AusIMM Branch | New Zealand

GEOCONTAM RISK MANAGEMENT
GREENROAD GROUP

Integrating Contaminated Sites Management Across the Mining Life Cycle

AusIMM NZ Branch

Conference 2024

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PRESENTATION OUTLINE

- Mine Site Contamination
  - Recognised activities
  - Sources and risks
- Traditional Approach to CS Management
  - Economic risk
  - Interrelated Regulations
- Life-Cycle Integrated CS Management
  - Opportunities and benefits
  - Return on investment

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NEW ZEALAND - HAIL ACTIVITIES

Category D

- **D4 – Metalliferous ore processing**, including the chemical or physical extraction of metals including smelting, refining, fusing or refining metals
  - Storage, smelting, refining using thermal treatment or aqueous solutions, leaching using chemicals, purification and metal recovery, waste disposal

Category E: Mineral extraction, refining and reprocessing, storage and use

- **E5 – Coal or coke yards**
  - Crushing, washing, storage and handling, waste
- **E7 – Mining industries**, including **exposure of faces** or **release of groundwater containing hazardous contaminants**, or the **storage of hazardous waste** including waste dumps or dam tailings
  - Extraction and stockpiling, waste disposal, chemical and fuel storage

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PRIMARY CONTAMINATION SOURCES IN MINING

SOURCES

- **WRDs**, **TSFs**, Run-of-Mine pads
- Adits, open pits and underground workings
- Crushing and **processing plants**
- **Fuel**/chemical **storage**, workshops, washdown
- Water treatment facilities – OWS, Biomax
- Landfills
- Fire training areas*
- **Legacy sites**
- Dust suppression*

CONTAMINATION RISKS

- ARD/AMD – metals, acidity, sulfur
- Hydrocarbons – fuels, oils and greases
- Chemicals – degreasers, acids and alkalis, solvents surfactants
- Naturally occurring radioactive materials (NORMs)*
- Asbestiform minerals
- Per- and poly fluoroalkyl substances (PFAS)* – fire-fighting foams, drill/processing fluids, recycled water*
- Nutrients – blast residue*

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HOW MANY TIMES HAVE YOU HEARD OR SAID THIS?

We regularly monitor our water quality

Tailings and waste rock are addressed by the Crown Minerals Act

CONTAMINATION IS A CLOSURE ISSUE

That's been there for decades – it was inherited from the previous owner

We have procedures in place for hydrocarbon spills

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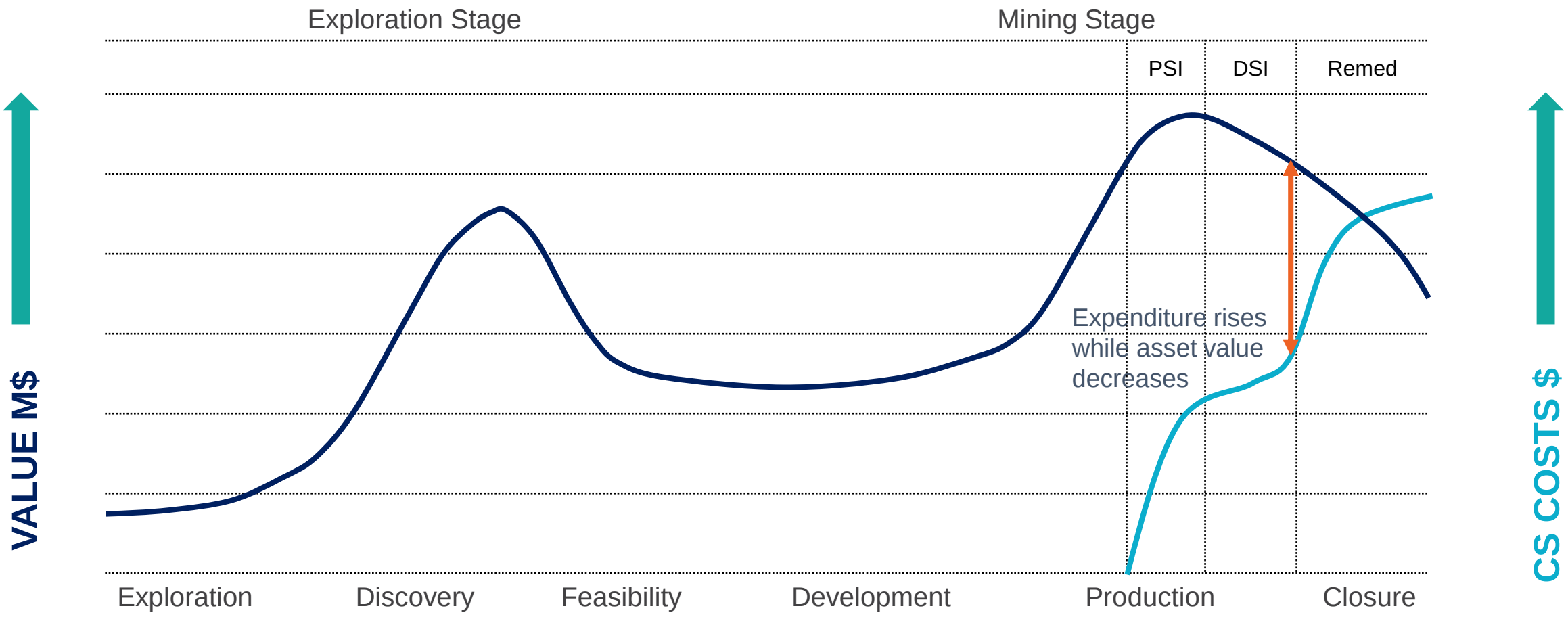
THE TRADITIONAL TIMING



