



Regulation of Tailings Storage Facilities in British Columbia Changes Following the Mount Polley Failure and Consideration of Filtered Tailings Facilities

MEND Presentation by
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Welcome, my name is Sarah Morse and I am presenting today on the Regulation of Tailings Storage Facilities in British Columbia, Changes following the Mount Polley Failure and Regulatory consideration of filtered tailings. I will also note that we are now in a new ministry, the Ministry of Mining and Critical Minerals, or MCM. I will generally refer to work done in the past as the same, MCM to avoid confusion and too many acronyms, but acknowledge that this work mostly done under EMLI, Energy Mines and Low Carbon Innovation, or EMPR Energy, Mines, and Petroleum Resources. I am also using an outdated PowerPoint template with the old ministry name.



Presentation Outline

- Overview of Mine and Tailings Storage Facility (TSF) Regulation in British Columbia
- Findings and Recommendations Following the Mount Polley Breach
- Changes to Regulation of TSFs
- Regulatory Consideration of Filtered TSFs
- Regulatory Consideration of 'Dry' Closure for Existing TSFs

Here is a brief overview of the topics I will be covering.

Starting with a general overview of Mine and TSF regulation in BC

Findings and recommendations following the Mount Polley Breach

Changes to regulation of TSFs in British Columbia since 2014

Regulatory consideration of filtered TSFs

And finally regulatory consideration of Dry closure for existing and legacy TSFs



Overview of Mine and TSF Regulation in British Columbia

Ministry of Mining and Critical Minerals (MCM) is the regulator for TSFs and contact water dams and conveyance structures on mine sites

- *Mines Act*
- Health Safety and Reclamation Code for Mines in British Columbia (the Code)
- Permits Issued under the *Mines Act*

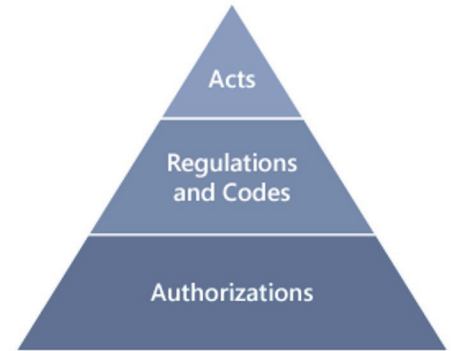


Figure 1. Hierarchy of laws

Regulation of Mines in British Columbia is conducted under the regulation of the Mines Act in conjunction with the Health Safety and Reclamation Code for Mines in British Columbia (the Code) which is established under the Act.

The *Mines Act* regulates all mining activities in British Columbia – from early exploration to development, production, reclamation, closure, and post-closure.

The Code provides overall health and safety requirements for all mines in British Columbia

Below this hierarchy there are guidance documents such as the Part 10 Guidance Document and the Joint Application Information Requirements Document.



Overview of Mine and TSF Regulation in British Columbia

Indigenous Rights and Reconciliation

- Declaration on the Rights of Indigenous Peoples Act
- Indigenous Nations and the Permitting Process
- Economic Reconciliation



The Declaration on the rights of indigenous peoples Act was passed in BC in 2019 – to advance reconciliation and go beyond the legal duty to consult. The Declaration Act in BC follows Canada’s endorsement of the 2010 United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP).

Indigenous Nations play a significant role in Major Mine permitting processes in BC.

Since UNDRIP, there has been an increase in Collaboration Agreements with Indigenous Nations involved in major mine permitting and regulation.



Overview of Mine and TSF Regulation in British Columbia

Professional Reliance Model

- Qualified Professionals are held accountable by their professional regulatory body
- Regulatory bodies are regulated by the Professional Governance Act (PGA)
- Designs by Professionals
- MCM Technical Reviewers and Inspectors do not direct work



- A key aspect of the regulatory model being used by MCM for permitting and compliance of mines is the Professional Reliance Model.
- Qualified Professionals are held accountable by their professional regulatory body.
- Regulatory bodies in British Columbia are regulated by the Professional Governance act.
- Facilities on a mine site must be designed by a professional Engineer or other Qualified Professional with exemptions for small low risk structures.
- For tsfs and dams, Annual performance reviews required by the Code must be carried out by a professional engineer
- Similarly issued for construction documents, construction record reports, as-built drawings and assurance statements certifying that a structure is suitable for use must be authenticated by a professional engineer
- MCM Inspectors or reviewers do not direct work on a mine site, participate in the development of designs or evaluations, or direct what engineering needs to be carried out, and regulatory or permitting reviews are not considered 3rd party reviews.



