Mined Land Rehabilitation in Australia

Hendry Baiquni

Workshop – Improving Mined Land Rehabilitation in Indonesia through Capacity Building for Practitioners

Bogor, 11-12 Sep 2013
The University of Queensland

- Founded in 1910
- 45,455 students
- 12,166 postgraduate students
- 4,039 RHD students (3,593 PhD)
- 9,000\textsuperscript{th} PhD graduation in 2010
- 11,364 international students
- 134 countries
- 7,453 staff
- Comprises Faculties and Institutes
The Sustainable Minerals Institute (SMI)

RESEARCH, EDUCATION AND CONSULTATION

SAFETY AND HEALTH

MINERAL PROCESSING

SOCIAL RESPONSIBILITY

MINING AND GEOLOGY

WATER MANAGEMENT

COAL SEAM GAS

ENVIRONMENT

COLLABORATION AND PROJECT MANAGEMENT
The Development of the SMI

<table>
<thead>
<tr>
<th>Education in Mining and Metallurgical Engineering commenced at The University of Queensland</th>
</tr>
</thead>
<tbody>
<tr>
<td>JKMRC</td>
</tr>
</tbody>
</table>

- **Income (AUD)**
  - **Income**: 0, 10,000,000, 20,000,000, 30,000,000, 40,000,000

- **Number of People**
  - **Number of People**: 0, 50, 100, 150, 200, 250, 300, 350, 400
About CMLR

- Formally established in 1993
- Collaborative and multi-disciplinary group of research, teaching and support staff and postgraduate students
- Dedicated to delivering excellence in environmental research and education to the minerals industry, government, non-government organisations and local communities
- Source of quality research at cutting edge of issues in mining environmental management and sustainability across full spectrum of resource commodities
- Provision of scientific research necessary to support decisions to minimise risks and maximise opportunities resulting from resource exploration, extraction and processing globally
Centre for Mined Land Rehabilitation

- Stable Landforms and Sustainable Substrates
- Water and Contaminants in the Landscape
- Ecosystem Structure and Function
- Monitoring and Mapping Technologies
- Mine Closure and End Use Planning
CMLR conducts research on materials characterisation: the chemical, physical and biological properties that a root zone must possess in order to support desired vegetative cover in the long-term.
An examination of options and strategies for tailings revegetation at Mount Isa and Ernest Henry Mines

- Key soil processes for reconstructing root zones
- Ecophysiological tolerance of key native species
- Tailings of Cu/ Pb/ Zn mines in semi-arid environment
- Soil physics, geochemistry & plant ecophysiology
MONITORING & MAPPING TECHNOLOGIES

CMLR conducts research using remote sensing technologies and spatial analysis methods for mapping and monitoring mined sites for rehabilitation management actions.
Monitoring with confidence

- Autonomous unmanned aerial vehicles for very high resolution change detection
- Low altitude imagery; repeatable in multiple conditions - GPS guided
Coal research at the Centre for Mined Land Rehabilitation

- Optimising slope angles and lengths and managing erosion in post-mined landforms through measuring and modelling soil physical properties
- Assessing environmental safety of in-pit tailings disposal
- Measuring the soil conditions required to ensure productive pastures
- Soil organic matter & green carbon in rehabilitation: role in the C balance
- Effect of longwall mine subsidence on crop production
- Rebuilding the capability of strategic cropping land after mining
- Challenging the post-disturbance landscape with grazing pressures
- Understanding dormancy & germination strategies of native understorey
- Predicting impacts of longwall mining on swamp hydrology and ecology
- Exploring impacts and habitat reconstruction protocols for flora & fauna
- Risk assessment tools to support end use decisions for coal-mined land
- Developing new technologies for effective & efficient monitoring at scale
As a result of our interest and active research into Mine Rehabilitation, CMLR has accumulated an extensive publication record and been involved in the development of several resources.
Resources

Abandoned Mine Hub

Managing Mining Legacies
a newsletter for stakeholders interested in abandoned/legacy mine challenges and opportunities

Waratah Germination Database

DIG – A coal mine rehabilitation bibliographic database

Dig A coal mine rehabilitation database
CMLR strives for excellence in education and training.

