ENVIRONMENTAL POLICY IN MINING

Corporate Strategy and Planning for Closure

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17 Current Regulatory Approaches to Mine Closure in the United States

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17.1 FRAMEWORK FOR THIS CHAPTER

17.1.1 Introduction

Nearly two centuries of intensive, widespread mining in the U.S. have produced enormous wealth, but have also left a legacy of externalised environmental costs and damage to the productive capacity of the environment. In response, the U.S. has developed a complex body of laws and regulations directed at control and management of these impacts.

This complex body of laws includes provisions directed at the impacts of prospecting and exploration, construction, operation, and closure of mines. This chapter focuses on the last of these topics, the legal regime for mine closure. Of course, the requirements that apply to other phases of the mining project have a very significant influence on the conditions of closure. The laws directed specifically to this subject are in the U.S. generally termed mine reclamation laws.

Serious attention to the environmental effects of mining has come in waves, resulting from specific incidents or problems which have concentrated public attention: a long series of slope failures and floods in the eastern coal mining regions, culminating in the Buffalo Creek disaster; the Douglas Smelter emissions; the tailings dam failure at Church Rock; discovery of the hazards of low levels of radioactive emissions from uranium mill tailings which had been used widely as construction material; and most recently, the bankruptcy of Colorado's Summitville mine. A recent example is the attention being received by environmental conditions in Butte, Montana (see Dobb).[1] Each of these highly publicised events catalysed the enactment of major changes in the body of regulatory law affecting the industry — but these sporadic intense bursts of public interest in environmental problems have not always translated into the steady vigilance needed for effective long-term management of environmental problems.

There are few better examples of the need for maintaining a consistent long-term approach to environmental aspects of a mining project than effective management of mine closure. By necessity, mine closure planning is not something that can be done at one point in time and put on a shelf. It is an ongoing, dynamic process which may span many decades, during which many variables

will certainly change, including the political context, legal systems, and the nature of industry-specific legal controls. If there is one key lesson from this experience, it is that failure to establish a plan at the level of conceptual engineering before project operations begin makes the process more expensive, less effective in managing post-closure environmental impacts, and more likely to generate conflicts. At the same time, new information will always be generated during operations, including all kinds of data about the mine site, the characteristics of mine wastes, and the functioning of the ecosystem in which the mine exists. The system must be flexible enough to incorporate this information into the planning process.

As will be explained below, mine closure for hard rock mines is dealt with at the state level in the American federal system. There is a great deal of variation in the state experience. Some states have had programmes for well over two decades, with very experienced staff, a reasonable level of resources, and significant practical experience with the nuances of mine closure planning; other states have only adopted programmes recently and have yet to fully institutionalise their systems.

17.1.2 Closure Programme Concepts

The fact that there are so many different systems of mine closure in the U.S. obscures the extent to which these many systems have gravitated toward some basic concepts. All, or virtually all, of the existing systems share these elements in common.

17.1.2.1 Requirement of a plan

New mining operations will not be authorised unless they first submit a plan showing, at the level of conceptual engineering, what the site will look like when mining is completed, predicting the likely impacts of the mine in that configuration, and proposing specific mitigation measures to deal with those impacts. In general, operations existing at the time the law became effective are required to submit plans, but have been given some period of time to comply.

17.1.2.2 Evolving technical standards

Each agency has evolved technical standards for plans based on its experience and the particular conditions of climate, geography, and mining operations in the area. These standards are almost necessarily somewhat general, because of the enormous differences among mining operations, but do serve to give mine planners some general objectives for their efforts; to help sort out approaches that have worked from those which have not; and to ensure some limits on administrative discretion.

17.1.2.3 Plan approval

The plan is not approved until after a technical review to verify its compliance with legal standards and technical requirements. There is almost always public participation, consisting of notice, an opportunity to review the plan and submit comments, and frequently a public hearing. In general, however, this is not an opportunity for the public to challenge basic decisions about land use, or the appropriateness of mining at this site. The issues are limited to the question of whether the closure plan complies with requirements and will be effective in achieving the post-mining condition called for in the plan.

17.1.2.4 Plan modification

Mining is a dynamic process. Most laws recognise that changes will inevitably occur in the mining operation and provide for easy flexible amendment of the closure permit. A company with a good internal environmental management system will, as part of its normal procedures, evaluate any

proposed change in operation to understand what its impact will be on the closure plan, and change its closure plan if necessary.

17.1.2.5 Bonding

In order to ensure that funds will be available to implement the plan, and to encourage ongoing reclamation efforts during the operational phase, almost all systems require the operator to submit some form of financial guarantee of the implementation of the closure plan. This is not a guarantee of any and all obligations that the company may incur, but simply an assurance of compliance with the defined plan. Existence of the guarantee system requires that the plan itself be sufficiently detailed to allow for engineering cost calculations to be done. In most cases, the guarantee is adjusted periodically to reflect the amount of work remaining to be accomplished.

17.1.2.6 Monitoring, reporting, inspection, and enforcement

As a mining project evolves, changes may affect the practicability and adequacy of the closure plan. Unanticipated problems may occur; problems that were anticipated may not arise. This may affect the adequacy of the guarantee. All of this requires regulators to remain aware of conditions at the site.

When the company believes it has completed the reclamation in accordance with the plan, the regulatory body must inform itself adequately to ensure that it agrees that the plan has been complied with, so that the guarantee will terminate and the company is freed of further obligations at the site.

The principal means for achieving these goals is reporting by the mine operator. Most systems require a report on the status of the mining operation to be submitted annually, or at some other specified interval. A further report is submitted when the company believes it has complied with the plan and is entitled to have its guarantee terminated. But these reports are supplemented by periodic inspections of the mine site by government personnel, designed to review the state of the operation and any factors that may affect the adequacy of the plan or the guarantee.

These elements are hardly unique to the U.S. They exist also, for example, in South Africa,[2] the major mining provinces of Canada,[3] Australia,[4] and other countries. While most developing countries have not at this point established all of the elements typically found in U.S. mine closure legislation, more complete regulatory schemes are clearly emerging.[5]

17.1.3 Results and Challenges

In most respects, the U.S. experience with legally required closure planning has been very positive. Often, significant environmental benefits have been achieved at little or no cost, simply because proper advance planning results in pollution prevention. For example, it may cost nothing to place tailings outside a stream bed, not to dump used crankcase oil on the ground, or to achieve an acceptable slope on a waste dump *if these steps are planned from the beginning.*

By contrast, moving the tailings out of the river, cleaning up petroleum-contaminated soil, or recontouring an established waste dump can be enormously expensive if no attention is paid to these issues until the mine closes. Further, mines almost always close when they are losing money and their operators are strapped for funds and facing a variety of other challenges. This is a poor time to be doing closure planning, and almost a guarantee that it will not be done well. And no one has ever been very good at predicting when closures will occur. One vivid example is the Exxon Colony oil shale project, in which the company invested over $2 billion. The mine and processing plant were largely constructed, but closed *before* they every reached commercial production.

There is not generally in the U.S. an explicit requirement that the closure plan result in conditions that will meet general environmental quality standards. There are several reasons for this.

First, limits for discharges of pollutants to water, air, and soil are generally set at the national level, while mine closure planning is a requirement of state law. Further, though the state may well

have responsibility for enforcing these environmental quality or emission standards, this is usually not a function of the mine closure agency.

Second, it is often quite difficult to predict precisely the levels of emissions from a given site ten, twenty, or more years into the future. For example, while general sediment loadings may be easier to predict, the future existence and level of acid mine drainage at a site are notoriously hard to predict.

Third, industry, government, and civil society have been slow to confront the extremely difficult policy choices in those situations in which it appears that no realistic plan can result in a "walk-away" closure of the mine site. In a true "walk-away," the potential future existence of environmental problems of significance on the site is so improbable it can essentially be disregarded.

The concept on which much of the existing closure legislation was built was that with proper advance planning, mine sites can, within a relatively short time after operations end, be brought to a condition which meets all closure objectives *and* which provides reasonable assurance of long term, maintenance-free compliance with air, water, and soil quality norms. Where this goal can be reached — and it often can — neither the company nor society at large need continue to expend resources on the site. The company can, in this ideal world, disregard the possibility of future liability for environmental conditions on-site, turn out the lights, and "walk away."

But not all mine sites have been found able to achieve this ideal objective. Those mines that have not been able to meet this objective fall into several categories.

17.1.3.1 Monitoring required

In a relatively large number of cases, there is sufficient uncertainty about conditions on-site such as water discharges, slope stability, or other parameters, that some period of monitoring is necessary to ensure that closure criteria have been met. In cases where noncompliance would present serious hazards, this period of monitoring may need to be quite lengthy, and can involve significant cost.

17.1.3.2 Passive care

In a smaller but still significant number of cases, some measures are needed to maintain acceptable conditions on-site, either because failure to take these measures would result in noncompliance with air, water, or solid waste rules, or because other closure objectives would not be met. A very common example is that valley fills of tailings or waste rock may create pollution or stability hazards if watercourses are allowed to flow directly into them. Generally, drains, tunnels, or ditches have been constructed to divert watercourses around these workings. But these drains, tunnels, or ditches will naturally tend to fill with fallen rock, sediment, or other debris over time. Where the clogging of these diversions will lead to unacceptable problems or hazards, they must be periodically maintained.

What characterises these measures as "passive" is that they are not continuous operations. On a day-to-day basis, the system functions without human intervention. However, someone (either the mining company, or someone else) must *monitor* to ensure that unacceptable conditions do not arise, and *maintain* the system to ensure its continued functioning.

17.1.3.3 Active care

In a yet smaller group of projects, passive care and monitoring cannot produce results that meet closure objectives and ensure compliance with environmental quality norms. "Active" measures, such as continuous operation of a water treatment facility, are needed to meet these goals. Obviously, this can imply very significant levels of expense.

It also raises the questions of how long such measures will need to be applied, and who will apply them. While every operator who finds a need for active measures hopes to be able to progress promptly from active measures to passive care to monitoring only to "walk away," the fact is that

there are some cases in which this is not possible, and in which very lengthy periods of active care, and high expense levels, will be necessary.

This raises a number of difficult issues. First, an ongoing obligation for active care has a bad effect on the balance sheet of the mining company. Decades of future operation of a water treatment plant at a non-operating mine property can hardly be looked on as other than a negative from the company's perspective.

Second, since mining is a highly competitive business in which the losers do not prosper, and prices are notoriously unstable, the state is faced with the question of whether or how to ensure that the resources continue to be available for active care at the mine site for as long as may be necessary.

And this leads to the most politically charged question of all: whether, if we can identify a particular project as posing an extremely high risk of a perpetual active care requirement, that whole cost must be internalised: somehow guaranteed "up front," or — in the views of some — the deposit simply not be mined.

These are the questions of the future for mine closure programmes in the U.S. and are dealt with in more detail in Section 17.6 below. While individual states have come up with reasonable solutions at some sites, satisfactory solutions of general application are yet to emerge.

The U.S. experience has been that closures tend to come in waves, in response to economic or political conditions. Thousands of silver mines closed in 1893–94, large numbers of uranium mines closed in the 1960s and then again in the 1980s with little or no warning, and these experiences have been repeated with virtually every mined commodity: gold, molybdenum, and copper, to name a few. This implies that the regulatory body, too, is likely to be stressed at the time closure occurs, suddenly having to cope with large numbers of virtually simultaneous unanticipated closures.

In dealing with the relatively conventional problems such as geotechnical stability, erosion control, revegetation, dust control, and control of hazards to public safety, closure planning has been very successful. But in the case of the relatively small but important number of mines with long-term care problems, most U.S. laws have not yet developed clear or consistent principles.

17.1.4 Mine Closure Systems in the U.S.

17.1.4.1 Coal mine reclamation

While the principal subject this chapter will explore is the system of closure requirements for metal or "hard rock" mines, the U.S. mine reclamation system has its origins in the experience of the Eastern coal fields, and the development and dissemination of ideas about closure necessarily starts with some description of that difficult history.

Coal mine reclamation, for historical reasons, is subject to a national system of regulation, based on national performance standards developed by the Office of Surface Mining, an agency of the U.S. Department of the Interior.[6] While states may apply for, and often receive, authority to administer the programme within their own borders, if they choose to operate the programme they must do so in compliance with these extremely detailed national standards, and under close national supervision. There is in U.S. environmental law no better example of "command and control" regulation than reclamation requirements under the Surface Mining Control and Reclamation Act (SMCRA) of 1977. The national regulations provide hundreds of pages of detailed requirements for construction, maintenance, and reclamation of each specific feature of the mine site.[7] While state programmes can apply more stringent standards than the federal rules, they cannot be less stringent. And whether proposed state standards are or are not equally or more stringent is decided, at least in the first instance, by the national agency, which has had a very low tolerance for differing approaches. After several attempts to promulgate rules that contained a limited number of differences from the federal rules had been rejected by the national Office of Surface Mining (OSM), the State of Colorado suggested rules *identical* to the federal rules. It was advised by OSM that

these were unacceptable, because the state's proposed explanatory preamble differed from the federal preamble, and therefore might lead readers to interpret the rules differently, despite the fact that they were identical.

The national agency not only approves all aspects of a state programme, including staffing levels, but also approves any changes in the state programme, and has an ongoing role in monitoring the way the state programme operates. Federal rules prescribe minimum frequency of inspections; federal inspectors appear unannounced to accompany state inspectors on some inspections; and they review state inspection reports to determine whether they meet standards. The national authority can revoke a state's authority if the state fails to meet standards on an ongoing basis.

The public is a watchdog over both state and federal inspectors. Members of the public who have made complaints are allowed to accompany inspectors during inspections. Detailed written records of all inspections must be kept and are available to the public. Complainants and mining companies both may avail themselves of a complex array of administrative and procedural remedies ranging from informal conferences at which all may be present to appeals of most types of decisions, usually to more than one administrative level. Individual discretion is very tightly controlled. There is little room for an inspector to "overlook" a violation of the rules based on an operator's informal promise to remedy the problem promptly; and there are prescribed schedules of monetary penalties for almost every conceivable violation.

