

Bauxite Mining Sustainably

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Abstract

In 1990, the International Aluminum Institute began a program to report on the bauxite mining and rehabilitation activities of the worldwide industry. A survey process was initiated and reports were published in 1992, 2000 and 2004. The most recent report includes extensive data on mines representing over 70% of the world's output of bauxite and includes a more detailed focus on the social and economic as well as the environmental performance of the industry.

Results of the survey show that the bauxite mining industry is continuously improving its rehabilitation performance, with rehabilitated areas increasing faster than mined areas, and that it is dedicated to minimizing the environmental impacts of its actions. As well as this the industry is engaging local communities, utilizing local knowledge and experience and investing considerable resources in socio-economic development programs, in addition to its role as an employer and taxpayer. The collected data demonstrates that the bauxite mining industry is improving in its aim to operate in a sustainable manner.

Introduction

After iron, aluminum is the world's second most used metal. Aluminum production is growing as more and more applications are developed for this adaptable, durable and recyclable metal. All around the world, demand for the metal is increasing, with aluminum now an essential element in everyday life. The business traveler, the tourist and the freight company depend on aluminum. For example, aluminum comprises around 65% of the structural weight of the Airbus A380. In motor vehicles, the lower weight of aluminum reduces fuel consumption and emissions and improves safety through better vehicle handling and through better energy absorption in the event of a collision. The aluminum content of new automobiles is increasing at a rate of over 4% per year, averaging over 130kg per car in 2003. Aluminum facilitates the construction of corrosion-resistant and low maintenance buildings. Aluminum in packaging preserves the quality of food and medicines, reduces waste and provides added convenience for users.

Bauxite, the raw material for the production of aluminum, is mined in many countries worldwide. Known reserves of high quality bauxite are sufficient to provide over 300 years supply at projected growth rates in aluminum use – aluminum compounds make up 7.3% of the earth's crust so there is little possibility that supplies will be exhausted. Most bauxite is refined into alumina, some of which is used in the chemical industries, although the majority is transformed into aluminum through an industrial electrolytic process known as the Hall/Heroult process. Between 4 and 6 tonnes of bauxite are required to produce one tonne of

aluminum metal. This is a modest use of mineral resources compared to many other materials.

Since the 1992 *United Nations Conference on Environment and Development*, the bauxite industry, and the minerals industry in general, have increasingly seen the Sustainable Development model as the best framework for addressing the concerns of the industry and external stakeholders

The most generally accepted definition of Sustainable Development is that of the *Brundtland Commission*, which defined it as 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (*World Commission on Environment and Development 1987*). A sustainable mining operation, therefore, is one that brings long-term social and economic benefits without causing lasting environmental damage, social dislocation or significant depletion of a resource.

Bauxite miners are leaders in developing environmental management programs and rehabilitation procedures for the minerals industry. In 1984 the *United Nations Environment Programme* issued a set of guidelines for the assessment of the environmental impacts of bauxite mines and alumina refineries, which has been used by many operations as an aid to developing their own procedures and standards.

Minimizing the environmental impacts of mining, protecting and restoring biodiversity, and rehabilitating disturbed areas to maintain the full range of possible land-uses protects natural capital. Net benefits to local communities, regions and countries from bauxite mining can come from:

- Investment;
- Export earnings;
- Compensation payments;
- Federal, state and municipal tax payments;
- Employment;
- Education and training;
- The development of local industries and businesses;
- The development of infrastructure;
- The provision of health and other community programs.

In 1991 and 1998, the *International Aluminium Institute* (IAI) commissioned surveys of bauxite mine rehabilitation programs, undertaken by operations around the world. The aim in both cases was to provide data on the environmental impacts of bauxite mines and their rehabilitation programs. In 2003, the third and most comprehensive survey was carried out to follow up and extend the first two, focusing attention on the socioeconomic impacts of mining and mine rehabilitation as well as environmental issues. Twenty-three operations in twelve countries, including, for the first time, Russia, responded to the survey of 2002 data.

Third Bauxite Mine Rehabilitation Survey Results

Bauxite Production

Total world production of bauxite in 2002 was 141 million dry tonnes (*US Geological Survey 2002*), of which over 70% (99 million tonnes) is represented by the twenty-three respondents to the 'Third Bauxite Mine Rehabilitation Survey'. Most bauxite is produced by a few large operations. Aggregate output from the five largest mines was nearly 70 million tonnes in 2002 (70% of total reported), nearly 68 million tonnes in 1997 (73%) and just over 54 million tonnes in 1990 (77%). The long-term sustainability of production at surveyed operations is healthy, with bauxite reserves totaling over 4.2 billion tonnes.

