# CORPORATE SOCIAL RESPONSIBILITY AND THE CASE OF SUMMITVILLE MINE

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## ABSTRACT

A growing literature is developing parallel to increasing "voice of society" concerns about corporate social and environmental responsibility. Emerging research suggests that, while public policy might provide the framework for the internalisation of previous external environmental damage costs, it is corporate strategy that can make the difference between environmental disaster and pollution prevention, and responsible business practice is defined by its anticipative and pro-active approach to ensuring that pollution is prevented and mine closure us accompanied by clean-up and reclamation. The Summitville gold mine, an abandoned open pit and underground operation in Colorado is often described as an 'environmental disaster' and the most notorious example of inadequate design, poor operation and failed environmental management at a mining operation in the US, past or present. Now a Superfund site, and the subject of numerous legal suits and counter-suits, its unplanned and sudden closure and abandonment in December 1992 has had profound implications for environmental protection, the costs and benefits of remedial treatment, technology issues and the regulatory process in both the USA and globally.

Of great import are the factors that influenced the development of events at Summitville, and these are discussed in two broad areas: corporate strategy during the development and operation of the site; and, the regulatory framework within which the mine was permitted, operated and abandoned. Finally, the implications of the abandonment of Summitville mine for the wider mining industry, regulatory authorities and the policy literature in this field, are discussed.

*Keywords:* Corporate social responsibility; Mine closure; Superfund; Environmental management; Acid rock drainage.

## CORPORATE SOCIAL RESPONSIBILITY

While in financial terms, the designation as a 'disaster' is probably true, with in excess of $150 million so far being spent from public monies on remedial work at the site since its abandonment, it is less clear as to whether the site is a 'disaster' in terms of impacts on the physical environment and potential risks to human health. It is not the purpose of this paper to merely review the wealth of technical, regulatory and legal literature that relates to Summitville. Instead, it analyses the chain of events that culminated in the abandonment of the site in 1992 and post-abandonment remedial work by the US Environmental Protection Agency (USEPA); and draws out the implications for corporate strategy. This is undertaken within the context of growing demands from society for the mining industry to be more socially and environmentally responsible for its long-term indirect as well as direct effects.

The development of the concept of corporate social responsibility has fast expanded since the days when it was considered that: "… the social responsibility of business is to increase profits…" (Friedman, 1970). For example, Andrews (1988) argued: "… corporate strategy …is the pattern of decisions in a company that determines and reveals its objectives, purposes, or goals, produces the principal policies and plans for achieving those goals, and defines the range of business the company is to pursue, the kind of economic and human organisation it is or intends to be, and the nature of the economic and non-economic contribution it intends to make to its shareholders, employees, customers and communities…". And, more recently, Drucker (1993) stated "….[corporate] citizenship means active commitment. It means responsibility. It means making a difference in one's community, one's society, and one's country…..".

Corporate social responsibility is defined here as the internalisation by the company of the social and environmental effects of its operations through pro-active pollution prevention and social impact assessment so that harm is anticipated and avoided and benefits are optimised (Warhurst, 2000a). The concept is about companies seizing opportunities and targeting capabilities that they have built up for competitive advantage to contribute to sustainable development goals in ways that go beyond traditional responsibilities to Shareholders, employees and the law.

The drivers of these changes include (Warhurst, 1998):

- Globalisation, liberalisation and increased foreign direct investment world-wide
- Societal pressures, which are increasingly expressed as demands to address quality of life impacts, consultation, accountability and disclosure, and are sometimes pushed by special interest groups (e.g. NGOs)
- Regulation, which is increasingly becoming more integrated across the three environmental media of land, water and air and covers impact assessment and planning for closure
- Financial drivers, that is environmental and social conditionality applied to the granting of credit, equity investment or political and environmental risk insurance
- Supply chain pressure, which includes purchaser's growing requirements for audited and verified environmental and, more recently, social proficiency
- Peer pressures from other companies and reputational management
- Internal pressures from employees and shareholders; and finally
- The natural dynamic of environmental change itself, such as climate change and rising sea levels.

It is in the context of the evolution of these drivers for enhanced corporate social responsibility that the Summitville mine operation was developed, operated and closed which, in part, accounts for the world-wide critical appraisal that accompanied its acquisition of "superfund" status.

As mining has continued along the path of mechanisation and automation, the direct links *via* employment and financial benefits for local communities have diminished, reducing the acceptability of mining in the eyes of local stakeholders and posing new challenges to companies in terms of preventing pollution affecting local communities' livelihoods and health and finding new ways to deliver benefits in the form of social development or community projects[1]. In a more general sense, the image of the industry has become increasingly battered since the rise of general environmental awareness in the 1970s and 1980s, with each new environmental incident adding a further dent. This has left the industry prey to small but vociferous pressure groups, which are able to command the environmental and ethical high ground, and as public opinion continues to swing against the industry, so this is increasingly reflected in regional and central governments' attitude towards the sector as a whole, particularly as the role of mining in generating GDP declines. This has become apparent in the past 3-4 years in the US, with the federal government taking an increasingly confrontational attitude towards the industry despite the major bridge building that has occurred between environmental regulatory agencies and the industry during that same time. Summitville mine is an operation that is often quoted by pressure groups to represent much that needs to be addressed by today's mining industry. However, the real situation is more complex than any such simplistic assessment, and involves broader elements of corporate strategy and regulatory control that must also be considered. This paper seeks to contribute to that process through:

- Reviewing of the events leading up to and taking place during the operation and post-abandonment at Summitville and their environmental consequences
- Suggesting some implications for corporate management and strategy
- Drawing some conclusions of relevance to the emerging field of corporate social responsibility.

