholith is unconformably overlain by clastic sedimentary rocks of the Tantalus Formation and andesitic to basaltic volcanic rocks of the Carmacks Group; both are assigned a Late Cretaceous age. Immediately east of the Granite Mountain Batholith is a package of undated mafic volcanic rocks, outcropping on the shores of the Yukon River. The structural relationship between the batholith and the undated mafic volcanics is poorly understood because the contact zone is not exposed.

The property lithology is characterized by predominantly igneous rocks of granodiorite composition. In the few available outcrops and drill core, two basic units are distinguished: an equigranular phase and a potassic feldspar megacrystic phase. The equigranular phase is relatively leucocratic, grey to whitish in colour, and uniform in texture. The potassic-feldspar megacrystic phase can be slightly darker, may contain more biotite and hornblende, and may be light pink in color. In surface exposures, the latter exhibits a very weak alignment of the feldspar megacrysts, defining an interpreted magmatic foliation.

Other rock types are volumetrically insignificant and include dykes of simple quartz-feldspar pegmatite, aplite; and an aphanitic textured intermediate composition rock. These units are thin and rarely exceed one metre core intersections. The dykes are relatively late in the geologic record, generally postdating the peak ductile deformation event; however, some pegmatite and aplite bodies observed in a rock cut north of the mill complex are openly folded. Conglomerate and volcanic flows have been logged in drill core by past operators, but have not been confirmed as the core was destroyed in forest fires and no new drilling has intersected such rocks.

2.5 Climate

The climate in the Minto region is subarctic continental characterized by long, cold winters and short, cool summers. The area experiences moderate precipitation in the form of rain and snow and a large range of temperatures on a yearly basis with a mean annual temperature below 0°C.

2.5.1 Temperature

The summer period, between late-May and early-September, is characterized by temperatures in the range of 10°C to 20°C. The winter period, between October and March, is characterized by larger diurnal temperature variations, typically between -10°C and -30°C, although winter temperatures in the range of 0°C and -40°C are not uncommon. The transitions between winter and summer are characterized by a quick rise or fall in air temperatures from March to late May and from early-September to October, respectively.

Based on the data record, daytime temperatures are expected to remain above zero between June and September, while temperatures typically remain below zero from October to March. The maximum recorded air temperature was 30.3°C on July 29, 2009 and the minimum was -43.2°C on November 27, 2006 and again on January 8, 2009. Air temperatures in excess of 5°C have been observed in every winter month while sub-zero temperatures have been recorded every month except in July and August.

2.5.2 Wind

Severe rime ice build-up on the anemometer cups has resulted in extended periods of recorded zero or diminished wind speeds during winter (EBA, August 2010). In order to remove any uncertainty in the data, all wind speeds recorded below 0°C were omitted from the analysis. As a result, the description of winds at the property excludes the majority of observations occurring in November through March and does not provide a complete assessment.

Based on recorded winds at temperatures above 0°C, winds predominantly blow from two directions: the south (including SSW, S and SSE), 23.5% of the time and the northwest (including NNW, NW and WNW) 17.8% of the time. Wind speeds are typically low, exceeding 6 m/s only 5% of the time. The mean annual wind speed is 3.4 m/s. The annual mean wind gust speed is 7.1 m/s. The highest recorded instantaneous gust was 23.8 m/s. The degree of difference between summer and winter winds has not been observed.

2.5.3 Precipitation

Precipitation data is recorded at nearby Pelly River Ranch (25 km NWN) and the on-site weather station. Data from the on-site station is periodic, so data is correlated with the Pelly River Ranch Environment Canada records using orographic factors (Clearwater Consultants, 2011). Estimated mean annual precipitation is 340 mm, with peak precipitation during July (58 mm) and minimum precipitation during March (14 mm). These numbers are slightly higher than precipitation records at Pelly River Ranch. Precipitation catchment areas for the Minto Mine are shown in Figure 2.

2.5.4 Solar Radiation

Maximum solar radiation is received near the summer solstice in late June (daily maximums on the order of 750 W/m^2). Minimum values around the winter solstice are slightly above 0 W/m^2 when the site experiences about three hours of direct sunlight. Large fluctuations in the general trend during summer are due to cloud cover.

2.6 Status

The Minto Mine has been in production since June 2007 starting with the Area 1 Open Pit, which completed development in April 2011. Subsequent development has been in the Area 2 Open Pit. To date, tailings have been dry stacked in the DSTSF. A switch to slurry tailings and tailings deposition in the Area 1 Open Pit is projected for June 2012.

2.7 History

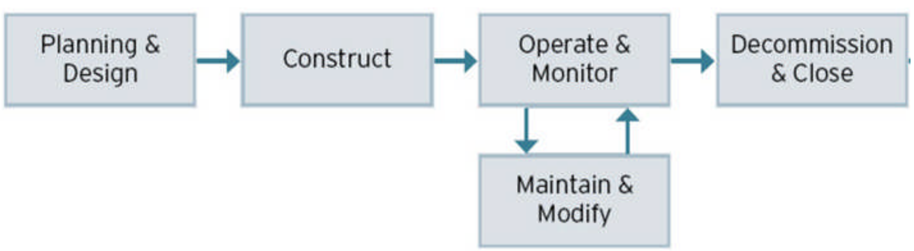
The following historical information was gathered from the Capstone Mining Corporation website.

The Minto project has a history of exploration and development dating back to the early 1970's. In the mid-1990's, a feasibility study was completed by prior owners and permits were obtained and construction of an open pit mine commenced. During that period, the mill foundations were poured, the ball and SAG (Semi-Autogenous Grinding) mills were purchased and moved to site, a permanent camp was constructed, and the site was connected to a permitted Yukon River crossing via a 29 kilometer production standard access road. Construction was suspended in 1997 due to depressed copper prices after an expenditure of approximately $10 million.

Capstone's predecessor, Sherwood Copper, acquired the Minto Project in June 2005 and, in just two years from acquisition, they re-drilled the deposit to modern reserve standards, completed a bankable feasibility study, arranged project financing, and built a $100 million open pit copper-gold mine. Commercial production commenced on October 1, 2007. The mill was expanded from its initial design throughput of 1,563 tonnes per day (t/day) to 2,400 t/day in March 2008, then 3,200 t/day in March 2009 and again to 3,600 t/day in June 2010.

3.0 OBJECTIVES OF TAILINGS MANAGEMENT PLAN

The life cycle for any tailings storage facility can be generalized by the following:



The purpose and objective of a tailings management plan is to describe the anticipated life-cycle processes required for the sustainable development of a tailings storage facility that meets with both territorial and federal regulatory requirements.

4.0 TERMINOLOGY AND DEFINITIONS

Definitions of specialized terminology used in this report are as follows:

Tailings

The fine-grained solid material remaining after recoverable metals and minerals have been extracted.

Dry Stacked Tailings

Dry stack tailings are produced by pressing process water from the processed tailings using filter presses. These tailings require less storage space than slurry tailings and there is no supernatant water to store during operations.

Dry Stack Tailings Storage Facility (DSTSF)

The Minto tailings storage area for dry stacked tailings.

Slurry Tailings

Slurry tailings contain enough water to allow the tailings to be pumped to the containment facility. Upon deposition the tailings settle out from the slurry and form a tailings beach and the supernatant water ponds on the tailings surface at the lowest point within the tailings containment facility.

Supernatant Water

The water ponded on a tailings surface following the sedimentation of the deposited slurry tailings.

Solids Content

The gravimetric percentage ratio of dry mass of solids divided by the dry mass of solids plus the mass of water.

5.0 TAILINGS AND PROCESS WATER FLOW SHEETS

There are three major stages in the Minto Phase IV Tailings Management Plan:

1. Dry stack tailings to DSTSF (Current Stage)
2. Slurry tailings to Area 1 Open Pit
3. Slurry tailings to Area 2 Open Pit

The three stages are classified by the type of tailings and their deposition location as discussed below.

Stage 1: Dry Stacked Tailings: Present – May 2012

The current tailings management stage is defined by the production of dry stack tailings, which are placed in the DSTSF. Figure 3 shows a schematic of the water balance during the production of dry stack tailings. The process plant receives Run of Mine (ROM) material from the stockpiles and Area 2. Process water is supplied by the Mill Water Pond and the Area 1 Open Pit water. The resulting dry stack tailings are transported to the DSTSF, where they are spread and compacted. Water run-off from the DSTSF (catchment A4-4) drains into the Mill Creek Detention Structure (MCDS).

Stage 2: Slurry tailings to Area 1 Open Pit: June 2012 – May 2015

The second tailings management stage is defined by the switch to slurry tailings disposal and the use of the Area 1 Open Pit as the containment facility. This plan assumes the switch will occur in June 2012, but the actual date depends on when Minto receives the necessary water use licence amendment and when the slurry tailings distribution system is completed. The overall water balance schematic for this stage is shown in Figure 4. ROM material will be sourced from the stockpiled material, Area 2 Open Pit, Area 118 Open Pit, and Area 2/118 underground. Process water supply will be from the Mill Water Pond and the Area 1 Open Pit supernatant water.

Stage 2: Slurry tailings to Area 2 Open Pit: June 2015 – November 2017

The third tailings management stage is defined by slurry tailings disposal into the Area 2 Open Pit starting in approximately May 2015. The water balance schematic for this stage is shown in Figure 5. ROM material will be sourced from the stockpiled material. Process water supply will be from the Mill Water Pond, Area 1 Open Pit supernatant water, and Area 2 Open Pit supernatant water.

6.0 DESIGN PARAMETERS

The following are design parameters and assumptions used for this management plan.

6.1 Water Balance Parameters

- The initial ROM feed (milling rate) is 3,600 t/day, which requires 3,400 m^3/day of process water. The ROM rate is projected to increase to 3,750 t/day in January 2012. In consultation with Minto, the tailings management plan has been designed around a 4,000 t/day increase in January 2012 and 3,800 m^3/day of process water to account for any future expansions of mill capacity and to provide a conservative projection. As per Minto's estimates, 75% of the process water will be sourced from the pit and the balance from the WSP.
- Hydrological and Meteorology assumptions are taken from Memo CCL-MC8 prepared by Clearwater Consultants Ltd. and submitted to Access Consulting Group on May 30, 2011 and included in Appendix B. Report assumptions include 70% of snowmelt occurs in April and 30% in May, pit seepage is 0.2 litres/s, and annual catchment evapotranspiration is 46% of annual WSP evaporation.
- Catchment volumes are assumed to flow to the WSP. The exception is during freshet when the volume of catchment water can exceed the WSP volume and water is diverted to a pit via the confluence area (in the case of A1, A2, A3) or pumped back from the WSP to the pit (A4-1, A4-4, A4-5). Catchment areas can be viewed in Figure 2.
- The water treatment plant operates from July to October and will process approximately 250,000 m^3 per year, of which 100,000 m^3 comes from the pit and 150,000 m^3 comes from the WSP.
- The km 0.5 and km 1.5 sump catchments (A4-2, A4-3) are pumped or drained off-site and are not part of the water balance. Likewise, camp water and sewage is on a separate water balance.

- Run-on water that collects in the Area 1 Open Pit after completion of tailings deposition in that area will either be used in the process plant or continue to be treated and released.

6.2 Tailings Model Parameters

Parameters used for the tailings planning purposes are presented in Table 1 and Table 2. Beached and sub-aqueous tailings are assumed to have a slope of 4%.

Table 1: Tailings Material Geotechnical Parameters

Tailings Type	Solids Content (S_o)	Dry Density (ρ_d)
Dry Stack Tailings (as placed)	83%	1,700 kg/m^3
Consolidated Dry Stack Tailings	84%	1,715 kg/m^3
Slurry Tailings	50%	733 kg/m^3
Consolidated Slurry Tailings	71%	1,300 kg/m^3

Table 2: Tailings Facility Overview

Tailings Facility	Tailings Storage Capacity to Tailings Elevation (10^6 m^3)	Tailings Deposition Type	Tailings Elevation (m)	Date Available
DSTSF	1.7	Dry stack	n/a	Present
Area 1 Open Pit	3.9	Slurry	786*	June 2012
Area 2 Open Pit	5.8	Slurry	800*	Aug 2013

* Tailings elevation limits are based on the elevation of the overburden contact near the spill point around the pit. A future evaluation of site conditions, in conjunction with controlled tailings beach placement, may allow tailings height to increase above this level.

7.0 CURRENT SOLIDS AND WATER MANAGEMENT OF THE MINTO TAILINGS STORAGE FACILITY

7.1 General Overview of Solids Management Process

The Area 1 Open Pit currently supplies ROM to the mill and the resulting dry stack tailings are placed within the DSTSF. Dry stack tailings placement will continue until the necessary permits are received and the tailings distribution infrastructure is completed to allow the discharge of tailings into the Area 1 Open Pit. The date for this proposed switch from dry stacked placement to slurry discharge is assumed to be June 2012.

7.1.1 Dry Stack Tailings Storage Facility

The DSTSF covers 0.4 km^2 and is designed to provide storage for the tailings processed from the Area 1 Open Pit.

The tailings are hauled to the DSTSF from the tailings stockpile beneath the conveyor belt discharge, directly south of the tailings filter building. At the DSTSF, the tailings are mechanically spread and compacted in controlled lifts.

Components of the DSTSF include a starter bench and drainage blanket for under-drain; finger drains along the valley lines within the DSTSF footprint; ditch for run-on surface water management; an exterior waste rock shell; and the tailings material. Also included is monitoring instrumentation such as vibrating wire piezometers, ground temperature cables, slope inclinometers, and survey hubs to assess the foundation sideslope performance of the DSTSF.

7.2 General Overview of the Current Water Management Process

Process water is taken from the WSP and the Area 1 Open Pit and recycled in the Mill Water Pond. Excess volumes from both the Area 1 Open Pit and WSP are pumped to the Water Treatment Plant for release to the environment. Most catchment or run-on water is kept separate from the pit water by diverting it to the local environment or the WSP. An exception occurs during freshet events when the volume exceeds the WSP storage capacity and catchment water is sent to the Area 1 Open Pit from the confluence area.

8.0 PROPOSED TAILINGS MANAGEMENT PLAN

8.1 General Overview

Phase IV Milling is anticipated to continue until late 2017, during which tailings will be deposited in the DSTSF, the Area 1 Open Pit, and the Area 2 Open Pit. Table 3 shows the proposed tailings deposition schedule.

Table 3: Proposed Tailings Deposition Schedule

Date Range*	Type of Tailings	Disposal Facility	Volume Available (10^6 m^3)	Tailings Volume to be Placed (10^6 m^3)
Present – May 2012	Dry Stack	DSTSF	1.2**	0.74
June 2012 – May 2015	Slurry	Area 1 Open Pit	3.9***	3.4
June 2015 – November 2017	Slurry	Area 2 Open Pit	5.8***	2.8

* Slurry tailings deposition dates depend on completion of distribution infrastructure and receipt of necessary permits.

** Volume available as of July 2011

*** Assuming tailings elevation limit given in Table 2

The volume used in each of the open pits will not reach the volume available, which are provided in Table 3. The volume available assumes a level surface, but the tailings surface will have an estimated 4° beach and sub-aqueous slope, resulting in unused space. This can be seen in the tailings deposition illustration in Figure 6.

8.2 Area 1 Open Pit

The Area 1 Open Pit can accommodate approximately 3.4 million m^3 of consolidated tailings. Tailings elevations will reach 786 m at the spigot deposition points. However, as noted previously, tailings elevation limits are based on the elevation of the overburden contact near the spill point around the pit. A future evaluation of site conditions, in conjunction with controlled tailings beach placement, may allow the tailings height to increase above this level.

Tailings deposition locations are shown in Figure 6. Six primary spigot locations will be used to fill the pit to approximately 86% of 786 m elevation capacity. More spigot locations can be used, but there are minimal improvements to the overall tailings volume.

The initial tailings deposition locations have been chosen on the southeast wall of the buttress to minimize potential fluid seepage to the Area 2 Open Pit. Likewise, a thin facing layer of tailings along the southeast wall should be considered to minimize potential seepage from the Area 1 Open Pit to the Area 2 Open Pit.

8.3 Area 2 Open Pit

Slurry tailings will be deposited in the Area 2 Open Pit from approximately May 2015 to November 2017. Total consolidated tailings accumulation is projected to be 2.8 million m^3. Facility volume to 800 m is 5.8 million m^3.

The tailings pipeline, deposition spigot locations, fill elevation, and estimated fill volume will be determined during detailed planning of the Area 2 Open Pit.

9.0 WATER BALANCE EVALUATION

The water balance analysis was carried out until the end of Phase IV milling in late 2017. The current Decommissioning and Reclamation Plan (EBA, November 2010) estimates that active water treatment will be required until 2020. As a result, any surface water management beyond 2017 will need to be addressed during detailed closure design.

The following presents the results of the water balance analysis in the form of water balance flow sheets and estimated water quantities. The flow sheet water routings are numbered to identify the relevant column on the tabulated monthly estimated water quantities.

Operating Period from Present – May 2012

Refer to Figure 3 and Table B-1.

Operating Period from June 2012 – May 2015

Refer to Figure 4 and Table B-2.

Operating Period from June 2015 – November 2017

Refer to Figure 5 and Table B-3.

10.0 INSPECTIONS AND MONITORING

Site monitoring is addressed in detail by the Yukon Water Board Licence QZ96-006 Amendment 7. Included in the licence are monitoring needs for:

- Surface and Groundwater
- Seepage

- Water balance
- Meteorological conditions
- Physical monitoring program (including geotechnical inspections)

Each tailings facility requires an Operations, Maintenance, and Surveillance (OMS) Manual, as set out by Yukon Energy Mines and Resources (EMR). The OMS Manual addresses specific monitoring requirements for the operation, safety, and environmental performance of each facility, including a framework for identifying, evaluating, and reporting significant observations. The DSTSF already has an OMS; the Area 1 and Area 2 Open Pits will each require an OMS Manual. The facility OMS Manual should be consulted for monitoring requirements beyond those given in the water licence.

11.0 DECOMMISSION AND CLOSURE

Closure details can be found in the Decommissioning and Reclamation Plan (EBA, 29 Nov 2010). Selected items relevant to the Tailings Management Plan:

- The DSTSF will use a soil cover to reduce potential neutral metal leaching.
- The Area 1 and Area 2 Open Pits will be flooded to reduce the oxidation of exposed materials in the pit walls.

12.0 SCHEDULE OF ACTIVITIES AND KEY DATES FOR THE TAILINGS MANAGEMENT PLAN

The Tailings Management Plan uses the following key dates based on current projections:

August 2011	Begin underground mining in Area 2/118
June 2012	Assumed completion of slurry tailings deposition system and receipt of water use licence amendment. Begin placing slurry tailings into the Area 1 Open Pit.
August 2013	Complete Phase IV Open Pit Mining (both Area 2 and Area 118)
June 2015	Switch slurry tailings deposition to Area 2 Open Pit
October 2015	Complete mining in Area 2/118 Underground
November 2017	End of milling Phase IV ore

13.0 SUMMARY AND CONCLUSIONS

This document has outlined the proposed Tailings Management Plan for Phase IV operations at Minto ending in late 2017. The switch from dry stack tailings to slurry tailings will occur in approximately June 2012, pending receipt of the necessary water use licence amendment and installation of the slurry tailings deposition piping. Initial Area 1 tailings deposition locations will be located on the southeast walls to minimize the potential seepage to the Area 2 Open Pit. Currently, six deposition points have been planned to reach 86% of the Area 1 Open Pit volume to an elevation of 786 m, although more deposition points can be used and a higher fill percentage can be reached. Slurry tailings will be switched to the Area 2 Open Pit in approximately June 2015 when Area 2 will have completed mining and the Area 1 Open Pit will be at capacity. Excess supernatant water from the tailings operations will be pumped to the water treatment plant for eventual release. Total tailings volumes in the Area 1 Open Pit and Area 2 Open Pit are projected to be 3.4 million m^3 and 2.8 million m^3, respectively.

14.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned at your convenience.

EBA, A Tetra Tech Company

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PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
SIGNATURE
Date Aug. 30, 2011
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

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Capstone Mining Corporation Website, http://capstonemining.com/s/Minto.asp?ReportID=343895.

Minto Mine 2010 Climate Baseline Report, Minto Mine, Yukon, EBA Engineering Consultants, Ltd., August 2010.

Minto Mine Expansion – Phase IV: Decommissioning and Reclamation Plan, Revision 3. EBA Engineering Consultants, Ltd. 29 November 2010.

Memorandum CCL-MC8: Minto Mine – Site Water Balance Update 2011. Clearwater Consultants Ltd. 30 May 2011.

TABLES

Area:	Mill and Mill Pond				WSP and MCDS							Confluence Area			Area 1 Open Pit			Water Treatment Plant		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)
Month	Process water from Mill Pond (m^3)	Recycled Water to Mill Pond (m^3)	Process Water from WSP (m^3)	Excess Mill Pond Water (m^3)	Catch. A4-5 (m^3)	Catch. A2, A4-1, A4-4 (m^3)	Minto Creek flow from MCDS to WSP (m^3)	MCDS Excess Freshet Water (m^3)	WSP Excess Freshet Water (m^3)	WSP Precip. Capture (m^3)	WSP Evaporation (m^3)	Catch. A1, A3 Feed into Conflu. (m^3)	Conflu. Catch. Water (m^3)	Conflu. Pit Water and Freshet (m^3)	Process Water from Pit to Mill Pond (m^3)	Pit Precip. Capture (m^3)	Pit Evap. (m^3)	Pit to Water Treat. Plant (m^3)	WSP to Water Treat. Plant (m^3)	Treated Water Dischar. (m^3)
Jan-11	15,996	21,700	25,110	24,707	0	1,601	0	1,601	0	0	0	0	0	0	19,003	0	0	0	0	0
Feb-11	14,448	19,600	22,680	22,316	0	1,446	0	1,446	0	0	0	0	0	0	17,164	0	0	0	0	0
Mar-11	15,996	21,700	25,110	24,707	0	1,601	0	1,601	0	0	0	0	0	0	19,003	0	0	0	0	0
Apr-11	15,480	21,000	24,300	23,910	89,331	139,779	0	139,779	460,258	23,755	420	517,414	517,414	0	18,390	19,597	150	0	0	0
May-11	15,996	21,700	25,110	24,707	38,285	60,842	0	60,842	221,749	16,232	4,031	221,749	187,899	33,850	19,003	13,391	1,986	0	0	0
Jun-11	15,480	21,000	24,300	23,910	0	1,549	0	1,549	0	10,623	5,829	0	0	0	18,390	8,764	5,945	0	0	0
Jul-11	15,996	21,700	25,110	24,707	6,721	12,001	0	12,001	0	15,327	5,331	38,929	38,929	0	19,003	12,644	6,793	25,000	37,500	62,500
Aug-11	15,996	21,700	25,110	24,707	3,826	7,521	0	7,521	0	11,072	4,011	22,159	22,159	0	19,003	9,134	4,962	25,000	37,500	62,500
Sep-11	15,480	21,111	24,300	24,021	16,958	27,789	0	27,789	56,266	7,981	1,399	98,220	98,220	0	18,390	6,584	1,767	25,000	37,500	62,500
Oct-11	15,996	21,700	25,110	24,707	0	1,601	0	1,601	0	0	0	0	0	0	19,003	0	0	25,000	37,500	62,500
Nov-11	15,480	21,111	24,300	24,021	0	1,549	0	1,549	0	0	0	0	0	0	18,390	0	0	0	0	0
Dec-11	15,996	21,700	25,110	24,707	0	1,601	0	1,601	0	0	0	0	0	0	19,003	0	0	0	0	0
Jan-12	15,996	19,160	25,110	22,167	0	1,779	0	1,779	0	0	0	0	0	0	19,003	0	0	0	0	0
Feb-12	14,448	16,821	22,680	19,537	0	1,664	0	1,664	0	0	0	0	0	0	17,164	0	0	0	0	0
Mar-12	15,996	19,160	25,110	22,167	0	1,779	0	1,779	0	0	0	0	0	0	19,003	0	0	0	0	0
Apr-12	15,480	18,653	24,300	21,563	89,331	139,952	0	139,952	517,414	23,755	533	517,414	478,967	38,446	18,390	19,597	680	0	0	0
May-12	15,996	19,160	25,110	22,167	38,285	61,020	0	61,020	221,749	16,232	4,031	221,749	190,438	31,310	19,003	13,391	5,143	0	0	0

NOTES

1. (1) to (21) correspond to schematic labels shown in Figure 3

2. Actual operating period end date depends on the necessary water use licence amendment and completion of the slurry tailings distribution system.

