



*Emerging Best Practices for Mine Site
Rehabilitation in the Territory*



A workshop convened on Thursday 14th November, at the CDU Darwin Waterfront precinct as part of the during the 2019 TNRM Conference



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Background

This document provides a summary overview of the scope of content and discussions encompassed by the workshop on 'Emerging Best Practices for Mine Site Rehabilitation in The Territory'. The workshop was convened on Thursday 14th November, as a session of the Northern Territory NRM Conference (2019) at the Charles Darwin University Waterfront precinct.

After recognition of the Larrakia Traditional Owners on whose land the workshop was convened, the workshop objective was introduced.

Mining was highlighted as an extremely important sector within the Territory economy, which over the last decade has consistently contributed between \$2.5-3 billion to the Gross State Product and still accounts for 13% of annual GSP. Consequently it has been a major source of employment and economic growth and, as such, has held a unique place in the Territory's economy for its great potential for driving economic growth.

But this industry success has come with a very mixed environmental track record in the Territory, with projects done decades ago leaving abandoned legacy mines scattered across the landscape and continuing to adversely impact surrounding environments. Consequently lots of rehabilitation work remains to be done and the lessons of the past need to be learned and applied in the future.

In recent years important steps have been taken, initiated by both Territory and Commonwealth governments and by the mining industry itself, to address legacy mines and to ensure that mining projects do not cause unacceptable environmental impacts. A more effective regulatory environment has been introduced, and innovative new initiatives have been implemented. In 2019 the industry now knows much more about the best ways to plan for and implement mine site rehabilitation.

While the workshop may not have been possible ten years ago, it was timely to reflect on the progress made by different stakeholders and reflect on lessons learned. While there is still a long way to go, positive first steps have been taken. The workshop brought together key stakeholders in mine site rehabilitation to explore and share emerging knowledge about how to best restore disturbed mining sites.

Workshop structure

Workshop was structured as a series of presentations followed by discussions and a more general concluding discussion to pull together the key findings and outcomes of the session.



Leading Practice in mine site rehabilitation: An MCA NT perspective

Janice Warren (*Minerals Council of Australia Northern Territory Division*)

The Minerals Council of Australia is the peak body representing the mining industry. It is committed to promoting the principles of Ecologically Sustainable Development (ESD). Consequently it supports the need for successful mine closure and site rehabilitation in order for the industry to (i) leave a positive and enduring legacy (ii) retain a social licence to operate and (iii) for companies to get their bonds back.

MCA NT utilises the term 'Leading Practice' to describe best approaches to mine rehabilitation, as the body of knowledge that guides rehabilitation is changing and evolving, and constantly integrating new technologies and methods. It proposes several key steps typical of leading practice rehabilitation:

- Early engagement with stakeholders to begin pre mine EIA
- Development plans to include post mining land use and conditions
- Early collection of baseline data to guide planning for site-appropriate rehabilitation
- Progressive rehabilitation (where possible) of disturbed land while mining still ongoing
- Closure and rehabilitation plans to have monitored performance targets
- Rehabilitation and closure planning built into original project design
- Rehabilitation does not necessarily mean restoration of same land use as before mine
- Not all mining voids must be or should be backfilled – depends on community aspirations and what is practical and environmentally sound.

A case study was provided to describe how the principles of leading practices had been successfully applied at the Mt Todd Mine site. This included early and strong engagement with both the community and the regulator and significant investment into research and monitoring to identify effective remedial measures.

MCA NT concludes that there are strong business reasons why mining companies should plan effective rehabilitation with community and regulators from the outset of mining activity, and remain well engaged through the process. While rehabilitation plans may evolve through time, they send a strong signal to the public, to regulators and investors that the company is serious about its rehabilitation obligations through all stages of the mine life cycle.

Key discussion points:

- What is meant by 'Social Licence'
- How companies respond to their community engagement objectives

Revegetation of the McArthur River diversion Channel (2006-2019)

Christine Jones (*McArthur River Mine, Glencore*)



McArthur River Mine (MRM) is located in the Gulf County 715Km from Darwin, and mines zinc lead and silver from important sedimentary stratiform deposits. In 2007 it transitioned to open cut mining, requiring a river diversion. Development and ongoing rehabilitation works at MRM have been guided by a complex series of approvals and compliance requirements.

