Tailings Under the Bridge: Causes and Consequences of River Disposal of Tailings, Coeur d'Alene Mining Region, 1886 to 1968

by Keith R. Long

Fresh from the Coeur d'Alene gold excitement over the winter of 1883–84, Prof. J. W. Tiernan told the *New York Tribune* that, in his opinion, "the history of the Colorado mining region will be repeated in the history of the Coeur d'Alene District: the real wealth will be found in the baser metals." His words were prophetic. From discovery to the present day, the Coeur d'Alene mining region has yielded over $26 billion worth of mostly lead, zinc and silver, as measured in today's dollars.[1]

While liberating these metals, miners also produced about 109 million metric tons of tailings. Of these, some 56 million tons, containing an estimated 800,000 ton of lead, were dumped into the Coeur d'Alene River and its tributaries. Discharging large volumes of heavy–metal–laden tailings into local streams created immediate problems for miners and those living downstream, and resulted in a long history of litigation and mitigation, constrained by physical and economic realities. The legacy of eighty years of river disposal of tailings hangs over the Coeur d'Alene mining region today, as governments and surviving mining companies search for a way to finance remediation of a contaminated area which stretches over a hundred kilometers from the Coeur d'Alene into eastern Washington (Fig. 1).[2]

Early Milling Operations

As prospectors swarmed over what would become

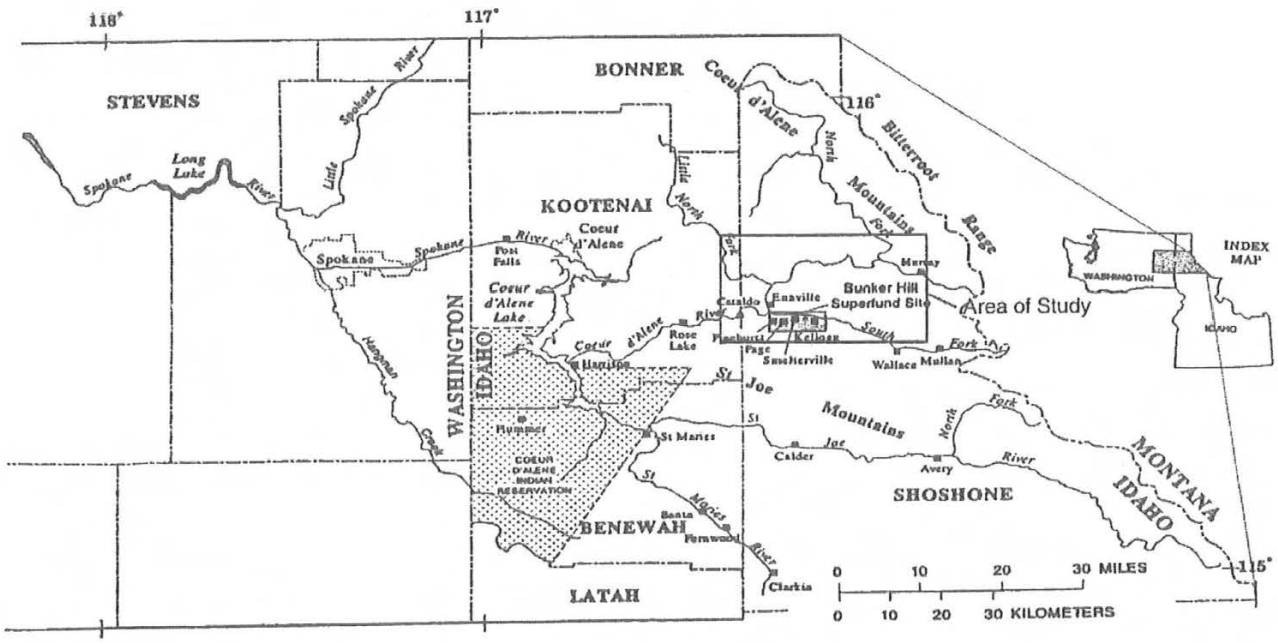


Figure 1. Map showing the location of the Coeur d'Alene mining region, Shoshone County, Idaho (indicated by the box labeled "Area of Study").