We offer coursework programs that can be taken from anywhere in the world and research programs that are completed using our facilities in-house (Brisbane, Australia).
Coursework and Research Study Options

CMLR offers Graduate Certificate, Graduate Diploma and Masters programs in Mineral Resources (Environment) covering a variety of topics including:

- Mine waste management and landform design
- Mining environmental management processes
- Soil and growth media management
- Ecological survey and analysis
- Vegetation and habitat rehabilitation
- Mining environmental regulation

CMLR also provides opportunities for students wanting to enrol in an Honours, Masters or PhD program under the following generic topics:

- Habitat Redevelopment
- Environmental Stress Physiology and Ecophysiology
- Plant - Soil Interface
- Soils and Environment
- Water Quality and Contamination
- Environmental Modelling
Negative environmental legacies
“Before you start, …. think of the finish”
Process of mine closure

- Closure planning is fundamental to the operation of a mine
- Closure plans should be developed at feasibility stage
- Closure plans need integration with long-term operational plans
- Require regular review to meet regulatory, technological and economic changes

Source: Queensland Resources Council
Closure process through mine life

Exploration

Feasibility

Planning

Construction

Mining

Rehabilitation

Decommissioning

Closure

Annual Reviews

Final Closure Plan

Monitoring

Financial Assurance

Closure Strategies

Closure Plan
POLICIES
and
LEGAL FRAMEWORKS
Federal and State Government Roles

• Commonwealth Constitution specifies the matters which are regulated by the Federal Government
• Environmental, planning, mining and resource access matters mostly regulated by the States and Territories
• Federal Government does have some powers regarding mining operations that will override any inconsistent State legislation and include trade and commerce with other countries relating to minerals export, taxation, nuclear (uranium) issues
• In line with society’s increasing environmental awareness, the Federal Government adopted a more centralist attitude to environmental matters and adopted legislation dealing with matters of national environmental significance:
  – World heritage properties and Ramsar wetlands
  – Nationally threatened species and ecological communities
  – Migratory species
  – Commonwealth marine areas
• Aboriginal issues regulated by both Federal and State governments
Inter-governmental agreement

To provide a mechanism to facilitate a:
- co-operative national approach to the environment
- better definition of the roles of the respective governments

National Environment Protection Council was established to set national environmental goals and standards through National Environment Protection Measures (NEPMs) to ensure that the people enjoy the benefit of equivalent protection from air, water or soil pollution and from noise, wherever they live and that decisions of the business community are not distorted, and markets not fragmented, by variations between member Governments in relation to the adoption or implementation of major environment protection measures.
Policy framework

Among the factors that have led to the development of policies around mining and the environment is the recognition that:

- Mining is a temporary form of land use;
- At the completion of mining there are opportunities for the land to be rehabilitated to one or more post-mining land uses;
- There has been an expansion in the rate of development of new mines and increased production at existing mines in recent times;
- There is an increasing expectation by communities about the degree to which environmental and social values are to be protected from mining impacts.
In 1992, the Commonwealth of Australia developed the **National Strategy for Ecologically Sustainable Development** (NSESD) to promote economic growth that:

- Safeguards the welfare of future generations
- Provides equity within and between generations
- Protects biological diversity
- Maintains essential ecological processes and life support systems

The NESD framework includes the “polluter pays” principle - those who generate pollution and waste should bear the cost of containment, avoidance or abatement.
The NSESD sets several objectives for mining including development of rehabilitation policies based on:

- Repairing the land so its ongoing maintenance needs are consistent with those of equivalent unmined land under equivalent land use
- Rehabilitation requirements that are open to public scrutiny
- Treating rehabilitation and mine closure as integral components of the planning and operation of mines
Policy framework

- 1992: Commonwealth government developed the National Strategy for Ecologically Sustainable Development

- 2000: MCA (Minerals Council of Australia) and ANZMEC (ANZ Minerals & Energy Council) jointly published the Strategic Framework for Mine Closure

- 2003: ICMM’s (Int’l Council on Mining & Metals) CEO-led Council committed corporate members to implement and measure their performance against 10 principles

- 2004: MCA developed Enduring Value, providing a framework for implementing ICMM principles in an Australian context
Policy framework

In May 2003, ICMM’s CEO-led Council committed corporate members to implement and measure their performance against 10 principles.

