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Review of Acid Rock Drainage & Metal Leaching in support of mine waste management

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CanmetMINING, Natural Resources Canada

Joint Review Panel Hearing for the Marathon PGM project

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Canada

Outline

- Mandate of CanmetMINING
- Description of acid rock drainage and metal leaching (ARD/ML)
- Current practice in ARD/ML predictions
- Role of ARD/ML predictions in water and mine waste management
- Main findings and recommendations

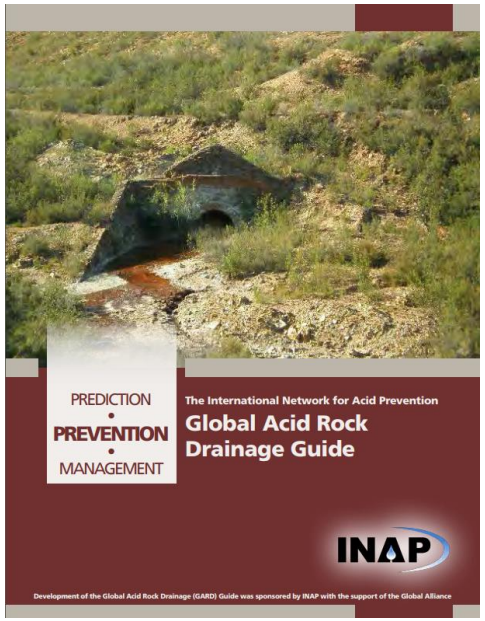
Mandate of CanmetMINING

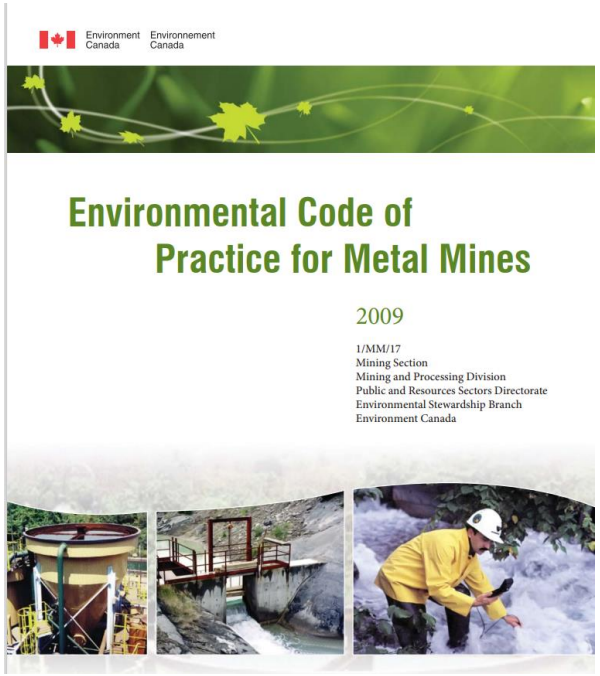
- Develop mining innovations to achieve sustainability across Canada
- Develop mine waste management strategies to limit impact of Acid Rock Drainage and Neutral Metal Leaching
- Develop mining effluent treatment technologies to improve best available treatment technologies economically achievable (BATEA) in Canada.

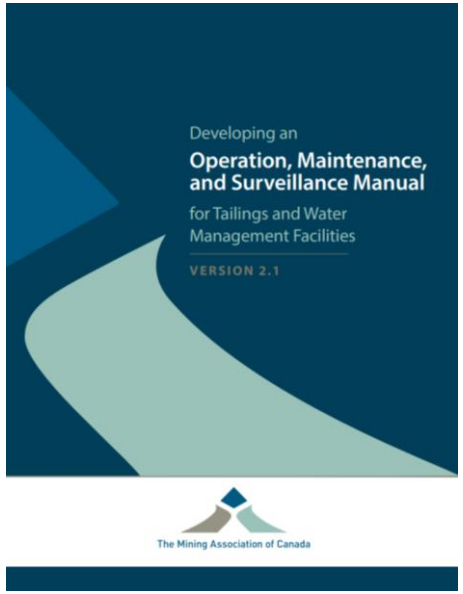
Mine waste management guidance

Prediction Manual for Drainage Chemistry from Sulphidic Geologic Materials

MEND Report 1.20.1

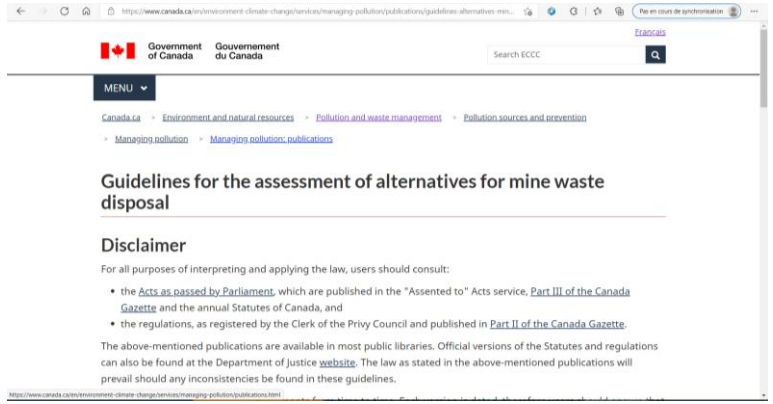






Study to Identify BATEA for the Management and Control of Effluent Quality from Mines

