RAINY RIVER PROJECT

PART IV - MINE ROCK POND - OPERATION, MAINTENANCE AND SURVEILLANCE MANUAL WATER MANAGEMENT STRUCTURES

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1.0 Regulatory Requirements

This document is consistent with the New Gold Tailings, Heap Leach and Waste Rock Facilities Management Policy and was prepared pursuant to the MAC guidelines for *Developing an Operation, Maintenance and Surveillance Manual for Tailings and Water Management Facilities* (MAC, 2011).

The following is a list of permits that this section of the OMS complies with:

- LRIA-FF-2015-05A: Construction Ditch and Dam, Mine Rock Pond Cofferdam, and the Ultimate Mine Rock Pond am.

2.0 FACILITY DESCRIPTIONS

The components of the RRM relative to the scope of the OMS include tailings and process water management, freshwater diversions and water treatment. The site layout is shown on Figure 3-1. While there is interconnectivity between the systems, for the purposes of the OMS they are categorised in these groupings and reference made between them where required e.g., water management pond, water discharge pond and constructed wetland.

Tailings and process water management are provided by the following;

- Tailings Management Area –TMA (including cells 1, 2 and 3 and associated pipelines);
- Mine Rock Pond - MRP.

The TMA provides long term containment for the tailings. The mill make-up water is reclaimed from the Tailings Management Area (TMA), Water Management Pond (WMP) and the Mine Rock Pond (MRP) as described in Appendix A.1. The TMA dam raising schedule is divided into five stages and has been set to ensure ample pond storage is available to satisfy mill make-up water supply and effluent management requirements.

3.0 Tailings Management Area

Design criteria, including mill throughput, used in the design of the TMA dams is summarised in the follow table. Subsequent sections describe tailings cells 1, 2 and 3 and associated seepage collection systems and supporting infrastructure.

Testing carried out in 2012 for the feasibility study determined that the tailings are non-plastic, predominantly silt sized particles, with 71% of the particles passing the 0.075 mm sieve. The specific gravity is 2.82. Column settling tests (undrained and drained) support a deposited void ratio of 1.0 for deposition planning purposes, inferring a dry density of about 1.4 t/m^3. This is quite typical for hard rock gold tailings. A much more conservative dry density of 1.1 t/m^3 was adopted for the design of the initial start-up cell due to the small footprint and relatively rapid filling.

Table 10-1; Mill and Tailings Operating Data used for design

Revision G		Symbol	Source	Total	Years 1 - 4	Years 4 - 14	Units (metric)
				Total	Total	Total	
Operating data provided (design criteria)							
Ore production							
Resource - Open Pit		A	New Gold	100.1	53.4	46.7	Mt
- underground		B	New Gold	4.2	0.5	3.7	Mt
Design production rate *(while operating)*		C	BBA		21,739	21,739	t/day
Mill availability *(% of the time the Mill operates)*		D	BBA	92			%
Nominal production rate*		E	C x D		24,000	24,000	t/day
Tailings production							
Tailings / ore ratio		F	BBA	1.0			
Slurry density in the Mill		s_o	BBA		50.0	50.0	% solids
Discharge slurry percent solids (*mass of solids / total mass)*		s_d	BBA		46.7	46.7	% solids
Tailings properties							
Specific gravity of solid tailings particles		G_s	AMEC		2.82	2.82	-
Void ratio of deposited tailings *(vol. of voids / vol. of solids)*		e	AMEC		1.0	1.0	-
Flows affecting the Mill water balance							
- Moisture content of the ore entering the Mill (mass of water/mass of solids)		G	New Gold	3.0			%
- Freshwater for glands & reagent mixing *(per ton of ore)*		H	AMEC M&M	0.08			m^3/ t
- Evaporation and spillage losses in the Mill (*per ton of ore)*		I	assumed	0.02			m^3/t
Calculated data (design parameters)							
Project design life		J	(A) / (E x 365)	13.5	7.0	6.6	years
Tailings production							
- Nominal tailings production	daily	K	E x F		24,000	24,000	t/d
	monthly		E x F x 30		720,000	720,000	t/mo
	annual		E x 365		8,760,000	8,760,000	t/y
	total		E x 365 x J	103.8	61.4	57.8	Mt
Deposited tailings							
- Dry density		r_d	G_s / (1+e)		1.41	1.41	t/m^3
- Volume	daily	L	K / r_d		17,021	17,021	m^3/d
	monthly				510,630	510,630	m^3/mo
	annual				6,212,665	6,212,665	m^3/y
	total		A+B/r_d	73.96	43.5	41.0	M-m^3
- Water content (at 100% saturation) *(mass of water/mass of solids)*		w	e / G_s x 100		35.5	35.5	%

- Water retained in voids	daily	M	K x w		8,520	8,250	m^3/d
	monthly				255,600	255,600	m^3/mo
	annual				3,109,800	3,109,800	m^3/y
Mill water balance							
- Water in ore entering the Mill		N	E x G x 30		21,600	21,600	m^3/mo
- Freshwater for glands and reagent mixing		O	K x H		57,600	57,600	m^3/mo
- Water leaving the Mill with the tailings		P	(K / s) - K		821,755	821,755	m^3/mo
- Losses in the Mill		Q	K x I		14,400	14,400	m^3/mo
- Make-up water required to balance the Mill		R	P + Q - N - O		756,955	756,955	m^3/mo

* assumes maximum capacity of 21 000 + 20%

3.1.1 TMA Cell 1

The purpose of Cell 1 is to allow for the deposition of tailings, outside of fish bearing waters i.e., no MMER Schedule 2 requirement. Cell 1 has been designed to contain 3.3 Mm^3 of tailings, or 4.5 months storage capacity. The dam has a 'very high' hazard potential classification equivalent to extreme hazard classification by the CDA. The design information for Cell 1 is within RRP-GEO-LRIA-004C August, 2016 and the design brief is RRP-GEO-REP-008 R2. A summary of design characteristics is provided in the table below. The IDF for spillway and design is the 24h PMF (516 mm) and the EDF is the 100 year 30 day event. The facility creates a ring dam therefore reducing inflows and water management requirements. As the TMA is raised in stages over the life of mine the cell will become encapsulated within the ultimate TMA facility requiring no change to the closure plan.

The Cell 1 will have a crest elevation of 371.5 masl, and consists of (also see Table 4-4):

- a continuous raise of the TMA south starter dam from elevation 366.5 masl to 371.5 masl between stations 0+000 to 0+800;
- a raise of the TMA west dam (WMP dam 4) from 366.5 masl to 371.5 masl between stations 1+000 to 1+900; and
- a standalone internal containment dam also built to elevation 371.5 masl.

Table 10-2; Summary of Cell 1 Dam Characteristics

	Spillway Invert Elevation (m)	Dam Crest Elevation (m)	Minimum Ground Elevation[1] (m^3)	Maximum Height (m)	Length (m)	Dam Fill Volume (incremental) (Mm^3)
TMA Start-Up Cell Dam	370.5	371.5	360.0	11.5	1,500	1.17
TMA South Dam - Stage 1		371.5	365.0	6.5	800	0.24
TMA West Dam - Stage 1		371.5	363.0	8.5	700	0.19

Notes:
1 Minimum ground elevation noted is original ground

The TMA start-up cell will have a maximum operating water level (MOWL) of approximately 369.90 masl, which corresponds to the operational pond volume of 200,000 m^3. Once the water level reaches the MOWL it must be pumped from the TMA start-up cell to the Mill Process Water Tank (MPWT), to maintain sufficient capacity to contain the EDF event. Due to the limited storage in the TMA start-up cell at this point in mine operations, no operating range can be allowed (i.e.,

any water above the MOWL must be pumped immediately). The TMA Cell 1 spillway has an invert elevation of 370.5 m and a base width of 8 m. The spillway discharges north into TMA Cell 2.

The primary dam construction materials are mine waste rock and select clay (overburden) obtained from a local borrow or from open pit development. The TMA South and West Dam have a clay core with select or processed sand filter/drain zones provided downstream of the core and above the foundation to inhibit the migration (piping) of fine-grained soils under seepage forces. The TMA Start-Up Cell Dam has an upstream bituminous liner to minimize seepage.

3.1.2 TMA Cell 2

The purpose of Cell 2, is to allow for continued operations and tailings deposition, following filling of Cell 1, as the ultimate TMA dams are constructed. TMA Cell 2 has been designed to provide containment for approximately 12 months of tailings deposition at maximum production rate based on the design criteria provided in this section (Table 4-1). The dam has a 'very high' hazard potential classification equivalent to extreme hazard classification by the CDA. The Design brief for Cell 2 dam is within RRP-GEO-REP-026 R1 Design Brief, April 28, 2017. A summary of dam characteristics is provided in the table below (Table 4-5). The IDF for spillway and design is the 24h PMF (516 mm) and the EDF is the 1:100 year 24h (127 mm) for containment below the spillway. The 19 m wide spillway with an invert of 364.70 is located in the north starter dam.

