RISK ASSESSMENT FROM A CLOSURE PRACTITIONER'S PERSPECTIVE

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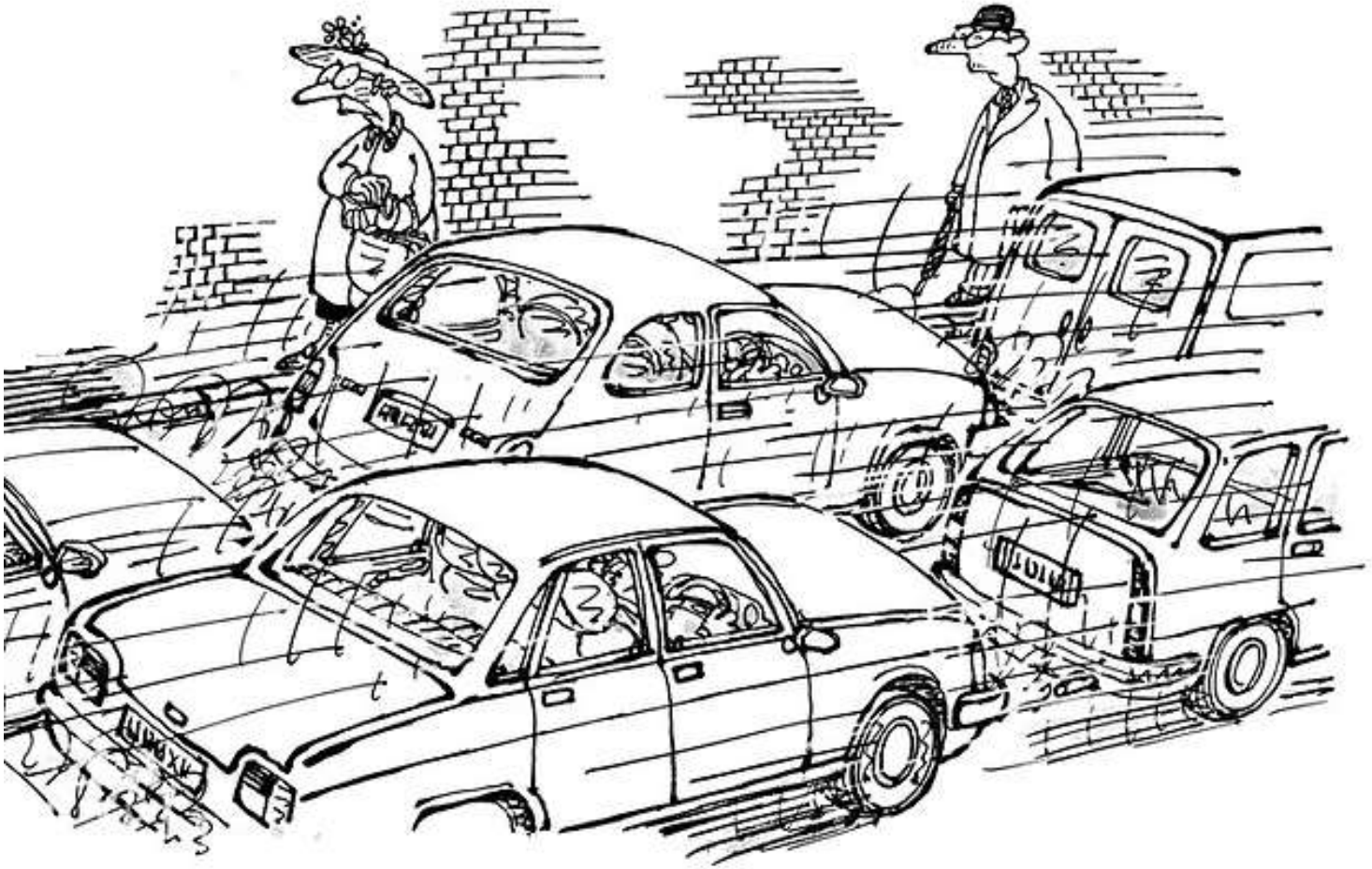
We do risk assessment all the time!



Risk assessment is second nature on a mine site

1. Stop, step back, observe
2. Think through the task
3. Identify any hazards
4. Control the hazards
5. Complete the task safely

- Project planning
- Project approvals
- Operational management
- Safety management
- Environmental management
- Closure planning

So what is the issue with closure risk assessments?