Findings and Recommendations Following the Mount Polley TSF Breach

Investigations and Reports:

- Auditor General's Report: An Audit of Compliance and Enforcement of the Mining Sector
- Investigation Report of the Chief Inspector of Mines: Mount Polley Mine Tailings Storage Facility Breach, August 4, 2014
- Independent Expert Investigation and Review Panel: Report on Mount Polley Tailings Storage Facility Breach



The Mount Polley Mine TSF Breach occurred on August 4, 2014, and resulted in the release of tailings and mine water into the environment.

There are three primary investigations and reports that provide assessment and recommendations following this event.

Each of these investigations had a different focus and terms of reference and they each resulted in reports which provided recommendations to improve TSF safety, including regulation, industry changes, and organizational changes.

The Auditor General's Report had been initiated prior to the Mount Polley Breach, had an objective to determine whether the regulatory compliance and enforcement activities of the Ministry of Energy and Mines and the Ministry of Environment pertaining to the mining sector were protecting the province from significant environmental risks.

The Chief Inspector's report had a mandate including a determination of the root cause or causes of the event; any contributory causes; and the preparation of findings that address the accountability of the industry, the regulator, engineering practices, and any other contributors to the event. According to the report, the Chief Inspector's intent was to determine how to reduce the risk of such an event occurring again, and make recommendations for regulatory changes for British Columbia and the mining community.

The report from the independent expert panel's terms of reference included:

- Identify any mechanism or mechanisms of failure of the TSF.

- Identify any technical, management or other practices that may have enabled or contributed to the mechanism or mechanisms of failure, including an independent review of the design, construction, operation, maintenance, surveillance and regulation of the TSF. and

- Identify any changes that could be considered to reduce the potential for future such occurrences.

In the following slides, I will summarize some of the key recommendations for each of these reports – details regarding how MCM has addressed each of the recommendations to date are publicly available in a tabulated format.



Findings and Recommendations Following the Mount Polley TSF Breach

Recommendations to MEM from the Auditor General

Seven key elements of a comprehensive compliance and enforcement program



Source: Office of the Auditor General of British Columbia, adapted from the Organisation for Economic Co-Operation and Development's *Ensuring Environmental Compliance: Trends and Good Practices* and MOE's *Compliance Management Framework*

The Auditor General's report provided several recommendations to both Ministry of Energy and Mines, and Ministry of Environment regarding the regulation of Mines:

The recommendations included

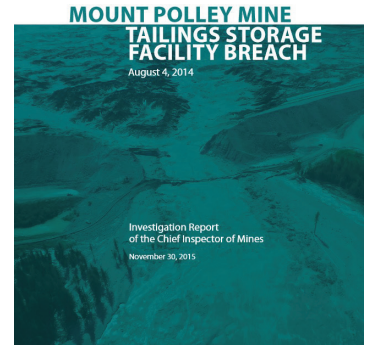
- overall re-organization of MCM to clearly separate the responsibilities for promotion of mining from regulation
- Strategic planning to provide an integrated and coordinated regulatory approach and capacity, tools, training and expertise to achieve this objective
- Improved permit language
- Incentives to promote environmentally responsible behaviour by industry
- Risk based approach to compliance verification activities
- Policies and procedures for the use and oversight of Qualified Professionals
- Development of policies, procedures, and enforcement tools for responding to non-conformances.
- Regular internal evaluation of the effectiveness of compliance and enforcement activities and tools
- Increase in public reporting as well as other recommendations.



