



12th ICARD

18-24 September 2022

VIRTUAL | Australia

12th International Conference on Acid Rock Drainage (ICARD)

www.icard2022.com.au

PART 1

David Jones – DR Jones Environmental Excellence

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Jeff Taylor – Earth Systems Pty Limited

Content of Presentations

Part 1

- The “Big Picture” – Conference Theme and Future Drivers for Management of ARD
- Conference topics, Papers, Registrants
- Key Topic Issues Identified During Conference

Part 2

- The Future of Tailings and Waste Rock Management
- Integration between Mine Planning and Waste Management
- Advances in Characterisation
- Treatment
- Pit Lakes
- Emerging Topics (CO₂ from waste, Li, REEs etc)

About ICARD

Terminology - ARD vs AMD; ICARD vs “ICAMD”

- Held every 3 years (ex Covid) in different locations (Volunteer Committee)
- The first ICARD (ICARD 001) - Roros Norway in 1988
- Last time in Vancouver 1997 (ICARD 4)
- Last time in Australia – Cairns 2003
- **ICARD 12 2022 (virtual) - “Brisbane” Australia (postponed from 2021)**
- ICARD 13 2024 (Live) –Halifax Nova Scotia

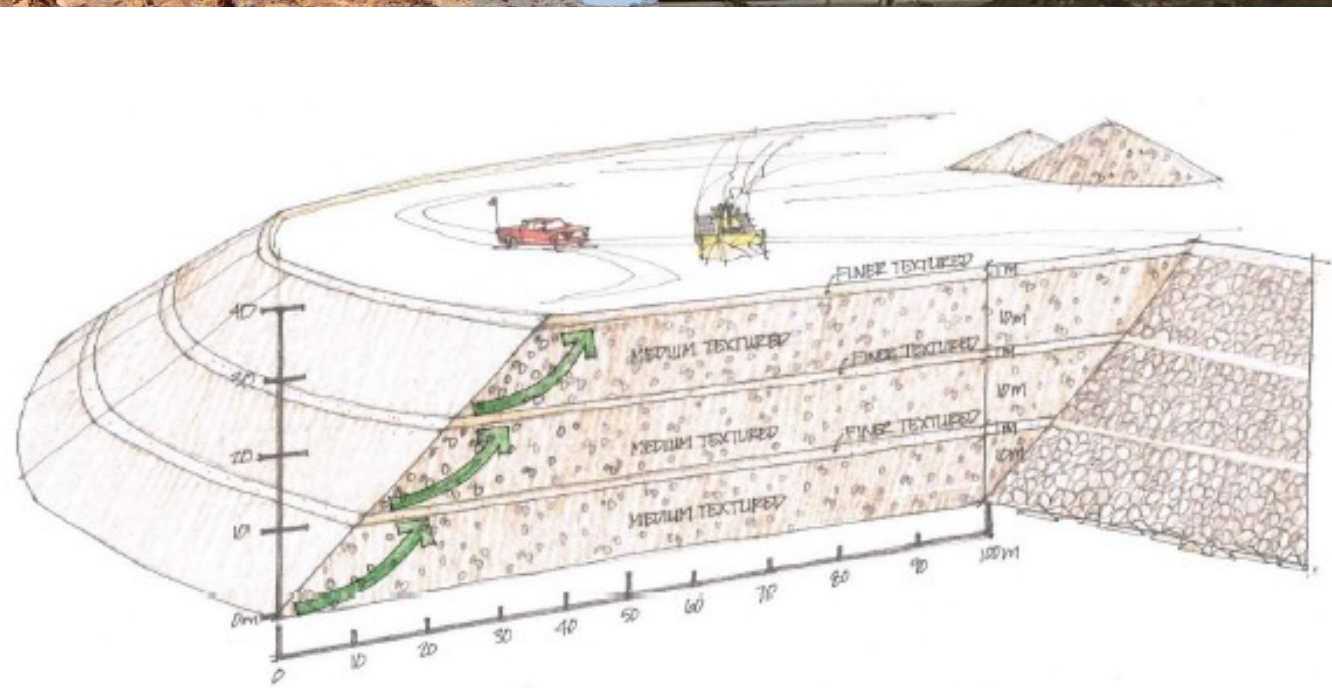
The Conference Theme – Proactive Actions for Lasting Outcomes