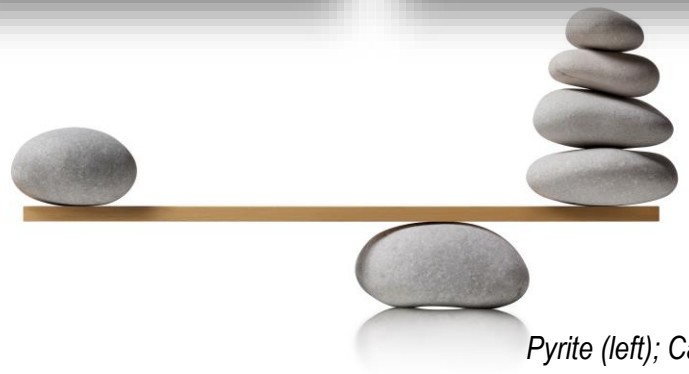
MEND Report 3.50.1



Acid Rock Drainage (ARD)/ Metal Leaching (ML)

Pyrite + Oxygen + Water → Acid + Metals + Sulphate

Can impact water and sediment quality and be toxic to aquatic life



- *Environmental impact of these reactions depends upon exposure of mine waste to oxygen and water, and balance of acid and buffering minerals*
- *However, measures exist to limit impacts to aquatic life (i.e. placement of waste rock under water, etc…)*

Pyrite (left); Calcite (right) photos from mindat.org

Geochemical Characterization to Assess ARD/ML Potential

Photos from MEND 1.20.1 and GARD guide

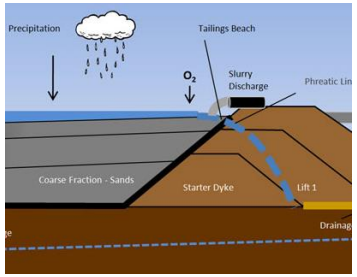
Iterative Process
Address Data Gaps and Refine Management Plans

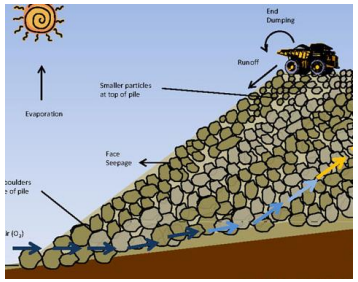
1. Sampling Program
- Mine rock, pit walls
- Process waste
- Representativeness

2. Analytical Program
- Static tests (potential)
- Kinetic tests (timing, chemical load)

3. Waste Management Planning
- Mine plan / sequencing
- Operational testing / segregation
- Closure plan

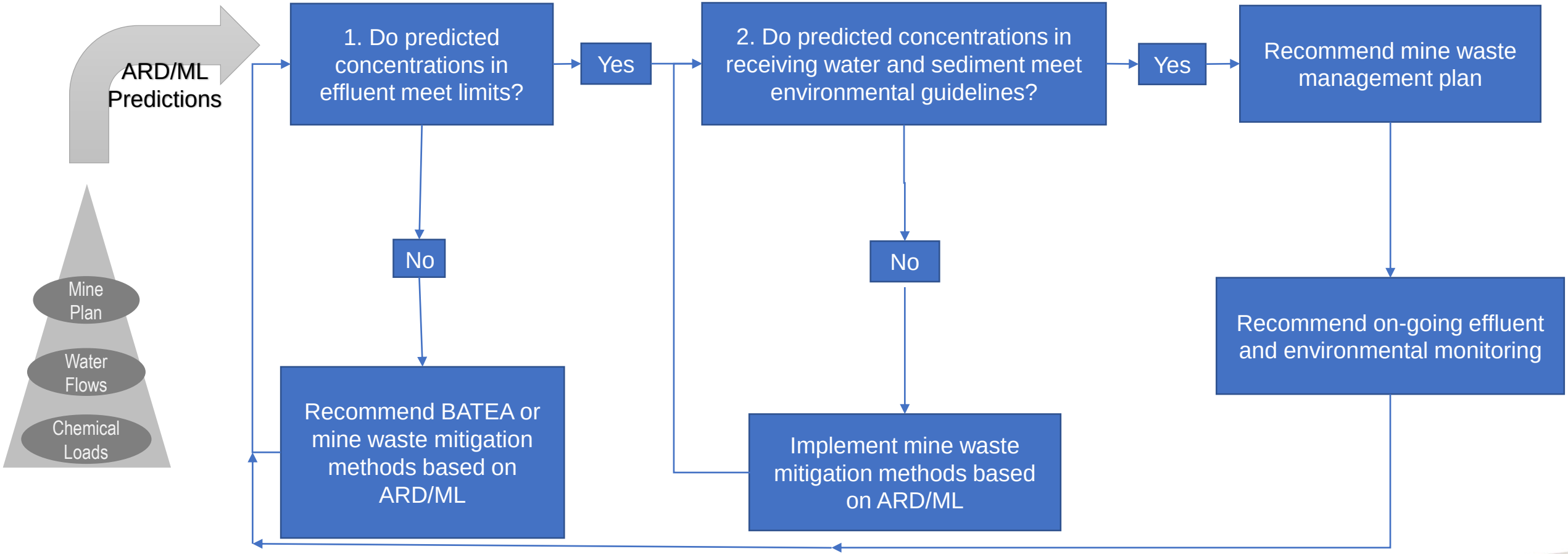
Mine Water Quality Estimates
Chemistry + water flows + mine plan





