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A Summary of Canadian & Regional Guidelines, Initiatives and Recommendations following the Mount Polley Tailings Dam Failure

Saskatchewan Mining Association – October 19, 2016



A world leader

Founded in 1911, SNC-Lavalin is one of the leading engineering and construction groups in the world and a major player in the ownership of infrastructure. From offices in over 50 countries, SNC-Lavalin's employees are proud to build what matters. Our teams provide EPC and EPCM services to clients in a variety of industry sectors, including oil and gas, mining and metallurgy, infrastructure and power. SNC-Lavalin can also combine these services with its financing and operations and maintenance capabilities to provide complete end-to-end project solutions.



Values that guide us

Our values keep us anchored and on track. They speak to how we run our business, how we express ourselves as a group, and how we engage with our stakeholders and inspire their trust.

Teamwork & excellence

We're innovative, collaborative, competent and visionary.

Customer focus

Our business exists to serve and add long-term value to our customers' organizations.

Strong investor return

We seek to reward our investors' trust by delivering competitive returns.

Health & safety, security and environment

We have a responsibility to protect everyone who comes into contact with our organization.

Ethics & compliance

We're committed to making ethical decisions.

Respect

We consistently demonstrate respect for all our stakeholders.



Outline

- › List of Events and Response
- › Quick Summary of the Failure
- › Responses
 - › Expert Panel Recommendations
 - › CIM Recommendations
 - › MAC guidelines review
 - › CDA guidelines review
- › Summary



Events and Response

- › Mount Polley Dam Failure – August 4, 2014
 - › International News
 - › Significant negative public reaction
- › Relatively quick action by BC Government
 - › Established Independent Panel
 - › Immediate DSIs and DSRs at all other BC mines
 - › Provincial Auditor review
 - › Chief Inspector of Mines Report and Recommendations
 - › Regulatory Review
 - › APEGBC Review (requested by Government)
- › Alberta Government also went through Audit and Regulatory Review
- › Secondary Response from Various Organizations (CDA, MAC)



Mount Polley Tailings Dam Failure – key points

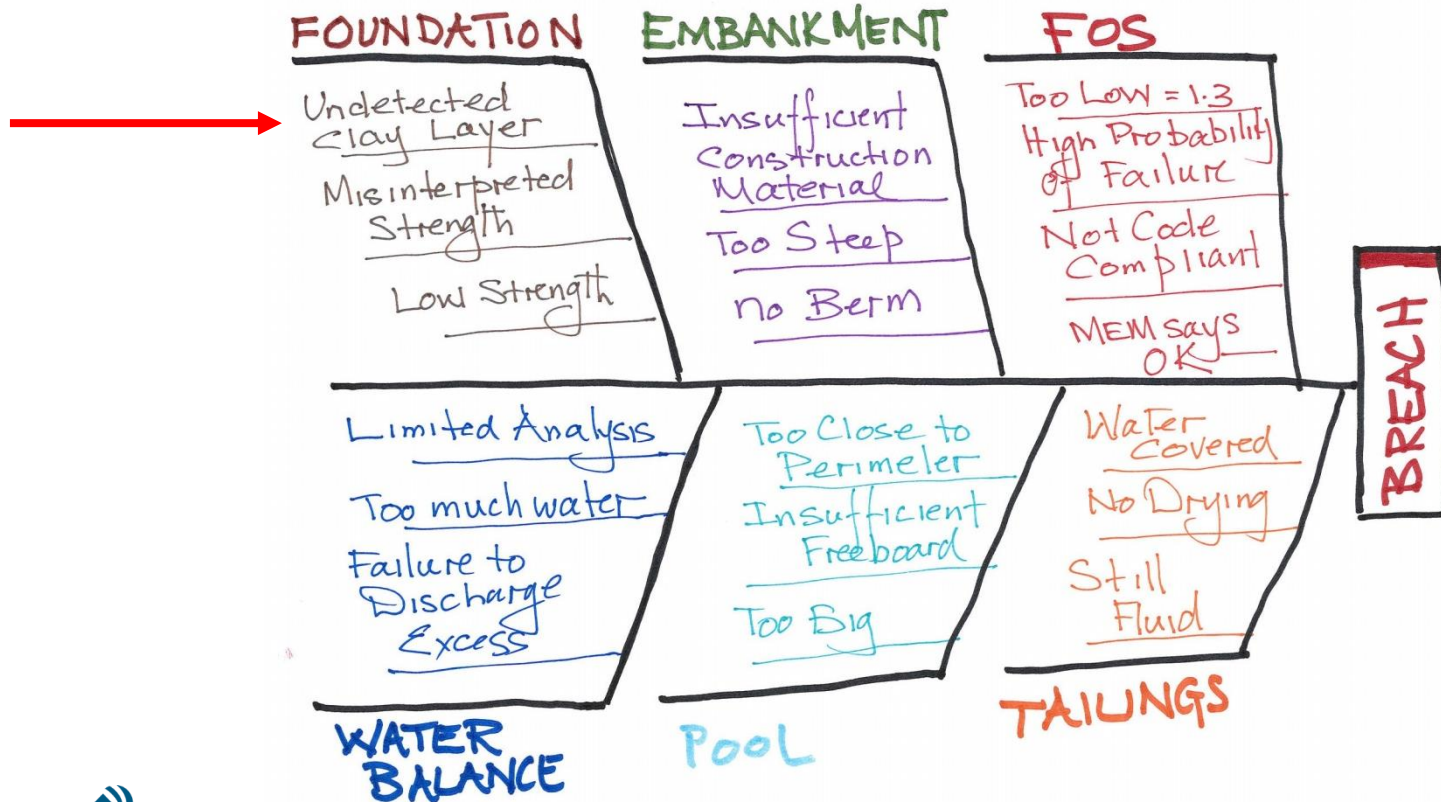
- › Imperial Metals – Mount Polley, near Likely, BC
- › August 4, 2014 tailings dam failure on northwest dyke
- › Released approximately 10,000,000m³ water, 8,000,000m³ solids
- › Independent Expert Panel attributed failure:
 - › *Primary Mechanism – Brittle failure originating in undetected Glaciolacustrine Unit (GLU)*
 - › *Several other contributing factors discussed*
- › Out of operation for approximately 1 year
- › Approximately \$90million in cleanup and repair costs
- › Surprisingly, consequence of failure was determined to be relatively low
- › Lawsuit underway: Imperial Metals vs. 3 Consultants