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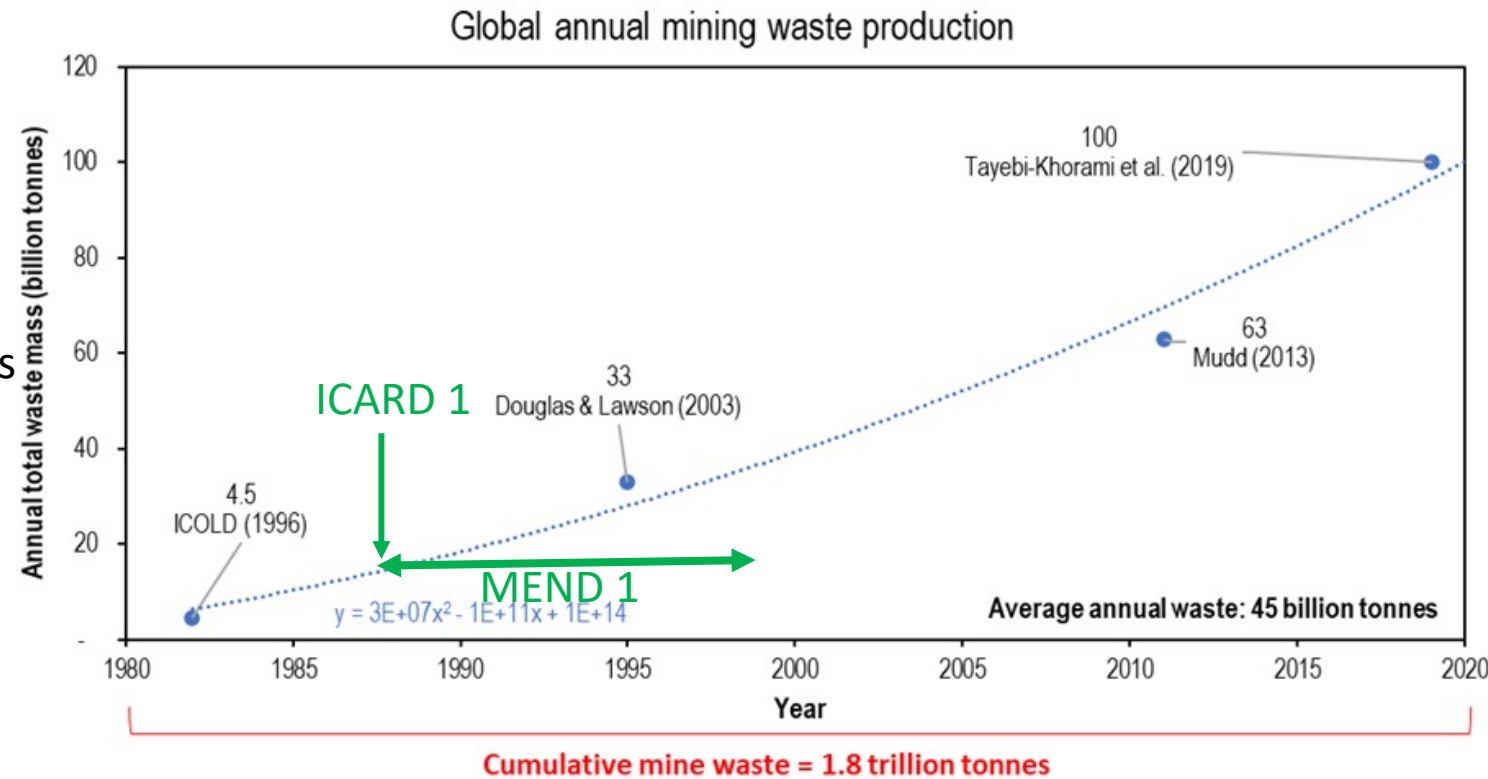


Earth Systems and Okane Consultants Jan 2020

History of ICARD and the Challenge of Managing Mine Waste

What has happened to the amount of mine waste produced since the first ICARD in Roros Norway in 1988?

