



**Supervising Scientist
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A System of Environmental Performance Assessment and
Reporting Which Serves the Needs and Expectations of
Operators, Regulators and the Concerned Public

Stewart Needham

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A SYSTEM OF ENVIRONMENTAL PERFORMANCE ASSESSMENT AND REPORTING WHICH SERVES THE NEEDS AND EXPECTATIONS OF OPERATORS, REGULATORS AND THE CONCERNED PUBLIC

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ABSTRACT

Uranium mining, national parks, and Aboriginal rights are all potent sources of concern to sections of the Australian community. In combination, in the case of uranium mines in the Kakadu region, special arrangements are needed to deliver the level of assurance expected by government and the public that social, environmental and public health issues are adequately addressed. This paper describes a mechanism which has been designed to deliver information, clarity of process and participation in a way which meets the expectations of a broad group of community, government and industry stakeholders. The mechanism is also being successfully applied to non-mining situations.

INTRODUCTION

Various sections of the community expect different types of accountability in respect of the uranium mines of the Kakadu region, ranging from financial performance, occupational health and safety of workers and nearby residents, protection of the Kakadu environment, safeguarding dietary and other risks to Aboriginal people, and reduction of long term risks after mine closure including site rehabilitation and long term containment of tailings. Stakeholders include the Aboriginal landholders; local residents; the mining company, shareholders and employees; the managers of Kakadu National Park and park visitors (i.e. tourists); Territory and Commonwealth regulators and interested departments of resources, environment, and health; and community environment and anti-nuclear groups. Tensions have developed as a consequence of these different and sometimes conflicting interests. Since 1993 a structure has been put in place which involves processes of stakeholder involvement, information sharing, joint problem solving, and public reporting. This structure adds up to a system of high public accountability, and presents an interesting case study in how widely varied stakeholder group interests and expectations can be accommodated.

THE SYSTEM

The system involves two main steps: environmental performance audits, and stakeholder consultation. These operate on a six month cycle, reflecting the dynamics of the activity, the level of interest in it, and the extreme pressures that the wet-dry tropical climate can impose upon environmental management at the mine (in particular, water management and disposal of excess water).

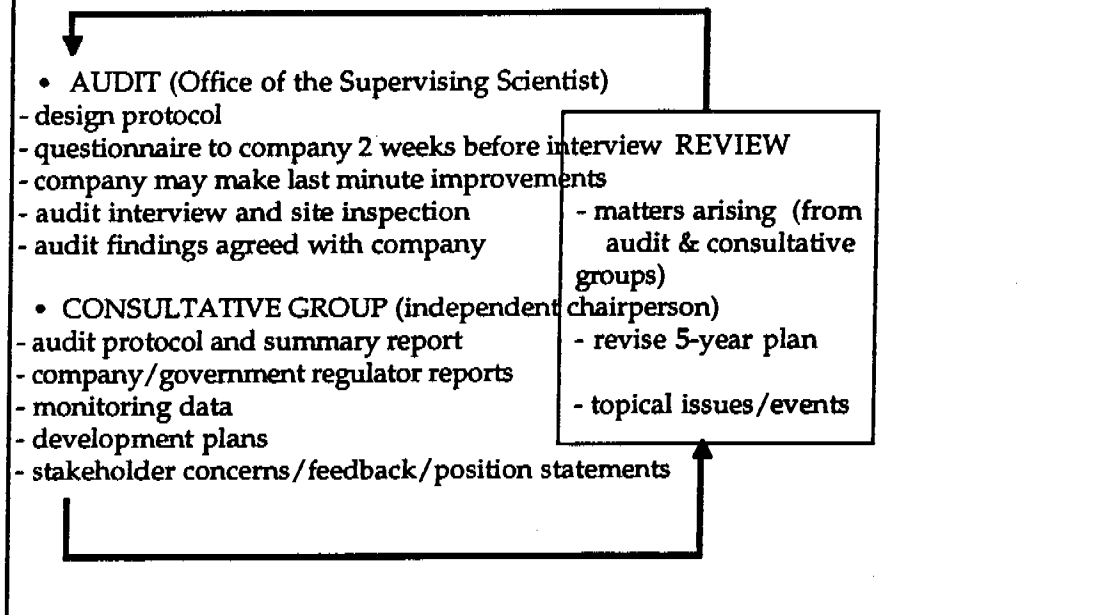
Key features

The key features of the system are shown in Figure 1. Important underlying principles are:

- there are no surprises or no secrets
- the focus is on outcomes rather than process
- continual improvement is encouraged by a shared problem-solving approach which is kept apart from regulatory, compliance-focused processes
- as far as possible, all relevant data are in the public domain
- the process is independently chaired
- key stakeholders are always consulted on major issues

- detailed scrutiny is expected from the broad stakeholder group
- the processes are transparent, predetermined, and frequent.

Figure 1: The audit/consultation cycle



Audit process

Audits of the mine sites are undertaken every six months. Termed "environmental performance reviews" they focus on measuring outcomes rather than process, and are not designed to operate as a regulatory compliance tool. Areas of performance which do not meet the reasonable expectations of the broad stakeholder group are examined to determine possible methods of achieving improved performance, and are commonly referred to working groups to evaluate options in terms of effectiveness, cost, and acceptability. Non-compliance issues may be exposed and are reported upon, but disciplinary action is pursued through the normal regulatory framework which provides a "safety net" of minimum acceptable performance to the environmental performance review process.

A five-year forward plan of audit focal issues is developed and available for adjustment by the broad stakeholder group. The plan recognises the appropriate frequency for issues to be revisited, based upon technical assessments of risk and consequences, and public perceptions of risk and consequences as voiced by the broad stakeholder group. The five-year plan is flexible, and accommodates topical issues which may arise for example from unusual rainfall patterns (which may stress the water management system of the mine), infringements, or public interest issues which may arise from time to time. Hence a normal audit will address matters arising from the previous review; issues on the forward plan, and topical issues of technical or public concern which have arisen in the period under review.

The audit protocol is in the form of a questionnaire which is provided to the company at least two weeks before the scheduled audit week. It includes prompts designed to assist the audit team in their work, but which also assist the company to identify particular matters of interest, documentary evidence required, etc. The company may then prepare for the review by carefully checking relevant data, operational systems (hardware and processes), and ensuring that documentary evidence is accessible. After two years of undergoing this audit process, Energy Resources of Australia (the operators of the Ranger uranium mine), began to prepare fully documented responses to the questionnaire which have considerably assisted in the detail and efficiency of the process.

Following the audit interview, a site inspection is made to examine areas of particular interest, including those where poor performance have been indicated. This is commonly the first step in discussions to identify possible reasons for poor performance, and options for improvement. Where improvement is indicated, joint technical working groups may be established to develop solutions, and the matter is placed on the agenda for examination at the next review in six months time and progress evaluated.

The questionnaire framework is used to develop an audit outcome report, and each item in the questionnaire is assessed as acceptable, unacceptable, or requiring further work. An example page from a recent review of the Ranger mine is shown in Figure 2. A scoring system, of for example a mark out of ten, is avoided, because this always implies that for any score of less than 10/10 there is a significant degree of under-performance and hence impact on or risk to the environment. This approach is not helpful; for example, it overlooks areas where insufficient data may be available to fully understand an issue, in spite of the fact that more environmental data may be available here than in any other known situation, and the company may already be committed to an ongoing program of investigation.

A summary report of the review is prepared in the same week of the audit process, and is signed by the principals of organisations participating in the review team. The outcomes are therefore agreed, and misunderstandings or differences of opinion are usually worked through before the results of the review process are presented to the stakeholder consultative group.

The consultative process

The stakeholder group meets in the same week of the environmental performance review, and is presented with copies of the audit assessment (as in Figure 2), and the summary report - normally only completed late the previous day. This information is made available two hours before the meeting commences, so that members may, if they wish, carefully examine it before the meeting, and that discussion focuses on up-to-date information. Other information provided includes reports by the NT government regulator and the Supervising Scientist for the period under review; annual reports by the companies; and additional reports the companies may wish to make available. These may include monthly or quarterly reports of monitoring data, one-off technical reports, and planning documents. The company staff commonly also give brief presentations on recent or planned developments at the mine sites. There is no restriction placed on the distribution of any material presented to the meetings.

The stakeholder group is made up of representatives of Aboriginal groups, environmental groups, unions, local government, and federal and territory departments and agencies of resources, health and environment. The stakeholder groups are approved by the Minister for the Environment, and the groups are free to select their representatives. Additional groups have come to be added to the consultative process to ensure that the consultative process is truly inclusive of all significant representative groups.

The committee is independently chaired. Debate is managed so as to focus on environmental protection from uranium mining; whilst some representatives have strong positions on whether or not uranium mining should be permitted in Australia, discussion on uranium mining policy is discouraged. "Meeting notes" are taken rather than minutes, in order to avoid acrimonious discussion on detail which was common in earlier forums.

Evaluation

The performance review approach to environmental audit has engendered a more harmonious working relationship with the company. This has resulted from a mutual

understanding that the intent is to identify areas where improvement is warranted to meet government and community expectations which exceed regulatory requirements, and that the response is one of shared commitment to problem solving rather than apportioning blame. The success of the procedure does rely heavily on trust between the parties - particularly trust on the part of the audit team that all relevant data are presented, and are presented objectively; and that the company is consistent and committed to pursuing improvement in areas identified as unacceptable or requiring further work.

The scope of the audit goes well beyond regulatory considerations, and so regulatory sanctions generally cannot be called upon in the case of this trust-based relationship breaking down, for example, evidence that a company may only be paying lip service to continual improvement. However, the sensitivity of the mining companies to negative perceptions in the community and government over uranium mining/national parks/Aboriginal issues, and the effectiveness of the stakeholder group as a conduit to expose controversial issues to community groups and government agencies, have to date guaranteed positive mining company participation in the performance review process.

Independent chairing of the consultative forum, and effective avoidance of a political agenda, has ensured a close focus on environmental performance as the main business of the group and improved the maturity and quality of discussion. Access to up-to-date comprehensive environmental data and interpretation, and the opportunity to discuss these in detail with the key information sources, has increased the responsible use and acceptance of this information, and reduced the prior tendency for its selective and sensationalist misuse.

Environmental performance reviews and stakeholder consultation processes have recently been introduced into the Indian Ocean Territories, where previously little environmental management expertise or regulatory framework were available. Unlike the uranium mining application, the objective is to increase the standard of performance to acceptable mainland standards, at which time regulatory mechanisms can be applied. It is unreasonable to apply regulations in a community which has poor environmental knowledge and infrastructure, without some transitional mechanism to bring community attitudes, behaviour and understanding of environmental issues to the level which will recognise the benefits of the new legislative framework and related standards.

The islands face significant environmental problems related not only to mining (mainly dust from phosphate mining and processing operations), but also to solid and liquid waste disposal, sewerage treatment, management of hazardous substances, and general community environmental understanding and behaviour.

The new procedures are proving effective in raising the level of environmental performance from a very low base, and the involvement of a range of sectors (mining, local government, tourism, service industries and various outposted government departments). A sense of shared commitment has also emerged from which a synergy has developed where the different sectors are exploring opportunities to learn from each other, share in the costs and benefits from expert consultants brought in to develop new systems, etc.

Conclusion

The combined approach of environmental performance review and stakeholder consultation processes is a successful case study of structures designed to deliver accountability in situations of particular environmental sensitivity to the community. The yardstick for measurement, and the main sanction for continued poor performance, is community reaction; regulatory mechanisms act as a "safety net" beneath these

processes to avoid the risk of significant environmental damage. Success depends to a large degree on mutual trust, developed from a clear definition of the environmental objectives and commitment by all parties to continual improvement. It may take several iterations of the audit/consultation cycle to generate a trustful relationship. The ultimate goal is to develop a shared, open team approach able to accept and absorb differences in position and principles, and robust enough to maintain focus through difficulties presented for example by accidents beyond the capacity of this (and usually any other environmental management system) to manage.