1. Implement and maintain ethical business practices and sound systems of corporate governance.
2. Integrate sustainable development considerations within the corporate decision-making process.
3. Uphold fundamental human rights and respect cultures, customs and values in dealings with employees and others who are affected by our activities.
4. Implement risk management strategies based on valid data and sound science.
5. Seek continual improvement of our health and safety performance
6. Seek continual improvement of our environmental performance
7. Contribute to conservation of biodiversity & integrated approaches to land use planning
8. Facilitate and encourage responsible product design, use, re-use, recycling and disposal of our products
9. Contribute to the social, economic and institutional development of the communities in which we operate
10. Implement effective and transparent engagement, communication and independently verified reporting arrangements with our stakeholders
The mining industry has been working with Australian governments to improve the mutual understanding of how rehabilitation can minimise the future impacts of mining activities.

**Program Handbooks**

- Airborne Contaminants, Noise and Vibration
- Biodiversity Management
- Community Engagement and Development
- Cyanide Management
- Evaluating Performance: Monitoring and Auditing
- Hazardous Materials Management
- Managing Acid and Metalliferous Drainage
- Mine Closure and Completion
- Mine Rehabilitation
- Risk Management
- Stewardship
- Tailings Management
- Water Management
- Working with Indigenous Communities
Environment Protection and Biodiversity Conservation Act 1999 is the Australian Government’s central piece of environmental legislation. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places — defined in the EPBC Act as matters of national environmental significance.

2013 Proposed EPBC Act amendment – Water trigger
The Australian Government is introducing an amendment to Australia's national environment law to provide that water resources are a matter of national environmental significance, in relation to coal seam gas and large coal mining development.
Under the EPBC Act:

- Rehabilitation indicators provide defensible measurements of progress towards the rehabilitation objectives.
- An indicator is defined as “something that can be measured and audited according to an established protocol and used to evaluate changes in a system”.
- Environmental indicators may involve the measurement of a single parameter or they may involve the amalgamation of measurements of several parameters into an index or model.
- The holder of the “Environmental Authority” is responsible for nominating and justifying the indicators for the mining project.
Under the EPBC Act:

- Rehabilitation completion criteria must provide a clear definition of successful rehabilitation at the mine site in the form of a set of measurable benchmarks against which the indicators can be compared to determine whether the objectives are being met.

- The criteria should be developed in consultation with stakeholders (e.g. the landowner, local government, indigenous groups, community groups and various government departments).

- A particular criterion may vary significantly across and between mines. The rehabilitation objectives will guide the selection of the indicators and the specific completion criteria.
Draft Framework of Standards for Accreditation

• In April 2012 the Council of Australian Governments (COAG) agreed to reform the administration of national environment regulation in order to reduce duplication and double-handling while maintaining high environmental standards.

• Released a draft Framework of Standards for Accreditation (the Standards) on 2 November 2012, made publicly available with an added explanatory preface.

• The draft Standards are an Australian Government document and form the basis for the Australian Government’s approach to the development of bilateral agreements. They set out both:

  Standards for accreditation – which reflect the specific accreditation requirements of the EPBC Act, and requirements of Commonwealth law and policy that are essential for the Commonwealth to be satisfied that high environment standards will be maintained, and

  Commonwealth considerations – which provide additional guidance to jurisdictions on areas that the Commonwealth will take into account when determining whether the standards have been met.

• The EPBC Act protects 8 matters of national environmental significance: World Heritage properties, National Heritage places, wetlands of international importance, listed threatened species and ecological communities, listed migratory species, protection of the environment from nuclear actions, the Commonwealth marine environment and the Great Barrier Reef Marine Park.

• The EPBC Act also provides protection in relation to other matters, specifically, actions taken by Commonwealth agencies and actions on Commonwealth land. These matters are not dealt with in this Framework of Standards document, as the EPBC Act does not contain specific requirements for bilateral agreements for these matters.
In Queensland, rehabilitation is required under the Environmental Protection Act (1994) which requires all reasonable and practicable measures be taken to protect environmental values from all sources of environmental harm and requires persons who cause environmental harm to pay costs and penalties for the harm

- The rehabilitation goals typically set by government policies require areas disturbed by mining should result in sites that are:
  1. Safe to humans and wildlife;
  2. Non-polluting;
  3. Stable; and

- There may be additional goals relevant at some sites through requirements under other legislation dealing with matters such as endangered species, water, heritage or regional or local planning.
In Queensland, mining projects have an environmental management plan which states the objectives for rehabilitation as well as measurable indicators and standards (called completion criteria) that are to be achieved.