- Annual volume of waste has risen 7-fold!
Driven by steady growth in demand, falling grades and greater stripping ratios.
- Mass of Waste Rock + Tailings is now growing by 100 billion tonnes per year.
- Implications for management of waste and AMD/ARD in particular.



Fortunate that we have seen the implementation by industry of many of the advances in practice developed by the MEND program and others and which have been promoted at successive MEND & ICARD events over the years.

BUT This was “business as usual”

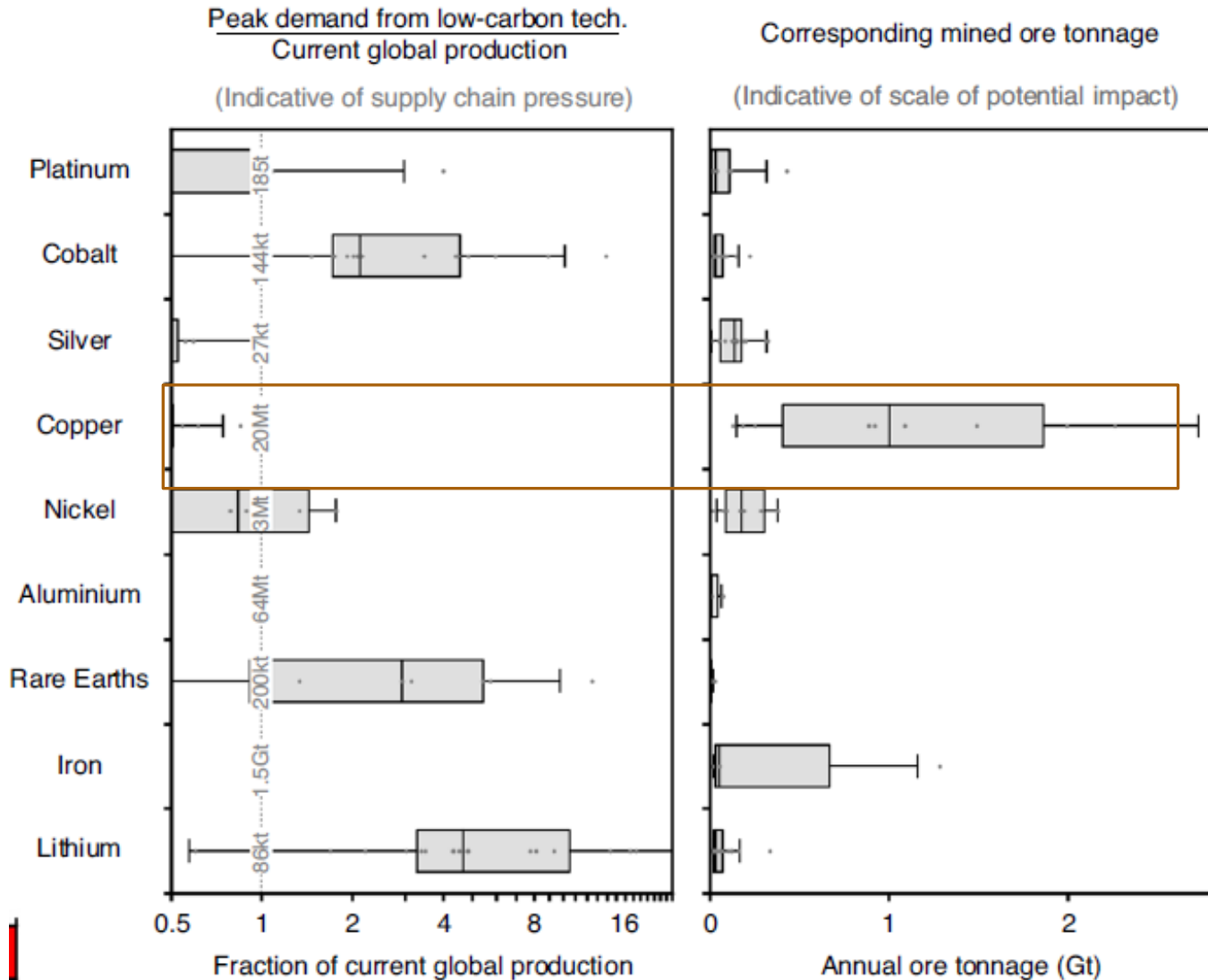
Climate Change, Decarbonisation and ARD

No Longer “Business as Usual”!