1	1	Water Management Issues						
1	1	1	Has the 5 year water management plan been updated?	✓			Five year plan, June 1966. Document 1.	The five year Water Management Plan was distributed in June 1996. There have been six meetings of the Water Management Group. ERA is committed to no release of untreated RRZ water. Disposal will use evaporation and land application. Water treatment options will be discussed at a future meeting. These meetings are to be continued as an integral part of water management Membership of the water management working group includes ERA, DME, NLC, OSS.
1	1	2	Is a long term water management plan for the operation being developed?	✓			ERA Five-Year Water Management Plan. Document 1.	Five year plan incorporates a general strategy for life of mine. The plan is strategic and can be modified as required.
1	1	3	Is interpretation of results now available on the effects of RP4 releases on Djalkmara Billabong wetlands?	✓			ERA Environmental Report 1996. Doc 2.	Dr Noller of DME advised that uranium removed by the wet land filter does not remobilise. This indicates that the life of the filter is endless at current loads.
1	1	4	Has a model been developed which describes the behaviour of groundwater in recharge/discharge areas?	✓	✓		Ranger Research Plan 1996/97, July 1996. Doc 3.	Satisfactory progress, but ongoing. A full time hydrogeologist has been employed by ERA Environmental Services who will work on this project.
1	1	5	How effective is the new water management strategy based on wetland filtration proving to be, in terms of both technical effectiveness and social acceptability?	✓	✓		ERA Wetland Filter Performance Report, Doc 4. Document 2.	Wetland filtration is now a successful and established technique. It is incorporated into normal practice at Ranger. The efficiency of the method depends of having adequate vegetation and organic matter. Research on understanding and improving the method continues. Discussions between ERA and NLC are continuing. Site visits by Traditional Owners have been made.
1	1	6	Did the consultants to OSS, DME, & ERA meet and agree a position on the significance of springs and the adequacy of piezometric monitoring with respect to the stability of the tailings dam and environmental effects?	✓			DME six monthly report no 31, Document 5.	Inspection held on 19 February 1996. At that meeting an additional six piezometers and two dewatering bores were agreed to be installed. These are now in effect. Meeting occurred in April between consultants Prof. Fell (for OSS) and Mr Burgess (for ERA). A design for toe loading and an application for installation has been lodged. Springs were due to elevated ground water table rather than seepage.
1	1	7	Have tailings deposited in the tailings dam continued to consolidate?	✓			Report by CSIRO April 1996, Doc 8.	The average dry density of the tailings is now 1.09. The tailings density is continuing to increase. The tailings are now achieving a dry density of 1.23.
1	1	8	Is information available on breakdown of the tailings gel?	✓	✓		Report outline of proposed research program, Doc 9.	Research continues. CSIRO have finalised a review of tailings densification techniques that might be applied to Ranger tailings.

Figure 2: Example page of Environmental Performance Review documentation

An Australian Initiative to Promote Best Practice
Environmental Management in Mining

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and Waste Management in Energy and Mineral Production

7 – 11 October 1996

Cagliari

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AN AUSTRALIAN INITIATIVE TO PROMOTE BEST PRACTICE ENVIRONMENTAL MANAGEMENT IN MINING

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SUMMARY: The Australian government and mining industry are working together on a program to promote the uptake of best practice in environmental management in the mining sector. To achieve the higher levels of environmental protection now expected by the community, the industry must perform beyond the levels set down by regulations, which are effectively a "safety net" to ensure that severe impact on the environment are avoided. A series of booklets and data bases are being produced with focus on different environmental issues in mining.

1 Introduction

Globalization is occurring in all industry sectors throughout the world. It is well under way in mining, transportation, communication and manufacturing. The Australian mining industry is now, more than ever, increasingly global in its outlook. Australian companies operate in the former Soviet Union, North America, South America, Africa, Asia and the Pacific. The recent merger between RTZ and CRA, into a corporate entity of global proportions, illustrates this trend.

Globalization necessarily invites comparison of performance on a world scale, including environmental performance.

Some Australian mining companies are world leaders in mine site rehabilitation, mineral processing and environmental management. For example, Alcoa of Australia is the only company in the world to win the United Nations Global 500 Role of Honour for its excellent work in mine site rehabilitation and revegetation. High levels of environmental performance have been required in order for some mines to obtain approval to operate in areas of particular environmental sensitivity or with high conservation values, such as at the Ranger uranium mine which operates in an area surrounded by Kakadu National Park, which is on the World Heritage list.

Australian companies have developed their current environmental awareness and expertise over a long time and have learned from some very costly past environmental mistakes. The Mt Lyell copper mine in Tasmania, where pyritic tailings were discharged for a 100 years directly into the now barren river system and SO₂ from smelting killed vegetation for over 50 km² about the site which in turn led to severe erosion around the minesite (McQuade et al., 1995), is now regarded as an icon of environmental bad practice and represents a management style far from acceptable by today's expectations. Even sites remediated as recently as 15 years ago such as the Rum Jungle uranium-copper-lead mine in the Northern Territory are widely regarded as not meeting the standards expected today (Applegate, 1993).

Mining will continue to be a mainstay to the Australian economy for the foreseeable future, and it is important for the industry to gain the confidence of the community if it wishes to continue to gain access to resources. Mine operators who have a less than satisfactory environmental performance record are now having difficulty in ensuring access to new resources. Mining no longer has an automatic priority in terms of land use, because proposals have to compete with other interests including conservation and tourism. Therefore there is now emerging in Australia a culture of "best practice" in environmental management, in an attempt to move environmental performance beyond that demanded by regulations. Government regulations now represent a "safety net" below which there is a high risk of severe environmental impact so that penalties are necessary to ensure that this minimum level of performance is met.

"Best practice" is simply the best way of doing things. It encompasses the principles of:

- best technology;
- continual improvement;
- agreed environmental quality objectives;
- pro-active planning and research with a risk based approach;
- philosophy of preventing contamination rather than treating;
- independent evaluation of environmental performance;
- outcomes focus rather than process focus;
- public disclosure.

Whilst the "safety net" of minimum standards imposed by government remains in place, the traditional approach of the government imposing its will coercively upon the industry through the threat of fines, is being replaced by a more cooperative approach to encourage a level of performance beyond the minimum requirements. State regulators assist the industry in developing Environmental Management Systems which incorporate environmental quality objectives, and performance is now more frequently assessed through a process of periodic auditing rather than through frequent site visits.

In concert with this move to a more collaborative approach, the Australian Environment Protection Agency has formed a partnership arrangement with several industry sectors to encourage improvement in environmental performance. The partnerships commonly also include the participation of community and consumer organisations, such as National Parks and Traditional Aboriginal land owners, to ensure that the program objectives are broadly acceptable. This partnership approach is proving to be most effective: industry involvement attracts acceptance by industry peers; government endorsement provides assurance to industry that the initiatives are consistent with government policy directions; and community participation provides a level of certainty that the program outcomes will be acceptable to the wider community.

The partnership dealing with the mining industry is called the Best Environmental Practice in Mining Program. The Program recognises that whilst some Australian mining companies are leaders in good environmental management, there are also companies whose performance is relatively poor. It is designed to complement a number of programs under way to encourage continual improvement by industry, such as award schemes for excellence in environmental management run by the industry or by State government. These award schemes offer a competitive environment for companies, organisations or individuals wishing to demonstrate their achievements, as well as offering financial rewards.

Elements of the Best Environmental Practice in Mining Program are:

- production of booklets and videos

- databases to provide easy access to key information
- training programs
- strategic research into environmental issues in mining.

2 Booklets on Best Practice Environmental Management in Mining

This project began in early 1995 following a suggestion from the World Bank that Australia could assist in dealing with a range of environmental issues in mining. The Environment Protection Agency formed a steering committee to guide and assist with the project. The steering committee members were chosen because of their interest, expertise and contacts on the subject of environmental management in mining. It includes representatives from the peak mining industry organisation (Minerals Council of Australia), an industry-based environmental focus group (the Australian Minerals and Energy Environment Foundation), the principal mining professional body (the Australasian Institute of Mining and Metallurgy), a key mining research organisation (the CSIRO Minesite Rehabilitation Research Group), the State Government based Chief Inspectors of Mines of Australia, and the Australian Conservation Foundation representing non-Government conservation groups.

To date nine booklets have been written by leading practitioners of environmental management in the mining industry, for their industry colleagues. The booklets were printed and published by the EPA, after intensive review by a sub-group of the steering committee with input from experts from the mining industry on each subject. In addition a 10 minute introductory video has been produced to illustrate the objectives and concepts of Best Practice Environmental Management in mining.

Topics covered by the booklets are an overview of best practice environmental management in mining, mine planning for environment protection, environmental impact assessment, community consultation and involvement, environmental management systems, environmental monitoring and performance, planning an environmental awareness training program, tailings containment, and rehabilitation and revegetation. Details of these booklets are given in Table 1.

Authors for the booklets were chosen on the basis of their expertise and availability. Where suitable authors from companies were not available consultants from the industry were engaged by the EPA.

The booklets contain a number of case studies which give examples of how specific components of environmental management programs are being implemented in a range of climatic conditions and mine sites across Australia. The booklets set out how to integrate environmental issues and community concerns through all phases of mining, from exploration through construction, operation and eventual mine closure.

The booklets were launched at the International Association for Impact Assessment conference in Durban, South-Africa in June 1995 and in Australia in Sydney and Perth in August 1995.

The booklets and the video are freely available and over 6000 packages of the first nine titles and the video have been widely distributed to industry, government, teaching institutions, consultants and individuals both in Australia and in 60 overseas countries.

Table 1 The first nine Best Practice Environmental Management booklets

Overview of Best Practice Environmental Management in Mining

Overviews the program of best practice environmental management and the attributes that go towards achieving best practice. Outlines the potential problems that can occur as a result of mining activities, and some operations that have achieved recognition for the quality of their environmental work. Also canvasses the financial benefits to mining operators of instituting best practice.

Mine planning for environment protection

Planning is the key to identifying and minimising the environmental impacts of mining. This booklet examines how mine planning for environment protection can help in developing projects that meet community expectations for minimal environmental impacts. It outlines the considerations that shape mining methods and the design of environmental safeguards.

Environmental impact assessment

This booklet introduces the background and purposes of environmental impact assessment (EIA). It covers briefly the legislative requirements within Australia, the key components of EIA, and the different levels of assessment that exist. The relationship of environmental management plans, monitoring and environmental management systems to environmental impact assessment is discussed.

Community consultation and involvement

The expectations and needs of communities affected by mining proposals are covered in this booklet. The processes involved in preparing for the consultation process are discussed in detail and the key community consultation techniques are described.

Environmental management systems

This booklet outlines the role and key components of an environment management system (EMS) as one tool to use in achieving the company's environmental objectives and targets. It explains how to operate, implement and maintain an EMS within daily operations, from exploration to mine closure.

Environmental monitoring and performance

Subjects covered include: the objectives of monitoring programs; selection of indicators; measurement methods; data collection and analysis; and reporting. Monitoring of water, air, dust, flora and fauna are covered. The linkages between environmental monitoring and performance and environmental auditing and environmental impact assessment predictions are discussed.

Planning an environmental awareness training program

This booklet explains the importance of planning a workforce environmental awareness training program to achieve an enduring and improving environmental culture. Corporate commitment is important to a successful program. A framework is provided which can be used in planning a workforce environmental awareness training program and evaluating its success.

Tailings containment

Planning, designing, constructing, operating and monitoring tailings disposal facilities are covered. The factors to consider in selecting suitable sites and the various disposal options for tailings are explained. The monitoring and control methods that can be used to minimise environmental impacts are discussed.

Rehabilitation and revegetation

The principles and practices of mine rehabilitation are outlined. Particular emphasis is given to the restoration of natural ecosystems. Topics covered include rehabilitation objectives, soil handling, earthworks, revegetation, soil nutrients, fauna return, maintenance, monitoring and success criteria.

