



Revision 2018-01
Tailings Management Plan
Minto Mine, YT

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Minto Mine
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Minto Mine Tailings Management Plan

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REVISION INFORMATION

Rev. Number	Issue Date	Description of Revisions Made
-	January 2011	Updated for Phase IV mine plan.
-	June 2013	Updated for Phase V/VI mine plan.
1	June 2014	Revised storage capacities.
Supplement	February 2015	Updated tailings/water balance and mine schedule.
2017-01	February 2017	Main Pit tailings dam removed from the mine plan. In-situ tailings density revised based on measured density to date.
2018-01	January 2018	Updated for Phase VII mine plan.

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1 Introduction

The objectives of the Tailings Management Plan (TMP) are to summarize the quantities of mine tailings that require management under the remaining Phase IV, Phase V/VI, and Phase VII mining plans, and to outline Minto Mine's plan for managing the tailings.

Remaining mining included in the Phase IV, Phase V/VI and Phase VII mine plans consists of three separate pits as well as underground mining of multiple separate ore zones. Ore released will be processed using the same milling infrastructure used in previous phases of mining, at a processing rate not exceeding 4200 tonnes per day, based on a 12-month average.

Where relevant, supporting engineering designs and plans for management of water, waste rock, and overburden are referred to in the document.

2 Mine Plan and Facilities Overview

2.1 Mine Plan Overview

Minto Mine has been operating since 2007. Mining is currently taking place as part of the Phase IV and Phase V/VI mine plans, approved under QML-0001. The components of each mining phase are listed below.

- Phase IV
 - Area 2 Stage 1 and 2 open pit – completed in 2015
 - Area 118 pit – completed in 2014
 - Area 2 underground – underway
 - Area 118 underground – completed in 2016
- Phase V/VI
 - Area 2 Stage 3 open pit – underway
 - Minto North open pit – completed in 2016
 - Ridgetop North and South open pits
 - Minto East underground - underway
 - Copper Keel underground
- Phase VII
 - Minto East 2 underground
 - Minto North underground

2.2 Overview of Tailings Management Facilities

Facilities relevant to tailings management at Minto are briefly described below and shown in Figure 2-1.

- Mill - Located on the north side of the Minto Creek valley, east of Main Pit and west of the camp. The mill processes stockpiled and run-of-mine ore at a nominal rate of 4200 tonnes per day and produces slurry tailings that are discharged to either the Main Pit Tailings Management Facility or the Area 2 Pit Tailings Management Facility.
- Dry Stack Tailings Storage Facility (DSTSF) – Construction of the DSTSF with filtered tailings placement was carried out from 2007 to 2012. The facility is now closed and is managed under the DSTSF Operations, Maintenance and Surveillance (OMS) Manual (Minto, 2014a).
- Main Pit Tailings Management Facility (MPTMF) - Centered in the Minto Creek valley west of the mill area, the Main Pit was the first deposit mined at Minto, with mining operations ending in April 2011. The pit then transitioned to a tailings management facility, with slurry tailings deposition starting in November 2012. Operations of the facility are managed under the MPTMF Operations, Maintenance and Surveillance (OMS) Manual (Minto, 2015a).

- Area 2 Pit Tailings Management Facility (A2PTMF) - Located south of the mill area and southeast of Main Pit. Mining of the first stage started in April 2011. The second stage, Area 2 Stage 2 (A2S2) pushed back the walls and deepened the pit in 2014.

Underground mining of one of the Area 2 ore lenses, known as the M-Zone, via a portal in the base of the pit commenced following completion of A2S2. The pit then transitioned to a tailings management facility, with slurry tailings deposition starting in March 2015. Area 2 Stage 3 (A2S3), located to the southeast of A2S2, commenced in Q1 2017. A2S3 mines partially into the south wall of the A2S2 pit, forming a saddle between the two pits. As tailings continue to be deposited in A2S2, they will eventually flow over the saddle into A2S3 in Q2 2018, after which it will be managed as part of the A2PTMF.