The TMA Cell 2 Dam has a crest elevation of 366.5 m which is equal to the crest elevation of the TMA Starter Dams and north starter dam forms part of the containment for tailings deposition. The cell provides containment for approximately 5.5 Mm3 of tailings. The facility is bounded by natural topography (high ground) in the north and by impoundment dams along the remaining perimeter. The facility will be encapsulated during the life of mine when the TMA Stage 2 raise (elevation 371.5 m) is constructed.

The dam section is a central clay core embankment with rockfill shells and a crest elevation of 366.5 m. Sand filter and transition zones are provided downstream of the clay core and a partial blanket beneath the downstream shell. The dam section requires shallow side slopes due to the characteristics of the foundation soils. Clean (NPAG) rockfill is required for construction of the downstream shell. Any rockfill (NPAG or PAG) may be used for construction of the upstream shell (outside Loslo Creek). Given the Schedule 2 approval schedule, 2x1600mm culverts will be placed in Loslo Creek until the approval is received, then these will be grouted and sheet piling used to close the dam.

Work on the dam is scheduled between approval (August) and December for clay placement, and sheet piling across Loslo Creek to be completed in 1Q2018, pending MMER Schedule 2 approval.

Table 10-3; Summary of Dam Characteristics for Cell 2

Tailings Management Area Dam	Spillway Invert Elevation (m)	Dam Crest Elevation (m)	Minimum Ground Elevation[1] (m^3)	Maximum Height (m)	Length (m)	Dam Fill Volume[2] (Mm^3)
Start-Up Cell Dam (Cell 1 Dam)	364.7	371.5	360.0	11.5	1,500	-
North Dam – Stage 1		366.5	363.5	3.0	1,100	-
West Dam (0+000 to 1+000)		366.5	363.5	3.0	600	-
West Dam (1+000 to 1+900)		371.5	363.0	8.5	650	-
South Dam (0+000 to 0+800)		371.5	365.0	6.5	800	-
South Dam (0+800 to 1+250)		366.5	364.5	2.0	300	-
Cell 2 Dam		366.5	356.0	10.5	900	0.47

Notes:
1 Minimum ground elevation noted is original ground.
2 Incremental fill volume to currently permitted structure.

3.1.3 TMA Cell 3

TMA cell 3 is a component of the ultimate TMA bounded by the TMA south starter dam and the Cell 2 dam. Cell 3 will provide containment for tailings/water for approximately 6 month (April to October 2019 prior to adjoining with Cell 2 through a spillway as part of the overall TMA.

The TMA south starter dam is will be built to 366.5 m and has a 'very high' hazard potential classification equivalent to extreme hazard classification by the CDA. The design brief for TMA dams is within Detailed Design Brief Design Brief - Tailings Management Dams 3098004-004000-A1-ETR-0006-00, July, 2014. This was revised following review by the ITRB and, for the starter dams, little design change was required to the 10:1 downstream slopes and the 4:1 upstream slopes (RRP-GEO-MEM-006 Rev 1). A summary of design characteristics is provided in design brief and in the summary table in this section. The IDF for spillway and design is the 24h PMF (516 mm) and the EDF is the 1:100 year 30 day event for containment below the spillway.

When full containment in the TMA is available (i.e. TMA South Dam is constructed to elevation 366.5 m), tailings will be discharged from the north side of the TMA South Dam (upstream slope).

An overflow spillway will connect TMA Cell 2 and 3 to allow for water reclaim during this period of operation. As tailings are discharged from the TMA South Dam, starting in April 2019 (approx.) the pond level in the cell will continue to increase until the water begins to passively overflow at elevation 364.5 m into TMA Cell 2. The TMA Cell 3 Overflow Spillway has an invert elevation of 364.5 m and a base width of 19 m. The spillway will allow TMA Cells 2 and 3 to act as one pond above this invert elevation.

3.1.4 Seepage Collection System

Seepage collection systems have been designed consistent with permitting requirements (MECP ECA #5178-9TUPD9) to contain seepage and a 1:25 yr 24h storm event (102 mm). However, seepage and runoff reporting to the MRP, from the EMRS and LGOS, is through ditching designed for a 1:100 yr 24h storm event, also consistent with the ECA approval. There is no requirement for seepage collection from the MRP, however, as noted elsewhere in this manual (section 5) the MRP will be managed with a minimum water level to reduce seepage and dewatered in winter to 5,000 m^3.

Seepage collection systems may be modified during construction, however the design criteria will not be reduced.

3.1.4.1 Cell 1

Cell 1 seepage collection is based on continuous ditches reporting to sumps and pump back. Cell 1 seepage details are outlined in RRP-GEO-MEM-043-R1. Seepage to the south east (through WMP Dam 4) is part of inflows to the WMP and managed as part of the WMP water.

Three sumps are proposed with the base of the sump 1 to 2 m below grade to allow for the incoming ditch invert. Combined seepage flow to these sumps is 29 m^3/day and final dimensions are being field fitted. Where required, the downstream side of the ditches will be raised to 362.0 m to prevent back flooding from Loslo Creek. Pumping sizing is intended to drain the sumps within 5 days.

Table 10-4; TMA Cell 1 Seepage Collection Sumps

Parameter	Sump 1	Sump 2	Sump 3
Location	North side of cell 1	East side of cell 1	South of TMA south dam
Seepage flow (m^3/day)	12	7	10
Runoff (m^3/day)	9,321	4,113	5,257
Ditch steady flow (m^3/day)	200	117	173
Storage volume required (m^3)	9,532	4,237	5,440
Pump capacity (m^3/day)	2,500	1,000	1,500

3.1.4.2 Cell 2

Seepage from cell 2 dam has been estimated to be approximately 9.2 m^3/day when the cell is at capacity (364.7 m). Until the TMA south dam is completed i.e., Marr and Loslo Creek are impounded, this seepage will be collected and pumped back into Cell 2, as such Cell 2 seepage management is temporary. Sumps and ditching have been designed for a 1:25 year event, consistent with seepage collection commitments;

- Seepage collection sump will be built with ~8,000 m^3 of live storage (NWL 354.0, MOWL 355.5)
- Minimum pumping capacity 1,600 m^3/day to dewater sump in 5 days

Seepage from the north starter dam, is estimated at 0.02 to 0.03 m3/day/m per metre run of dam which will be captured in WMP sump 3.

3.1.4.3 Cell 3

Cell 3 is not anticipated to impound tailings until April 2019 and as such seepage is not anticipated until after this time. Seepage from the south starter dam, is estimated at 0.02 to 0.03 m3/day/m per metre run of dam which will be directed via ditching to the water discharge pond, or if necessary pumped back.

3.1.4.4 WMP

Seepage from the WMP, similar to other dams is designed to be collected in ditches, routed to sumps and pumped back to the WMP. The ditches are designed to convey the 1:25 yr 24h event with flows typically around 5 m^3/s and up to 8.3 m^3/s. The ditches have 1 m bottom width, 3:1 slopes and up to 2 m flow depth. The following table provides a summary of the sumps.

Table 10-5; WMP Seepage Collection Sumps

Parameter	Sump 1	Sump 2	Sump 3
Location	Dam 2	Dam 3	North of WMP by North starter dam
NWL	359.5	358.0	361.5
MOWL	361.1	360.2	364.0
Storage volume required (m^3)	18,200	11,800	20,000
Pump capacity (m^3/day)	4,000	2,500	3,500
Note; Sump 3 to be expanded in 2018 to include seepage from North Dam – Cell 2			

3.1.5 Supporting Infrastructure

Site infrastructure have been constructed with locally available materials produced through the development of the Open Pit or quarrying sand/gravel deposits and bedrock. Figure 3-1 shows the general arrangement of the RRM, including site and haul roads, laydown areas, and stockpiles.

3.1.5.1 Pipelines

There are five pipeline corridors sed to transfer tailings, fresh water, and reclaim water on site. Drawing 100126-4500-DD10-PIP-0001.001 shows the key plan of the tailings and reclaim pipelines that interact with the plant site. Drawing 100126-6200-DD10-PIP-0001.001 shows the key plan of the Pinewood Pipeline used for effluent discharge (see Appendix B).

- Tailings Pipeline: the tailings pipelines are 4,000 m in length between the Mill and the TMA and are used to transfer tailings to the TMA for discharge. The tailings line is contained within a lined corridor with six emergency dump ponds. The line is with in additional containment over West Creek and its tributaries.
- TMA Reclaim Pipeline: the TMA reclaim pipeline is 4,000 m in length between the TMA and the Mill and is used to transfer mill make-up water. The reclaim line is contained within a lined corridor with six emergency dump ponds. The line is with in additional containment over West Creek and its tributaries.
- MRP Reclaim Pipeline: The MRP reclaim pipeline is 1,750 m in length between the MRP and the Mill and is used to transfer mill make-up water.
- Open Pit Pipeline: The Open Pit pipeline is 1,400 m in length between the Open Pit and the MRP and used to transfer pit dewatering to the MRP.
- TMA Transfer Pipeline: The TMA transfer pipeline is 2,300 m in length between the TMA and the WMP and are used to transfer TMA surplus water to the WMP.
- WMP Freshwater Pipeline: The WMP freshwater pipeline is 4,000 m in length between the WMP and the plant site and used to transfer freshwater to plant site infrastructure and the Mill (if required).