To supply the metals needed to produce the wind turbines, solar panels and battery storage will require the greatest rate of increase in metals production since the start of the industrial revolution!



Climate Change, Decarbonisation and ARD Contd



Lebre et al Nature Communications 2020

Copper demand to grow from 25 million metric tons (MMt) per year today to about 50 MMt by 2035, and continue to grow to 53 MMt by 2050.

Projects under development today will not be sufficient to offset the projected shortfalls in copper supply, **even if approvals** and construction were able to be accelerated – S&P Global 2022

The Mine Approvals Process and Effect of ARD

ERM (2018)* looked at 72 mining projects and found that almost half of major capital projects missed their delivery date commitments between 2008 and 2016.

Most delays were because of:

- community opposition (42%),
- environmental concerns (35%),
- difficulty in obtaining permits (23%),

* Reiterated by Ernest & Young 2022



ESD morphs into ESG!

Much stronger investment focus on social acceptance and environmental performance

The EITI (Extractive Industries Transparency Initiative) reports on 700 critical mineral sites in the 57 countries:

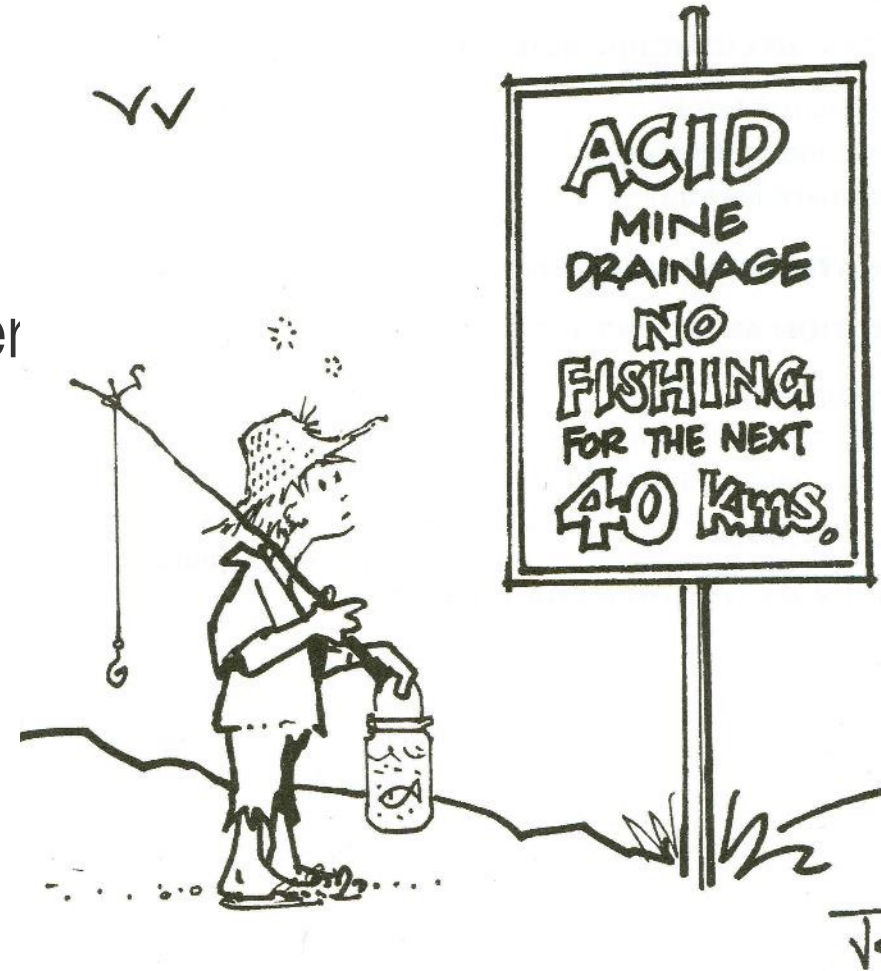
- 50% impact on conservation areas.
- 80% are near or on the land of indigenous people or are of cultural significance