By 2008, two major diversion channels were completed on the McArthur River and the Barney Creek and as conditions of development approval, revegetation works began. These continued through to 2019. Key rehabilitation challenges have included:

- A tight pre-flood window of opportunity to access site and establish vegetation
- High water velocities during the wet season
- Poor soil condition, including heavy clay content, poor nutrient content and high erosion

Rehabilitation actions at McArthur River continues to be directed by the Rehabilitation Management Plan (2018-2020). An annual rehabilitation strategy calls for progressive plantings along the length of the diversion channels, with approximately 1.15 million trees expected to be planted by completion in 2023. Species have been carefully selected based upon the attributes of the area to be revegetated with 120,000 tubestock planted each year. Plantings are supported by programs of weed and pest management and other ongoing site maintenance. Most tubestock planted at MRM is sourced from local seeds grown in an on-site nursery. The mine has a team of 11 workers dedicated to revegetation during the dry season and these are currently exceeding their annual target.

Other techniques have assisted rehabilitation: Large Woody Debris placed in the diversion channels has improved fish habitat, facilitated fish migration upstream and improved bank stability. A dedicated irrigation system has been established within the diversion channel to irrigate during the dry season to assist revegetation with 6km installed during 2018-2019 alone. Success of the MRM rehabilitation strategy is measured against diverse performance targets set in the Rehabilitation Management Plan. Monitoring includes:

- Vegetation establishment
- Aquatic fauna diversity
- Acoustic monitoring of Sawfish and Barramundi
- Riparian birds

Results of ecological monitoring suggest success in the recreation of habitat for fish and birds along the diversion channel, with populations of both trending towards those at reference sites. Monitoring for the EPA suggests the McArthur River is back in 'good condition'.

Key discussion points:

- Course of the rehabilitated river channel
- Public access to the long term rehabilitation plan
- Employment opportunities created for local people



Rum Jungle Rehabilitation – Stage 2A

Jackie Hartnett (Department of Primary Industries and Resources)

Rum Jungle is a former Uranium and Copper mine, active from the 1950s to the 1970s. Remediation works undertaken in the 1980s were not to contemporary standards and need to be revised with current best practice. The site is Crown Land and currently under claim by the Finnis River Aboriginal Land Trust. It encompasses recognised sacred sites and so requires significant rehabilitation before it can be safely and appropriately returned to Traditional Owners. Consequently, the Commonwealth entered into a project agreement with the Northern Territory to develop a new remediation plan. Development and delivery of this has been structured into successive project stages:

- Stage 1: Research monitoring and Consultation
- Stage 2: Concept delivery, refined remediation plan, consultation
- Stage 2A: Environmental Impact Statement, business case and detailed engineering design
- Stage 3: Construction, stabilization and monitoring
- Stage 4: Longer term monitoring

As elevated levels of Copper, Manganese, Nickel, Zinc and Cobalt have been detected a little distance downstream from the mine on the Finnis River East Branch (EBFR), a key goal of the project is to reduce acid mine drainage occurring from the site. Therefore, the project will implement current best practices to reduce acid mine drainage by removing and storing waste rock at new facilities and covering, lime dosing and compacting pits to prevent oxygen and water infiltration. The project will also establish drainage systems to redirect water and prevent erosion and pump residual acid mine drainage impacted groundwater for treatment. At a broader scale, project objectives are to:

- Restore the flow of the EBFR to its original course
- Rehabilitate local ecology and habitats
- Isolate sources of radiological hazard
- Preserve aboriginal cultural artefacts and places
- Maximise opportunities for Traditional Owners to work on site.

The project team are now very close to submission of an Environmental Impact statement to the NT EPA. They are particularly keen that the lessons learned from progressing the project and achieving best practice outcomes are shared, and expect the project to serve as a case study to inform rehabilitation of other sites (both currently operating and legacy).