The objectives of the project are to:

- improve the level of environment protection associated with mining in Australia and overseas;
- share Australian expertise in environmental management in mining with people overseas;
- work on a cooperative/partnership basis with industry to promote best practice through all sections of the mining industry in Australia; and
- encourage industry to perform better than that required under regulation.

To build on the success of the existing project, more booklets are planned, and about 20 to 25 booklets may be prepared in total. Each will be written by recognised leaders from the industry in their particular fields of expertise. Topics covered by booklets now in preparation are listed in Table 2.

Table 2 Booklets in preparation

- | | |
|----------------------------------|-------------------------|
| • Environmental Auditing | • Mine Water Management |
| • Offshore Exploration | • Cleaner Production |
| • Acidic Drainage | • Noise and Vibration |
| • Management of Hazardous Wastes | • Landform Design |

The booklets are not designed to be comprehensive technical manuals giving precise details on what is best practice at a mine site and how to do it. By its very nature, best practice may differ from one site to another, and will evolve over time. The booklets are designed instead to present the philosophy of best practice, with enough supporting factual information, general descriptions of techniques, and case studies containing examples of best practice already in operation. The booklets are therefore designed to convince the reader that best practice is a worthwhile objective. An extension program is being developed to provide more detailed information to encourage the wider adoption of best practice in environmental management.

3 Databases

The EPA has already established the "EnviroNet Australia" database, accessible on the Internet, which provides information relevant to all industry sectors on Australia's capabilities in environmental management. Four interlinked databases provide information on case studies in environmental management; expertise in environmental management; environmental education courses; and cleaner production; research and development in waste management and pollution control (Table 3). A fifth data base is currently being developed titled - "Environment technologies reference sites" and will contain some 80 environmental case studies of operating industries.

To complement these databases, and to provide information of direct use to the mining sector, EPA is currently developing four additional databases. Each will contain information classified by issue (eg. water management; mine planning; auditing; slope stability). The databases will be:

- technical information - up to 5 references to technical information in books, journals, manuals etc which will be chosen on their practicality, currency, and availability
- expertise - a list of environmental management expertise in mining-related issues, including the private, government and academic sectors
- training courses - upcoming training courses, workshops, and conferences related to mining and the environment
- best practice sites - a listing of sites where examples of best practice are in operation.

Table 3 EnviroNET Australia

EnviroNET Australia is a series of complementary databases aimed at improving environment protection by maximising the use of information on solutions to environmental problems. The idea behind EnviroNET Australia is that a strong environment management industry is required to ensure effective environment protection. The databases provide a range of Australian environmental information covering: the environmental capabilities of private and public sector organisations; tertiary level environment education and training courses; case studies on cleaner production; research and development in waste management and pollution control; and research and development of scheduled waste treatment technologies.

Use of the database is via Internet - it is currently being accessed over 7000 times per month. The database has developed into a key source of leading-edge environmental information - in January 1996 it was recognised by the Swedish-based Eco-Network as one of the top 100 Internet environmental sites, and the best international environmental management site.

<http://www.erin.gov.au/net/environet.html>

National Cleaner Production Database

This database assists small to medium sized businesses to maintain a competitive edge by supplying case study information about cleaner production methods. Information focuses on production processes and products which minimise harmful environmental impacts, and improving management practices and housekeeping, while reducing production costs. It contains:

- Case studies from a wide variety of industries which demonstrate that cleaner production can be both environmentally sound and cost-effective.
- Bulletin board of general cleaner production information and events.

Environment Management Capabilities database

Details over 1500 Australian companies with expertise in solving environmental problems. These include: manufacturers of instrumentation and monitoring equipment, enviro-technologies, environmental consulting services including engineering, information technology, and environmental legal services. It also lists environmental management expertise in government environment agencies in Australia and the Asia-Pacific region.

Environment Education Courses database

Gives information on all environment related university level courses in Australia.

Research and Development in Waste Management and Pollution database

Links environmental problems to Australian research and development activities in waste management and pollution. It reveals whether a technology currently exists to solve a specific problem, and if not, whether there is current research or scope for such research, to fill the gap.

4 Training programs

There is a high demand for training in environmental management in mining. For training to be effective, courses need to be targeted at all levels of the workforce, from the truck driver and security officer through to senior managers rather than focussed on environmental management staff. The Australian EPA has recently entered into an arrangement with an industry group (the Australian Centre for Minesite Rehabilitation Research), to identify training needs, with a view to developing an integrated program of training courses to meet these needs. Australia is in a good geographic position to offer access to training through Asia and the Pacific, and so training programs need to

cater for situations with various economic, social, climatic and geographic conditions which may differ considerably from the Australian situation. The intention is to design highly specific workshops on key environmental issues in mining for different target groups, and coordinate the availability and timing of these to both the domestic and overseas markets.

5 Communication

A key to improving environmental performance within the mining industry is the enhancement of communication between, often remote, environmental practitioners with the day to day responsibility of implementing best environmental practice. There are few outlets for the transfer of environmental technology beyond national and international conferences, that few site based environmental practitioners attend. AMENET is a Internet based list server - Australian Mining Environmental Network managed by the research arm of the Australian Environmental Protection Agency. Through AMENET practitioners may request information, assistance with specific problems, announce training programs or conferences. To subscribe to AMENET send a message to "majordomo@oss.erin.gov.au" with the body of the text "subscribe AMENET".

6 Strategic research

Many areas require further research to determine fully effective methods in environment protection, such as acidic drainage, long term tailings management, management of mining voids, revegetation, and measurement of rehabilitation success in the short and long term. The arrangement with the Australian Centre for Minesite Rehabilitation Research extends to joint sponsorship with industry of research projects which are strategic in nature - that is, they are of general application throughout the industry and will lead to better long term solutions. Research which is more site-specific is funded wholly by the industry.

7 Conclusions

Community expectations for environmental protection are ever increasing. Since the Rio Earth Summit in 1992 there has been a greater awareness by governments of the need to implement Ecologically Sustainable Development, and by industry that a good international corporate image is an important ingredient in developing a successful long term business. ESD symbolises a balance of economic exploitation of resources together with effective environment protection.

The Best Practice Environmental Management Program is an example of a cooperative partnership between Australian government and industry which is focused on bringing forward solutions consistent with ESD related to the mining sector. The partnership is built around the principle of best practice. The booklets are the first stage of a long term plan to provide a range of resources which will enable the mining industry to improve its general level of environmental performance. Mining is a major activity in Australia, and it is a priority for our country to ensure that mining is able to operate at levels of environmental impact acceptable to the public and compatible with other competing land uses.

Australia also has a responsibility to contribute to improvement in the level of environmental protection in mining internationally, particularly because its own mining sector is active in resource development in many other countries. Translation of the booklets into other languages will facilitate their usefulness internationally. It is hoped there will be an opportunity to develop collaborative programs in environmental protection in mining between Australia and other nations to further build on the program described in this paper.

8 References

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ABSTRACT
and appropriate
nature and
ecological

improvement

approach
management
balance

- Computer
technology
- Rational
protection
- Ecological
for environment

economical
rational

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An Australian Initiative to Promote Best Practice
Environmental Management in Mining

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An Australian Initiative to Promote Best Practice Environmental Management in Mining

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Abstract

The Australian government and mining industry are working together on a program to promote the uptake of best practice in environmental management in the mining sector. To achieve the higher levels of environmental protection now expected by the community, the industry must perform beyond the levels set down by regulations, which are effectively a "safety net" to ensure that severe impacts on the environment are avoided. A series of booklets is being produced which focus on different environmental issues in mining. Eleven booklets have been produced so far. They represent a model of the Australian approach to best environmental management in mining, which may be useful to other countries - particularly the developing countries - as a guide to determining whether their own practices are consistent with world best practice. To make the information more readily accessible in countries in the Asia-Pacific region, the booklets are currently being translated into Bahasa Indonesian, Mandarin Chinese, and Spanish. The next stage of the program is the production of databases on technical information, best practice expertise, best practice sites, and training opportunities, and development of an integrated training program which matches the demand for training in environmental management in mining in Australia and its neighbour countries.

Introduction

Globalization is occurring in all industry sectors throughout the world. It is well under way in mining, transportation, communication and manufacturing. The Australian mining industry is now, more than ever, increasingly global in its outlook. Australian companies operate in the former Soviet Union, North America, South America, Africa, Asia and the Pacific. The recent merger between RTZ and CRA, into a corporate entity of global proportions, illustrates this trend.

Globalization necessarily invites comparison of performance on a world scale, including environmental performance.

Some Australian mining companies are world leaders in mine site rehabilitation, mineral processing and environmental management. For example, Alcoa of Australia is the only company in the world to win the United Nations Global 500 Role of Honour for its excellent work in mine site rehabilitation and revegetation. High levels of environmental performance have been required in order for some mines to obtain approval to operate in areas of particular environmental sensitivity or with high conservation values, such as at the Ranger uranium mine which operates in an area surrounded by Kakadu National Park, which is on the World Heritage list.

Australian companies have developed their current environmental awareness and expertise over a long time and have learned from some very costly past environmental mistakes. The Mt Lyell copper mine in Tasmania, where pyritic tailings were discharged directly into the river system for 70 years and SO₂ from smelting killed vegetation which led to severe erosion

around the minesite, is now regarded as an icon of environmental bad practice and represents a management style far from acceptable by today's expectations. Even sites remediated as recently as 15 years ago such as the Rum Jungle uranium-copper-lead mine in the Northern Territory are widely regarded as not meeting the standards expected today.

Mining will continue to be a mainstay to the Australian economy for the foreseeable future, and it is important for the industry to gain the confidence of the community if it wishes to continue to gain access to resources. Mining no longer has an automatic priority in terms of land use, because proposals have to compete with other interests including conservation and tourism. Therefore there is now emerging in Australia a culture of "best practice" in environmental management, in an attempt to move environmental performance beyond that demanded by regulations. Government regulations now represent a "safety net" below which there is a high risk of severe environmental impact so that penalties are necessary to ensure that this minimum level of performance is met.

"Best practice" is simply the best way of doing things. It encompasses the principles of:

- best technology
- continual improvement
- agreed environmental quality objectives
- pro-active planning and research
- independent evaluation of environmental performance
- outcomes focus rather than process focus
- public disclosure.

Whilst the "safety net" of minimum standards imposed by government remains in place, the traditional approach of the government imposing its will coercively upon the industry through the threat of fines, is being replaced by a more cooperative approach to encourage a level of performance beyond the minimum requirements. State regulators assist the industry in developing Environmental Management Systems which incorporate environmental quality objectives, and performance is now more frequently assessed through a process of periodic auditing rather than through frequent site visits.

In concert with this move to a more collaborative approach, the Australian Environment Protection Agency has formed a partnership arrangement with several industry sectors to encourage improvement in environmental management. The partnerships commonly also include the participation of community and consumer organisations to ensure that the program objectives are broadly acceptable. This partnership approach is proving to be most effective: industry involvement attracts acceptance by industry peers; government endorsement provides assurance to industry that the initiatives are consistent with government policy directions; and community participation provides a level of certainty that the program outcomes will be acceptable to the wider community.

The partnership dealing with the mining industry is called the Best Environmental Practice in Mining Program. The Program recognises that whilst some Australian mining companies are leaders in good environmental management, there are also companies whose performance is relatively poor. It is designed to complement a number of programs under way to encourage continual improvement by industry, such as award schemes for excellence in environmental management run by the industry or by State government. These award schemes offer a competitive environment for companies, organisations or individuals wishing to demonstrate their achievements, as well as offering financial rewards.

Elements of the Best Environmental Practice in Mining Program are:

- production of booklets and videos
- databases to provide easy access to key information
- training programs
- strategic research into environmental issues in mining.

Booklets and video on Best Practice Environmental Management in Mining

This project began in early 1995 following a suggestion from the World Bank that Australia could assist in dealing with a range of environmental issues in mining.

Table 1: The first eleven BPEM booklets

Overview of Best Practice Environmental Management in Mining.