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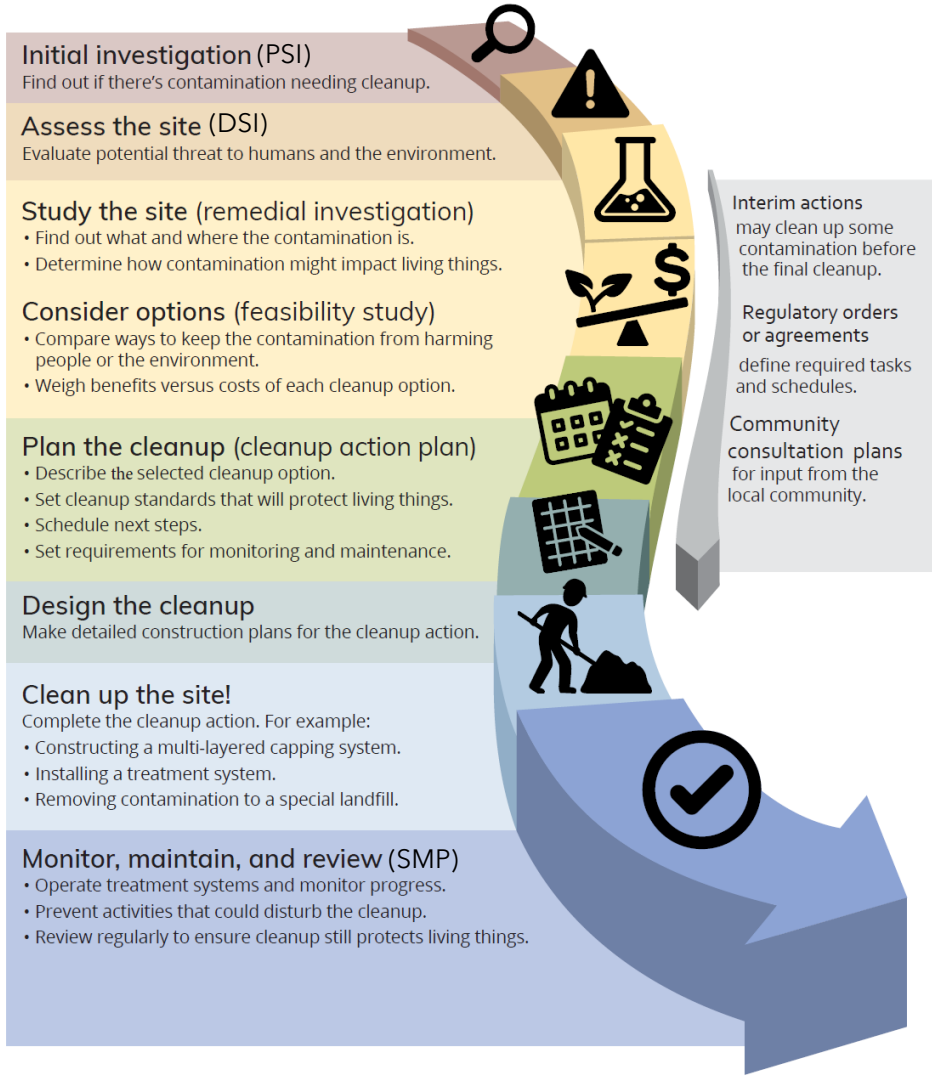
Conceptual diagram adapted from: https:www.geologyforinvestors.com/life-cycle-of-a-mineral-deposit-stock-price-implications/ and ITRC (2015) ISC-1