July 24, 2014 to August 5, 2014

Mount Polley – Canada – August 4, 2014



Expert Independent Panel

- › BC Government immediately hired expert panel to determine cause of the failure
 - › Dr. Norbert Morgenstern
 - › Dr. Dirk Van Zyl
 - › Steven Vick
- › Panel report available to the public (approximately 1,200 pages – But executive summary gives a great description)
<https://www.mountpolleyreviewpanel.ca/final-report>
- › Report included 7 Recommendations to prevent further incidents

Highlights:

BAT and BAP (vs CATNIP)

Compliant with MAC guidance

Identify risks at 43-101 stage,
where possible

Define and Monitor QPO's
(KPI's)

- 1) **To implement BAT using a phased approach:**
 - a. **For existing tailings impoundments.** Rely on best practices for the remaining active life.
 - b. **For new tailings facilities.** BAT should be actively encouraged for new tailings facilities at existing and proposed mines.
 - c. **For closure.** BAT principles should be applied to closure of active impoundments so that they are progressively removed from the inventory by attrition.

See section 9.3.
- 2) **To improve corporate governance:**

Corporations proposing to operate a tailings storage facility (TSF) should be required to be a member of the Mining Association of Canada (MAC) or be obliged to commit to an equivalent program for tailings management, including the audit function.

See section 9.4.1.
- 3) **To expand corporate design commitments:**

Future permit applications for a new TSF should be based on a bankable feasibility that would have considered all technical, environmental, social and economic aspects of the project in sufficient detail to support an investment decision, which might have an accuracy of $\pm 10\%$ – 15% . More explicitly, it should contain the following:

 - a. A detailed evaluation of all potential failure modes and a management scheme for all residual risk.
 - b. Detailed cost/benefit analyses of BAT tailings and closure options so that economic effects can be understood, recognizing that the results of the cost/benefit analyses should not supersede BAT safety considerations.
 - c. A detailed declaration of Quantitative Performance Objectives (QPOs).

See section 9.4.2.



Highlights:

Utilize ITRB's

Evaluate whether similar failure modes are possible at other existing sites

Improve guidance by Professional Organization

Improve guidance by Regulator, rather than only relying on other Organizations (Dangerous?)

4) To enhance validation of safety and regulation of all phases of a TSF:

Increase utilization of Independent Tailings Review Boards.

See section 9.4.3.

5) To strengthen current regulatory operations:

a. Utilize the recent inspections of TSFs in the province to ascertain whether they may be at risk due to the following potential failure modes and take appropriate actions:

- i. Undrained shear failure of silt and clay foundations
- ii. Water balance adequacy
- iii. Filter adequacy

b. Utilize the concept of QPOs to improve Regulator evaluation of ongoing facilities.

See section 9.4.4.

6) To improve professional practice:

Encourage the APEGBC to develop guidelines that would lead to improved site characterization for tailings dams with respect to the geological, geomorphological, hydrogeological and possibly seismotectonic characteristics.

See section 9.4.5.