NOTES

STATUS
ISSUED FOR REVIEW

CLIENT
MINTO
EXPLORATIONS LTD.
A Subsidiary of Capstone Mining Corp.

eba
A TETRA TECH COMPANY

TAILINGS MANAGEMENT PLAN
MINTO MINE, YT

WATER BALANCE:
OPERATING PERIOD TO MAY 2012

PROJECT NO.	DWN	CKD	APVD	REV
W14101068.017	CLS	RZ	RZ	0

OFFICE: EBA-EDM

DATE: August 2011

Table B-1

Q:/Edmonton/Drafting/DIVISIONS2007/Other Offices/W141/W14101068.017/Corel/W14101068017_Table B-1.cdr

Area:	Mill and Mill Pond				WSP and MCDS							Confluence Area				Area 1 Open Pit			Water Treatment Plant		
Diagram ID:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Month	Process water from Mill Pond (m^3)	Recycled Water to Mill Pond (m^3)	Process Water from WSP (m^3)	Excess Mill Pond Water (m^3)	Catch. A4-5 (m^3)	Catch. A2, A4-1, A4-4 (m^3)	Minto Creek flow from MCDS to WSP (m^3)	MCDS Excess Freshet Water (m^3)	WSP Excess Freshet Water (m^3)	WSP Precip. Capture (m^3)	WSP Evaporation (m^3)	Catch. A1, A3 Feed into Conflu. (m^3)	Area 2 Pit Water to Conflu. (m^3)	Conflu. Catch. Water (m^3)	Conflu. Pit Water and Freshet (m^3)	Process Water from Pit to Mill Pond (m^3)	Pit Precip. Capture (m^3)	Pit Evap. (m^3)	Pit to Water Treat. Plant (m^3)	WSP to Water Treat. Plant (m^3)	Treated Water Dischar. (m^3)
Jun-12	87,000	1,445	30,000	1,445	0	0	0	0	0	10,623	5,596	0	7,477	0	0	87,000	8,764	9,984	0	0	0
Jul-12	89,900	1,493	31,000	1,493	0	10,400	0	10,400	0	15,327	4,935	38,929	10,788	38,929	0	89,900	12,644	9,670	25,000	37,500	62,500
Aug-12	89,900	1,493	31,000	1,493	0	5,920	0	5,920	0	11,072	3,465	22,159	7,793	22,159	0	89,900	9,134	7,375	25,000	37,500	62,500
Sep-12	87,000	1,445	30,000	1,445	8,182	26,240	0	26,240	0	7,981	1,104	98,220	5,617	98,220	0	87,000	6,584	2,741	25,000	37,500	62,500
Oct-12	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	25,000	37,500	62,500
Nov-12	87,000	1,445	30,000	1,445	0	0	0	0	0	0	0	0	0	0	0	87,000	0	0	0	0	0
Dec-12	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Jan-13	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Feb-13	81,200	1,349	28,000	1,349	0	0	0	0	0	0	0	0	0	0	0	81,200	0	0	0	0	0
Mar-13	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Apr-13	87,000	1,445	30,000	1,445	61,386	138,230	0	138,230	285,135	23,755	195	517,414	16,720	517,414	0	87,000	19,597	1,275	0	0	0
May-13	89,900	1,493	31,000	1,493	20,257	59,242	0	59,242	221,749	16,232	4,031	221,749	11,425	218,798	2,951	89,900	13,391	9,829	0	0	0
Jun-13	87,000	1,445	30,000	1,445	0	0	0	0	0	10,623	5,829	0	7,477	0	0	87,000	8,764	15,176	0	0	0
Jul-13	89,900	1,493	31,000	1,493	0	10,400	0	10,400	0	15,327	5,101	38,929	10,788	38,929	0	89,900	12,644	14,380	25,000	37,500	62,500
Aug-13	89,900	1,493	31,000	1,493	0	5,920	0	5,920	0	11,072	3,596	22,159	7,793	22,159	0	89,900	9,134	10,871	25,000	37,500	62,500
Sep-13	87,000	1,445	30,000	1,445	8,182	26,240	0	26,240	0	7,981	1,169	98,220	5,617	98,220	0	87,000	6,584	3,994	25,000	37,500	62,500
Oct-13	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	25,000	37,500	62,500
Nov-13	87,000	1,445	30,000	1,445	0	0	0	0	0	0	0	0	0	0	0	87,000	0	0	0	0	0
Dec-13	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Jan-14	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Feb-14	81,200	1,349	28,000	1,349	0	0	0	0	0	0	0	0	0	0	0	81,200	0	0	0	0	0
Mar-14	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Apr-14	87,000	1,445	30,000	1,445	61,386	138,230	0	138,230	304,223	23,755	248	517,414	16,720	517,414	0	87,000	19,597	1,770	0	0	0
May-14	89,900	1,493	31,000	1,493	20,257	59,242	0	59,242	221,749	16,232	4,031	221,749	11,425	218,798	2,951	89,900	13,391	12,246	0	0	0
Jun-14	87,000	1,445	30,000	1,445	0	0	0	0	0	10,623	5,829	0	7,477	0	0	87,000	8,764	17,705	0	0	0
Jul-14	89,900	1,493	31,000	1,493	0	10,400	0	10,400	0	15,327	5,101	38,929	10,788	38,929	0	89,900	12,644	16,525	25,000	37,500	62,500
Aug-14	89,900	1,493	31,000	1,493	0	5,920	0	5,920	0	11,072	3,596	22,159	7,793	22,159	0	89,900	9,134	12,246	25,000	37,500	62,500
Sep-14	87,000	1,445	30,000	1,445	8,182	26,240	0	26,240	0	7,981	1,169	98,220	5,617	98,220	0	87,000	6,584	4,426	25,000	37,500	62,500
Oct-14	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	25,000	37,500	62,500
Nov-14	87,000	1,445	30,000	1,445	0	0	0	0	0	0	0	0	0	0	0	87,000	0	0	0	0	0
Dec-14	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Jan-15	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Feb-15	81,200	1,349	28,000	1,349	0	0	0	0	0	0	0	0	0	0	0	81,200	0	0	0	0	0
Mar-15	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Apr-15	87,000	1,445	30,000	1,445	61,386	138,230	0	138,230	304,223	23,755	248	517,414	16,720	517,414	0	87,000	19,597	1,770	0	0	0
May-15	89,900	1,493	31,000	1,493	20,257	59,242	0	59,242	221,749	16,232	4,031	221,749	11,425	218,798	2,951	89,900	13,391	12,246	0	0	0

NOTES

1. 1 to 21 correspond to schematic labels shown in Figure 4
2. Actual operating period start date depends on the necessary water use licence amendment and completion of the slurry tailing distribution system. The end date is also an approximation based on currently available information and may change.

NOTES

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TAILINGS MANAGEMENT PLAN MINTO MINE, YT

WATER BALANCE: OPERATING PERIOD FROM JUNE 2012 – MAY 2015

PROJECT NO.	DWN	CKD	APVD	REV
W14101068.017	CLS	RZ	RZ	0
OFFICE	DATE			
EBA-EDM	August 2011			

Table B-2

Q:/Edmonton/Drafting/DIVISIONS2007/Other Offices/W141/W14101068.017/Corel/W14101068017_Table B-2.cdr

Area:	Mill and Mill Pond				WSP and MCDS							Confluence Area				Area 2 Open Pit			Water Treatment Plant		
Diagram ID:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Month	Process water from Mill Pond (m^3)	Recycled Water to Mill Pond (m^3)	Process Water from WSP (m^3)	Excess Mill Pond Water (m^3)	Catch. A4-5 (m^3)	Catch. A2, A4-1, A4-4 (m^3)	Minto Creek flow from MCDS to WSP (m^3)	MCDS Excess Freshet Water (m^3)	WSP Excess Freshet Water (m^3)	WSP Precip. Capture (m^3)	WSP Evaporation (m^3)	Catch. A1, A3 Feed into Conflu. (m^3)	Area 2 Pit Water to Conflu. (m^3)	Conflu. Catch. Water (m^3)	Conflu. Pit Water and Freshet (m^3)	Process Water from Pit to Mill Pond (m^3)	Pit Precip. Capture (m^3)	Pit Evap. (m^3)	Pit to Water Treat. Plant (m^3)	WSP to Water Treat. Plant (m^3)	Treated Water Dischar. (m^3)
Jun-15	87,000	1,445	30,000	1,445	0	0	0	0	0	10,623	5,799	0	8,764	0	0	87,000	7,477	1,787	0	0	0
Jul-15	89,900	1,493	31,000	1,493	6,721	12,305	0	12,305	0	15,327	5,440	37,891	12,644	37,891	0	89,900	10,788	6,672	25,000	37,500	62,500
Aug-15	89,900	1,493	31,000	1,493	3,826	7,004	0	7,004	0	11,072	3,842	21,569	9,134	21,569	0	89,900	7,793	5,008	25,000	37,500	62,500
Sep-15	87,000	1,445	30,000	1,445	16,958	31,045	0	31,045	0	7,981	1,265	95,601	6,584	95,601	0	87,000	5,617	1,830	25,000	37,500	62,500
Oct-15	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	25,000	37,500	62,500
Nov-15	87,000	1,445	30,000	1,445	0	0	0	0	0	0	0	0	0	0	0	87,000	0	0	0	0	0
Dec-15	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Jan-16	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Feb-16	81,200	1,472	28,000	1,472	0	0	0	0	0	0	0	0	0	0	0	81,200	0	0	0	0	0
Mar-16	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Apr-16	87,000	1,445	30,000	1,445	89,331	163,544	0	163,544	325,431	23,755	303	503,619	19,597	503,619	0	87,000	16,720	910	0	0	0
May-16	89,900	1,493	31,000	1,493	38,285	70,090	0	70,090	215,837	16,232	4,031	215,837	13,391	211,090	4,747	89,900	11,425	6,651	0	0	0
Jun-16	87,000	1,445	30,000	1,445	0	0	0	0	0	10,623	5,829	0	8,764	0	0	87,000	7,477	9,930	0	0	0
Jul-16	89,900	1,493	31,000	1,493	6,721	12,305	0	12,305	0	15,327	5,101	37,891	12,644	37,891	0	89,900	10,788	9,509	25,000	37,500	62,500
Aug-16	89,900	1,493	31,000	1,493	3,826	7,004	0	7,004	0	11,072	3,596	21,569	9,134	21,569	0	89,900	7,793	7,423	25,000	37,500	62,500
Sep-16	87,000	1,445	30,000	1,445	16,958	31,045	0	31,045	0	7,981	1,158	95,601	6,584	95,601	0	87,000	5,617	2,792	25,000	37,500	62,500
Oct-16	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	25,000	37,500	62,500
Nov-16	87,000	1,445	30,000	1,445	0	0	0	0	0	0	0	0	0	0	0	87,000	0	0	0	0	0
Dec-16	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Jan-17	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Feb-17	81,200	1,349	28,000	1,349	0	0	0	0	0	0	0	0	0	0	0	81,200	0	0	0	0	0
Mar-17	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	0	0	0
Apr-17	87,000	1,445	30,000	1,445	89,331	163,544	0	163,544	291,677	23,755	244	503,619	19,597	503,619	0	87,000	16,720	1,212	0	0	0
May-17	89,900	1,493	31,000	1,493	38,285	70,090	0	70,090	215,837	16,232	4,031	215,837	13,391	211,090	4,747	89,900	11,425	8,901	0	0	0
Jun-17	87,000	1,445	30,000	1,445	0	0	0	0	0	10,623	5,829	0	8,764	0	0	87,000	7,477	13,374	0	0	0
Jul-17	89,900	1,493	31,000	1,493	6,721	12,305	0	12,305	0	15,327	5,101	37,891	12,644	37,891	0	89,900	10,788	12,440	25,000	37,500	62,500
Aug-17	89,900	1,493	31,000	1,493	3,826	7,004	0	7,004	0	11,072	3,596	21,569	9,134	21,569	0	89,900	7,793	9,219	25,000	37,500	62,500
Sep-17	87,000	1,445	30,000	1,445	16,958	31,045	0	31,045	0	7,981	1,158	95,601	0	95,601	0	87,000	5,617	3,332	25,000	37,500	62,500
Oct-17	89,900	1,493	31,000	1,493	0	0	0	0	0	0	0	0	0	0	0	89,900	0	0	25,000	37,500	62,500
Nov-17	87,000	65,416	30,000	65,416	0	0	0	0	0	0	0	0	0	0	0	87,000	0	0	0	0	0

NOTES

1. (1) to (21) correspond to schematic labels shown in Figure 6
2. Period start and end dates are approximations based on currently available information and may change.

NOTES

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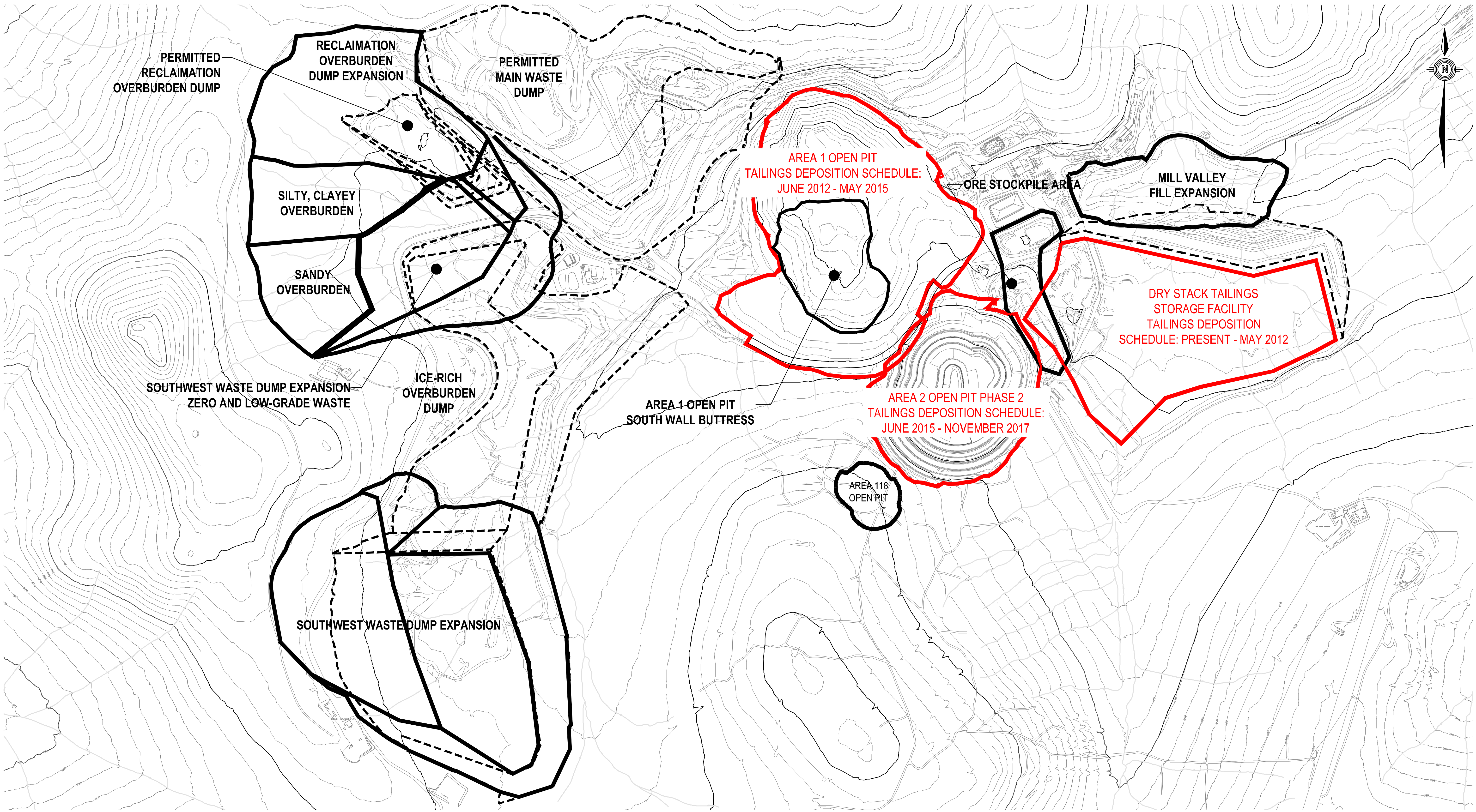
TAILINGS MANAGEMENT PLAN
MINTO MINE, YT

WATER BALANCE:
OPERATING PERIOD FROM
JUNE 2015 – NOVEMBER 2017

PROJECT NO.	DWN	CKD	APVD	REV
W14101068.017	CLS	RZ	RZ	0
OFFICE	DATE			
EBA-EDM	August 2011			

Table B-3

FIGURES



LEGEND

0 500 m

Scale: 1: 10 000

NOTES:

1. 3 m INTERMEDIATE AND 15 m INDEX CONTOUR DATA SHOWN BASED ON APRIL 2010 SURVEY DATA PROVIDED BY MINTO.
2. TAILINGS MANAGEMENT COMPONENTS OUTLINED IN RED, OTHER PHASE IV DEVELOPMENT COMPONENTS SHOWN IN BLACK.
3. PERIOD STAGE AND END DATE ARE APPROXIMATIONS BASED ON CURRENTLY AVAILABLE INFORMATION AND MAY CHANGE

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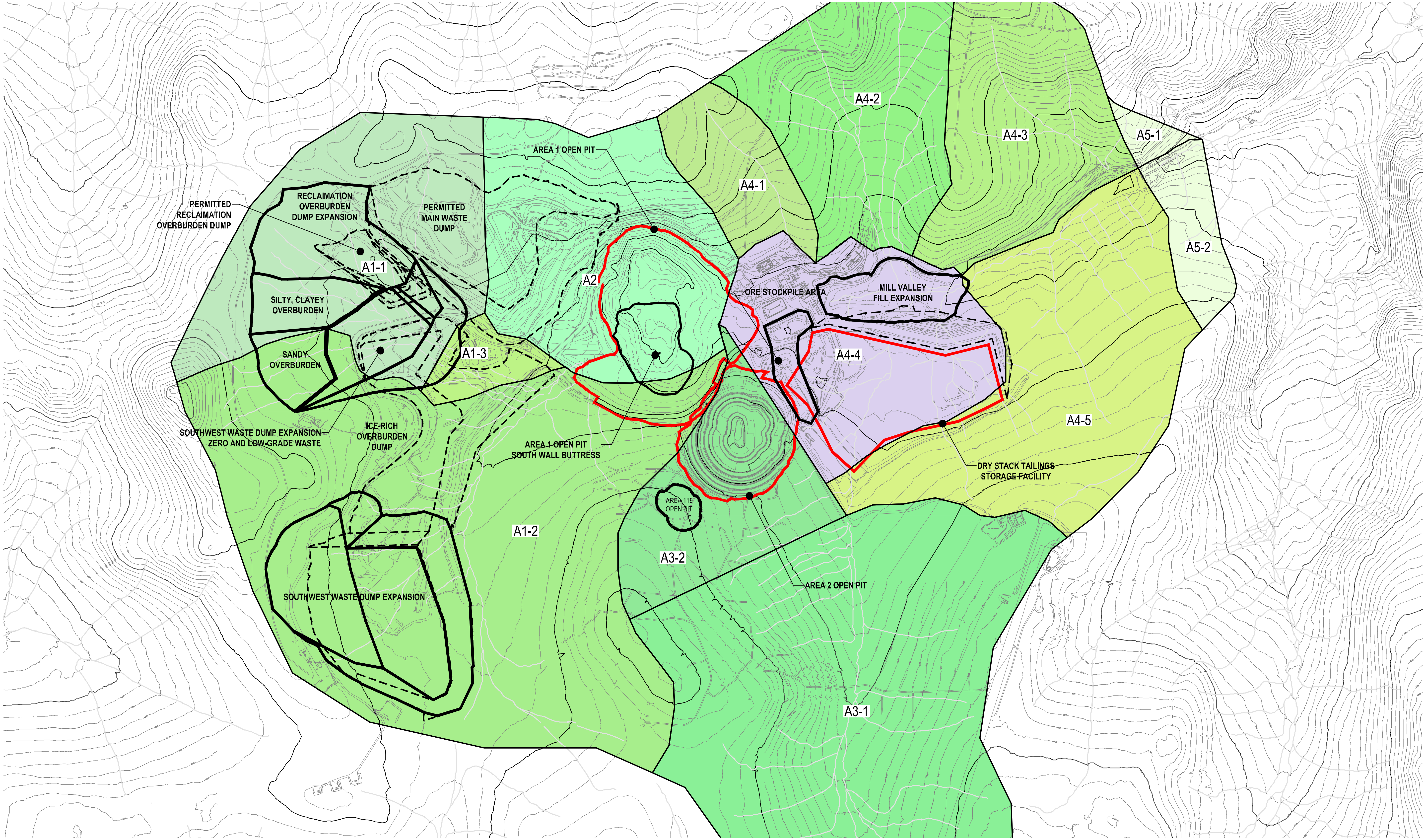
TAILINGS MANAGEMENT PLAN
MINTO MINE, YT

SITE PLAN

PROJECT NO.	DWN	CKD	REV
W14101068.017	CB/EL	JGD	0

OFFICE	DATE
EBA-WHSE	August 29, 2011

Figure 1



LEGEND

0 500 m

Scale: 1: 15 000

NOTES:

1. 3 m INTERMEDIATE AND 15 m INDEX CONTOUR DATA SHOWN BASED ON APRIL 2010 SURVEY DATA PROVIDED BY MINTO.
2. SUB-CATCHMENTS SHOWN IN DIFFERENT COLOURS FOR CLARITY.
3. TAILINGS MANAGEMENT COMPONENTS OUTLINED IN RED, OTHER PHASE IV DEVELOPMENT COMPONENTS SHOWN IN BLACK.