ARD and Water

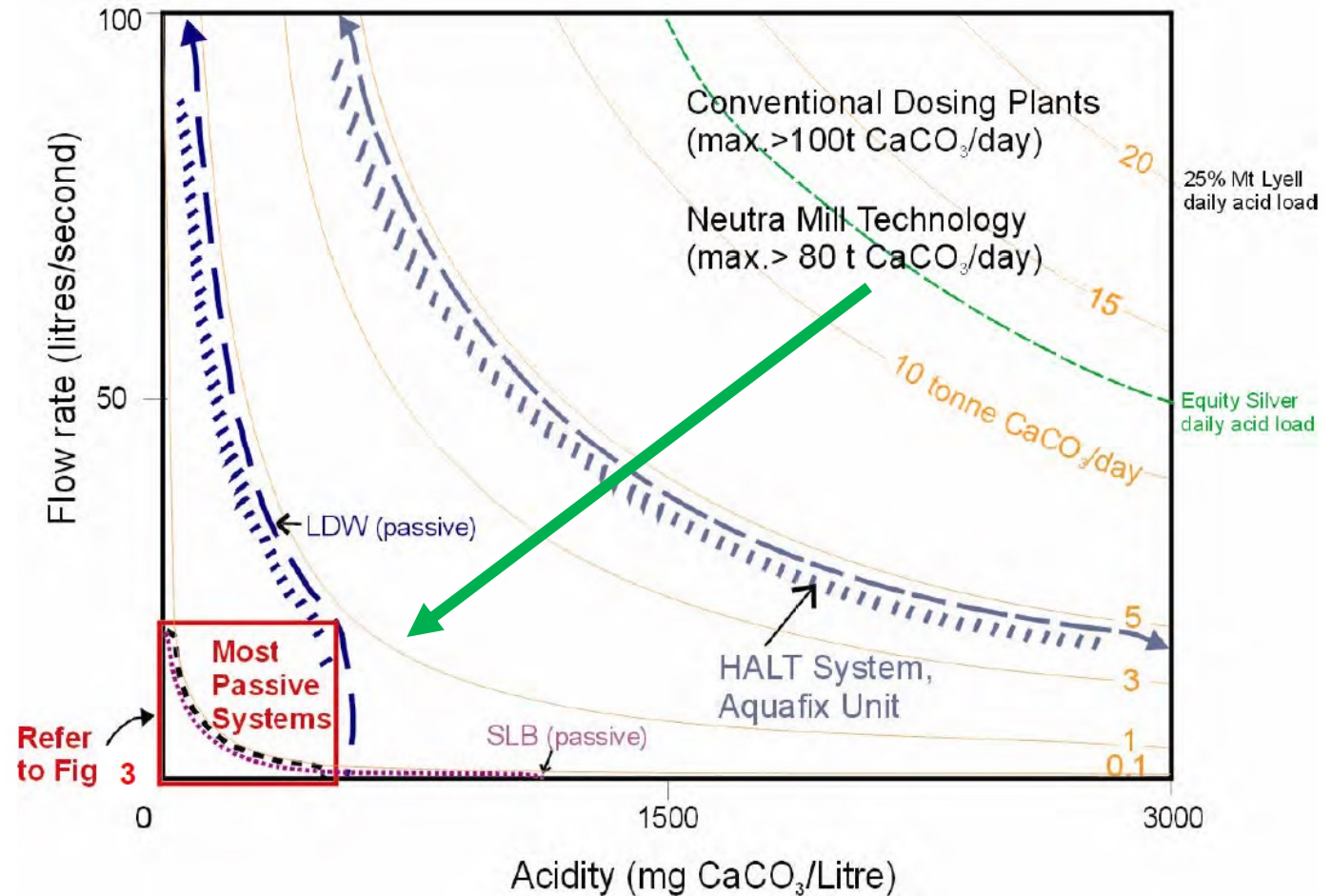
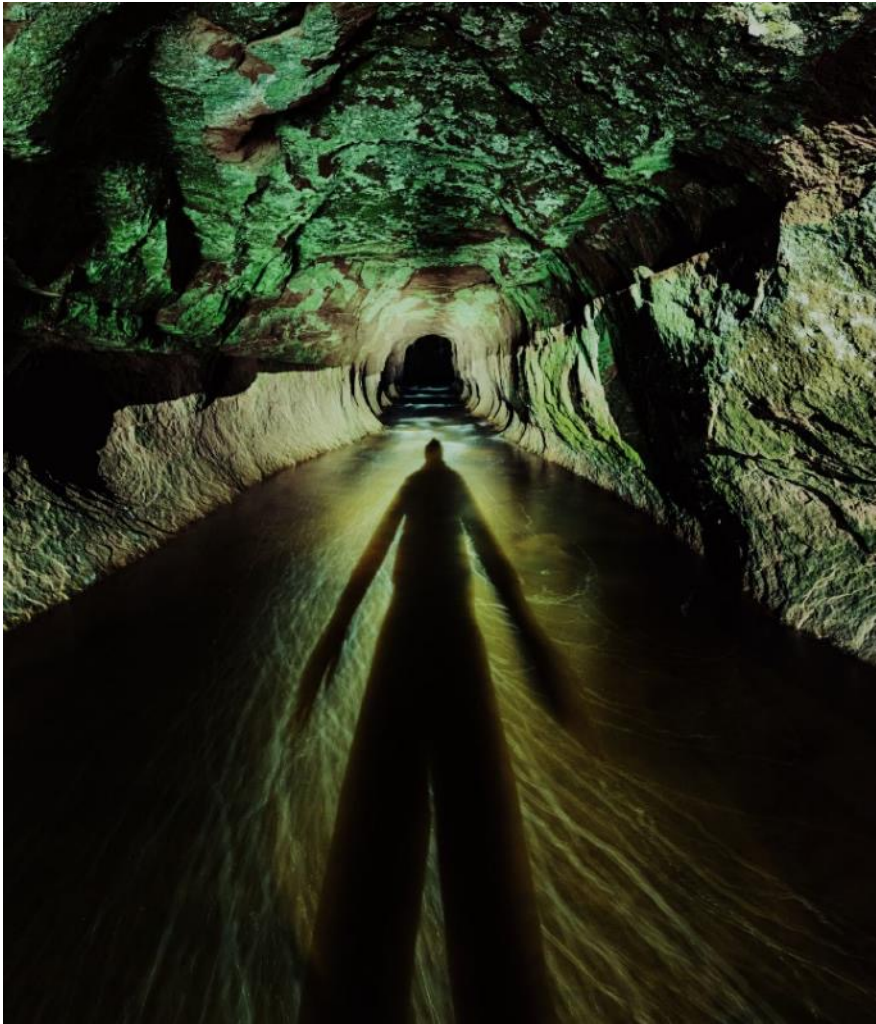
Mines required to monitor and manage water much longer than anticipated after closure – increased closure costs and negative stakeholder perception.