- Pinewood Pipeline: The Pinewood pipeline is 10,300 m in length between the WMP and the Pinewood Pumphouse. It is used to discharge WMP effluent into the Pinewood River.

3.1.5.2 Utilities

The following utilities are used on site:

- Power to the plant site is provided by 230 kV transmission lines that are connected to Hydro One northwest of the site at a Switching Station;
- The main 230 kV substation is located near the concentrator building to provide power to the process equipment via underground supply lines. Power to the remainder of the site is provided by a network of overhead power lines fed from the main substation; and
- Site telecommunications and Process Control are distributed via fiber optic lines.

3.1.5.3 Water Circulation Systems

Appendix B contains supporting information for the pumping requirements and design of pumps and pipelines. Mill make-up water is provided from the TMA, WMP -and MRP. The TMA reclaim recirculates water from the mill after the tailings solids have settled in the TMA. The MRP reclaim pumps water collected from the EMRS and Open Pit/future underground mine. Mill make-up water will be preferentially pumped from the MRP with the TMA supplying the remainder of make-up water.

Freshwater pipelines transfer water to the Plant site for the freshwater requirements at the Mill, as well as to provide water to the truck filling station, truck shop, truck wash facility, and fire water tank. Surplus water in the WMP may also be pumped to the Pinewood Discharge Structure for discharge into the Pinewood River. Details on effluent discharge via the Pinewood Pipeline are described in Section 4.4.

3.1.5.4 Mill Make-up Water Supply

Mill make-up water is provided by reclaim from the WMP, TMA cells and MRP. The reclaim water from the TMA is pumped from the central pond using the following three pumps:

Table 10-6; Make up water supply pump ID and capacity

Equipment ID	Name	Capacity
4520-PU-0023	Process Plant Pump	1,350 m^3/hr
4520-PU-0024	Process Plant Pump (Standby)	1,350 m^3/hr
4520-PU-0035	WMP Pump (Standby)	1,350 m^3/hr
4520-PU-0036	WMP Pump	1,350 m^3/hr

Reclaim water from the MRP is pumped using the following two pumps.

Equipment ID	Name	Capacity
2590-PU-0030	Mine Rock Pond Water Pump	680 m^3/hr
2590-PU-0031	Mine Rock Pond Water Pump	680 m^3/hr

3.1.6 Mine Rock Pond

The Mine Rock Pond has been designed to collect runoff and seepage from the East Mine Rock Stockpile (EMRS), Low Grade Ore Stockpile (LGOS), and dewatering from the Open Pit and future underground mine. The MRP design details are summarized in the following documents and drawings with the latest revision RRP-GEO-MEM-019 R0 – AMECFW 2016h. The dam has a 'very high' hazard potential classification equivalent to extreme hazard classification by the CDA. As-built details will be provided in the MRP as-built report to be issued 90 days following construction completion.

Document Title	**Reference**
Design Brief – Water Management Dams	(Amec Foster Wheeler, 2015b)
Mine Rock Pond Dam – Design Revision and Operating Guidelines	(Amec Foster Wheeler, 2016h)
MRP As-built Report	TBD
Drawing Title	**New Gold Document Number**
Mine Rock Pond Dam – Typical Cross Section	3098004-002590-A1-D70-0004
Interim Mine Rock Pond – Plan, Cross Sections, and Details	3098004-002590-A1-D50-0006

The design criteria for the MRP ultimate dams are summarized in section 4.1. Typical dam cross sections are provided on Drawings 3098004-002590-A1-D70-0004 for the MRP ultimate dam. The design basis for the MRP includes, but is not limited to, the following:

- 24h PMF and 1:100 year 30 day storm
- Maximum operating water volume: 0.5 Mm3;
- Maximum water stored: 1.3 Mm3;
- Minimum operating water volume: 0.05 Mm3;
- Constructed from local materials as a clay core and rockfill embankment; and
- Decant pumping to the Mill via pipeline is at a rate of up to 680 m3/hr.

The dam crest elevation is 360.2 m with an emergency spillway invert of 358.9 m. The available pond storage at the emergency spillway invert is reduced to 1.3 Mm3. The MRP pumps will pump 680m3/hr, and run continuously until the pond is empty. This 30% increase to the pumping rate and change in pumping philosophy means the normal pond will range between 5000 m3 and about 525,000 m3 depending on the open pit dewatering pump capacity. The larger decant pumps also mean that the EDF capacity required in the MRP is 775,000 m3. The Maximum Operating Water Level (MOWL) in the MRP has been set at elevation 356.8 m (525,000 m3).

Completion of the Mine Rock Pond Dam commenced in 2015, and with a hiatus in 2016, is expected to be completed in the fall of 2017. Until the dam is complete, runoff and seepage water

from the EMRS will be diverted to the temporary Sediment Pond system located within the north portion of the ultimate MRP footprint and discharged to the remnant Clark Creek.

3.2 Instrumentation

3.2.1 Dam Safety

Instrumentation has been and will be installed during construction. Instrumentation will include instrumented dam sections that will monitor dam foundation and clay fill pore pressures to infer consolidation characteristics, as well as monitor any movement of dam fill due to deformation. Each dam instrumentation section will include: standpipe(s), a settlement plate, slope inclinometer(s), survey pins/monuments, and a terminal arrangement with data logger and vibrating wire piezometers.

Following construction, the instrumentation will remain for dam monitoring purposes. A detailed report containing the proposed locations, usage, and analysis of all instrumentation is provided in the *Geotechnical Monitoring Plan* (Amec Foster Wheeler, 2016b). The design details for the installed or proposed dam instrumentation is summarized in Table 4-14. The design information provided in Table 4-14 will be confirmed and updated as may be required following development of the As-Built drawings.

Table 10-7; Dam Instrumentation Summary

Facility		Dam Instrumentation							
		Slope Stability			Foundation Consolidation		Phreatic Level and Seepage		
	Section	Slope Inclinometers	Survey Pins	Survey Monuments	Vibrating Wire Piezometers	Settlement Plates	Vibrating Wire Piezometers	Standpipe Piezometers	Pond Level Gauge
	(Sta.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(no.)	(type)
TMA North	3+300	0		0	2	1	1	2	
	Mass array				142				
TMA South	1+000				2				
	1+380				2	1	1	1	
	1+450	2		2	4	2	1	2	
	1+600	1			4	2	1	1	
	2+200	2		2	4	2	1	2	
	2+350	1			4	2	1	1	TBD
	Mass array				176				
TMA West	0+300			0	1		1		
	0+460	2		0	5		2	1	
	1+450	0	35	0	0	1		0	
	1+500	2		0	4	0	3	0	
	Mass array				82				
TMA Start-up Cell	0+400				2				
	1+000				2				TBD
	Mass array				88				
WMP Dam 1			16						- Staff gauge
WMP Dam 2	0+950	1	34	0	2	0	2	2	- Survey stakes
WMP Dam 3	0+300	0	17	0	1	0	1	2	
	0+500	1		0	2	1	4	1	
Mine Rock Pond	0+220	1		2	2	1	1	4	- Staff gauge
Clark Creek									- Staff gauge
Teeple Road									- Staff gauge
Stockpile Pond	0+125	1	8	0	1	0	1	2	- Staff gauge
West Creek	0+291				2			2	
	0+320	2	2						- Staff gauge
	0+340	2	2		2	1	1		
Water Discharge Pond									TBD
Constructed Wetlands									
- Pond A									TBD
- Pond B									TBD
- Pond C									TBD
- Pond D									TBD
- Pond E									TBD
Sediment Pond #1									TBD
Sediment Pond #2									TBD
Temporary Sediment Pond									TBD

Notes:
1) Survey pins installed at 100 m centres along 3-5 lengthwise lines (crest, toes, etc.) Quantities are total for each dam
2) TMA Dams feature mass array of VWP instruments installed in grids within the dam foundation. Installation of these instruments is currently on-going

In addition to the instrumentation described above, the TMA dams are equipped with an additional suite of vibrating wire piezometers (VWPs) to provide enhanced monitoring resolution during construction. A total of 524 VWPs were installed in the TMA dam foundations, arranged in a grid pattern, and managed with a remote wireless data acquisition and management system.

Instrumentation associated with the management of the dams is being managed through a software system that includes integration with data loggers and data storage and is configured such that alarms for alert levels are defined and available. The software routinely generates reports and if trigger levels are exceeded sends out alarm notifications.

3.2.2 Other instrumentation

Additional instrumentation to support the OMS manual and management of water includes;

- Densometer on the tailings pipeline;
- Flow meters on the water management pipelines including from the Pinewood River, tailings reclaim lines, MPR line and freshwater line from the WMP and
- Pressure transducers in the WMP, Clark/Teeple Ponds.