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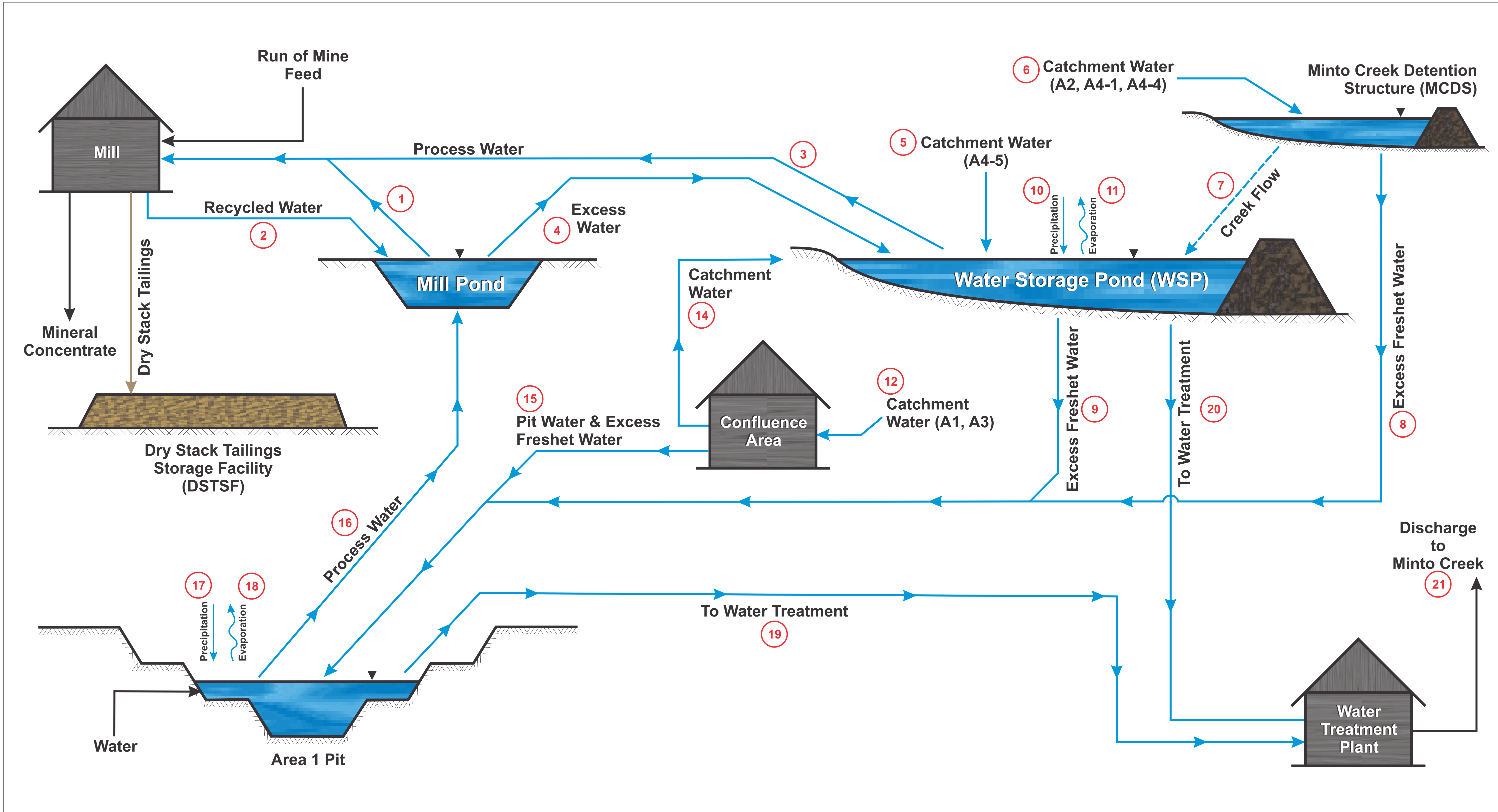
TAILINGS MANAGEMENT PLAN
MINTO MINE, YT

SUB-CATCHMENTS

PROJECT NO.	DWN	CKD	REV
W14101068.017	CB/EL	JGD	0

OFFICE	DATE
EBA-WHSE	August 29, 2011

Figure 2



NOTES

1. (1) to (21) correspond to monthly water balance values listed in Table B-1 under a mean precipitation year
2 Water treatment plan operation is from July - October
3. Actual operating period end date depends on the necessary water use licence amendment and completion of the slurry tailings distribution system

NOTES

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TAILINGS MANAGEMENT PLAN
MINTO MINE, YT

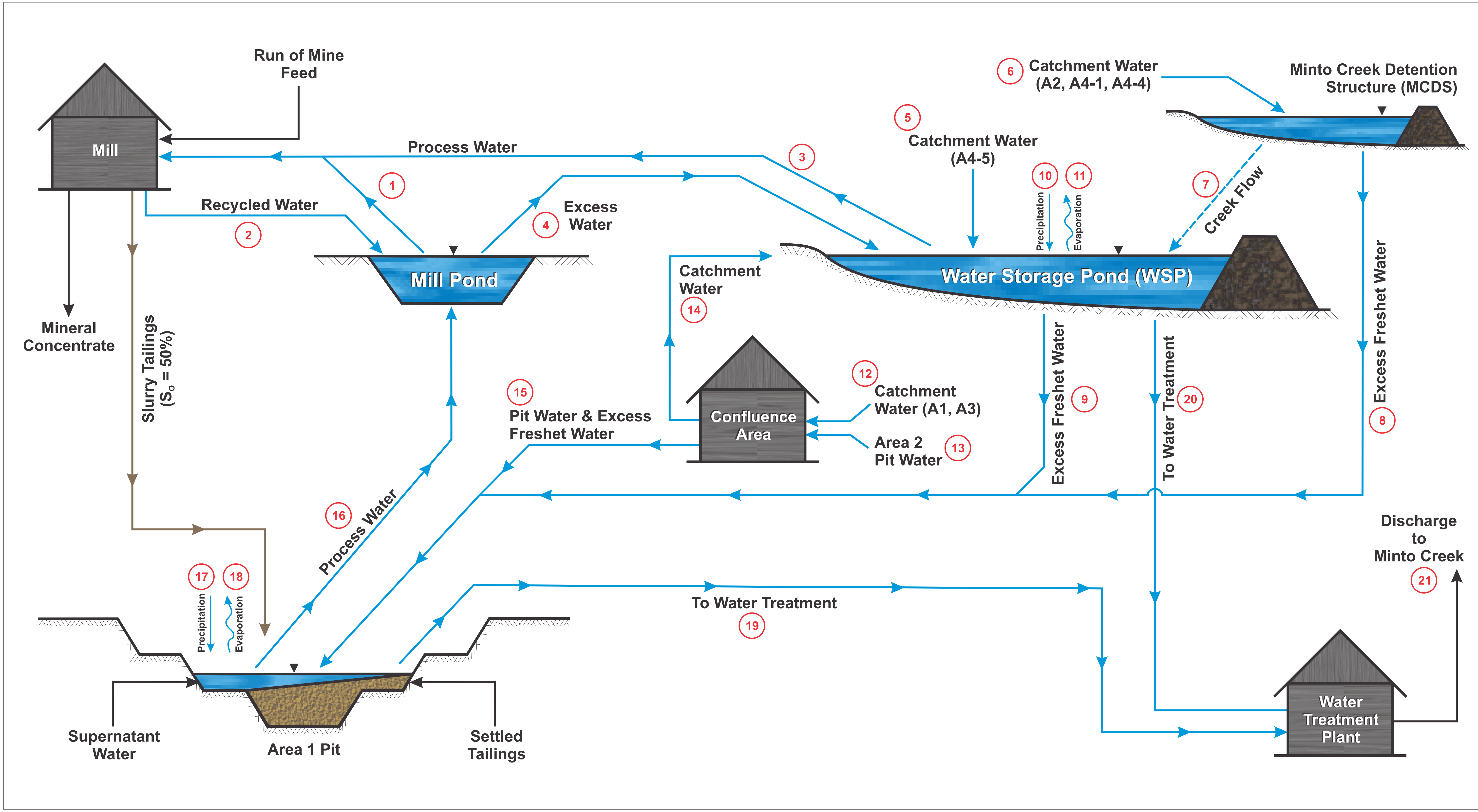
SCHEMATIC WATER BALANCE:
OPERATING PERIOD TO MAY 2012

PROJECT NO.	DWN	CKD	APVD	REV
W14101068.017	CLS	RZ	RZ	0

OFFICE	DATE
EBA-EDM	August 2011

Figure 3

Q:/Edmonton/Drafting/DIVISIONS2007/Other Offices/W141/W14101068.017/Corel/W14101068017_Figure 3.cdr



NOTES

1. (1) to (21) correspond to monthly water balance values listed in Table B-2 under a mean precipitation year
2. Water treatment plan operation is from July - October
3. Actual operating period start date depends on the necessary water use licence amendment and completion of the slurry tailings distribution system. The end date is also an approximation based on currently available information and may change.

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TAILINGS MANAGEMENT PLAN
MINTO MINE, YT

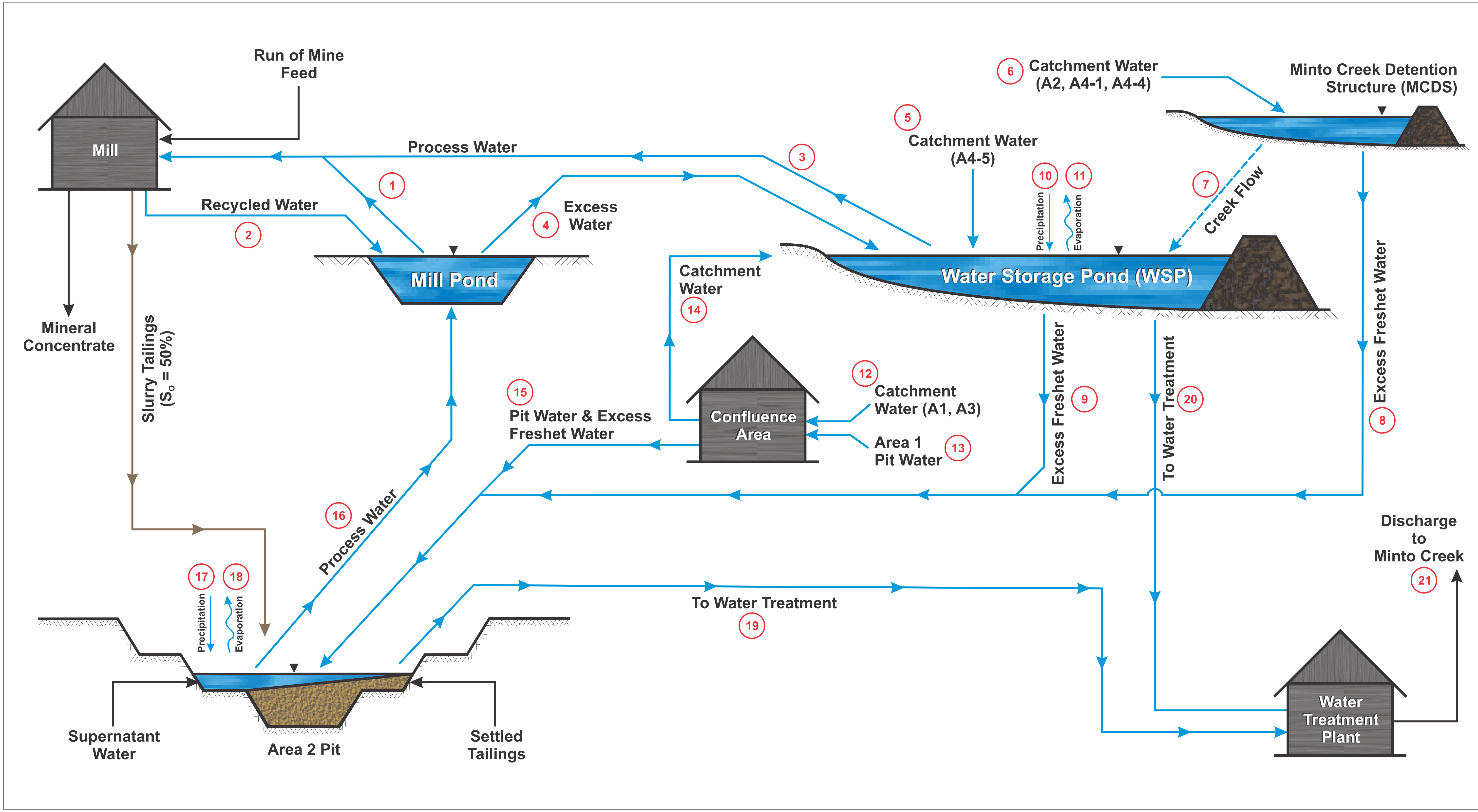
SCHEMATIC WATER BALANCE:
OPERATING PERIOD FROM
JUNE 2012 - MAY 2015

PROJECT NO.	DWN	CKD	APVD	REV
W14101068.017	CLS	RZ	RZ	0

OFFICE	DATE
EBA-EDM	August 2011

Figure 4

Q:/Edmonton/Drafting/DIVISIONS2007/Other Offices/W141/W14101068.017/Corel/W14101068017_Figure 4.cdr



NOTES

1. 1 to 21 correspond to monthly water balance values listed in Table B-3 under a mean precipitation year
2. Water treatment plan operation is from July - October
3. Period start and end dates are approximations based on currently available information and may change

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TAILINGS MANAGEMENT PLAN
MINTO MINE, YT

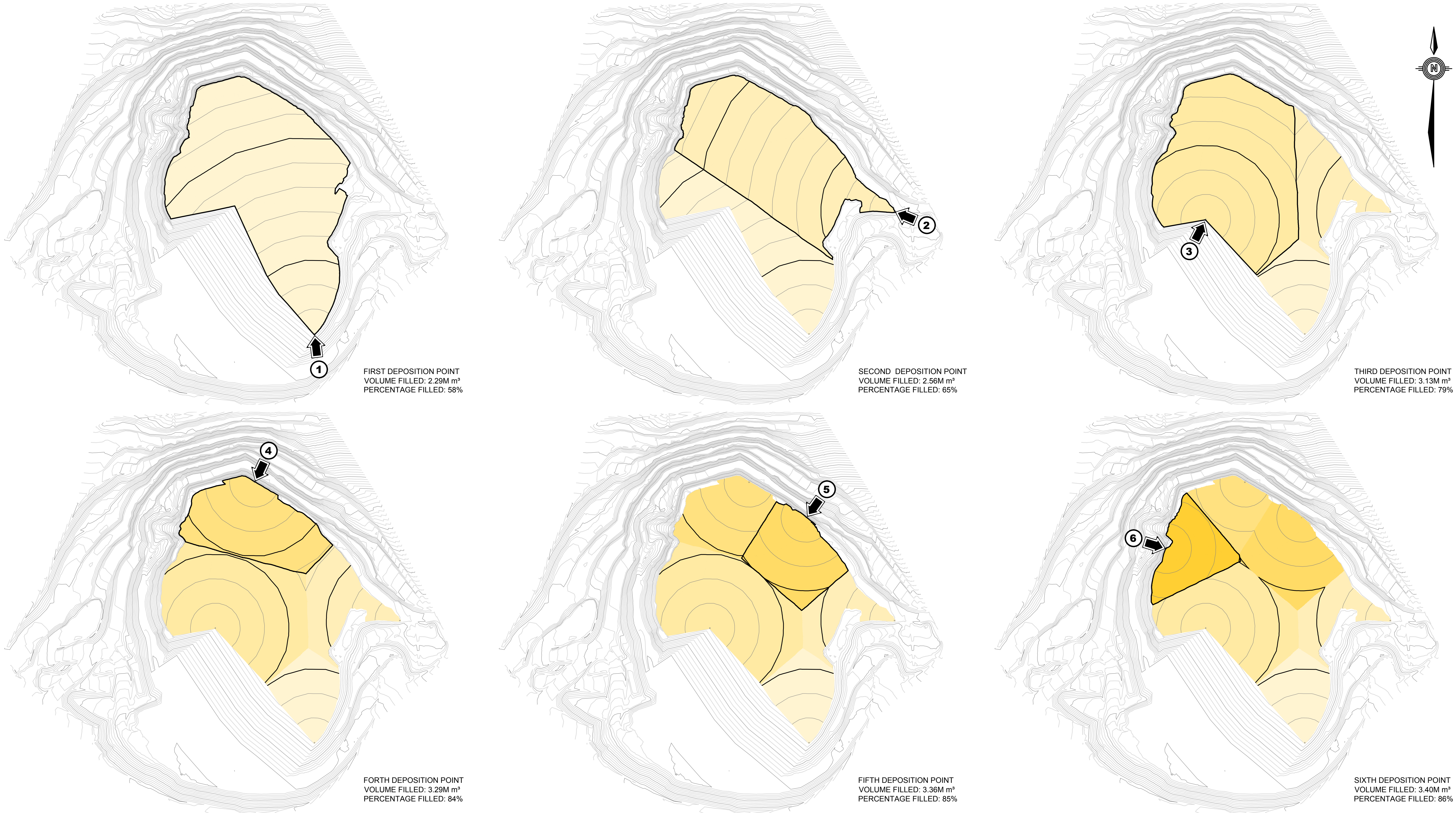
SCHEMATIC WATER BALANCE:
OPERATING PERIOD FROM
JUNE 2015 - NOVEMBER 2017

PROJECT NO.	DWN	CKD	APVD	REV
W14101068.017	CLS	RZ	RZ	0

OFFICE	DATE
EBA-EDM	August 2011

Figure 5

Q:/Edmonton/Drafting/DIVISIONS2007/Other Offices/W141/W14101068.017/Corel/W14101068017_Figure 5.cdr



NOTES:

1. ALL DEPOSITION POINTS ARE AT THE 786 m ELEVATION
2. AREA 1 PIT VOLUME TO 786 m ELEVATION: 3.94M m^3
3. 4% GRADE ON BEACHED AND SUBMERGED TAILINGS

0 250 m

Scale: 1: 7 500

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TAILINGS MANAGEMENT PLAN
MINTO MINE, YT

TAILINGS DEPOSITION: AREA 1 PIT

PROJECT NO.	DWN	CKD	REV
W14101068.017	CB/EL	RZ	0

OFFICE	DATE
EDM	August 9, 2011

Figure 6

APPENDIX A

APPENDIX A GEOTECHNICAL REPORT – GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA's Client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's Client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA's instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

8.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

9.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

10.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

11.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

12.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

13.0 SAMPLES

EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

14.0 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of the report, EBA may rely on information provided by persons other than the Client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B

APPENDIX B CLEARWATER CONSULTANTS MEMO CCL-MC8

Memorandum CCL-MC8

Date: May 30, 2011 **Our File:** 087.08

To: Access Consulting Group – Scott Keesey (skeesey@accessconsulting.ca)

From: Clearwater Consultants Ltd. - Peter S. McCreath (pmccreath@shaw.ca)

Subject: Minto Mine – Site Water Balance Update 2011 **FINAL**

1. Introduction

As required by the terms of Amendment #7 to the Type A Water Licence QZ96-006, this Memorandum CCL-MC8 prepared by Clearwater Consultants Ltd. presents an update of the Minto Mine site area water balance model to April 2011. Details of the water balance model operation were presented in Design Memorandum CCL-MC4, "Water Balance Update" dated July 24, 2009, and in Memorandum CCL-MC5 "Minto Mine Site Water Balance Update 2010" dated May 21, 2010.

2. Water Balance Model Revisions and Input Data Updates

During April 2010 natural runoff from sub-catchment areas designated A4-2 and A4-3 were diverted past the Water Storage Pond and discharged directly to Minto Creek downstream of the dam. This diversion decreased the catchment area draining into the Water Storage Pond by a total of 148.1 ha (87.1 ha for area A4-2 and 61.0 ha for area A4-3) to 194.0 ha. In the water balance model the other total catchment areas remained the same as previously reported and as summarized in Table 1.

Table 1 – Catchment Areas (ha) used in Water Balance Model

Location	TOTAL	Disturbed	Land	Pond	Description
Mill Pond	544.1	19.0	524.1	1.0	A1-1,A1-2,A1-3, A3-1,A3-2, A2 minus Pit, Waste Dumps, IROD
W.S. Pond	194.0	62.8	131.2	0.0	A4-1, A4-4, A4-5
Open Pit	87.9	58.5	28.4	1.0	within Mill Pond catchment
Waste Dumps	57.0	57.0	0	0	within Mill Pond catchment
IROD	9.0	9.0	0	0	within Mill Pond catchment
TOTAL	**892.0**	**206.3**	**683.7**	**2.0**	

Monthly precipitation data (rainfall and snowfall) were collected for the climate station at Pelly River Ranch Station number 2100880 (elevation 454.2m) up to and including July 2010, the last date for which precipitation data has been published for that station.