ARD/ML predictions and waste management recommendations

Recommendations based on consultation with federal departments (i.e., ECCC, DFO, HC) and federal and provincial regulators (i.e., MECP, ECCC)



Main findings: Type 1 Rock Metal Leaching

Findings

- Type 1 mine rock will be used for construction or stored in Mine Rock Storage Area (MRSA)
- Testing demonstrates some potential for neutral mine drainage
- Follow-up testing is proposed using run-of-mine rock in early operations

Recommendations

- Evaluation of neutral leaching potential in the Mine Rock Segregation Program
- Follow-up monitoring and mitigation in the event that neutral mine drainage develop in MRSA

➢ *Could lead to local effects to groundwater quality and the aquatic environment if drainage is not appropriately captured*

Main findings: Type 2 Mine Rock Volumes

Findings

- Spatial gaps in mine rock sample distribution in all pits
- Potential for underestimation of Type 2 mine rock volumes

Recommendations

- Mine Rock Segregation Program should in include on-going:
  - testing to address data gaps
  - refinement of volume estimates
- Ensure adequate operational monitoring and adaptive management strategies are in place

➢ *Could lead to effects to groundwater quality and aquatic habitat if there is inadequate management of Type 2 rock*

Main findings: Type 2 Mine Rock in MRSA

Findings

- Imperfect segregation of Type 2 rock could result in its placement in MRSA
- Not considered as sensitivity analysis in water quality estimates

Recommendations

- Complete water quality estimates considering Type 2 mine rock in MRSA for operations through post-closure
- Ensure adequate water treatment, mitigation, and monitoring measures are in place for operations through post-closure

➢ *Could have implications on seepage and runoff quality in operations, closure and post-closure that affects aquatic habitat*

Main findings: Pit Lake Water Quality

Findings

- Pit lake water quality estimates consider complete submergence of pit walls and backfilled Type 2 waste prior to acidification
- Faster reacting minerals present in the deposit could result in a shorter time to acidification than currently estimated

Recommendations

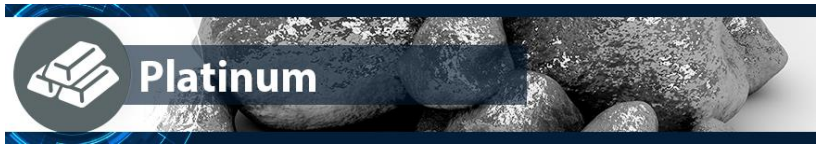
- Complete additional kinetic testing of Type 2 mine rock to refine estimates of timing to acidification
- Update the water quality estimates with acidic loading rates and timing estimates

➢ *Overestimation of timing to potential ARD/ML could result in acidification prior to scheduled management and mitigation strategies*

Main findings: Platinum Group Metals (PGMs)

Findings

- PGMs are not of concern as there are no environmental quality guidelines
- Recent science suggest PGMs, are more soluble and toxic to aquatic life



Recommendations

- Provide preliminary predictions of PGMs in effluent and receiving environment using exploration drill core data
- During construction, conduct additional testing to verify predictions of PGM release rates, their levels in effluent and the environment
- Use predictions or water quality criteria as compliance measures during environmental monitoring and adapt effluent and mine waste management if necessary

➢ *Ignoring PGMs could prevent the implementation of economically feasible effluent and waste management strategies and lead to effects to aquatic life*

Conclusion

CanmetMINING is satisfied with the proposed mine waste management program but recommend that Marathon PGM:

- Continue refining its Segregation of Type 1 and 2 waste
- Continue refining the timing to acidification of Type 2 waste
- Update MRSA and pit lake water quality estimates considering acidification of Type 2 mine rock
- Provide estimate of PGMs release
- Adjust mitigation measures as appropriate

➢ *Overlooking these recommendations could lead to preventable effects to aquatic life*

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