It is important to note that, despite the current trend away from "command and control" regulation, this system exists only because the industry failed to take advantage of the many opportunities it had to live under more flexible regulatory regimes. And the system has had some incontrovertible successes. The past environmental legacy of the coal industry, particularly in the eastern coal states, is regarded as unacceptable by contemporary community standards. Current practice, particularly at some of the large western coal surface mines, is generally if not always good. There are many examples of excellent reclamation practices in coal mining: the Trapper and ColoWyo Mining Company operations in northwestern Colorado are two fine examples. Much of the credit for this improvement is due to the people who created and who operate the current regulatory system. Also, the U.S. has remained at or near the top of world coal production and industry productivity while this has been done. The effect of all these rules has been, *inter alia*, to force most operators to hire competent trained personnel who really understand reclamation. Getting these professionals inside the tent at mining companies has had benefits far beyond just regulatory compliance.

17.1.4.2 Non-coal mining

Closure planning outside the coal industry has been influenced by the experience with coal, though more by way of reaction than emulation. The approaches are quite dissimilar. Mine closure or reclamation programmes for non-coal minerals exist at the state level, and each state is free to make its own choices, or even to have no programme at all. The standards imposed by the national land management agencies, the Forest Service, and the Bureau of Land Management, for operations on the nearly one third of the national territory of the U.S. which they control are important, but hardly amount to systems of mine closure. The standards of these land management agencies "today serve as a floor" basically in cases where state requirements are inapplicable or not well enforced.[8] Some states, at the time of the major wave of U.S. environmental legislation in the 1970s, adopted reclamation laws. Others chose not to. This of course did not mean that no environmental standards applied to mining. Air quality, water quality, and solid waste laws profoundly affected the way mining was conducted during the operational phase, which has enormous implications for closure planning. A mine that operates cleanly is much less of an effort to close. What it did mean was that if there was any comprehensive, ongoing effort to plan for mine closure, it was being done at the initiative of the mining firm. Typically, the programmes adopted were based not on the kind of tight prescriptive standards that characterise the coal programme, but on very general performance

requirements, implying high levels of discretion for programme administrators. They were enacted not over the bitter opposition of the mining industry, but with the support of large segments of it, who preferred what were seen as industry-friendly programmes at the state level to a less understanding regulatory approach from Washington. Specifically, the industry has seen the type of regulation that exists in the coal industry as undesirable, and has promoted state regulation based on general performance standards as an alternative.

In recent years, there has been a push from the environmental community and others to enact national mine reclamation legislation for hard rock minerals. Passage of something like the national coal reclamation legislation for metals mining has been regarded as an industry nightmare. As national reclamation legislation in some form came closer to passage, proponents pointed to the absence of reclamation laws in some important mining states as an example of the need for a federal law. Just as this issue was heating up in Congress, the unplanned emergency closure of the Summitville Mine, with its serious environmental implications and enormous cost to government, created even more pressure on the states with no closure requirements.

As this process continued, the important mining states that still lacked reclamation laws discovered, often with some encouragement from industry, that they wanted to adopt reclamation laws. As one author noted in 1994, Colorado, New Mexico, Oregon, and Washington "dramatically revised their reclamation statutes and regulations within the last three years. As a result of the Summitville debacle, others are in the process of revising theirs."[8] Thus, while all the important mining states now have such programmes, some have adopted them only recently. For example, Arizona adopted its reclamation statute only in 1994. However, Arizona, the leading state in mineral production, did have an Aquifer Protection Permit programme relating to groundwater protection, obviously a critical issue in that desert state. This was far short of a requirement for comprehensive planning for closure.[9]

At this point, then, the nature, effect, and requirements of mine closure planning, to the extent it is a regulatory requirement, are still largely determined by state law. For a general discussion of the problems associated with closing a mine under U.S. law, see Williams.[10] These state programmes exist in the context of a very complex, highly developed system of national and state environmental legislation in air quality, water quality, and solid waste, which profoundly affect the way they are structured. Closure plans are simply one tool of environmental management. They cannot be expected to address all concerns or solve all problems. Proper development of closure plans is dependent on recognising the point at which closure planning is not the appropriate tool for a particular purpose, and turning to a more appropriate method. Systems of air, water, and soil quality norms and their related monitoring, reporting, and enforcement mechanisms are important management tools in every country with a developed system of environmental law, and form part of the setting in which the closure plan is developed. Part of the challenge is coordinating the appropriate use of these and other tools, such as environmental impact statement requirements. But any overall requirement for planning for mine closure is still a matter of state choice.

17.1.5 Focus of this Chapter

While this chapter will discuss many aspects of this complex and varied set of laws, it is not intended as a comprehensive survey of every aspect of the subject. It will treat many different state systems, but its most immediate focus will be the mine closure programme of the state of Colorado: Colorado passed its mine reclamation law in the mid-1970s and has two decades of experience with its administration. Colorado has one of the more mature state programmes. It is also a substantial programme, with over 1900 mines now holding active permits. It is also the state in which the unhappy events at Summitville, which have had such a profound effect on regulatory systems, unfolded. Colorado was one of the first states to react with new legislation and regulatory approaches to the clear inadequacies exposed by those events, and it reacted with significant reform

legislation that passed both houses of the state legislature unanimously, with the support not only of the Sierra Club, Trout Unlimited, and other environmental organisations, but also the Colorado Mining Association, the state's Rock Products Association, and other industry associations, as well as the state regulatory agencies. In contrast with the Colorado experience, the effort to develop better mine closure practice in the U.S. has been marked by much conflict, with a few exceptions.[11]

One of the authors, Mr. Danielson, was for most of the last decade, which included the *dénouement* if not the origins of the Summitville problems, a member of the Colorado Mined Land Reclamation Board, the state commission with responsibility for mine closure programmes. He was also one of the authors of the state's recent legislative and regulatory changes.

In turn, the chapter will treat questions about the basic structure of mine closure programmes (Section 17.2); the mine closure plan, its contents, review, and approval (Section 17.3); financial warranties and systems of guarantee (Section 17.4); reporting, inspection, monitoring, and enforcement (Section 17.5); current issues of concern (Section 17.6); and examples of current best practice (Section 17.7).

17.2 THE STRUCTURE OF MINE CLOSURE PROGRAMMES

17.2.1 What are the Programme's Goals?

There is hardly a question more important than definition of the programme's fundamental goals. Yet there is hardly a question with such a diversity of answers from the several states. Some of these stated goals seem to focus on the mine site itself, while others are directed not so much to the mine site as to its impacts on surrounding lands.

The stated goal of the Colorado general mining reclamation programme, and of its specific construction materials legislation, both discussed below, is to "reclaim land affected by [mining] operations so that [it] may be put to a use beneficial to the people of this state...."[12] Other goals stated in state legislation aim to prevent unnecessary and undue degradation of the environment,[13] to establish plant cover and stabilise the soil,[14] to minimise post-closing visual effects,[15] to protect public health and safety,[16] to achieve a self-sustaining ecosystem following closure,[17] or to provide that mines "no longer pose a threat to water quality."[18]

The national Surface Mining Act, applicable to coal mines, contains a long list of performance standards, which include restoration of mined land to a condition capable of supporting pre-mining uses or acceptable higher or better uses; restoration of the approximate original contour of the land (with limited exceptions); stabilisation of surface areas to control air and water pollution; minimisation of the effects of mining on the hydrologic balance and the quality and quantity of water in surface and subsurface systems; and protecting offsite areas from slides or damage.[19]

For all their variously stated goals, the general principle underlying all these laws is that the choice of the post-mining use of the land affected by mining resides with the private landowner, and is not subject to dictation by the government, except to the extent that any land is subject to local zoning, planning, or other land use regulations. The closure authority concerns itself not with the end, but with the means: whether the plan proposed provides sound technical means to reach the final use which is chosen by the operator, usually in conjunction with the underlying landowner. However, there is a limit on any principle: if the chosen land use does not provide for creation of a "self-sustaining ecosystem" or to "establish plant cover and stabilise the soil," or is not "beneficial to the people of the state," that limit is reached. A proposal to make the site a "museum of poor mining practices" would thus probably be unacceptable. This example is not as fanciful as it sounds: state efforts to remediate environmental problems at abandoned mine sites have a number of times run into stiff opposition from historic preservation advocates who have resisted reclamation programmes because they would affect dangerous historic head frames, unguarded historic mine shafts, or even historic acid drainage.

17.2.2 How Many Different Regulatory Systems are Needed?

Out of necessity, those American states which mine both coal and non-coal resources have two separate sets of requirements. If the state has decided to create its own programme, under federal oversight, to manage coal mine operation and reclamation, the coal programme will be one of innumerable specific rules, procedures, and requirements, closely monitored by national authorities for any sign of lack of diligence. One of the common critiques of the coal reclamation programme is that its highly prescriptive and detailed requirements come largely from the experience in the eastern U.S., and fail adequately to take regional variation in climate, land use, and other circumstances into account. The state's reclamation programme for non-coal resources is not subject to any national oversight, and states are free to construct their own requirements. There are thus in every such state at least two sets of regulations. It is not uncommon for states to divide regulatory responsibility further, and have more than two separate regulatory schemes.

Every state, province, or nation which has decided to develop mine closure legislation has faced the fact that the mining "industry" is in fact *several* different industries — each with its own environmental issues and closure problems. The industry is divided by the products it produces and also by the scale of operations. While the focus is often on the enormous scale of the modern mines of multinational mining companies, there are other producers of significance in the industry, and they often have different needs and capabilities.

The economics of the regulatory process are also important. Regulatory approaches that are cost-effective and appropriate when dealing with the largest segment of the industry are inefficient, expensive, and difficult at smaller scales.

Finally, its environmental issues divide the industry. These are a function of the physical surroundings in which the industry operates, the processes it employs, and the managerial and technical capacity of the mining enterprises. Few manufacturing industries locate plants below sea level, at altitudes of 4000 meters or more, in swamps, or in the centre of great deserts. Yet mines are found in all these locations.

Few types of products are produced by more than one of a handful of alternative manufacturing processes. Yet the range of technologies employed in mining is enormous.

There is no such thing as artisanal production of cars or computers. Yet the mining industry, while it includes some of the largest and most sophisticated firms in the world, also includes thousands of individual "pick and shovel" miners, even in as advanced a country as the U.S. A regulatory system that ignores the limits on the capabilities of the regulated community is headed for conflict.

Some segments of industry are seen to raise specific concerns, which may well lead to continued tightening of standards. Idaho, for example, has a specific law governing mineral recovery operations which use cyanide,[20] and another specific code for placer and dredge operations.[21] California has developed a system where requirements vary substantially depending on whether the mine wastes are classified as Type A, (hazardous), Type B (a variety of different types of wastes which could cause water quality violations), and Type C (not expected to cause adverse water quality effects other than turbidity).[22] Montana has a specific law for open pit operations, the Opencut Mining Act.[23] Many of the controls that focus on hazardous materials, or cyanide in particular, are a result of the situation at the Summitville Mine in Colorado. Environmental contamination at the Summitville Mine has led to a tightening of regulatory requirements throughout much of the U.S. Colorado itself, in the wake of the events at Summitville, adopted major revisions to its mine closure law, imposing specific requirements for a new classification of "Designated Mining Operations," which include those that have significant onsite chemical processing, or high acid drainage potential (see Proceedings of the Summitville Forum '95, Colorado Department of Natural Resources, 1995, for further information on the Summitville incident).

Other portions of the industry have resisted a tightening of their own rules, in the wake of Summitville. The Colorado construction materials industry, for example, successfully argued that

it should not be burdened with the tougher post-Summitville requirements, and secured passage of its own separate closure law, the "Colorado Land Reclamation Act for the Extraction of Construction Materials."[24] Previously, all mining other than coal mining had been subject to the same law.

The result of all this diversity in the industry has typically been that states develop more than one type of permit system. The distinctions among the different types of permits are typically based on (a) differences in the technologies employed; (b) differences in the environmental sensitivity of the area where the mine is to be developed; (c) differences in the scale of operations, or some combination of these factors.

Colorado thus has, in addition to a Coal Mine Reclamation Act,[25] the previously referenced Colorado Land Reclamation Act for the Extraction of Construction Materials, which applies to sand, gravel, stone, borrow material and other construction materials, and a Colorado Mined Land Reclamation Act,[26] which applies to all other forms of mining, including metal, or "hard rock" mining. There are three levels of permits for construction materials for large, small, and very small operations, and a special category that applies to mines developed for construction materials for government highway projects. Colorado's metal mining reclamation law recognises, in essence, five types of permits, which are distinguished both by their size and by the environmental risks, e.g., use of acid or other toxic chemicals onsite, or potential for generation of acid or toxic materials.[27] Montana has the above-noted "small miner exclusion" to its Metal Mine Reclamation Act. However, the small miner is not exempt from having to reclaim to general statutory standards, simply from having to obtain a specific permit. The small miner files a statement annually, verifying continued observance of the limits of the small miner limitation. This is simply another example demonstrating that approval of closure plans by a regulatory agency is simply one tool of environmental management. It cannot be expected to address all concerns or solve all problems: promulgation of general performance standards, without requiring submission or approval of a specific plan, is an alternative option seen in many environmental programmes. There is in Montana yet another category, or an exemption to the exemption: if the small miner uses or stores cyanide, a special cyanide permit must be obtained.[9]

Montana also has a separate Opencut Mining Act,[28] and specific permits for cyanide use. Idaho has its ordinary permit system plus special permits for placer/dredge operations and for cyanide operations; in Nevada, "abbreviated permit application requirements apply to small scale, pilot, testing, placer, or other facilities that rely solely on physical separation methods to process ore."[29]

Arizona still has a unitary system, with only one kind of permit. However, this may simply be a reflection of the fact that Arizona was the last of the major mining states to adopt mine closure planning, and the forces which have pushed other states in the direction of diversification may not yet have had time to exert themselves. Arizona, which had resisted such a system for years, almost certainly acted as a result of a threat that national level legislation would be imposed, and the fact that advocates of that legislation were pointing to Arizona's lack of such legislation as an argument for its passage.[30] While the proponents of reform of the national mining law have not yet achieved that goal, they deserve a great deal of credit for motivating states to significant improvements in their programmes.