Operations of the facility are managed under the A2PTMF Operations, Maintenance and Surveillance (OMS) Manual (Minto, 2015b).

- Ridgetop North and South Pits – Located to the south of Area 2 Stage 2 and 3 pits. Mining has not commenced. Once mining is completed, the Ridgetop North pit will become a tailings management facility.

Previous versions of the Tailings Management Plan included the construction of a dam on the east side of the Main Pit to increase storage capacity. Based on placed tailings densities achieved to date and the current mine plan, the dam is not required and has been excluded from this plan.



Figure 2-1: Existing and Planned Tailings Management and Surface Facilities

3 Tailings Storage Requirements

3.1 Tailings

Estimated ore release and tailings production through the remainder of Phase IV, Phase V/VI and Phase VII mining are presented in Table 3-1. Tailings production estimates are based on 96.3% mass pull to the tailings stream (average from 2012 to 2016), with the balance reporting to concentrate. The density of deposited tailings used in planning is 1.33 t/m³. Bathymetry surveys conducted in 2016 indicated densities of 1.33 t/m³ in the Area 2 Pit Tailings Management Facility and 1.35 t/m³ in Main Pit Tailings Management Facility. These densities are based on >5 Mt of placed tailings and are considered reliable for planning purposes.

Table 3-1: Estimated Ore Release and Tailings Storage Requirements as of December 1, 2017

Mining Area	Ore Release (Tonnes)	Tailings Mass (Tonnes)	Tailings Volume (m ³)
Area 2 Pit	730,000	700,000	530,000
Ridgetop North Pit	1,830,000	1,770,000	1,330,000
Ridgetop South Pit	280,000	270,000	200,000
Area 2 Underground	160,000	160,000	120,000
Minto East Underground	630,000	600,000	450,000
Copper Keel Underground	1,620,000	1,560,000	1,170,000
Minto East 2 Underground	1,000,000	960,000	720,000
Minto North Underground	260,000	250,000	190,000
Stockpiles	480,000	460,000	350,000
Total	6,980,000	6,730,000	5,060,000

3.2 NP:AP<3 Waste Rock

For planning purposes, 20% of all future waste rock mined is assumed to be NP:AP<3 requiring placement in saturated conditions. This is considered a conservative estimate; Area 2 Stages 1 and 2 historically produced between 13% and 17% NP:AP<3 waste rock, based on blasthole samples.

An additional 741,000 BCM of NP:AP<3 rock has also been included to account for material currently on the Main Pit south wall buttress, which may be relocated as part of closure activities.

For each mining area, the estimated total waste rock and NP:AP<3 waste rock release are presented in Table 3-2. Storage requirements are based on bank cubic meters (BCM); swell factor is not applied as pore space will be filled with water and/or tailings once the rock is placed in a tailings management facility.

Table 3-2: Estimated NP:AP<3 Waste Rock Storage Requirements as of December 1, 2017

Mining Area	Total Waste Rock Volume (BCM)	NP:AP<3 Waste Rock Volume (BCM)
Area 2 Pit	770,000	154,000
Ridgetop North Pit	2,628,000	526,000
Ridgetop South Pit	482,000	96,000
Area 2 Underground	-	-
Minto East Underground	13,000	13,000 *
Copper Keel Underground	47,000	47,000 *
Minto East 2 Underground	49,000	49,000 *
Minto North Underground	13,000	13,000 *
NP:AP<3 on Main Pit South Wall Buttress	741,000	741,000
Total NP:AP<3 Storage Requirement	4,743,000	1,639,000

* Due to the operational difficulty of segregating waste underground, all rock produced by underground mining is assumed to have NP:AP<3 for planning purposes.

3.3 Water

Plans for water management during operations are detailed in the Water Management Plan (WMP) (Minto 2018a). A surge capacity of 1M m³ must be available as of October 31st of each year, as per Water Licence QZ14-031.