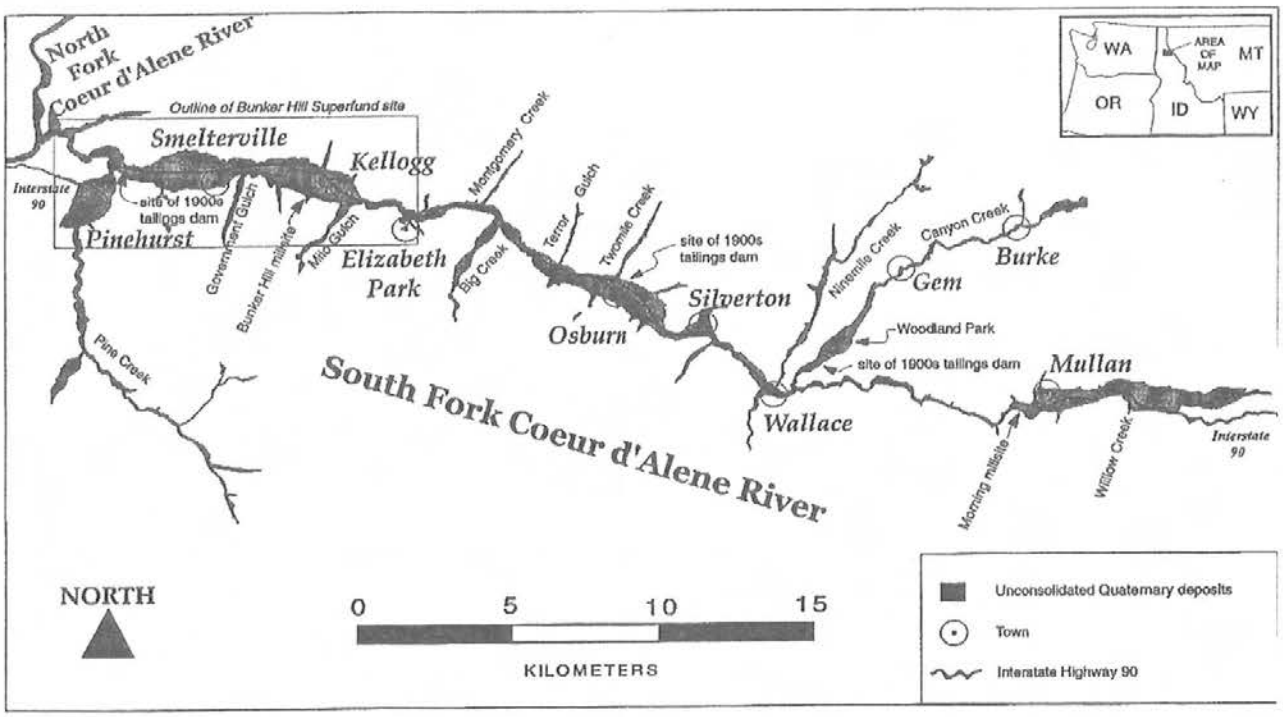


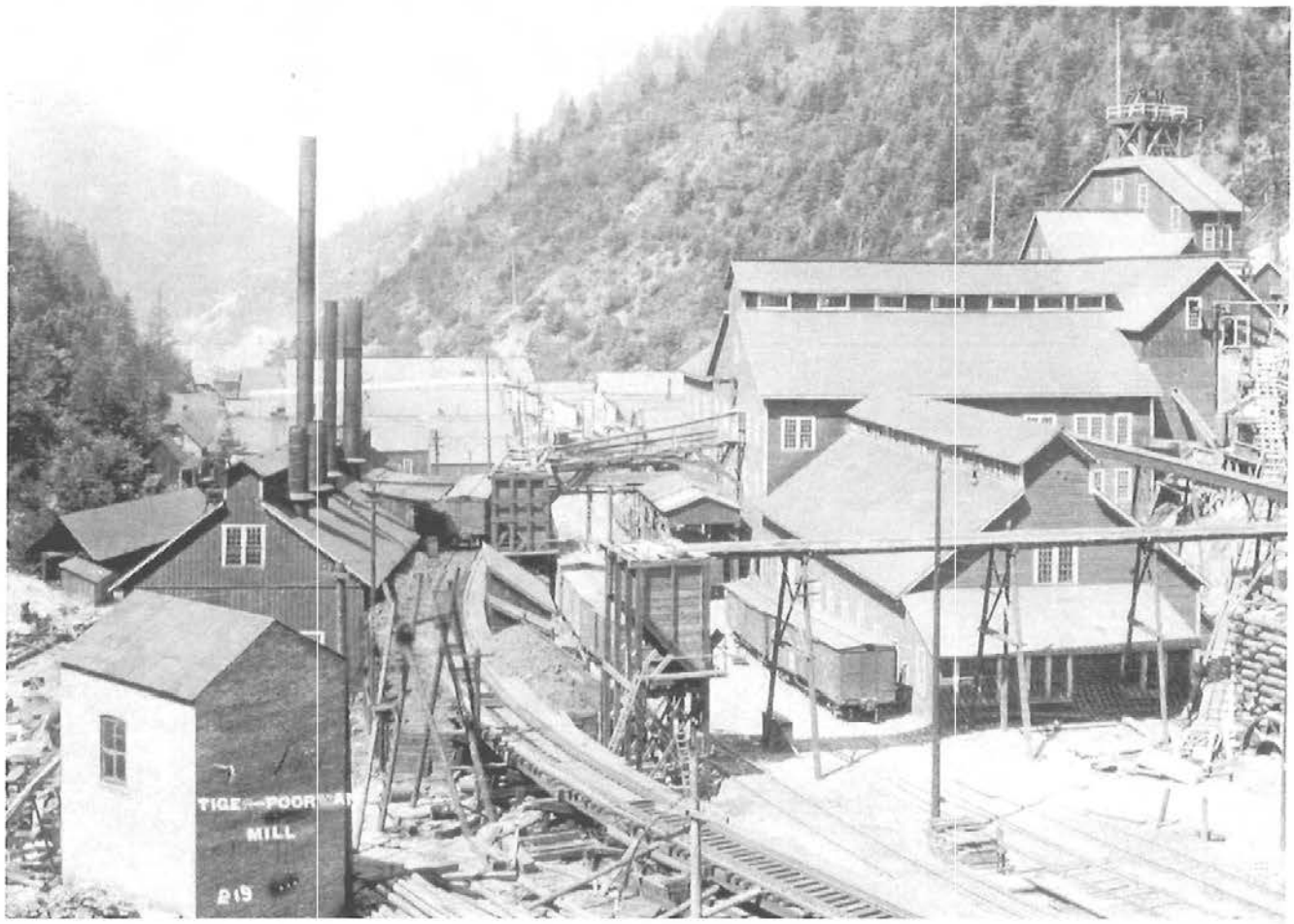
Figure 2. Map of the principal part of the Coeur d'Alene mining region, showing the flat areas suitable for tailings storage (in stippled gray). Note the location of the three tailings dams, built from 1901 to 1903, at Pine and Canyon Creeks and the town of Osburn.

the Coeur d'Alene mining region late in the spring of 1884, they found spectacular veins of high grade silver–lead carbonate and sulfide ores along Canyon Creek, in Milo Gulch, and elsewhere. Once these veins were opened, miners quickly learned that while quantities of high–grade, direct–shipping ores were small, milling–grade ores were abundant. The Helena Concentrating Co. built the first concentration mill in the region in 1886 at the Bunker Hill & Sullivan Mine in Milo Gulch. More than ten concentrating mills were built elsewhere in the region over the next three years. The technology of the day dictated the choice of concentrating method. This system—originally developed in the lead fields of southeastern Missouri—consisted of the close sizing (sorting by particle size) of relatively coarsely–crushed ore, followed by jigging of coarser and tabling of finer fractions, and some attempt to use a canvas plant or round tables to treat slimes. Metallurgical efficiencies ranged from about 40 to 70 percent, which meant a considerable loss of metals in the tailings.[3]

Tailings disposal is a basic problem in locating a mill. Knowing the potential loss of economic values to tailings, engineers were keen to stockpile them pending technological improvements that would warrant their reprocessing. But the topography of the Coeur d'Alene mining region was a major obstacle to that practice. Only a small percentage of the region consists of flat valley bottoms, the remainder is mountainous (Fig. 2). The few low, flat areas often lay a considerable distance from the mines and had to accommodate urban, transportation, and other land–use requirements. Limitations of space are most obvious at Canyon Creek, where a very narrow valley had to accommodate a mine, surface plants, concentrating mills, two railroads, a wagon road, offices, stores, homes, liveries, and saloons. The narrow range of choices for locating a mill and arranging tailings disposal is well illustrated by a report which dealt in part with the location of a mill for the Black Bear Mine about 1916. The company had to choose between a site at the mine in Canyon Creek which had no space to store tailings, and a leased mill near Wallace with room to store only part of the tailings to be produced. No mill was ever built.[4]