Findings and Recommendations Following the Mount Polley TSF Breach

Recommendations from the Chief Inspector

1. Proponent Governance
2. TSF Design
3. Professional and Association Standards
4. Regulator Functions
5. Strengthening Records Management
6. Regulatory Integration
7. Fostering Innovation



Recommendations from the Chief Inspector included Recommendations under the headings of proponent governance, TSF design, professional and association standards, regulator functions, strengthening records management, regulatory integration, and fostering innovation, with multiple recommendations under each heading

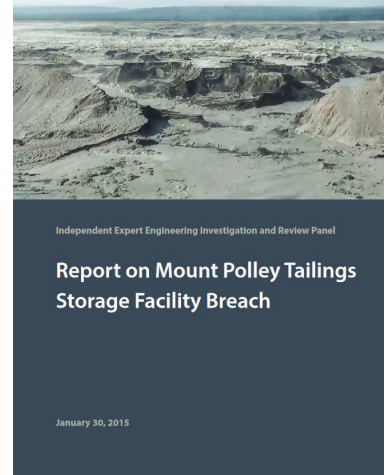
The recommendations under Regulator functions included a comprehensive review of the Code, requiring life of mine planning for permitting, a review of MCM's investigation, compliance and enforcement capacity, increased internal capacity for geotechnical oversight including a Regulatory Dam Safety Manager, and an organizational review of the inspectorate.



Findings and Recommendations Following the Mount Polley TSF Breach

Recommendations from the Independent Expert Panel

1. To implement Best Available Technology (BAT) using a phased approach
2. To improve corporate governance
3. To expand corporate design commitments
4. To enhance validation of safety and regulation of all phases of a TSF
5. To strengthen current regulatory operations
6. To improve professional practice
7. To improve dam safety guidelines



The recommendations from the Independent Expert Panel were:

1. To implement Best Available Technology (BAT) using a phased approach
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3. To expand corporate design commitments
4. To enhance validation of safety and regulation of all phases of a TSF
5. To strengthen current regulatory operations
6. To improve professional practice
7. To improve dam safety guidelines

As you can see, there is a lot of overlap in the recommendations provided, with some differences depending on the focus of each of the investigations and reports.



Changes to Regulation of TSFs

Summary:

- July 2016: Code Changes – Introduction of new requirements for TSF design and oversight
- April 2021: Audit of Code Requirements for Tailings Storage Facilities
- April 2024: Code updates with additional requirements for TSF design and oversight
- 2019 to 2023 MCM organizational changes



The changes to MCM's regulations of TSFs to improve safety since the Mount Polley Breach are extensive. The Major steps to date in this are as follow:

July 2016 code changes introducing significant new requirement for TSF design and oversight

April 2021: MCM carried out an audit of the Code requirements for Tailings Storage Facilities

April 2024: MCM published an updated Code with significant changes to Part 10 pertaining to TSF design and oversight.

Between 2019 and 2023, MCM has undergone significant organizational changes resulting in the separation of mine permitting and compliance and enforcement activities.



Changes to Regulation of TSFs

July 2016: Code Changes – Introduction of new requirements for TSF design and oversight

- New Application Requirements
- Design Standards
- Engineer of Record
- Breach and Inundation Study or Failure Runout Assessment
- Water Balance and Water Management Plan prepared by a qualified person
- Quantifiable Performance Objectives (QPOs)
- Governance requirements
- Operations Maintenance and Surveillance Manual requirements
- Reporting Requirements

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The changes to the Code requirements for TSF design and oversight in the 2016 Code update were extensive. My description here is a brief summary.

The changes included New Application requirements including:

- Description of Quantifiable Performance Objectives (QPOs)
- Prediction, identification and management of risks associated with TSFs
- Alternatives assessments in accordance with the Metal and Diamond Mining Effluent regulations for the proposed TSF that assesses best available technology and
- Closure plan for the TSF

New code requirements also included design Standards and development and documentation of design criteria – in this area, the code was supported by the Part 10 guidance document which provided additional guidance on what was expected as a minimum.