Process water for milling operations is drawn from the MPTMF; supernatant water from the other tailings management facilities will be pumped back to the MPTMF. Minto will aim to store approximately 600,000 m³ on site to ensure that the mill has a reliable source of process water. If necessary, water from unimpacted catchments, such as that collected at W35, will be routed to the MPTMF. Estimates and methodology for runoff, water conveyance, and water treatment are discussed in the WMP.

3.4 Total Storage Requirements

Table 3-3 summarizes the total tailings management facility storage requirements, including tailings, water and NP:AP<3 waste rock.

Table 3-3: Life-of-Mine Tailings Management Facility Storage Requirements, as of November 1, 2017.

Component	Required Storage Volume (m ³)
Tailings	5,060,000
NP:AP<3 Waste Rock	1,639,000
Surge Capacity	1,000,000
Total Volume Required	7,699,000

4 Tailings Storage Capacity

Two pits at Minto Mine currently receive tailings: the Main Pit Tailings Management Facility (MPTMF) and the Area 2 Pit Tailings Management Facility (A2PTMF). As part of Phase V/VI mining, the Ridgetop North Pit will be added as a tailings management facility once mining is complete. No tailings will be deposited on the Dry Stack Tailings Storage Facility. The following sections describe the facilities and their storage capacities.

4.1 Main Pit Tailings Management Facility

The MPTMF holds 3.35 Mt of tailings deposited from November 2012 to July 2015. A bathymetry survey conducted in October 2016 showed a deposited dry tailings density of 1.35 t/m³. As of that survey, the remaining storage capacity of the MPTMF up to 786 masl is 920,000 m³. No tailings have been deposited in MPTMF since the survey was completed. A graph showing remaining storage capacity as a function of elevation is shown in Figure 4-1.