Large areas of land (1.6 million hectares) are under lease or concession for bauxite mining, although only around 150,000 hectares of this is expected to be disturbed over the lifetime of the mines. This area is substantial, but small when compared to areas disturbed for other purposes. For example, an estimated 470,000 hectares of land was cleared in Australia in 1999 alone, mostly for agriculture and urban development (*Australian Bureau of Statistics 2002*).

The area mined each year at the different operations depends on production rates and the depth of ore bodies. The total reported area mined is 2,000 hectares per annum, compared with 1,600 hectares in 1997 and 1,400 hectares in 1990. Only five operations mine more than 100 hectares per annum and a further five mine between 20 and 100 hectares. The two largest operations mine 572 and 673 hectares per annum and the smallest 0.8 hectares. The total area cleared at the reporting locations is 52,224 hectares, 17% of which is for infrastructure and 83% for mine pits.

An average 4.92 dry tonnes of bauxite and 2.04 tonnes of available alumina are mined from each square meter on a production-weighted basis. In the 1991 and 1998 surveys the production-weighted means were 5.24 and 5.65 tonnes of bauxite per square meter (enough to produce one tonne of aluminum metal). Some of the largest producers mine the lowest grade and/or thinnest ore deposits. In 2000 the average price of bauxite imported into the USA was US \$23.09 per tonne (*US Geological Survey 2002*). Using this price, the average value of bauxite mined per hectare, on a production-weighted basis, is US \$1.14 million.

More than 98% of the total reported bauxite is mined by open-cut methods. At one operation all the mining is underground and at another two operations ore is mined by both underground and open-cut methods. The average thickness of bauxite deposits varies from 2-30m with a median of 4.8m. Median overburden thickness at the 20 open-cut mines is 2.1m.

Mine Infrastructure

A total area of 6,130 hectares has been cleared for infrastructure, including transportation systems, at reporting operations. Nearly 72% of this will eventually be rehabilitated, while some of the haul roads will often be left as access roads in the region of the rehabilitated areas.

Transport distances to alumina refinery stockpiles or to shipping points range from less than 10km to more than 320km. Twelve

operations are 50km or less from a shipping point or refinery, three are 51-100km, one operation reported a transport distance of 2-120km, three are 100-200km and four further than 200km.

The average energy required to extract and transport ore from mines is 102 MJ per dry tonne of bauxite. Diesel fuel and fuel oil provide the bulk of the energy used. Operators have adopted a number of strategies to use energy more efficiently and to reduce emissions, both of which are key factors in the improvement of environmental performance.

Biogeography

Fifty nine percent of all bauxite is mined in tropical regions and almost 39% in regions with a Mediterranean-type climate. Fifteen operations, which mine 69% of the bauxite, monitor environmental conditions so that seasonal and climatic changes can be determined.

Nineteen operations, representing more than 95% of the mean amount of land cleared for mining in the last five years, report details of the vegetation cover before mining. An additional three operations state that the land was essentially barren prior to mining. Various types of forest covered 66% of the land, averaged over the operations. This is a slightly lower figure than the 61% reported in 1998. Assuming that the proportions of various pre-mining vegetation types reported are applicable to these recently cleared areas, then 89% of the total recently cleared land was forested before mining commenced, 12% of which was tropical rainforest, and 8% was used for some form of agriculture.

General Rehabilitation

A sustainable mining operation maintains the natural capital of the area in which it operates and rehabilitation of disturbed areas is an essential element of this process. Successful rehabilitation ensures that bauxite mining is a temporary land-use that does not compromise other long-term uses.

Integrating rehabilitation with mining reduces its environmental impact in a cost-effective manner. Eighteen operations, producing 84% of the reported bauxite, conduct rehabilitation programs that are integrated with their mining activities. Integration is implemented in a number of ways at different operations by:

- Factoring rehabilitation into mine plans;
- Making rehabilitation the responsibility of production staff and including rehabilitation targets in their performance appraisals;
- Linking rehabilitation contracts to mining contracts;
- Government regulation.

All operations have clearly defined rehabilitation objectives including:

- Restoring pre-mining ecosystems with their ecological and other values intact;
- Establishing self-sustaining ecosystems of native plant and animal species;
- Restoring original land-uses;
- Rehabilitating to new land-uses to benefit local communities.