But closure must achieve:

- No ongoing liability for stakeholders
  (a ‘walk away’ solution)

- Acceptable rehabilitation performance in perpetuity
  (centuries not decades)

Walk Away solution:

- During operations we aim for low (minimal) maintenance
- At closure we have to aim for maintenance free structures

- Otherwise require transfer of liability possibly with a trust fund

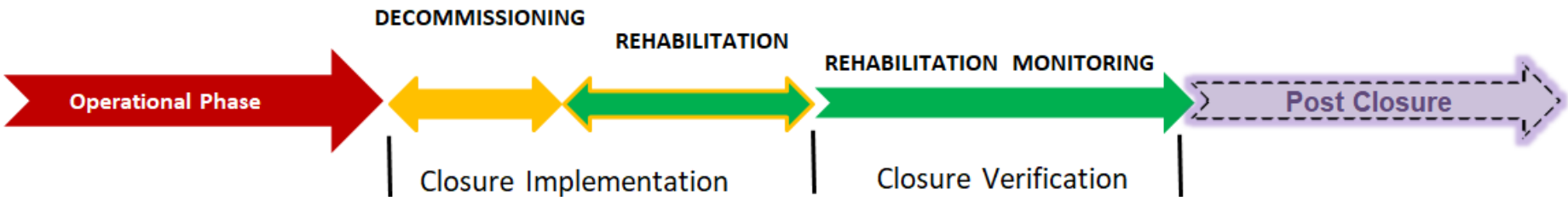
In perpetuity?

Closure planning strategies to meet 1000 year criteria

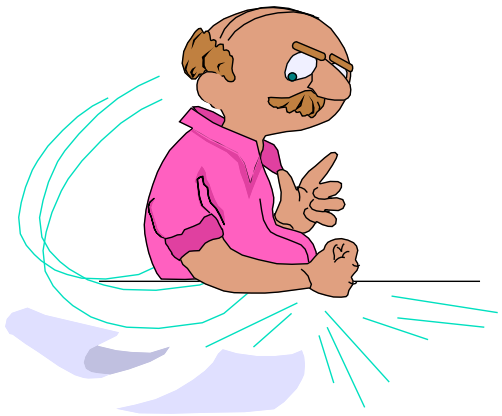
Imagine the possible changes in climate over a 1,000 year period!

The mine closure risk assessment covers two periods:

- Closure planning & implementation phase
- Post closure phase (>300 year time frame)



The mine closure risk assessment has to consider the needs of the:



- Mine owners
- Government regulators
- Local community
- Closure team

Primary drivers:

Government objective

Rehabilitated mines to be (physically) safe to humans and animals, (geo-technically) stable, (geo-chemically) non-polluting / non-contaminating, and capable of sustaining an agreed post-mining land use.

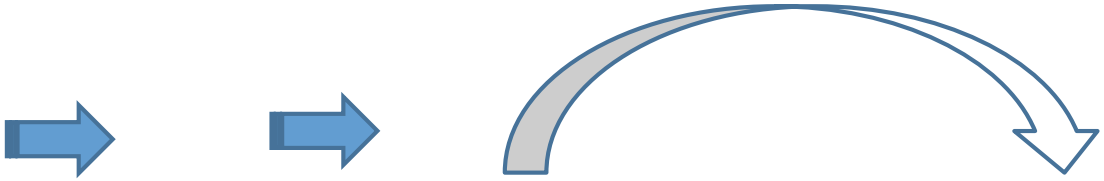
Mining Company objective

Mine closure must be cost effective with timely relinquishment.

Must consider the impact on:

- Safety
- Cost
- Environment
- Community Relations
- Legal Compliance
- Corporate Reputation

Closure Risk Assessment Approach



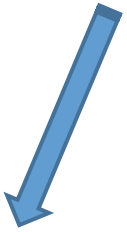
Scenario			Current (Operational) Controls	Likelihood	Impacted Area Consequence							Inherent Risk	Proposed Closure Controls
Risk Description (unwanted event)	Potential Cause (pathway)	Potential Consequence (impact)			Financial	Health & Safety	Environmental	Community Relations	Company Reputation	Security	Legal Compliance		
Changing stakeholder expectations over life of project	Change in government; Change in knowledge base regarding rehabilitation; Change in best practice over time.	Stakeholders expectations not met causing delay in relinquishment with increased closure period and costs.	- On-going consultation and communication with key stakeholders (includes submission of MCP, MMPs etc).	B	3	N/A	N/A	3	3	N/A	3	High	- Implementation of closure strategy / designs as per approved MCP - Ongoing consultation with regulators and other stakeholders as per developed consultation and communication plan within MCP.
Contaminated soils and aquifers remain undetected during decommissioning phase	Inadequate planning and review of operations and potential contaminated areas	- Soil and water contamination. - Prolonged closure period - Increased costs	- Project based contaminated site soils investigation/analysis (eg staging ponds) - Contaminted areas identified as part of site risk assessment	C	3	2	3	2	2	N/A	3	Medium	- Assessment of site contamination completed as part of decommissioning process. - Investigation and schedule for remediation of areas requiring remediation to be developed as per regulatory requirements.