Overviews the program of best practice environmental management and the attributes that go towards achieving best practice. Outlines the potential problems that can occur as a result of mining activities, and some operations that have achieved recognition for the quality of their environmental work. Also canvasses the financial benefits to mining operators of instituting best practice.

• ***Mine planning for environment protection.***

Planning is the key to identifying and minimising the environmental impacts of mining. This booklet examines how mine planning for environment protection can help in developing projects that meet community expectations for minimal environmental impacts. It outlines the considerations that shape mining methods and the design of environmental safeguards. These include: air, water and noise quality; transport; biological resources; social and economic factors; surrounding land uses; and heritage places and artefacts.

• ***Environmental impact assessment.***

This booklet introduces the background and purposes of environmental impact assessment (EIA). It covers briefly the legislative requirements within Australia, the key components of EIA, and the different levels of assessment that exist. The relationship of environmental management plans, monitoring and environmental management systems to environmental impact assessment is discussed.

• ***Community consultation and involvement.***

The expectations and needs of communities affected by mining proposals are covered in this booklet. The processes involved in preparing for the consultation process are discussed in detail and the key community consultation techniques are described. The booklet focuses on a community-centred rather than a project-centred approach to community consultation and involvement.

• ***Environmental management systems.***

This booklet outlines the role and key components of an environment management system (EMS) as one tool to use in achieving the company's environmental objectives and targets. It explains how to operate, implement and maintain an EMS within daily operations, from exploration to mine closure.

continued

Table 1 continued

Environmental monitoring and performance.

Subjects covered include: the objectives of monitoring programs; selection of indicators; measurement methods; data collection and analysis; and reporting. Monitoring of water, air, dust, flora and fauna are covered. The linkages between environmental monitoring and performance and environmental auditing and environmental impact assessment predictions are discussed.

- ***Planning an environmental awareness training program.***

This booklet explains the importance of planning a work force environmental awareness training program to achieve an enduring and improving environmental culture. Corporate commitment is important to a successful program. A framework is provided which can be used in planning a work force environmental awareness training program and evaluating its success.

- ***Tailings containment.***

Planning, designing, constructing, operating and monitoring tailings disposal facilities are covered. The factors to consider in selecting suitable sites and the various disposal options for tailings are explained. The monitoring and control methods that can be used to minimise environmental impacts are discussed.

- ***Rehabilitation and revegetation.***

The principles and practices of mine rehabilitation are outlined. Particular emphasis is given to the restoration of natural ecosystems, especially the re-establishment of native flora. Topics covered include rehabilitation objectives, soil handling, earthworks, revegetation, soil nutrients, fauna return, maintenance, monitoring and success criteria.

- ***Environmental auditing***

Auditing is shown to be an important tool for any mining operation to measure its performance against current and expected regulatory requirements, improve its credibility with the general public, assess its level of risk exposure, and access loan capital. A range of different types of audit is described to meet different objectives, and examples given of audit checklists.

- ***Onshore exploration***

Significant environmental damage can result from ground disturbance, clearing of vegetation, careless handling of materials such as drilling fluids, lubricants, fuel etc. Techniques are described to avoid damage, such as through proper consultation with local people, alternatives to widespread bulldozing, design of earthworks to minimise erosion, rehabilitation of drill holes, and proper handling of contaminants.

The Environment Protection Agency formed a steering committee to guide and assist with the project. The steering committee members were chosen because of their interest, expertise and contacts on the subject of environmental management in mining. It includes representatives from the peak mining industry organisation (Minerals Council of Australia), an industry-based environmental focus group (the Australian Minerals and Energy Environment Foundation), the principal mining professional body (the Australasian Institute of Mining and Metallurgy), a key mining research organisation (the CSIRO Minesite Rehabilitation Research Group), the State Government based Chief Inspectors of Mines of Australia, and the Australian Conservation Foundation representing non-Government conservation groups.

To date eleven booklets have been written by leading practitioners of environmental management in the mining industry, for their industry colleagues. The booklets were printed and published by the EPA, after intensive review by a sub-group of the steering committee with input from experts from the mining industry on each subject. In addition a 10 minute introductory video has been produced to illustrate the objectives and concepts of Best Practice Environmental Management in mining.

Topics covered by the booklets are an overview of best practice environmental management in mining, mine planning for environment protection, environmental impact assessment, community consultation and involvement, environmental management systems, environmental monitoring and performance, planning an environmental awareness training program, tailings containment, and rehabilitation and revegetation. Details of these booklets are given in Table 1.

Authors for the booklets were chosen on the basis of their expertise and availability. Where suitable authors from companies were not available, paid consultants from the industry were engaged by the EPA.

The booklets contain a number of case studies which give examples of how specific components of environmental management programs are being implemented in a range of climatic conditions and mine sites across Australia. The booklets set out how to integrate environmental issues and community concerns through all phases of mining, from exploration through construction, operation and eventual mine closure.

The booklets were launched at the International Association for Impact Assessment conference in Durban, South Africa in June 1995 and in Australia in Sydney and Perth in August 1995.

The booklets and the video are freely available and over 6000 packages have been widely distributed to industry, government, teaching institutions, consultants and individuals both in Australia and in 60 overseas countries.

The objectives of the project are to:

- improve the level of environment protection associated with mining in Australia and overseas;
- share Australian expertise in environmental management in mining with people overseas;
- work on a cooperative/partnership basis with industry to promote best practice through all sections of the mining industry in Australia; and
- encourage industry to perform better than that required under regulation.

To build on the success of the existing project, more booklets are planned, and about 20 to 25 booklets may be prepared in total. Each will be written by recognised leaders from the industry in their particular fields of expertise. Topics covered by booklets now in preparation are listed in Table 2.

The booklets are not designed to be comprehensive technical manuals giving precise details on what is best practice at a mine site and how to do it. By its very nature, best practice may differ from one site to another, and will evolve over time. The booklets are designed instead to present the philosophy of best practice, with enough supporting factual information,

general descriptions of techniques, and case studies containing examples of best practice already in operation. The booklets are therefore designed to convince the reader that best practice is a worthwhile objective. An extension program is being developed to provide more detailed information to encourage the wider adoption of best practice in environmental management.

Table 2: Booklets in preparation

- Offshore Exploration
- Acid Mine Drainage
- Management of Hazardous Wastes
- Mine Water Management
- Cleaner Production
- Noise and Vibration
- Landform Design

Databases

The EPA has already established the "Environet Australia" database, accessible on the Internet, which provides information relevant to all industry sectors on Australia's capabilities in environmental management. Four interlinked databases provide information on case studies in cleaner production; expertise in environmental management; environmental education courses; and research and development in waste management and pollution control (Table 3).

To complement these databases, and to provide information of direct use to the mining sector, EPA is currently developing four additional databases. Each will contain information classified by issue (e.g. water management; mine planning; auditing; slope stability). The databases will be:

- **technical information** - up to 5 references to technical information in books, journals, manuals etc which will be chosen on their practicality, currency, and availability
- **expertise** - a list of environmental management expertise in mining-related issues, including the private, government and academic sectors
- **training courses** - upcoming training courses, workshops, and conferences related to mining and the environment
- **best practice sites** - a listing of sites where examples of best practice are in operation.

Training programs

There is a high demand for training in environmental management in mining. For training to be effective, courses need to be targeted at all levels of the work force, from the truck driver and security officer through to senior managers rather than focussed on environmental management staff. The Australian EPA has recently entered into an arrangement with an industry group (the Australian Centre for Minesite Rehabilitation Research), to identify training needs, with a view to developing an integrated program of training courses to meet these needs. Australia is in a good geographic position to offer access to training through Asia and the Pacific, and so training programs need to cater for situations with various economic, social, climatic and geographic conditions which may differ considerably from the Australian situation. The intention is to design highly specific workshops on key

environmental issues in mining for different target groups, and coordinate the availability and timing of these to both the domestic and overseas markets.

Table 3. EnviroNET Australia

EnviroNET Australia is a series of complementary databases aimed at improving environment protection by maximising the use of information on solutions to environmental problems. The idea behind *EnviroNET Australia* is that a strong environment management industry is required to ensure effective environment protection. The databases provide a range of Australian environmental information covering: the environmental capabilities of private and public sector organisations; tertiary level environment education and training courses; case studies on cleaner production; research and development in waste management and pollution control; and research and development of scheduled waste treatment technologies.

Use of the database is via Internet – it is currently being accessed over 6500 times per month. The database has developed into a key source of leading-edge environmental information – in January 1996 it was recognised by the Swedish-based Eco-Network as one of the top 100 Internet environmental sites, and the best international environmental management site.

National Cleaner Production Database

This database assists small to medium sized businesses to maintain a competitive edge by supplying case study information about cleaner production methods. Information focuses on production processes and products which minimise harmful environmental impacts, and improving management practices and housekeeping, while reducing production costs. It contains:

- Case studies from a wide variety of industries which demonstrate that cleaner production can be both environmentally sound and cost-effective.
- Bulletin board of general cleaner production information and events.

Environment Management Capabilities database

Details over 1500 Australian companies with expertise in solving environmental problems. These include: manufacturers of instrumentation and monitoring equipment, enviro-technologies, environmental consulting services including engineering, information technology, and environmental legal services. It also lists environmental management expertise in government environment agencies in Australia and the Asia-Pacific region.

Environment Education Courses database

Gives information on all environment related university level courses in Australia.

Research and Development in Waste Management and Pollution database

Links environmental problems to Australian research and development activities in waste management and pollution. It reveals whether a technology currently exists to solve a specific problem, and if not, whether there is current research or scope for such research, to fill the gap.

Strategic research

Many areas require further research to determine fully effective methods in environment protection, such as acid mine drainage, management of mining voids, revegetation, and measurement of rehabilitation success. The arrangement with the Australian Centre for Minesite Rehabilitation Research extends to joint sponsorship with industry of research projects which are strategic in nature - that is, they are of general application throughout the industry and will lead to better long term solutions. Research which is more site-specific is funded wholly by the industry.

Conclusions

Community expectations for environmental protection are ever increasing. Since the Rio Earth Summit in 1992 there has been a greater awareness by governments of the need to implement Ecologically Sustainable Development, and by industry that a good international corporate image is an important ingredient for successful business. ESD symbolises a balance of economic exploitation of resources together with effective environment protection.

The Best Practice Environmental Management Program is an example of a cooperative partnership between Australian government and industry which is focused on bringing forward solutions consistent with ESD related to the mining sector. The partnership is built around the principle of best practice. The booklets are the first stage of a long term plan to provide a range of resources which will enable the mining industry to improve its general level of environmental performance. Mining is a major activity in Australia, and it is a priority for our country to ensure that mining is able to operate at levels of environmental impact acceptable to the public and compatible with other competing land uses.

Australia also has a responsibility to contribute to improvement in the level of environmental protection in mining internationally, particularly because its own mining sector is active in resource development in many other countries. Translation of the booklets into other languages will facilitate their usefulness internationally. It is hoped there will be an opportunity to develop collaborative programs in environmental protection in mining between Australia and other nations to further build on the program described in this paper.

Australian Initiatives for Best Practice Environmental
Management in Small Scale Mining in the Asia-Pacific

Peter Hancock and Stewart Needham

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AUSTRALIAN INITIATIVES FOR BEST PRACTICE ENVIRONMENTAL MANAGEMENT IN SMALL SCALE MINING IN THE ASIA-PACIFIC

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INTRODUCTION

Small scale mining is an activity that is better known by its heritage and environmental impacts than by definition of its scale. It encompasses a range of mining operations from very small-scale, essentially manual or artisanal mining to small mines of up to 100,000 tpy which may be mechanised and involve a modest level of capital. The Australian federal Environment Protection Authority (EPA) has an interest in addressing environmental management at all levels and types of small scale mining in developed and developing countries in its region. This paper outlines the measures the EPA has taken to foster environmental best practice in mining in general and how it now seeks to work with India and other countries to include small scale mining.