Key discussion points:

- The importance of consultation with Traditional Owners and how this has informed planning
- How best to share and utilise the lessons from the Rum Jungle Rehabilitation project



Revegetation Strategy and practice at Ranger uranium mine

(Ping Lu Energy Ranger Mine, Resources of Australia)

Ranger mine is located 250 km east of Darwin close to Jabiru township in an exclusion from the Kakadu World Heritage Area. Mining commenced in 1981, ceased in 2012 and processing of stockpiled ore will cease in January 2021. Rehabilitation will require moving over 90 million tonnes of material with 960 ha scheduled to be rehabilitated by 2026. Over 1.2 million trees and plants will be established.

Rehabilitation is intended to introduce native plant species at densities similar to reference sites in Kakadu WHA, to establish a viable ecosystem similar to those in Kakadu. ERA faces several environmental challenges to achieve this:

- Climate: strong seasonality, inter-annual variability in rainfall, extreme events
- Final land form condition: fire and weeds pressure from Kakadu, rock growth medium

ERAs rehabilitation strategy has been informed by 30 years of trials and research into the local ecology and vegetation dynamics. It continues to develop with new research and stakeholder consultation. To inform this strategy, the Ranger team have studied:

- Landscape vegetation relationships (e.g. geomorphic features and soil attributes)
- Vegetation dynamics (how different plants grow and their growth attributes)
- Predictability of performance (e.g. long term development trajectories for plant communities)

The ranger team have found that grasses and Acacias alone produce unstable systems, whereas inclusion of framework species introduces greater stability... Species selections are based upon reference sites, trials and cultural consultations, and introduced in stages to reduce competition between species. Key elements of the revegetation strategy include;

- 82 woody species and 10 grasses established
- Tubestock for most species with direct seeding for a few
- Irrigation and slow release fertilisers to assist establishment
- Fire resilient species and careful fire management for first 5 years
- Effective weed control before and after plantings

A revegetation trial applying these principles was established on an 8 hectare site in 2009. It has demonstrated successful plantings on rock media (after careful site preparation) and proven effective management of weeds among established vegetation through use of controlled cool burns. Today the site has more than 35 species flowered and fruited (some already naturally reproducing) and evidence for animal colonisation of the trial area

Key discussion points:

- How the lessons of Ranger have been shared and communicated
- Ranger revegetation strategy and Mine Closure Plan publications



Environmental monitoring to support rehabilitation outcomes

Amie Leggett (Supervising Scientist, Department of Environment and Energy)

The Supervising Scientist Branch (SSB) was established out of the recommendation of the 1970s Fox reports of the need to protect significant values of the Alligator Rivers Region. Environmental requirements established for the Ranger mine required that it should have no detrimental impacts on the surrounding environment and after mining operations are complete, a sustainable ecosystem similar to surrounding environment be restored. The SSB has undertaken 40 years of research and monitoring to collect baseline data, assist in the regulation of operational impacts and help inform rehabilitation design. A diversity of methods have been utilised including the latest tools and techniques.

SSB have played a key role in informing and guiding progressive rehabilitation at Ranger by:

- Monitoring processes and outcomes effecting the Pit1 land form trial
- Developing, calibrating and validating diverse rehabilitation models
- Setting rehabilitation standards

Post closure monitoring activities will be designed to achieve evaluation and optimisation, including:

- The environment remains protected under a changed management regime.
- Progress is being made towards the end state
- Traditional Owners are involved to build capacity and environmental stewardship

The success of the SSB mission and model of activity is indicated by the outcomes achieved over 40 years, and by the fact that no environmental impact has been detectable downstream of Ranger mine during this period. SSB point to a number of key lessons relevant to future monitoring in support of mine-site rehabilitation:

- Clear objectives are critical from the outset
- Documented monitoring and data management plans
- Data quality integral to monitoring design
- Evaluation and review of monitoring

SSB also highlight the importance of effective communications of findings:

- Outcomes communicated in a way which is understandable
- Stakeholder interests need to be understood and met
- Take the opportunity to educate and be educated

Key discussion points:

- Standardisation or comparability of monitoring at Ranger sites with environmental monitoring elsewhere in Kakadu
- Management of environmental impacts



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Mine rehabilitation and indigenous cultural values

Will Kemp (Charles Darwin University)

Mining operations can result in a number of detrimental effects, including loss of biodiversity, altered contours, rocky debris, water flows polluted contaminated or changed, salinity and heavy metal residues. Various standards exist for mine rehabilitation, and these are generally challenging to achieve. In the Territory approximately 50% of the land area is indigenous owned, and 9 mines are currently operating. Mining has potential to impact on indigenous people in a number of ways.