A new mining project

Unwanted Event

Pathway / Cause

Impact / Consequence



Inherent Risk  **Residual Risk**

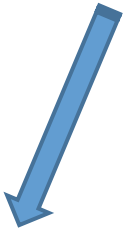
Current (Operational) Controls [EMP]	Likelihood	Impacted Area							Inherent Risk	Proposed Closure Controls [MCP]	Likelihood	Impacted Area Consequence							Residual Risk	Monitoring & Measurement
		Financial	Health & Safety	Environmental	Community Relations	Company Reputation	Security	Legal Compliance				Financial	Health & Safety	Environmental	Community Relations	Company Reputation	Security	Legal Compliance		Agreed Action
- On-going consultation and communication with key stakeholders (includes submission of MCP, MMPs etc).	B	3	N/A	N/A	3	3	N/A	3	High	- Implementation of closure strategy / designs as per approved MCP - Ongoing consultation with regulators and other stakeholders as per developed consultation and communication plan within MCP.	C	3	N/A	N/A	3	3	N/A	3	Medium	- Review and implement closure stakeholder consultation and communication plan
- Project based contaminated site soils investigation/analysis (eg staging ponds) - Contaminted areas identified as part of site risk assessment	B	3	2	3	2	2	N/A	3	High	- Assessment of site contamination completed as part of decommissioning process. - Investigation and schedule for remediation of areas requiring remediation to be developed as per regulatory requirements.	D	3	2	3	2	2	N/A	3	Low	

An existing mine

Unwanted Event

Pathway / Cause

Impact / Consequence



Inherent Risk → **Residual Risk** → **Ongoing Risk**

Current (Operational) Controls [EMP]	Likelihood	Impacted Area							Inherent Risk	Proposed Closure Controls [MCP]	Likelihood	Impacted Area Consequence							Residual Risk	Additional Mitigation Measures [Up-dated MCP]	Likelihood	Consequence	On-going Risk
		Financial	Health & Safety	Environmental	Community Relations	Company Reputation	Security	Legal Compliance				Financial	Health & Safety	Environmental	Community Relations	Company Reputation	Security	Legal Compliance					
- On-going consultation and communication with key stakeholders (includes submission of MCP, MMPs etc).	B	3	N/A	N/A	3	3	N/A	3	High	- Implementation of closure strategy / designs as per approved MCP - Ongoing consultation with regulators and other stakeholders as per developed consultation and communication plan within MCP.	C	3	N/A	N/A	3	3	N/A	3	Medium	- Further consultation on particular issues with identified stakeholders as needed.	D	3	Low
- Project based contaminated site soils investigation/analysis (eg staging ponds) - Contaminted areas identified as part of site risk assessment	B	3	2	3	2	2	N/A	3	High	- Assessment of site contamination completed as part of decommissioning process. - Investigation and schedule for remediation of areas requiring remediation to be developed as per regulatory requirements.	D	3	2	3	2	2	N/A	3	Low	- 3rd Party audit and assessment of remediation	E	3	Very Low

Mitigation measures to address risk

Closure strategies and solutions that factor in engineering designs for:

- a ‘walk away’ solution
- perpetuity (1,000 years)

  - extreme climatic conditions
  - ever changing expectations

Engineering design criteria for closure

Hydrologic Design Specifications:	
Performance Objectives: All drainage control structures to be designed to extreme storm conditions to ensure integrity over minim 300 year period.	
Design Storm for Containment	12-hour probable maximum precipitation (PMP) event
Design Storm for Conveyance (downdrain drop structure and stilling basin)	15-minute PMP (~720 mm/hour)
Downdrain Revetment	To be determined based on hydrology and hydraulic calculations
Minimum Freeboard	0.3-m
Target Design Life	300-years
Stability	
Static Factor of Safety	≥ 1.5 for water retention structures
Pseudo-Static Safety Factor	≥ 1.0, or acceptable magnitude of deformation
Seismicity	Design event acceleration to be based upon a 1 in 10,000 year event given that these will remain as potential water retention structures.

Mine Closure Planning Risk Assessment requires:

- Australian Risk Assessment Standards
- Multidisciplinary input to risk assessment
- Regular update
- A degree of realism / pragmatism
- Thinking long term

Questions?

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