ERM Survey results indicated that post closure:

- 91% of sites still manage water.
- 51% are monitoring water.
- 33% are actively treating water.
- 27% are passively treating water.



Source Control and Water Treatment – The In-Perpetuity Spectre



Taylor et al 2005- Fifth Australian Workshop on Acid Drainage, 29-31 August 2005

From Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition-World Bank 2020

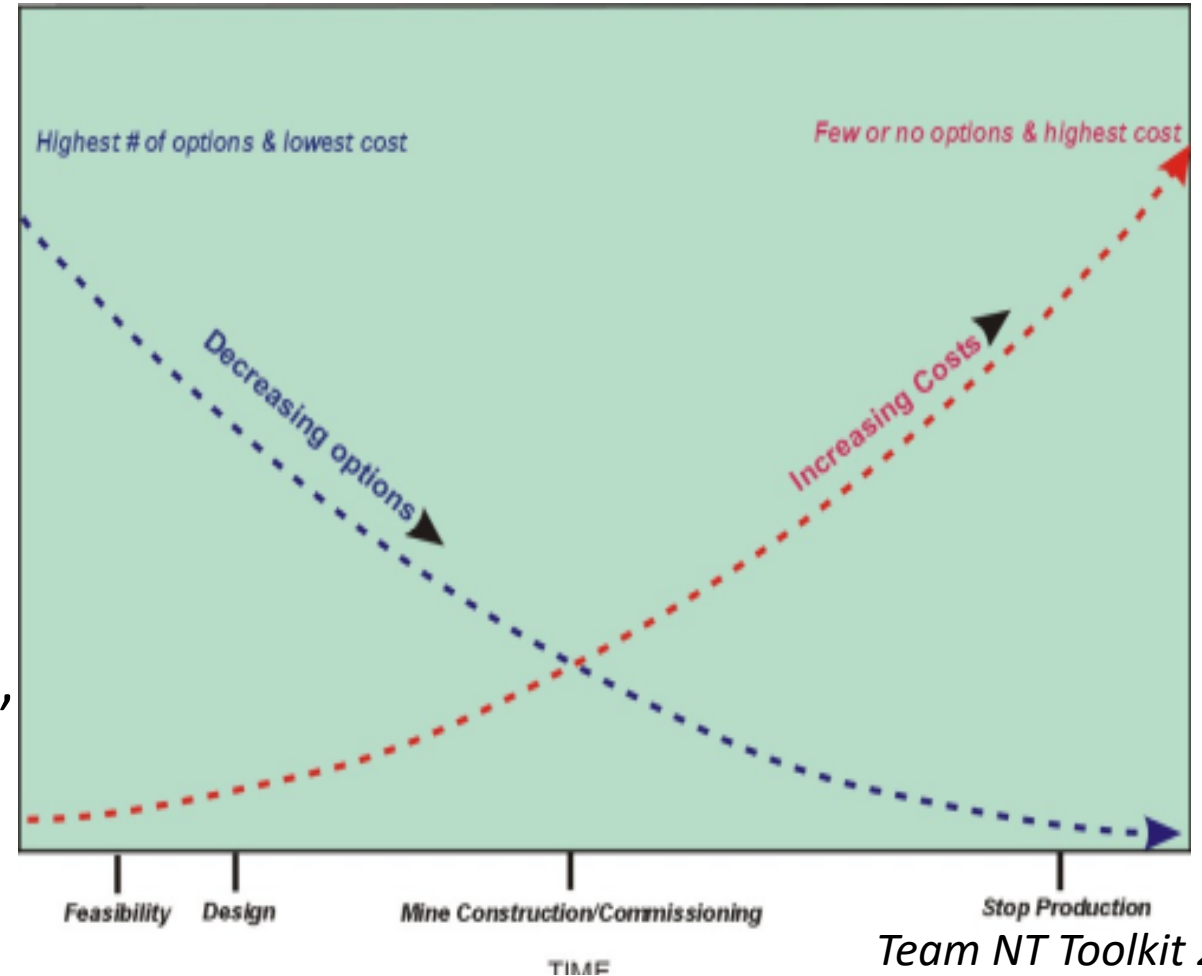
Conference Theme Revisited

Proactive Measures for Lasting
Outcomes

or

“A Stitch in Time saves Nine”

“Source Control – the gift that keeps on giving!”



Team NT Toolkit 2004

ARD 2022-2050- Not Business as Usual!

A huge challenge for all of us in this room, from technical professionals involved in aspects of characterisation and prediction, and for integrated mine planning from start of operations to closure and beyond

ICARD 12 Content



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- 5 short course workshops on the two days prior
- Start of “Day” – single session invited talks –plenaries and keynotes
- Two extended panel discussions covering crossover and emerging issues
- Second half of “day” – 4 parallel sessions of contributed reviewed papers
- Virtual Field Visits

Disappointingly low number of posters – only 5 finally received – probable reflection of the nature of the format. Face-to-face interaction really important for posters

ICARD 12 Outputs



- All Presentations and Short Course Materials will be available for access to registrants for 6 months after the conference.
- Written papers from each session available for individual download.
- A 950 page Proceedings (PDF) containing all of the submitted accepted and peer-reviewed papers.