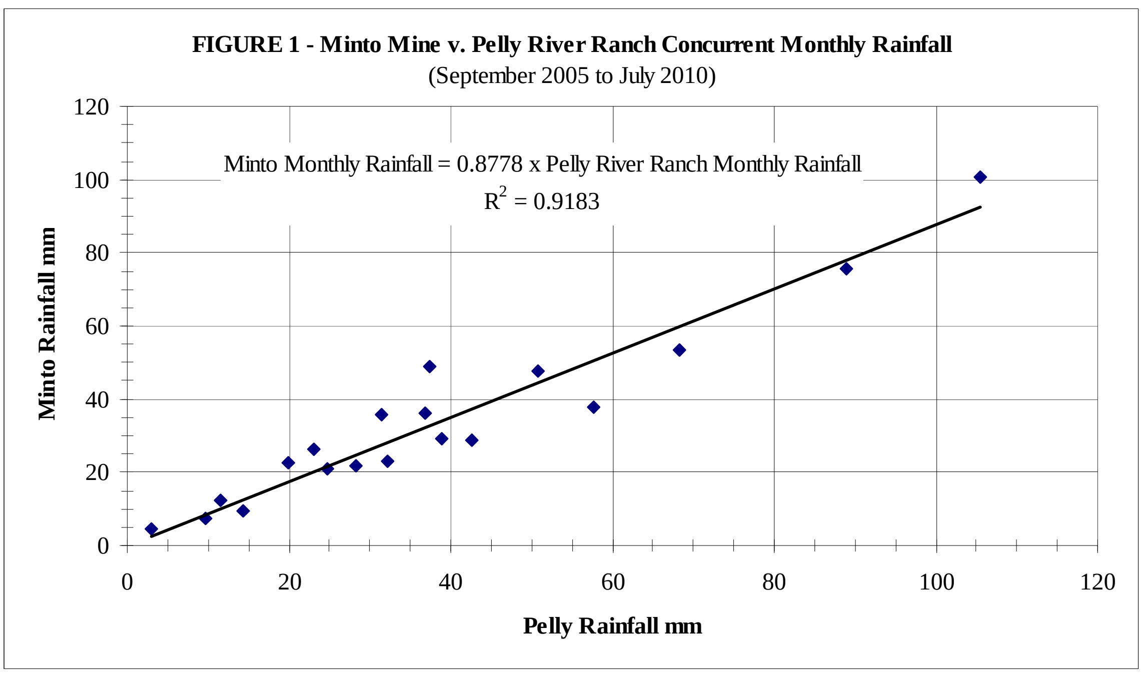
Climate and mine operational data up to April 2011 were provided by Minto Explorations and included:

- Precipitation: summer rainfall data measured at site. Winter precipitation (snowfall) is not measured at the Minto site.
- Snow survey data collected at three snowcourses at or near month-end between February and April 2010 and 2011. Winter precipitation (as equivalent rainfall) was estimated based on the snow water equivalent (SWE) results of the snow surveys
- Monthly ore, tailings and concentrate tonnages to the end of April 2011

- Monthly tailings and concentrate moisture losses to April 2011. As advised by Minto personnel, tailings moisture contents and concentrate moisture contents were assumed to be 16% and 9% (respectively) from March 2010 to February 2011.
- Water Storage Pond elevations and volumes to May 7, 2011. The maximum storage volume in the Water Storage Pond is 324,828 m^3 corresponding to a pond elevation of 716.19 m, the overflow spillway invert elevation. A nominal minimum volume of 10,000 m^3 was assumed.
- Measured water levels and estimated volumes of water stored in the open pit in each month up to May 7, 2011. These data were used to estimate volumes of runoff water diverted to the pit and volumes pumped to or from the Water Storage Pond from or to the pit.
- Water volumes discharged from the Water Storage Pond seepage recovery pond to Minto Creek. Based on acceptable water quality test results, these releases continued from June 2010 until late January 2011.
- Water volumes released from the Water Treatment Plant to Minto Creek from mid-July to early November 2010. Water for the Water Treatment Plant was taken from the Open Pit and from the Water Storage Pond.

3. Precipitation Conditions

Previous hydrology analyses assumed that orographic effects would result in higher annual precipitation at the higher elevation Minto Mine site than at the lower elevation Pelly River Ranch climate station. Concurrent rainfall data for the May to September period at the Minto Mine site and at Pelly River Ranch were compared as shown on Figure 1. A total of 19 concurrent months of data were available. Correlation analysis indicated that rainfall at Minto may be about 12% less than at Pelly River Ranch.



No concurrent measurements of winter precipitation (snowfall) exist. Comparison of the measured SWE's at Minto (2007 to 2010) with cumulative winter precipitation at Pelly River Ranch indicated that, although highly variable from year to year, the Minto site may experience approximately 20% more snowfall than Pelly River Ranch. Overall, the limited dataset indicates that, although higher in elevation, the annual total precipitation at the Minto site may not differ significantly from annual total precipitation at Pelly River Ranch.

Due to the limited concurrent dataset and reported problems with operation of the precipitation gauge at Minto, it is recommended that the previously-developed method of estimating precipitation at Minto be continued. The method as described in Clearwater Consultants Ltd. Memorandum CCL-MC1 "Minto Copper Project – Site Hydrology Update" dated October 6, 2006, uses orographic factors to estimate annual rainfall, snowfall and total precipitation at Minto based on using the Pelly River Ranch data and the differences in elevation between the two stations. This method results in more conservative (i.e. higher) estimates of annual precipitation at Minto than would be indicated by the comparison of the limited available concurrent data described above.

Since the 2006 study additional precipitation data are available for Pelly River Ranch. These data were added to the previous database and analyzed to review and revise estimated average monthly conditions and annual total precipitation for extreme wet and dry year conditions. The additional five years of data for Pelly River Ranch did not result in any significant changes to either average monthly conditions or extreme annual conditions based on frequency analyses. The revised average monthly precipitation depths for Pelly River were adjusted for orographic effects and included in the water balance model as assumed average conditions for May 2011 onwards. Table 2 compares the annual total precipitation frequency analyses results from 2006 with the present.

Table 2 – Comparison of Annual Precipitation Frequency Analyses

Return Period (years)	Annual Total Precipitation (mm) for Minto Creek area at elevation 885 m	
	Data to October 2004	Data to July 2010
10 Year DRY Year	268	270
Average	341	343
10 Year Wet Year	420	420
50 year	478	474
100 year	500	495
200 year	521	515

NOTES

1) Frequency analyses for Pelly River Ranch based on 3-parameter log-normal distribution with 52 points, mean 304 mm, standard deviation 52.4 mm.
2) Annual precipitation assumed to increase at 2.94% per 100 m elevation increase above Pelly River Ranch elevation 454.2 m.
3) Results using data to July 2010 used in Water Balance Update 2011

4. Evaporative Losses

The previous versions of the water balance model assumed average annual lake evaporation of 430 mm, average annual evapotranspiration losses of 215 mm (50% of lake evaporation), and losses from disturbed ground of 107.5 mm (25% of lake evaporation). Calculations of potential evapotranspiration using site climatic data (temperatures, humidity, solar radiation) using the WREVAP program confirmed the reasonableness of these values.

As described in Memorandum CCL-MC5 (Site Water Balance Update 2010) and based on model calibration from 2007 to 2009, the average adjusted values were: lake evaporation 440 mm, evapotranspiration 202 mm (46% of lake evaporation), disturbed ground losses 122 mm (27% of lake evaporation). These latter values were used in the model from May 2011 onwards.

5. Updated Water Balance Results

The water balance results are presented as a series of tables in Appendix 1 as follows:

- Table MC8-1 – Input Data and Assumptions
- Table MC8-2 - Monthly Water Balance Volumes (4 pages)

The model was first calibrated using all available actual monthly input data to the end of April 2011. The model was then used to simulate future conditions up to March 2014, a total potential operating period of about seven years. For May 2011 onwards, average climate and mill operational parameters were assumed as summarized in Table MC8-1 in Appendix 1.

5.1. Model Calibration

The model was calibrated by using all available measured data up to April 2011. Summer precipitation (rainfall) measured monthly at the site was input to the model and winter snowfall precipitation was estimated based on the results of the snowcourse surveys each year. Where monthly rainfall was not measured at the site due to instrument malfunction or other reasons, average rainfall was assumed for that month. Adjustments were made to monthly evaporation and evapotranspiration rates so that the calculated volumes corresponded reasonably with the measured volumes of water stored in the Water Storage Pond and in the Open Pit. Minor allowances for apparent winter groundwater baseflow inflows to the Water Storage Pond were added as required. Calculations after April 2011 assumed average operational conditions including average monthly rates of precipitation and evaporation.

5.2. Model Projections

For each of the water years (November to October) from 2006/07 to 2010/11, the actual annual volumes of excess water generated by runoff from the site catchment areas were calculated as:

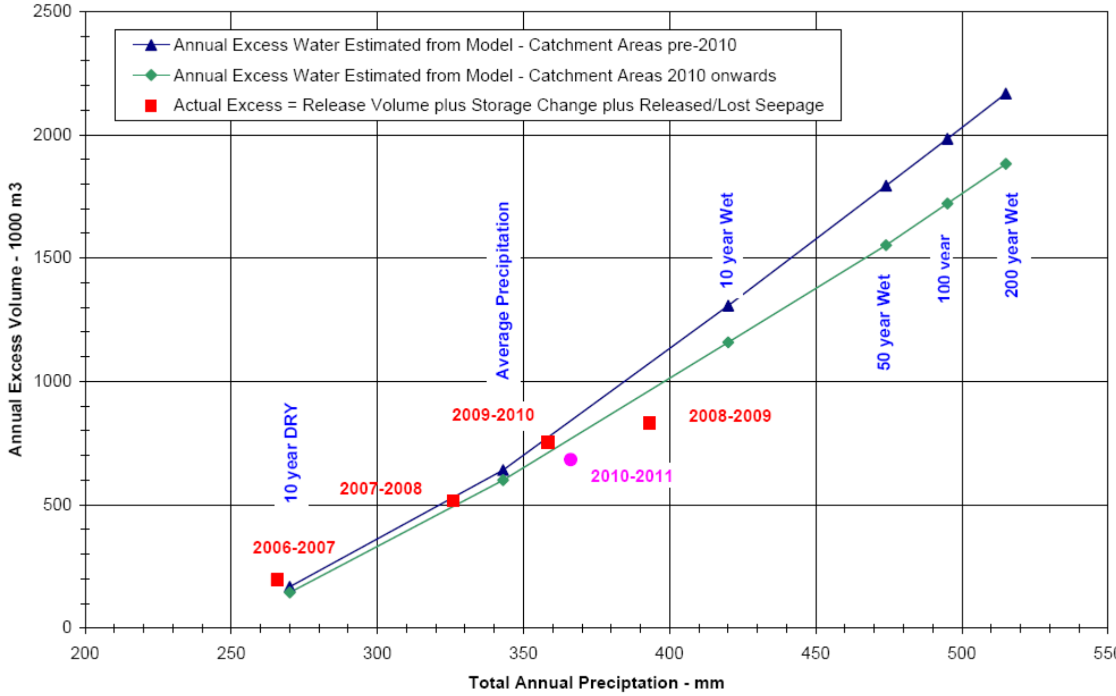
Annual Excess Water = Measured volume of water released from the site during the year
plus
Measured change in water stored on the site in the Water Storage Pond for the year
plus
Estimated seepage losses plus Measured Releases from the Water Storage Pond
.

The calculated excess water volumes were compared to the actual total precipitation depth measured/estimated for the site each year.

The model was then used to estimate potential annual volumes of excess water for a range of assumed annual precipitation depths from 10 year dry conditions to 200 year wet conditions. The results are shown on Figure 2 and indicate that the model methodology appears to provide good estimates of annual site runoff volumes over a range of annual precipitation depths.

For a given annual precipitation, the actual volume of excess water generated over a year will depend strongly on factors such as the actual monthly distribution of the precipitation, the relative amounts of rainfall and snowfall, the timing of and rate of snowmelt in the spring, the daily distribution of rainfall in the summer, and actual temperatures and amount of sunshine during the year. Potential runoff volumes will also change as mining proceeds and the pit(s) and waste dump(s) configurations and sizes change the amount of disturbed ground within the catchment.

FIGURE 2 - Minto Mine Water Balance - Annual Excess Water v. Annual Total Precipitation
Comparison of Actual v. Modeled Results for Various Return Periods



* Water Years from November to October
** Model estimates based on catchment areas for 2010 onwards
*** 2010-2011 estimated with actual data up to April 2011

6. Conclusions

The continuous simulation monthly site water balance model for the Minto Mine site has been updated to include actual climatic and process operating conditions from May 2007 to April 2011. The following conclusions are drawn:

- Although limited correlation analyses indicates that annual total precipitation at the Minto site may be similar in magnitude to Pelly River Ranch, it is recommended that the previously-developed method of estimating precipitation at Minto using orographic factors be continued. This results in more conservative (higher) estimates of annual precipitation at Minto and is consistent with annual excess volumes estimated since 2006.
- The addition of five more years of monthly and annual precipitation data at Pelly River Ranch did not significantly change average monthly precipitation values or annual extreme wet and dry year values estimated from frequency analysis.
- Based on behaviour at the site since 2006, average adjusted values for annual evaporative losses were: lake evaporation 440 mm, evapotranspiration 202 mm (46% of lake evaporation), disturbed ground losses 122 mm (27% of lake evaporation)
- With minor adjustments to monthly evaporative losses the model closely simulates actual total volumes of water flowing to and stored in the Water Storage Pond up to April 2011
- The model provides reasonable estimates of total annual excess runoff volumes from the Minto Mine site area for a range of precipitation return periods.
- All components of the water balance should continue to be monitored to allow modifications to be made as required to the model assumptions and parameters so as to better reflect actual site operating and hydrological conditions. On-going water balance monitoring should include:
  - Summer rainfall and winter snowfall precipitation;
  - Temperatures, sunshine hours and wind speeds;
  - Snowpack conditions and variations from January to the completion of the snowmelt;
  - Water Storage Pond and Open Pit water levels and water storage volumes;
  - Volumes of water released from the site and the associated dates. Releases could be from the Water Treatment Plant or other sources if water quality is acceptable;
  - Volumes of water treated from the open pit and from the Water Storage Pond;
  - Volumes of water diverted into the open pit from the upper catchment areas;
  - Ore, concentrate, tailings and waste rock tonnages and moisture contents and any other consumptive uses of water;
  - Streamflows at key locations such as W3, MC-1 and W1 in Minto Creek downstream of the water storage pond and other locations as required by the Water Licence.

CLEARWATER CONSULTANTS LTD.

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APPENDIX 1

Minto Mine

Site Water Balance Update 2011 - Tables

Table MC8-1 – Input Data and Assumptions

Table MC8-2 - Monthly Water Balance Volumes – Average Conditions (4 pages)

Table MC8-1 - Minto Mine Project Water Balance Update - Input Data & Assumptions

VERSION 1.5

1) Hydrology

Annual Snowfall each year =	42.3%	of Total Precip
Annual Pond Evaporation =	440	mm
Annual Beach & Disturbed Ground Losses =	120.6	mm, or 27.4% of Pond Evap.
Annual Evapotranspiration =	202.4	mm, or 46.0% of Pond Evap.
Snowmelt Distribution	April/May split defined for each year	
Winter Snowpack Losses =	80	mm (sublimation)
Average October Rainfall Runoff =	15%	of October Precipitation
Evaporation Sensitivity =	100%	

2) Process Parameters

	Total	
Initial Ore Throughput (tpd) =	2,400	3,200 tpd after 2011
Tailings Specific Gravity =	2.69	
Settled Tailings Density =	1.880	tonnes/m3 (assumed for Dry Stack)
Void water Losses =	16.02%	of weight of tailings in Dry Stack
	45.0%	loss if not filtered
Total Ore Reserve (x 106 t) =	6.13	million tonnes
No. Years Operations =	7	
Average Concentrate Percent Tonnage =	6.90%	of throughput (= loss from total tailings)
or,	165.6	tpd Conc. 9.0% moisture by weight

Other Water Losses & Usage

Assume	2.0	L/s to Exploration Drills (March to October)
	0.0	L/s Other
Moisture Losses to Ore =	3.0%	by weight
Moisture Losses to Waste Rock =	3.0%	by weight
Main Pond completed on =	01-Oct-06	
Mill started -	01-May-07	(50% of 1500 tpd capacity until July 2007)

3) Seepage Conditions

Total Seepage from Main Pond =	7.0	L/s (measured near W3)
Seepage Recovery percentage =	0%	Year 1, tc 90% Year 2 onwards
Pit Seepage Inflows =	0.2	L/s
Maximum Mill Pond Seepage =	0.5	L/s to Main Pond

4) Pond Volumes

	WSP	MILL	
Minimum Water Volume =	10,000	100	m3
Maximum Water Volume =	324,828	5,800	m3

(WSP = Water Storage Pond)

5) Annual Precipitation Probability (mm)

Return Period		Annual Precip. (mm) Revised	Previous
10 year	1	270	268
Average	2	343	341
Wet	10	420	420
Wet	50	474	478
Wet	100	495	500
Wet	200	515	521

6) Average Monthly Conditions (mm)

	Values Revised May 2011					Average Values Previously used				
Month	Average Precip.	Average Snowfall	Lake Evaporation	Actual EvapoTrans	Disturbed Losses	Average Precip.	Average Snowfall	Lake Evaporation	Actual EvapoTrans	Disturbed Losses
April	16.5	13.0	12.0	5.5	3.3	16.4	13.0	12.0	6.0	3.0
May	24.4	0.0	83.0	38.2	22.7	24.2	0.0	83.0	41.5	20.8
June	40.2	0.0	120.0	55.2	32.9	40.0	0.0	119.0	59.5	29.8
July	58.0	0.0	112.0	51.5	30.7	57.7	0.0	112.0	56.0	28.0
Aug	41.9	0.0	83.0	38.2	22.7	41.7	0.0	80.0	40.0	20.0
Sept	30.2	0.0	30.0	13.8	8.2	30.1	0.0	24.0	12.0	6.0
Oct	29.2	29.2	0.0	0.0	0.0	29.0	29.0	0.0	0.0	0.0
Nov	27.1	27.1	0	0.0	0	27.0	27.0	0	0.0	0
Dec	23.7	23.7	0	0.0	0	23.6	23.6	0	0.0	0
Jan	22.0	22.0	0	0.0	0	21.9	21.8	0	0.0	0
Feb	16.5	16.5	0	0.0	0	16.4	16.4	0	0.0	0
Mar	13.7	13.7	0	0.0	0	13.7	13.6	0	0.0	0
YEAR	343.2	145.2	440.0	202.4	120.6	342	144	430.0	215.0	107.5

7) Waste Dump Runoff

	Operations	Closure	
Infiltration =	70%	30%	April/May Snowmelt
	70%	30%	June to October
	(Infiltration = P - E/T)		
Void Losses =	80%	30%	of Infiltration

8) Pit Runoff

Pit Walls Runoff Coefficient = 0.8 (summer only)

MINTO MINE Project - CATCHMENT AREAS

YEAR	Water Year	Return Period	Tailings Generated (tonnes)	Mining Rates (1000 t/y) Ore	Waste	MILL Pond Areas (km2) A1-1+A1-2+A1-2+A3-1+A3-2 - W Dumps, IROD Total	Dist'd	Land	Pond	Water Storage Pond Areas (km2) A4-1, A4-2, A4-3, A4-4, A4-5 Total	Dist'd	Land	Pond
-1	2005/06	2	-	0	0	6.553	0.05	6.493	0.01	3.461	0.32	3.111	0.03
1	2006/07	2	403,922	434	434	6.553	0.05	6.493	0.01	3.46	0.32	3.111	0.03
2	2007/08	2	831,966	894	894	6.553	0.05	6.493	0.01	3.46	0.32	3.111	0.03
3	2008/09	2	1,026,781	1,103	1,103	5.441	0.19	5.241	0.01	3.421	0.748	2.643	0.03
4	2009/10	2	899,540	966	966	5.441	0.19	5.241	0.01	1.94	0.75	1.162	0.03
5	2010/11	2	1,087,408	1,168	1,168	5.441	0.19	5.241	0.01	1.94	0.75	1.162	0.03
6	2011/12	2	1,087,408	1,168	1,168	5.441	0.19	5.241	0.01	1.94	0.75	1.162	0.03
7	2012/13	2	1,087,408	1,168	1,168	5.441	0.19	5.241	0.01	1.94	0.75	1.162	0.03

YEAR	Pit Areas (km2) Area A2 Total	Walls	Land	Pond	Waste Dumps (km2) (within Mill Pond catchment) Total	Dist'd	Land	Pond	Ice Rich Overburden Dump (km2) (within Mill Pond catchment) Total	Dist'd	Land	Pond	Snowmelt Distribution April	May
-1	0.29	0.28	0.00	0.01	0.23	0.23	0.00	0.00	0.09	0.09	0.00	0.00	70%	30%
1	0.29	0.28	0.00	0.01	0.23	0.23	0.00	0.00	0.09	0.09	0.00	0.00	0%	100%
2	0.29	0.28	0.00	0.01	0.23	0.23	0.00	0.00	0.09	0.09	0.00	0.00	0%	100%
3	0.879	0.585	0.284	0.01	0.57	0.57	0.00	0.00	0.09	0.09	0.00	0.00	15%	85%
4	0.88	0.59	0.28	0.01	0.57	0.57	0.00	0.00	0.09	0.09	0.00	0.00	5%	95%
5	0.88	0.59	0.28	0.01	0.57	0.57	0.00	0.00	0.09	0.09	0.00	0.00	5%	95%
6	0.88	0.59	0.28	0.01	0.57	0.57	0.00	0.00	0.09	0.09	0.00	0.00	0%	100%
7	0.88	0.59	0.28	0.01	0.57	0.57	0.00	0.00	0.09	0.09	0.00	0.00	0%	100%

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Table MC8-2 - Minto Mine Project - Monthly Water Balance Update - Volumes (1000 m^3)