Brazil, India, Indonesia and Zaire are estimated to each have some 500,000 artisanal miners, while in China the number directly engaged in small-scale mining has risen from 5 million in 1986 to 8.85 million in 1994 working some 280,000 mines (Li Peiji and Li Guangwei 1996). There are now some 11 million artisanal miners globally.

Artisanal and other small scale miners account for a significant proportion of the world's mineral production, including 31% of industrial minerals, 20% of coal, 12% of metals, 20% of gold, almost 40% of diamonds and practically all other gemstones (Noestaller 1987 and 1995, Labonne 1996). In some countries this is much greater. In China 43% of the country's 1993 coal production of 1150 million tonnes and most of the industrial minerals were from small scale mines.

In rapidly expanding economies where small scale mining provides a high proportion of minerals needed for domestic consumption and development, governments want to increase production by improving the efficiency of small scale mining. Although productivity and efficient extraction may well be the primary goals, governments and communities now recognise that improved environmental management is required to reduce environmental impacts and rehabilitate mined land to a valuable post-mining land-use. This is an essential component of sustainable economic development.

Many countries now have legislation that requires all mining operations to be licensed and responsible for occupational health and safety (OH&S) and environmental impacts. Legislation alone cannot translate into improved performance in small scale and artisanal mining, except where there is a high level of literacy and environmental awareness. In most situations there will have to be a reaching out to the individual miner with hands-on demonstrations of how they can improve their environmental performance in order to improve their production, profits, OH&S and quality of life. This requires an understanding of the economic, educational, and cultural setting of small scale miners, whether they be cottage industry, artisanal miners using traditional manual methods or miners with powered excavators and recovery plants.

In addressing ways to further environmental best practice in small scale mining, the EPA recognises the enormous importance of artisanal mining in terms of its positive attributes:

- gainful employment and relative economic wellbeing by alleviation of poverty for so many
- rapid flow of virtually all gross revenue through wages and profits into the local economy because there is virtually no capital to repay or service
- significant contribution to global mineral output
- extraction of small or low value resource occurrences which would not otherwise be utilised, being uneconomic for medium to large-scale corporate miners

Similarly, the EPA recognises the negative environmental and socio-economic effects of small-scale and artisanal mining, many of which can be addressed by working towards best practice in environmental management. These include:

- loss of vegetative cover and degradation or destruction of landscapes and ecosystems
- erosion and siltation
- pollution of streams and rivers
- high level of injury and sickness
- poor social, health and safety conditions at mining sites
- inefficient extraction of resources
- gender inequity - almost half of the six million artisanal miners are women, but their share of the benefits is far from commensurate (Labonne 1996)

Problems and remedial policies pertaining to artisanal mining have frequently been ventilated at international conferences (Burke 1996, Labonne 1995, Noetstaller 1995) and are well known to governments of countries with these problems. This paper looks beyond discussion of the problems and policies to link the issues into solutions with practical measures. It invites developing countries to liaise with the Australian EPA to define country issues. It seeks their opinion on how the EPA can assist with advice and training so that Australia's substantive environmental management experience can be adapted and applied in their country.

Substantial benefits of a more sustainable development of small-scale mining can be enjoyed in developing countries if environmental and related socio-economic problems and their underlying issues can be addressed with practical systems and measures. It is the aim of Australia's EPA to facilitate this.

UNDERLYING ISSUES

Occupational health and safety (OH&S) and community health

These are priority concerns in developed or developing countries. Best practice environmental management and OH&S go hand-in-hand in mining operations. Many of the negative impacts on the bio-physical environment that arise from poor environmental management also impact negatively on the miners themselves and the local community. The wellbeing of artisanal, and to a lesser extent other small-scale miners, is often compromised by unsafe working conditions. This is commonly caused by lack of knowledge or disregard of the risks.

Examples are:-

- unstable batters and benches formed in quarries and pits
- unstable underground workings with inadequate support structures causing ground failures
- poor ventilation and lighting, flooding and gas accumulation in underground workings
- damaging levels of dust and noise
- inadequate mining equipment and lack of training
- unstable spoil heaps adjacent to working and living sites
- non-availability of, or failure to use, personal safety equipment
- mercury poisoning of miners using the amalgam process to recover gold and contamination of waterways and food chain with mercury

Water management issues

Water resources require careful management in any environment to ensure adequate supply and quality for mine and worker use. Good environmental management of water necessitates planning to control the flow, containment and discharge of all mine water and run-off (storm water) to prevent:-

- contamination of streams and rivers with suspended solids, increased acidity and heavy metals in solution that may affect aquatic life and downstream communities (eg. suspended solids, acid generation, heavy metal concentrations, mercury contamination)
- contamination of aquifers
- erosion, siltation and loss of vegetative cover from run-off and the damaging practice of ground and river bed sluicing
- discharge or spillage of oil, reagents and human wastes into water courses or aquifers.

Excavation, overburden/waste rock and tailings placement issues

Best practice environmental management of excavation and placement of top soil, overburden/waste rock and tailings not only minimises the environmental impact and facilitates rehabilitation, but can also improve mining efficiency - including improved recovery of the resource and income. Destruction of vegetative cover, whether by siltation, erosion or clearing for mining operations, causes loss of habitat so that ecosystems are degraded and biodiversity is diminished.

Environmental best practice includes:-

- minimising the clearance of vegetative cover
- retaining top soil so that it can be replaced over mined ground and overburden to support vegetative cover and re-establishment of habitat
- avoidance of ground sluicing unless tailings, waste rock and overburden are impounded in stable forms away from watercourses
- keeping mining operations out of active water courses by stream diversion, paddocking or contained dredge ponds

Exploration, definition and planning for optimal recovery of *in situ* resource

Traditionally, the small scale miner's understanding of a mineral resource occurrence is from pre-existing local knowledge. Their information on the quantity, grade, extent, disposition and ground conditions is often minimal - and hence, they are unable to develop the best mine plan and mining method for the local conditions. Mining is commonly by trial and error, resulting in poor recovery, high grading and sterilisation of the unworked resource and compounding environmental impacts. The outcomes are lower net income, resource wastage and greater environmental impact than if the resource was better understood and mining planned from the outset.

Exploration and definition of a mineral resource, together with some basic planning for its extraction, will enable small scale mining to be more profitable, more efficient in resource utilisation and to reduce environmental impacts. However, this involves mapping, sinking pits, trenching, drilling, bulk testing of many samples and geological interpretation. Apart from time-consuming manual crushing of samples, hand-dug pits, washing and pan concentrating this is beyond the means of the individual artisanal miner.

Achieving best practice in environmental management and more efficient production in any mining operation requires planning for all stages, from exploration through to rehabilitation of the disturbed ground. The need for planning is even greater when there are numerous small scale mining operations working the same mineral occurrence. Exploration, definition of the resource, mine planning, and rehabilitation all involve environmental management, which should be integrated for the total resource area or natural landscape unit. This is a function for a government regulatory and advisory agency.

Impact assessment, rehabilitation and monitoring

Assessing and monitoring environmental impact and rehabilitating ground disturbed by mining are integral parts of medium to large scale mining operations in most countries. These functions are carried out by specialists employed by the corporate or government miner and performance is checked by government agencies. Artisanal miners clearly do not have the means or expertise to carry out these functions in the same way. The EPA wishes to work with governments of developing countries to assist in the development of impact assessment, monitoring and rehabilitation appropriate for small scale mining.

Labour migration, spread of infectious diseases, lawlessness

Where a large number of artisanal miners "rush" to a mineral field and set up camp, there is no sanitation, infrastructure, stability of family life or established community structure. There is commonly lawlessness, social disruption and spread of infectious diseases. Rushes of artisanal miners are not just an historic feature of the developed new world. Some 500,000 people took part in the 1986 rush in the Philippines. The consequences of such illegal mining can be serious, and as demonstrated at Mt Kare in Papua New Guinea, can result in disastrous conflict with the development of large scale corporate operations.

Bringing small scale mining into the formal economy

Where mining is illegal, the production of high value minerals, such as gemstones and gold, is sold outside the formal economy. It is sold on the black market at a discount to world prices, and often smuggled out of the country of production to the detriment of that country and the miner. In Indonesia, more gold from small scale mining was smuggled out of the country in 1989 than was sold through official channels. Best practice environmental management cannot be adopted for such mining. Legalising mining with licences and facilitating sales through buying facilities that pay world prices has brought an end to black market sales and gold smuggling for Ghana and Zimbabwe. This has brought extra revenue to these countries - \$80 million a year in the case of Zimbabwe. It has also opened the door to improved environmental performance by way of obligations, security of tenure and rights that can be attached to a licence.

When artisanal miners are legalised and given security of a licence, their productivity and environmental performance can be improved through positive use of licensing (Burke 1995). This can include being able to sell to government buying stations at world prices, the availability of equipment to rent at a reasonable fee and access to local mineral processing services. The cost of providing government facilities can be well rewarded. Over a ten year period Ghana recovered in gold revenue one hundred times the cost of the buying stations (Labonne 1996). With these services, technical advice and even hands-on training can be provided in the use of equipment and general mining methods by local offices of the government's mineral/ mining agency.

Another way of moving small scale and artisanal mining towards best practice is through demonstration recovery plants and mines. In the 1980s, Peter Hancock (of the Centre for Resource and Environmental Studies, Australian National University), on behalf of the Canadian National Research Council, demonstrated the application of best practice small scale alluvial gold mining to miners in Yukon Territory. This included skid and pontoon mounted, trommel and riffle, alluvial gold recovery plants with a closed water circulation system. This mining method is more efficient and has much less environmental impact than the then traditional practice of hydraulicking and ramming giant sluices upstream through sediment in and around active stream beds. Because the method demonstrated produced higher recoveries and enabled more ground to be worked, it was well received and progressively adopted by the local miners. The miners and various government agencies were also pleased to find that they could now avoid massive contamination of streams from the sluicing of overburden and tailings.

EPA INTEREST AND MANDATE

It is the policy of Australia to assist countries in Asia and the Pacific region in industries and issues where it has expertise. The EPA has a mandate for this on behalf of the government and people of Australia. The exploration, mining and processing of mineral resources is Australia's leading industry. Australian mineral production accounts for Aus\$33 billion in export income and approximately 40 percent of total exports of goods and services. This makes Australia unique, being the only developed country with such a high percentage of mineral industry activity, and demonstrates that a diversified mineral based economy can support a high standard of living across its population. Australia has become a world leader in mineral exploration, mining and best practice environmental management and is exporting this expertise to assist other countries in sustainable development of their mineral resources.

The Australian government wishes to foster sustainable development, including ongoing improvement of environmental and social conditions for countries in the region. The objective of the EPA is to raise the standard of artisanal and small scale mining through transfer of technology, provision of environmental management expertise and application of practical measures, systems and training. The nature of these measures is determined with representatives of local country government and industry in accordance with country needs and conditions.

INITIATIVES TAKEN

Information modules

The EPA has compiled and distributed a series of information modules, Best Practice Environmental Management in Mining as a series of booklets. These booklets mainly describe large scale, technically advance mining, and use case studies from throughout Australia. The first eleven booklets, listed in Table 1, and a video are now available.

Table 1: The first eleven Best Practice Environmental Management in Mining booklets

- *Overview of Best Practice Environmental Management in Mining*
Overviews the program of best practice environmental management. Outlines the potential problems of mining activities, and some operations recognised for their environmental work. Canvasses the financial benefits of instituting best practice.
- *Mine Planning for Environment Protection*
Explains how planning is the key to identifying and minimising the impacts of mining and how it can help meet community expectations/ aspirations for minimal environmental impacts. It outlines the considerations that shape mining methods and the design of environmental safeguards. These include: air, water and noise quality; transport; biological resources; social and economic factors; surrounding land uses; and heritage places and artefacts.
- *Environmental Impact Assessment*
Introduces the background and purposes of environmental impact assessment (EIA). It covers briefly the legislative requirements within Australia, the key components of EIA, and the different levels of assessment. The relationship of environmental management plans, monitoring and environmental management systems to environmental impact assessment is discussed.