For most mine operators, unable to stockpile, getting rid of tailings posed a major and costly problem. Some mills, such as the Standard, gave tailings to any taker—principally railroads, which used them for ballast. Tailings became the preferred material for any type of fill or road building, and were even used to make bricks. A more convenient and common way to dispose of tailings was to dump them into a flowing stream to be washed away. But most streams in the region do not flow at a useful rate year–round; they often become a trickle or even dry up in the late summer and fall. Tailings would then accumulate in the channel, until no more could be held, and mills would shut down until the next "freshet" washed the tailings away. Even when streams were flowing adequately, mines upstream would pollute the water used downstream, generating acrimony and litigation. On 26 December 1892, the flume which carried tailings from the Frisco Mill around the town of Gem broke, nearly drowning the town. Tailings choking river channels increased the frequency of flooding, posing a hazard to towns all along the Coeur d'Alene River and killing some fish.[5]

During the 1890s, as milling operations expanded, the lower Coeur d'Alene River Valley was homesteaded. This area ran from the confluence of the river's North and South Forks, just below the mining region, to Lake Coeur d'Alene. Those farmers located right along the river would soon find their lands covered with tailings–contaminated sediments after spring floods had subsided. It is not clear when tailings first reached these homesteads, but some controversy may have developed by 1900, be-



Tiger-Poorman Mine and Mill complex at Burke on Canyon Creek, Lelande Mining District, Coeur d'Alene mining region in 1904. The narrow canyon left little room for a mine and mill plant, two railroads, a wagon road, houses, offices, and businesses --forcing mine operators to build over Canyon Creek, which passes through an underground conduit. (Photo 8 -X219, Barnard-Stockbridge Collection, University of Idaho Library.)

cause the following year the Bunker Hill & Sullivan Mining and Concentrating Co. built a dam across the South Fork just above its confluence with Pine Creek to capture slimes discharged by its large milling complex at Kellogg. The dam caught tailings from other mills farther upstream as well as material eroded by the river from the large stockpiles of tailings accumulating next to the Bunker Hill's mills. Other mining companies subsequently built tailings dams across South Fork at Osburn and on lower Canyon Creek (Fig. 2).[6]

The Bunker Hill company may not have needed a public outcry to encourage it to improve its tailings disposal practices. By then the company had retained Curtis H. Lindley, a leading authority on mining law and the author of *Lindley on Mines*, as its chief counsel. In his treatise on mining law, Lindley noted that English common law had long prohibited poisoning waters with mining wastes. This prohibition had been established in Idaho law in 1875 when the Territorial Supreme Court had ruled in *Ralston et al vs. Ploughman* that "No person . . . has the right to cover his neighbor's land with debris from his mine or mill. . . ."[7]

Lindley summed up his legal opinion on river disposal of tailings as follows:

> Any discharge of tailings is not held to be a nuisance *per se*. Any unreasonable restriction is to interdict the prosecution of lawful enterprise and practically to confiscate property of considerable value. However, courts have

Tailings-laden waters of the South Fork of the Coeur d'Alene River, Shoshone County, Idaho. Contemporary accounts describe the river as having a "lead-gray" color due to the fine tailings held in suspension. This photo was taken 4 December 1811 by T.N. Barnard as part of a series documenting the condition of the South Fork within the Coeur d'Alene mining region. (Photo 8-A71f, Barnard Stockbridge Collection, University of Idaho Library.)

Town of Wardner stretching up Milo Gulch, Yreka Mining District, Coeur d'Alene mining region. The dump of the Last Chance Mine and Mill is to the left, with the Bunker Hill & Sullivan Workings in the foreground. Lack of room for tailings disposal forced the removal of the Last Chance and Bunker Hill & Sullivan Mills to the Smelterville Flats area outside Kellog by the time this photo was taken by F. L Ransome on July 31, 1904. (U.S. Geological Survey Photographic Collection, Denver, Colorado)

> never held that depositing tailings on the lands of another is the same, or has the same rights, as using a stream by prior appropriation. One may only obtain the rights by prescription to use streams to dispose of wastes, not to flood lands with debris and damage property values. Although first use determines water quality standards under riparian law, if damages or nuisance is substantial, common law applies. Injunction may be granted if the costs of impoundment or other remedy are found to be inexpensive.[8]