This instrumentation provides continuous recording, which is collected during routine inspections and included.

3.3 Regulatory Requirements

Regulatory requirements, permits and authorizations are summarized in section 1.1. Key approvals include the Federal and Provincial Environmental Assessment conditions and commitments and permits including those issued pursuant to the LRIA and EPA. Additional legislation to be considered in implementing the OMS manual includes the MMER and various Ontario regulations including waste management.

No direct discharges are intended from any of the structures described in this section except the WMP which is described in sections 4 and 5. Seepage will be collected and pumped back from the WMP and TMA cells. Subsequent to this revision and LRIA approvals, additional details for the WDP, CW and sediment ponds discharges will be developed.

4.0 OPERATIONS

The overall operational objectives of the TMA and associated dams and facilities are to dispose and store the tailings and to manage all site water in a safe, economical and environmentally responsible manner. This section defines operating standards in accordance with design criteria and regulatory requirements specified in section 4.

4.1.1 Mine Rock Pond

The pond collects runoff and seepage from the East Mine Rock Stockpile (EMRS) and Low Grade Ore Stockpile (LGOS) and receives dewatering from the Open Pit and future underground mine.

Currently, the MRP Dam is not complete and the remnant Clark Creek drainage is required (by LRIA approvals) to be diverted through the construction diversion ditch to the remnant Clark Creek. Following completion of this dam, and approval from MNRF, the MRP will operate as described here based on RRP-GEO-REP-007 R1, September 15, 2016. A stage storage relationship is provided below.

- The MRP will be operated to minimize volume in the pond to reduce seepage and for increased dam safety, there is no seepage collection system for the MRP as it is the seepage collection system for the EMRS.
- The MOWL of the MRP is 356.8 m (525,000 m^3) and has been constructed with an 80 m spillway at an invert of 358.9 m (1.3 Mm^3) to store the EDF (775,000 m^3).
- The MRP will operated with a freeboard of 3.4 m to allow for the EDF (1:100 year 30 day event), a maximum wave height of 0.78 m with a required 0.31 of freeboard remaining.

Decanting from the pond is via fixed pumping station that supplies mill make-up water:

- 680 m^3/hr pump subject to pump availability and pond level controls, which is able to supply 59 % of the total mill make-up water demand;
- Supplies approximately 45 % of the mill make-up water annually; and
- Prior to the winter, the MRP will be drawn down to the minimum pond volume (5,000 m^3) to reduce ice losses.

If the MRP MOWL (356.8m) is exceeded, pumping into the MRP from the open pit / future underground mine will cease and pumps will pump water toward the plant site/WMP/TMA. The ECA approval requires that there will be no direct discharge from the pond to the environment.

Table 11-1; Mine Rock Pond Stage-Storage Relationship

Elevation (m)	Volume (m^3)	Notes
351.0	0.0	
352.0	3,104	
353.0	25,569	

354.0	82,650	
355.0	176,903	
356.0	332,548	
356.8	525,000	MOWL
357.0	579,383	
358.0	931,120	
358.9	1,300,000	Spillway elevation
359.0	1,382,836	
360.0	1,930,022	
360.2	2,048,496	Dam Crest
Source; RRP-GEO-REP-007 Sept 14, 2016		

4.2 Progressive Reclamation and Closure

Some progressive reclamation with respect to the TMA is proposed as part of mine operations. By the end of the operations phase a low permeability overburden cover of approximately 150 m in width will be placed on the upstream side of the TMA dam. The overburden cover will cover approximately two thirds of the ultimate perimeter, with the remaining approximately one third of the length to be reclaimed at closure. This cover is intended to prevent the tailings permanent water cover from coming into contact with the TMA dams, and will also serve a secondary function of limiting oxygen diffusion into the uppermost portion of the tailings underneath. The overburden cover will be seeded or hydroseeded with a native seed mix or equivalent, and will be armoured with NPAG rock at the transition zone of the cover with the tailings to prevent suspension and oxidation of solids.

Closure of the RRM in respect to tailings, process water and freshwater management will include but is not limited to the following:

- At closure the MRP will collect runoff and seepage from the EMRS which will then be directed to the Open Pit to help flooding;

4.3 Safety and Security

The site safety and security will be following the RRM Health and Safety Management System including but not limited to the following:

- The site will be gated with restricted access to authorized personnel only;
- The TMA will be fenced along portions of the old highway 600 and access will be restricted to authorized personnel only;
- No public access;
- Construction Management provided security measures; and
- Onsite health and safety policies for working around bodies of water, working alone or crossing ice.

4.4 Environmental Protection

The Environmental Department has oversight over the EMS which contains tailings operations related environmental aspects including:

- Fugitive and point source dust emissions;
- Hydrocarbon Spills and Leaks;
- Pipeline Rupture and Leaks;
- Surface and ground water quantity and quality; and
- Wildlife management (including species at risk).

An environmental aspect register is a comprehensive inventory of tailings operations activities, environment aspects, assessment of risk and identification of controls. Tailings personnel have responsibility to implement and maintain the controls including monitoring and inspection. Refer to the Environment Department for the environmental aspect register (in prep) and environmental related procedures.

As outlined in orientation training, it is every RRM employee's responsibility to report a suspected spill or uncontrolled release event to their supervisor. This includes suspicious flows of water out of the area, escaping tailings, etc. The sooner appropriate persons can begin to correct a situation, the less likely it is that severe impacts will follow.

Table 5-3 provides a summary of the MECP effluent discharge limits that must be met to discharge from the WMP.

Table 11-2; MECP Effluent Discharge Limits from the WMP

Constructed Wetland Final Discharge and Water Management Pond Pipeline Discharge (to the Pinewood River) as stated in MECP ECA 5178-9TUPD9		
Effluent Parameter	**Daily Maximum Concentration (mg/l)**	**Monthly Average (mg/l)**
Cadmium	-	0.0010
Cobalt	-	0.0044
CBOD5	-	25.0
E.coli	-	100/100ml geometric mean density
Total Suspended Solids	30	15
Total Phosphorus	-	0.10
Cyanide (total)	0.1	0.05
Cyanide (free)	0.02	0.01
Total Arsenic	0.034	0.017
Total Copper*	0.028	0.014
Total Nickel	0.094	0.047
Total Lead*	0.030	0.015
Total Zinc*	0.348	0.174
Un-ionized Ammonia	0.08	0.04
Acute Toxicity (Rainbow Trout and Daphnia Magna)	Non-acutely lethal (not greater than 50% mortality in undiluted effluent)	
pH of the effluent maintained between 6.0 to 9.5, inclusive, at all times		
Notes: 1. *Proposed effluent criteria for Total Copper, Total Lead, and Total Zinc are based on a hardness of 200 mg/L CaCO3. In the event that water quality sampling indicates that 75th percentile hardness concentrations are		

less than 200 mg/L CaCO3, the effluent limits may be changed by the District Manager in writing, consistent with achieving no impairment for receiving waters. 2. Additional effluent limits for sediments 1&2 are stated in MECP ECA 5178-9TUPD9 3. The effluent discharge rate from the Constructed Wetland Final Discharge and the Water Management Pond Pipeline Discharge such that at all times the ratio of the combined flow rate of these effluents to the flow rate of the receiving surface water (Pinewood River) is less than or equal to 1:1 (i.e. the cumulative flow rate of the effluent must be less than or equal to the flow rate of the receiving surface water). 4. Prior to commencing Operations Phase discharges (Constructed Wetland Final Discharge, Water Management Pond Pipeline Discharge, Sediment Pond #1, and Sediment Pond #2), the method for determining daily effluent to receiver flow mixing ratios shall be approved by the District Manager. 5. For sampling frequencies and full parameter list refer to MECP ECA 5178-9TUPD9; sampling frequency varies from thrice weekly to quarterly depending on the parameter

4.5 Reporting Requirements

Reporting is sub-divided as routine, planned reports of defined frequency, and those that are non-routine i.e., event driven.

Routine

- Submission of asbuilts within 3 months of construction for WMP, TMA, MRP and sediment ponds 1 and 2
- Monthly monitoring report including a summary of all monitoring data collective, all non routine calibration/maintenance procedures, tabulation and description of any bypass/upset conditions
- Annual reporting to MECP on March 31 for the previous year, a works performance report and a surface water monitoring report
- Quarterly electronic effluent monitoring reports to ECCC
- Annual electronic effluent monitoring report and environmental effects monitoring reports to ECCC by March 31

Non-routine

- Report all spills as defined in the Environmental Protection Act immediately to spills action centre SAC, follow New Gold Incident Reporting Guidelines and follow up in writing to MECP within 10 days describing the cause and discovery of the spill or loss, clean-up and recovery measures taken, preventative measures to be taken and schedule of implementation
- Any observation of sheen/foam/settable solids within the works report immediately to (SAC) immediately and written reporting within 7 days
- Any exceedance of effluent limits report to SAC immediately, written confirmation to MECP within 7 days
- If acute toxicity tests fail, within 15 days report in writing to MECP with the cause and remedial actions proposed/implemented
- Notify ECCC immediate if MMER Sch 4 limits are exceeded, pH is outside 6-9.5 range or if the effluent is acutely lethal with a written report within 30 days

Records are retained consistent with CEAA condition 11 for a minimum of 25 years or until decommissioning ends, whichever is longer and kept locally. This exceeds the ECA permit requirement of 3 years. Records include place/date/time of sampling, dates and analysis performed, analytical techniques used, names of persons collected/analyzing sampling and results of analysis.