Table 1 continued

- *Community Consultation and Involvement*
Explains the expectations and needs of communities affected by mining proposals. The processes involved in preparing for the consultation process are discussed in detail and the key community consultation techniques are described. The booklet focuses on a community-centred rather than a project-centred approach to community consultation and involvement.
- *Environmental Management Systems*
Outlines the role and key components of an environmental management system (EMS) as one tool to use in achieving the company's environmental objectives and targets. It explains how to operate, implement and maintain an EMS, from exploration to mine closure.
- *Environmental Monitoring and Performance*
Covers the objectives of monitoring programs; selection of indicators; measurement methods; data collection and analysis; and reporting. Monitoring of water, air, dust, flora and fauna are explained. The linkages between environmental monitoring and performance and environmental auditing and environmental impact assessment predictions are discussed.
- *Planning an Environmental Awareness Training Program*
Explains the importance of planning a work force environmental awareness training program to achieve an enduring and improving environmental culture. Corporate commitment is important to a successful program. A framework is provided which can be used in planning a work force environmental awareness training program and evaluating its success.
- *Tailings Containment*
Planning, designing, constructing, operating and monitoring tailings disposal facilities are covered. The factors to consider in selecting suitable sites and the various disposal options for tailings are explained. The monitoring and control methods that can be used to minimise environmental impacts are discussed.
- *Rehabilitation and Revegetation*
The principles and practices of mine rehabilitation are outlined. Particular emphasis is given to the restoration of natural ecosystems, especially the re-establishment of native flora. Topics covered include rehabilitation objectives, soil handling, earthworks, revegetation, soil nutrients, fauna return, maintenance, monitoring and success criteria.
- *Environmental Auditing*
Auditing is shown to be an important tool for any mining operation to measure its performance against current and expected regulatory requirements, improve its credibility with the public, assess its level of risk exposure, and access loan capital. A range of audit types is described and examples given of audit checklists.
- *Onshore Exploration*
Significant environmental damage can result from ground disturbance, clearing of vegetation and careless handling of materials such as drilling fluids, lubricants, fuel, etc. Techniques are described to avoid damage, such as consultation with local people, alternatives to widespread bulldozing, earthworks to minimise erosion, rehabilitation of drill holes, and safe handling of contaminants.

Seven further booklets are in preparation and will cover:

- offshore exploration
- acid mine drainage
- management of hazardous wastes
- mine water management
- cleaner production
- noise and vibration landform design

Additional modules will be produced, resulting in a set of 25 to 30 booklets.

The booklets are written in simple English language. They are understandable to English speakers with a good general education to high school level (grade 12 in developed countries). They focus on issues, principles, practices and use case studies to illustrate key points. They have been distributed in 60 countries and are being translated into various languages, including Bahasa (Indonesian), Mandarin (Chinese) and Spanish. The first of these have already been launched in Indonesia and have been well received.

Databases

The EPA has established the "Environet" Australia Database, accessible on the Internet, which provides information on Australia's capabilities in environmental management. This is being further developed with information for miners, training courses and conferences, available environmental expertise, case studies and technical references for specific mining-related issues. The Internet address for "Environet" is <http://www.erin.gov.au/net/environet.html>

Training programs

Training needs for environmental management in mining are being identified in association with the Australian Centre for Minesite Rehabilitation Research. Courses and workshops will use best practice sites as examples. They will target all levels of the work force rather than just focussing on environmental staff. Australia is well located to offer access to training throughout the Asia-Pacific region. The EPA wishes to explore with countries in the region training requirements that will cater for their conditions.

Target audience

Achieving best practice environmental management is a partnership affair between the miners, government and the community. The EPA initiatives therefore attempt to involve all these stakeholders to raise their awareness, assist with the initiation of measures to establish best practice environmental management, and achieve a more sustainable development of mineral resources.

RELEVANCE OF THE EXISTING BEST PRACTICE BOOKLETS

The booklets identify, raise awareness and address the environmental issues for medium to large scale mining. Whilst the general philosophy, many of the issues and some of the prescriptions apply to small scale mining, the EPA is now considering developing products aimed specially at small scale and artisanal mining. It is exploring views and needs to determine what type of product will be most useful. For example, the EPA is working with Indonesia with a view to producing printed materials for artisanal and small scale mining in that country.

In India and other developing countries, as in Indonesia, the EPA wishes to work with government and industry to identify and provide environmental management products that will reduce or avoid the negative effects and facilitate more efficient and economic mining.

ASSISTANCE OFFERED AND FEED-BACK SOUGHT

The EPA invites developing countries to discuss with it how the Australian mineral sector's experience and the initiatives referred to in this paper and Best Practice booklets can be adapted and used to achieve best practice for small scale and artisanal mining in their country or region. In liaison with those countries, the EPA will then be pleased to adapt the information, according to cultural and literacy situations, into several booklets for small scale and artisanal miners, community and government stakeholders. It will also assist with related training and data sets. Developing country stakeholders' assistance and ideas are sought on how the EPA may work with them to produce a successful product, ie. a product which describes:-

- measures and systems that their miners, communities and governments can afford and that will benefit environmental performance and productivity; and
- measures that communities see as reasonable and which can be made relevant to the small scale and artisanal miners.

DEVELOPING A STRATEGY TO WORK WITH INDIA AND OTHER DEVELOPING COUNTRIES FOR ENVIRONMENTAL BEST PRACTICE

The work of small scale miners is unspecialised. Environmental performance and practices cannot therefore be neatly parcelled off into tidy specialised compartments - as they are in the existing booklets which are appropriate for large scale mining with its readily available specialist expertise.

The issues to be managed in small scale mining vary widely according to the type of mining, country situation and stakeholders interests. In many cases important issues may not be recognised until awareness of the effects are developed through information, personal experience or changing community values. To help identify the priority issues to be addressed they are grouped and interrelated in various ways by cross-referencing issues with stakeholders, as for example in the hypothetical case for, say, an iron ore quarry as in Table 2.

Table 2: Identifying the priority Issues for country situations

Stakeholder Issue	artisanal miners	mechanised/ capital intensive. Miners	policy makers	regulators/ advisers	community
water availability/ management	X	X			X
health and safety	X	X	X	X	X
disease/ social unrest/ law			X	X	X
chemical use/ contamination			X	X	X
vegetation/ biodiversity			X		
erosion/ siltation					X
tailings/ overburden waste rock placement			X	X	
resource utilisation/ sterilisation			X	X	
productivity	X	X			
noise		X			X
dust		X			X

The stakeholders (eg. artisanal miners, small scale mechanised/ capital intensive miners, government policy-makers, regulators/advisers and community) are listed against the various issues (eg. water use, safety, chemicals, waste materials, noise, dust, etc.) so that the priority concerns can be checked off for any country and stakeholder interest. Countries are invited to use this approach to help identify the range of relevant issues for small scale and artisanal mining in their country, and help to determine what the most useful products would be to address these issues.

EXAMPLES OF ACHIEVABLE OUTCOMES

Positive outcomes for small scale and artisanal mining have been achieved by legalising mining through licences issued to mine within a specified area. Zimbabwe and Ghana provide positive incentives by buying gold at world market prices and at the same time can impose reasonable performance conditions on the licensee. Licensed small mine sites can then be both assisted and controlled. The following are examples of potentially achievable outcomes.

- simple mine rehabilitation and environmental management plans to be completed and followed for each small mine site and to comply with regional requirements
- linkage of licensing to inspection, access to mining equipment, inspection, advice and training
- best practice demonstration sites and plant, such as simple trommel and riffle plants for alluvial mining with continuous rehabilitation and closed system water management
- Infrastructure for small scale mining areas, providing efficient crushing, grinding, concentrating and amalgam retorting facilities

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Best Practice Environmental Management – A Critical
Strategy for the Future of the Mining Industry

Stewart Needham

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Abstract

The role of government and the community has changed significantly over the last two decades in relation to environment protection, particularly in the mining sector. Increased community expectations have moved well ahead of regulatory requirements, and there is now a much greater appreciation generally of the concepts of ecologically sustainable development and intergenerational equity, and the gap between current practice and practices which would be in harmony with these concepts. Besides providing a "safety net" through regulations to ensure that basic environmental performance standards are met, government is now working proactively with the mining industry to encourage higher levels of environmental performance. This paper describes some initiatives between the Commonwealth government and the industry designed to achieve these higher levels of environmental performance, through programs aimed at the paradigms of best practice environmental management and continual improvement.

Introduction

The last twenty five years has seen a major change in the level of public interest in the environment. Perhaps related to the creation of many national park and heritage areas, exposure through the print and electronic media to the many wonders of the natural world in the form of natural history documentaries, and the growth of the environment as a major recreational resource, many Australians now have profoundly different attitudes towards the environment.

Changing community and government roles

The environment used to be regarded as the responsibility largely of government, and the community was content to leave it up to the government, through regulation, to protect the environment. However, with the development of a greater sense of understanding of the environment, its values, diversity and vulnerability, the community now has a sense of ownership. The rapid growth in the number, membership and activity of community environment groups reflects a sense of custodianship, developed partly because of the perception that the traditional form of environmental protection through government regulation was falling short of what the community expected.

This problem is by no means limited to the mining industry. Indeed, the degree of environmental degradation in urban industrial and rural agricultural settings is commonly much more serious. Unfortunately for our industry, mines are commonly situated out in the bush, in relatively unspoilt countryside, and the contrast between the pre-mining landscape and the area affected by mining is extreme; after all, it's hard to mine without digging big holes in the ground and piling up the waste rock. We argue that in comparison to other industries, mining disturbs only a small area of land, and the level of economic benefit for the area affected is much greater, but that is not sufficient to assuage the concerns of the more ardent members of the public.

The public now plays a very different role in influencing government policy than it used to. Whereas environmental regulation was determined by government and applied to the industry, with the public knowing, understanding, or caring little (except, obviously, for major incidents), today the public is much more concerned and plays arguably a more significant role than government in setting the environmental agenda and influencing environmental standards setting. Northparkes is a good example: whilst there may have been some work going on behind the scenes between the company and government to address the issues of the bird kills on the tailings dam, it was the media coverage and the public outrage that followed that prompted major action and initiated an inquiry into cyanide use which may well lead to setting of national standards for the industry.

In effect, public opinion is commonly the main driving force for industry to react and improve; government regulations and standards play the role of a "safety net" which tends to lag behind the level of performance expected by society.

It is naive of any of us to consider that the level of public concern is going to diminish. I believe that the model of industry working to keep pace with reasonable community expectations for environmental protection is here to stay. The mining industry should regard itself as a temporary user of land owned by the community. The overall objective is to operate in a way which does not threaten the offsite environment, and to leave the site in a form which is available for some form of subsequent use. It is not acceptable for any section of the community or industry to indulge in "once-only" land use which leaves an area devoid of any value for future generations.

The industry must realise the imperatives of achieving ecological sustainability and intergenerational equity in its operations. To do so will provide a firm basis for the industry for the future - land access, approval processes, community acceptance, risk insurance, loan funding, and product acceptance are all clear benefits from good environmental practice. Trends in some parts of the world towards consumer preferences for manufactured goods being influenced by their whole-of-product environmental friendliness will ultimately impact upon the producers of the raw materials, including metals.

The changes in community attitudes and expectations have placed a significant burden on the mining industry, but this is surely for the better. I think we would all agree that it is right for our industry, with such strong links to the bush, to adopt the role of environmental custodians. We in Australia have a significant natural advantage to build a strong future for the industry at home, and to build a competitive edge in resource development and capacity building in other countries.

Best practice environmental management

Best practice environmental management is a powerful way of demonstrating to regulators and the general community that the industry is committed to protecting the environment. BPEM requires operators to go beyond the regulatory requirements, and to apply the best available technology to minimise impacts. This approach is relevant at the planning, operational, closure and post-closure stages of mining. Poor environmental practices of the past have left a legacy of damage which strongly influences public opinion on the mining sector, even though the standard of environmental practice has improved greatly in the last two decades.