		Hydrologic Parameters						MILL Pond Inflows		Waste Dump Inflows			Overburden Dump Inflows			Open Pit Inflows & Losses					MILL Pond Losses & Outflows					Mill Pond	
Month & Year	Tailings (tonnes)	Return Period (years)	Total Precip mm	Pond Evap mm	Actual E'Trans mm	Dist'd Losses mm	Total Make-Up Required	Direct Rainfall	Snowmelt + Runoff	Surface Runoff	Seeps	Other Local Runoff	Surface Runoff	Seeps	Other Local Runoff	Direct Rainfall	Snowmelt + Runoff	Seepage Inflows	Evap Losses	To Ore & WR Moisture	Evap Losses	Lost Seepage	Net Inflow to Mill Pond	Reclaim to Mill	Spill	Total OUT	Mill Pond Volume
Sep-06																											0
Oct-06	0	2	0	-	0	-	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nov-06	0	2	0	-	-	-	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dec-06	0	2	0	-	-	-	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jan-07	0	2	0	-	-	-	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Feb-07	0	2	79.3	-	-	-	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mar-07	0	2	19.4	-	-	-	0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Apr-07	0	2	12.0	12	6	3	0	0.7	39	0.6	0.3	0.0	0.2	0.1	0.0	2.8	0.0	0.0	0.1	0.0	0.3	1.3	42.4	0.0	36.6	36.6	5.8
May-07	21,646	2	4.6	83	15	21	13.3	0.3	58	0.2	0.1	0.0	0.1	0.0	0.0	1.1	5.4	0.5	0.8	1.4	1.9	1.3	59.9	13.3	46.6	59.9	5.8
Jun-07	20,948	2	36.0	119	60	30	12.9	2.2	0	0.4	0.2	0.0	0.2	0.1	0.0	8.4	0.0	0.5	1.2	1.4	2.7	1.3	5.5	11.2	0.0	11.2	0.1
Jul-07	43,292	2	47.8	112	46	28	21.2	2.9	12	1.4	0.6	0.0	0.5	0.2	0.0	11.2	0.0	0.5	1.1	2.8	2.5	1.3	21.3	21.2	0.0	21.2	0.2
Aug-07	43,292	2	21.0	80	19.7	20	13.7	1.3	8	0.1	0.0	0.0	0.0	0.0	0.0	4.9	0.0	0.5	0.8	2.8	1.8	1.3	8.6	8.6	0.0	8.6	0.1
Sep-07	41,895	2	33.8	40	38	31	13.3	2.0	0	0.2	0.1	0.0	0.1	0.0	0.0	7.9	0.0	0.5	0.4	2.7	2.0	1.3	4.5	4.5	0.0	4.5	0.1
Oct-07	31,287	2	11.8	-	0	0	9.8	0.7	23	0.1	0.1	0.0	0.0	0.0	0.0	0.4	0.0	0.5	0.0	0.9	0.0	1.3	22.6	9.8	7.1	16.9	5.8
Nov-07	29,170	2	27.0	-	-	0	3.9	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.3	-1.3	3.9	0.0	3.9	0.6
Dec-07	33,268	2	23.6	-	-	0	4.2	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.5	-0.5	0.0	0.0	0.0	0.1
Jan-08	46,388	2	21.9	-	-	0	5.7	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Feb-08	42,150	2	2.7	-	-	0	5.5	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Mar-08	50,588	2	14	-	-	0	11.9	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Apr-08	52,105	2	16	12	11	3	11.9	1.0	35	0.9	0.4	0.0	0.4	0.2	0.0	3.8	0.0	0.5	0.1	3.4	0.3	1.3	37.5	11.9	19.9	31.8	5.8
May-08	68,533	2	9.4	83	13	9	14.8	0.6	100	1.3	0.6	0.0	0.5	0.2	0.0	2.2	5.4	0.5	0.8	4.4	1.3	1.3	103.1	14.8	88.3	103.1	5.8
Jun-08	70,574	2	26.2	119	25	18	15.1	1.6	8	0.6	0.3	0.0	0.2	0.1	0.0	6.1	0.0	0.5	1.2	4.5	2.1	1.3	8.0	13.7	0.0	13.7	0.1
Jul-08	68,954	2	53.4	112	56	28	14.6	3.2	0	1.8	0.8	0.0	0.7	0.3	0.0	12.5	0.0	0.5	1.1	4.4	2.5	1.3	10.4	10.4	0.0	10.4	0.1
Aug-08	70,684	2	100.6	90	79	25	15.9	6.0	140	5.2	2.4	0.0	2.0	1.0	0.0	23.5	0.0	0.5	0.9	4.6	2.2	1.3	172.1	15.9	150.5	166.4	5.8
Sep-08	73,974	2	21.8	24	14	4	15.9	1.3	51	1.2	0.6	0.0	0.5	0.2	0.0	5.1	0.0	0.5	0.2	4.8	0.4	1.3	53.3	15.9	37.5	53.3	5.8
Oct-08	61,305	2	9.4	-	3	0	13.8	0.6	6	0.1	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.5	0.0	0.9	0.0	1.3	5.7	11.4	0.0	11.4	0.1
Nov-08	74,922	2	27.0	-	-	0	9.7	0.0	12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.3	11.0	9.7	0.0	9.7	1.3
Dec-08	74,594	2	23.6	-	-	0	9.3	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.2	-1.2	0.0	0.0	0.0	0.1
Jan-09	67,001	2	34.2	-	-	0	8.9	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Feb-09	65,321	2	17.3	-	-	0	13.3	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Mar-09	83,999	2	40.7	-	-	0	16.9	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Apr-09	88,514	2	16.4	12	6	3	16.0	3.3	114	4.1	1.9	0.0	0.6	0.3	0.0	7.8	12.3	0.5	0.1	5.7	0.7	1.3	137.3	16.0	115.6	131.6	5.8
May-09	90,718	2	24.2	83	33	21	17.7	4.8	279	10.9	5.1	0.0	1.7	0.8	0.0	11.6	50.4	0.5	0.8	5.8	4.8	1.3	352.5	17.7	334.8	352.5	5.8
Jun-09	88,022	2	50.0	119	46	30	14.9	10.0	21	3.5	1.6	0.0	0.5	0.3	0.0	23.9	1.1	0.5	1.2	5.7	6.8	1.3	47.4	14.9	32.5	47.4	5.8
Jul-09	90,193	2	57.7	112	57	42	15.6	11.5	4	2.7	1.3	0.0	0.4	0.2	0.0	27.6	0.2	0.5	1.1	5.8	9.1	1.3	30.8	15.6	15.2	30.8	5.8
Aug-09	83,349	2	50.8	80	50	33	16.2	10.2	4	3.0	1.4	0.0	0.5	0.2	0.0	24.3	0.2	0.5	0.8	5.4	7.1	1.3	30.0	16.2	13.8	30.0	5.8
Sep-09	95,869	2	30.1	30	28	17	18.7	6.0	11	2.2	1.0	0.0	0.4	0.2	0.0	14.4	0.6	0.5	0.3	6.2	3.5	1.3	24.7	18.7	6.0	24.7	5.8
Oct-09	95,454	2	21.2	-	0	0	21.9	4.2	19	0.6	0.3	0.0	0.1	0.0	0.0	1.7	1.0	0.5	0.0	3.3	0.0	1.3	22.8	21.9	0.9	22.8	5.8
Nov-09	74,673	2	27	-	-	0	14.7	0.0	14.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.3	12.8	14.7	0.0	14.7	4.0
Dec-09	90,651	2	24	-	-	0	18.8	0.0	9.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.3	8.5	12.4	0.0	12.4	0.1
Jan-10	77,138	2	39.1	-	-	0	13.7	0.0	4.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.3	2.8	2.8	0.0	2.8	0.1
Feb-10	69,422	2	13.0	-	-	0	16.5	0.0	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.2	5.6	5.6	0.0	5.6	0.1
Mar-10	82,779	2	14	-	-	0	22.0	0.0	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.3	5.8	5.8	0.0	5.8	0.1
Apr-10	55,964	2	16	12	6	3	7.5	3.3	71	2.8	1.3	0.0	0.4	0.2	0.0	7.8	5.3	0.5	0.1	3.6	0.7	1.3	87.3	7.5	74.1	81.6	5.8
May-10	67,350	2	7.6	83	46	21	9.0	1.5	72	6.6	3.1	0.0	1.0	0.5	0.0	3.6	34.5	0.5	0.8	4.3	4.8	1.3	111.9	9.0	102.9	111.9	5.8
Jun-10	51,055	2	48.8	119	60	37	6.8	9.8	0	2.0	0.9	0.0	0.3	0.1	0.0	23.3	0.0	0.5	1.2	3.3	8.2	1.3	23.0	6.8	16.2	23.0	5.8
Jul-10	73,275	2	75.6	112	56	28	9.8	15.1	103	8.1	3.8	0.0	1.3	0.6	0.0	36.1	5.6	0.5	1.1	4.7	6.4	1.3	160.3	9.8	150.5	160.3	5.8
Aug-10	78,612	2	46.4	80	29	20	10.4	9.3	91	4.5	2.1	0.0	0.7	0.3	0.0	22.2	4.9	0.5	0.8	5.1	4.6	1.3	124.0	10.4	113.6	124.0	5.8
Sep-10	79,357	2	18.2	24	7	6	10.5	3.6	59	2.1	1.0	0.0	0.3	0.2	0.0	8.7	3.2	0.5	0.2	5.1	1.4	1.3	70.3	10.5	59.7	70.3	5.8
Oct-10	71,631	2	29	-	0	0	9.5	5.8	46	1.5	0.7	0.0	0.2	0.1	0.0	4.2	2.5	0.5	0.0	4.6	0.0	1.3	55.2	9.5	45.7	55.2	5.8
Nov-10	90,642	2	27	-	-	0	12.1	0.0	21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.3	19.9	12.1	7.8	19.9	5.8
Dec-10	83,767	2	24	-	-	0	11.2	0.0	15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.3	13.5	11.2	2.3	13.5	5.8
Jan-11	84,233	2	26.0	-	-	0	11.1	0.0	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.3	9.6	11.1	0.0	11.1	4.2
Feb-11	74,133	2	35.7	-	-	0	11.4	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.2	-1.2	2.9	0.0	2.9	0.1
Mar-11	89,521	2	14	-	-	0	12.4	0.0	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.3	9.4	9.4	0.0	9.4	0.1

VERSION 1.5

Table MC8-2 - Minto Mine Project - Monthly Water Balance Update - Volumes (1000 m^3)

		Hydrologic Parameters						MILL Pond Inflows		Waste Dump Inflows			Overburden Dump Inflows			Open Pit Inflows & Losses					MILL Pond Losses & Outflows					Mill Pond	
Month & Year	Tailings (tonnes)	Return Period (years)	Total Precip mm	Pond Evap mm	Actual E'Trans mm	Dist'd Losses mm	Total Make-Up Required	Direct Rainfall	Snowmelt + Runoff	Surface Runoff	Seeps	Other Local Runoff	Surface Runoff	Seeps	Other Local Runoff	Direct Rainfall	Snowmelt + Runoff	Seepage Inflows	Evap Losses	To Ore & WR Moisture	Evap Losses	Lost Seepage	Net Inflow to Mill Pond	Reclaim to Mill	Spill	Total OUT	Mill Pond Volume
Apr-11	92,595	2	16	12	6	3	11.9	3.3	78	2.8	1.3	0.0	0.4	0.2	0.0	7.9	6.0	0.5	0.1	6.0	0.7	1.3	92.0	11.9	74.4	86.3	5.8
May-11	92,355	2	24	83	38	23	17.8	4.9	267	11.0	5.1	0.0	1.7	0.8	0.0	11.6	51.4	0.5	0.8	6.0	5.2	1.3	341.0	17.8	323.2	341.0	5.8
Jun-11	89,376	2	40	120	55	33	17.2	8.0	0	1.2	0.6	0.0	0.2	0.1	0.0	19.2	0.0	0.5	1.2	5.8	7.4	1.3	14.2	17.2	0.0	17.2	2.7
Jul-11	92,355	2	58	112	52	31	17.8	11.6	34	4.7	2.2	0.0	0.7	0.3	0.0	27.7	1.8	0.5	1.1	6.0	7.0	1.3	68.2	17.8	47.4	65.2	5.8
Aug-11	92,355	2	42	83	38	23	17.8	8.4	19	3.3	1.5	0.0	0.5	0.2	0.0	20.0	1.0	0.5	0.8	6.0	5.2	1.3	41.6	17.8	23.8	41.6	5.8
Sep-11	89,376	2	30	30	14	8	17.2	6.0	86	3.8	1.8	0.0	0.6	0.3	0.0	14.4	4.7	0.5	0.3	5.8	1.9	1.3	108.8	17.2	91.6	108.8	5.8
Oct-11	92,355	2	29	-	0	0	17.8	5.8	23	0.7	0.3	0.0	0.1	0.1	0.0	2.1	1.2	0.5	0.0	3.9	0.0	1.3	28.7	17.8	10.9	28.7	5.8
Nov-11	89,376	2	27	-	-	0	12.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.3	-1.3	4.4	0.0	4.4	0.1
Dec-11	92,355	2	24	-	-	0	12.4	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Jan-12	92,355	2	22	-	-	0	12.4	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Feb-12	86,397	2	16	-	-	0	11.6	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Mar-12	92,355	2	14	-	-	0	17.8	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Apr-12	89,376	2	16	12	6	3	17.2	3.3	60	2.3	1.1	0.0	0.4	0.2	0.0	7.9	3.1	0.5	0.1	5.8	0.7	1.3	70.3	17.2	47.4	64.6	5.8
May-12	92,355	2	24	83	38	23	17.8	4.9	185	8.4	3.9	0.0	1.3	0.6	0.0	11.6	38.1	0.5	0.8	6.0	5.2	1.3	240.9	17.8	223.1	240.9	5.8
Jun-12	89,376	2	40	120	55	33	17.2	8.0	0	1.2	0.6	0.0	0.2	0.1	0.0	19.2	0.0	0.5	1.2	5.8	7.4	1.3	14.2	17.2	0.0	17.2	2.7
Jul-12	92,355	2	58	112	52	31	17.8	11.6	34	4.7	2.2	0.0	0.7	0.3	0.0	27.7	1.8	0.5	1.1	6.0	7.0	1.3	68.2	17.8	47.4	65.2	5.8
Aug-12	92,355	2	42	83	38	23	17.8	8.4	19	3.3	1.5	0.0	0.5	0.2	0.0	20.0	1.0	0.5	0.8	6.0	5.2	1.3	41.6	17.8	23.8	41.6	5.8
Sep-12	89,376	2	30	30	14	8	17.2	6.0	86	3.8	1.8	0.0	0.6	0.3	0.0	14.4	4.7	0.5	0.3	5.8	1.9	1.3	108.8	17.2	91.6	108.8	5.8
Oct-12	92,355	2	29	-	0	0	17.8	5.8	23	0.7	0.3	0.0	0.1	0.1	0.0	2.1	1.2	0.5	0.0	3.9	0.0	1.3	28.7	17.8	10.9	28.7	5.8
Nov-12	89,376	2	27	-	-	0	12.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.3	-1.3	4.4	0.0	4.4	0.1
Dec-12	92,355	2	24	-	-	0	12.4	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Jan-13	92,355	2	22	-	-	0	12.4	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Feb-13	83,418	2	16	-	-	0	11.2	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Mar-13	92,355	2	14	-	-	0	17.8	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Apr-13	89,376	2	16	12	6	3	17.2	3.3	60	2.3	1.1	0.0	0.4	0.2	0.0	7.9	3.1	0.5	0.1	5.8	0.7	1.3	70.3	17.2	47.4	64.6	5.8
May-13	92,355	2	24	83	38	23	17.8	4.9	185	8.4	3.9	0.0	1.3	0.6	0.0	11.6	38.1	0.5	0.8	6.0	5.2	1.3	240.9	17.8	223.1	240.9	5.8
Jun-13	89,376	2	40	120	55	33	17.2	8.0	0	1.2	0.6	0.0	0.2	0.1	0.0	19.2	0.0	0.5	1.2	5.8	7.4	1.3	14.2	17.2	0.0	17.2	2.7
Jul-13	92,355	2	58	112	52	31	17.8	11.6	34	4.7	2.2	0.0	0.7	0.3	0.0	27.7	1.8	0.5	1.1	6.0	7.0	1.3	68.2	17.8	47.4	65.2	5.8
Aug-13	92,355	2	42	83	38	23	17.8	8.4	19	3.3	1.5	0.0	0.5	0.2	0.0	20.0	1.0	0.5	0.8	6.0	5.2	1.3	41.6	17.8	23.8	41.6	5.8
Sep-13	89,376	2	30	30	14	8	17.2	6.0	86	3.8	1.8	0.0	0.6	0.3	0.0	14.4	4.7	0.5	0.3	5.8	1.9	1.3	108.8	17.2	91.6	108.8	5.8
Oct-13	92,355	2	29	-	0	0	17.8	5.8	23	0.7	0.3	0.0	0.1	0.1	0.0	2.1	1.2	0.5	0.0	3.9	0.0	1.3	28.7	17.8	10.9	28.7	5.8
Nov-13	89,376	2	27	-	-	0	12.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	1.3	-1.3	4.4	0.0	4.4	0.1
Dec-13	92,355	2	24	-	-	0	12.4	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Jan-14	92,355	2	22	-	-	0	12.4	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Feb-14	83,418	2	16	-	-	0	11.2	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Mar-14	92,355	2	14	-	-	0	17.8	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.1

Table MC8-2 - Minto Mine Project - Monthly Water Balance Update - Volumes (1000 m3)

(continued)

VERSION 1.5

actual pond elevations at month-end

Month & Year	Additional Pit Inflow/Outflows & Storage: Runoff To Pit Storage	Pumped TO (From) Pit	Calc Pit Water Volume	Actual Pit Water Volume	WS Pond Inflows: Direct Rainfall	Snowmelt + Runoff	Total in to WSP	WS Pond Losses & Outflows: Evap Losses	Net Lost Seepage	Reclaim to Mill	TOTAL OUT	Net INFLOW to WSP	Extra Make-up Required	Potential Water in Storage	Pumped From (TO) Pit	Spill or Release	Estimated Total Water in Storage	Estimated Pond Elevation (m)	Actual Pond Elevation (m)	Actual Pond Volume	Volume Difference	Comment
Sep-06																	0					
Oct-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
Nov-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
Dec-06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
Jan-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
Feb-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0					
Mar-07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	702.60	702.60	0.0		
Apr-07	0	0	0	0	4	21	63	1	0	0	1	62	0	62	0	0	61.6	708.64	707.95	47.2	-14.3	
May-07	0	0	0	0	2	30	80	9	0	0.0	9	71	0	132	0	0	132.5	711.31	711.31	132.4	0.0	E/T adjusted to balance pond volume
Jun-07	0	0	0	0	13	0	14	13	18.1	1.7	33	-19	0	113	0	0	113	710.67	710.82	117.8	4.4	
Jul-07	0	0	0	0	17	6	24	12	18.7	0.0	31	-7	0	106	0	0	106	710.41	710.37	104.9	-1.1	E/T adjusted
Aug-07	0	0	0	0	7	4	13	9	18.7	5.1	33	-20	**5.7**	86	0	0	92	709.89	709.84	90.5	-1.3	E/T adjusted
Sep-07	0	0	0	0	12	0	13	11	1.8	8.8	22	-9	**28.6**	83	0	0	112	710.61	710.66	113.1	1.3	E/T adjusted
Oct-07	0	0	0	0	4	11	24	0	1.9	0.0	2	22	0	133	0	0	133	711.34	711.44	136.4	2.9	
Nov-07	0	0	0	0	0	0	1	0	1.8	0.0	2	-1	0	133	0	0	133	711.33	711.50	138.3	5.3	est'd elev Nov 30
Dec-07	0	0	0	0	0	0	0	0	1.9	4.2	6	-6	0	127	0	0	127	711.14	711.37	134.3	6.9	est'd elev Dec 31
Jan-08	0	0	0	0	0	0	0	0	1.9	5.7	8	-8	0	120	0	0	120	710.89	710.75	115.8	-4.0	est'd elev Jan 31
Feb-08	0	0	0	0	0	0	0	0	1.8	5.5	7	-7	0	112	0	0	112	710.64	710.45	107.1	-5.3	est'd elev Feb 29
Mar-08	0	0	0	0	0	0	0	0	1.9	11.9	14	-14	0	99	0	0	99	710.15	710.23	101.0	2.3	est'd elev Mar 31
Apr-08	0	0	0	0	6	19	46	1	1.8	0.0	3	42	0	141	-	-	141	711.59	711.71	144.9	3.8	E/T adjusted
May-08	0	-	36.1	36.1	3	53	145	5	1.9	0.0	7	138	0	279	-	-	279	715.23	715.27	281.3	1.9	E/T adjusted
Jun-08	0	-	36.1	36.5	9	4	14	9	1.8	1.4	13	2	0	281	-	-	281	715.26	715.30	282.7	1.6	est'd Jun 30 elev
Jul-08	0	-	36.1	47.9	19	0	20	12	1.9	4.2	18	2	0	283	-	-	283	715.30	715.35	284.9	2.2	est'd July 31 elev
Aug-08	11.8	152.4	200.3	200.3	35	67	242	11	1.9	0.0	13	230	0	513	(152.4)	57.5	303	715.73	715.72	302.0	-0.6	Pump TO Pit FROM Pond and Spill & syphoned releas
Sep-08	0	(70.2)	130.1	130.1	8	24	71	2	1.8	0.0	4	67	0	369	70.2	305.2	135	711.38	711.42	135.8	1.3	Spill & syphoned release and pump
Oct-08	0	(130.1)	0.0	0.0	3	3	8	0	1.9	2.5	4	3	0	138	130.1	-	268	714.97	714.97	267.8	0.0	TO Pond FROM Pit (Sept 21 to Oct 14)
Nov-08	0	-	0.0	0.0	0	6	7	0	1.8	0.0	2	5	0	273	-	-	273	715.09	714.95	267.0	-6.2	
Dec-08	0	-	0.0	0.0	0	0	1	0	1.9	9.3	11	-10	0	263	-	-	263	714.86	714.84	262.2	-1.1	
Jan-09	0	-	0.0	0.0	0	0	0	0	1.9	8.9	11	-11	0	253	-	-	253	714.62	714.55	249.6	-2.9	
Feb-09	0	-	0.0	0.0	0	0	0	0	1.7	13.3	15	-15	0	238	-	-	238	714.26	714.20	235.1	-2.4	
Mar-09	0	-	6.1	6.1	0	0	0	0	1.9	16.9	19	-19	0	219	-	-	219	713.79	713.56	209.6	-9.2	
Apr-09	115.6	51.3	173.1	173.1	13	72	86	3	1.8	0.0	4	81	0	300	(51.3)	-	248.9	714.53	714.55	249.6	0.7	Divert AND Pump TO Pit FROM Pond
May-09	334.8	151.6	659.5	659.5	19	176	196	18	1.9	0.0	20	176	0	425	(151.6)	-	273	715.10	715.02	270.0	-3.4	Pump TO Pit FROM Pond
Jun-09	0	49.8	709.2	709.2	39	11	83	26	1.8	0.0	28	56	0	329	(49.8)	36.3	243	714.39	714.42	244.2	1.2	Pump TO Pit FROM Pond and Release from Pond
Jul-09	0	(56.2)	653.1	653.1	45	2	63	35	1.9	0.0	37	27	0	270	56.2	251.3	74	709.20	709.17	73.7	-0.7	Pump TO Pond FROM Pit and Release from Pond
Aug-09	0	(239.6)	413.5	413.5	40	2	57	27	1.9	0.0	29	28	0	102	239.6	224.7	117	710.80	710.74	115.5	-1.7	Pump TO Pond FROM Pit and Release from Pond
Sep-09	0	(359.4)	54.1	54.1	23	5	36	14	1.8	0.0	15	21	0	138	359.4	290.6	207	713.48	713.43	204.7	-1.9	Pump TO Pond FROM Pit and Release from Pond
Oct-09	0	(40.7)	13.3	13.3	16	9.5	28	0	1.9	0.0	2	26	0	233	40.7	168.3	105	710.39	710.42	106.3	0.8	Pump TO Pond FROM Pit and Release from Pond
Nov-09	0	-	13.3	13.3	0	7.1	8	0	1.8	0.0	2	7	0	112	-	-	112	710.62	710.67	113.4	1.3	added November baseflow
Dec-09	0	-	13.3	13.3	0	6.2	8	0	1.9	6.4	8	-1	0	111	-	-	111	710.60	710.61	111.7	0.3	added December baseflow
Jan-10	0	-	13.3	13.3	0	0	1	0	1.9	10.9	13	-11	0	100	-	-	100	710.19	710.18	99.6	-0.3	added Jan Groundwater Baseflow
Feb-10	0	-	13.3	13.3	0	0	1	0	1.7	10.9	13	-11	0	89	-	-	89	709.76	709.68	86.4	-2.2	added Feb Groundwater Baseflow
Mar-10	0	-	13.3	13.3	0	0	1	0	1.9	16.2	18	-17	0	72	-	-	71.8	709.09	709.10	72.0	0.1	added Mar Groundwater Baseflow
Apr-10	74.1	-	87.4	137.5	13	25	39	3	1.8	0.0	4	35	0	107	-	-	107	710.44	710.51	108.8	1.9	5% Snowmelt in April 2010
May-10	102.9	(53.0)	137.3	137.1	6	26	33	18	1.9	0.0	20	13	0	120	53.0	-	173	712.55	712.55	172.8	-0.1	pump from pit to WSP
Jun-10	0	(69.5)	67.8	67.7	38	0	55	31	6.1	0.0	37	18	0	191	69.5	-	261	714.80	714.81	260.9	0.4	pump from pit to WSP
Jul-10	0	116.0	183.8	183.6	59	23	233	24	23.4	0.0	48	186	0	446	(116.0)	69.4	261	714.81	714.78	259.6	-1.3	Water Treatment Plant started operating
Aug-10	0	(4.7)	179.1	178.9	36	20	171	17	14.5	0.0	32	139	0	400	4.7	146.0	259	714.77	714.78	259.6	0.6	WTP operating
Sep-10	0	(88.1)	91.0	90.9	14	13	88	5	13.1	0.0	18	70	0	329	88.1	180.1	237	714.24	714.23	236.3	-0.6	WTP operating
Oct-10	0	(76.8)	14.2	14.0	23	10	80	0	30.5	0.0	31	49	0	286	76.8	131.9	231	714.10	714.13	232.2	1.0	WTP operating
Nov-10	0	(4.3)	9.9	9.8	0	0	9	0	16.5	0.0	16	-7	0	224	4.3	2.4	226	713.97	713.99	226.5	0.8	WTP stopped Nov 2, added November baseflow
Dec-10	0	-	9.9	9.8	0	0	4	0	15.8	0.0	16	-12	0	214	-	-	214	713.66	713.71	215.5	1.9	added December baseflow
Jan-11	0	-	9.9	9.8	0	0	1	0	2.8	0.0	3	-2	0	212	-	-	212	713.62	713.65	213.1	1.0	added Jan Groundwater Baseflow
Feb-11	0	-	9.9	9.8	0	0	1	0	1.7	8.5	10	-9	0	203	-	-	203	713.39	713.21	196.5	-6.6	
Mar-11	0	20.0	29.9	29.8	0	2	4	0	1.4	3.0	4	-1	0	202	(20.0)	-	182	712.82	712.81	182.0	-0.4	added Mar Groundwater Baseflow