## Overview of Events – From Permitting to Abandonment (1982-1992)

Summitville mine is located in Rio Grande County, Colorado (USA) at an average elevation of 11,500 feet. Surrounded by the Rio Grande National Forest, the site is bounded to the north by the Wightman Fork of the Alamosa River and to the east by Cropsy Creek. Cropsy Creek meets Wightman Fork near the north eastern perimeter of the site. This also represents the downstream boundary of the site (Pendleton *et al*., 1995). Wightman Fork enters the Alamosa River approximately four and a half miles downstream of the confluence with Cropsy Creek. Annual precipitation at the site (1,400 mm, mainly as snow) significantly exceeds water lost through evaporation (610 mm per annum).

Before 1870, when mining for gold began, the site consisted of uplands, wetlands and South Mountain. Since that time, mining has radically altered the local topography and biophysical environment. Although placer mining took place on Cropsy Creek and Wightman Fork from 1870 to 1873, it was extensive underground mining of the north-eastern flank of South Mountain between 1873 and 1940 that had a far greater disruptive impact due to the creation of access roads and waste disposal sites. In the late 1960s, Wightman Fork was also diverted to the north of the site to enable

[1] Natural Resources Cluster of the World Bank: Business Partners for Development Papers produced by Mining & Energy Research Network, Corporate Citizenship Unit, Warwick Business School, UK: Carter, 2000; Carter & Kapelus, 2000; Molloy, 2000; Warhurst, 2000b, Warhurst 2000c.

the construction of a large tailings pond. Consequently, by the 1980s, when the chain of events that lead to the eventual abandonment of the site and its classification as a Superfund site, there already existed a considerable legacy of land and water contamination over and above that resulting from the occurrence of natural mineralisation in the region (as detailed by Posey et al. (2000), natural mineralisation upstream of Summitville has an impact on water quality of the Alamosa River downstream of the site).

The principal owners of the surface and mineral estates of the area that encompassed the Summitville mine at the time of the events described in this paper were Aztec Minerals Corporation, Gray Eagle Mining and South Mountain Minerals Corporation. In 1984 the owners leased the property on which Summitville mine is located to Galactic Resources Inc. (GRI), and its wholly owned subsidiary Summitville Consolidated Mining Company Inc. (SCMCI), which designed, built and operated the final mine facility.

Operational design and environmental management in the context of declining gold prices.

Groundwater at the site occurs in a number of discontinuous and shallow perched aquifers. Some of these shallow systems discharge waters to the surface on a seasonal basis. Bedrock throughout the site is highly fractured and numerous springs and seeps occur, linked to the annual precipitation cycle (Pendleton et al., 1995). Rainstorm-related seeps also arise, particularly during the month of August. Therefore, it is clear that water management was always going to be a serious issue at the site.

In terms of setting the environmental baseline, SCMCI were required to create no incremental impacts in addition to those already in existence. They met the permitting requirements set at the time, and were not required to clean up prior mining impacts. The baseline conditions were assessed at the site and submitted to the Colorado Mined Land Reclamation Board (CMLRB) and were accepted as being adequate as judged against the standards across the state operating at the time of the submission. From the outset, the decision not to address past pollution suggests that a potential future problem was being built into the project and; from a corporate social responsibility perspective, we can note a regulatory framework that did not require past pollution to be addressed that could be interpreted as storing up problems for the future.

Beginning in 1984, SCMCI, the designer and operator of the final mining operation at the site, excavated waste rock and ore to create an open pit on the northeastern flank of South Mountain. The excavated material was either dumped in waste piles along with fines (undersize material) or placed on heap leach pads prior to the recovery of gold. Waste rock was also used extensively in the construction of roads, embankments and parking areas on the site (Pendleton et al., 1995).

Initially, there were plans to process separately the two types of ore found in the deposit: clay ore and vuggy silica ore. Indeed, a separate crusher and conveyor system was installed for each ore type. However, plans to agglomerate and leach the clay ore never came to fruition, and the ore remained stockpiled with the dedicated crusher and conveyor almost unused (Pendleton et al., 1995). One explanation for the latter was the high cost of the process in the context of the decline in gold price from nearly US$800 in 1982 to half that amount by the time operations began in 1986. The decline in gold price also exerted pressure on the operator to begin production as quickly as possible, without a fully detailed plan. Further problems arose as SCMCI changed consultants during the construction process, compounding continuity and management problems.

Although the abandonment itself was sudden, with the benefit of hindsight, there were indications of trouble ahead before the dramatic fall in gold price. For almost one and a half years before the abandonment, GRI and SCMCI had been subject to State agency mandates, requiring them to evaluate contaminants being released from the site. They were also required to develop remedial measures with the aim of eventual site reclamation (Pendleton et al., 1995).