The requirement for an Engineer of Record for a TSF was introduced including the requirement that the EoR acknowledge that they had taken on the role and identifying responsibilities including a duty to report QPOs determined and reviewed by the engineer of record and the TSF qualified person

New Governance requirements including

- Requirement for a tailings management system
- Designation of a TSF qualified person
- Establishment of Independent Tailings Review Board
- And others.

Operations Maintenance and Surveillance Manual Requirements were included as were annual reporting requirements.



Changes to Regulation of TSFs

April 2021: Audit of Code Requirements for Tailings Storage Facilities

To determine whether the 2016 Code revisions pertaining to TSFs were consistent with the direction given to the Code Review Committee, have provided the Ministry with clear and enforceable regulations that are consistent with engineering best practice and among the best in the world, are systematically verified and enforced by the Ministry, and are being complied with by industry

AUDIT OF CODE REQUIREMENTS FOR TAILINGS STORAGE FACILITIES



In response to the recommendations from the post-Mount Polley reports, the MCM Mines Audit Unit was established.

The Mine Audits Unit is a specialized group in the MCM. It consists of a team of auditors with expertise and experience in mining, regulatory oversight and audit best practice. The team operates under the direction of the Chief Auditor. Who has a mandate to conduct audits to evaluate the effectiveness of the regulatory program for mining in British Columbia.

The first audit carried out by this team was the Audit of Code Requirements for Tailings Storage facilities.

The objective of the first audit was

To determine whether the 2016 Code revisions pertaining to TSFs were consistent with the direction given to the Code Review Committee, have provided the Ministry with clear and enforceable regulations that are consistent with engineering best practice and among the best in the world, are systematically verified and enforced by the Ministry, and are being complied with by industry

The Audit included recommendations under the headings of Alignment of Regulations, Health, Safety and Reclamation Code Guidance, Interpretation of Code and Compliance Verification, and Data Systems. Actions by MCM to address these recommendations included development of policies including a Review and Update Policy for the regulatory framework of TSFs, Role of the Reviewer Policy to provide guidance for Technical Reviewers, Establishing a code-review sub-committee to review the audit findings and recommendations and propose Code changes related to TSFs, and updating of the Code Guidance Document as well as others.



Changes to Regulation of TSFs

April 2024: Updates to Code Requirements for TSFs

- Responsibilities
- Updated definitions and terminology
- Design Requirements
- Reporting Requirements
- First Nations engagement and information sharing
- Water Management
- Closure Design

Health, Safety and
Reclamation Code
for Mines in
British Columbia

Ministry of Energy, Mines and Low Carbon Innovation
Victoria, British Columbia
Revised April 2024



The outcome of the Code Review Sub-Committee on TSFs that was created as a response to the Audit was Code changes for TSF regulation in the April 2024 revision to the Code

The changes were significant and included Clear designation of responsibilities for Mine Managers, TSF QPs, Dam QPs, and Engineers of Record, including timelines for reporting dam safety deficiencies if necessary.

Updated definitions and terminology including the definition of a TSF, which went from 'a facility that stores tailings' to a facility that stores tailings and manages water, if any, related to the tailings, including tailings dams, tailings deposition, water reclamation systems, water management systems and associated engineering works and structures, but does not include tailings placed in an underground mine,

Increased Design requirements including

- Details for minimum requirements for Design Reports
- tsf design summary document and change register
- consideration of climate change and
- Site Characterization Requirement

Updates also included increased reporting requirements including the Annual Facilities Performance Report (formerly DSI) with minimum requirements, a summary of outstanding TSF and dam orders with scheduled completion dates annually and added assurance statement requirements for several documents. As well, First Nations engagement requirements and information sharing by Mine Operators, requiring consideration of Indigenous knowledge in design including water management, providing reports including Annual Facilities Performance Reports and Dam Safety Reviews to First Nations and engagement with First Nations when establishing an Independent Tailings Review Board. It Codified and clarified Water Management Requirements And added Closure design requirements



Regulatory Consideration of Filtered Tailings Facilities

Best Available Technology (BAT)