7) To improve dam safety guidelines:

Recognizing the limitations of the current Canadian Dam Association (CDA) Guidelines incorporated as a statutory requirement, develop improved guidelines that are tailored to the conditions encountered with TSFs in British Columbia and that emphasize protecting public safety.



Chief Inspector of Mines Report – Recommendations

Recommendations for the mining operator:

Proponent governance

1. Mine dam safety manager – any mine with a tailings storage facility (TSF) should have a qualified individual designated as a mine safety manager responsible for oversight of planning, design, operation, construction and maintenance, and surveillance of the TSF, and associated site-wide water management (aligns with independent panel recommendation).
2. Water balance management – water management and water balance issues for mining projects must be designed by a qualified professional (aligns with independent panel recommendation).
3. TSF operations manual – mine manager should ensure the operation, maintenance and surveillance manual required by the Code for all impoundments adheres to applicable Canadian Dam Association and Mining Association of Canada guidelines.
4. Mine emergency response plan – mine manager must ensure that the Mine Emergency Response Plan adheres to applicable regulations, is maintained on a regular basis for currency, incorporates appropriate response measures to emergencies including those involving the TSF, and is written and distributed in such format as to serve as a procedural guide during an emergency or other event.
5. Risk recognition and communication – all mine personnel have a role to play in recognizing and reporting risk conditions, especially those that could affect health, safety and environmental protection, and should be educated in the recognition of conditions and events that could impact TSF safety or contravene applicable permit conditions and regulations.



Chief Inspector of Mines Report – Recommendations

Recommendations for the mining industry:

TSF design

6. Tailings storage and water management systems and structures should be designed for worker and public safety and the protection of the environment (aligns with independent panel recommendation).
7. Mines with impoundments should each develop independent technical review boards to provide additional perspectives on site investigation, site selection, design, construction, maintenance, operations, surveillance, water management and closure (aligns with independent panel recommendation).

Recommendations for professional organizations:

Professional and association standards

- * 8. The Association of Professional Engineers and Geoscientists of BC, The Mining Association of Canada, and the Canadian Dam Association should update and strengthen guidelines and standards of practice including those specific to TSF design and management, dam safety and construction (aligns with independent panel recommendation).
9. The Regulator (MEM) should consider and incorporate as appropriate guidelines from these external associations as applicable and consistent with MEM objectives (aligns with independent panel recommendation).



Chief Inspector of Mines Report – Recommendations

Recommendations for the regulator:

Regulator functions

10. The Regulator should undertake a comprehensive review of the Code to ensure that the lessons learned and recommendations from this report are fully considered and appropriately incorporated.
11. The Regulator should ensure a perspective that spans the life of the mine be considered for Mines Act permit applications, while acknowledging that the nature of mining frequently requires changes to the life-of-mine plan (aligns with independent panel recommendation).
12. The Regulator must enhance its investigative capacity, as well as its ability to exercise its existing compliance and enforcement authority under the Mines Act and Code. A supported director-equivalent position specific to investigation, compliance and enforcement should be established to evaluate and oversee these roles. To increase compliance and achieve greater safety at mines, a full range of regulatory tools, such as incentives, administrative penalties, outside agency collaboration and other best practices should be considered (aligns with independent panel recommendation).
13. A regulatory dam safety manager position dedicated to the coordinated regulatory oversight of tailings dams should be established (aligns with independent panel recommendation).
14. The Ministry of Energy and Mines should conduct an internal review of operational and business practices.



Chief Inspector of Mines Report – Recommendations

Recommendations for the regulator:

Strengthening records management

15. To support long-term integrated decision-making by the Regulator, (MEM) should establish a formal documentation management system for all mines from development to post-closure. This system will provide greater openness and transparency of MEM decisions.

Regulatory integration

16. Government should review the Ministries of Environment (MOE) and Energy and Mines and look for opportunities where processes and standards can be aligned to support timely and effective outcomes that meet agency objectives (environmental protection, worker health and safety, facilities integrity).
17. Government should review MEM and MOE permitting processes and look for opportunities to integrate and align them as appropriate to avoid duplication and increase efficiencies.

Fostering innovation:

18. MEM, the industry, professional organizations, and educational institutions should continue to seek new collaborative opportunities to foster education. This initiative could include the availability of standards for education to better define the knowledge, skills and abilities for various accountabilities within mining, and to increase the knowledge base, information sharing and innovation.
19. Government and industry should support research and development efforts to improve tailings processing, dewatering and discharge water treatment technologies (aligns with independent panel recommendation).