In the period prior to the abandonment, other state and federal agencies were also involved in the monitoring of the mine site and the surrounding areas. Environmental and operational management issues identified at the site included:

- The permit was issued and construction commenced before a number of critical issues were fully resolved, on condition that they would be resolved later on. In a very real sense, planning never caught up with what was happening on the site. This particularly relates to closure planning.
- Difficulties in maintaining the integrity of the liner system under the heap leach pad, following its construction during the winter. Concerns regarding bank financing of the operation and the fear of reducing the potential profitability of stock options made to senior staff appear to have generated significant pressure on contractors to remain on schedule with the liner construction despite extreme weather conditions (Wilkinson, 1997). Deadlines that related to bank loan commitments also appear to have been a contributing factor (Danielson, *pers. comm*). Moreover, a number of changes were also made to the design of the liner system that were neither submitted to the state regulators for approval nor properly considered prior to implementation (Danielson *et al*., 1994).
- Leaks were detected between the upper and lower liners, and through the lower liner within a week of beginning heap leach operations in June 1986. This leaked effluent was subsequently pumped back onto the heap leach, further aggravating the overall water imbalance (1,400mm per annum precipitation against 610mm per annum evaporation) at a site where the leach portion of the project was initially envisaged as being zero discharge (Colorado Court of Appeals, 1996) through water entrainment in the leach material, enhanced evaporation and “aggressive” surface water management.
- Failure to stop construction and repair the liner when significant leakage became obvious also contributed to the unfolding environmental impacts and liabilities.

In 1989, SCMCI obtained approval for a process water treatment plant. However, this plant was unable to meet the water treatment standards required, and SCMCI then sought and obtained permission to allow for land application of the treated process water. This application was to be undertaken at a controlled rate to allow evaporation and percolation into the ground and attenuation of the contaminants. However, the company obtained approval for a land application system as an interim response without making it clear that it did not own all the land that it wished to use for the application. When the company failed to obtain permission to use the neighbouring land, it increased the rate of application on the land that it did own, contributing to overload flows to Wightman Fork and Cropsy Creek (Colorado Court of Appeals, 1996). It is worth noting that many of the clean-up standards were considered futile at the time by SCMCI due to the existing contamination from historical mining activity and natural mineralisation.

Each of these issues reflects significant failures in planning, and operational and environmental management in the face of increasing financial pressure to enter and continue the production phase in the context of declining gold prices.

**Site abandonment and crisis management**

The day before SCMCI petitioned for bankruptcy, the company submitted a revised reclamation plan to the Colorado Division of Minerals and Geology (CDMG) and the Colorado Mined Land Reclamation Board (CMLRB) that included additional costs ranging between $20.6 and $38.6 million. Had this plan been accepted, the company would then have been required to provide additional funds in the form of a bond amounting to the projected costs of reclamation (Pendleton et al., 1995). In the aftermath of the abandonment, some of the remedial measures presented in the plan were actually implemented by the USEPA (Miller *et al*., 1995) (see below).

On 1 December 1992, GRI alerted authorities of the State of Colorado that they intended to declare bankruptcy and abandon operation of the site on 16 December, 1992 (Pendleton et al., 1995). At this time the fluid level in the cyanide heap leach pad was five feet below the emergency spillway (giving a storage capacity, assuming normal precipitation, of 2-3 months) and contained an estimated 160 million gallons of cyanide and metal-bearing waters. It was also anticipated that any failure in pumping capacity from the heap leach underdrain would result in the direct discharge of acidic cyanide-bearing effluent into Cropsy Creek and subsequently Wightman Fork, a tributary of the Alamosa River, (Pendleton et al., 1995). These two immediate threats apparently could not be dealt with at State level and a request was made for emergency response assistance from Region VIII of the USEPA on 4 December 1992, under the Emergency Response Fund of the Superfund. USEPA personnel and contractors, working with SCMCI staff ensured that the necessary water circulation and treatment were continued to remove the immediate threat of direct effluent discharge (Pendleton et al., 1995).

**Bonding as a mechanism to assure environmental responsibility**

In retrospect, reclamation bonds at the site could be deemed to have been inadequate. Indeed the initial bond was set in 1984 before the Superfund system was sufficiently understood by the mining community and before Colorado had an effective mine permitting structure. The mining permit issued in 1984 required a reclamation bond of $1.3 million This applied to the grading, shaping and capping of surface wastes, but did not include a component for heap detoxification, water treatment or remediation. An additional surety of $0.9 million posted in August 1989 covered a "one-time" rinse of the heap, but this still did not include water treatment costs. An additional bond of $5 million was posted on June 21, 1992 following the realisation that major revisions would be required to the reclamation plan. By the autumn of 1992, with site grading completed, and the commencement of water treatment, the company requested and obtained the release of $2.5 million. On site abandonment, therefore, the surety bond was approximately $4.7 million (Filas and Gormley, 1997). However, this was effectively to guarantee performance of a predefined reclamation plan, rather than to address potential "disasters" or sudden site abandonment. Additionally, much of the bond was effectively worthless as it was in the form of equipment (such as the water treatment plant) which could not be removed from the site. Also, the non-payment of taxes led to tax liens senior to the reclamation lien.