Table MC8-2 - Minto Mine Project - Monthly Water Balance Update - Volumes (1000 m3)

(continued)

VERSION 1.5

	Additional Pit Inflow/Outflows & Storage				WS Pond Inflows			WS Pond Losses & Outflows														
Month & Year	Runoff To Pit Storage	Pumped TO (From) Pit	Calc Pit Water Volume	Actual Pit Water Volume	Direct Rainfall	Snowmelt + Runoff	Total in to WSP	Evap Losses	Net Lost Seepage	Reclaim to Mill	TOTAL OUT	Net INFLOW to WSP	Extra Make-up Required	Potential Water in Storage	Pumped From (TO) Pit	Spill or Release	Estimated Total Water in Storage	Estimated Pond Elevation (m)	Actual Pond Elevation (m)	Actual Pond Volume	Volume Difference	Comment
Apr-11		131.6	161.5	161.4	13	28	116	3	1.8	0.0	5	112	0	294	(131.6)	-	162	712.24	712.175	160.1	-2.3	5% Snowmelt in April 2011
May-11		-			19	95	439	20	1.9	0.0	21	417	0	580	-	254.9	325	716.19				
Jun-11		-			31	0	33	28	1.8	0.0	30	3	0	327	-	2.5	325	716.19				**Recalibration revised May 2011**
Jul-11		-			45	8	101	26	1.9	0.0	28	73	0	398	-	73.2	325	716.19				**up to & including end of April 2011**
Aug-11		-			33	4	62	20	1.9	0.0	21	41	0	365	-	40.6	325	716.19				
Sep-11		-			23	19	135	7	1.8	0.0	9	127	0	451	-	126.6	325	716.19				
Oct-11		-			23	5	40	0	1.9	0.0	2	38	0	363	-	38.2	325	716.19				
Nov-11		-			0	0	1	0	1.8	7.6	9	-8	0	317	-	-	317	716.03				
Dec-11		-			0	0	0	0	1.9	12.4	14	-14	0	302	-	-	302	715.73				
Jan-12		-			0	0	0	0	1.9	12.4	14	-14	0	288	-	-	288	715.42				
Feb-12		-			0	0	0	0	1.8	11.6	13	-13	0	275	-	-	275	715.12				
Mar-12		-			0	0	0	0	1.9	17.8	20	-20	0	255	-	-	255	714.68				
Apr-12		-			13	21	83	3	1.8	0.0	5	78	0	333	-	8.3	325	716.19				
May-12		-			19	66	309	20	1.9	0.0	21	288	0	613	-	287.8	325	716.19				
Jun-12		-			31	0	33	28	1.8	0.0	30	3	0	327	-	2.5	325	716.19				
Jul-12		-			45	8	101	26	1.9	0.0	28	73	0	398	-	73.2	325	716.19				
Aug-12		-			33	4	62	20	1.9	0.0	21	41	0	365	-	40.6	325	716.19				
Sep-12		-			23	19	135	7	1.8	0.0	9	127	0	451	-	126.6	325	716.19				
Oct-12		-			23	5	40	0	1.9	0.0	2	38	0	363	-	38.2	325	716.19				
Nov-12		-			0	0	1	0	1.8	7.6	9	-8	0	317	-	-	317	716.03				
Dec-12		-			0	0	0	0	1.9	12.4	14	-14	0	302	-	-	302	715.73				
Jan-13		-			0	0	0	0	1.9	12.4	14	-14	0	288	-	-	288	715.42				
Feb-13		-			0	0	0	0	1.7	11.2	13	-13	0	275	-	-	275	715.13				
Mar-13		-			0	0	0	0	1.9	17.8	20	-20	0	255	-	-	255	714.69				
Apr-13		-			13	21	83	3	1.8	0.0	5	78	0	334	-	8.8	325	716.19				
May-13		-			19	66	309	20	1.9	0.0	21	288	0	613	-	287.8	325	716.19				
Jun-13		-			31	0	33	28	1.8	0.0	30	3	0	327	-	2.5	325	716.19				
Jul-13		-			45	8	101	26	1.9	0.0	28	73	0	398	-	73.2	325	716.19				
Aug-13		-			33	4	62	20	1.9	0.0	21	41	0	365	-	40.6	325	716.19				
Sep-13		-			23	19	135	7	1.8	0.0	9	127	0	451	-	126.6	325	716.19				
Oct-13		-			23	5	40	0	1.9	0.0	2	38	0	363	-	38.2	325	716.19				
Nov-13		-			0	0	1	0	1.8	7.6	9	-8	0	317	-	-	317	716.03				
Dec-13		-			0	0	0	0	1.9	12.4	14	-14	0	302	-	-	302	715.73				
Jan-14		-			0	0	0	0	1.9	12.4	14	-14	0	288	-	-	288	715.42				
Feb-14		-			0	0	0	0	1.7	11.2	13	-13	0	275	-	-	275	715.13				
Mar-14		-			0	0	0	0	1.9	17.8	20	-20	0	255	-	-	255	714.69				

Appendix B
Pre-feasibility Engineering Review of Minto Mine Tailings Deposition

By Knight Piesold Consulting

Knight Piésold
CONSULTING

File No.:VA101-365/3-A.01
Cont. No.:VA11-01315

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September 15, 2011

Mr. Ted Kenny
Lead Mechanical Engineer
Capstone Mining Corp.
900 - 999 West Hastings Street
Vancouver, BC V6C 2W2

Dear Ted,

Re: Pre-feasibility Engineering Review of Minto Mines Tailings Deposition

Knight Piésold Ltd. (KPL) was retained by Capstone Mining Corp. Minto Operation (CMO) to assist with the review of the planned slurry tailings disposal into the Main Pit at the Minto Mine in central Yukon Territory. Tailings deposition methods, the anticipated settled tailings densities and reclaim water recovery were discussed by CMO and KPL on two separate teleconference meetings held on August 24th, and September 1st of 2011. The following letter outlines the optimal tailings deposition method and the anticipated settled densities for the settled tailings slurry as requested by Capstone for the design of the pipeworks and slurry discharge system.

Tailings Density in Main Pit

A 2009 Prefeasibility Technical Report by SRK[1] indicated a tailings dry density in the range of 1.12 to 1.25 t/m³ may be achieved in the main pit. Subsequent laboratory testwork indicated that a tailings average dry density of approximately 1.3 t/m³ may be achieved under the anticipated sub-aqueous deposition conditions[2]. Slurry consolidation testwork, provided to CMO by EBA in August 2011, reported high tailings density values in the order of 1.6-1.7t/m³. However, the slurry consolidation testwork was completed on samples that were fully consolidated at normal stresses of 200 kPa. It is noted that the filling rate for in-pit disposal will be relatively high and that the tailings solids will be deposited sub-aqueously. These operating conditions will result in the accumulation of tailings solids that are not fully consolidated and will therefore achieve lower densities than indicated in the EBA testwork. Knight Piésold therefore suggested that the initial settled density of the tailings is more likely to be less than 1.3 t/m³ based on experience at other copper mines.

KPL experience

Knight Piésold has evaluated the settling and consolidation characteristics for numerous tailings impoundments throughout the world. A general rule of thumb is that unsegregated tailings from copper flotation processes can achieve higher densities and a relatively fully consolidated state if the rate of rise for the tailings mass is less than about 3 meters per year. The filling characteristics for in-pit tailings disposal are typically significantly higher than this, especially in the early months/years of operation when the bottom of the pit is filled.

The Kemess Mine in northern BC represents an example where in-pit disposal of tailings has recently occurred. Kemess Mine deposited tailings in the mined out West Pit by means of end-of-pipe discharge

[1] Minto Phase 1V, Pre-Feasibility Technical Report, SRK Consulting, December 15, 2009.
[2] Minto Phase V, Preliminary Feasibility Study Technical Report, SRK Consulting, March, 2011.

provided by the Kemess Mine was used to back calculate the in-situ average dry density of the deposited tailings. Both tailings slurry and waste rock have been disposed in the West pit at the Kemess Mine, so it was necessary to estimate the respective volumes of both the waste rock and tailings solids in back calculating the settled density of the in-pit tailings at Kemess.

With the available survey data, both before and after deposition, a volume was generated using AutoCAD Civil 3D software. The tailings tonnage and an estimate of the waste rock deposited in the open pit were provided by the mine. Assuming a dry density for the waste rock of approximately 1.8t/m^3, the tailings dry density was back calculated as 1.2 t/m^3.

Tailings accumulated in the pit with a relatively high rate of rise as the base of the pit filled. The on-going rate of rise progressively decreased over time due to the geometry of the pit. The early high rate of rise, along with the material characteristics, results in settled tailings solids that are only partially consolidated. The partially consolidated tailings solids have a high entrained moisture content and a correspondingly lower dry density than tailings that were deposited in the on-land facility where a lower rate of rise (and higher consolidation) were achieved.

The Kemess experience is not directly applicable to the proposed in-pit tailings disposal concept planned for the Minto Main pit as the filling rate and tailings material characteristics are different. In general, it is anticipated that the Minto tailings are slightly coarser and are expected to have better consolidation characteristics. However, the general rate of rise considerations and incomplete consolidation processes are expected to be similar and are unlikely to result in settled tailings densities in the same order as the Kemess example, but could be approximately 10 to 20% higher during the later months of operation at the Minto pit.

Comments and Recommendations

Multiple deposition options, including multiple spigots, sub-aerial deposition, etc., were discussed during the teleconference meetings. However, based on pit geometry and the associated high rate of rise of the slurry, the most feasible and effective deposition approach would be the single end-of-pipe discharge method. There would be no advantage to implementing simultaneous deposition from multiple spigots for the Minto in-pit tailings deposition; in fact this could become a major disadvantage during the cold winter months when icing of spigots and/or ice entrainment within the deposited tailings could become problematic. It is therefore recommended that a very simple single point deposition plan be implemented. The location of the single point discharge can be varied every few months in order to develop a relatively flatter tailings surface below water. The deposition locations should be integrated with the reclaim water strategy to minimize potential problems with return water clarity; the reclaim barge should be situated as far as possible from the discharge point to maximize solids settling prior to reclaim water recovery.

The initial settled density of the tailings solids is expected to be relatively low due to the very rapid rate of rise in the early months of operation and the resulting incomplete consolidation of the settled solids. Some improvement in the overall settled density would generally be anticipated over time as the rate of rise decreases and on-going self-weight consolidation occurs. It is possible to get a more accurate estimation of the expected settled density of the tailings by evaluating the rate of rise of the Minto tailings using a one-dimensional large-strain consolidation model. This modelling exercise would be of limited value at present, but could be considered after a year or two once the initial pit filling characteristics are measured and the initial settled density can be back calculated. This consolidation modelling exercise can be used to determine post closure consolidation settlements and can also be used to evaluate the applicability of remedial methods such as wick drains to improve the overall storage capacity for tailings solids.

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It is possible to enhance the ultimate settled tailings density by utilizing wick drains as they can be used to accelerate consolidation and improve tailings densification during the later stages of pit filling. A reference paper by Brouwer and Brown (1994) is attached and describes how this technique was first used to densify tailings by allowing pore water to be removed.

The recommended course of action is to adopt a very simple single point tailings deposition strategy for the initial tailings deposition program. Annual surveys of the tailings solids surface should be developed using simple sounding methods and the tailings dry density back calculated. It is anticipated that a settled dry density of approximately 1.2 t/m^3 is a reasonable target for initial pit filling, but it is expected that the ultimate tailings density can likely be increased to about 1.3 to 1.4 t/m^3 due to on-going or enhanced consolidation using wick drains should this be required to extend the life of in-pit tailings disposal in the Main pit.

Please feel free to contact the undersigned, should you have any questions or require additional assistance.

Yours truly,
KNIGHT PIESOLD LTD.

Signed:
Mihajlo Samoukovic, EIT
Staff Engineer

Reviewed:
Les Galbraith, P.Eng.
Senior Engineer

Approved:
Ken Brouwer, P.Eng.
Managing Director

Attachments:
Tailings Consolidation Using Wick Drains by K.J. Brouwer & B.S. Brown, 1994

Copy To: Les Galbraith

/ms

Tailings Consolidation Using Wick Drains

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Abstract: The degree of consolidation of a tailings deposit is a key consideration for reclamation, particularly when surface capping is required. Low-density mine tailings which continue to consolidate after closure will develop on-going differential settlement of the tailings surface and prolonged seepage after closure. Prediction of the consolidation rate, the magnitude of surface settlement and seepage flow rate after closure is facilitated by means of specialized laboratory testwork on tailings slimes, and detailed finite element consolidation modelling using variable consolidation parameters and actual basin filling characteristics. Consolidation of the tailings mass can be enhanced by installation of vertical wick drains during operations using a recently developed floating track mounted pontoon system. Installation of wicks during operations results in: enhanced recovery of process solutions, increased tailings density with corresponding improved storage characteristics, increased impoundment stability, reduced post-closure consolidation seepage, and shortened reclamation time period.

A case history for the Montana Tunnels Mine is presented to illustrate the application of wick drains to facilitate consolidation of active tailings impoundments.

Key Words: large strain consolidation, tailings, wick drains, reclamation

1. Introduction

Many tailings impoundments contain saturated tailings which are only partially consolidated during operations and at closure. Incomplete consolidation results in high pore pressures within confining embankments which incorporate tailings materials. These excess pore pressures may compromise the stability of the impoundment. In addition, on-going consolidation results as excess pore pressures dissipate and interstitial fluids are expelled from the tailings mass. The consolidation process results in gradual surface settlement of the impounded tailings and prolonged tailings seepage will continue, often for decades after the completion of mining operations. This can result in a major long-term environmental liability unless positive actions are initiated during operations and/or at closure.

The process of consolidation in an active tailings impoundment depends on the geometry of the tailings basin, the rate of rise of the tailings surface, the characteristics of the tailings solids and on the drainage path lengths. Consolidation times have been observed to be extremely long at some tailings ponds due to the low self-weight consolidation stresses, high compressibility of the slimes after sedimentation and the low permeability of the tailings mass. The magnitude of post-closure settlements for loose tailings slimes from hard rock mines can also be very large and may be over 35 percent of the initial slimes thickness.

Consolidation and pore pressure dissipation can be dramatically enhanced by means of wick drains [1]. Wick drains are typically comprised of a band of high transmissivity geosynthetic core material surrounded by geotextile. The bands are supplied in long rolls which are punched into the soil using a mandrel at predetermined spacings in order to enhance the drainage characteristics of fine-grained soils. This paper describes the application of wick drains and provides a case history of wick drains used to consolidate an active tailings impoundment.

3rd International Conference on Environmental Issues and Waste Management in Energy and Mineral Production, August, 1994. Perth, Australia

2. *Function and design of wick drains*

Wick drains provide high permeability drainage paths for removal of excess pore pressures from unconsolidated tailings. By enhancing consolidation during mine operations, wick drains can improve embankment stability and can improve the storage efficiency for a tailings impoundment by increasing the average density of the stored tailings. This improved stability and/or enhanced storage efficiency will translate into savings in on-going construction costs for staged development of embankments.

Consolidation of tailings deposits during operations also facilitates better recovery of process solutions and reduces on-going consolidation seepage from the tailings mass. The improved recovery of process solutions can result in significant economic benefits during operations, as the make-up water requirements are reduced and, in the case of cyanide gold tailings, increased gold recovery is possible. Post-closure benefits may also result for reduced consolidation settlement, and when lower long-term seepage results in a reduced environmental impact.

There are numerous factors which must be integrated into the design of a successful wick drain program, including:

- material parameters;
- the nature, distribution and rate of rise of tailings materials;
- the magnitude of excess pore pressures and boundary drainage conditions (i.e. underdrainage and/or lateral drainage) for the tailings mass;
- the time for consolidation and the degree of consolidation required in the tailings mass, which will determine the required wick drain spacing;
- the construction methods and equipment, which will depend on the access constraints and maximum depth of treatment;
- wick drain compatibility with fine tailings, to both allow drainage and prevent clogging (wick drains should also retain longitudinal flow capacity during buckling);
- cost/benefit analyses.

These various factors are discussed in terms of a case history at the Montana Tunnels Mine in the following sections.

3. *Project description*

To date, the authors have designed wick drain programs at three separate tailings impoundments. A large-scale wick drain program recently completed at the Montana Tunnels Mine in Montana, USA provides a useful case history to illustrate the benefits of wick drains installed in an active tailings impoundment.

The Montana Tunnels Mine is an open pit operation which involves processing gold, lead, zinc and silver ore at a rate of approximately 13,700 tonnes per day. The mine has been operating since 1987. Total mineable reserves from inception of mining have recently been expanded from 38 to 62 million tonnes.

The overall site layout is illustrated on Figure 1. Tailings from the mineral extraction process are discharged into a drained tailings impoundment with supernatant water decanted into a process water pond prior to recycling to the mill. Tailings are discharged at 32 to 35 percent solids from multiple spigots situated around the perimeter of the impoundment and along the embankment crest. The tailings segregate after deposition, with the coarser fraction forming relatively dense sandy beaches and the finer silt fraction forming an extensive deposit of very loose, unconsolidated slimes which extend over approximately 60 percent of the impoundment surface. Deposition of tailings from the embankment and the resulting segregation of the sand fraction has allowed staged construction of the fully-drained main embankment by modified centreline methods, as illustrated on Figure 2.

Modified centreline construction [2, 3, 4] is similar to conventional centreline construction except that the contact between compacted fill and the stored tailings slopes slightly upstream and there is no fill placed on the downstream face of the embankment. It is, however, different from upstream construction as the stability of the embankment is ensured by the relatively thicker wedge of compacted embankment fill and does not rely on the strength of the tailings mass. Therefore, the modified centreline embankment section is stable during seismic loading and when impounded tailings have liquefied.

The Montana Tunnels tailings impoundment includes a partial basin underdrain and a free-draining embankment section. These features function to decrease drainage path lengths and enhance consolidation of the stored tailings. The current reclamation concept is to obtain access to the final tailings surface as soon as possible after mine closure for placement of a cap rock layer and topsoil to return the tailings area to wildlife/livestock habitat and its original grazing potential.