MINING APPROVALS AND CONTAMINATED SITES

- During approvals contamination from **legacy sites** may be assessed (this is relatively new)
- Future operational contamination risks often incorporated into **Mining Licence**
  - Facility design
  - Monitoring programs – water quality, discharge
- Like rehabilitation, many jurisdictions now require **progressive contaminated sites management** to be integrated into their **Closure Plan**.
- **Separate approvals** may be required **for remediation systems** (water treatment, hydrocarbon bioremediation).
- Contaminated sites assessment process has multiple stages and can take months to years to implement. Needs to align to **Mine Closure Plan** and consider:
  - **Completion Criteria** - closure domain classifications/endpoints
  - **Stakeholder Engagement** – early and on-going is beneficial



Adapted from Washington State – Department of Ecology, Jan 2024, publication 19-09-166

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RESPONSIBLE CONTAMINATION RISK MANAGEMENT PRACTICES

- Maintain a risk-ranked **contaminated site features register** of legacy and operational assets/liabilities
- Early development of site-wide **conceptual site model** (CSM) – periodic review and update
- Prepare an appropriate **Site Management Plan** (SMP)
- **Respond** to small release events early – remediation, process change
- **Manage environmental data** (including QA/QC) – don't lose the history of knowledge
- Develop a **progressive** contaminated sites **investigation/remediation plan** tied to closure timing

Feature	Description	Contaminants of Potential Concern	Key Migration Pathways and Receptors	Data Gaps	Environmental Risk	Proposed Scope of Work	MCP Timing
Process Ponds	Process Ponds were installed with clay liner **Overtopping events** occurred in 1998, 2003, 2010. **GW monitoring** results **confirm seepage** from the pond in 3 monitoring wells	**Low pH, metals, sulfate** **Hydrocarbons** **PFAS**	**Groundwater** in the shallow aquifer discharges to a perennial **stream** to the east	**Extent of soil impacts** around the pond is unknown **Delineation of the GW plume** to the north and west is unknown **Risk assessment** has not been conducted	**HIGH**	Continue **quarterly monitoring**. Prepare an **SAQP** for soil impact delineation and implement **DSI**	**Current MCP cycle** (2022-2024)
						Evaluate remediation/management options. Install a GW interception system, if required. Define post-closure monitoring program	**Next MCP cycle** (2025-2027)
						Implement **remediation** and validation program Post remediation monitoring	**Within 1 year of asset closure**

OPPORTUNITIES WITH INTEGRATED CS MANAGEMENT

- Exploration/Discovery/Feasibility:
  - Obtain **background data** before “background” is disturbed – supports **appropriate future remediation endpoints**
  - Identify and investigate **legacy risks** – possible ability to negotiate out responsibility for remediation?
  - Capture relevant information on **shallow subsurface** – geology, hydrology, chemistry, ecology
  - Incremental additional analysis is orders of magnitude less than redrilling
- Development
  - Appropriate **site management plans** (SMPs) developed for all risks (historic and potential future)
  - **Monitoring programs** designed with CS data requirements (**sampling methods, QA/QC**) in mind
  - Contamination risks and strategies defined in **closure plans – DSIs tied to asset closure schedule**

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OPPORTUNITIES WITH INTEGRATED CS MANAGEMENT

- Production
  - **DSIs** and **remedial options evaluations/trials** progress through life-cycle
  - Compliance data collected in context of CS requirements – **data fit for multiple purposes** = less rework
  - Sufficient time to identify, **trial and optimise remedial measures** – "order-of-magnitude" savings achievable at closure
  - Adequate time for **stakeholder engagement** on remediation options, closure endpoints
- Closure
  - **Fewer "surprises"** = smoother journey due to forward planning
  - **Legacy issues not left behind** due to insufficient closure fund provision