**Long-term environmental issues**

In terms of pollution issues, the post-closure environmental concerns largely mirrored the concerns that were extant prior to abandonment (e.g. water contamination by cyanide and heavy metals); rather it was the scale of potential impact that changed following abandonment by SCMCI. The environmental issues of concern are summarised below:

**Acid Rock Drainage**

Surface drainage from the site ultimately reported to Terrace Reservoir, approximately 17 miles downstream of the confluence of the Wightman Fork and Alamosa River. From there it continued to the San Luis Valley where homes, farms and ranches depended on wells or river water for potable drinking and agricultural water supplies (Pendleton et al., 1995). As such, the movement of contaminants into surface and ground waters was the principal concern. Prior to mining, shallow water flow was controlled by non-mineralised faults in the rock mass and the permeable vuggy silica zone (Plumlee *et al*., 1995b). Sub-surface workings then became the major controlling factor via the creation of drainage adits. These were in turn modified by the creation of the open pit, which aided the transfer of water into the sulfide-rich mine workings below (Plumlee et al., 1995b).[2]

Although it was the potential release of cyanide that catalysed the mobilisation of state and federal staff and the involvement of the USEPA at the site, it was the generation of acid rock drainage (ARD) that represented the most significant of the long-term environmental risks. ARD at Summitville is among the most acidic and metal-contaminated in Colorado (Plumlee et al., 1995a) and has been an issue for many decades. The situation was aggravated by water-soluble secondary salts (e.g. iron and copper sulphates) formed by the evaporation of metal-contaminated acid waters during dry periods in summer and autumn. These salts subsequently re-dissolved in rainwater and snowmelt to form highly acidic, metal-rich waters. Therefore, the major long-term challenge was ultimately to prevent the oxidation of sulphides and dissolution of secondary metal salts, particularly from the numerous waste piles situated on the site (Plumlee et al., 1995a).

**Waste rock piles**

The initial assumption that since the ore body was in the oxidised zone associated wastes would not generate acid, was proved to be incorrect. Substantial quantities of sulphide minerals were present in the oxidised zone as pockets, and these were removed along with the gold-rich oxide mineral assemblage. Failure to properly identify potential acid-generating material inhibited the implementation of

[2] Part of the remedial plan submitted the day prior to notice of abandonment was to assess the possibility of reconfiguring the pit to increase surface run-off, and reduce infiltration to ground water (Miller et al., 1995).

pollution prevention from the outset and also had severe detrimental impacts on the capacity of the waste management plan to deliver an appropriate level of environmental protection. As gold present in sulphide minerals was not amenable to cyanidation, SCMCI limited the amount of sulphide-rich material reporting to the leach pads, instead dumping it on waste piles. These extensive sulphide-rich waste piles became a major source of ARD, exacerbated by poor and haphazard waste management practice. For example, at least one of the waste piles was dumped on a spring-fed bog, which increased the volume of ARD generated and the release of metals into solution (Pendleton et al., 1995).

Waters from the waste piles and adits ranged in pH from 2.3 to 3.2 and contained extremely high concentrations of metals and other elements. In general, the waters from the waste piles were of lower pH and higher metal concentrations than the discharges from the adits (Plumlee et al., 1995a).

**Reynolds Adit**

Although there are other adits on the site, Reynolds Adit was the most significant as it was the lowest of the historic underground workings (Roeber *et al.*, 1995) (approximately 200 feet lower than Chandler Adit, and 550 feet lower than Iowa Adit). Reynolds Adit was used to lower the water table at the Summitville site and thus reduce the costs of pumping. Flow-rates varied between 380 l $min^{-1}$ up to an average peak of 1,500 l $min^{-1}$ during the spring when snowmelt was occurring (Pendleton et al., 1995).[3] As it drained the mineralised zone of South Mountain, dissolved metals in the discharge from the adit were relatively high. Prior to 1988, copper was present at 20-30 mg $l^{-1}$. However, it appears that the excavation of the open pit (the floor of which was about 300 feet above the adit) promoted infiltration of water and oxidation of the ore, and in 1989 the concentration of dissolved copper began to rise, reaching approximately 130 mg $l^{-1}$ by 1992. In June 1993, copper reached its highest documented concentration of 650 mg $l^{-1}$. Work by Plumlee et al. (1995a) indicated that iron, aluminium, zinc and arsenic showed a similar increasing trend in concentration. The quantity of metal discharged from Reynolds Adit was equal to that discharged from the remainder of site, including the waste piles.[4]

**REMEDIAL ACTION AT SUMMITVILLE: RETROSPECTIVE RESPONSIBILITY**

Cropsy Waste Pile, Cleveland Cliffs Tailings Pond, the Beaver Mud Dump, the open pits and the underground workings were identified as the major sources of ARD on the site (Ketellapper *et al.*, 1995). These were the priorities for a three phase programme[5] of remediation which was chosen on the basis of cost effectiveness and potential efficacy from five alternatives (Ketellapper et al., 1995; Ketellapper and Christiansen, 1998).

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[3] Although undocumented flows up to 6,000 l $min^{-1}$ have been reported.

[4] The amount of copper released from the entire mine site was up to 4.1 t $day^{-1}$, approximately half of which was discharged from Reynolds Adit prior to its plugging in 1994.