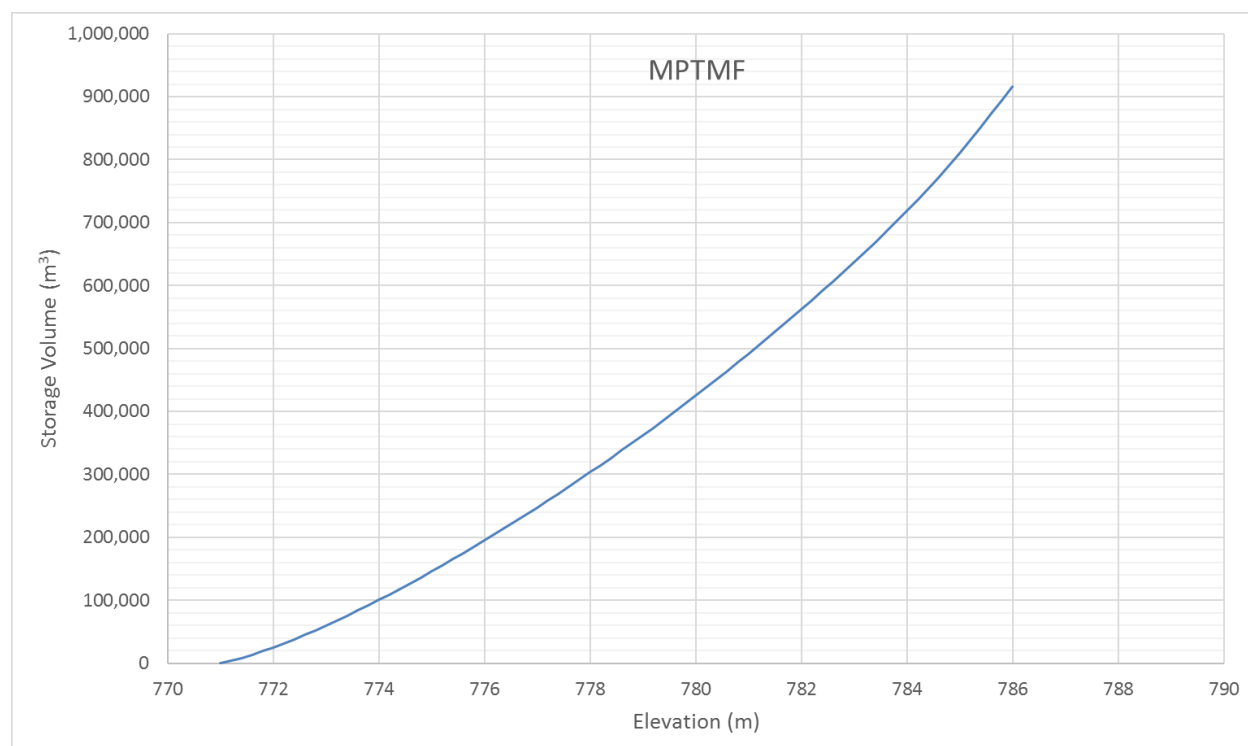


Figure 4-1: Main Pit Tailings Management Facility Storage Capacity Curve

Details on closure plans for the facility are contained in the Reclamation and Closure Plan.

4.2 Area 2 Pit Tailings Management Facility

Tailings have been deposited in the A2PTMF since March 2015. As of December 1, 2017 it holds 3.64 Mt of tailings. A bathymetry survey conducted in October 2016 showed a deposited dry tailings density of

1.33 t/m³. As of that survey, the remaining storage capacity of the A2PTMF, up to 799 masl, is 6.1 Mm³. A graph showing remaining storage capacity as a function of elevation is shown in Figure 4-2.

The final A2PTMF will consist of two intersecting pits, Area 2 Stage 2 and Area 2 Stage 3, separated by a saddle at approximate elevation 775 masl. The increase in capacity at the 775 masl represents the transfer of tailings across the saddle from Area 2 Stage 2 into the Area 2 Stage 3 pit. The total storage capacity is calculated up to the original ground spill point of 799 masl on the east rim of the Area 2 Stage 2 pit.