The Idaho state constitution of 1890 established a strict riparian rule for apportionment of water, gave absolute preference in water use to mining in established mining districts, and declared mining a public use with powers of eminent domain. An ex-

treme interpretation of these provisions, unsupported by precedent, would translate this absolute preference into a right to pollute. Although Lindley obviously rejected this view in favor of the less risky strategy of purchasing pollution easements, many mine operators strongly argued that having absolute preference in water rights gave them a right to do anything they wanted with that water. The courts would uniformly reject this view and vindicate Lindley's position. The Bunker Hill company, in building its dam, was acting quite consistently with what Lindley would likely have advised—that the company reduce its exposure to common law liability for damages caused by the river disposal of part of its tailings.[9]

Litigation Begins

Homesteaders Josiah and J. S. Hill filed the first lawsuit alleging damages from river disposal of tailings in 1903. The defendants, the Standard Mining Co. and copartners in the Mammoth Mine, with adjacent mills on Canyon Creek just above Wallace, had long disposed of tailings into the South Fork of the Coeur d'Alene River. The plaintiffs claimed $12,000 in damages. The defendants contested the allegations vigorously, despite the modest sum involved, perhaps fearing more suits if the plaintiffs succeeded.[10]

Other lawsuits followed, including *McCarthy et al vs Bunker Hill*, which would eventually reach the U. S. Court of Appeals, and *Doty et al vs Bunker Hill* which alleged $1,223,000 in damages. As these suits wound through the courts, mine owners hired a detective to spy on the plaintiffs, all farmers living along the lower reaches of the Coeur d'Alene River. Casner shows that little was gained from these undercover efforts, but several companies, including the Bunker Hill, began purchasing land and pollution easements along affected parts of the river. Serious flooding of Wallace in the fall of 1905 was blamed on tailings clogging the river. In response, mine owners purchased a tract near Wallace for tailings storage and installed a 3,000 short–ton–per–day scraper–conveyor in the river bed to cut a new channel.[11]

In 1906, the Idaho Supreme Court awarded damages on appeal of the original lawsuit, *Hill et al vs Standard Mining Co. et al.* The judges, appraised of the practical difficulties of tailings disposal by the defendants, concluded that the damages were not preventable but were compensable. Judge J. Ailshie, in overall concurrence, qualified this opinion, writing: "I do not conceive it necessary to successful operation of a milling or concentrating plant that thousands of tons of rock, waste and debris should be dumped into the stream from which water is taken. But, if it should be shown that no other dumping ground could be had, then it would seem clear that diligence and care should be exercised in impounding such debris."[12]

Casner portrays the verdict in *Hill et al vs Standard Mining Co. et al* as a clear–cut victory for the mining companies, but the ruling certainly conforms to Lindley's opinion, discussed above. By placing tailings in waters owned by the state of Idaho, the mining companies put themselves at risk for damages and injunction. Their "victory" consisted of escaping the latter, but the plaintiffs had not sought an injunction against river disposal of tailings, only damages. Under these circumstances, the subsequent actions of mine owners make sense. They aggressively sought out–of–court settlements, which enabled them to settle for damages without exposing themselves to the risk of injunction, and they took other measures to prevent lawsuits, including purchasing affected lands, gaining pollution easements, and building protective dykes.[13]

The Hill brothers' success in securing payment for damages may have stimulated more lawsuits. Mrs. Mathilde Matheson through attorney A. G. Keans, for example, brought individual suits against each of the mining companies for amounts varying from $1,500 to $12,000. Some litigants did pursue injunctive relief. In 1908, the U. S. Court of Appeals in San Francisco decided *McCarthy et al vs Bunker Hill et al.*, rejecting injunctive relief but granting damages. The court had difficulty accepting claims of damages based on anecdotal evidence. Even granting these damages, the court found them to be quite small relative to the costs of shutting down one of the most productive mining regions in the country.