[5] Each phase of the remedial plan had a voluntary contribution of 10% from the State of Colorado (Williams, 1995). Phase III also involves a potential nine year period of flushing of contaminants from the areas beneath the sites of Cropsy Waste Pile, Cleveland Cliffs and Beaver Mud Dump prior to their removal to the open pits (Williams, 1995).

**Waste backfilling**

The three phases were designed in order to remove acid generating rock from saturated areas, to backfill the open pits and also reduce infiltration into the underground mine workings (Ketellapper and Christiansen, 1998).

- Phase I and Phase II consisted of the lining of the north and south open pits with a clay liner and two feet of lime and subsequent removal of the majority of Beaver Mud Dump, Cropsy Waste Pile and Cleveland Cliffs Tailings Pond to the lined pits. Approximately 3.6 million $m^3$ of acid generating waste were relocated to the pits during the period 1993-1996.
- Phase III included capping and vegetation of the infilled south pit in 1995 and revegetation of the sites from which waste had been removed (Ketellapper et al., 1995). The north pit backfilling is continuing (Ketellapper and Christiansen, 1998) and eventually it is planned that this will also be capped.

Active treatment of ARD from Reynolds Adit in the form of a portable interim treatment system (PITS) using caustic soda solution as the precipitating agent, was installed in July 1992 (Logsdon and Mudder, 1995; Roeber et al., 1995). The coagulated and flocculated sludge was disposed of on the heap leach pad. This was subsequently backfilled to the open pits.

In 1995, the area around the tailings pond was excavated and re-designed as the Summitville Dam, which was to serve as a catchment area for the majority of flows generated on the site and to facilitate water treatment through a single central facility (Ketellapper and Christiansen, 1998). At present, the Dam has a capacity of $3.4 \times 10^8$ L and the treatment facility a capacity of 3,400 L $min^{-1}$.

**Adit plugging**

In January 1994, Reynolds Adit was plugged in order to reduce the discharge and re-establish pre-adit hydrologic conditions (Plumlee et al., 1995b). Some discharge continues from the adit due to fractures in the rock around the plug (Plumlee et al., 1995b). Plugging was suggested in the remedial plan lodged by SCMCI the day before abandonment as a means of saturating the workings and controlling the ingress of oxygen (and oxidation of sulphides) (Brown, 1995). The assumption that saturation will control sulphide oxidation is not necessarily correct due to the presence of ferric iron (a strong oxidant) in secondary salts. However, plugging is also expected to promote the movement of water through the rock mass, increasing the opportunities for attenuation.[6]

The full effects of plugging and pit capping have yet to be determined in terms of source reduction of acid, metal-laden waters. However, it is assumed that if land reclamation and revegetation on site is successful, that water treatment may no longer be a continuous necessity as preventative measures improve water quality (Ketellapper and Christiansen, 1998) due to the reduced infiltration of water and the

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[6] Based on batch tests, the attenuative capacity of the rock mass (assumed to act as a porous body) for copper was calculated as at least 123,000 t and for zinc at 11,000 t. This capacity could theoretically hold all the copper present in the ore body above the elevation of Wightman Fork and 25% of the total zinc present in the same portion of the ore body (Brown, 1995).

return of the sub-surface environment to its pre-mining anoxic state.[7] This preventative approach is potentially important when it is considered that to date nearly 55% of the project costs (approximately $65 million) have been spent on water treatment (Ketellapper and Christiansen, 1998). By way of comparison, adit plugging has accounted for approximately 1% of the total project cost, yet may well have contributed significantly to source reduction in the short-term.

However, capping and flooding of the workings above the Reynolds Adit will not completely stop water flow into the pit area as cavity-bearing silica outcrops and faults outside the backfilled and capped area may allow groundwater recharge of the area beneath the cap (Plumlee et al., 1995b). Therefore, any cavity-bearing or faulted areas may also have to be isolated or capped.

Equally, adit management through the use of plugs may only reduce the metal loading in the short-term, depending on the future movements of subsurface water and their expression at the surface via seeps, springs and streams. Water may also exit through adits at higher elevations as the head of water builds. Redirecting water from one route (e.g. by adit plugging) may lead to greater metal loading if that water is forced through more highly mineralised wastes or in-situ workings. At Summitville this occurred when seeps reappeared on the north side of the site (due to the plugging of adits) and water passed through the North Waste Dump (waste rock pile).

### Seeps and springs

Prior to backfilling of the wastes to the open pits, seeps and springs drained the various waste dumps (with at least one waste dump positioned on a spring-fed bog). Historic (pre-mining) seeps and springs are marked by deposits of ferricrete (precipitates of iron oxide/hydroxide minerals that occur as iron-rich acidic groundwater flowed to the surface) (Plumlee et al., 1995b). These gave some indication of the possible discharge points that might re-activate when Reynolds Adit was plugged (in 1994). Since the plugging of the adit, seeps east and north of the open pit have either started or increased in flow rate (Plumlee et al., 1995b), typically at sites of historic flow. In particular, seeps bearing increased metal loads appear to be the result of water passing though the North Pit Waste Dump

The removal of the priority waste dumps to the open pits was considered likely to reduce the significance of new seeps and springs. However, with the plugging of Reynolds and Chandler Adits, the historic seeps and springs along the northern site boundary are considered likely to be of greater significance as groundwater flow returns to its pre-mining pathways. These discharges, however, need to be viewed in the context of other natural sources of acidity and dissolved metals in the Alamosa River basin (Plumlee et al., 1995a) et al et al et al