Indigenous peoples take their responsibilities for caring for country very seriously and their strong connection with the land and its use as a source of food leaves them vulnerable to consuming toxins in plants or animals. Active involvement with caring for country has been shown to result in both strong social and health benefits in communities.

Given that health and life expectancy is worse for indigenous than non-indigenous peoples, it is important that restoration of indigenous cultural values are designed into mine site rehabilitation to enable them to exercise customary practices. There are precedents for Indigenous cultural values being integrated in rehabilitation planning:

- Overseas, Canadian and Yukon governments collaborated with first nations to develop a remediation plan for the Faro mine
- Cultural heritage attributes have been identified and incorporated into planning for the Rum Jungle Rehabilitation project
- Energy Resources Australia have carried out detailed consultations with Traditional Owners to determine post mining land use at Ranger mine

Consideration of indigenous cultural values in rehabilitation planning can be justified a:

- Doing the right thing
- Social licence to operate
- Better indigenous health outcomes
- Better for the environment
- Doing it right the first time to reduce cost of having to do it again

This ongoing research project will explore the indigenous cultural values which relate to the rehabilitation of mined lands, and how well rehabilitation can restore cultural landscape. It will ask how current systems and processes for mine rehabilitation could be improved to better capture these values. The research will be based upon interviews with both Traditional Owners of mined lands and mine site rehabilitation professionals. It aims to produce recommendations that will guide both mining companies and Traditional Owners to achieve better mine site Rehabilitation outcomes.

Key discussion points:

- The importance of doing it right first time
- Lessons to be learned from current rehabilitation processes in the Territory



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Concluding points discussion summary

➤ Emerging knowledge

Recent successes and steps forward in Territory rehabilitation practices are less the product of emerging new technologies and techniques than steps forward in leadership, management and coordination. Industry is essentially responding to changing times, values and standards. But there is still a lot of scope to improve practices, engage communities better and improve planning and project design.

➤ Industry playing 'catch-up'

The industry perceives itself as trying to make the best of a bad situation. It is confronted with the legacy of something that has already happened, and the historic poor practices of companies that have already left the Territory... While it cannot go back and change these poor practices of the past, it can look forward to learning from them and improving the practices of the future. The learning the lessons is critical for future operations

➤ Planning for closure and rehabilitation

It is clear that industry needs to look beyond the life of a mine site as soon as it begins planning for production. A key business principle is that any project needs to be sure to produce more value than the total cost of rehabilitation, otherwise there is no point in proceeding. In order to ensure public confidence and social licence for a project, this planning should be as transparent as possible with stakeholders and community able to understand plans for rehabilitation.

➤ The regulatory environment

There was discussion about improving the regulatory environment in the Territory, from approvals to post-closure. It was suggested that project authorisations should be more strongly linked to clear demonstrations of post-closure planning. There was further discussion about the need for Territory- specific closure and rehabilitation guidelines to inform the process. It was suggest these already existed in draft form and were a work in progress.

➤ Social licence

Social licence is essential to the success of the industry. Companies need to establish trust with their investors, stakeholders and local communities. Some consultations processes in the Territory have demonstrated commitment to meaningful engagement, but there still remains much to be learnt about how the industry can best incorporate feedback into project designs, establish and maintain ongoing communications with stakeholders.



➤ **Laying the groundwork**

Rehabilitation can mean different things in different contexts. But it is clear that mine rehabilitation depends upon effective research, monitoring, applied trials and consultations to develop plans and strategies appropriate to particular sites. While some sites in the Territory have benefited from a great deal of site-specific research, these research findings and results could potentially have broader significance if communicated effectively.