An Operations Report will be prepared by the Mill Manager or designate. The report will include metrics and information collected as part of normal operation. Examples of information contained in the Operations report include:

- Total monthly tailings deposition tonnage and slurry water volume;
- Total monthly reclaim volume;
- Pond level and freeboard;
- Updated water balance;
- Water quality results; and
- Intake / Discharge quantities.

Each of the regulatory approval requirements related to the construction, operation and eventual reclamation of the Site have specific compliance reporting requirements with defined deadlines or reporting periodicity. In general, the reporting includes:

- Operation, Maintenance and Surveillance Plan(s) for dams, water management (water quality) and air/noise emissions;
- Emergency Preparedness Plan(s);
- As-Built Drawings and related Construction Reports;
- Dam Safety Inspection and Review Reports
- Environmental Monitoring Plans; and
- Environmental Monitoring and Performance Reports.

The environmental approvals and permits received from the government that are maintained by the New Gold Environmental Department should be referred to for details of monitoring, inspection and reporting requirements.

In addition, the New Gold Environmental Department should be notified of any proposed major modification to RRM facilities, in order that they can liaise with the appropriate government ministries to determine if additional approvals or amendments to existing approvals are required.

5.0 MAINTENANCE

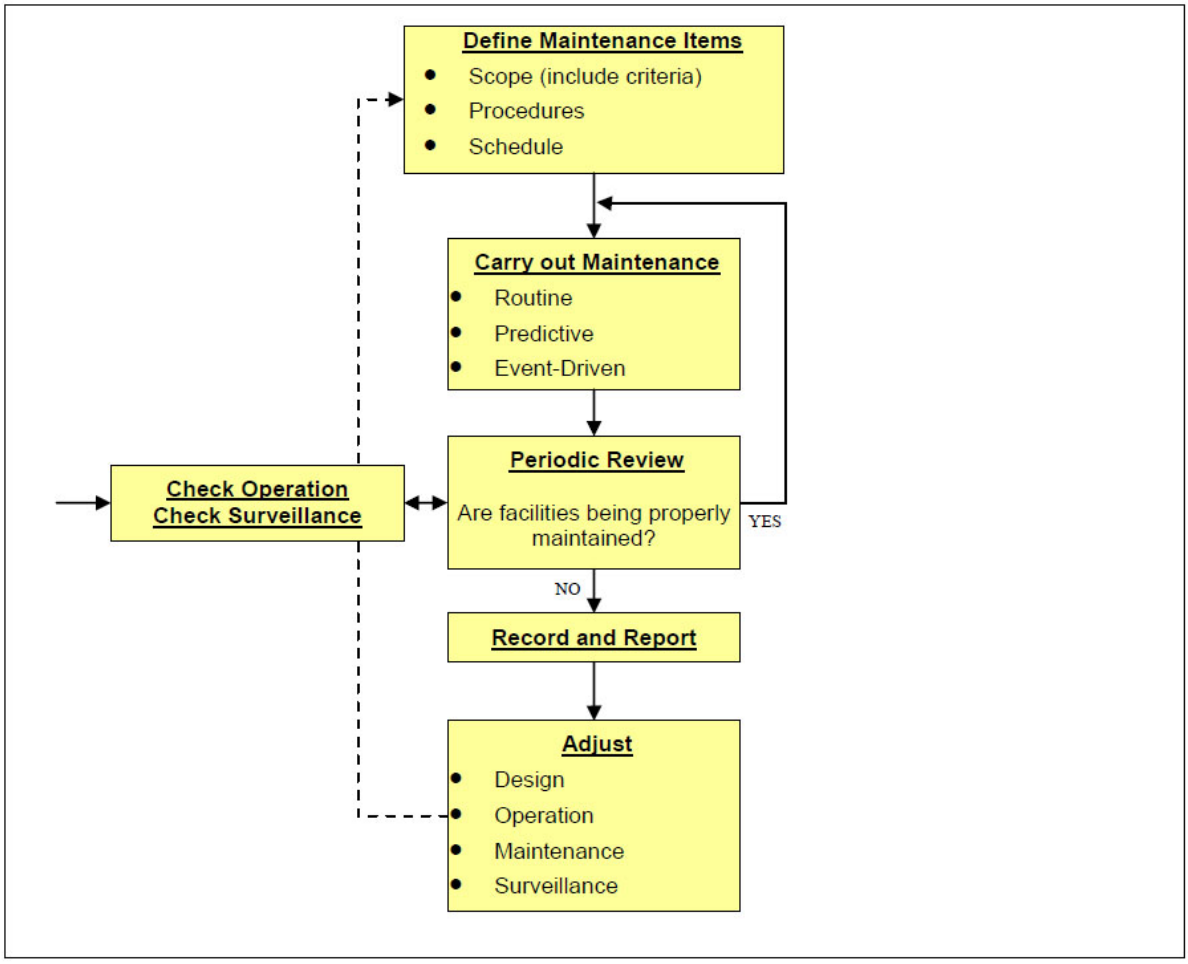
The following periodic maintenance is required:

1. Maintain the tailings and reclaim pumps and associated lines and containment;
2. Clear debris, snow and ice which may block flow through the decant facility or emergency spillways;
3. Maintain water management structures including spillways, ditches and diversions;
4. Maintain equipment, power and water lines, and instrumentation;
5. Repair any deficiencies as noted in the Dam Safety Inspections (DSI); and
6. Reconstruct the support for tailings discharge pipelines wherever washouts occur.

Maintenance records are retained by maintenance personnel performing the work in accordance with the procedures described in this document. Timing of maintenance actions for unusual conditions should be based on specific recommendations from surveillance findings. Scope and time frames for routine maintenance activities are determined and scheduled by the Maintenance Department and based on manufacturer's recommendations and best practices.

The maintenance flowchart is illustrated in Figure 6-1.

Figure 12-1; Maintenance Flow Chart



5.1 Routine and Predictive Maintenance

Routine and predictive maintenance includes removal of vegetation, beaver dams, ice blockage or sediment accumulation that would otherwise affect the performance of a structure when required.

5.2 Maintenance and Emergency Preparedness

A weekly table-top exercise will be conducted with the pump management team to ensure that crews are intimately familiar with the operational strategies for a broad range of operating and emergency scenarios. These table tops will be documented and New Gold management will ensure that any ongoing lessons learned from day-to-day operation are captured including the updating of any corresponding plans, maps, flowsheets or procedures.

The maintenance of pumps is the responsibility of New Gold and maintenance records are required to be maintained. Each installation requires to be equipped with spill pan, spill kits

and the necessary signage. Changes to pumping configurations, ditching, piping or operating parameters need to be approved by the New Gold Mill Manager, the New Gold Maintenance Manager and the New Gold Environmental Manager, during normal working hours. This is particularly the case if splash pads need to be altered in any way. In an emergency call out (after hours), the Managers or their alternate, will provide direction in consultation with the New Gold Environmental Department.

During depositing of tailings the above-mentioned crews are required to complete their inspections daily. Reporting is to be escalated to hourly observations if a rainfall event is escalating and the Cell 2 level is within 200 mm of the intermediate fill elevation of 363.2 masl. The general manager can then decide whether to provide additional surveillance resources in the case where additional duties including maintenance and operation of the Cell 2 dewatering pumps is required to be performed by the allocated crews.

A summary report titled " TMA Cell 2 Water Levels " is circulated each morning at 9 a.m. to summarize the measured water and tailings levels as of 4 p.m. the day prior. This report is prepared and circulated by the mill superintendent or his alternate. The purpose of the report is to highlight trend data for Cell 2.

Fundamental to the successful operation of the ponds and pumping strategy is a timely reaction to rainfall events, and ensuring that pumps come 'on line' or are taken 'off line' as design trigger levels are reached.

5.2.1 Dams

The following are examples of specific maintenance activities:

- Regularly check diversion ditches, spillways and culverts for accumulation of debris or sediment, or any other form of blockage including ice, and remove if required;
- Visually inspect diversions, spillways, seepage collection sumps, dams and all ditches for cracking, bulging, slumping, and any other indications of slope movement (note, any indications of slope movement shall be reported to a qualified geotechnical engineer);
- Re-grade the dam crest, as required, to prevent local ponding and direct surface runoff towards the pond;
- Repair erosion gullies, local slumps or slides in the dam face, diversion ditches or spillway channels; and
- Regularly check diversion ditches for accumulation of debris or sediment, or any other forms of blockage, and remove if required.
- If annual survey determines necessary, correct dam crest, overflow spill way and diversion channel invert irregularities to avoid concentrated runoff.