Arizona's system for implementation of its law is still in development. The law applies to surface disturbances of five acres (about two hectares) or greater, and only to metal mining. Under the state's new Mined Land Reclamation Act, all new metal mining operations, whether in the exploration phase or the production phase and which meet the size requirement, are required to obtain approval of reclamation plans and financial assurances.[31]

A final reason for the variety of permit sizes and types relates to the fees that government charges for the various steps in the process: application fees, permit review fees, annual fees, and the like. States have discovered that the costs of application, review, inspections, and other oversight activities are much higher for certain kinds of permits than for others. Distinguishing among different categories of operations allows government to allocate the costs of its activities among the regulated enterprises in a more economically efficient manner.

17.2.3 What are the Proper Limits of the Mine Closure Programme? What is "Mining?"

There are important and complicated issues regarding the limits of the activities that should be included in mine closure planning. These issues arise from differences of scale among mining operations (the *de minimis* concern), and from the differences in types of mining activities.

17.2.3.1 Lower limits of regulation

At very low scales of effort, there are serious questions about whether closure planning is the appropriate tool to deal with perceived environmental problems. Regulatory programmes face these questions constantly: are weekend gold panners "operators" who need to have reclamation plans? What would their closure plans consist of? Although, as in the case of mercury contamination of streambeds and aquatic biota by artisanal placer miners, there may be serious environmental issues that need to be addressed, mine closure requirements may not be the appropriate tool. Closure plans are simply one tool of environmental management. They cannot be expected to address all concerns or solve all problems. Proper use of closure plans is dependent on recognising the point at which they are not the appropriate tool for a particular purpose, and turning to a more appropriate tool, such as exempting small operations so long as they are not using dangerous substances (e.g., mercury and cyanide), or requiring attendance at educational programmes as a requirement for engaging in the activity.

Many American mine closure systems have some lower limit on the scale of the activities to which they apply. As indicated above, Arizona requires an operating permit only for surface disturbances of more than five contiguous acres (about 4.5 hectares).[32] Nevada employs a very similar exemption from reclamation requirement for small-acreage operations.[33] In California, a Surface Mining and Reclamation Act permit is not required if the disturbed area is one acre (about 0.4 hectare) or less and if the amount of overburden is less than 1000 cubic yards.[34] Montana allows a mining operation to operate without an operating permit if the operator will not remove material in excess of 36,500 tons in any calendar year, and if the operation is one site that disturbs and leaves unreclaimed less than five acres (or two sites disturbing and leaving unreclaimed less than five acres, approximately 2.25 hectares, so long as certain restrictions apply).[35] Wyoming imposes reduced requirements on operations that mine less than 10,000 cubic yards and affect less than ten acres (approximately 4.5 hectares) per year.[36]

17.2.3.2 What is mining?

There clearly are some circumstances in which, while closure plans may be useful, they are not *mine* closure plans. Closure plans exist for many kinds of facilities other than mines: landfills, electrical power stations, nuclear waste disposal sites, and chemical plants, to name just a few. In our view, key indicators that closure plans are likely to be effective tools of environmental management in a given circumstance are (1) that environmental costs are externalised not just in space but in time; i.e., that a significant portion of the uninternalised social cost will occur after the revenue-generating activities have ended; (2) a potential for very significant environmental effects; (3) reasons to believe that those effects would be very expensive or impossible to reverse once experienced; and (4) actors with the technical capacity to apply the concept effectively. Clearly, mining is not the only human activity that disturbs large areas of the earth. It is not as easy as it might seem to distinguish between "mining" and other activities such as reservoir construction, road projects, agricultural improvements, sanitary landfills, and even urban developments, because these activities often involve selling sand, gravel, or borrow material (or even alluvial gold contained in these materials) and because these are frequently claimed by opponents to be subterfuges to avoid mine closure requirements. Colorado has had some interesting examples of road projects

which do not seem to go anywhere except into the centre of aggregate deposits, or reservoirs that are being constructed on a time scale of decades, by people who own no water with which to fill them, right in the centre of valuable mineral deposits — the products of which are being sold in the process.

And the questions only proliferate. Is peat, as an organic material, a "mineral" subject to the Act? Does it really matter in an environmental management sense if "extracting" it is doing long-term environmental damage, and closure planning is a good way of dealing with it? If leveling of land for a building site produces excess material that is sold, is this a "mine"? Is hand collection of decorative stone from fields, without use of tools, a "mining operation"?

The Colorado mine closure agency, the Division of Minerals and Geology of the Colorado Department of Natural Resources, has spent a remarkable amount of time on such issues over the years. In the author's view, the issue should not be legalistic haggling over the definition of "mine" or "mineral," but the more functional questions of (a) identifying the circumstances in which mine closure programmes are effective management tools, the circumstances in which they are not, and (b) the alternative tools most appropriate to employ when there *are environmental impacts*, but closure plans are not the best way to deal with them. The definitions of the terms "mine" and "mineral" need to be shaped based on this judgment, rather than the scope of the programme being shaped by fine legal arguments over the definitions. This comment applies equally to the other common issue of this type: "custom" milling operations. Under most, if not all, U.S. systems, the closure requirement applies to milling and processing operations conducted at a mine site by the mining company. But closure requirements may not apply to an independent milling operation, which may be under different ownership, remote from the mine site, and may accept ore from a number of different mining operations. Here, the logic would seem to favor imposing closure requirements, since the character of the environmental effects is hardly different because of accidents of ownership.

17.2.3.3 When does the mine closure obligation begin?

Mining is a process that begins with a generalised search for minerals, and continues with more specific investigation of a particular occurrence, definition of reserves, bulk sampling, and production. Defining the point at which the legal obligation to submit a mine closure plan attaches is not as easy as it might seem.

Many states have specific reclamation requirements for exploration sites.[37] These requirements generally do not apply to prospecting methods such as aerial magnetic surveys that do not disturb the land surface, or to the odd geologist chipping a sample off a rock outcrop. They apply to "significant" surface disturbances.

There are of course restrictions which landowners, private or governmental, may impose on activities involving entry on their lands. The obligation of the operator who holds a mining lease to the landowner, or of the owner of the mineral right to the owner of the surface right, while important parts of the closure equation, are outside the scope of this chapter.

But recognising that exploration may have impacts of a type which closure plans can helpfully address, most states do require some sort of closure plans for prospecting activities which exceed certain thresholds of disturbance. This may be through either individual permit requirements, or generally applicable statutory prescriptions.

17.2.4 Treatment of Existing or Abandoned Facilities

Some provision needs to be made for mines in operation at the time a mine closure system goes into effect, to take into account past choices; the operator's investment in those choices; and the economic consequences of trying to change them *post facto*. Standard international practice in environmental management now recognises a hierarchy of steps required for good project planning.

1. Environmental impacts must be clearly identified, ranked in importance, and evaluated for positive and negative aspects. This ranking usually recognises criteria of intensity of the impact, probability of occurrence, reversibility, and anticipated duration.
2. All reasonable steps are taken to avoid negative impacts entirely, by, for example, changes in project design.
3. Negative impacts that cannot reasonably be avoided must be minimised, in a systematic and rigorous analysis.
4. If negative impacts of significance still exist after the process of minimisation, they need to be mitigated, preferably by physical measures; and to the extent these are not available, by management or institutional measures.
5. Negative impacts remaining after this process must be compensated for; there is a hierarchy of the types of desirable compensation measures.
6. Positive project impacts should be enhanced, where possible, also through a rigorous system of analysis.

The decisions as to what is "reasonable" to accomplish at each step are heavily influenced by economic considerations. When a mine is in operation, some decisions have already been made. If 100 million tons of tailings exist in a particular location, that has to influence the analysis rather heavily. Thus, closure planning for a mine in operation tends to focus more on minimisation, mitigation, and compensation and less on avoidance.

The alternatives available are obviously much greater when the analysis is applied to a mine not yet underway than to a mine with five, ten, or thirty years of operations behind it. Alternatives are reduced even further in the case of abandoned mine workings, which may have continuing impacts on the environment. Deciding how, whether, and to what extent these belong inside a mine closure programme depends on a series of judgments, based on factors such as:

1. Whether it seems economically inefficient, and environmentally shortsighted, to spend available resources imposing a very high degree of control on impacts from existing operations when the same level of resources would give much greater environmental returns if devoted to improvement of conditions at abandoned sites.
2. The fact that failure to address closure issues at abandoned sites may sometimes mean that enforcing expensive regulations at existing or new sites creates little environmental value. If the river is contaminated by effluent from abandoned mines to a level at which aquatic organisms cannot exist, or at which downstream communities are going to pay excessive water treatment costs regardless of the level of control at new mines, imposing controls on new mines hardly makes sense, *unless there is some commitment to addressing closure issues at abandoned mines.*
3. Recognition of the fact that there are an infinite variety of circumstances in which mines have been abandoned. At one extreme are very old mines which were abandoned a century or more ago, which complied with whatever legal requirements (if any) were effective at the time, and whose owners, if natural persons, have long since gone to their reward. At the other end of the spectrum are mines recently abandoned, which *did not* comply with regulations in effect at the time of their closure, and whose former owners, or stockholders, are walking the streets of Sydney, or Vancouver, or San Francisco with pockets full of money. At the former end of the scale, it seems that implementation of closure systems at abandoned sites is clearly a social cost to be borne by the state. At the latter end, this is not so clear. And where we are to draw the line is not simple. The U.S. experience, for example, is that identifying and imposing liability retroactively on owners can have very high transaction costs which cannot be ignored.

When Nevada created its system, it provided that all facilities in existence on September 1, 1989 had to obtain a permit within three years of that date. No new facilities or modifications could be built after July 1, 1990 without permits. Each "process component" was required to meet whatever regulations were in effect at the time its construction commenced.[38] New Mexico's Rule 5 provided what amounts to a phase in of the law's requirements for "existing mining operations," which were defined as "an extraction operation that produced marketable minerals for a total of at least two years between January 1, 1970 and June 18, 1993."[39] When Colorado began its current programme, it required permits for all new mines and gave operators of existing mines three months to apply for permits.[40] With this advance warning, mines could operate up to the legal deadline without incurring reclamation liabilities. A few in fact closed the day before the deadline in order not to have to deal with the new regulation. But any portion of the mine works that was operated after the deadline required a reclamation plan. The World Bank has suggested a distinction, which could be useful in this regard between "contamination flows," which are an integral part of ongoing production at a site, and "pollution stocks" which are not. The reclamation obligation at an existing site could be seen as applying to everything except pollution stocks in existence on the date of effectiveness of the law.[41]

Obviously, this approach can lead to disputes over whether or not there were operations after the cutoff date and whether reclamation is therefore required. The state's failure to appreciate this soon enough and consequent lack of good baseline data have led to many disputes which could have been prevented.

Whether because state law explicitly says so, or as a result of administrative practice, mines which were in operation at the time the closure permit law became effective are not required to develop closure plans as if they are new mines, but to develop plans based on the existing reality. Each of the various "transitional provisions" has its own set of consequences. There is no significant state law reclamation requirement for operations that ceased activity before the law became effective.

Thus, to summarise, the state reclamation programmes provide (a) for closure planning from the outset of new mining operations or major modifications to existing ones; (b) reduced or "phased-in" requirements for operations which were already in operation when the individual state's law became effective; and (c) little or no reclamation of sites where mining ceased before the law became effective.

There is a fund — the Abandoned Mine Reclamation Fund — established by Title IV of the federal Surface Mining Act originating in a national tax on coal mining, which is distributed to qualifying states for use in reclamation of abandoned mine sites. The coal industry in general feels that it is unreasonable to ask it to pay all the cost for reclamation on all types of mine sites. One obvious reason to base this fund on a coal tax is a pragmatic one: given the relatively low value to weight ratio of coal, transportation costs are a very high fraction of total costs, and the market is more regional than global. Thus, a tax on coal is not as likely to have an adverse effect on the competitive position of the domestic industry as would, for example, a tax on gold production. Reflecting that perceived unfairness, the fund prioritises reclamation of abandoned coal mines over other types of abandoned mines, regardless of the relative environmental or safety problems at the sites. Further, it prioritises anything classified as a "safety" problem, no matter how petty, over "environmental" problems, no matter how acute.

Colorado's share of these funds was adequate to provide for construction of 202 engineered closures of dangerous abandoned mine openings in 1996 out of an estimated total of 23,000 which existed in the state when the programme began.[42] As the programme goes forward, an increasing part of its budget is spent on repair and restoration of its own previous work which has been subject to vandalism or other misfortune; the amount of money provided each year is in any case declining.

Other than a small amount of money originating in grants from EPA's Clean Water Act non-point source programme for demonstration projects, essentially nothing is spent by government on dealing with the enormous environmental legacy of abandoned mines, except under the Superfund

programme. And most of the remedial work under the non-point source programme has been stalled, precisely because state authorities are concerned that making any alterations at old mine sites will expose them to enormous liabilities under either CERCLA, the statute which creates Superfund, or the Clean Water Act itself. These problems are discussed in Section 17.6 below.

It seems self-defeating to create regulatory schemes which require industry to spend enormous amounts of money on environmental controls to reach, for example, very stringent water quality discharge standards when the receiving waters are severely contaminated by discharge from abandoned mines over which there is no control at all; and where absent some commitment to remediation at those sites, streams will be devoid of life forever from that cause regardless of the discharge standards applied at new mines. And that commitment, except to a limited extent under the Superfund statute and related solid waste laws, has been lacking.

Superfund was principally designed to deal with orphan chemical dumpsites and the like. It has had limited application to mine problems, and is somewhat cumbersome for that purpose. Nationwide, it has been employed at perhaps several dozen sites. "Approximately 39 western U.S. mining sites have been proposed for inclusion on the NPL ([National Priorities List) since 1981. Thirty-one of the 39 sites were formally listed on the NPL as of May 1994."[43] This represented three percent of the Superfund Priorities List at the time, but no data were found available for the number of eastern mine sites which might be on the list. Some of these comprise more than one mine property. The Clear Creek-Gilpin site in Colorado alone is comprised of hundreds of individual mines, mainly dating from the 1880s and 1890s.