- Recommended in Independent Expert Panel Report
- BAT Assessment Required for Environmental Assessment and *Mines Act* Applications

Moving on to Regulatory Consideration of Filtered Tailings

One of the recommendations from the Independent Expert Panel Review for the Mount Polley breach was To implement Best Available Technology (BAT) using a phased approach

BAT assessments are now required for Environmental Assessment Applications for projects with New TSFs and are required for all Mines Act Applications and Amendments for projects with TSFs

BAT assessments provided in Applications are included in overall Alternative Assessments for tailings facilities, Filtered tailings facilities are required to be considered in the alternatives assessment.

MCM does not dictate the type of facility used to contain tailings and relies on the BAT assessments in conjunction with the Alternative Assessments prepared by qualified professionals to provide proponents with the information needed to select appropriate facilities for their sites and conditions.



Regulatory Consideration of Filtered Tailings Facilities

Adequate mitigation or monitoring proposed associated with the risks or uncertainties of Filtered TSFs:

- Geotechnical
- Geochemical



Since the Mt. Polley Breach, MCM has permitted 4 new major mines with TSFs, this does not include new TSFs permitted as a result of Amendments to existing permits. of the 4 new mine permits with TSFs - two are filtered facilities (Cariboo Gold and Silvertip), one is an in-pit subaqueous tailings disposal facility (Brucejack), and one is a slurry TSF with dams (Blackwater).

We also have a number of co-mingled facilities in the province, where waste rock is mixed with tailings. These are not in the scope of this presentation, but represent another type of TSF that is being permitted.

One challenge for permitting filtered tailings facilities is to ensure that adequate mitigation or monitoring measures are proposed associated with the risks or uncertainties of the Filtered TSF. These include Geotechnical and Geochemical risks and uncertainties.

The following slides regarding the challenges are based on our experience to date. Unlike for conventional TSFs, we do not have a long history of experience permitting these facilities in British Columbia, so each one will present new challenges from a regulatory and permitting perspective.



Regulatory Consideration of Filtered Tailings Facilities

Review of Geotechnical Risks

- Variability in moisture contents
- Filtered material physical property understanding
- Understanding of phreatic surface
- Mitigation measures and demonstration of how potential adverse conditions can be managed operationally

Geotechnical Risks and Uncertainties Include

During review of Applications, MCM needs the proponent to demonstrate that the facility meets stability requirements, depending on the design that may require a thorough understanding of the filtered tailings strength and potential variability due to moisture content changes, and managing storage and placement during significant rain events.



Regulatory Consideration of Filtered Tailings Facilities

Review of Geochemical Risks

- Oxidation of partially saturated PAG
- ML/ARD due to placement method and low saturation level
- Time between placement of layers
- Erosion

Geochemical Uncertainties

- Long term effects of tailings ageing in dewatered facilities
- Main geochemical source terms
- Effects of filtered tailings on seepage chemistry
- Extended use of compaction as an ML/ARD control

Some of the geochemical considerations during regulatory review are:

Geochemical risks are highest during operations

Partially saturated PAG tailings will oxidize and generate ML and ARD

Time between placement of layers must be carefully managed

Precipitation and wind can result in increased erosion

Challenges in meeting material specifications during operations and construction

of the facility, which increases the likelihood of reactivity of the tailings

Effectiveness of compaction in minimizing water and oxygen infiltration. This is

dependent on tailing's properties, including mineralogy and grain size, which

impact the moisture content and achievable compaction

Geochemical uncertainties that have been a challenge in permitting include understanding of:

Long term effects of tailings ageing in dewatered facilities on permeability, geotechnical stability, saturation, and ML/ARD behaviour

The main geochemical source controls including mineralogy, water content, and mineral availability are subject to on-going research

Effects of filtered tailings on seepage chemistry

Extended use of compaction as an ML and ARD control and permeability control



Regulatory Consideration of Filtered Tailings Facilities

Mitigation

- Effective operational plans
- Progressive reclamation
- Temporary Covers
- MLARD Water Management
- Permanent closure Cover
- Base liner under facility?