Considerable financial resources are committed to the rehabilitation of bauxite mines. The mean cost is US\$ 11,966 per

hectare rehabilitated and the median US\$ 5,900 per hectare rehabilitated. The mean amount per tonne of bauxite extracted is US\$ 0.11.

Twenty-one operations, which mine 97% of the total reported bauxite, have formal, written rehabilitation procedures compared with operations mining 88% of the reported bauxite in 1998 and 82% in 1991. Nineteen respondents, responsible for mining 95% of the total reported bauxite, have made financial provision for rehabilitating all disturbed land and for the final decommissioning and closure of mines and infrastructure.

The first rehabilitation undertaken by any of the respondents was in 1965. The most recent operation to initiate rehabilitation, in 1999, was a mine established in 1997. A total of 28,245 hectares have been rehabilitated to date at 22 operations.

The largest operation reported rehabilitating more than 600 hectares of land per annum for the five years 1998-2002. The average area rehabilitated at the reporting operations is 73 hectares but this figure is dominated by the three operations that rehabilitated more than 200 hectares per year. The median area rehabilitated is 12 hectares per year. There is an agreed end land-use for rehabilitated areas at 16 operations (82% of bauxite production). These agreements have been made with traditional owners; landowners; federal, state and municipal government agencies and regulators; local communities and conservation NGOs.

Most areas disturbed by mining are rehabilitated to the original land-use. Almost all of the total area rehabilitated to date has been returned to forest (80% to native forest and 10% to tropical rainforest). Commercial forestry, dairy and agricultural crops are important land-uses for rehabilitated land at some operations, but are minor land-uses in terms of the total area rehabilitated by the worldwide industry.

One of the aims of Sustainable Development is the minimization of resource consumption. Vegetation from areas cleared for mining is salvaged for use by 15 operations (73% of total reported bauxite production). Products harvested from areas to be mined include saw logs, firewood for domestic and industrial use, and fence posts. Vegetation is often mulched and applied to areas undergoing rehabilitation, as well as being spread over rehabilitated areas as a seed source and as animal habitat.

Education of the mining workforce is an important way of instilling environmental awareness in employees and contractors. Seventeen operators, who between them mine 81% of the total reported bauxite, have an environmental awareness and training program for their rehabilitation workforce. Programs at most operations are not restricted to rehabilitation concerns and rehabilitation workers but include all the environmental aspects of the mining operation and are undertaken by all mine employees and contractors. They range from an introductory one-hour session on important local issues, to comprehensive and ongoing training sessions in topics such as forest hygiene, spillage and waste management and basic environmental awareness programs.

Wildlife and Flora Protection

Sixteen operations (60% of reported bauxite production) report that they do not impact on any areas within the International

Union for the Conservation of Nature (IUCN) Protected Areas Management Categories I-VI. Only two operations (1% of production) impact on any of the four highest categories. These areas are managed for wilderness protection and operate under a high degree of environmental control - both sites have ISO 14001 certification. Five other operations, which mine a substantial proportion of the total reported bauxite (39%), impact on lower categories of protected areas and this has been a significant driver for the development of environmental management best practices within the industry.

It is recognized that, in order to protect rare species and ecosystems, some areas should not be mined. Four of the above seven operations, and six other operations (53% of reported production in total), have forgone part of the bauxite resource to protect biodiversity. One respondent estimates that 33% of the bauxite reserves have been forgone; two other operations estimate that they have forgone 10% and 26% respectively.

Other measures that have been taken to protect biodiversity include:

- Establishing flora reserves on other company-owned land;
- Providing alternative cooking fuels to indigenous people to reduce the felling of trees for firewood;
- Relocating plants growing in cleared areas;
- Leaving strips or islands of native vegetation within mining areas;
- Providing financial and other aid to groups with an interest in conservation;
- Minimizing unnecessary clearance;
- Reconstructing fauna habitats using rocks and logs taken from areas being cleared for mining;
- Providing fauna nesting boxes in rehabilitated areas;
- Using native plant species for rehabilitation.

Native fauna populations are monitored at four of the largest operations (53% of production) both within the rehabilitated areas and within the unmined portion of the concession or lease.

Soil Protection and Management

Restoring pre-mining biodiversity requires that areas be protected from erosion and that the original topsoil be managed to retain its value as a seed source and growing medium. Eighteen operations (92% of reported production) report that they separate topsoil from the remaining overburden and retain it for use in rehabilitation. Topsoil is most valuable, as a source of seed, nutrients, organic matter and beneficial micro-organisms, when it is fresh, hence a median topsoil storage time of nine months or less is typical. Several operations remove topsoil from areas being cleared and replace it immediately on rehabilitation areas.