Colorado has the dubious honor of being home to quite a number of these, including Leadville's California Gulch (the Yak Tunnel), the Eagle Mine, Clear Creek-Gilpin (including the Argo drainage tunnel), Idarado, and of course Summitville. While the programme has made some gains at these and other mega-sites, such as Butte in Montana, it is not the solution to remediating the tens of thousands of abandoned mine sites in Colorado, or the hundreds of thousands in the west as a whole. Inclusion on the National Priorities List is based on a Hazard-ranking System developed by the United States Environmental Protection Agency (USEPA).[43] The majority of abandoned mine sites, even those presenting serious environmental degradation, are unlikely ever to get close to making the list. The result, sadly, is that staggering amounts of money will be spent cleaning a relative handful of sites to "background" levels, while nothing at all is spent on the other sites.

Building a constituency for cleanup for even the high priority sites is difficult. Consciousness of the problem is not high in many areas, at least in part because no one has ever seen these mining districts in their natural condition; moreover, it is hard to build enthusiasm to pursue the villains responsible, because many of them, if villains they were, are long dead.

Thus, the focus of all state programmes is overwhelmingly on the problems of new mines, or mines which have been in operation since the respective effective date of the laws.

17.3 PREPARATION, REVIEW, AND APPROVAL OF THE MINE CLOSURE PLAN

This section focuses on the contents of the mine closure plan and the circumstances of its review and approval.

17.3.1 What Baseline Information is Needed for the Closure Plan?

One of the most significant sets of issues in mine closure revolves around the question of what baseline information is required to obtain a permit. The variety of judgments that may have to be made in the future about a mine site is staggering. Are there violations of emission rules? What will be the environmental impacts of modifications in processes or the mine plan? Have there been increases in contaminant levels in environmental media? What is the source of unexpected drops

in water levels — are they effects of natural cycles or something new? Are mine operations somehow related to changes in fish or wildlife populations? *Are* there in fact such changes?

Without a good idea of pre-mining conditions, there is no way to define success in closure efforts. This can be critical, because successfully completing closure requirements has major financial consequences for the mining enterprise. And when, as is often the case, the mining company does not own the land on which it mines, the owner has certain expectations about the condition in which the land will be returned to him or her; long, expensive conflicts can ensue regarding whether the closure has successfully met those requirements.

The only hope for rational resolution of these conflicts, or to make the necessary technical judgments on the soundest possible footing, is to have reliable information on conditions prior to disturbance by mining. Careful gathering of good scientific data is also the clearest way to learn and improve our understanding. Most states, and the national coal programme, have detailed descriptions of baseline data requirements.

The problems are, first, that the necessary information often relates to natural cycles: hydrologic cycles, life cycles of living species, climate and weather cycles, and the like, which cannot be gathered in a hurry. A year seems to be the absolute minimum period for which data should be gathered for many of these variables, and a year's data may be inadequate for some of them. It is questionable, for example, if adequate data for prediction of acid drainage potential can be gathered in a year.[44] Some kinds of data, such as those related to storm event impact on water quality, may be hard to get without very frequent or even continuous monitoring, and perhaps a bit of luck. Data can be expensive to gather, too. A number of enterprises have spent a considerable amount of money on studies of acid generation potential, sometimes without developing useful predictions. Second, the question of which data to gather is highly site-specific, as a function of the local environment, the proposed mine plan, processing technology, and other variables.

The concern is clear from the point of view of industry: enormous expenditure on exploration leads to a prospect which is laboriously defined, expensive and time-consuming studies of everything from workforce requirements to tax structure to transportation, electric power, water availability, the market, and a host of other variables are undertaken; a profitable mine is defined; the project is ready to go; and someone identifies a seemingly trivial piece of data — the breeding habits of a rare mouse, iron concentrations in water at time of low flow — which cannot be gathered quickly, and the project is stalled, with extremely expensive consequences.

There is probably no perfect way around this problem. The data needs *are* site-specific. The consequences of not having them *can* be disastrous. They *do* take time to gather. Our experience leads to three less than fully satisfactory observations:

1. The environmental variable as a management issue for the firm is much like other management issues. It is a series of risks and opportunities for the enterprise. It is rarely possible to eliminate all the risks, or to capture fully all the benefits of the opportunities. The enterprises that manage these risks and opportunities best tend to be more competitive in the marketplace. All variables are managed best when there is adequate good, current information available to managers.
2. It is sometimes possible to observe a "negative feedback loop." Mining companies that do not understand the environmental permitting process, or the goals of closure requirements, sometimes avoid contact with regulators to the maximum possible extent, postpone the necessary studies as long as possible, and do not start the permitting process until they have resolved all of the other feasibility issues relating to the mine. This not only makes it very hard for the enterprise to go through the systematic process of identification of impacts and their avoidance, minimisation, mitigation, and compensation, as described above, but much increases the chance that baseline data issues with a high likelihood of disturbing the project schedule will arise late in the day. When they

do, it can reinforce management's negative impression of the regulatory process, and disinclination to deal with environmental issues any sooner than they have to.

3. One of the benefits to an early and open approach to mine development is that baseline data needs and related closure issues tend to get identified earlier, minimising the chance of unpleasant surprises at later project stages. The idea that it is better not to develop too much information early in the process because problems could be uncovered seems to be losing favour as companies experience the consequences of those problems surfacing unexpectedly later, at a much more costly phase. And it is a remarkable concept of management that managers are better off with incomplete or unreliable information when making decisions involving millions of dollars. If it is good not to gather "too much information," it is hard to understand why this concept should be limited to the environmental sphere: if the company is better off with spotty, limited environmental information of poor quality, why is this not also a good idea when dealing with ore reserve information? After all, better studies might indicate that the reserves are less than expected, perhaps not even adequate to support the project, and then the project might not go forward. It would be interesting to apply this principle to transportation studies, energy supply studies, and the like.

There is a final issue. The environmental impact statement in the U.S. is generally a creature of federal, not state law (there are some states, such as Montana and California, which do have state-level environmental impact statement requirements — the majority of the major mining states do not). There is no guarantee that the baseline information needed for the federally required environmental impact statement system will be the same as that needed for the state system. Though much of it may overlap, there may be specific items required at one level which are not required at the other, or which must be gathered according to different methodologies.

17.3.2 What are the Contents of the Mine Closure Plan?

When Colorado first established its programme about 20 years ago, many of the early mine reclamation plans were, literally, sketchy: hand drawn, not-to-scale diagrams of the intended post-mining configuration. As both the agency and the regulated community have gained experience with the system, the requirements, particularly for the category of permits which includes the largest mines, and the mines which use toxic processing agents, have rapidly become more sophisticated and complex.

Colorado's detailed requirements now include submission of an index map, pre-mining maps, a mining plan map, a mining plan, a reclamation plan, a reclamation plan map; information on water resources, wildlife, soils, vegetation, and climate; an estimate of reclamation costs; a list of other permits and licenses which the applicant is seeking; a demonstration that the mining company will have legal right to enter the premises to perform reclamation work; identification of all owners with an interest in the property; identification of all municipalities within two miles; proof that local government officials have been provided with notice of the application; identification of all man-made structures in or adjacent to the area to be mined; a geotechnical stability analysis; and, for "designated" operations which are thought to represent particular hazards because of acid drainage potential or use of hazardous chemicals in processing, an "environmental protection plan." Where hazardous chemicals are present, this last item must include an emergency response plan in case of spills or accidents. Each of these elements must be prepared according to prescribed procedures. These are reasonably typical of requirements in most other states.

Basically, there are two plans which need to be coordinated to work together. The reclamation plan defines the beneficial use for which the site is destined post-closure, with the details of final configuration, measures for geotechnical stability, drainage control, erosion control, topsoiling, vegetative cover, and the like. The operating plan is designed to produce ore from the mine in an

efficient and economical way, leading to a configuration close to what is called for in the reclamation plan, so that fulfillment of closure obligations becomes as easy and inexpensive as possible once production ceases. Colorado requires submission of both plans as part of the permit application.

The basic configuration of the mine, location of storage piles, overburden, roads, and waste dumps all have to be planned from the outset with closure in mind, and the mine closure agency must of necessity concern itself with a plan which includes the operational phase.

The part of the state regulatory programme that is of most direct interest to mining companies is the set of technical criteria which the state applies in deciding whether a plan is adequate. Almost always, these technical criteria are subject to exceptions if they are deemed impractical in the circumstances of a particular project, but generally they are a good guide to what the agency expects: that absent compelling reasons to the contrary, for instance, that waste dump slopes should be no steeper that 3h: 1v; that to prevent runoff from reaching excessive velocities and creating gullying problems, there should be terraces at intervals of no less than 50 vertical feet; and that topsoil should be stockpiled separately and protected from wind and water erosion until it is reused in the final cover for the reclaimed site.

Most states have developed many such criteria. They are generally known to the operators in the state, or consultants who aid in the preparation of plans, but in few cases have been published. They tend to be specific to individual states because the problems in each state tend to vary significantly with the type of mining, climate, wildlife resources, vegetative cover, and so on.

17.3.3 What is the Review Process for the Plan?

The principal elements of review common to all states' systems include notice provisions; a procedure for soliciting the opinions of various other organs of government with a potential interest in the project; staff technical review; an opportunity for public participation; and either administrative appeal of the decision by affected parties, or recourse to the court system, or both.

The review is often constrained by time limits. In Colorado, which has different time limits for different kinds of permits, the permit is deemed approved if it is not denied within specified time periods. This is typical of most states.

17.3.4 How Does the Public Participation Process Work?

Permit processes in the U.S. typically provide for public participation. This begins with some requirement that the operator of the proposed facility notify potential interested parties, often by publication in newspapers, posting notices in local government offices, posting signs near the proposed mine site, or mailing notices to adjacent landowners or other designated persons. Most systems employ some mix of these types of notice. Some states define relatively narrowly the class of people who are entitled to receive notice: in Colorado, for example, only owners of land within 200 feet of the affected area are entitled to notice; in Wyoming, the figure is one half mile. In general, it appears that states with very broad notification requirements are more flexible in overlooking technical defects in notification, and states with narrow requirements tend to interpret them inflexibly, though generalisation on this subject is difficult.

Typically, following the notice is a period for written comment. Most systems also provide for some form of hearing at which those who object to some aspect of the proposed project may appear and make their views known. In general, the agencies apply a very broad definition of "interested parties," calling any doubts in favor of allowing participation. The level of public participation varies tremendously. Colorado has had a number of permit proceedings where hundreds of people and organisations have commented or spoken at public hearings for or against projects, and one — relating to a proposed gravel quarry in the Denver suburbs — at which over 3000 people requested formal status as parties to the proceeding. Yet many permit proceedings draw little or no attention from the public at large. The key factors that determine the level of public participation

seem to include perceived threats to the value of neighboring property, water supplies, the disturbance and annoyance of having an active mining operation nearby, and the proximity of the mine to sensitive areas, such as national parks or wilderness sites. Frequently, the state agency is faced with what are essentially land use issues relating to perceived incompatibility of mining operations with surrounding land uses. The state agencies that administer mine closure requirements typically do not have the authority to decide issues on compatibility of land uses, but are constrained by law to base their decisions on technical considerations of adequacy of the closure plan, or environmental mitigation measures. Typically, organs of local government or federal land use agencies decide the land use compatibility issues. One of the common criticisms of the U.S. Mining Law is that it does not provide balancing of mining against other potential land uses. Most federally managed land, except for parks and wilderness areas must, under this 1872 law, be available for mining if the claimant has discovered a valuable mineral deposit. The conflict over mining on the federal lands is exacerbated by the relative difficulty of mining hard rock minerals on private lands in the U.S. under the common law system of "fee simple" ownership, and the lack of a right on the part of the discoverer to exploit those deposits without landowner agreement.

17.3.5 By What Standards is the Adequacy of the Plan Judged?

Most state mine closure laws are structured so that the applicant is entitled to a permit unless the agency in charge makes specific findings, stated in the law. In Montana, the permit issues unless there is a finding that the operation would violate the state's clean air or clean water laws or the regulations thereunder, or the application fails to specify an "acceptable" programme of reclamation.[29]

In Colorado, the reclamation plan is tied to achieving a specified post-mining land use. Applications have been denied for failure to give the appropriate public notice; because the application fails to contain all the required contents; because the applicant had failed to pay outstanding fines for previous violations; because the plan fails reasonably to assure that the post-mining land use will be achieved; for failure to comply with specific provisions of the Act or implementing rules, such as the requirement that the plan ensure that it will "protect the hydrologic balance"; and for other reasons.

In general, the decision to grant or deny a permit is based on technical evaluation of the proposed reclamation plan to determine whether it will achieve the post-mining land use proposed by the applicant in a manner consistent with the requirements of the law and regulations. The decision is also based on whether there has been compliance with procedural requirements. Typically, as noted above, the state mine closure agency has no authority to decide whether mining is an appropriate land use, or consistent with surrounding uses. It is rare for applications to be denied outright: generally, agency staff communicate any reservations to the proponent, who then makes appropriate changes to the proposal in order to make it "approvable." Sometimes the agency's outstanding concerns are also dealt with by attaching conditions to issuance of the permit.

17.3.6 How Can the Plan be Changed?

One frequently voiced objection to the concept of closure plans is that mining is a dynamic process, involving constant refinement of the understanding of the orebody, changing definition of reserves, developments in technology, and so on. It is suggested that conditions may change too frequently for a defined plan to hold. This concern has been addressed by creation of flexible and easy amendment processes. Where the mine is sold, typically the new operator simply acquires the permit and assumes the liabilities of the old operator; this is not an occasion for wholesale review and revision of the permit. However, in several states it does trigger a review of the adequacy of the bond amount.

There is here an enormous difference between permit changes triggered by the operator's voluntary choice, and changes triggered unilaterally by the state. The latter are regarded as anathema

by much of the industry, which hopes, in submitting to the regulatory system, to gain in return some certainty about what requirements it will have to meet in the long run. Most state programmes provide that the permit is valid for the "life of the mine," or some similar formula (reclamation permits "shall be effective for the life of the particular mining operation if the operator complies with the conditions of such reclamation permits and with the provisions of this article and rules...."),[45] which means that so long as the operator is in compliance with the regulations and the permit terms, the state cannot impose additional closure requirements. This creates a powerful incentive for mine operators to remain in compliance with their permits.