As recently as three years ago, riverine disposal of tailings was still undertaken at the Mount Lyell mine in Tasmania, flowing into a harbour system which extended into a World Heritage area. More recently, routine or accidental disposal of tailings into river environments in other countries by mining operations with Australian connections has turned the international spotlight our way. Clearly, the trend to better practices is not yet sufficiently widespread in the industry, nor sufficiently responsive or anticipative of community expectations. These community expectations need to be addressed through demonstrated improved practices if the industry is to maximise the opportunities available both at home and abroad.

Industry and government partnerships on environmental best practice

Failure to meet increasing expectations for environmental protection could threaten the future strength of the Australian mining industry, both at home and abroad. Perceptions about the environmental credentials of our industry generally, are affected by a few highly publicised events. The only effective ways of countering these perceptions is to improve the level of best practice environmental management throughout the industry to reduce the probability of major environmental incidents, and to increase the level of understanding by community groups and governments of the improvements being made by the industry in this area. The government's concern is not limited to the continuing economic strength of the mining sector at home, but also to the competitiveness of the industry in overseas resource development; environmental track records are becoming increasingly important to foreign governments when assessing proponents for resource development projects.

The government is therefore keen to work together with industry to help it achieve improvements in environmental performance. A number of initiatives are already under way which involve partnerships between government and industry, and between Commonwealth and State government. These focus on:

- raising awareness of best practice and its benefits
- demonstrating the application of best practice
- strategic research into environmental problems
- building expertise and providing information
- development of systems which encourage continual improvement.

Best practice awareness

The Commonwealth EPA is producing a series of booklets which describe the benefits arising from best practice applied to particular environmental issues. The issues already covered and some others in progress are listed in Table 1. The booklets are written by industry experts selected by a panel of industry representatives (companies, Minerals Council of Australia, AusIMM, AMEEF), State and Federal government resource industry agencies (DPIE, Chief Inspectors of Mines), and environment NGOs (ACF).

Over 6000 copies of the booklets have been distributed - mostly in Australia, but copies have also been requested from 60 other countries. This level of interest has prompted translation into Indonesian, Mandarin Chinese and Spanish, and industry has been invited to assist with translation into other languages. A cooperative program on mining and environmental protection is being negotiated with the Indonesian government as a flow-on from these booklets.

Demonstration of best practice

Each booklet contains several case studies to demonstrate the practical application of BPEM in a range of situations at Australian mine sites.

The Commonwealth and Tasmanian governments are working on a joint program to determine practical and cost-effective remediation options for the environmental damage (caused mostly from riverine discharge of tailings and acid drainage up to 1994) at Mount Lyell. Best practice solutions generated from specialist studies by leading industry, academic and government research organisation experts will be provided to government as a basis for a remediation program to begin in 1997. This program provides a model for the selection and application of best practice options, particularly as they relate to sites impacted by previous mining operations.

Strategic research

Much of the environmental research conducted by the mining industry is site-specific or directed to specific issues, where the company undertaking or sponsoring the research is able to directly capture the benefits and apply them to its operations. Solutions to many generic environmental problems relevant to broad sections of the industry require basic research, perhaps spanning many years. In this case, significant benefits may take many years to eventuate, and it is unlikely for individual companies to gain a competitive advantage for themselves. Because of these characteristics, a collaborative research approach to generic environmental problems is more appropriate.

There are mechanisms in place for arranging and funding strategic research, for example through AMIRA. The Minerals Council of Australia and the Australian Centre for Minesite Rehabilitation Research have both conducted exercises to identify and prioritise the strategic environmental research requirements for the industry. The ACMRR and the government have entered into an arrangement

to increase the level of strategic research, which is funding the development of research proposals, and assisting industry to fund research projects. The emphasis is on key issues such as acid drainage and rehabilitation.

Building expertise and information

High quality environmental management requires an increasingly sophisticated understanding of environmental problems and solutions. For example, design and evaluation of a revegetation program may require knowledge in botany, soil science, entomology, geomorphology and hydrology. The ACMRR/government arrangement also provides funding for organising short courses and workshops, to build skills in the industry mainly in the area of mine rehabilitation. As a consequence of the partnership, the number of course or workshops run by ACMRR each year has increased from 1-2 to 5-6.

Databases are also being designed to provide information to back up the best practice booklets. The databases will contain information on current technical references, best practice case studies, upcoming training courses, and specialist expertise, categorised by environmental issue.

Encouraging continual improvement

As discussed previously, community expectations commonly require a company to attain standards higher than those specified in legislation. A "beyond compliance" attitude is gradually becoming the norm, and the Minerals Council of Australia code of practice includes a number of features consistent with this trend.

If the community is to accept the industry commitment to improved environmental practice as credible, it will be necessary to demonstrate improved performance. The initiative of WMC in producing an annual environmental report, which includes performance indicators, is to be highly commended. The government is also exploring a joint project with industry to develop sustainability indicators which can be used consistently across the industry, and which are also comparable with other industry sectors, so that statistics are presented in a way which is unambiguous and meaningful, and compatible with the trend towards "state of the environment" reporting.

Another recent development within government has been the change from a regulatory approach to supervision of uranium

mining at the Commonwealth level, to an approach which encourages continual improvement. Twice-yearly environmental performance audits are undertaken at the Ranger mine which focus on environmental outcomes rather than process; any weaknesses identified are responded to by joint company/government/landowner working groups to develop mutually acceptable solutions to the problem - for example, treatment and disposal of contaminated water. This process is linked to a broad stakeholder consultative arrangement, so that regular feedback can be gained and incorporated into the improvement cycle.

This approach is also being applied on Christmas Island, where environmental improvement is being fostered from a very low base. The tourist industry (casino), local council, and service industry are also participating in this process along with the phosphate mining company. Again, community information and feedback are incorporated as essential components of the process.

Conclusion

Community reaction to what it perceives as unacceptable performance is now placing very considerable demands upon the mining industry above and beyond the regulatory requirements of government. The future well-being of the industry, particularly in terms of certainty of process and outcomes relating to land access and project approvals, depends on its ability to meet these community expectations. The key expectations are that mining companies will act as responsible temporary tenants of the land and leave it in a fit state for alternative use, with no significant impact on human health or the environment either during operation or after mine closure.

The government wishes to work with the industry towards the continuing viability of the Australian mining sector at home and abroad. The most important requirement is for the industry to embrace the concept that mere regulatory compliance is no longer sufficient to deliver a high enough standard of environmental performance. Regulations are now effectively a safety net to catch the poor performers, but they do not keep pace with community expectations and therefore in themselves do not guarantee that problems with the media or public will be avoided.

The industry therefore has to accept more responsibility than in the past for determining the level of environmental performance it needs to achieve - a responsibility once the exclusive domain of

government. Best environmental practice and continual improvement are tools which can be used to raise the level of performance to the high standard expected by the community, and keep them there. Whilst the government's role is to provide a "safety net" through regulation for minimal levels of environmental performance, it also wishes to work collaboratively with industry to achieve ecological sustainability and intergenerational equity in mining, minimise future liability, and provide a competitive international advantage based on sound environmental performance.

Table 1: Best practice environmental management in mining booklets

published:

- Overview of Best Practice Environmental Management in Mining.
- Mine planning for environment protection.
- Environmental impact assessment.
- Community consultation and involvement.
- Environmental management systems.
- Environmental monitoring and performance.
- Planning an environmental awareness training program.
- Tailings containment.
- Rehabilitation and revegetation.
- Environmental auditing
- Onshore exploration

in preparation:

- Offshore Exploration
- Acid Mine Drainage
- Management of Hazardous Wastes
- Mine Water Management
- Cleaner Production
- Noise and Vibration
- Landform Design

An Australian Initiative to Promote Best Practice
Environmental Management in Mining

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An Australian Initiative to Promote Best Practice Environmental Management in Mining

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Abstract

The Australian government and mining industry are working together on a program to promote the uptake of best practice in environmental management in the mining sector. To achieve the higher levels of environmental protection now expected by the community, the industry must perform beyond the levels set down by regulations, which are effectively a "safety net" to ensure that severe impacts on the environment are avoided. A series of booklets is being produced which focus on different environmental issues in mining. Eleven booklets have been produced so far. They represent a model of the Australian approach to best environmental management in mining, which may be useful to other countries - particularly the developing countries - as a guide to determining whether their own practices are consistent with world best practice. To make the information more readily accessible in countries in the Asia-Pacific region, the booklets are currently being translated into Bahasa Indonesian, Mandarin Chinese, and Spanish. The next stage of the program is under way and will produce databases on technical information, best practice expertise, best practice sites, and training opportunities, and development of an integrated training program which matches the demand for training in environmental management in mining in Australia and its neighbour countries and elsewhere.

Introduction

Globalization is occurring in all industry sectors throughout the world. It is well under way in mining, transportation, communication and manufacturing. The Australian mining industry is now, more than ever, increasingly global in its outlook. Australian companies operate in the former Soviet Union, North America, South America, Africa, Asia and the Pacific. The recent merger between RTZ and CRA, into a corporate entity of global proportions, illustrates this trend.

Globalization necessarily invites comparison of performance on a world scale, including environmental performance.

Some Australian mining companies are world leaders in mine site rehabilitation, mineral processing and environmental management. For example, Alcoa of Australia is the only company in the world to win the United Nations Global 500 Role of Honour for its excellent work in mine site rehabilitation and revegetation. High levels of environmental performance have been required in order for some mines to obtain approval to operate in areas of particular environmental sensitivity or with high conservation values, such as at the Ranger uranium mine which operates in an area surrounded by Kakadu National Park, which is on the World Heritage list

Australian companies have developed their current environmental awareness and expertise over a long time and have learned from some very costly past environmental mistakes. The Mt Lyell copper mine in Tasmania, where pyritic tailings were discharged directly into the river system for 70 years and SO₂ from smelting killed vegetation which led to severe erosion around the minesite, is now regarded as an icon of environmental bad practice and represents a management style far from acceptable by today's expectations. Even sites remediated as recently as 15 years ago, such as the Rum Jungle uranium-copper-lead mine in the Northern Territory, are widely regarded as not meeting the standards expected today.

Mining will continue to be a mainstay to the Australian economy for the foreseeable future, and it is important for the industry to gain the confidence of the community if it wishes to continue to gain access to resources. Mining no longer has an automatic priority in terms of land use, because proposals have to compete with other interests including conservation and tourism. Therefore there is now emerging in Australia a culture of "best practice" in environmental management, in an attempt to move environmental performance beyond that demanded by regulations. Government regulations now represent a "safety net" below which there is a high risk of severe environmental impact so that penalties are necessary to ensure that this minimum level of performance is met.

"Best practice" is simply the best way of doing things. It encompasses the principles of:

- best technology
- continual improvement
- agreed environmental quality objectives
- pro-active planning and research
- independent evaluation of environmental performance
- outcomes focus rather than process focus
- public disclosure.

Whilst the "safety net" of minimum standards imposed by government remains in place, the traditional approach of the government imposing its will coercively upon the industry through the threat of fines is being replaced by a more cooperative approach to encourage a level of performance beyond the minimum requirements. State regulators assist the industry in developing Environmental Management Systems which incorporate environmental quality objectives, and performance is now more frequently assessed through a process of periodic auditing rather than through frequent site visits.

In concert with this move to a more collaborative approach, government has formed a partnership arrangement with several industry sectors to encourage improvement in environmental management. The partnerships commonly also include the participation of community and consumer organisations to ensure that the program objectives are broadly acceptable. This partnership approach is proving to be most effective: industry involvement attracts acceptance by industry peers; government endorsement provides assurance to industry that the initiatives are consistent with government policy directions; and community participation provides a level of certainty that the program outcomes will be acceptable to the wider community.