Nineteen operations, accounting for 91% of total reported bauxite production, reshape their mined land. Reshaping blends mined areas into the surrounding landscape, lowers the likelihood of erosion, by reducing slope angles and lengths, and allows natural drainage patterns to be maintained.

Despite often being located in areas with heavy seasonal rainfall, most operations rate the erosion risk at their mines as low. This is due to effective mitigation measures, which prevent soil loss during clearing, mining and stockpile storage, including:

- Building structures to retain runoff water;
- Preventing water running on to disturbed areas or soil stockpiles;
- Vegetating soil stockpiles;
- Landscaping to reduce slope lengths and angles;
- Constructing banks, channels or ditches to control water flow;
- Revegetating disturbed areas promptly.

Four operations, representing 5% of production, report having acidic soils which might restrict plant growth, although none of the surveyed mines report having soils with sodicity, salinity or chemical toxicity problems. Soil strata are replaced selectively (in layers) at seven operations (46% of production) to avoid creating surface soils with any of the above problems. Soil compaction during mining and rehabilitation is identified as the main adverse soil factor affecting the growth of plants. Fifteen operations (90% of production) rip the soil to a depth of at least one meter during rehabilitation in order to relieve any soil compaction.

Revegetation

All operations that responded to the question report using at least some native plant species for rehabilitation. Native tree and shrub species are widely used by operations that produce 74% of the reported bauxite and used to some extent by operations that produce a further 19% of the reported bauxite. The majority of operations also use native herbaceous species for rehabilitation.

Ten operations (54% of reported bauxite production) run nurseries to propagate and grow native plant species. The median number of plants grown is 32,500 per year, the mean 125,000 per year and the maximum 700,000 per year. Native species are also established on rehabilitated areas via the sowing of seed and the replacement of topsoil.

Most operations monitor the development of rehabilitation areas. Vegetation density and cover are the most widely monitored parameters. A considerable proportion of the industry carries out more time-consuming and complex studies, such as biomass and seed production. Other studies conducted by, and for, some operations have investigated forest litter build up, soil nutrient levels, soil development, nutrient cycling, soil fauna recolonization and mycorrhizal recolonization.

Environmental Impacts

Identifying the possible environmental impacts of mining and establishing procedures to mitigate these impacts is a key element of Sustainable Development.

Thirteen operations, producing 78% of the bauxite, have downstream users of runoff water. The runoff water is used for a variety of purposes, including domestic and industrial use, drinking and irrigation. Nineteen operations, accounting for 95% of the reported bauxite produced, monitor the quality of the surface water leaving their mines.

Operations have extensive procedures in place to prevent chemical contamination of the surface water leaving their mines, including:

- Storing chemicals and hydrocarbons in areas with secondary containment;

- Having documented emergency procedures in place to contain and clean up any spillages quickly;
- Having oil treatment plants for water draining from workshops, refueling areas and vehicle parking bays;
- Disposing of waste or contaminated material in secure landfills.

Thirteen sites, accounting for 66% of bauxite production, monitor groundwater quality for parameters such as dissolved and suspended solids, pH and metal content.

Employees at nine operations, mining 42% of the total reported bauxite production, consider fugitive dust to be a problem and six operations, representing 19% of total reported production, report that their neighbors consider it a problem. Dust is primarily generated during blasting, mining, transporting and crushing of bauxite. Fine dust is the most problematic, as it can cause respiratory problems, but all dusts cause some nuisance. Dust levels within the mines are monitored by seventeen operations, producing 68% of the bauxite. Eleven of these operations also monitor the dust levels outside the mine boundaries. The watering of haul roads is the principal method for the alleviation of dust and is carried out at twenty two operations, producing 99% of the total reported bauxite. Four of these operations (38% of reported production) also use chemical additives to control dust.

Noise from mining and transport is considered a problem by neighbors at five operations producing 41% of the total reported bauxite. Noise from blasting is considered a problem by neighbors at five operations (43% of reported production). Noise mitigation strategies include buffer areas; modified timing of operations; modified equipment and changes to mining methods.