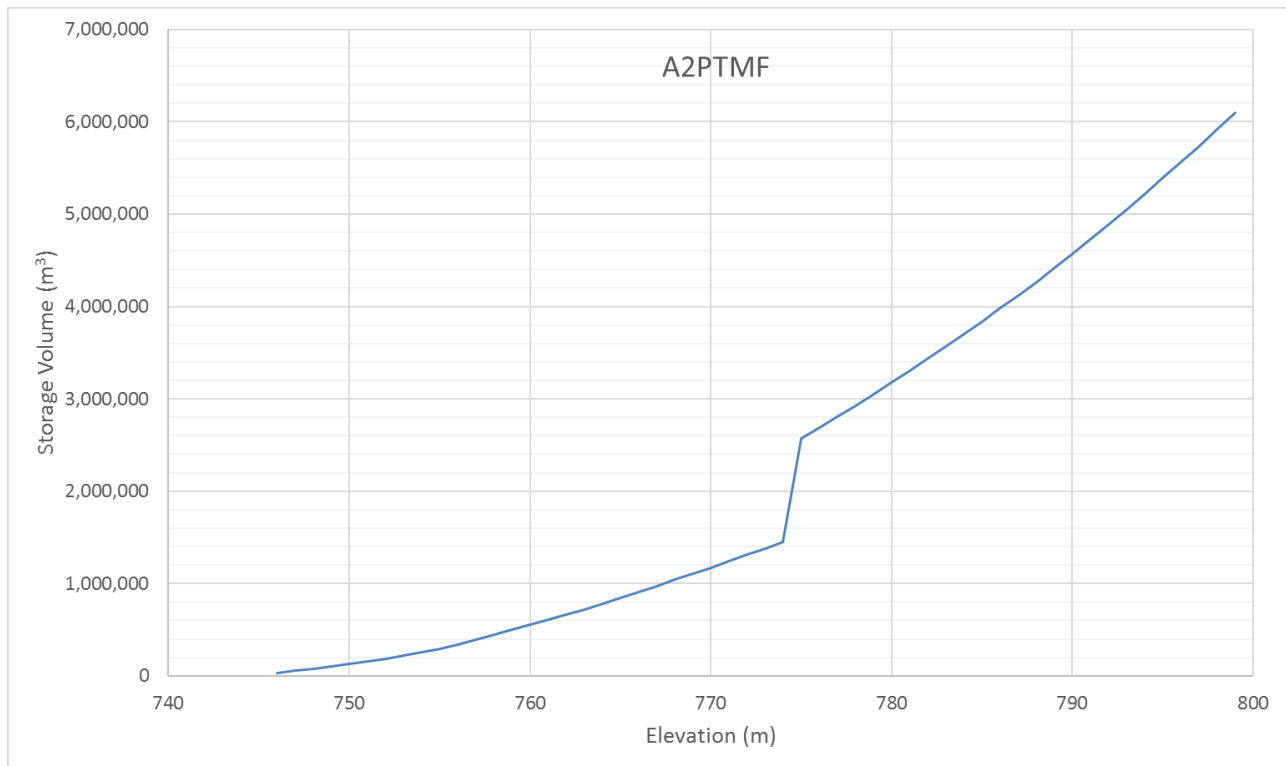


Figure 4-2: Area 2 Pit Tailings Management Facility Storage Capacity Curve

Details on closure plans for the facility are contained in the Reclamation and Closure Plan.

4.3 Ridgetop North Pit Tailings Management Facility

Upon the completion of mining, the Ridgetop North Pit will be transitioned to a tailings management facility. The total storage capacity was calculated up to the spill elevation of 862 masl. The total storage volume is 1.9M m³. The storage curve, showing capacity at each elevation, is shown in Figure 4-3.

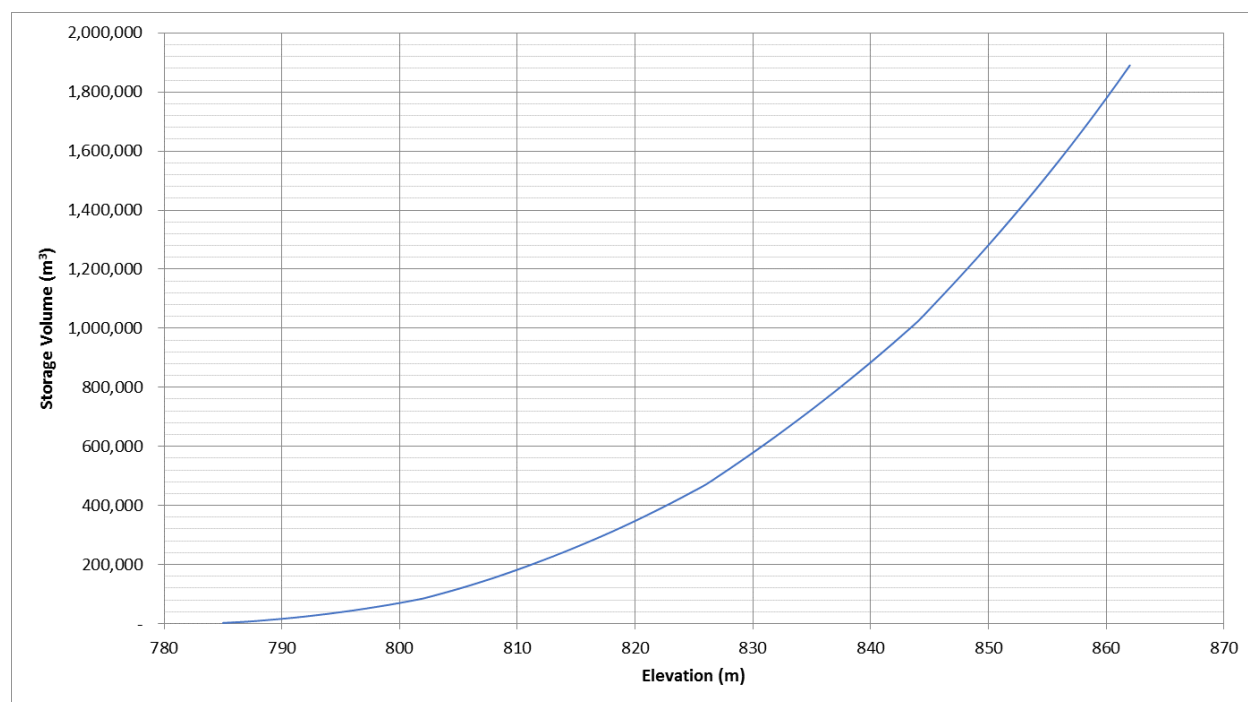


Figure 4-3: Ridgetop North Pit Tailings Management Facility Storage Capacity Curve