The partnership dealing with the mining industry is called the Best Practice Environmental Management in Mining Program. The Program recognises that whilst some Australian mining companies are leaders in good environmental management, there are also companies whose performance is relatively poor. It is designed to complement a number of programs under way to encourage continual improvement by industry, such as award schemes for excellence in environmental management run by the industry or by State government. These award schemes offer a competitive environment for companies, organisations or individuals wishing to demonstrate their achievements, as well as offering financial rewards.

Elements of the Best Practice Environmental Management in Mining Program are:

- production of booklets and videos
- databases to provide easy access to key information
- training programs
- strategic research into environmental issues in mining.

Booklets and video on Best Practice Environmental Management in Mining

This project began in early 1995 following a suggestion from the World Bank that Australia could assist in dealing with a range of environmental issues in mining.

A steering committee was formed to guide and assist with the project. The steering committee members were chosen because of their interest, expertise and contacts on the subject of environmental management in mining. The Steering Committee includes representatives from the peak mining industry organisation (Minerals Council of Australia), an industry-based environmental focus group (the Australian Minerals and Energy Environment Foundation), the principal mining professional body (the Australasian Institute of Mining and Metallurgy), a key mining research organisation (the CSIRO Minesite Rehabilitation Research Group), the State Government based Chief Inspectors of Mines of Australia, and the Australian Conservation Foundation representing non-Government conservation groups.

To date eleven booklets have been written by leading practitioners of environmental management in the mining industry. The booklets were printed and published after intensive review by a sub-group of the steering committee with input from experts from the mining industry on each subject. In addition a 10 minute introductory video has been produced to illustrate the objectives and concepts of best practice environmental management in mining.

Topics covered by the booklets are an overview of best practice environmental management in mining, mine planning for environment protection, environmental impact assessment, community consultation and involvement, environmental management systems, environmental monitoring and performance, planning an environmental awareness training program, tailings containment, rehabilitation and revegetation, environmental auditing, and onshore exploration. Details of these booklets are given in Table 1.

Authors for the booklets were chosen on the basis of their expertise and availability. Where suitable authors from companies were not available, paid consultants from the industry were engaged.

Table 1: The first eleven BPEM booklets

• *Overview of Best Practice Environmental Management in Mining.*

Overviews the program and the attributes that go towards achieving best practice. Outlines the potential problems that can occur as a result of mining activities, and some operations that have achieved recognition for the quality of their environmental work. Also canvasses the financial benefits to mining operators of instituting best practice.

• *Mine planning for environment protection.*

Planning is the key to identifying and minimising the environmental impacts of mining. This booklet examines how mine planning for environment protection can help in developing projects that meet community expectations for minimal environmental impacts. It outlines the considerations that shape mining methods and the design of environmental safeguards. These include: air, water and noise quality; transport; biological resources; social and economic factors; surrounding land uses; and heritage places and artefacts.

• *Environmental impact assessment.*

This booklet introduces the background and purposes of environmental impact assessment (EIA). It covers briefly the legislative requirements within Australia, the key components of EIA, and the different levels of assessment that exist. The relationship of environmental management plans, monitoring and environmental management systems to environmental impact assessment is discussed.

• *Community consultation and involvement.*

The expectations and needs of communities affected by mining proposals are covered in this booklet. The processes involved in preparing for the consultation process are discussed in detail and the key community consultation techniques are described. The booklet focuses on a community-centred rather than a project-centred approach to community consultation and involvement.

• *Environmental management systems.*

This booklet outlines the role and key components of an environment management system (EMS) as one tool to use in achieving the company's environmental objectives and targets. It explains how to operate, implement and maintain an EMS within daily operations, from exploration to mine closure.

• *Environmental monitoring and performance.*

Subjects covered include: the objectives of monitoring programs; selection of indicators; measurement methods; data collection and analysis; and reporting. Monitoring of water, air, dust, flora and fauna are covered. The linkages between environmental monitoring and performance and environmental auditing and environmental impact assessment predictions are discussed.

• *Planning an environmental awareness training program.*

This booklet explains the importance of planning a workforce environmental awareness training program to achieve an enduring and improving environmental culture. Corporate commitment is important to a successful program. A framework is provided which can be used in planning a workforce environmental awareness training program and evaluating its success.

continued.....

Table 1 continued

• **Tailings containment.**

Planning, designing, constructing, operating and monitoring tailings disposal facilities are covered. The factors to consider in selecting suitable sites and the various disposal options for tailings are explained. The monitoring and control methods that can be used to minimise environmental impacts are discussed.

• **Rehabilitation and revegetation.**

The principles and practices of mine rehabilitation are outlined. Particular emphasis is given to the restoration of natural ecosystems, especially the re-establishment of native flora. Topics covered include rehabilitation objectives, soil handling, earthworks, revegetation, soil nutrients, fauna return, maintenance, monitoring and success criteria.

• **Environmental auditing.**

Auditing is shown to be an important tool for any mining operation to measure its performance against current and expected regulatory requirements, improve its credibility with the public, assess its level of risk exposure, and access loan capital. A range of audit types is described and examples given of audit checklists.

• **Onshore Exploration.**

Significant environmental damage can result from ground disturbance, clearing of vegetation and careless handling of materials such as drilling fluids, lubricants, fuel etc. Techniques are described to avoid damage, such as consultation with local people, alternatives to widespread bulldozing, earthworks to minimise erosion, rehabilitation of drill holes, and safe handling of contaminants.

The booklets contain a number of case studies which give examples of how specific components of environmental management programs are being implemented in a range of climatic conditions and mine sites across Australia. They set out how to integrate environmental issues and community concerns through all phases of mining, from exploration through construction, operation and eventual mine closure.

The booklets were launched at the International Association for Impact Assessment conference in Durban, South Africa in June 1995 and in Australia in Sydney and Perth in August 1995.

The booklets and the video are freely available and over 6000 packages of the first eleven titles and the video have been widely distributed to industry, government, teaching institutions, consultants and individuals both in Australia and in 60 overseas countries.

The objectives of the project are to:

- improve the level of environment protection associated with mining in Australia and overseas;
- share Australian expertise in environmental management in mining with people overseas;

- work on a cooperative/partnership basis with industry to promote best practice through all sections of the mining industry in Australia; and
- encourage industry to perform better than that required under regulation.

To build on the success of the existing project more booklets are planned, and about 20 to 25 booklets may be prepared in total. Each will be written by recognised leaders from the industry in their particular fields of expertise. Topics covered by booklets now in preparation are listed in Table 2.

Table 2: Booklets in preparation

- Acid Mine Drainage
- Management of Hazardous Wastes
- Water Management and Wetlands
- Cleaner Production
- Noise and Vibration
- Landform Design

The booklets are not designed to be comprehensive technical manuals giving precise details on what is best practice at a mine site and how to do it. By its very nature, best practice may differ from one site to another, and will evolve over time. The booklets are designed instead to present the philosophy of best practice, with enough supporting factual information, general descriptions of techniques, and case studies containing examples of best practice already in operation. The booklets are therefore designed to convince the reader that best practice is a worthwhile objective. An extension program is being developed to provide more detailed information to encourage the wider adoption of best practice in environmental management.

Databases

Environment Australia has established a network of databases "*EnviroNET Australia*" accessible on the Internet (<http://www.erin.gov.au/net/environet.html>). It provides information on Australia's capabilities in environmental management. Six interlinked databases provide case studies in cleaner production and environment technologies; fully searchable information on environmental management expertise, environmental education courses, and research and development in waste management and pollution control (Table 3).

Environment Australia plans to develop a similar network of databases to provide information of direct use to the mining sector. Each will contain information classified by issue (e.g. water management; mine planning; auditing; slope stability). The databases will be:

- *technical information* - up to 5 references to technical information in books, journals, manuals etc which will be chosen on their practicality, currency, and availability
- *expertise* - a list of environmental management expertise in mining-related issues, including the private, government and academic sectors
- *training courses* - upcoming training courses, workshops, and conferences related to mining and the environment
- *best practice sites* - a listing of sites where examples of best practice are in operation.

Training programs

There is a high demand for training in environmental management in mining. For training to be effective, courses need to be targeted at all levels of the workforce, from the truck driver and security officer through to senior managers rather than focussed on environmental management staff. An arrangement with an industry group (the Australian Centre for Minesite Rehabilitation Research) has recently been entered into to identify training needs, with a view to developing an integrated program of training courses to meet these needs. Australia is in a good geographic position to offer access to training through Asia and the Pacific, and so training programs need to cater for situations with various economic, social, climatic and geographic conditions which may differ considerably from the Australian situation. The intention is to design highly specific workshops on key environmental issues in mining for different target groups, and coordinate the availability and timing of these to both the domestic and overseas markets.

Strategic research

Many areas require further research to determine fully effective methods in environment protection, such as acid mine drainage, management of mining voids, revegetation, and measurement of rehabilitation success. The arrangement with the Australian Centre for Minesite Rehabilitation Research extends to joint sponsorship with industry of research projects which are strategic in nature - that is, they are of general application throughout the industry and will lead to better long term solutions. Research which is more site-specific is funded wholly by the industry.

Table 3. EnviroNET Australia

EnviroNET Australia is a network of complementary databases available on the Internet designed to maximise access to environmental information. It is currently being accessed over 22000 times per month and has developed into a key source of leading-edge environmental information – in January 1996 it was recognised by the Swedish-based Eco-Network as one of the top 100 Internet environmental sites. Through the following specially designed databases and directories it links people with problems, in Australia or overseas, to Australian solutions:

Cleaner Production Case Studies Database

This database assists small to large businesses to maintain a competitive edge by drawing on case study information about cleaner production methods. Information focuses on production processes which minimise harmful environmental impacts by improving management practices from the beginning to the end of the production process. Cleaner production processes are shown to actually reduce costs to business.

Environment Industry Expertise Database

Lists the environmental expertise of over 950 private and public sector organisations. Powerful search facilities find organisations who offer technologies, products and services to solve problems in the following categories: air pollution; water pollution; waste management; noise, vibration and radiation; chemicals for environment management; environment monitoring and measurement; and general environment management (such as environmental law' economics, policy, auditing, planning and training).

Environment Education Database

Provides comprehensive information on environmental education and training courses available from Australia universities and other institutions.

Pollution Prevention Research and Development Database

Lists waste management and pollution control expertise and reveals whether a technology currently exists to solve a specific problem, and if not, whether there is current research or scope for such research to fill the gap.

Technology Case Studies Directory

Contains information on 'best-practice' operating solutions to environment problems - for example, innovative sewage treatment processes, technology to recycle green waste, or environment monitoring equipment. Each case study provides detailed performance data on a product, technology or process which is being successfully applied in Australia.

Hazardous Waste Treatment Technologies Directory

An independent source on the status of technologies capable of treating hazardous scheduled wastes in Australia. These are chlorinated hydrocarbons that are toxic, persistent and bioaccumulative.

Conclusions

Community expectations for environmental protection are ever increasing. Since the Rio Earth Summit in 1992 there has been a greater awareness by governments of the need to implement Ecologically Sustainable Development, and by industry that a good international corporate image is an important ingredient for successful business. ESD symbolises a balance of economic exploitation of resources together with effective environment protection.

The Best Practice Environmental Management in Mining Program is an example of a cooperative partnership between Australian government and industry which is focused on bringing forward solutions consistent with ESD related to the mining sector. The partnership is built around the principle of best practice. The booklets are the first stage of a long term plan to provide a range of resources which will enable the mining industry to improve its general level of environmental performance. Mining is a major activity in Australia, and it is a priority for our country to ensure that mining is able to operate at levels of environmental impact acceptable to the public and compatible with other competing land uses.

Australia also has a responsibility to contribute to improvement in the level of environmental protection in mining internationally, particularly because its own mining sector is active in resource development in many other countries. Translation of the booklets into other languages will facilitate their usefulness internationally. It is hoped there will be an opportunity to develop collaborative programs in environmental protection in mining between Australia and other nations to further build on the program described in this paper.