Legislation and Regulations

Mines have a broad spectrum of legislation, regulations and guidelines for many aspects of their activities. State and Federal agencies are the principal environmental control bodies to which operators must report. Governments have increased their regulation of the industry in recent years. In the 1991 and 1998 surveys two operations (19% and 4% of reported production respectively) reported that there were no government regulations, licenses or bonds required for them to operate. In the latest survey only one mine, producing 2% of the total reported bauxite, reports that there are no such regulations, licenses or bonds required. However, this site does have ISO 14001 certification and extensive company standards with which it must comply.

Self-regulation is an important part of the sustainable management of the industry. Operations producing more than 90% of the total reported bauxite mined are covered by internal guidelines. Twelve sites (69% of reported production) have ISO 14001 certification. The ISO 14001 environmental standard provides a framework for continuous improvement in environmental performance through planning, operating, monitoring and auditing environmental issues. The number of operations that have gained certification is an indication of the commitment the industry has to environmental management.

An environmental license was required for the construction and commencement of fourteen of the operations (producing 77% of reported bauxite production). Nineteen of the operations (90% of reported production) require an environmental license to operate

and ten operations (29% of reported production) have had to lodge bonds or securities for rehabilitation with a regulatory authority. Eleven operations (52% of production) have rehabilitation completion certificates issued to them by an environmental or land management agency.

Economic and Social Dimensions

It is important that mining operations engage with local and indigenous communities, compensate them for any disruption and provide opportunities for everyone to benefit from mining. The aim is to ensure that the benefits generated by mining are shared throughout the community and among future generations.

The potential impact of mining on local communities is examined in detail for sixteen operations, representing 77% of the total reported production, as part of their environmental assessment. At four sites (9% total reported production), potential impacts on indigenous communities living traditional lifestyles or on scheduled castes are identified.

Local people have been displaced by eight operations, representing 50% of reported production. In two cases the displacement was temporary and in six cases permanent (20% of reported production). Relatively few people have been affected, with groups ranging in size from 10 to 1,358 individuals, and all have been compensated. Compensation was purely monetary in three cases. In three other instances the compensation included employment, in five cases it included resettlement and in four cases it included the provision of alternative land. Five of the six operations where people have been displaced permanently are in countries with an average per capita GDP of less than US\$ 3,000.

Bauxite is mined in countries with both developed and developing economies. Forty four per cent of the total reported bauxite is mined at four operations in countries with high per capita GDP (greater than US\$ 20,000). One quarter is mined by nine operations in countries with a per capita GDP less than US\$ 1,000. Bauxite mining makes a significant contribution to the national economies of a number of these countries and is a cornerstone of development in many regions. In addition to paying taxes, providing employment opportunities and supporting local businesses and contractors, many operations have extensive social programs that benefit and help the community become more sustainable in the long-term. Operations with a company-developed town are particularly active supporters of social programs, building vital infrastructure for current and future generations, providing training opportunities and developing socio-cultural networks that link communities together. All respondents report having programs that help local communities including:

- Medical care;
- Provision of safe water supplies, managed wastewater systems and solid waste facilities;
- Infrastructure development;
- Cultural development and the arts;
- Crisis counseling (drugs, alcohol, etc.);
- Schools, scholarships, apprenticeship programs and youth support programs;
- Parks and recreational programs;
- Vaccination and mosquito management plans to protect employees and local people from malaria and other diseases.

For operations with a company developed town the mean expenditure on community programs is US\$ 904,341 and for those without US\$ 129,534. The maximum amount spent annually on community programs is US\$ 3,900,000 by an operation that manages a company town with a population of 6,500. The amounts spent on community projects are substantially greater than the mean of US\$ 75,543 and maximum of US\$ 1,200,000 reported in the 1998 survey.

Local communities need to be engaged when decisions about natural resource management that affect them are made. Consultation on bauxite mining issues is important in minimizing the negative social impacts of mining. The majority of operators hold community consultation meetings and maintain formal links with community leaders to ensure that communities are informed about and have input to significant decisions. Nineteen operations, representing 86% of total reported bauxite production, have formal procedures in place to deal with complaints about the operations from neighboring communities. Most sites reported that 10 or fewer formal complaints are addressed per year.

A number of the operators acknowledge the special relationship between indigenous people and the land by using traditional ecological knowledge extensively in their environmental programs through biodiversity assessments, rehabilitation planning and operations and seed collection.

Human Resources

To carry out world-class rehabilitation requires a workforce with environmental expertise. Seventeen operations employ or contract specialist rehabilitation staff (80% reported bauxite production), mostly agricultural scientists, foresters, botanist and horticulturalists. Four other operations reported that they employ, on at least a part-time basis, consultants or staff with relevant secondary or tertiary qualifications.