4.4 Underground Tailings Management Facilities

Upon completion of mining each zone in the Minto South Underground, it becomes available for the storage of tailings and/or water.

Table 4-1: Storage Capacities of Underground Ore Zones

Facility	Volume (m³)
Area 118 Zone	262,000
Area 2 Zone	110,000
Minto East Zone	197,000
Copper Keel Zone	600,000
Minto East 2 Zone	370,000
Total Underground Storage Capacity	1,539,000

The surface tailings management facilities have sufficient capacity to hold the volume of tailings and NP:AP<3 waste produced in the mine plan. Given the capacity in the surface tailings management facilities, underground disposal of NP:AP<3 waste rock from surface mining is not economically viable. Although the economic feasibility of underground tailings storage has not yet been proven, as detailed engineering designs have not yet been prepared, it has been successfully implemented at other mines and has resulted in efficient use of available storage. Placing tailings underground would preserve capacity in the surface TMFs for storage of waste rock, tailings from future expansions, or additional water from

pits after cessation of mining and milling operations and prior to their filling and releasing water to the environment. Minto will implement underground tailings disposal if further evaluation shows an economic case for it.

4.5 Remaining Storage Capacity

Table 4-2 summarizes the total remaining storage capacity, based on the facilities described above, and provides the total estimated storage requirement (from Table 3-3) for comparison. The underground workings are approved for tailings storage under the Phase V/VI licenses and the total volume of the mined out underground production workings at closure has been included as storage capacity.

Table 4-2: Remaining Storage Capacity as of December 1, 2017

Facility	Spill Elevation (masl)	Volume Below Spill Elevation (m ³)
Main Pit Tailings Management Facility	786	920,000
Area 2 Pit Tailings Management Facility	799	4,660,000
Ridgetop North Pit Tailings Management Facility	862	1,900,000
Total Underground Storage Capacity	-	1,539,000
Total Storage Capacity	-	9,019,000
Total Storage Requirement (Table 3-3)	-	7,699,000
<i>Total Excess Storage Capacity</i>	-	<i>1,320,000</i>

5 Deposition Schedule

The current deposition plan is summarized below:

- Tailings are currently being deposited in the A2PTMF. Deposition to A2PTMF will continue until Ridgetop North pit is completed, at which time deposition will switch to the RNPTMF.
- Supernatant water will be pumped from the active tailings deposition area to MPTMF to be used as mill process water. Water is currently being pumped from A2PTMF to MPTMF.
- A portion of the storage capacity remaining in the MPTMF will be maintained throughout the mine life as a source for mill process water. The MPTMF will remain available for tailings deposition if operational factors necessitate it.
- When capacity is reached at RTNPTMF, tailings deposition will switch back to A2PTMF.
- The NP:AP>3 waste located above the final water elevation of the Main Pit Tailings Management Facility will be relocated upon completion of milling in 2022. Further study and design work may

result in alternate strategies for managing this material; it has been included in this plan to ensure that the required volume under the final flood elevations of the TMFs is reserved.