5.2.2 Ditches and spillways

Ditch maintenance includes replacement or enhancement of erosion protection to prevent sediment generation or sloughing of slopes, as required.

5.2.3 Geotechnical and Water Monitoring Instrumentation

Instrumentation is calibrated by the manufacturer prior to shipment. Calibration certificates will be maintained by maintenance department. Following instrument installation, initial reading procedures will be followed. Subsequent calibration will follow manufacturer's recommendations.

Malfunctioning or damaged instruments may require repair or replacement per manufacturer guidelines or approved procedure. In the event of replacement of dam instrumentation, several overlapping readings of the old and new instrument are required to ensure continuity of the data records.

5.2.4 Pumping Systems and Pipelines

Maintenance of the tailing delivery, water recirculation systems and seepage pumps will include:

- Perform regular performance tests of the Pinewood Pumphouse pumps and inspections of pump fish screens to remove any debris;
- Perform regular performance tests on seepage pond pumps
- Perform annual calibration and maintenance as required on flow meters;
- Perform regular non-destructive testing appropriate for components of the tailings delivery system, including for example, periodic measurement of pipeline thickness to identify areas of wear and to schedule pipeline replacement if necessary and repair liners as required;
- Replace pipe work, bends and fitting components as required;
- Remove accumulated debris from valves, reducers and off takes;
- Carry out maintenance as recommended by fitting and valve suppliers;
- Regularly inspect major wear components;
- Maintain emergency dump ponds in a dewatered/empty state; and
- Maintain and replace system instrumentation as required.

5.2.5 Mobile Equipment

Mobile equipment is maintained on the basis of a planned reliability program and as otherwise required. Equipment in question includes:

- Dozers;
- Excavators;
- Water truck;
- Pickup trucks;
- Mobile crane;
- Flatbed and picker truck; and
- Replacement of mobile equipment as required.

5.3 Event-Driven Maintenance

In the event of unusual conditions or incidents that require immediate maintenance actions but are not considered an emergency, repairs and replacement of facility components are made as

required and activities are documented. RRM staff will provide a means to assess event driven maintenance needs through response action planning. Response planning is based on risk prioritization, maintenance crew mobilization or “call out” procedures, required repairs and replacement material availability. Event driven maintenance actions will follow applicable safety and performance procedures. Normal documentation and maintenance records will be maintained as a result of any event driven maintenance actions. Unusual conditions that require maintenance are also communicated to maintenance staff as they occur.

5.3.1 Pipeline Leaks or Breaks

In the event of a pipeline leak or break the system in question is de-energized and repaired as follows:

- Inspect entire pipeline;
- Repair or replace affected components;
- Perform opportune and scheduled maintenance;
- Repair any collateral damage caused by a leak or break;
- Collect any released tailings and place in the tailings impoundment;
- Reclaim any disturbed areas; and
- Follow any spill reporting that may be required pending type of spill and following documentation procedures.

5.3.2 Earthquake Occurrence

Following an earthquake, the following are undertaken:

- Inspect dam and beach areas for sign of distress due to deformation;
- Inspect dam for signs of liquefaction (e.g., local sand boils, etc.);
- Measure freeboard for compliance with design requirements;
- Inspect toe area of dam for signs of deformation or piping of fines;
- Inspect diversions, ditches and spillways for sign of slumping or changes in geometry;
- Inspect seepage collection areas; and
- Collect instrumentation data and submit to EOR for analysis.

5.3.3 Flood Event

Following extreme storms (as defined in section 7) the following are undertaken:

- Measure freeboard for compliance with design requirements;
- Inspect dam, diversions, ditches, spillways and diversions for signs of excessive erosion and repair if required;
- Inspect seepage return system for adequacy; and
- Implement appropriate response based on observations/measurements as defined in this manual.

5.4 Reporting Requirements

Maintenance information will be communicated internally through formal and informal meetings, interaction between various levels of the organization (department and/or crew meetings), through information posted at the site and through this OMS Manual.

Communications with applicable contractors involved in tailings management will be conducted daily and weekly during tailings activity meetings, as appropriate. All employees and contractors are encouraged to communicate openly with site management about operational conditions requiring maintenance and reporting any significant observations such as event-driven maintenance or any maintenance requirements that exceed expected norms.

Equipment logs and manuals will be maintained for reference and use by responsible staff.

Maintenance diaries and logs shall be maintained and accessible for review by other parties.

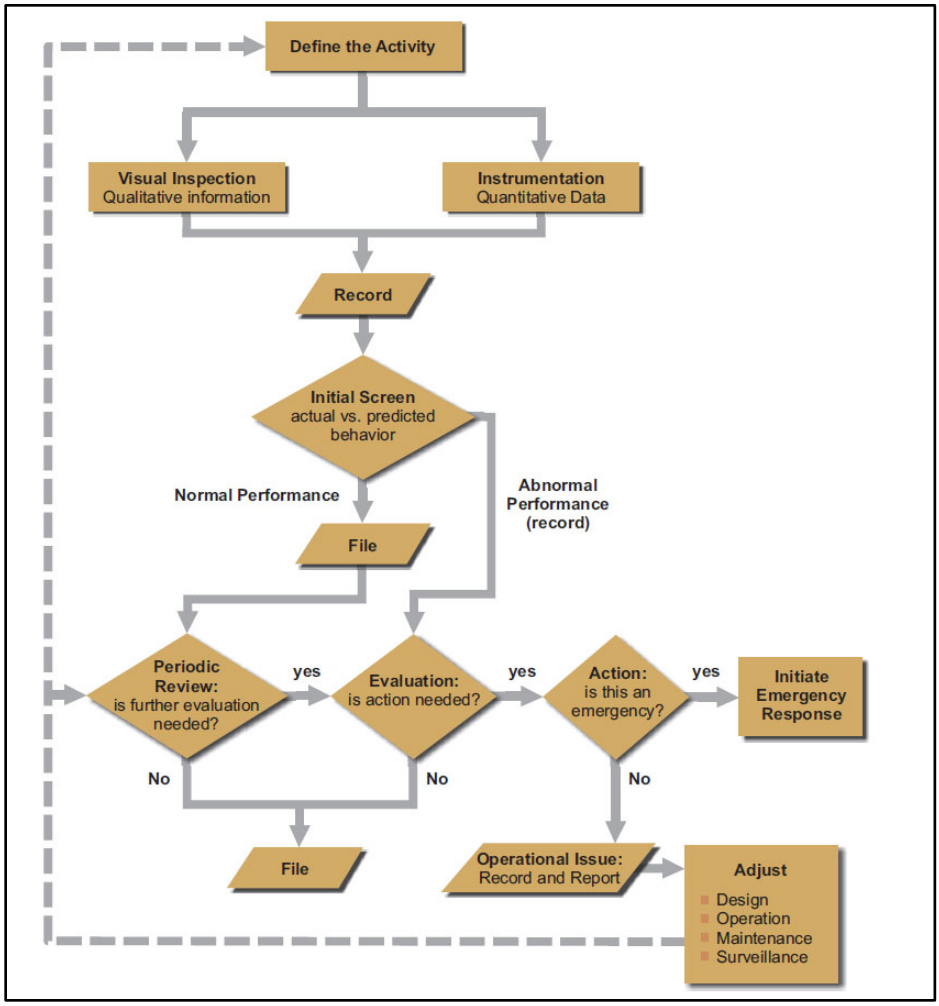
6.0 DAM SAFETY AND SURVEILLANCE

The RRM tailings and water management surveillance activities involve inspection and monitoring of the operation, structural integrity and safety of a facility. Regular review of surveillance information can provide an early indication of performance trends that, although within specifications, warrant further evaluation or action. The objectives of our surveillance program are as follows:

- Monitoring the operation, safety and environmental performance of tailings and water management facilities;
- Promptly identifying and evaluating deviations from expected behavior that affect operational safety, structural integrity and environmental performance of the facility; and
- Reporting significant observations for response.

The flow chat for surveillance is shown in Figure 7-1. Surveillance is undertaken in two primary methods – visual inspection and reading of instruments. Results of these qualitative and quantitative observations are compared to the expected performance of the TMA and water management facilities. If observations are within the expected range or performance, the results of the surveillance are simply recorded. If observations are outside the expected range, further evaluation is completed to determine if remedial action is necessary. If necessary, this action is taken and may range from a minor adjustment to operational procedures to initiation of emergency response, depending on the severity and nature of the deviation from expected performance.

Figure 13-1; Surveillance Flow Chart



6.1 Surveillance and Inspections by Mine, Mill and Environment Operations Staff

The purpose of the surveillance program is to identify and classify problems and/or unsafe conditions that are visually evident. Visual inspections are an integral part of proper maintenance and performance of monitoring programs for the TMA and water management facilities. Failure to correct identified maintenance and repair items, or potential adverse behaviour, could result in unsafe conditions or lead to a failure of operating systems or cause an adverse environmental effect.