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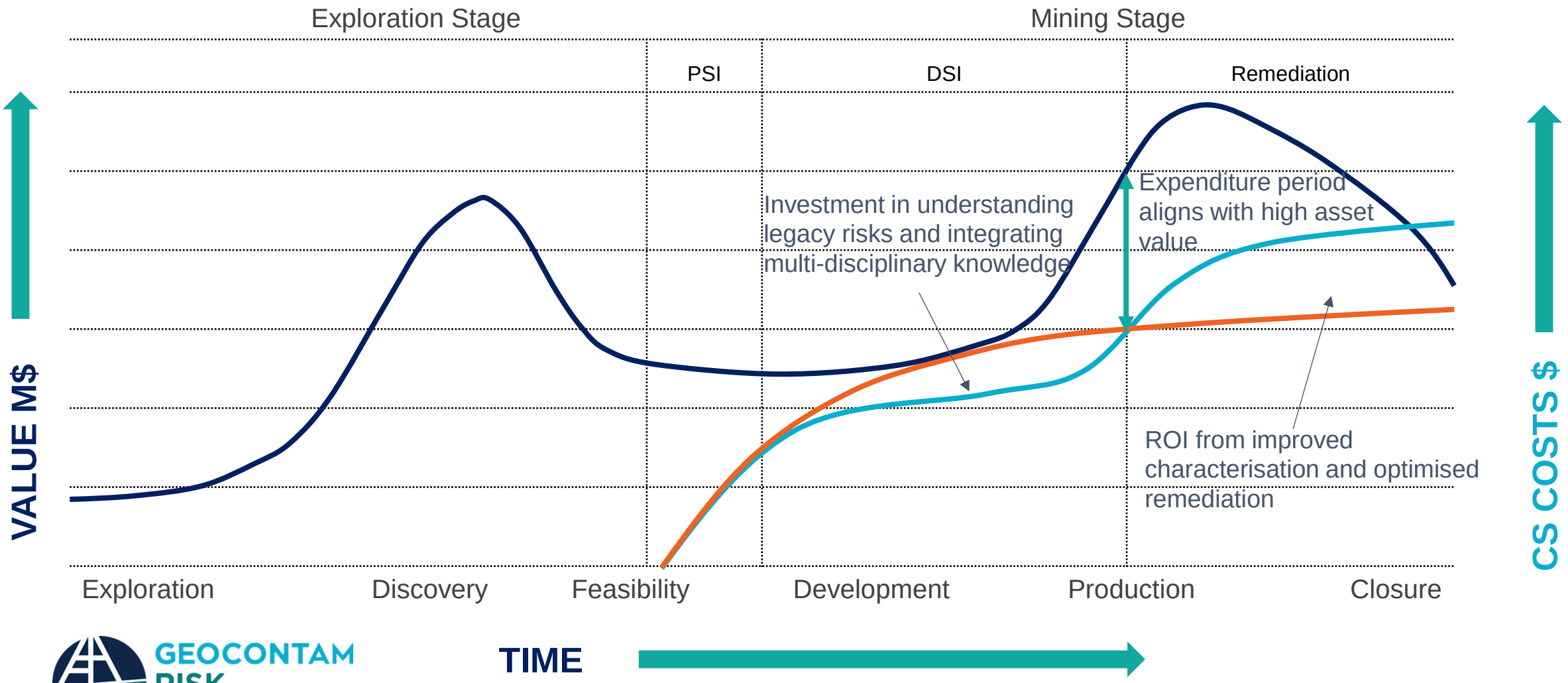
EARLIER CS MANAGEMENT INTEGRATION IMPROVES ROI



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CONCLUSIONS

- Opportunities to recognise and address site contamination risks exist at all stages of the mining life-cycle
- Integrated CS planning better ensures the resources and materials required for remediation are available to undertake the required work
- Not managing contamination issues throughout the life-cycle will:
  - Result in an increase of the extent of contamination
  - Represent an exponentially greater cost of remediation at mine closure (many legacy sites are the result of insufficient finances at closure to complete remediation)
  - Delay completion of closure due to insufficient planning and post closure monitoring obligations

SIGNIFICANT REMEDIATION ROI/COST SAVINGS POSSIBLE WHEN WE DON'T THINK OF CONTAMINATED SITES AS A CLOSURE ISSUE

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RESOURCESTACK

GR PROJECTS