One other phenomenon is worth noting. When a new mining operation is first proposed for a community, it seems local officials, anxious for the revenue and employment, are often among the most vocal proponents of relaxing environmental laws to let the project proceed. Yet in the closure phase, where the local payrolls and revenue are coming from reclamation work, these officials have been known to change direction dramatically and insist that ever more complex and costly reclamation requirements be imposed.

Colorado recognises two types of changes to existing permits: the amendment and the technical revision. The former implies a substantial change in operations, such as adding new land to the permit area, and is accompanied by most of the same information, notice, and public participation procedures used for issuing new permits. The latter is generally handled at a staff level, and is designed to keep the permit and the mining operation in conformance with each other in cases where the proposed change does not fundamentally affect the resources being impacted, the hazards of the operation, or the costs of reclamation.

17.3.7 Duration of the Permit

Permits are usually issued for the "life of the mine," and are not subject to expiration or unilateral revision by government agencies barring unusual circumstances so long as the operator is in compliance with the plan. Colorado's law now, in the wake of Summitville, allows retroactive changes to permit conditions, but only after a special proceeding of which all affected parties must have notice, and only when it is determined that failure to do so will pose unreasonable environmental risks.

17.4 PERFORMANCE WARRANTY AND GUARANTEE

One of the most difficult groups of issues surrounding mine closure is the issue of performance warranties and guarantees. These issues are difficult for several reasons.

First, it is hard to run an effective programme without them. Prices of mineral commodities are more volatile than prices in general; mine closure is usually more a function of commodity prices than of physical exhaustion of resources. This means that precisely when the mine is closing, there is often serious financial stress on the enterprise. Further, it means that mine closures tend to come in waves, something with which the U.S. has, like all mining countries, ample experience.

Colorado has experienced, just to name a few, the silver boom of the 1880s, followed by the Silver Panic of 1893; the closure of the gold mines in response to World War I; the boom in oil shale of the early 1920s, followed by the bust of the mid-1920s; the enormous uranium boom of the early 1950s, followed by the crash occasioned by the end of government purchases, followed by recovery in the 1970s, followed by another, seemingly terminal crash in the early 1980s; another oil shale boom in response to the Arab oil embargo and the Iranian revolution and resulting oil shortages, followed by a complete cessation of the industry in the early 1980s; and various booms and busts in other mineral commodities, notably molybdenum, of which the state has long been a leading producer. Each of these events has left its mark on the landscape; Colorado's experience, and the experience in the West as a whole, is that mine closures have come suddenly and in waves.

If closure obligations are to be fulfilled, there also has to be some viable means of assurance. The association of large numbers of mine closures with sharp downturns in mineral prices also means that they are likely to occur at a time when general economic conditions in the mining region are not good, and if the area is one heavily dependent on the mineral economy, it is likely to be a time when public resources are in scarce supply.

Second, maintaining adequate financial guarantees is expensive for industry. Even where the company is allowed to self-insure, an option usually only available to the large, publicly traded company, it requires maintenance of a certain margin of uncommitted assets, limiting the company's options. Freezing cash in a certificate of deposit is expensive, but so are the various forms of insurance company or bank guarantees. These institutions generally insist on collateral. An excellent guide to the economic consequences to companies of various bonding alternatives can be found in Hayes.[8]

Third, the programmes are difficult and cumbersome to administer. Accurate calculation of bond amounts, as with any engineering cost estimate, is fraught with difficulty; the consequences of being wrong can be serious for the enterprise or the state. Performing all the legal steps necessary to perfect and maintain the government entity's legal rights in the guarantee is a difficult and time-consuming task, often beyond the capabilities of agencies typically staffed with engineers, geologists, or others without the necessary training in finance.

17.4.1 What Does the Enterprise Guarantee?

One common misconception about bonding for mine closure is that the bond insures against any possible accident, problem, emergency or undesirable development — but the financial assurance cannot address all these possibilities. Calculating accurately the cost of completing the closure plan is hard enough; trying to define possible accidents and their consequences in financial terms is an order of magnitude harder. Further, it is hard to understand why the mining industry should be singled out in this respect. The mining industry is hardly the only sector that can have expensive accidents. Until the chemical plants, dams, and electrical stations of the world insure the public against credible accidents (which might be a good idea), there seems to be no compelling need to require mines to do so. And since the "worst case" accident will in many instances as a practical matter have an enormous price tag, bonding for that eventuality — even if somehow desirable — is enormously expensive. Nor should the reclamation bond be confused with another instrument, discussed in Section 17.6: the bond for long-term performance of post-closure monitoring, maintenance, or environmental control on the site. In conditions where there are no practicable technical means to achieve acceptable post-mining conditions (such as some acid drainage conditions), there may be a need for very long-term activity on the site (such as perpetual operation of a water treatment plant). Some jurisdictions are starting to explore various forms of guarantee for performance of these obligations. This is very different from the bond here considered, which is simply a guarantee that the reclamation or closure plan will be implemented.

17.4.2 What are the Acceptable Forms of Guarantee?

17.4.2.1 Under current law

Typically, states will accept one of a variety of specific financial instruments to guarantee the closure obligation. Usually, a combination of different forms of guarantee is also acceptable. The types of guarantee instruments most often accepted include surety bonds, certificates of deposit, trust funds, irrevocable letters of credit, insurance policies, deeds of trust or mortgages, security agreements encumbering real or personal property, and cash deposits with the state treasurer. Some states allow companies who are able to meet specific tests of financial soundness to provide certificates of self-insurance, or a self-guarantee.

The issues surrounding the type, nature, and conditions of guarantees are critical, though not always well understood. First, whatever the law says about the guarantee, when major problems

arise with a mining company or mine site, what ensues is going to be a negotiation. The company is likely to want to scale back its reclamation commitments, or postpone them, or propose alternatives that may be less desirable, all in the interest of saving money.

The form that negotiation takes depends substantially on the adequacy of the guarantee and whether it is a "real" guarantee — something that can effectively be turned into money in a reasonable period of time in an amount adequate for the government agency to implement the closure plan itself if the firm cannot or will not. If the guarantee is "real," the agency has the opportunity to consider any ideas that may be proposed, knowing that it is not going to face the unhappy situation of a failed mining company and an unreclaimed mine site, without the funds to get the job done. If the guarantee is not "real" the consequence is predictable: a long agonising process of compromise, indecision, retreat, and abandonment of standards, as occurred in the Summitville situation, where much of the state's hesitation to act was a function of its knowledge that the financial assurance it held came nowhere close to what the closure costs would be.

An abandoned, unreclaimed mine site can deteriorate quickly. Particularly where there are harsh climate conditions, or conditions which may impose seasonal limits on construction activities, it is important that a guarantee be convertible to cash efficiently, and within a reasonable amount of time. One of Colorado's post-Summitville reforms was an amendment allowing the agency to reject any proposed form of guarantee that is not convertible to cash within 180 days. If an unplanned closure is the result of a long deterioration of the financial condition of the enterprise, by the time of abandonment the mine site is likely to have a long list of deferred maintenance items, neglected drainage systems, plugged culverts, leaking pipes, safety hazards, and the like. Prompt action is required if the cost of solving the problems is not to escalate out of control. The need for a state emergency response fund to deal with issues of this nature was another of the important lessons of Summitville.

Another point that has been learned the hard way is that the value of the guarantee should not be dependent upon the economic success or viability of the mining operation. If the mining operation can be operated profitably, it probably will be, and there will probably not be a closure. If the mining operation is unprofitable in the hands of the operator, the chances that a state regulatory agency can move in and make money from it are virtually nonexistent. Yet many mining companies often want, for example, to offer a mortgage or other encumbrance of the mine itself as a guarantee — and not at the value it would have as pasture land or in some alternative use, but at the value it has as a mineral property, usually using some optimistic estimate of future mineral prices as a base. This poses obvious problems as well as problems that are not so obvious. Under the federal Superfund legislation, or the Clean Water Act, as explained later in this chapter, it is possible that owners of the site may take on liabilities far in excess of the value of the land, a situation which more than once has deterred state agencies from realising on their guarantees by foreclosing mortgages or otherwise taking possession of land offered as a guarantee. It of course limits the interest of potential purchasers as well. Even property not directly related to the mine site could have a value dependent on the success of the mining operation. The Mid Continent mine in western Colorado gave a deed of trust on a rock dust plant as collateral for its closure obligation. Mid Continent went bankrupt. It turned out that the rock dust plant, which had a substantial value as a going concern, had to be sold for next to nothing, because the one customer for its product was — the Mid Continent Mine. It developed its own environmental problems as well — a real concern for agencies which do not want to inherit sites that have to be cleaned up before they can be sold.

Second, certain forms of guarantee require substantial due diligence and maintenance by the closure agency if they are to maintain value. In the U.S., unpaid real estate taxes become a lien senior to mortgages. If taxes go unpaid for several years, the value of the agency's mortgage is much reduced. If real estate is accepted as a guarantee, there needs to be a way to determine its realistic value. Letters of credit expire. Someone needs to watch the expiration date to make sure a replacement letter is posted before the old one expires. Where some form of self-guarantee is

accepted, someone has to maintain vigilance over the financial condition of the enterprise, to make sure that it continues to meet the financial requirements for the self-guarantee. The fact that an enterprise is a large one does not immunise it against failure, or sudden adverse financial events.

These financial issues are often very difficult for mine closure agencies because they often lack the business and financial expertise to understand all the issues and pitfalls. Colorado has had numerous examples of things that can go wrong with bonds: deeds of trust which were never properly recorded before the operator sold the land they were intended to encumber; banks failing and being unable to honor letters of credit; poorly done or inflated appraisals of both real estate and personal property; and environmental contamination reducing the value of the pledged property. The list is a long one. These problems have been reduced over the last several years, but the lesson is that the agency needs someone with commercial experience who knows how to deal with these types of potential pitfalls.

17.4.2.2 The concept of risk pools

There has been a great deal of discussion in recent years about pooling of risk in a way to allow smaller and medium mining enterprises to post financial warranties without incurring prohibitive costs. This concept may have significant merits and should be thoroughly explored. To date, it has been discussed mainly by regulatory departments, engineers, lawyers, and geologists.[47] The right financial and actuarial experts have yet to be brought adequately into this discussion — and there needs to be a certain sense of realism about the concept.

Consider the following issues:

- There is no doubt that the credit standing of the smaller players in the industry, medium national mining companies, and artisanal gold panners alike would be enhanced by having the mining giants of the world stand behind their obligations. This is, however, a role these companies have not rushed to embrace. In part this may be because many of the systems which do require bonding allow self-bonding for the bigger companies. But there are other factors, too. "... [T]he pools insure a high-risk group of operators. Further, operators paying into a bond pool may be tempted to consider their bond pool payments to be an adequate substitute for reclamation itself. It may be because of these difficulties that states with bond pool arrangements have been rather slow in implementing their programmes."[8]
- Without the big international companies, the risk pool at best becomes a large mass of companies — some good, some not so good. In fact, more than half of the companies probably fall into the not-so-good category, because the well-run companies seem disproportionately able to make their own individual bond arrangements, just as they are disproportionately able to make profits, or find minerals.

The result is thus a group of smaller companies — some good, many not — all exposed to the same basic risk: commodity prices. As the companies get smaller, the transaction costs of analysing the risks present at each specific site and monitoring the ongoing performance of the insured — both important functions in any insurance-like arrangement — become more significant, another deterrent to such programmes. While on a worldwide basis this risk can be diversified because of the numerous commodities that are produced and the numerous markets in which they are sold, the mining industry in any one state, country, or province is likely to be less diversified. The risk pool is not worth having if it is not strong enough to survive most foreseeable events, including sharp mineral price downturns. If it is not that strong, maintaining the risk pool is just a way of pretending there is security when there is none, and setting things up for a real crisis.

- If the risk pool is backed by commercial insurance arrangements, it still has to be solvent or the commercial insurance will be as prohibitive as the bond was in the first place. Most insurance companies are not willing to write millions of dollars of insurance against the risk of changes in mineral prices.

These realities have limited state experimentation with this concept. The most substantial experience with such programmes appears to be Nevada's state-run bond pool. The bond pool was established by statute in 1989, and is administered by the state Division of Minerals, within the Department of Business and Industry.[46] The programme is designed to serve operators of small and medium size mines who encounter difficulties obtaining bonding from private bonding companies or for whom the financial burden of obtaining a bond from a private company would be prohibitive. To qualify for the bond pool, the operator must have been rejected three times by bonding agencies at current market rate premiums and must have been required to post more than 15% collateral. Additionally, the bond pool administrators conduct an analysis of each applicant and make on-site inspections before enrolling an operator in the programme. The bond pool is not intended to compete with private bonding companies — it is intended only to provide bonding for operators who are unable to obtain bonding from private companies. The maximum coverage offered by the bond pool is $1 million per operator for mining operations or for both mining and exploration operations, and $250,000 per operator for one or more exploration projects. The operator pays the bond pool a 15% deposit and an annual premium equal to 5% of the bond coverage. Interest earned by funds in the bond pool is credited to the pool. If an operator covered by the bond pool is required to forfeit a bond, the bond pool pays the agency collecting the bond amount directly, then the state can sue the operator to recover the amount paid by the bond pool.

According to the Nevada programme's director, since its inception the programme has enrolled eight mining companies for a total of nine projects. About the same number of companies have applied for the programme, but did not enroll for various reasons. One company enrolled in the programme has since become large and financially strong enough to exit the programme and use a corporate guarantee for warranty purposes. The bond pool programme has experienced no forfeitures of bonds. A few other states have initiated bond pool programmes similar to Nevada's, or have considered doing so.

17.4.3 How Can the Level of Guarantee be Changed?

The amount of the guarantee should be adjustable at any time, so long as (1) it continues to be based on sound engineering cost estimates; (2) there is opportunity for public participation; and (3) companies whose guarantees are adjusted upward have a reasonable time to post any additional guarantee needed. Obviously, one major concern for mining investors is that they do not, in mid-project, suddenly want to face enormous increases in the bond costs, and protection against administrative arbitrariness is critical if industry is to support the programme.