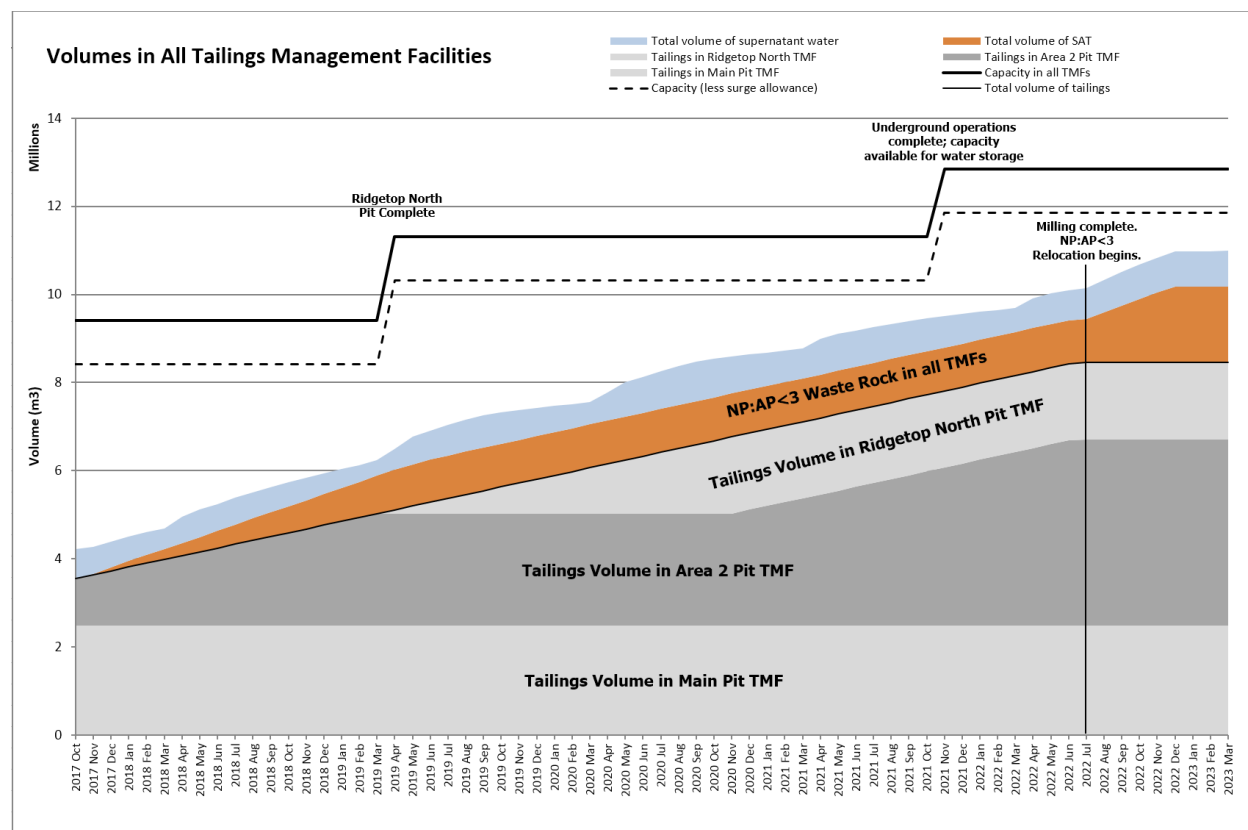


Figure 5-1: Phase VII Tailings Deposition Schedule

Based on the plan described above, the Figure 5-1 shows a schedule of total volumes in the tailings management facilities. It is subject to change as a result of operational factors such as water levels, mining rates, as-built surveys of completed open pits, and changes in recovery and mineability of underground or open-pit reserves.

6 References

Minto Explorations Ltd. 2014a. Operation, Maintenance, and Surveillance Manual – Dry Stack Tailings Storage Facility, Rev 2014-1.

Minto Explorations Ltd. 2015a. Operation, Maintenance, and Surveillance Manual – Main Pit Tailings Management Facility, Rev 2015-2.

Minto Explorations Ltd. 2015b. Operation, Maintenance, and Surveillance Manual – Area 2 Pit Tailings Management Facility, Rev 2015-2.

Minto Explorations Ltd. 2018a. Minto Mine Water Management Plan.

Minto Explorations Ltd. 2018b. Minto Mine Phase VII Waste Rock and Overburden Management Plan.