## ANALYSIS: CORPORATE STRATEGY AND ENVIRONMENTAL IMPLICATIONS

The legacy that SCMCI inherited was, in retrospect, a considerable one - with Summitville a site that had been subjected to massive and continuous surface disturbance, accompanied by fundamental changes to ground and surface water flow paths. There existed little historic documentation of the nature of wastes disposed of

[7] Equally important of course are any changes in the acceptable concentration of metals in waters discharged from the site.

around the site. Undoubtedly, changes in operational responsibility since the site was first worked in 1872 were an important factor in determining the final environmental impact of the site, as contaminating wastes were deposited or discharged and responsibility for them was “lost” by subsequent owners and leasing companies.

From the perspective of SCMCI and GRI, inheritance of a legacy of on- and off-site environmental problems could have been mitigated in part by a proactive and thorough baseline survey of existing conditions from the outset of their involvement. More importantly, the leasing of the site itself might have been reconsidered had GRI considered environmental liabilities previously identified in a mine feasibility study undertaken by Anaconda in 1983 (Anaconda, 1983). This had contributed to Anaconda's assessment that the mine development was not economically viable. The issue of environmental liabilities appears to have been ignored by GRI.

Irrespective of the fact that it inherited a significantly contaminated and disturbed site, SCMCI failed to address the issue of social responsibility and its environmental implications. It had in its power the capacity to predict potential ARD generation from waste piles (through, for example, the application of static and kinetic leach tests). It also had the opportunity to take the necessary steps to avoid acid generation by implementing various waste management control options (e.g. isolation of sulphidic material and minimisation of the exposure of sulphide-rich altered clay zones in the open pit). Evidence suggests it followed neither of these routes.

Furthermore, SCMCI did not appear particularly adept at meeting the requirements of day-to-day operation and rehabilitation on-site. Although permits require reclamation on closure, no studies are required to prove that the company involved can actually achieve the proposed reclamation targets (Williams, 1995). This gap between apparent capacity and reality seems to have been a significant factor for SCMCI. Radical changes were made to Colorado’s mine permitting laws as a result of this (see Danielson and Nixon, 1999 for further details relating to changes in permitting and bonding in Colorado).

There has been a considerable debate as to whether Summitville is sufficiently different from other mine sites to justify the higher level of expenditure that has occurred, as summarised in Table 1, and if the risks to human or wider ecosystem health were as large or significant as originally anticipated. According to Williams (1995), Summitville is far from unique in terms of type and location. Neither is it the only mine being addressed under the USEPA’s Superfund programme. However, it is the first of the modern heap leaching gold mines to be addressed in this way, and it is also the sole mine on the Superfund list for which the associated watershed has not been irretrievably degraded by historic mining activity. Notwithstanding, it should be noted that other factors such as local geochemical conditions, construction of logging roads, accelerated erosion and tourism have also been quoted as significantly degrading the quality of the river (Mendonca, in NAM, 1997).

**Table 1. Costs of remedial action at Summitville mine (data from Ketellapper and Christiansen, 1998)**

| ACTIVITY | COST | COMMENTS |
|---|---|---|
| Water treatment | US$65 million (to end of 1997) | Includes treatment of cyanide bearing water from the heap leach pad and ARD |
| Source removal and pit capping | US$32 million (to end of 1997) | Does not include cost of capping the north open pit |
| Adit plugging | US$1.7 million | Total cost – plugging programme completed |
| Recontouring and reclamation | US$45 million (estimated) | Cost of recontouring and capping the heap leach pad was US$15 million. Estimated cost to complete site reclamation is US$30 million |

Therefore, relative to other mining-related Superfund sites, the Summitville Mine is a potential long term economic “sink” as more money is poured in to prevent deterioration of water quality in the Alamosa River basin.

Some researchers have questioned whether the total estimated investment of $150 million in remediation will ultimately prove worthwhile given the other non-mining related pressures on water quality in the region (Mendonca, in NAM, 1997). This seems to be borne out in part by the recent work of Posey *et al*. (2000) that defines the significant contribution to water quality deterioration of natural acid drainage formation (*i.e.* that which is not anthropogenic in origin) and earlier work by Bove *et al*. (1995) indicating that acid generation in the Alamosa River basin predated mining activity by millions of years based on the local and regional geology. Other researchers have stated that considerably less investment was required to achieve an acceptable level of remediation. This last point may have some justification, given that the purpose of Superfund clean-ups is to reduce or eliminate risk to human or ecosystem health, not to return a site to its pre-industrial condition (Wilkinson, 1997). Notwithstanding any of these points, the Superfund programme cannot have clean-up goals at Summitville beyond pre-mining water quality conditions.