Monitoring

- Tailings properties
- In-situ density testing
- Seepage chemistry
- Water quality trends
- Moisture and Oxygen content within the TSF



Karara Iron Ore Mine, AUS
<https://www.srk.com/en/projects/karar-iron-ore-mine-tailings>

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The main mitigation requirements considered for permit conditions in our review of Filtered Tailings TSF to address potential risks have included

- Effective timing of production versus deposition, and appropriate compaction and staging contributing to management of variable moisture conditions and can help control ML/ARD and limit active water management
- progressive reclamation can also help control ML/ARD and limit active water management
- Temporary Covers and progressive reclamation can be implemented to preserve permeability controls of the filtered tailings
- MLARD water management such as water diversion, ponds, seepage pump back system and/or active water treatment requirements
- Requiring final design of the closure cover capable of maintaining permeability control and preserving physical and geochemical stability (e.g. cover with geosynthetic liner or clay layer).
- The construction of a filter stack for acid-generating tailings may require an encapsulation system consisting of a base liner under the stack to manage seepage to the receiving environment.

With monitoring requirements considering:

- On-going characterization of the filtered tailings properties including mineralogy and grain size to meet consistent moisture content and compaction
- Testing of compaction and moisture content of the tailings placed in the filtered TSF to

ensure consistency of permeability control and strength characteristics for stability considerations.

- Seepage chemistry can indicate the chemical stability of the tailings placed in the filtered TSF
- The efficiency of a progressive and final cover can be measured through instrumentation and monitoring on-going water quality trends.



Regulatory Consideration of Filtered Tailings Facilities

Reclamation and Security Costing

- MLARD water management/water treatment costs
- Contingency costs for temporary closure
- Long-term maintenance and monitoring

Ministry of Energy, Mines and Low Carbon Innovation
Major Mines Reclamation Security Policy
(Interim)

Version 1.0

April 5, 2022

- The main considerations for review of the reclamation and security costing have been:
 - MLARD water management and water treatment cost could be significant depending on progressive reclamation efforts
 - Consideration of Contingency costs for temporary closure
 - Long term maintenance and monitoring costs for the closure cover
 - Long term monitoring costs for monitoring surface water and groundwater quality on the mine site and being discharged to the receiving environment.



Regulatory Consideration of Dry Closure for Existing TSFs

- Closure design reports are required under Part 10.6.12 of the Code for all new and existing TSFs
- Closed TSFs require Annual Facility Performance Reports (AFPRs) and Dam Safety Reviews (DSRs)
- Can apply for reduction in Permit and/or Code requirements substantial work towards final closure has been completed (Part 10.6.13)
- Demonstrating reduced risk for reduction of Permit and/or Code requirements may be simplified for a 'dry' facility.

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As the regulator, MCM does not prescribe closure design requirements for existing or newly permitted TSFs beyond seismic and flood criteria, and physical stability. Closure design reports are now required under Part 10.6.12 of the Code, they are required to address physical stability, long-term prevention, mitigation and management of metal leaching and acid rock drainage, ecological and landform aspects, and land and water use objectives.

Closed TSFs require annual facility performance reports and Dam safety reviews, ITRB reports and all other TSF Code requirements at the same frequency as active facilities in perpetuity

However, mines can apply for a reduction in Permit and/or Code requirements substantial work towards final closure has been completed under Par

In order for MCM to consider this reduction in permit or code requirements for a TSF, the mine would have to clearly demonstrate that risks associated with the TSF had been reduced to a level that would allow for reduced oversight of the facility. It is likely that this task would be simplified if the facility was not retaining water or saturated tailings.

Closure

- Regulation of TSFs has increased significantly since the Mount Polley Breach
- Ongoing Audits of the regulation of mines in British Columbia
- Regulators do not dictate the type of facilities constructed to contain mine waste
- Filtered Tailings do not eliminate all risks associated with TSFs
- Planning for dry TSF conditions at closure may simplify applications for reduction of ongoing monitoring and reporting requirements



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Questions?



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