Estimates of the tailings deposit density, together with pore pressure measurements within the tailings mass, have indicated that the tailings are not achieving a suitable degree of consolidation. This has been attributed to the very fine gradation of the tailings slimes and the relatively rapid rate of basin filling. The incomplete consolidation of the tailings slimes has resulted in a relatively low slimes dry density of about 1.0 tonnes per cubic metre (64 pounds per cubic foot). The coarse sandy fraction of the tailings has been deposited at an estimated average dry density of about

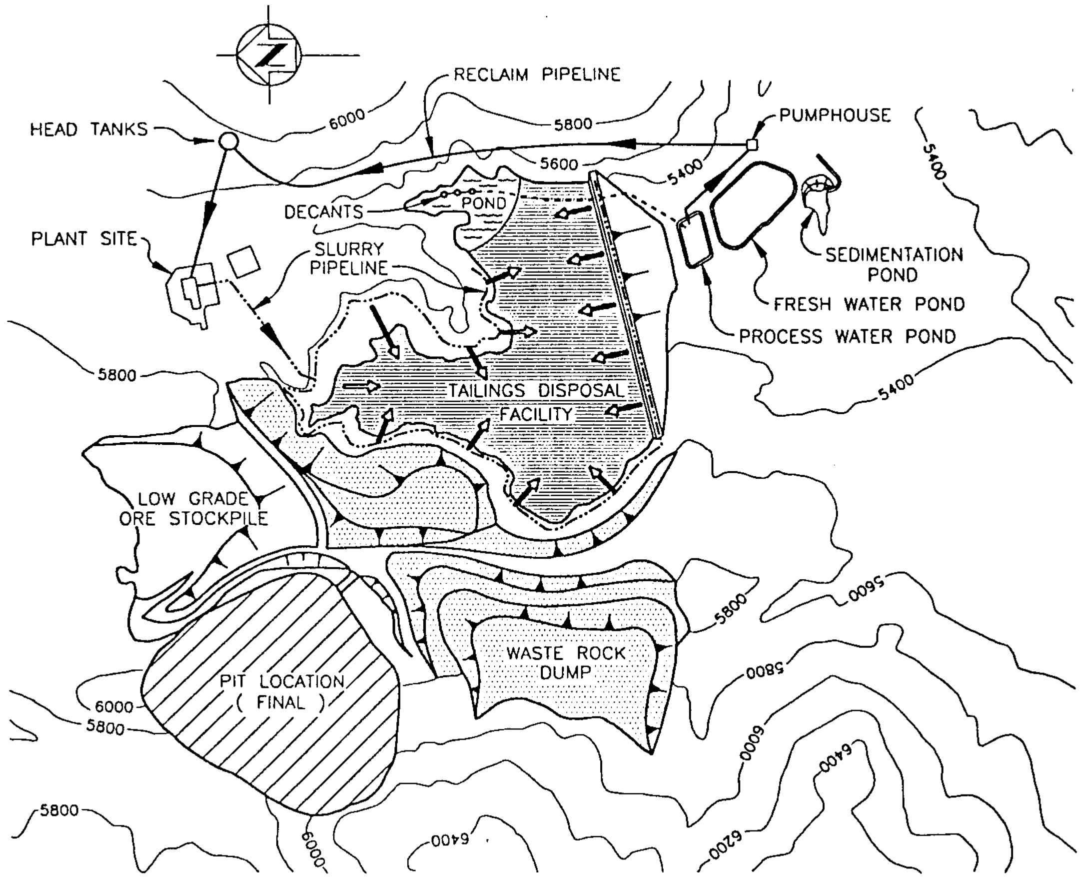


Figure 1 Layout of Montana Tunnels minesite

MATERIAL PLACING AND COMPACTION REQUIREMENTS		
MATERIAL TYPE	LOCATION	PLACING AND COMPACTION REQUIREMENTS
Diatreme	D1 Zone	Placed, moisture conditioned and spread in max. 12" layers after compaction. Vibratory compaction as directed by the Engineer.
Random Rockfill	D3 Zone	Placed and spread in maximum 36" layers after compaction. Vibratory compaction as directed by the Engineer.
Non acid generating rockfill	D4 Zone	Placed and spread in 36" layers after compaction. Vibratory compaction to 90% of maximum density.
Free Draining Rockfill	U2a Zone	Placed and spread in maximum 36" layers. Compaction as directed by the Engineer.
Unprocessed Colluvium	CF Zone	Placed and spread in 36" layers. Vibratory compaction as directed by the Engineer.
Coarse filter material	C1 Zone	Placed and spread in 36" layers after compaction. Vibratory compaction as directed by the Engineer.

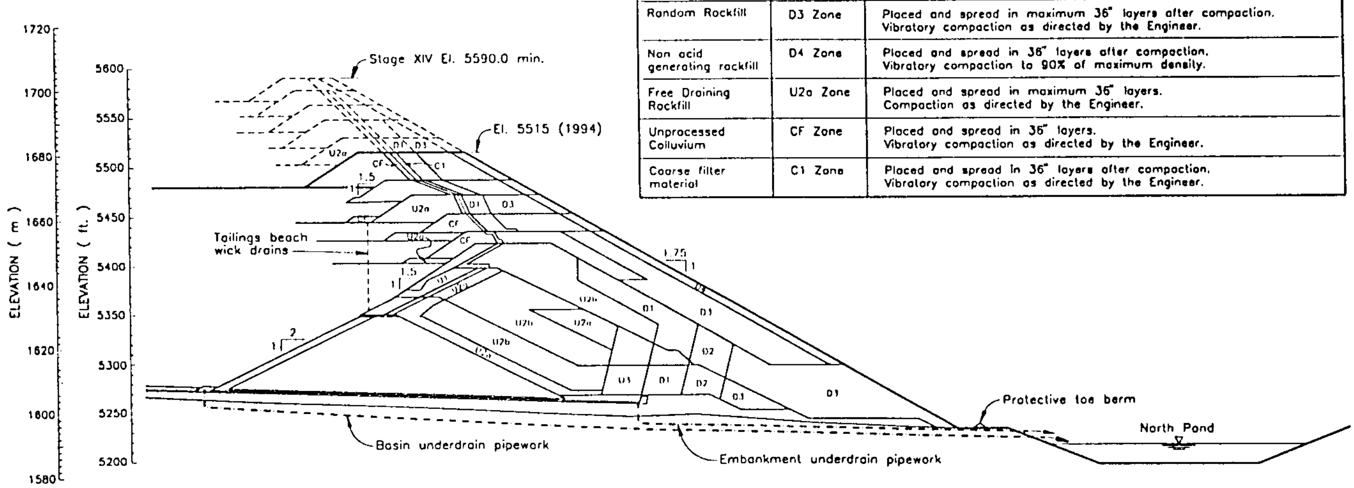


Figure 2 Free-draining modified centreline embankment cross-section

1.7 tonnes per cubic metre. The overall tailings dry density has been determined to be about 1.35 t/m^3, whereas a value of 1.44 t/m^3 was assumed for the original design. The lower tailings density results in additional storage capacity requirements. Also, since the mine has recently increased the total ore reserves by 24 million tonnes, a substantial expansion to the tailings facility is necessary to provide additional storage capacity.

A series of wick drain programs have been initiated at the tailings facility in order to densify the fine tailings, improve storage efficiency of the impoundment, and reduce post-closure reclamation requirements. The wick drains will also reduce pore pressures in the densified tailings materials, further enhancing the static and seismic stability of the impoundment.

The additional storage capacity needed for the expanded facility requires additional permit approval from regulatory agencies. Future permit approvals were uncertain because the agencies have had concerns about the practical ability to reclaim a relatively unconsolidated tailings mass in the center of the impoundment. The wick drain program was implemented to address these concerns and enhance relations with the agencies.

4. Design methods

The design process for the Montana Tunnels wick drain program followed the following general sequence:

(i) Field measurements were conducted to establish in-situ tailings properties and baseline pore pressures.
(ii) Laboratory testwork was completed on tailings samples.
(iii) Large-strain finite element modelling was used to predict tailings consolidation behaviour.
(iv) A field trial wick drain program was designed and implemented.
(v) The consolidation characteristics of the tailings were back-calculated from the trial program monitoring data.
(vi) The design was modified based on results of the trial.
(vii) The final wick drain program was implemented.

The characteristics of the Montana Tunnels tailings deposit have been routinely monitored during operations by means of detailed filling records and water balances which have been used to evaluate the overall stored density of the tailings mass.

Numerous vibrating wire piezometers have also been installed at various locations within the tailings mass. The piezometers have been routinely monitored on a weekly basis for durations of up to eight years. These pore pressure records provide a good indication of the magnitude of tailings pore pressures and degree of consolidation at various locations within the impoundment.

Specialized laboratory methods were used to define the consolidation characteristics of tailings slimes at low effective stresses. The laboratory test results included evaluation of void ratio versus confining stress (Figure 3), void ratio versus permeability (Figure 4) and void ratio versus coefficient of consolidation (Figure 5). The compatibility of different types of wick drains with the tailings slimes was evaluated concurrently. On the basis of this, Mebra 88 wicks were chosen for the Montana Tunnels program.

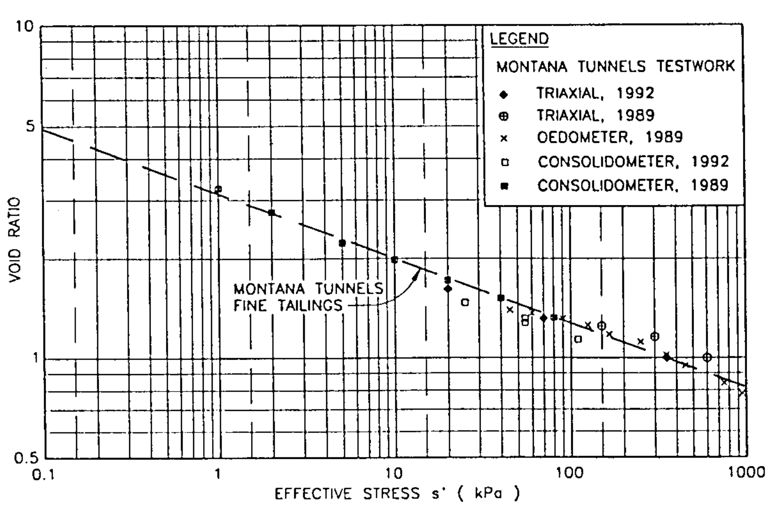


Figure 3 Void ratio vs confining stress

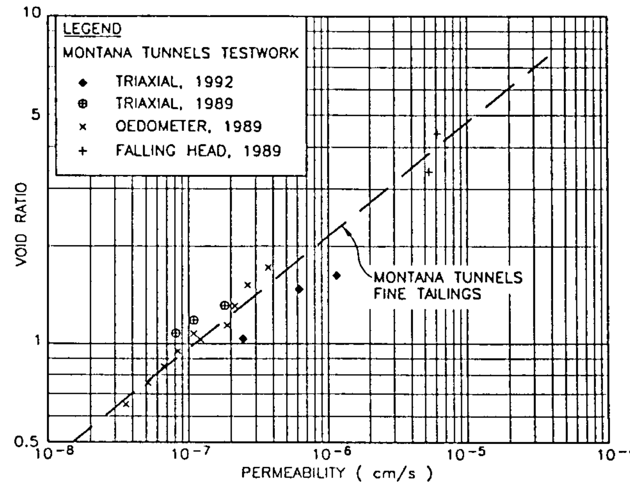


Figure 4 Void ratio vs permeability

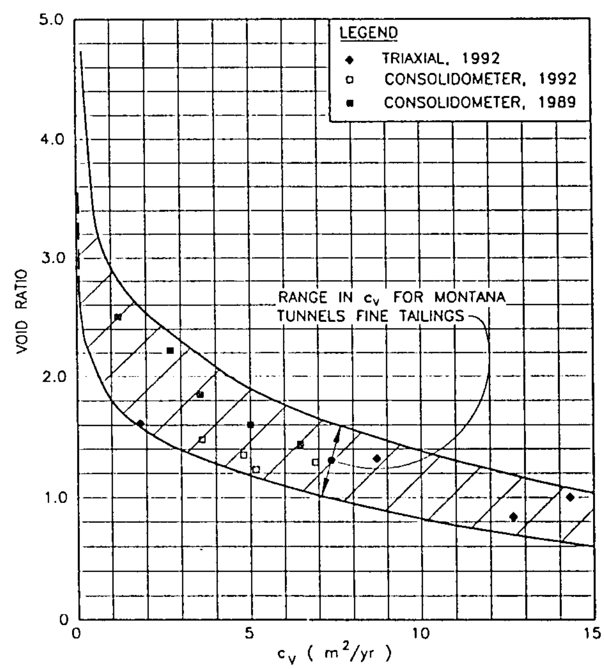


Figure 5 Void ratio vs coefficient of consolidation

The large-strain consolidation parameters were combined with the impoundment filling characteristics in a one-dimensional finite element computer model developed by Knight Piésold Ltd. A similar computer model for settling ponds is discussed by Yong *et al* [5]. The Knight Piésold Ltd. model incorporates large-strain consolidation analyses and the actual filling rate of the impoundment along with variable coefficients of consolidation. The model was used to predict the naturally-occurring one dimensional consolidation process and also incorporates a radial consolidation subroutine to predict the performance of wick drains. The flow chart for the computer model is included on Figure 6.

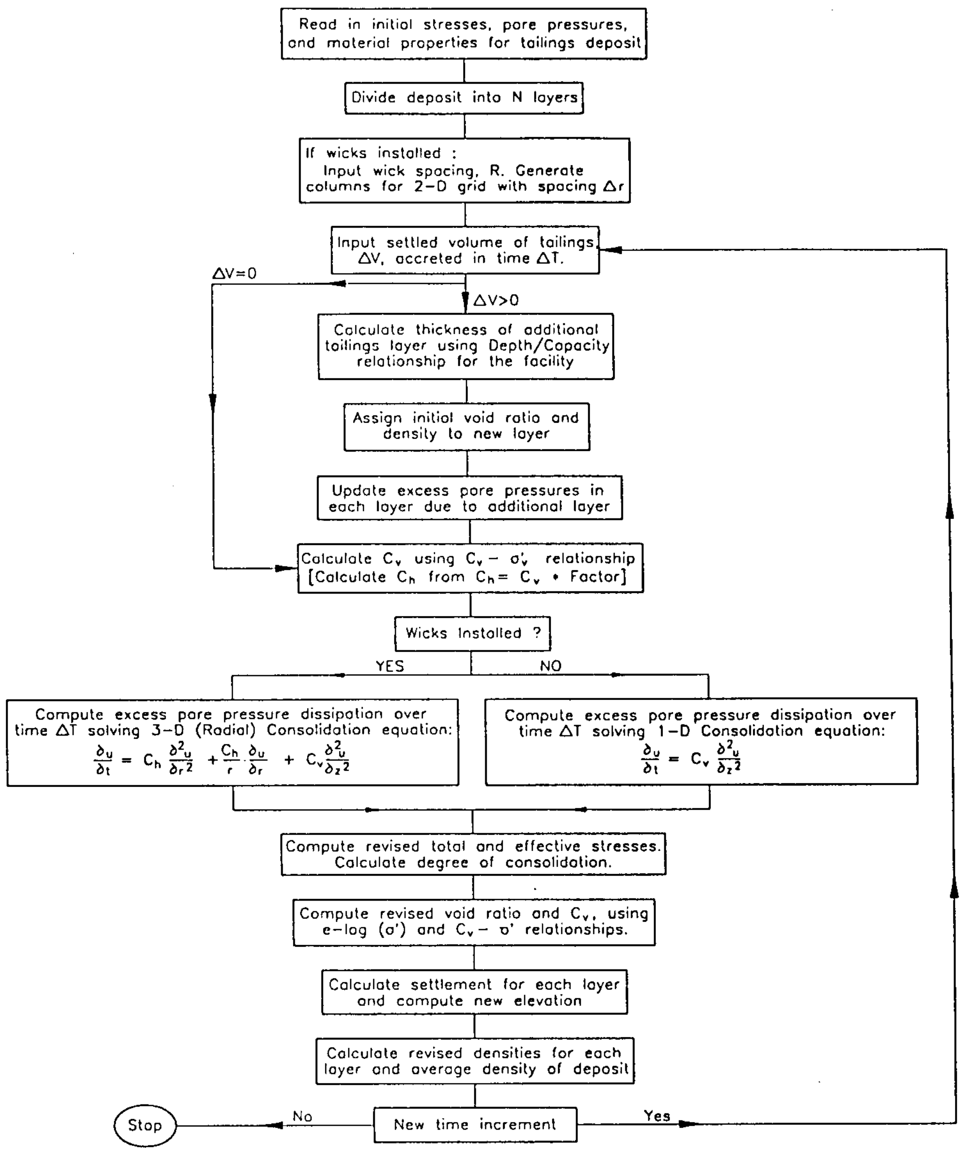


Figure 6 Finite element consolidation model

A wick drain trial program was recommended based on the results of laboratory testwork and finite element modelling. A wick drain spacing of 4.6 metres was selected to allow 90 percent consolidation to occur within a two-year period.

The trial wick program was conducted in the slimes deposit at the Montana Tunnels tailings facility during October to November in 1992. The program was carried out by Nilex Corporation who installed 94 wicks to depths of up to 29 metres in a triangular grid pattern.

Three settlement gauges were placed on the test plot for additional monitoring of the wick drain effectiveness. However, the gauges froze in the ice on the supernatant pond over the winter and no settlement readings were obtained. The settlement gauges have since been removed.

The effectiveness of the wick drains was verified by visual observations. As the wicks were installed, they filled immediately and were wicking significant volumes of clear water to the surface of the supernatant pond. Over the 1992/1993 winter, water flowing from the wicks was observed degrading the ice on the supernatant pond at the test plot area, resulting in surficial flows to the basin decants. Such flows had not been observed in the past.

Six vibrating wire piezometers were installed at various depths on two planes to monitor pore pressures in the wick drain test plot. Only two piezometers continued to operate after one month of monitoring because the large consolidation strains caused four of the leads to break. The piezometers which survived showed dramatic decreases in pore pressures over a period of about four months. An average *in-situ* horizontal coefficient of consolidation (c_h), determined by back-calculation of the piezometric responses, was determined to be 20 m²/yr. This is significantly higher than the values measured in the laboratory testwork, as shown on Figure 5.

The monitoring results for the trial program indicated that the wicks would be effective in increasing tailings density, which would improve the tailings impoundment storage efficiency and would also enhance final reclamation. In addition, a large-scale wick program would improve the static and seismic stability of the impoundment and thus enable the additional ore reserves to be accommodated by on-going modified centreline expansion of the tailings embankment. The trial monitoring program also allowed the design spacing of the wick drains to be increased from 4.6 metres to 6.1 metres for the large-scale wick program based on the higher values of c_h.

It is recognized however, that the large-scale wick drain program may only be effective in densifying tailings slimes over the depth interval of wick drain treatment. On-going tailings deposition will likely result in the accumulation of additional low-density tailings slimes above the zone of wick drain treatment. Two additional wick drain programs have been planned for implementation at the Montana Tunnels tailings facility in order to achieve their post-closure reclamation objectives, provided the current program is effective. The anticipated influence of the three proposed wick drain programs has been evaluated in the finite element model as shown on Figure 7.

The post-closure seepage rates for the tailings impoundment have also been determined from the large-strain consolidation model as shown on Figure 8. It is evident that enhanced tailings consolidation during operations is expected to result in a dramatic reduction in the magnitude and duration of post-closure seepage from the tailings impoundment.

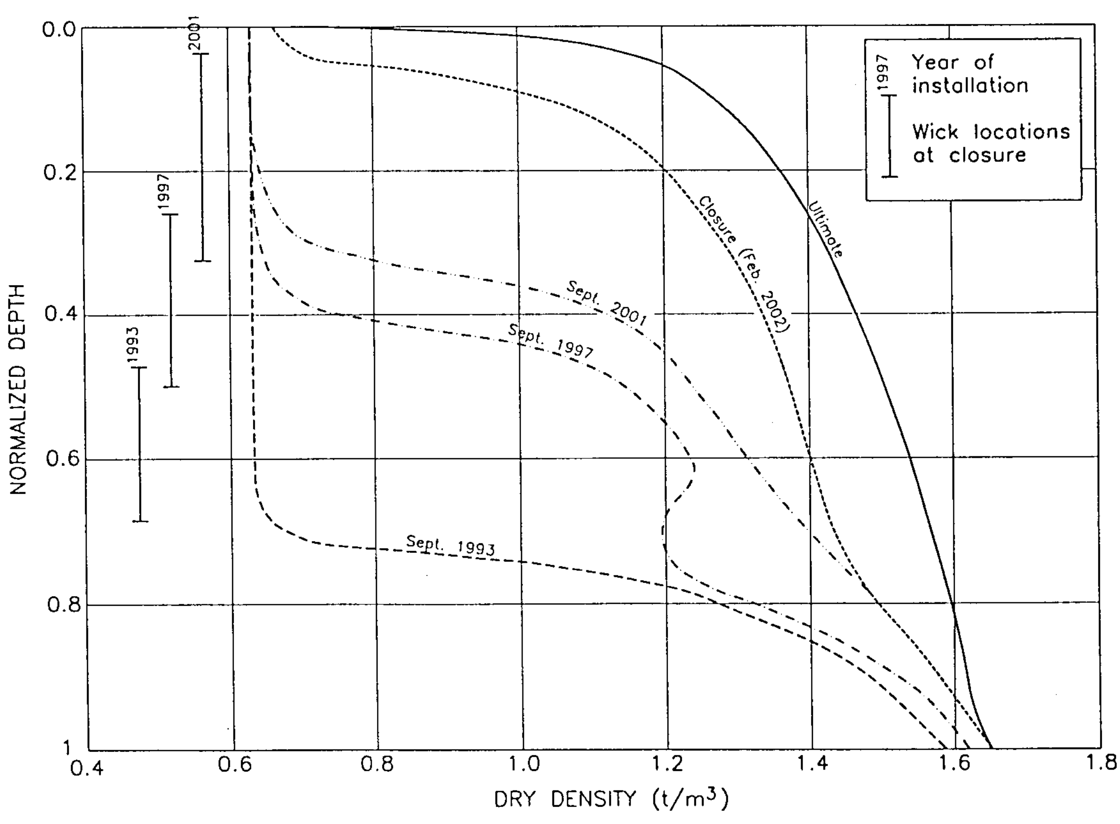


Figure 7 Projected slimes tailings density profiles due to wick installation

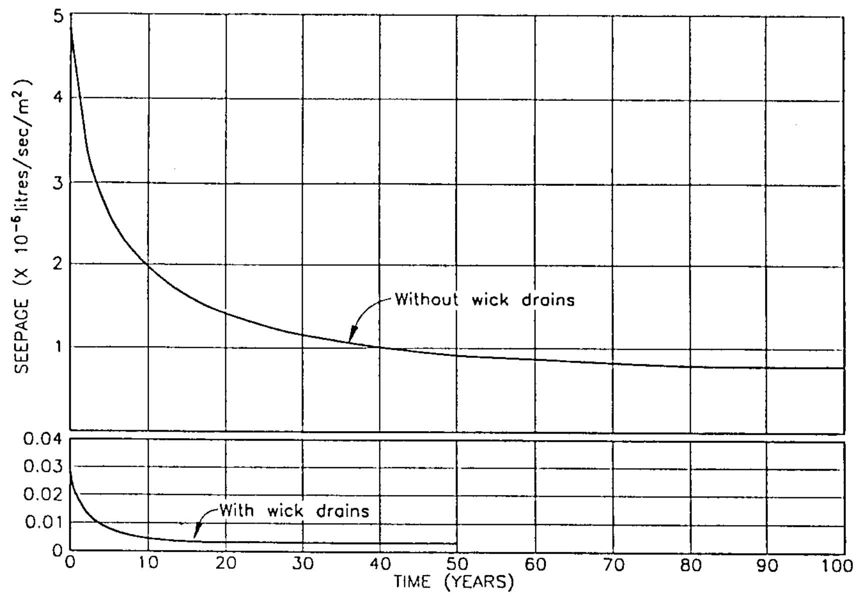


Figure 8 Influence of wick drains on post-closure seepage

5. Construction methods

Wick drain installation from a reasonably competent tailings surface is relatively straight forward provided that the surface is trafficable. Standard cranes or backhoes are often used when good access is available. The Montana Tunnels tailings deposit however, contains fine-grained slimes which are essentially heavy fluids. A specialized floating tracked pontoon barge system was developed in conjunction with Nilex Corporation to facilitate wick installations in these very soft, fluid materials. The barge system, known as a marsh buggy, was fitted with a 40 metre long cable-stayed mandrel guide and was capable of wick installation to depths of 43 metres. Nilex Corporation utilized a flat bottom skiff with an air-cooled outboard motor for transport of crew, equipment and supplies to and from the marsh buggy. In addition, a second smaller skiff was kept at the marsh buggy in case of emergency.