These principles, which have been recognised in the Colorado law since the 1970s, allow for such approaches as phased bonding, in which the bond amount changes as the project proceeds. This encourages concurrent reclamation, in which parts of the mine that have reached their ultimate post-mining configuration can be closed, and the corresponding portion of the guarantee released, while mining continues in other parts of the project area. This extremely beneficial practice should be encouraged, and allowing adjustment of the guarantee encourages the promptest possible reclamation of portions of the mine site, and avoids imposing unnecessary costs on industry.

The experience in all American states is that reclamation gets better results and costs less if done as soon as possible. If nothing else, it is a general requirement that soils be salvaged and stockpiled, and it appears that the useful biological activity in soils deteriorates over time. Plus, concurrent reclamation can reduce dust control costs, and reduce the risks inherent, for example,

in seeding the whole site at once at the end of the project, only to find that the seed mix or soil amendments were not appropriate, or that it was the driest year in the last 20. Concurrent reclamation therefore has multiple benefits: it allows for controlled, systematic experimentation with various reclamation techniques to identify and refine the most effective and economical ones; it reduces the environmental impacts during the operational phase; and it reduces the overhanging risk of an enormous "all at once" reclamation programme at the end of the operational phase, to the benefit of the enterprise, the state, and the environment. This is reflected in savings on bond costs: if the bond is posted as a single amount at the outset, as was the case with much past practice, it is calculated based on the point in the operation at which reclamation costs would be highest if the operator defaulted. This point only exists once during the life of the mine, yet fixes the bonding cost for the whole operational phase.

In general, operators are not only free to seek, but encouraged to seek, partial release of the bond whenever they can demonstrate partial achievement of the closure plan. If the reclamation liability can be reduced as the project moves forward, the result is less money being posted for less time (see Morrey, Chapter 13). The caveat — and there always is one in such cases — is that the state must spend more time in inspecting and evaluating such sites, in order to make certain that the lower bond amount is really justified by physical reclamation results on the ground, rather than paper reclamation plans. There have been a number of unhappy surprises in this area.

In a similar sense, many bonds are calculated for a particular phase of the operation. Rather than bond for anticipated expansion at the outset, the company may bond only for the initial phase and agree that it will not start the next phase until an additional bond is posted.

Another aspect of the bonding problem is that costs change, and inflation exists. Mine projects may have a long life, and a guarantee that is perfectly adequate at the outset will, if there is no way to adjust for inflation, certainly be inadequate in time. Colorado has had trouble on this score. In the early days of the programme, the agency lacked experience in cost calculation and many bonds were set at inaccurate figures, most often too low. Now that the agency has developed much more precise techniques for bond calculations, there are still many older bonds which never were adequate to begin with, and which are even less adequate after years of inflation.

The agency has made enormous efforts to catch up with this backlog, while also observing some other principles: (a) the bond should be calculated again any time there is an inspection indicating a deviation from the mine closure plan; (b) the bond is reevaluated whenever there is a transfer of the property to a new owner; and (c) there must be a recalculation any time that there is a change to the permit that may affect costs of completing the approved closure plan. It may still be some time before the agency has completed the task of updating all bond amounts; there is a fair amount of adverse fallout from the effort, as smaller marginal operations learn that they must now increase their bond amounts in some cases by several hundred percent. Further, though it is clearly necessary to base bond amounts on sound engineering cost estimation, this has one disadvantage compared to wild guessing or the "negotiated" bond amount: it takes time to do it right.

The lesson from this experience is that such a situation should not be allowed to develop. Much easier would be a plan where the bond amount, once established, is adjusted each year automatically by some appropriate measure of inflation, perhaps the Construction Cost Index.

17.4.4 When and How Does the Guarantee Terminate?

It is important to mining enterprises to know that when the prescribed closure steps are completed, their financial guarantee can be terminated promptly, and that a clear dispute resolution mechanism exists to resolve any disagreement on this subject. Several states have systems aimed at achieving such certainty and promptness in guarantee termination.

In Colorado, a company may report that it has completed its obligations under the reclamation plan. The state has a limited time to do whatever inspections or investigations it believes necessary and to raise any resulting objections, after which the company's bond is released automatically if

the state fails to raise specific objections.[47] Similar mechanisms exist elsewhere. For example, in Arizona, an owner or operator may apply for a release from all or part of the financial assurance mechanism. The state must then release all or part of the financial assurance except for any amount necessary for reclamation within 60 days of receiving such a request.[48] Similarly, in Nevada, the state must respond to an owner or operator's request to release the surety partially or fully within 30 days after receiving a request for release.[49]

One concern of mining firms has been that it is still impossible to assure prompt return of the bond, because many states allow the landowner, or affected citizens, to object to or appeal a bond release decision, and the bond is not released until the appeal is resolved. In practice, however, appeals of bond release decisions have been rare, at least in any of the states with which we are familiar, and they tend to be resolved quickly: in Colorado, generally within one or two months.

17.5 REPORTING, MONITORING, INSPECTION, AND ENFORCEMENT

There are needs for ongoing monitoring and inspection at the mine during the operational phase which are beyond the scope of this paper. As they impact mine closure, the principal functions of reporting, monitoring, inspection, and enforcement are two. First, since the closure plan is closely linked to the methods of operations, and the financial guarantee is dependent upon the plan, departures from the approved operating plan can have drastic impacts both on the feasibility of the closure plan and the cost of its implementation. If a mine is approved for four hectares of surface disturbance, and bonded for reclamation of that amount, there needs to be an "early warning system" to bring to the attention of the agency the fact, e.g., that the mine has now grown to 20 hectares and changed its processing system without amending its plan. Second, mining impacts are difficult to predict; if important impacts, not foreseen earlier, develop during operations, or if mitigation measures are not proving effective, it is important to be sure this is recognised early.

In systems that require financial guarantees, the cost of maintaining the guarantee and the advantages of lowering or terminating it are strong incentives to begin the closure programme and to pursue it diligently. In systems without a guarantee, the incentive is completely reversed, and it is very important to have some outer limit, after which mines that have shown no sign of operating must begin the closure process. This is one reason that states which have not had financial guarantee requirements have tended to adopt them. It is another important function of the inspection and reporting programme.

An additional reason for the system is of course to detect people who should be in the system but who are not.

17.5.1 Inspections

Mines are in some ways more difficult and expensive to inspect than are many other types of facilities. Largely, this is a function of location. Mines are not, like many industrial facilities, conveniently clustered around major urban centers (the exception to this statement is probably construction material mining: the transportation costs of sand and gravel, for example, give certain advantages to location near urban centers). On the contrary, mines are often in remote, difficult to access terrain. Obviously, mines are inspected for a variety of reasons by a variety of agencies. The focus here is on inspections related to the ultimate objective of mine closure.

Mine inspections undertaken to ensure compliance with mine closure-related requirements are not a quick check of one or two parameters, but can be quite involved and include many aspects of the operation. The goals could be stated perhaps as (1) identifying any areas of noncompliance with the operating plan that will affect closure; (2) identifying any unanticipated environmental problems that are developing on-site; and (3) identifying any factors that could affect the adequacy of the financial warranty. If these problems are identified quickly, while the level of deviation is

small, they can often be dealt with informally before any environmental problems become acute; before conditions occur which make the closure plan infeasible; before the amount of the existing financial warranty is greatly exceeded by additional unforeseen closure costs; and before it becomes necessary to invoke legal sanctions.

Every mine inspection programme in the country has its stories of the mine which, when inspected, turns out to be at a different location than specified in its plan; or is considerably larger than it is supposed to be; or which has unexpectedly encountered great quantities of water; or which has made radical changes in its production or processing technology. "Daylighting" a tunnel and suddenly becoming an open pit operation, deciding one morning to try some cyanide to see how it works, and other deviations from the approved plan are hardly unheard of, particularly at the small end of the industry.

Frequent inspection is one solution to the problem. The federal laws covering coal mining and state laws passed to comply with its requirements prescribe minimum frequencies for inspections. State inspectors may be required to visit every coal mine subject to their authority a minimum of once a month. On a certain percentage of these inspections, without advance notice, federal inspectors will appear and accompany state inspectors to ensure the state inspections are adequately conducted.

There is nothing nearly so frequent or so rigorous in state inspections of non-coal mines. Some states do not even seem to keep reliable statistics on frequency of inspections. In Colorado, which we believe is above average among state programmes in the number of inspections conducted, inspections are targeted on certain types of facilities that are believed to present more than average risks. For example, Independence Mining Company's Cresson Project, a recently developed gold cyanide project, had a state inspector on-site virtually full time during the critical phase of liner construction. However, many types of facilities are, on average, inspected less than once a year.

17.5.2 Monitoring and Reporting

Of necessity, then, great reliance must be placed on monitoring and reporting by the firm itself. The specific things that must be reported and the frequency of reporting are to a large extent site-specific and dealt with in individual permits. Where information is not provided as required, administrative penalties can be levied in most states. Some of the more stringent penalties levied in recent years in Colorado were against Battle Mountain Gold's San Luis Project for failing properly to report cyanide levels in ponds which exceeded its permit limits. Company management responded forcefully and vigorously to this situation, installing new systems of internal controls to ensure improved future reporting. The most severe sanctions have generally been applied where there has been knowing concealment of information or provision of false information in order to mislead regulators. Among these are penal provisions, which may include incarceration for intentional or willful violations.

17.5.3 Procedures in Case of Violations

Many state programme staffs report to boards of appointed citizens with powers to hear disputes and make determinations, including imposition of penalties. Where there is serious noncompliance with the statute, regulations, or permit conditions, the Board that oversees the state mine closure agency staff or the staff itself typically has authority to issue an order requiring compliance, and to file an action in court to enforce the compliance order. Additionally, the Board or mine closure agency may take a variety of further actions, usually after a hearing at which the firm and any affected members of the public may present their positions. Options include suspension or revocation of permits or reclamation plan approval, orders requiring specific corrective actions, forfeiture of the financial warranty, and imposition of significant financial penalties on the operator. In severe cases, the state attorney general's office may institute a lawsuit or seek criminal penalties against the operator.

17.6 CURRENT ISSUES

The mine closure plan, while not a contract in the legal sense, is an important understanding between the government and the company, that if the company fulfills the steps outlined in the closure plan — and no major unexpected problems crop up — that is all the company will have to do. The state has the advantages of implementation of the plan; the mining enterprise has the advantage of knowing its target and being able to assign cost estimates to it with some confidence. This has been the traditional concept of mine closure planning.

There are challenges emerging to this basic concept, from two principal sources. One is the increasing recognition that in some cases implementation of the closure plan will not result in a "walk-away" closure: a maintenance-free, self-sustaining site which will comply with environmental norms in the long run without further intervention. In short, a post-closure phase may be needed which may consist, as noted in the introduction, of monitoring, passive controls, or even of active measures. Some of these, at certain sites, may need to be employed for a very long time at a very great cost.

The second challenge is a set of legal developments outside the framework of mine closure laws — principally from the solid waste laws, RCRA and CERCLA, and under the Clean Water Act.

17.6.1 Post-Closure Obligations

While any model oversimplifies, it might be appropriate to conceive of the U.S. Clean Air Act and Clean Water Act in the early 1970s as representative of a first phase of environmental management. These laws heavily emphasised identification of pollutants, and reducing or eliminating them through emission limits or ambient air or water quality standards. It was understood that some enterprises might not be able to meet standards and might have to close, but there was a general concept underlying the structure of the law that *if the operations which caused pollution stopped, we would at least be free of the pollution, because it would stop, too.*

There was a second wave of environmental legislation a few years later based on a more sophisticated appreciation that environmental impacts sometimes can continue even when operations cease. Important mine reclamation legislation began to be enacted in the mid-1970s, such as Colorado's Mined Land Reclamation Act. These laws seem in retrospect to have been based on the concept that even if post-operational impacts might exist, they could always, with proper planning, be reduced to an acceptable level. There was little recognition that any attention was needed to mine closure issues beyond the point at which reclamation was deemed "completed." The underlying idea was that *with proper planning, acceptable environmental conditions could be achieved at an affordable cost.*

Colorado's Mined Land Reclamation Act contemplates that all sites will be reclaimed and bonds returned to operators within five years after operations cease.[50] Other state reclamation laws seem to be based on this same general concept, in that they simply fail to make provision for situations in which all the king's horses and all the king's men (even with most of the king's money) simply cannot reduce the impacts to levels considered acceptable.[51]

Similar in underlying conception is the federal "Superfund" legislation, which imposes liability — often without fault — on broad classes of entities and individuals, with the goal of cleaning up existing contamination, even very old existing contamination. A key difference between state mine reclamation laws and the Superfund statute is that the Superfund legislation applies liability *retroactively*, while the mine closure legislation generally does not. One of the concerns often expressed about the Superfund legislation is that it requires cleanup of contaminated sites essentially to background level[52] and essentially regardless of cost; thus, it is based on the very similar concept that *existing environmental impacts can always be remediated at an affordable cost.*

These concepts are adequate and appropriate in the great majority of cases: in most cases, with proper planning, impacts can be reduced to an acceptable level and a "walk-away" closure achieved.

To the extent that there has been contamination which needs to be remediated before closure is deemed complete, it usually can be remediated at an acceptable cost.

In the discussion that follows, therefore, it is important to keep in mind that we are focusing on problems, which while difficult, apply only in a minority — perhaps a small minority — of cases. Perhaps Colorado's experience with mines that were abandoned in the past without planning can be some guide. If we accept for purposes of order-of-magnitude estimates the figure of 23,000 abandoned mines in the state, it appears that acid drainage, clearly the most serious post-closure impact, occurs in perhaps 2000 to 3000 sites, or about 10%. Of course, many of these other mines do have problems, such as safety hazards or blowing tailings, which should be remediated. The point is that in most cases this remediation can be accomplished with known technology at a reasonable cost, and it is quite possible to imagine that with a little energy this could be done. Further, it appears that the great bulk of this problem occurs at no more than 200 to 300 sites, or roughly 1% of the total. Yet this problem is a severe one which affects an enormous part of the state, leaving rivers and streams virtually devoid of life, increasing water treatment costs, and limiting tourist development, with very serious economic consequences.