The events leading up to the incidents at Summitville are generally well understood (although as with any human endeavour, the written word can only paint a rough picture of cause-and-effect relationships). It is accurate to say that none of the different actors were entirely blameless and that none were entirely to blame, and that the permitting and regulatory frameworks shaped events as much as the mismanagement at the corporate strategy level that occurred during site development and operation. The regulatory framework as it existed at the time could be considered in part a catalyst for the events that followed – leeway and loopholes combined with a lack of a strategy of corporate social responsibility will often lead to unforeseen and undesirable effects. However, the design, implementation and enforcement of regulations are complex procedures, and as with many human activities, can be undermined by human fallibility. Regulatory frameworks must evolve, as must the industry, to incorporate lessons from past shortfalls in compliance and performance. In Colorado at least there are clear signs that the regulatory framework has adapted to ensure a greater degree of regulatory control over all stages in the mining process – from permitting through to eventual closure.

SCMCI has been the subject of a great deal of 'retrospective criticism' (based, in part, on applying 1990s standards to a 1980s operation) as a result of its corporate strategy and inability or unwillingness to remain with the confines of the regulatory framework. Although regulation (in the form of the Colorado Mined Land Reclamation Act of 1976) was limited in its scope and relatively lenient, SCMCI was deemed to have violated a number of key provisions under the Act, for example, partially or completely changing or omitting design features outlined in its permit application without consulting either the CDMG or CMLRB (Danielson et al, 1994). Indeed, on 2 May 1996, SCMCI pleaded guilty to 40 felony violations of federal environmental laws at the Summitville site, and was fined $20 million. SCMCI entered guilty pleas to charges of conspiracy, unauthorised discharge of pollutants, failure to make required reports and making false statements or documents. The company was indicted in June 1995 along with the mine's environmental manager Tom Chisholm. Additional charges were filed against the mine, Chisholm and the general manager Samye Buckner in November of the same year.

Although the SCMCI operation did undoubtedly cause greater oxidation of sulphides and release of metals (see, for example, water quality data in Van Zyl, 1996), it begs the question of whether it is appropriate to criticise the company for that increased ARD generation at the time when the mining, regulatory and environmental communities did not have the same awareness of acid drainage as is nowadays the case. Against this must be balanced the fact that neither a pro-active nor an integrated approach to environmental management and pollution prevention was apparent in the strategy of SCMCI at Summitville. All this, of course, is in the context of a regulatory framework that limited the regulators' capacity to intervene directly.

There are, in any case, specific lessons to be learned from Summitville, including the necessity of effective isolation of sulphidic wastes from water and oxygen in wet climates[8] and the need to reduce the effects of wet-dry cycles and the concomitant build-up of secondary metal salts. Seeps and springs need to be properly documented before mining takes place to ensure acid-generating wastes are not placed near them (Plumlee *et al*., 1995b). Perhaps the most pertinent fact is that these points are largely accepted as being in line with definitions of "best practice" and - based on years of costly experience within the industry – common sense approaches to water and waste management. However, it appears that dissemination of best practice within the industry in the area of ARD is not as effective as it could be. This could be considered to typify the whole issue of ARD; an increasing knowledge base is being generated about preventative and control methods, yet it continues to feature as a major environmental problem.

## CONCLUSIONS: CORPORATE SOCIAL RESPONSIBILITY: TOWARDS ENVIRONMENTAL PERFORMANCE BEYOND COMPLIANCE

Summitville is proof that the potential for substantial environmental impact remains a reality even at modern mine sites, as indeed, Danielson *et al*. (1994) note.

[8] In wet climates, the absence of neutralising minerals in the ore or host rock indicates that the risks of ore exploitation may be high in the context of ARD generation. The movement of ARD off-site in the absence of buffering capacity is also aggravated (Plumlee et al., 1995b). One could question whether such deposits should be worked at all.

But equally, it can be used to demonstrate that a number of discrete factors need to occur in sequence for such disastrous pollution events to occur, and in the majority of cases most mining operations in well regulated and enforced regimes cannot truly be considered “the next Summitville waiting to happen”. There is however a risk that the resultant “over-regulation” of operations in certain countries (e.g. the USA, Canada and Australia) may cause the problem to be transferred to countries where regulation is less stringent, or cannot be enforced.

Moreover, the Summitville case demonstrates that there were other strategies that SCMCI and GRI could have followed that would have been more socially responsible and have yielded fewer negative implications

Mining – barring a paradigm shift in technology – by its very nature will continue to have impacts on the physical environment, be they transient, temporary or permanent. It is perhaps easier now to envisage a time when negative environmental and social impacts can be properly managed, minimised or eliminated throughout the industry. Technological change and the development of effective environmental management systems have contributed significantly to merit this optimism. Against this must be balanced the benefits that the extraction and processing of mineral resources can bring. Although impacts continue, the mining industry is largely unlike that of 50 or even 25 years ago. However, the relationship between most stakeholder groups and mining companies is based largely on past, rather than present, performance and impacts. It is unreasonable to suggest that every mining site is a “Summitville waiting to happen” – although undoubtedly there are many that represent a serious environmental and/or social risk beyond that which is acceptable. Equally, it is problematic to criticise retrospectively or prosecute companies that can be shown to have met regulatory obligations in place at the time of starting operations. Notwithstanding this view, the new concept of a corporate strategy of social responsibility does address the fact that there indisputably exists a pro-active role that can be played by business; and, the Summitville case illustrates how, in one situation, corporate strategy might have been implemented differently, The burden of responsibility, however, may need to be shared with government (Tilton, 1994). Where voluntary initiative has not been taken, in those cases where companies have actively sought to exploit loopholes in regulation or have stepped outside of the regulatory process as part of a purposeful policy to achieve internal strategic or operational targets, there is still a need for strict regulatory enforcement. It is not always easy, or even possible, to differentiate between these two scenarios of “responsible but misconceived compliance” or “opportunistic compliance”. Even in the case of Summitville, some would argue that the nature of the regulatory framework aggravated the likelihood of a pollution event.