The surveillance program will consist of making regular observations relating to:

- The conditions and performance of the dams including indications of cracking, bulging, depressions, sinkholes, vegetation, surface erosion and seepage;
- Water levels and pump intake zones;
- Function of ancillary hydraulic structures (diversions, spillways, pipelines etc.);
- Discharge pipeline operations and tailings beach development; and

- Total facility performance.

During inspections, observations will be made at the upstream slope, crest and downstream slope with respect to signs of erosion, scouring, cracking, settlement, deformation, and any instability and abnormality. Seepage rates will be visually estimated and recorded on the inspection forms. Changes in the seepage rate or clarity (i.e., turbidity) require immediate reporting to the Engineer-of-Record.

6.1.1 Daily Inspections

During first filling of all dams except the TMA dams Surveillance records will be maintained in logs at site and submitted to the EOR for review daily and on a monthly basis thereafter, or more frequently as warranted. Any abnormal behaviour including slope slumping, erosion of crest settlement will be reported immediately to the Engineer-of-Record.

Routine daily visual inspections of critical dams (TMA, WMP and MRP), spillways, pipelines, pipeline containment and pumping infrastructure will be carried out on an on-going basis to confirm normal operations and identify unusual or anomalous conditions such as pipeline leaks, pump intake blockages, etc. All active pipelines will be inspected twice per 12 h shift, consistent with EA conditions.

Daily inspection sheets and provided in Appendix F.

6.1.2 Weekly Inspections

Physical inspections of the TMA, process water, water treatment and diversion dams will be conducted on a weekly basis. The weekly inspections will include those discussed in Section 7.1.1 and the following tasks:

- Photographic record of key features;
- Physical inspection of dams, dykes, diversion, ditches and spillways:
    - Indicating and reporting any seepage and erosion.
- Pond levels and freeboard:
    - Additional monitoring maybe required during spring freshet of the dams.

Weekly inspection sheets and SOPs are provided in Appendix F. All weekly inspections will be documented in a report and will be compiled as part of the annual DSI (Section 7.4).

6.1.3 Other Inspections

6.1.3.1 Water Treatment

6.2 Inspection Required After an Unusual Event

Several potential failure modes exist for the various tailings and water management and water diversion storage facilities. These potential failure modes, along with likely triggers, observable visual and instrumentation indicators of the failure mode are presented in Table 9-1. Special inspections will be carried out immediately if any of the following events occur:

- Events such as an earthquake, large rainfall (greater than 1:2 year rainfall (51mm)) or large snowfall/snowpack;
- Operating events such as rupture of a pipeline, particularly if on the slope or crest of the dam, sudden loss of pond water, sudden rapid rise of pond water;

- Observations such as cracks, excessive settlements, sinkholes, large slope or foundation deformations, increased seepage, turbidity of seepage water; and
- Instrument readings that deviate from historical trends, or are within “alert” action levels (e.g., trigger levels).

Special inspections after unusual events are necessary as summarized in Tables 7-1 to evaluate whether there has been any damage requiring correction, any safety measures or special operating procedures that need to be implemented, or if there is a need to initiate emergency procedures as described in Section 9.0.

Table 13-1; Maintenance Requirements following an Unusual Event

Unusual Event	Post – Event Inspection/Surveillance
Earthquakes	Carry out a detailed walkover of all dam structures, including crests, downstream and upstream (visible) slopes and dam toes, and all spillways, looking for signs of cracks, bulging, settlement and/or other deformations. Look for and note any changes in seepage, particularly with respect to the rate of seepage flows at dam slopes and seepage clarity. Read all piezometers. Inspect downstream toes of dams for sand boils and dam slopes for sinkholes. Inspect ponds upstream of the dams looking for ‘whirlpools’. Inspect all pump stations and pipelines. Discuss findings with the Dam Safety Inspector.
Rapid snowmelt and/or heavy rainstorms exceeding a 1:2 year rainfall (51 mm)	Inspect the (visible) slopes and the crests of all the tailings dams looking for areas of concentrated runoff and erosion. Make note of saturated ground/soft ground conditions at dam slopes and toes. Examine dam slopes for indications of localized slumping/instability. Inspect all pump stations and pipelines. Check the water levels in all ponds/reservoirs against the critical levels, and keep checking these levels until the pond/reservoir inflows subside. Discuss findings with the Dam Safety Inspector. Check piezometric levels at dam sites if instructed to do so.
Unusually high winds (exceeding 60 kph i.e., 75 % of maximum likely used in design)	Check the condition of erosion protection on the upstream slopes of the dams.
Extreme snow pack (170cm cumulative snowfall) (i.e., 120% or greater than normal snowfall at Barwick)	Check the water levels in all ponds/reservoirs against the critical levels, and keep checking these levels until the spring freshet is over. Evaluate the situation in terms of possible snowmelt scenarios. Make predictions as to the expected storage capacity available in ponds/reservoirs. If deemed necessary, mobilize pumping and mobile treatment equipment to site.
Significant, relatively rapid erosion (any cause) of dam slope of ‘sudden’ seepage break at dam slope or downstream of dam in form of continuous seepage or boils	Inspect clarity of seepage, rate of seepage and amount of material sloughed. Notify tailings coordinator – site engineering and EOR. Consider initiating Emergency Response Plan
Pond level close to, or approaching a critical level	Notify Manager. Consider initiating Emergency Response Plan
Significant change in an instrumentation reading – see table below for definition of significant change	Check the historical readings paying special attention to seasonal changes and check the measurement again. Carry out visual inspection of all areas in the vicinity of the instrument of interest. Contact the Engineer of Record.

6.3 Dam Instrumentation and Monitoring

The instrumentation data is reviewed regularly to identify anomalous readings that could indicate a change in the conditions of the tailings and water management facilities. Dam instrumentation lists are provided in section 4.6. Instrumentation reading and reporting frequencies are outlined in Table 7.2. Responsible parties' record notes and takes pictures of any potential anomalies to provide further information to the EOR. Instrument trigger and alert levels are provided in Table 7.3. Additional details on instrument reading frequencies can be found in the *Geotechnical Monitoring Plan* (Amec Foster Wheeler, 2016b).

Piezometers:

- Vibrating Wire Piezometers shall have a reading frequency every hour and recorded by a data logger, with data collected daily during construction. Post-construction after the readings have stabilized, the reading frequency will be reduced to every 12 hours, as defined in the table below;
- Standpipe piezometers shall be measured weekly during construction and monthly following construction;
- The following are considered anomalous:
    - Sudden increases or decreases that do not correlate with seasonal variations (e.g., groundwater recharge during snowmelt affecting foundation piezometers);
    - Trend of piezometric increase that approaches or exceeds the rate of rise of the tailings pond; and
    - Pattern of sudden and large increases followed by rapid declines.

Inclinometers:

- Inclinometers shall be monitored semi-weekly during construction and weekly following construction;
- Anomalous data includes:
    - Sudden increases in cumulative displacement/rate of movement of the inclinometers;
    - Zones of concentrated or discrete displacement; and
    - Blockages of the inclinometer casing.

Settlement Plates and Survey Pins/Monuments:

- Settlement Plates and Survey Pins/Monuments shall have a reading frequency of semi-weekly during construction and weekly following construction;
- Anomalous data includes:
    - Sudden displacements of the settlement monuments (x, y, z directions); and
    - Accelerating displacement trends (over two or more readings).

If anomalous readings are observed, the following actions should be taken:

- Check data, reductions and calculations for accuracy and correctness;

- If no errors are found in the calculations, notify the EOR, Geotechnical Engineer and Environmental Manager that an anomalous reading has been observed and that further assessment is going to be conducted;
- Check readout equipment to verify that it is functioning correctly; verify calibration;
- Re-read all instrumentation of the type for which the anomalous reading was observed, in order to check the reading and reading in adjacent instruments;
- If it is observed that an instrument or piece of readout equipment has stopped functioning, notify the Mill Manager and/or Superintendent, and the EOR immediately. If considered critical, a replacement instrument should be installed;
- If the anomalous reading is confirmed, notify the Superintendent and EOR immediately; and
- A detailed review of the effects of the reading should be carried out and the monitoring frequency of the instruments in the area of the anomaly increased to assess the progression of the anomaly. Design or remedial actions should be implemented if determined necessary.

All results are downloaded and provided to the EOR. Any anomalies are noted and a request for an additional reading may occur. The EOR will review the data in quarterly monitoring reports, and make any recommendations, such as increased reading frequencies, pertaining to anomalous readings. The EOR, will also assess the trigger and alert levels and update them as necessary, once per year, as part of the DSI.