In other words, conventional closure planning should be able to result in a "walk-away" closure at the great majority of sites. In this sense it has been and is a very significant success story.

The critical problem is to deal with that limited number of sites which present very serious adverse environmental effects that cannot be remediated to a maintenance-free state with any known technology, at least not at a cost anyone can be found to pay. The focus is how to respond to situations where there are no technical solutions which will reduce pollution to acceptable levels, or where the cost of such cleanup is absolutely prohibitive, and how to determine at the outset which sites those are. One answer, for new projects, is that such situations are to be avoided unless there are very compelling reasons to the contrary. In other words, if there is no way to return land affected by mining "to a use beneficial to the people of the state," or to "establish a self-sustaining ecosystem" on lands affected by mining, or to prevent undue risks to water quality, or whatever the individual state's formula may be, then the permit cannot be granted and mining may not proceed. Pennsylvania has apparently taken this position in the case of coal mining.

An example can illustrate. The San Juan Mineral Belt is historically one of Colorado's most important and productive. It was the centre of the state's enormous silver boom of the 1880s.[53] Yet it, like some other mining districts, is rich in acid-generating sulfides, and an area of heavy precipitation to boot. There is a significant existing water quality problem in the rivers in the area, to which historic mines make a significant contribution.[54] This may not affect every potential mine in the region, but let us suppose that a mining project is presented which has a high potential for creating a long-term acid drainage problem to which the only technological solution capable of meeting water quality standards is ongoing operation of an active treatment plant, for at least many decades, if not centuries, and then a need for ongoing maintenance of passive treatment systems after that.

Who is going to pay to operate that plant indefinitely until that hoped-for time when water quality improves to the point where it meets standards without treatment? Who is going to pay to rebuild or renovate the plant every 20 or 30 years? The enterprise has this burden, not under reclamation laws, but under water quality laws. As has often been pointed out, though, a company that over the years acquires more and more such obligations becomes less attractive to investors and less competitive with companies without such obligations. Also, perpetual operation of water treatment plants has not been regarded as part of the "core business" of mining companies.

It is tempting to say that this obligation should be guaranteed, because no one really believes it is sensible to rely on private corporations to continue to exist and fulfill obligations — particularly such unattractive ones — for centuries. We are here talking about something quite distinct from the traditional reclamation guarantee, which is simply a guarantee of compliance with the closure plan. But there currently is no mechanism in the law to accept a bond beyond the period in which reclamation is complete, because the law simply was not conceived based on an understanding that

such situations may exist. And the law simply does not recognise situations in which the reclamation plan cannot be taken to "completion" within a relatively short period of time after operations end.

The cost of such a perpetual bond would be enormous. In the Superfund situations where something like this exists, the cost has been tens of millions of dollars in immediate cash to create a fund to continue to finance the obligation.

But the alternative of saying that important parts of one of the state's most important mining districts, which has produced phenomenal amounts of silver, gold, and other minerals, cannot be mined is startling to say the least — and hard for many people, in and out of the mining industry, to accept. The issue is hardly unique to the San Juan Mineral Belt.

Colorado has appointed a Mine Water Quality Task Force to study these issues and, if possible, recommend legislative, regulatory, or policy changes to deal with them more effectively. They are very similar in some respects to the problems emerging under the national Clean Water Act, dealt with below. Colorado's process is a continuation of dialogue that began with the adoption of major legislative reforms after the Summitville events, and continued through the development of the state's new implementing regulations. Bluntly, even after consensus had been reached on a host of other issues, the acid rock drainage issue remained intractable. While ultimate solutions have not emerged from this process, the fact that the issues are being discussed straightforwardly by industry, government, environmental representatives, and technical experts is in itself a promising development.

17.6.2 Legal Developments Under National Law

There has been much written about the regulatory problems of the U.S. mining industry, and the extent to which regulatory issues are responsible for the problems of the industry. One thing is clear: mine closure legislation is not the major impediment to mining development in the U.S. The key regulatory problems that are troubling the industry are *not the result of mine closure laws*, but of other separate legislation, principally water pollution legislation and the Superfund law.

The U.S. has been a pioneer in dealing with many of these issues: everyone involved in the process has realised that the best solutions would be arrived at only by a process of successive approximation; part of the genius of U.S. environmental law has been its willingness to pitch in and try innovative concepts where some others have seemed to wait indefinitely for a train that never comes. The challenge now in U.S. environmental law is to show that same willingness to try new concepts and, building on past experience, to revise the statutory schemes it has created to make them better.

17.6.2.1 Clean Water Act issues

There has been much debate and uncertainty in recent years over whether and how the national Clean Water Act applies to inactive or closed mines. The Act originally was written very generally; it does not differentiate between active and inactive phases of a project or activity, perhaps because, as discussed above, there was an underlying assumption in 1973 that cessation of the economic activity giving rise to the pollution would generally stop the pollution, and an assumption that any residual contamination can be remedied. As a result, the Act leaves much room for interpretation in how it applies to mining in general, how it applies to closed or inactive mines, and how it applies when water quality standards are very difficult or even impossible to achieve. It has become clear in recent years, however, that both the U.S. Congress and the USEPA intend to apply the Clean Water Act to mining operations, both active and inactive, very aggressively. This application of the Clean Water Act can have significant impacts on the mining industry.

17.6.2.1.1 The Dodson letter

The National Pollutant Discharge Elimination System (NPDES) permit requirement is the centerpiece of the U.S. Clean Water Act.[55] In general terms, the Act prohibits any person from discharging

pollutants from a "point source" into the "waters of the U.S." without a valid NPDES discharge permit.[56]

One of the issues which affects mining the most is the question of how broadly the term "point source" should be defined in the case of mining operations. The Act defines the term as "any discernible, confined and discrete conveyance," and gives such examples as a pipe, ditch, channel, tunnel, conduit, well, discrete fissure, or container.[57] The courts have interpreted the term "point source" broadly. In an important early case, the Tenth Circuit reversed a lower court's finding that mining is inherently a non-point source.[58] The Court went on to hold that an unplanned overflow from a reserve sump used in gold leaching operations qualifies as a "point source."

In 1993, the State of Montana's Water Quality Bureau requested the USEPA to clarify its position on several issues regarding NPDES permitting of hard rock mines. The USEPA's response, commonly referred to as the Dodson Letter, contains a very broad interpretation of the term "point source," and takes an aggressive stance toward regulation of inactive or abandoned mines.[59]

The USEPA made two major assertions in the Dodson letter. First, the agency asserted that not only mine adits, but also such "less obvious" sources as "seeps and other ground water discharges hydrologically connected to surface water from mines" qualify as "point sources" and require NPDES discharge permits. The USEPA reasoned that "it is more the mine or the facility itself that is subject to NPDES regulations," so that any seeps coming from "identifiable sources of pollution" at a mine would need to be regulated by discharge permits. This was an aggressive position for the agency to take, given the statutory language, but is consistent with the agency's policy of broadly construing the definition.[60]

Second, the USEPA took the position that NPDES permit requirements apply to inactive and abandoned mines as well as active operations. Specifically, the agency stated that mine adits at active, inactive, or abandoned mines fall under the NPDES permit programme, and that its current practices for permit issuance "incorporate historic mine drainage into NPDES permits for active mines if the active mine influences the pollution discharge from the historic area," and that if the firm operating an active mine "owns or has control" over an adjacent historic mining area, the firm must also apply for an NPDES permit for the discharge from the inactive area.

At least some of the consequences of this approach are that permits must be maintained for present mines once they enter the post-closure phase *so long as they are discharging pollutants.* Since the permit conditions must be adequate to prevent water quality limits from being exceeded, the implication is that expensive active treatment systems, adequate to meet all water quality standards, must be kept in operation *until the day when untreated effluent meets all applicable standards without treatment,* or at least meets them with passive measures alone. Suffice it to say that at some sites this could be a very long time, and could imply a very great deal of money: it is hard to call a site at which a million dollars a year are being spent on water treatment "closed."

17.6.2.1.2 Storm water regulations

For many years, the USEPA refrained from actively regulating stormwater runoff under the Clean Water Act. However, in November 1990, the USEPA published new regulations establishing a separate type of permit for pollutants contained in storm water discharges.[61] Storm water is defined as "storm water runoff, snow melt runoff, and surface runoff and drainage."[62] Under the storm water programme, permits must be secured for all stormwater discharges from a point source which are associated with an "industrial activity."[63] The regulations expressly state that either an active or an inactive mine is an "industrial activity."[64]

This affects the mining industry two ways. First, types of water discharges which were previously unregulated now are subject to permit requirements, again probably until the untreated effluent from the mine site meets standards without active treatment, which implies a long-term obligation. Second, so long as there is a stormwater programme, industry would like to include in the stormwater discharge permit various types of runoff, because in practice the standards in stormwater permits have been less stringent than those in traditional NPDES permits. Although, technically,

stormwater permits are to include numerical limitations based on effluent standards and water quality standards, just as traditional NPDES permits do, the first round of stormwater permits issued typically have not included such numerical limitations. Instead, the permits have included "best management practices" that the particular permit holder or industry group is required to implement. These best management practices in turn derive from a stormwater management plan that the permit applicant develops. The perception is that stormwater permit requirements are easier to meet than the numerical-based requirements of traditional NPDES permits.

In the Dodson Letter, the USEPA took pains to emphasise limitations on the types of discharges that it believes are subject to the storm water programme. According to the letter, storm water discharges are limited to those "directly associated with a precipitation or snow melt event." As a result, "any dry weather flow from mine adits, seeps, french drains and culverts are mine drainage or wastewater," and require permits under the traditional NPDES programme, which results in more stringent limitations. Under this EPA interpretation, most areas at an active mine require traditional NPDES permits, because the contributions of contaminants from storm water flows were considered in setting the effluent limitations which the NPDES permit standards are intended to help achieve, Thus, according to EPA, only certain ancillary areas of active mines, as well as inactive areas, can be handled with storm water permits. All other areas require the "traditional" NPDES permit.

The issue, as it is with the state reclamation laws, is that if there is going to be a requirement for perpetual or near-perpetual active treatment of effluents, there is no mechanism established in the law for ensuring that this is done. It is simply not reasonable to think that today's mining companies will be, or will want to be, around operating a growing list of water treatment plants at non-revenue generating sites; and there is little concept of what kinds of institutions, other than mining companies, can or should do this work. As agencies and companies develop *ad hoc* solutions to the problem, there are no solid legal criteria for deciding what kinds of arrangements are adequate.

17.6.2.1.3 Solid waste laws

Added to the concerns about requirements to treat water from historic abandoned sites, and the possible need to acknowledge a perpetual treatment obligation under the Clean Water Act, are the concerns (dealt with in part above) about liability under CERCLA, the statute which creates the Superfund. This is not the place for a treatise on the complex features of this statute, but a few comments are in order.

The Superfund concept was developed in response to a realisation that the country was home to a number of "orphan" landfills and chemical dumps, which were in some cases presenting a threat to public health or the environment, or were contamination sources whose effects were unknown. The consequences of applying this law to old mine sites were perhaps not considered carefully.

CERCLA[65] creates a system to identify potentially hazardous sites and list them on a National Priorities List. Sites are subject first to investigation. If the investigation confirms the existence of a serious problem, the process continues culminating in the design and implementation of a remedial programme.

The law also creates a federally controlled fund, the Superfund, which was formed by a tax on the chemical industry.

When a site starts into this process, the USEPA notifies all "potentially responsible parties" (PRPs) it is able to locate. These parties, who are the ones on whom the government will seek to impose liability if the fund itself is forced to pay for the investigation and cleanup, have the option to conduct the investigation and cleanup themselves, subject to government oversight. They often do so, because most PRPs have felt they can control costs — which they will ultimately have to pay — most effectively if they are managing the process themselves.

The entire process: site identification, investigation, listing, evaluation of possible cleanup options, and conduct of the cleanup are subject to numerous opportunities for public participation both for the PRPs and any other interested members of the public. This results in a somewhat slowed process, which has been one of the major criticisms of the act.

At bottom, the law has two distinct features. The first is taxing a specific industry that is thought not to have internalised its environmental costs in the past, in order to create a fund. The second is the attempt to identify and pursue specific parties at each site to reimburse the fund for its costs at that site. The former seems much less problematic and controversial than the latter.

The potentially responsible parties fall into four categories: the generators of any waste disposed of at the site, the operators of the site, transporters who brought any of the waste to the site, and owners of the site (at the time it was contaminated and after). Each of these four categories is subject to very broad definition; suffice it to say that almost any action on the site (drilling boreholes, moving waste material around, digging holes) which even arguably has added to the contamination, helped it spread, or made it less manageable is adequate for membership in the group.

Liability is retroactive, without limit. It is "joint and several," which means that any one or group of the PRPs may be liable for the whole cost of investigation or remediation if the others cannot be found or lack assets. And liability is without fault.

Obviously, no one likes being a PRP at a Superfund site. Just as obviously, *some* sort of mechanism to deal with cleanup at abandoned sites is an absolute necessity. There are some specific concerns which crop up in the mining industry, however, which are very significant at some sites.

One is that the history of the mining industry is replete with examples of new discoveries and rediscoveries in historic mining districts. The heavily mineralised zones generally were identified long ago and have historic mine workings, which often have environmental problems. Hypothetically, a chemical company that wanted to start a new plant today using all the most modern available concepts of pollution prevention and control could find many potential sites, which might be good sites or bad, but which at least would not involve becoming a PRP at a Superfund site. An equivalent mining company, wanting to run the cleanest possible operation, would find that many if not most of the places it could operate have previous environmental problems from historic mining which present some risk of Superfund liability. This is to say nothing of the fact that it is bad policy to give powerful incentives to develop new sites, often in healthy ecosystems, in preference to working in areas where impacts already have occurred.