➤ **Communications**

Communication, both peer-to-peer between scientist and professionals, and between companies, communities, regulators and other stakeholders, underlies successful rehabilitation. At present there exist important opportunities for stakeholders to learn from each other and improve rehabilitation performance. The production of technical reports, of research papers and sharing of data has been prioritised by some actors. Events such as this workshop can also promote a spirit of information sharing, and peer-to-peer learning.



Registered Workshop Attendees

	Name	Organisation
Brian	Austral	Tiwi Resources Pty Ltd
Cassie	Bell	Mcarthur River Mining Pty Ltd
Liz	Bird	Centralian Land Management Assoc
Chris	Brady	Northern Land Council
Christine	Burke	Dhimurru Aboriginal Corporation
Susanne	Casanova	Territory NRM
Brooke	Cawood	Department Of Primary Industry & Resources
Diane	Chanut	Parks, Wildlife & Heritage Division
Rhys	Clarke	Department Of Primary Industry & Resources
Evana	Coote	Department Of The Chief Minister
Wanda	Dempster	Department Primary Industry & Resources
James	Desantis	Tiwi Resources Pty Ltd
John	Dockrill	Northern Land Council
Scott	Downs	Department Of Primary Industry & Resources
Angelica	Driss	Department Of Primary Industry & Resources
Simon	Ferguson	Territory Wildlife Park
Rebecca	Gentle	Mcarthur River Mining
Kez	Hall	Lok Landji Family Association P/I
Andria	Handley	Department Of Primary Industry & Resources
Ian	Harris	Northern Land Council
Jackie	Hartnett	Department Of Primary Industry & Resources
Adam	Hatfield	Mcarthur River Mining Pty Ltd
Edward	Henry-Whiting	Tiwi Resources Pty Ltd
Phil	Hickey	Department Of Environment And Natural Resources
Bruce	Holland	Tiwi Resources Pty Ltd
Lisa	Howat	Department Of Primary Industry & Resources
Aliesha	Hvala	Nt Airports (cdu Student)
Christine	Jones	Mcarthur River Mining Pty Ltd
Louise	Kean	Parks And Wildlife Commission
Will	Kemp	Charles Darwin University
Colin	Kerinaiaua	Tiwi Resources Pty Ltd
Tito	Khatiwada	Charles Darwin University
Amie	Leggett	Supervising Scientist
Jeannine	Lisle	Department Of The Environment And Energy
Ping	Lu	Energy Resources Australia
Cameron	Machan	Mcarthur River Mining Pty Ltd



Jyoti	Maggu	Department Of Primary Industry & Resources
Clare	Martin	Territory NRM
Ella	Mason	EcOz Environmental Consulting
Debbie	McGregor	Amangal Aboriginal Corporation
Jennifer	McGregor	Amangal Aboriginal Corporation
Shar	Molloy	Environment Centre NT
Jo	Neyens	Department Of Primary Industry & Resources
John	O'Rourke	Afs Miindallaray
Armando	Padovan	Department Of Primary Industry & Resources
Vernon	Patullo	Kungarakan Aboriginal Corporation
Tiffanie	Pearse	NT Airports
Warrick	Puruntatameri	Tiwi Resources Pty Ltd
Steve	Reynolds	Territory NRM
Jeff	Richardson	Ecoz
Clinton	Rioli	Tiwi Resources Pty Ltd
Willie	Rioli	Tiwi Resources Pty Ltd
Chris	Roach	Gaia Resources
Willie	Roberts	Tiwi Resources Pty Ltd
Alan	Roe	Territory NRM
Tony	Scherer	Department Of Primary Industry & Resources
Donald	Shadforth	Northern Land Council
Kerry	Sharp	Kerry Sharp Journalist
Sarah	Smith	SLR Consulting
Max	Smith	Department Of Primary Industry & Resources
Sam	Strohmayr	Mcarthur River Mining
Rojita	Thapa	Department Of Primary Industry & Resources
Stephen	Trudgeon	Department Of Primary Industry & Resources
David	van den Hoek	Ecoz
Kate	Vanson	Skills Impact
Glen	Ware	Newmont
Janice	Warren	Minerals Council Of Australia
Kylie	Welch	EcOz Environmental Consultants
Anna	Wilkins	
Joni	Woollard	Department Of Primary Industry & Resources