Rehabilitation objectives must provide a clear description of proposed rehabilitation outcomes and must:

- Address potential environmental impacts
- Achieve highest practicable level in the rehabilitation hierarchy
- Identify post-mining land uses acceptable to the community, local government and any other relevant stakeholders
In assessing the acceptability of rehabilitation objectives, government will consider those strategies listed higher in the hierarchy should be adopted in preference to those listed lower, unless there are significant environmental, economic or social issues that override such a selection:

1. Avoid disturbance that will require rehabilitation
2. Reinstate an ecosystem as similar as possible to the original
3. Develop an alternative land use with a higher economic value
4. Reinstate previous land use and of similar value
5. Develop lower value land use
6. Leave the site in an unusable condition
In 1999, the State Government proposed new laws to administer environmental management of Queensland’s mining industry. Under the *Environmental Protection and Other Legislation Amendment Act 2000*, provisions in the *Mineral Resources Act 1989* (MR Act) relating to environmental management of mines were transferred to the *Environmental Protection Act 1994* (EP Act); further amended 2004 to simplify approval procedures for low impact mining projects.

Under the arrangements, the administering authority (Department of Environment and Heritage Protection) has responsibility for environmental impact assessment, administration of environmental authorities, as well as compliance, auditing and monitoring of the environmental management of mining.
EIA Process

- Screens out environmentally-unsound projects
- Proposes modified designs to reduce impacts
- Identifies feasible alternatives
- Predicts significant adverse impacts
- Identifies mitigation measures to reduce, offset, or eliminate major impacts
- Engages and informs potentially affected communities and individuals
- Influences decision-making & development of terms & conditions

Under Queensland law there are a range of EIA processes that may potentially be triggered or required by government decision-makers.
Conclusions

– Best practice principles of mine closure require that planning for rehabilitation & post-mining land use must be considered from the early stages of project evaluation
– Legal obligations & corporate policies also require companies to plan early for rehabilitation & to designate a sustainable end land use
– In the Bowen Basin of central Qld, susceptibility of mined land to water erosion is a threat to site stability & hence to the sustainability of its end land use
– Cattle grazing is potentially a sustainable end use for mined land, a capability demonstrated both theoretically & in practice, but the way the cattle (& the land) are managed is still a critical factor in ensuring the sustainability of grazing
– Understanding the requirement to manage & re-establish native ecosystems & associated habitats for fauna are realistic & preferred options in particular post-mined landscapes
– Addressing & understanding the social as well as the biophysical constraints & conflicts around competing uses for post-mined land will minimise the risks & maximise the opportunities
Research Funding

ACARP

Australian Coal Association Research Program

Established in 1992 ACARP is an industry research program funded by a 5 cent per tonne levy and is managed by industry representatives.

ACARP invests approximately $15 million per year in research projects of relevance to all areas of coal production and of importance to the Australian black coal industry.

ACARP funds projects in the areas of:
• Occupational Health and Safety
• Environment and Rehabilitation of Mined Land
• Community Concerns and Land Access
• Cost of Production
• Technical Support for Marketing Australian Coals
• Mine Site Greenhouse Gas Mitigation
International Collaboration

IM4DC

International Mining for Development Centre

Aims at sharing Australia’s significant expertise and experience in mining to assist resource rich developing countries to maximise the benefits and opportunities of mining.

Since Nov 2011 to June 2013 has achieved many significant milestones:
• 30 short courses, workshops and study tours in Australia and developing countries
• 900 participants from 36 developing countries
• 30+ institutional linkages and partnerships created with Australian, overseas and international organisations
• 5,000 participant training days, boosted mining for development knowledge and expertise
• 20 action research projects, target priority needs
• 4 guides to Australian Practice published
• 30% female participation in the IM4DC program
• 11 fellowships hosted in Australia
• 700+ delegates attended two international conference events

Is a joint venture between UW and UWA, funded by Australian Government through AusAID.