And the risk is in some sense unknowable and unmanageable. Summitville had historic environmental problems before any of the recent mining activity on the site. However, these were probably not great enough to attract the attention of the Superfund authorities or merit a National Priorities List designation. Several mining companies, interested in the property, apparently conducted exploration programmes on the site, some of which reportedly involved drilling, sampling, or otherwise altering site conditions. Presumably, they were in compliance with all applicable laws. They decided not to develop the property, sold out, and moved on. Later, another company, Galactic Resources, and the related Summitville Consolidated Mining Company decided to develop the site. As they say, the rest is history.

When a few years later the then-bankrupt firm abandoned the site, it did have more than enough environmental problems to qualify for the National Priorities List. Galactic and Summitville appear to have no ability to pay for the cleanup. Their principal promoter is outside the U.S., apparently successful to date in avoiding any legal liability for the events, and having failed to date to reimburse the government for its costs.

The various mining companies that did nothing but explore the property, possibly causing some incidental effects in the process, are now either PRPs with joint and several liability for the whole cleanup bill, or at a minimum are under threat of being assigned PRP status in the future. How do you manage risk *when something someone else might do later* makes you jointly and severally liable for a $150 million cleanup?

The final note is that there is no effective programme in the U.S. for dealing with the environmental legacy of past mining. Superfund may address a few dozen of the worst sites, but it is too blunt a tool for the thousands of smaller cleanup actions required. In the absence of any serious funding for this purpose, one of the principal possibilities is remining: recovery of residual mineral values from tailings or other old mine workings, and relocating and reclaiming these wastes in the

process. Conducting this kind of operation in a historic mining district with existing environmental problems is, under the current parameters of Superfund, something only for the bold. And Superfund is not the only worry.

17.6.3 Fear of Retroactive Liability and its Effect on the Industry

An example of the problems that can arise in connection with activities undertaken on a historic mining site is the Penn Mine case from California, decided under the Clean Water Act. In the 1960s, a local utility district acquired part of the abandoned Penn Mine property, intending to build a reservoir on the property. The utility district and the state water quality control board then built a facility to contain toxic runoff from the old copper and zinc mine on the site. In normal conditions, the facility contained the seepage. However, in very rainy periods, it overflowed. Because the runoff containment facility did not eliminate *all* discharges from the site, an environmental group later sued the two agencies for discharging pollutants without an NPDES permit. The suit was successful, and the agencies, which had never been involved in operating the mine, were required to undertake further and very costly cleanup at the site.[66] The Penn Mine case is viewed by many, particularly in the Western states, as a barrier to state and local government and other third parties who may want to remediate abandoned mine sites, because it presents the potential of heavy liability, possibly perpetual, at any site where remediation fails to eliminate *all* discharge of contaminants, even if it represents an improvement over historic conditions.

The decision to develop a mining property requires analysis of a multitude of financial variables, some very hard to know, and taking significant risks. Any step which helps define or quantify the uncertain variables makes the decision easier. However, if the answer is that the obligation is now quantified but very costly, the decision may be easier to make; it is more likely to be no.

The critical regulatory issues in mine closure today in the U.S. do not in our view come from the body of mine closure legislation itself, which is working reasonably well. The real concerns seem to arise under the federal Clean Water Act and CERCLA, the Superfund legislation, and amount to:

1. Lack of clarity as to the long-term responsibility of the mining enterprise in maintaining the quality of water discharged from the mine site. This is critical because it appears that at some potential mining properties, no technology short of ongoing active treatment is going to meet water quality requirements. Many U.S. water quality parameters for such discharges are difficult and expensive to meet. If they have to be met in perpetuity, enormous costs are added. Whether or not the mining industry *should* have to pay these costs, the fact is that it has not in the past done so.
2. Lack of clarity as to how committed the U.S. is to maintaining the principle that, at least in most cases, requirements will not be imposed retroactively. Retroactive requirements may not be so great a problem in, let us say, light manufacturing, where the costs of the capital infrastructure are recouped in 6 to 8 years, and where technology may be subject to rapid change, obsolescence, and replacement. It is quite a different thing in the mining industry. The examples of litigation to require mining companies to pay to clean up problems created in the 1890s cause people in the industry to wonder how far this retroactive application of liability will be carried in the future.
3. Concern that if there is going to be a requirement for perpetual maintenance of water quality, mineral production in the U.S. can remain competitive with production in countries where industry does not face these costs.

The question may be less what is desirable than what is achievable: the world is rapidly globalising; the mining industry is at the forefront of this trend. The real issue is whether these problems can be solved by unilateral national decisions, or whether this is an example of the limits

or the ability of one country, even a rich and powerful one, to force global environmental policy changes unilaterally.

There are various ideas as to how to resolve these issues, which are largely beyond the scope of this chapter: however, the so-called "good Samaritan" proposal, deserves some mention, if only as an illustration of the tensions involved. As part of the pending Clean Water Act reauthorisation process, an effort has been undertaken, chiefly by the western states, to persuade Congress to amend the Act to include a "good Samaritan" provision. Such a provision would protect agencies or other third parties, which acquire abandoned or inactive mine sites for purposes of remediation by insulating them from liabilities of certain types after they complete their cleanup efforts.

The party doing cleanup could be exempt from future responsibility for post-cleanup discharge under the Clean Water Act so long as the cleanup met certain requirements. What those requirements are may be problematic: certainly, they should include the idea that someone who currently has liability to maintain water quality or protect other environmental values under the Clean Water Act or CERCLA, the Superfund law, cannot avoid existing obligations under those laws by some sort of half effort. If the goal is, and perhaps it should be, to identify situations in which the cleanup standards of Superfund or Clean Water Act discharge standards need to be relaxed because society cannot rationally justify meeting them, this should be done explicitly.

The other major provision of the "good Samaritan" proposal would exempt the entity cleaning up the site from Superfund liability, by clarifying that any resulting effluent would be a "federally permitted release" for which CERCLA does not impose additional liability.

Several issues regarding "good Samaritan" proposals remain unresolved. These include whether the exemption from liability should extend to any citizen-initiated lawsuits, and whether the exemption should extend to remaining of abandoned sites for profit. For a detailed discussion of the problems of remining historic or abandoned mines under the Clean Water Act, see Barry.[67]

The real issue remains: at many potential mineral deposits, including many in the historic mining regions of the U.S., there is now no technology that can deliver a "walk-away" site at the end of the closure period, i.e., capable of meeting existing clean water laws without ongoing expenditure into the indefinite future. The alternatives seem to be (a) to accept the idea of such perpetual liabilities and fund them by some enormous "up front" contribution deemed adequate to provide all costs necessary for perpetual treatment; (b) to accept the ongoing pollution as a necessary consequence of mining, and to develop some set of reduced, less stringent standards for these situations; or (c) to say "no" to mining at such sites. If the level of consumption by the U.S. consumer is not reduced, this will result simply in exporting this same set of extremely difficult decisions to other parts of the globe.

Finally, proposed reform of the 1872 Mining Law, which governs mining on public lands in the U.S., poses a whole new set of closure issues. Reform of this law is needed, but the consequences of the proposed legislative changes in the context of closure have been among the least examined and least satisfactory aspects of the proposed reform. The principal reform bill would, for example, further Balkanise the already fragmented administration of these programmes by creating yet another closure authority and yet another set of standards — these applicable only to certain types of mines, and only located on federal lands. The spectre is of competing agencies, none big enough to have the technical skill, the variety of experience, or the political clout to maintain an effective programme. One of the principal lessons of Summitville appears to have been that an agency needs a certain "critical mass" and a certain diversity of expertise in engineering, soil science, botany, law, geochemistry, and other specialties to be effective. "Carving out" a limited number of mines on federal lands and subjecting them to a different system does not seem the best solution.

17.7 CURRENT EXAMPLES OF BEST PRACTICE IN MINE CLOSURE

At its best, the U.S. system of mine closure planning has resulted in some significant accomplishments.

While industry commentators, watchdog groups, and regulators disagree about how to evaluate overall success of mine closure planning efforts in the U.S., there are mines that can claim some consensus of approval for their reclamation programmes. Indeed, these companies' reclamation practices are considered by some to represent the state-of-the-art in the mining industry. Examples of mines that have won praise from numerous quarters, including the industry watchdog group Mineral Policy Center in Washington, D.C., are Coeur d'Alene Mine Corporation's Thunder Mountain Mine in Idaho, and Homestake Mining Company's McLaughlin Mine in California.[68]

Coeur d'Alene has received mining industry awards as well as state and federal government awards for its operations and reclamation practices in Idaho and elsewhere.[69] Its Thunder Mountain gold mine in central Idaho, which was closed in 1990 and reclaimed by 1992, has been praised for its detailed reclamation plan and successful reclamation methods. Because the mine was located adjacent to a pristine wilderness area, there had been increased concerns about impacts on the environment — especially water quality — from mine operations and closure. Coeur d'Alene employed techniques in water management controls including silt fences, infiltration basins, and dispersion terraces[70] that some have credited with preventing adverse impacts to water quality.[69] Coeur d'Alene also did extensive work in cyanide management, including treating used ore with chlorine to oxidise the remaining cyanide, and placing a 20-foot deep clay liner in the mine pit before returning the ore to the pit; recontouring the heap leach pad areas, covering them with soil, and replanting the surface; and wrapping sediment from the solution ponds in plastic blankets, and then backfilling the ponds.[71]

At its "state-of-the-art"[68] McLaughlin Mine in northern California, Homestake has committed to achieving specific post-mining uses at various parts of the mine area, including wildlife habitat, recreation, and grazing.[72] Homestake has conducted reclamation throughout the life of the mine. The company additionally plans to achieve post-closure reclamation through use of such tools as covering a tailing impoundment with topsoil and revegetating the area; extensive backfilling, fencing and installing vegetative screening around the mining pit; and using native grasses and woody plants to increase wildlife habitat value and lessen visual impact.[73] Moreover, Homestake is reclaiming the 10,000-acre project site for use as an environmental studies research station, which it plans to develop in cooperation with local universities.[72] Homestake has stated that it will donate information and materials to the centre, including environmental baseline data, monitoring data, mapping materials, and geologic core.

17.8 CONCLUSION

At this point, all the major U.S. mining states have regulatory programmes requiring mine closure planning at most "hard rock" metal mines. While the state programmes differ in details, and while some of the state programmes are very new, the more established programmes such as Colorado's have accumulated substantial experience and have a major influence on mine closure practice in industry. This article has focused on the situations in which the regulatory programmes have encountered difficulties, which have been quite real: at the same time, the existence of these programmes has brought a new level of awareness to not only the large international operators, but the hundreds or thousands of mines operated by the medium and smaller national segment of the industry as well.

The greatest impact of regulatory mine closure programmes may well have been less to push the newest ideas or lead the dissemination of best practice in the industry, although there are examples where that has happened. The greatest impact may have been to encourage the spread of what is at minimum acceptable practice throughout the industry: some "floor" of performance.

These programmes have had the most impact in dealing with new operations that have come on line since the programmes were created. They have also had positive effects on closure planning at existing operations, though these effects have been limited by the realities of previous mine development, which was not planned with closure as an objective in many cases. The U.S. has yet

to develop an effective strategy for dealing with the significant environmental impacts at historic mines that were abandoned without closure work. There has been little progress in dealing with any but the most serious of these sites.

Experience indicates that there are three important aspects to a successful regulatory programme.

First is the closure plan itself. The plan must be based on sound baseline information and developed in conjunction with an operating plan before ground disturbance begins. If there are particular hazards on the site (e.g., acids, cyanide, or other toxic reagents) it is advisable to have an emergency plan for the site as well. These plans should be reviewed by an agency that has a variety of expertise in different disciplines, and should be subject to a public participation process.

Second, there is the matter of the financial guarantee. While many states have tried to find alternatives to the system of financial guarantee to avoid imposing these significant costs on industry, all of the major hard rock mining states have eventually found that some form of guarantee system makes the closure planning programme more effective. If there is to be a system of guarantees, the only sound basis for calculating their amount is good engineering estimates; any attempt to cushion the costs on industry by agreeing to bond amounts which are less than these actual costs loses much of the benefit of the system and opens the door to bureaucratic arbitrariness. Obviously, bonds need to be kept adjusted for changes in the operation or simply for inflation.

Third is the information element: baseline data, ongoing monitoring, reporting requirements, inspections, and enforcement. If the mine closure plan is to become an ongoing iterative process, which benefits from new information as it is developed, attention needs to be devoted to the less than glamorous questions of data acquisition, communication, and processing.

Finally, U.S. programmes are facing the challenge of a fundamental conflict. A major attraction to mine closure programmes from the industry viewpoint is the lure of being able to terminate the firm's responsibility for the site, absent unforeseen conditions, when a specific set of well-defined steps have been completed. Mine closure programmes have been developed with this concept as a fundamental underpinning: industry agrees to undertake certain steps, so long as they are required of everyone in the industry, and in return expects those steps to be the limit of its responsibility.

Major mining enterprises almost anywhere in the modern world will experience closure costs. The disadvantage in some places is that those costs are unknown, and thus very hard to anticipate or plan for. The advantage that U.S. regulatory programmes have sought to offer is that those closure costs can be fixed, with a significant degree of certainty.

Now, it is becoming clear for at least some sites that this kind of "walk-away" goal is not going to be met, at least not on a time scale of immediate relevance to those now living. To try to maintain the goal of a prompt, relatively clean closure at these sites may do violence to the nation's efforts to protect the quality of its waters. To "solve" this problem by requiring perpetual operation of active water treatment plants as the price of mining, but without requiring these costs to be paid "up front" is to invite a serious day of future reckoning. Requiring that those costs be paid or guaranteed in advance would be very expensive indeed, and may not, for reasons of cost competition, be something that can be implemented unilaterally by the U.S. in disregard of the regulatory posture of other major mining nations.

Implementing such a system would at least remove some of the current uncertainty over the retroactive application of new environmental laws: that could be brokered into a legislative compromise if nothing else. But if — and the subject deserves careful study — it imposes a cost level which excessively disadvantages U.S. producers, the consequence will be to export the production, and often the exact same problems, to nations with less technical and regulatory ability to deal with them. But profligate use of mineral resources coupled with unwillingness to experience directly the environmental externalities of their production would hardly be the first example where the consumers in the developed world have appeared hypocritical.

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