Great Support from Industry & Consulting Groups



Conference Topics

| Theme | Abstracts (Oral+Poster) |
|--|-------------------------|
| Characterisation, Classification, Prediction | 33 |
| Designing, managing and closing of mine waste facilities | 17 |
| Modelling | 12 |
| Active and Passive treatment | 9 |
| Pit walls and pit lakes | 5 |
| Instrumentation, Monitoring, Data Management | 4 |
| Remediating legacy sites | 4 |
| Geomicrobiology | 2 |
| Scaling from laboratory to field | 2 |
| Economics of ARD management | 2 |
| Mine Planning | 2 |
| Climate change effects | 1 |
| Regulatory policy | 1 |
| Corporate governance and social licence | 0 |
| Community perspectives | 0 |

Country of Origin (Papers)

| Country | Number of Papers |
|-----------------------------|------------------|
| Australia | 29 |
| Canada | 26 |
| United States | 13 |
| United Kingdom | 11 |
| Brazil | 3 |
| South Africa | 3 |
| Chile | 1 |
| China | 1 |
| Congo (Democratic Republic) | 1 |
| Denmark | 1 |
| Japan | 1 |
| Peru | 1 |
| Philippines | 1 |
| Turkey | 1 |

Country of Origin (Delegates) – 400

| Country | Numbers |
|--------------------|---------|
| Australia | 143 |
| Canada | 123 |
| United States | 47 |
| United Kingdom | 18 |
| South America | 14 |
| South Africa | 12 |
| Scandanavia | 10 |
| Europe | 5 |
| Japan | 4 |
| Africa | 4 |
| New Zealand | 1 |
| Others | 4 |
| Eurasia, Indonesia | 0 |

Key Topics/Issues (1)

- Integrated Mine Planning to couple physical and geochemical characterization and waste management scheduling throughout LOM.
- Focus needs to be on building better waste rock piles – e.g. thin lift, base up methods - to limit production of AMD from the start.
- Increasingly, the role of cover systems is being seen to be for controlling infiltration and supporting physical stability and vegetation, rather than being the primary control of the long term geochemical stability of sulphidic waste.
- Application of Characterization methods that are fit-for-purpose.
- Regulation - Regulators need to incentivize companies to implement source control methods (eg ground up construction) for all new WRDs and for extensions to existing WRDs, and encourage industry to test (eg by field trials) innovative approaches, or else practice will not advance.
- Stop “Kicking the Can Down the Road” – Closure issues/problems are often the result of unresolved operational issues with managing wastes. Solutions are available, but good implementation is often an issue.

Key Topics/Issues (2)

- Models are powerful tools to explore possibilities, but do not replace the need for robust physical and geochemical characterization, and trials to demonstrate performance at larger scale.
- Field scale studies need to be run for many years to demonstrate sustainable performance. This is NOT a short term proposition – the work needed will likely extend well beyond the timeframe for a University research project or the tenure of the original company project champion.
- The consumption of water due by oxidation processes in WSFs and the influence of other factors such as temperature, secondary mineral phases and the ionic strength of the percolating water needs to be better incorporated into assessments of potential seepage composition.
- CO₂ emissions from sulphidic mine waste is becoming recognized as a potentially globally significant source, affirming the importance of effective waste management to lower the release of both acid and metals as well as meeting net zero CO₂ emission commitments.

Questions?



Conference Competition and Covid!

Many Mining-Related Conferences Postponed out of normal sequence due to Covid restrictions on gatherings and travel

Last quarter of 2022

- ICARD 12 – September 18-23 (Virtual) – “Brisbane”
- Mine Closure – October 4-6 (Live) - Brisbane
- IMWA 2022 – 6-10 November (Live) – Christchurch NZ
- Mend 2022 – November 30- Dec 1 (Hybrid) – Vancouver