The task that the industry faces, it is suggested here, is communicating effectively the difference between these two scenarios to stakeholder groups by pro-actively addressing pollution that has resulted in cases of “misconceived compliance” and by isolating, rather that protecting, opportunistic polluters.

How can the wider industry distance itself from specific incidents as they continue to occur at various locations around the globe? One potential answer lies in the emerging capacity to allow consumers (via intermediaries such as manufacturers and fabricators) to differentiate between sources of metals, and apply pressure through the supply chain on poor performers. Through an overarching framework of environmental and social performance indicators (ESPIs), it would be possible to audit companies at corporate and site-specific levels. This auditing process might be undertaken by an independent body, for which funding could be partially derived from a premium applied to metals from “quality assured” sites (with part of the premium also passing to the company in question). This approach is of course open to abuse, particularly in countries where regulatory frameworks and enforcement are weak, or where corruption is endemic, but the concept is not without precedent (e.g. the accreditation of timber producers under a general theme of “sustainability”).

The Proceedings of Summitville Forum ’95 contains a whole gamut of opinion and evidence from the narrowly technical and scientific, through to the sociological which could be considered to be more value-laden. What is almost more important than the content of the proceedings is that this range of opinion exists as it does, demonstrating that the same incident when viewed from different perspectives can lead to so many diverse assessments.

Events such as occurred at Summitville will undoubtedly occur again sporadically and it is important that lessons be drawn from this case to reduce the likelihood of future pollution.

In a more general sense, conclusions that can be drawn from this case include:

- Modern as well as historic mining may be associated with environmental problems.
- Proactive baseline monitoring and ARD prediction, monitoring and management from the outset are of paramount importance.
- Environmental liabilities need to be assessed and addressed before new mining begins or when ownership of a site changes - responsibilities need to be defined from the outset.
- Management capacity, as much as technical expertise, is paramount in putting together the elements of what could be considered good practice in ARD and other pollution prevention and management.
- A cost-effective approach by the industry must be to anticipate and plan effectively, proactively preventing environmental damage rather than reacting to *post-facto* damage.

Todd and Struhsacker (1997) contend that the past performance of the mining industry as represented by old or abandoned operations does not represent what will happen at new and modern sites. This point is certainly borne out by the results of their (limited) survey. However, it is interesting that a notable absentee from the mines that they considered was Summitville. While using Summitville as a “stick” with which to beat the industry cannot be justified, on account of the specific circumstances of that site, neither can the experience of such modern sites, where significant errors have occurred, be ignored. By failing to analyse the problems the industry runs the risk of failing to learn from past experience and meet its societal obligations to plan for optimal and acceptable environmental performance at future sites.

The Summitville story is a useful demonstration of what is meant by corporate social responsibility in operational terms. It demonstrates first, that regulatory weakness - the failure of the public policy framework – is not the sole cause of environmental pollution. It shows that there is not "one way" to do mining. It suggests that different companies can achieve good or poor performance. It demonstrates, secondly, that companies can take different strategic options. They are neither bound by regulation nor need to be limited by it, where experience dictates superior strategies to prevent pollution or manage environmental impacts in innovative ways.

Therein lies the operationalisation of the concept of corporate social responsibility – the pro-active implementation of a strategy of internalising responsibility to protect the environment and mitigate negative social impacts, even where the regulatory framework has not anticipated a problem and the safeguards put in place wouldat the outset have been considered, albeit erroneously, as adequate.

At present the mining sector is judged by its worst performer, therefore, the Summitville story warrants analysis; and, we are not suggesting our conclusions are the only ones that could be drawn. There is a misconception, within a broad sector of society, that mining is necessarily polluting and that this is the only way it can be done. The analysis above suggests the industry needs to address how best to differentiate between three key categories of corporate strategies and to demonstrate their different implications to a critical public:

- Poor environmental performers exhibiting mismanagement, technical blunders and an abuse of a weak regulatory regime or regulatory loopholes
- A compliant performer that is within the law but exhibits poor performance on account of regulatory weakness or failings and a genuine failure to predict pollution in spite of best efforts
- Good environmental performers that endeavour to select socially responsible corporate strategies irrespective of regulatory requirements so as to prevent pollution, avoid disaster and ensure mining truly contributes to sustainable development goals.

It is in the power of individual companies to choose which category they operate in, and clearly we have a situation world-wide where companies can be empirically located by virtue of their performance in each of these categories. The first step forward for business, however, is to define which strategic option is to be pursued and, secondly, those companies following the third "strategic option" may need to differentiate themselves from other companies and report comprehensively to interested stakeholders on their performance beyond compliance. By the same token, it is becoming even more important for a discerning public and for critical special interest groups to encourage and recognise those companies that are distinguishing themselves and are behaving responsibly, so as to help ensure an upward trajectory of improvement continues.

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