Table 13-2; Dam Instrumentation Surveillance Requirements

Type	Frequency
Routine Inspection:	
Dam	Weekly
Diversions	Weekly
Ditches	Weekly
Seepage collection system	Weekly
Spillways	Weekly
Pipelines	Once per 12 h shift
Tailings Pond Monitoring:	Weekly
Pump intake	Weekly
Staff gauges	Weekly (initially every ~12h) in Cell 1 borrow
Inflows, Outflows, Condition	Monthly
Dam Instrumentation:	Weekly
TMA, WMP and MRP Comprehensive (and water diversions during initial filling)	• Daily during construction and initial filling • Weekly, during initial operations depending on trend • Monthly during routine operation
Annual Dam Inspection	Annually, with no snow cover
Event Driven Inspection	Following unusual events (defined in table 7.1)
Comprehensive Review (DSR):	
Low and Moderate HPC dams	Every 10 years and prior to decommissioning
Very High HPC dams	Every 5 years and prior to decommissioning

Notes:

1. Dam Hazard Potential Classification (HPC) requires review when changes are made or downstream conditions change.
2. Monthly facility inspections should be carried out by the same staff or small group of staff such that subtle changes in the conditions can be detected.

Table 13-3; Instrument Trigger and Alert Levels

Instrument	Parameter	Trigger Level	Alert Level	Remarks
VWP/STP	Pore Pressure Ratio	r_u = 0.4	r_u = 0.5	Pore pressure data to be evaluated with corresponding fill elevation, and monitored movements at SPs and INs
Survey Pin	Lateral Movement Rate	Uniform (but less than max 75 mm magnitude)	Accelerating	To be evaluated with IN data to define zones of movement
Slope Inclinometer	Lateral Movement Rate	Uniform	Accelerating	Deformation rates will be associated with rate of construction and post construction movements
	Share Strain Magnitude	2%	5%	If specific plane(s) of shearing is observed within the foundation, the construction shall be limited, progressed with caution or ceased depending on the observed phenomena

Notes:
1. r_u of 0.4 corresponds to a piezometric head at 80% of the dam height. r_u 0.5 is at pietometric head at the crest of the dam.
2. r_u of 0.5 is a design criteria to meet dam stability requirements.

Source; Geotechnical Monitoring Plan (AMECFW, August 2016)

6.4 Dam Safety Inspections (DSIs) and Dam Safety Reviews (DSRs)

Consistent with MECP ECA approvals, with the regulatory exception of the Clark and West Creek Diversions, engineering inspections will be conduct following best management practices as per the Canadian Dam Association's (CDA) Dam Safety Guidelines (2007, revised 2013, as amended from time to time), and the 2014 CDA Technical Bulletin: Application of Dam Safety Guidelines to Mining Dams (as amended from time to time).

6.4.1 Dam Safety Inspections

Annual inspections are intended to be part of a more thorough review of the condition of the facility, and are carried out by the EOR. The inspections will include the following key items:

- Visual inspection of the facility by the engineer, including taking appropriate photographs of the observed conditions;
- Review of routine inspection records prepared by operating personnel in the past year;
- Review whether or not recommendations from previous year's inspection(s) have been addressed, and any incidents or actions arising from those previous recommendations;
- Review of instrumentation and monitoring data;

- Review of tailings deposition and water management operations of the facility including reconciliation of the annual water and mass balance. Review of pond levels (and depth) and freeboard, and reports of any incidents (and remedial measures) that may have occurred;
- An evaluation and interpretation of the structural performance of the dam and related components, and identify any potential safety deficiencies or recommended items that need to be addressed in the coming year;
- Review construction records, QA/QC data and as-built information on dam construction and beaching; and
- Evaluation of the OMS Manual to assess the need for updating.

The results of the inspection and review will be documented in a report.

6.4.2 Dam Safety Review

The Canadian Dam Association (CDA) Dam Safety Guidelines (CDA, 2007) recommend a comprehensive dam safety review be carried out every 5 years during operations, prior to decommissioning and following closure, by a qualified 3rd party consultant.

The comprehensive review provides independent verification of:

- Safety and environmental performance of the facility;
- Adequacy of the surveillance program;
- Adequacy of delivery of OMS Manual requirements;
- Design basis with respect to current standards and possible failure modes; and
- Compliance with new engineering standards (including analysis to confirm if necessary).

6.5 Documentation

Documentation of surveillance and monitoring activities shall be maintained by the Mill Manger, or as designated, as described in the preceding sections and will include recording of:

- Routine visual observations (departures from normal conditions);
- Photographs;
- Instrumentation monitoring and testing;
- Analyses and evaluations; and
- Reviews.

Documentation will include, as a minimum, the following:

- Weekly routine inspection log;
- Monthly tailings facility and process water pond monitoring report;
- Quarterly instrumentation reports;

- Annual Dam Safety Inspection reports; and
- Comprehensive Dam Safety Review report every 5 years.

Documentation will include a hard copy (paper) and electronic filing system for inspection reports, photographic and video records, incident reports, instrumentation readings, instrumentation plots, annual inspections and third-party reviews, so that they can be quickly retrieved for review and in case of an emergency.

6.6 Reporting

The Mill Manager, or designated responsible party, and Geotechnical Engineer will review collected data records from facility monitoring and assess the need for maintenance activities or response. Corrective actions will be identified and tracked to closure. The Environmental Manager is responsible for overseeing sample and data collection and analysis. Reporting will meet MECP requirements and the annual DSI report will also be submitted to the MRNF. Reporting includes;

- As built reports of the dams, excluding the Clark and West Creek diversions, will be submitted to MECP within 90 days of completion;
- An annual report based on the DSI including ECA approval requirements;
- Monthly water quality monitoring report; and
- Annual report including any operating problems and corrective actions, a summary of calibration and maintenance works, use of contingency plans, surface water and groundwater monitoring reports including water balance, ML/ARD updates, discharge volumes and quality.

Additional reporting requirements may be developed as the RRM progresses.

7.0 CLOSURE PLAN

This section summarizes the objectives of the Closure Plan. The *Rainy River Project – Closure Plan* (Amec Foster Wheeler, 2015c) provides the closure plan and includes temporary closure options for short and medium-term shut-down of site facilities.

7.1 Tailings Management Area

Closure of the TMA will include, but is not limited to, the following:

- Flooding of the TMA with a 2 m or deeper water cover;
- A perimeter zone of tailings beach will be maintained to keep the central pond away from the dams, this zone will be covered with a low permeability cover;
- NPAG rock will be placed at the TMA transition zone with the tailings to prevent erosion and suspension and oxidation of solids; and
- Dam structures containing the TMA have been designed with adequate safety factors to provide overall long term safety and stability.

7.2 Embankments

Closure of the embankments will typically involve, but is not limited to reaching of embankments to prevent ponding of water and revegetating slopes to reclaim the area. Some embankment structures will still have a role during the closure phase and these will not be breached. The following structures will continue to be operated during the closure phase:

- MRP will collect runoff and seepage from EMRS, which will be directed to the Open Pit to help flooding;
- Sediment Ponds #1 and #2 will be maintained until site is recognized as a closed mine and monitoring associated with the Metal Mining Effluent Regulation is no longer required

Freshwater diversion and constructed wetland structures are designed to operate passively and will remain in place at closure.

7.3 Monitoring

Monitoring requirements are described in the *Rainy River Project – Closure Plan* (Amec Foster Wheeler, 2017c).

8.0 CONTINGENCIES

The operations are sensitive to water balance and water quality in discharges. The following are contingencies based on water management and functioning of the diversions.

8.1 TMA

8.1.1 Cell 1 contingency

- Maintain or add additional pumping capacity to the WMP to drain the cell if required due to the MOWL being exceeded;
- Manage filling of the WMP to consider additional storage capacity of the EDF from cell 1; and
- Accelerate construction of cell 2, where permitted.

8.1.2 Cell 2/3 Contingency

- The TMA has been designed to operate with a pond volume of 4-6 Mm^3, with additional capacity for up to 8 Mm^3. In a wet year pumping to the WMP can be extended longer than planned and discharged from the WMP, pending receptor capacity (Pinewood River flow)
- Any additional precipitation events after the EDF, prior to dewatering, could cause an uncontrolled release of untreated water to the environment, and alternative contingency measures would be required to reduce the water level at a faster rate (i.e. such as pumping excess water to the open pit or transferring TMA Cell 2 water into the WMP with no treatment).
- Pumping will be considered directly from the WMP to TMA Cell 3 to reduce WMP volumes to 1.0 Mm^3 prior to discharge from Cell 2 through the WTP into the WMP.
- Water treatment plant to be completed in September 2018 to allow pumping from cell 2, if required

- TMA raises to be sequenced to avoid a water deficit, however, reduction in discharges to the CW and additional takings from the Pinewood River, West Creek and Clark Diversions will be considered, subject to maintaining minimum flows

8.2 Process Water

8.2.1 Mine Rock Pond

- If the MRP MOWL (356.8m) is exceeded, then pumping into the MRP from the open pit will cease and pumps will pump water toward the plant site/WMP/TMA at 680 m^3.

- Overtopping of the Clark Creek Dam was considered in the design of the MRP. The Clark Creek Dam and Pond are designed for a 1:100 year 24h event, if this is exceeded then water will spill from the dam and flow toward the EMRS. Water on the eastern side of the EMRS reports to a sump and flows through NAG rock under the EMRS to the MRP. Given this flow path the contribution of this flow is not significant on the peak inflows to the MRP.

9.0 REFERENCES

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