BAT/BAP

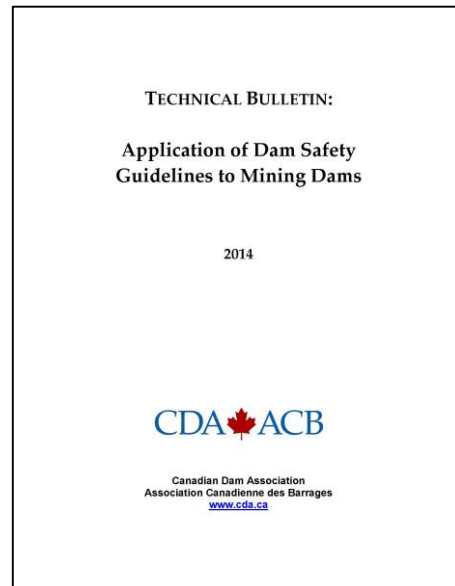
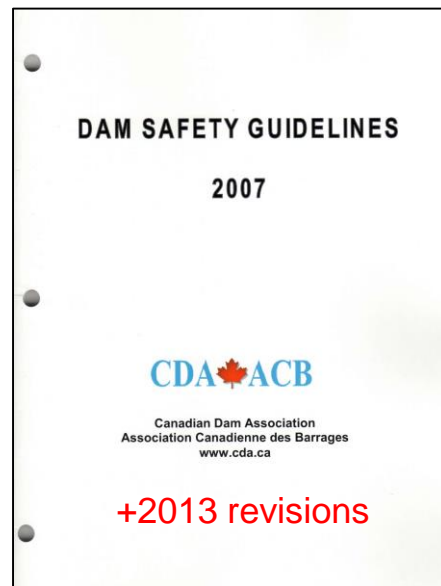
Guidance Available Prior to Mt. Polley Failure

- › MAC Guidelines (3)
 - › CDA Guidelines, Bulletins, and Mining Dams Supplement
 - › ICOLD Bulletins (example: Bulletin 139 – Improving Tailings Dam Safety)
 - › Various training and workshops
 - › Few university courses on Mining Dams Design (now one through UofA, Dr. Ward Wilson)
- “You’re doing good!”

Updates following Mt. Polley Failure

› CDA MDC:

- › Response to Panel Report
- › Revisions to Bulletin
- › Various Working Groups
- › Guidance on definitions of responsibilities of dam safety personnel
 - › Owner,
 - › Dam Safety Manager
 - › Engineer of Record (EOR)
 - › Designer of Record (DOR)
- › Guidance on Geotechnical Criteria (FOS),
- › Draft BAP list (ongoing)



Updates following Mt. Polley Failure



Hot off the Press: Draft BAP List

1. Roles & Responsibilities
2. Management Systems and Funding
3. Communications and Protocols
4. Checking Audits and Corrective Action
5. Environmental Management Systems
6. Documentation and Record Management
7. Permitting and Compliance
8. Communities of Interest Engagement
9. Risk Management
10. Management of Change
11. Qualification Based Selection
12. Competency of Parties
13. Comprehensive Design
14. Best Available Technology
15. Construction Quality Control / Quality Assurance (QC/QA)
16. Emergency Preparedness Plan
17. Emergency Response Plan
18. Designer of Record
19. Engineer of Record
20. Dam Safety Manager
21. Independent Technical Review Board
22. Operating Patrols and Surveillance
23. Dam Safety Inspections
24. Dam Safety Reviews
25. Operations, Maintenance & Surveillance
26. Closure Plan and Financial Assurance
27. Tailings Management Plans
28. Water Balance
29. Site Security
30. Survey Controls



Updates following Mt. Polley Failure

- › MAC Guidance Documents: Under review and revision (ongoing)

**A Guide
to the Management
of Tailings Facilities**
Second Edition, 2011



Developing an
**Operation, Maintenance and
Surveillance Manual**
for Tailings and Water Management Facilities
2011



A Guide to
**Audit and Assessment of
Tailings Facility Management**
2011



Updates following Mt. Polley Failure

- › APEGBC: Site Characterization Guidelines (2016)
- › BC MEM: Mining Code Review and Revision (2016)
 - › Mandatory Management Roles, Reporting, and Design Criteria (i.e. Prescriptive from Government)
- › Alberta Environment and Parks: Revised Dam Safety Guidance (2016)
- › CIM: Workshops on mining dams, future guidance expected (ongoing)
- › ICMM: Global review of tailings practices (ongoing, started after Samarco)

- › Others?

Summary

- › ‘*Volumes*’ of work completed since Mt. Polley
 - › Reviews
 - › Recommendations
 - › Guidance
 - › Regulation
- › Canada leading the industry in revisions to industry guidance
- › Expect more to come
 - › Following Samarco
 - › More failures...undoubtedly
 - › More guidance...undoubtedly
 - › More debate...undoubtedly
 - › Legal Definition of EOR...maybe

Thank-you