Montana Tunnels Mining Inc. leased a Geodimeter 4400 one man total station survey instrument in order to ensure that the wicks were placed at 6.1 metre centres in the proper locations. The mine provided an operator to guide the driver of the marsh buggy and to instruct the driver when to stop and install each wick.

The 1993 wick drain program was conducted over the period June 1 to August 13, 1993. The program lasted a total of fifty-six working days. There were seventeen non-working days, which included downtime due to windy weather or thunderstorms, mechanical difficulties and Sundays off. A total of 8,831 wicks were installed in the area illustrated on Figure 9 for a total lineal coverage of 224,880 metres. The average wick depth was 25.5 metres, including all waste and an additional stick-up of 1.8 metres per wick.

6. Monitoring

Monitoring systems are an important aspect of any geotechnical program. The monitoring program is particularly important for cost effective design of a wick drain system as field measurements often indicate that wick drain spacings can be increased. The overall cost of a wick drain program is related to the square of wick spacing. For example, the wick spacing at Montana Tunnels was increased from 4.6 metres in the trial program to 6.1 metres in the final program, with a corresponding cost reduction of over 40 percent.

Monitoring programs were also included in the final wick drain program to verify the tailings improvement process and to allow long-term benefits to be evaluated. The monitoring systems include

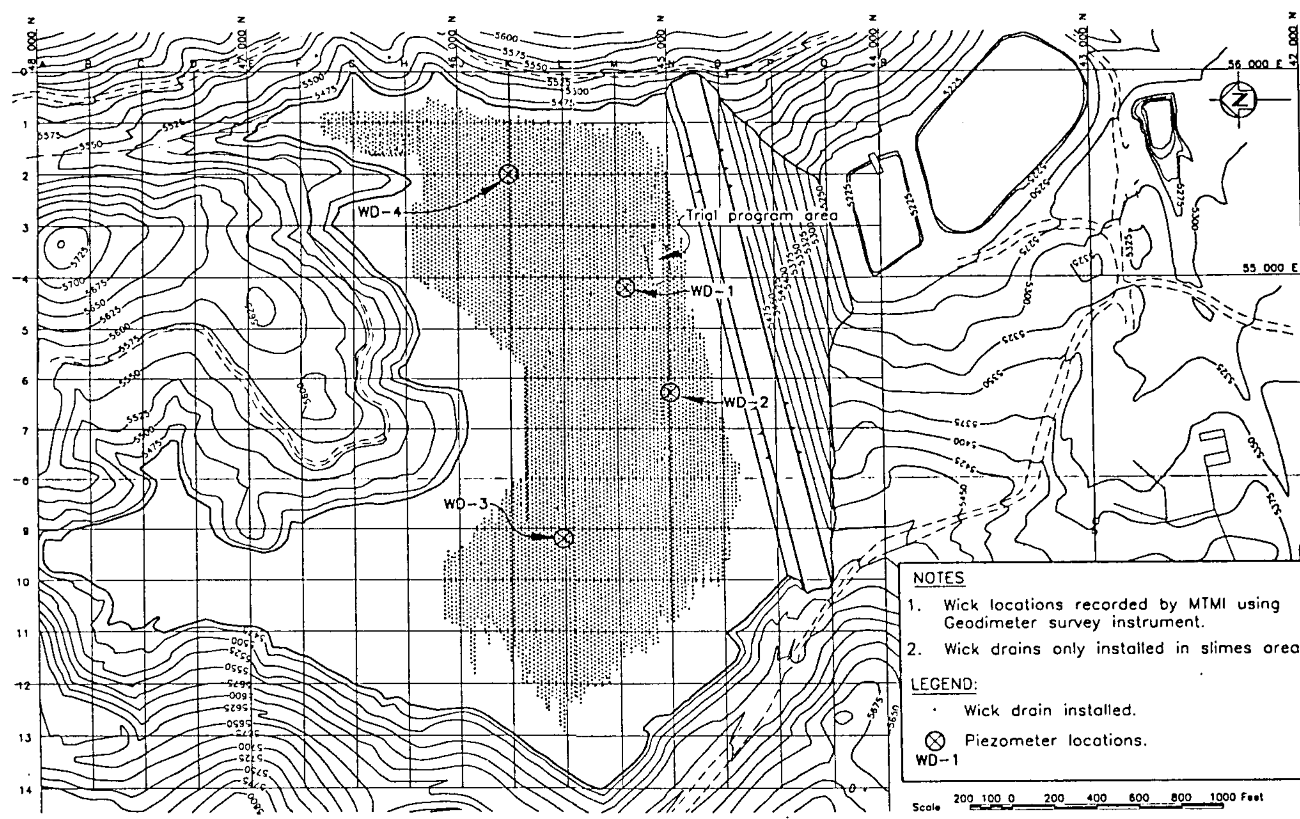


Figure 9 Tailings wick drain installation area

density sampling, electric vibrating wire piezometers, and detailed water balances for the tailings facility. Settlement gauges were installed in the trial program but were not effective and were not included in the final program. Cone penetration testing has been considered but has not been conducted in the slimes tailings to date.

Tailings Density Improvement

Density sampling was conducted from a small pontoon barge owned by the Montana Tunnels Mine. The barge is equipped with a hydraulic ram which enabled slimes samples to be collected at 3 metre depth increments using a special torpedo sampler designed and constructed at the mine. Shelby tube samples were also collected in denser more consolidated slimes tailings. In-situ dry densities (γ_d) were back-calculated for each of the disturbed tailings samples from the natural moisture content (MC) and specific gravity (SG) using the following soil identity formula:

$$\gamma_d \ (t/m^3) = \frac{SG}{(1 + (MC * SG/S_r))}$$

Where S_r is the degree of saturation (equal to 1.0 for saturated materials).

The tailings deposit was sampled on a 60 metre grid pattern prior to the installation of wick drains. The median-density profile is shown on Figure 10. The baseline sampling program indicated that the average dry density of the slimes tailings was 64 pcf. On-going sampling will be continued in 1995 and 1996 in order to evaluate the improvement in density of the tailings deposit due to the installation of wick drains. The overall tailings density improvement has also been evaluated from detailed milling records and the depth capacity relationship for the impoundment. The results are presented on Figure 11, which illustrates an improvement in the overall dry density from about 1.35 to 1.38 t/m^3 after installation of the wick drains over a period of about three months since the installation program was finished. The tailings

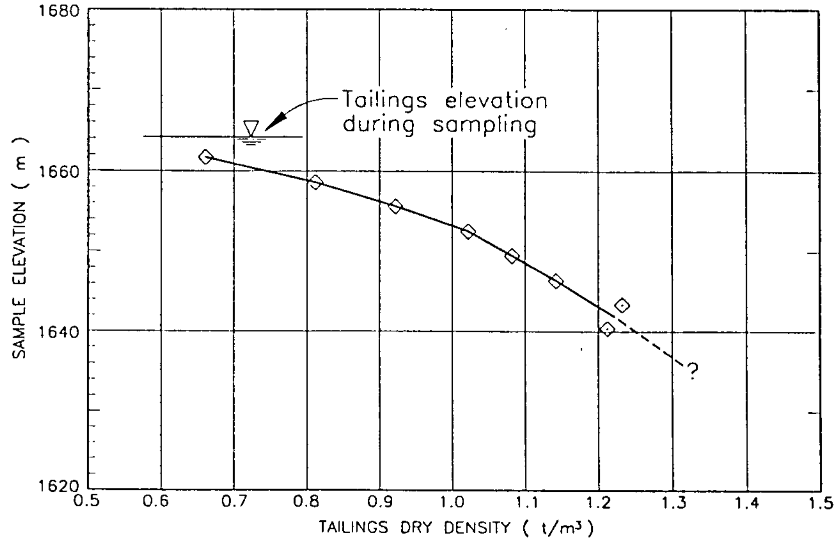


Figure 10 Median baseline tailings density profile

densities are expected to gradually increase until the benefits are no longer evident due to on-going accumulation of low-density slimes above the zone of wick drain treatment. The ultimate dry density of impounded tailings is predicted to reach about 1.5 t/m^3 at closure, after completion of one or two more wick drain programs.

Piezometer Records

Vibrating wire piezometers were installed at depths of about 10, 15 and 21 metres at each of four separate locations within the tailings slimes, as shown on Figure 9.

Special heavy-duty, steel-reinforced cables were specified, as standard piezometer leads used in the trial program had all broken due to the large consolidation strains. These cables have performed well to date. A typical pore pressure response for piezometer 02-PE2-54, situated at a depth of 21 metres at location WD2, is shown on Figure 12. Initially, very little pore pressure reduction was observed, even though the piezometers were installed about four weeks after the wick drains were placed and even though large volumes of water were visibly being expelled to the surface throughout the four week period.

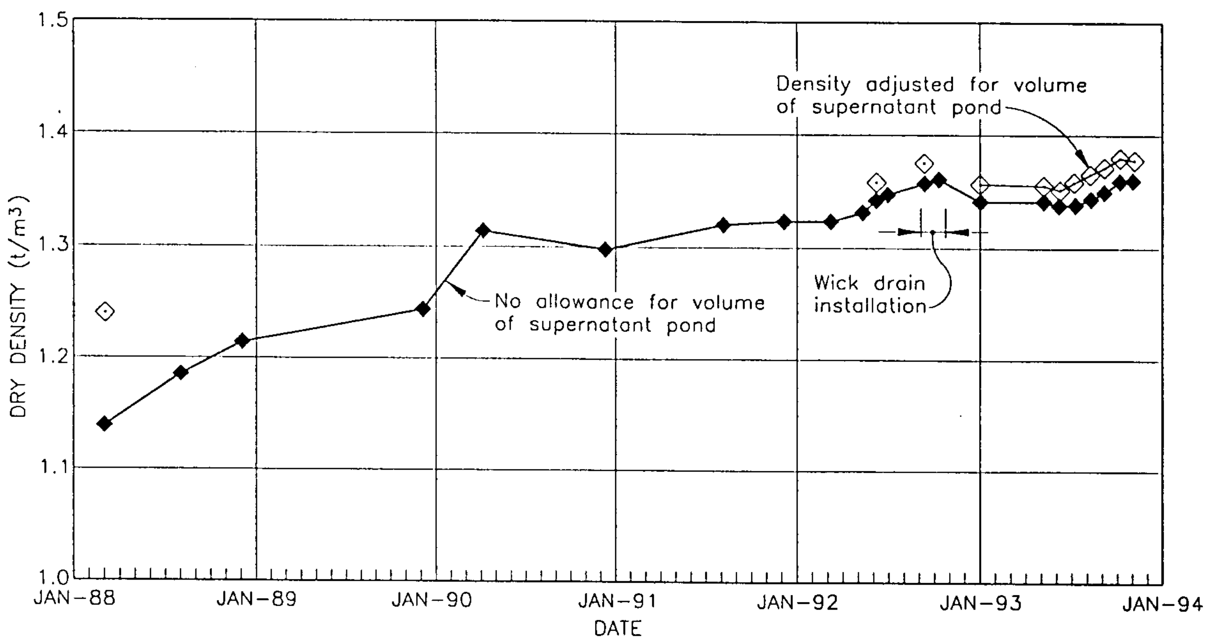


Figure 11 Average tailings density versus time

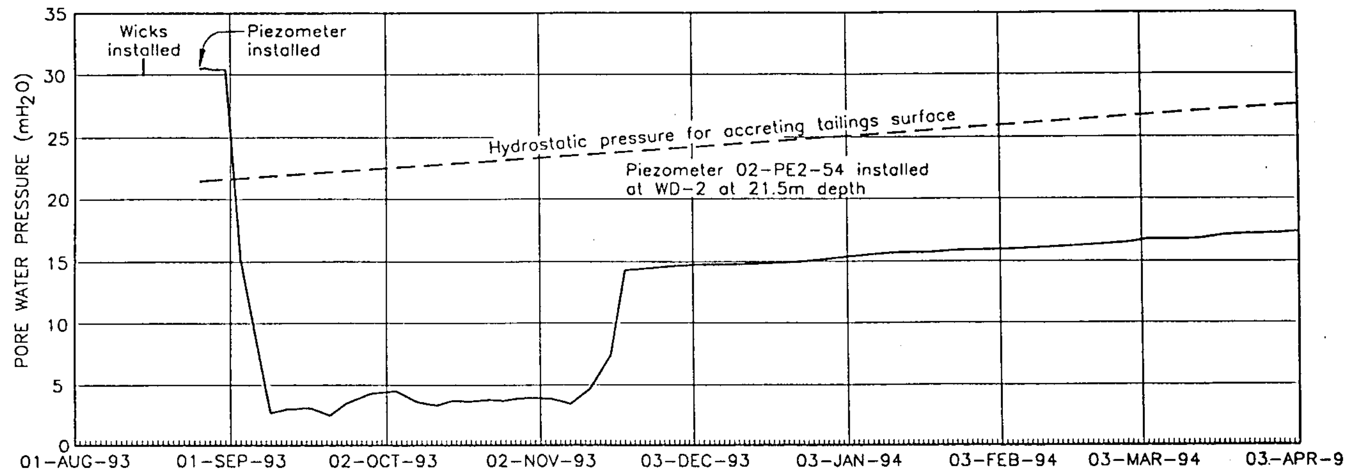


Figure 12 Typical piezometer record

This feature was also recognized during the trial wick program and occurs because of the very high initial compressibility of the tailings slimes. As shown on Figure 3, a substantial reduction in void ratio initially occurs for a very small increase in effective stress. Therefore, large volumes of water are expelled before a significant pore pressure reduction is detected in the piezometers.

On-going consolidation results in a dramatic pore pressure reduction, which is well below the hydrostatic pore pressure (21 metre head) originally expected. It is assumed that significant lateral drainage into the free-draining embankment face allowed the pore pressures to dissipate to these low levels. These lateral drainage paths appear to have been disrupted in mid-November 1993, when the pore pressures were observed to increase. The disrupted drainage paths may have resulted from the large consolidation strains in the tailings mass which could interrupt the lateral continuity of more permeable sandy layers and restrict lateral pore water migration into the embankment face. The increase in pore pressures may also be related to a combination of piezometer tip settlement and on-going deposition of tailings slimes above the zone of wick drain treatment.

On-going Monitoring Records

The most dramatic physical evidence of the wick drain performance was obtained by observing the water flowing out of the wicks shortly after installation. Some of the band-shaped wicks swelled up like fire hoses. Water was visibly being expelled to surface and resulted in local areas of cloudy water as fine loose surface tailings slimes were resuspended in the currents from the upwelling fluids. The onset of winter and freezing conditions provided further visual evidence as the ice cover was degraded above the wicks resulting in a dotted pattern on the ice.

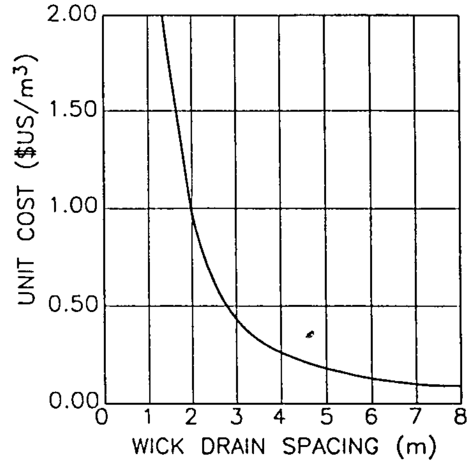
The project water balance was re-evaluated as it became evident that the make-up water requirements had been significantly reduced. It has been determined that the wick drains produced an average flow rate of about 500 US gpm (30 l/s) during the six-month monitoring period since the start of wick drain installation. The displaced volume of pore water corresponds to a calculated settlement of approximately 1.4 metres over the wick drain area. These settlements have also been observed to have caused some minor cracking along the sandy, less compressible, tailings beaches.

7. Costs

The overall costs for implementing a wick drain program depend on various considerations, but the most significant factors are the design of wick drain spacing and the size of the program. Figure 13 illustrates the influence of wick spacing on the unit cost and Figure 14 illustrates the potential economies of scale.

The cost for the wick drain program conducted in 1993 at the Montana Tunnels Mine was just under U.S. $1 million. The cost included contractor installation, wick drain material, geotechnical support, labour, materials, supplies, and miscellaneous small equipment purchases. Considerable experience was gained during the test program of 1992 that helped reduce costs of the larger program in 1993.

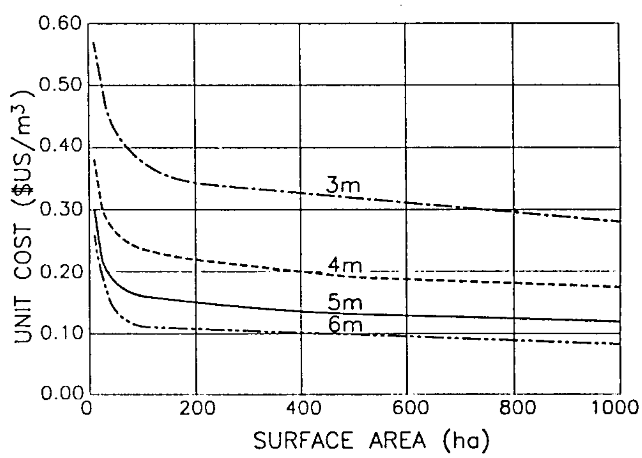
AVE WICK DEPTH	WICK SPACING	APPROXIMATE COST		
(m)	(m)	$/m3	$/hectare	$/acre
35	1	3.50	1,225,000	495,774
35	1.5	1.72	602,000	243,638
35	2	0.97	339,500	137,400
35	2.5	0.62	217,000	87,823
35	3	0.43	150,500	60,909
35	4	0.26	91,000	36,829
35	5	0.18	63,000	25,497
35	6	0.13	45,500	18,414
35	7	0.10	35,000	14,165
35	8	0.09	31,500	12,748



NOTES
1. COSTS ARE PRORATED FROM PROGRAM OF 50 HECTARES TO 35m DEPTH.
2. WICK SPACING DEPENDS ON TAILINGS PROPERTIES AND TIME FOR CONSOLIDATION.
2. ALL COSTS IN $US

Figure 13 Approximate wick drain costs

AREA (ha)	COST FOR WICK SPACINGS ($US/m³)			
	3m	4m	5m	6m
10	0.57	0.38	0.30	0.26
20	0.51	0.31	0.23	0.20
30	0.47	0.29	0.20	0.17
40	0.45	0.27	0.19	0.15
50	0.43	0.26	0.18	0.13
60	0.41	0.26	0.17	0.13
70	0.40	0.25	0.17	0.12
80	0.39	0.25	0.17	0.12
90	0.38	0.24	0.17	0.12
100	0.37	0.24	0.16	0.11
200	0.35	0.22	0.15	0.11
500	0.32	0.19	0.13	0.10
1000	0.28	0.18	0.12	0.08



NOTE
1. Costs assume average wick depth of 35m.

Figure 14 Approximate wick drain costs vs area of treatment

Installation techniques, equipment size and type may vary at different tailings disposal facilities. The variations are primarily a result of variances in the physical characteristics of the tailings material. The equipment used for installation is very specialized and may be unique for the specific application. The single most costly item of wick drain installation is this specialized equipment.

8. Conclusions

Wick drains are widely used by geotechnical engineers to enhance consolidation and dissipate excess pore pressures in fine-grained soils. To date, much of the experience with wick drains has been for improvement of naturally-occurring soils. The authors have been involved at three separate tailings storage facilities which have incorporated wick drains and consider that many other minesites may benefit from recent developments in wick drain technology.

The recent experience at the Montana Tunnels Mine indicates that wick drains can be installed during operations, in an active tailings deposit. Monitoring programs at this minesite are still at an early stage, but initial records indicate that approximately 500 USgpm (average of 0.06 gpm per wick drain) of pore water was being expelled to the surface over the first six months since wick installation started. Corresponding surface settlements of about 1.4 metres were estimated and significant pore pressure reduction has been measured in vibrating wire piezometers installed in the tailings mass. On-going monitoring will include detailed water balances, piezometric records and *in-situ* density measurements.

The positive benefits indicated by the monitoring conducted to date have resulted in a commitment by the Montana Tunnels Mine to include up to two additional wick programs in the future, with one program in three to four years and a final program at closure of the mine. The projected cost for these future programs is estimated to be about U.S. $1.2 million each. This proactive approach has enhanced relations with regulatory agencies. Their concerns over the actual ability to reclaim the tailings mass due to lack of consolidation have been addressed with positive results to date. This work has improved the ability of Montana Tunnels Mine to obtain future regulatory approval, including an increased capacity for tailings storage related to the expanded reserves.

Acknowledgements

The authors gratefully acknowledge the support and commitment of Pegasus Gold Corporation. In particular, the foresight demonstrated by Mr. Tom Weitz and Mr. John Fitzpatrick in recognizing the potential benefits of the wick drain program cannot be overestimated.

The authors would also like to thank Nilex Corporation for their enthusiastic response, their resourcefulness, professional attitude, and for the construction expertise they brought to the project. Messrs. Ken Embree and Graham Greenaway of Knight Piésold Ltd. also made major contributions to the design and implementation of the program.

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