Continuous improvement in environmental management requires personnel to keep abreast of developments in the field. Industry seminars and industry publications are ranked as the preferred medium by which specialist environmental staff are able to increase their knowledge of environmental best practice. Scientific papers and conferences are also ranked highly. Several respondents comment that visits to other mining operations and internal company sources such as a company intranet are valuable resources for environmental staff.

Mine Rehabilitation Promotional Activities

Miners need to be open and transparent in their dealings with stakeholders and the public if their environmental management efforts are to be recognized. Bauxite miners are keen to inform the public about their operations. Videotapes or handouts showing specific information about mine rehabilitation are distributed to the public by ten operations. Seventeen operations provide tours of their facilities to the public. In addition many operations hold open days for local landowners and give educational tours and presentations to school and community groups.

Many operations have developed environmental management techniques and practices that have been adopted throughout the

mining industry. Ten operations (47% of production) report that various best practice environmental management activities at their mines have been formally recognized as outstanding or innovative either by management or by outside agencies

Research and Development

Nineteen operations, representing 94% of total reported bauxite production, report undertaking or supporting environmental research compared with sixteen in 1998. On average six full-time equivalent staff are involved in this research. The two operations most involved in research have sixteen and twenty two full-time equivalent research staff respectively. The mean annual research and development budget total environmental and rehabilitation programs is US\$ 207,430 and the maximum is US\$ 1,100,000.

Key focus areas for research are:

- Increasing plant species diversity on rehabilitated areas;
- Making rehabilitation more attractive for wildlife;
- Improving soil handling and ripping strategies;
- Vegetation succession and resilience to disturbance on rehabilitated areas;
- Soil development on rehabilitated areas;
- Nutrient cycling; recolonization of soil fauna and mycorrhiza;
- Finding appropriate indicators of rehabilitation success and sustainability.

A number of operations have published the results of their research in peer-reviewed journals. In addition various environmental publications have been produced for a more general readership.

Conclusions

The results of the 'Third Bauxite Mine Rehabilitation Survey' demonstrate that bauxite miners are making substantial efforts towards a sustainable industry. While the total annual area mined by reporting operations has grown by 25% since 1998, the area rehabilitated per year has increased by 33%. Operations, representing 97% of the total reported bauxite, have formal, written rehabilitation procedures compared with operations mining 88% of the reported bauxite in 1998 and 82% in 1991. Bauxite mining operations are continually striving to improve their environmental performance through formal frameworks such as ISO 14001 certification, by employing specialist staff and by supporting environmental research and development projects. Operations are retaining, and in many areas improving, the natural capital of the areas in which they mine, through the identification of possible environmental impacts and by taking appropriate actions to monitor and minimize these. For instance, nineteen operations, representing 95% of reported bauxite production, monitor the quality of surface water leaving the mines, compared to 85% in 1998. Typically the minimization of environmental impacts is achieved by setting environmental standards, often reinforced by legislation, and by developing environmental planning, training, management, monitoring and rehabilitation processes that enable standards to be met. The success of various operations in developing innovative environmental management and rehabilitation techniques is evinced by the number of awards these environmental programs have amassed.

Bauxite miners are engaging with local communities and are ensuring that the benefits of mining are shared with present and future generations. Good environmental management and rehabilitation, which ensure that a range of potential land-use options are made possible, is one way in which the industry is meeting its responsibility to the wider, global community. Other ways in which the industry supports the maintenance and development of local communities are by:

- Providing well-paid employment under conditions that comply with accepted labor standards;
- Providing training opportunities;
- Supporting local businesses;
- Supporting community initiatives;
- Supporting various social programs;
- Building infrastructure that will benefit the communities into the future;
- Providing compensation for those people who are disadvantaged or displaced by mining.

The amounts that the industry spends on community projects annually are substantially more than those reported in the 1998 survey. Formal links between the community and the miners are a feature of most operations. These links empower communities by providing a forum through which they can have input to, and be kept informed of, significant decisions that may affect them. Most operations also have formal procedures through which community complaints can be addressed.

Industry groups will continue to promote the principle that all operators should adopt the existing best environmental practices of the industry. Through the report based on the results of this survey, and other industry wide activities, all operators will continue to be encouraged to make further improvements in their environmental management and rehabilitation procedures and to continue to ensure that the benefits of mining are shared with existing and future populations in the communities in which they operate. Future surveys will show how successful industry groups have been at promoting the concepts of Sustainable Development and continuous improvement throughout the industry.

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