After this ruling, enthusiasm among the plaintiffs waned and many sold their land or granted pollution easements to mining companies.[14]

Some mining companies touted this ruling as a vindication of their view that the supremacy of mining in the allocation of water rights in mining districts also conferred a right to pollute those waters. A careful reading of the ruling shows otherwise. Again, Lindley's opinion was upheld, and even cited, but the ruling also introduced a consideration Lindley did not anticipate. The judges used what we would call a cost–benefit test to help determine whether injunctive relief was called for. Assuming that an injunction would close most or all of the mines in the Coeur d'Alene mining region, the court concluded that the costs of terminating the employment of thousands of miners and depriving mine owners and the nation of millions of dollars in mineral production far exceeded the damages alleged by the plaintiffs.[15]

After this case concluded, mine owners removed their spy and continued to purchase lands and easements, a process not completed until 1911. In 1910, a jury awarded one million dollars— the largest settlement to date—in *Doty et al vs Bunker Hill.* Reports of lawsuits disappear from the mining journals and the local press after 1910.[16]

Tailings Reclamation

Tailings in the river were not just a problem, they were an opportunity. Fresh, unoxidized tailings could be treated in improvised jigs or canvas plants, yielding a marketable product. No report of such activity has been found prior to 1904, when the Safford brothers began sluicing tailings into a jig plant from the site of the old Last Chance Mill in Milo Gulch. They quickly encountered a problem which would confront all future tailings reclamation operations: the same river and dumps used to dispose of tailings were also used to dispose of sewage and garbage. The Safford brothers—jigging a tailings stockpile also used as a garbage dump—actually had something of a windfall, recovering old coins, scrap iron, axes, cartridges, revolvers, hammers, wrenches, drill bits, gold rings, and all manner of domestic refuse.[17]

In 1905, Bunker Hill began to experiment with reworking its jig tailings stockpiles at Kellogg, efforts which led to rebuilding the Sweeny Mill for tailings reprocessing in 1919. The first efforts to recover river tailings on land leased behind the Pine Creek and Canyon Creek Dams were reported at the same time. Recovery of lead and zinc concentrates from river tailings was first reported in the U.S. Bureau of Mines Permanent Individual Mine Records in 1906. Increasing prices for zinc and the relative resistance of sphalerite in river tailings to oxidation helped stimulate these efforts. These seasonal operations were conducted by small, independent miners who were able to make a modest recovery of zinc values and a smaller amount of lead. In 1907, Guggenheim Exploration sampled and conducted flotation tests on the larger tailings dumps and accumulations in the Coeur d'Alene mining region, but concluded that reprocessing would be uneconomical.[18]

Flotation was first introduced into the region at the Morning Mine of the Federal Mining & Smelting Co., which installed the McQuiston flotation process in 1911 to recover zinc concentrate which had previously been discarded with tailings. From 1913 to 1914, more conventional flotation machines were installed at several mills. These successfully recovered lead concentrate from vanner tailings, and zinc concentrates from jig and table tailings. Confidence in the flotation method grew quickly, and the flotation process completely replaced vanner concentration over the next two decades. The use of flotation to treat river tailings was quickly mooted, but not attempted until 1917, when the Hayes Company began reprocessing tailings dredged from behind the Pine Creek tailings dam. The presence of sewage, wood pulp, and other vegetable matter in the dredged tailings caused considerable trouble. The company resorted to screening out garbage and wood pulp, and treating what remained with sulfuric acid, which sulfidized carbon so that it would not interfere with oil–based flotation. This operation continued—apparently at a profit—until the supply of treatable tailings was exhausted in 1929. Other attempts to process river tailings by flotation were not as long–lived or economically successful. Re-

Black Cloud Mill, lower Ninemile Canyon, Placer Center Mining District, Coeur d'Alene mining region, 1907. This is a typical, if small, gravity mill which used jigs, tables, and vanners to recover lead concentrate. Concentrates were bagged and loaded into box cars such as the ones shown next to the mill. Two flumes are shown, one carrying coarse tailings from the jig section (upper flume) and the other removing middling tailings from the table section (lower flume). These flumes conveyed tailings to stockpi les on the flat land adjacent to the mill. A third flume, at ground level, carries slimes from the vanner section to the creek. Operators of this mill were fortunate to have lands suitable for storing the coarser fraction of their tailings. (Photo 8 -C32, Barnard Stockbridge Collection, University of Idaho Library.)

processed tailings yielded new tailings, which were largely disposed of by dumping them into rivers. Hence, tailings reprocessing was never seen as a practical solution to the tailings disposal problem.[19]

Effects of Flotation

The introduction of the flotation process gradually changed the character of the tailings produced. Pure gravity mills generated mostly coarse to middle–sized tailings from jigs and tables, along with a relatively small amount of slimes. Recovery by flotation improved if tailings from jigs and tables were reground to 150–mesh or less prior to treatment. This greatly increased the relative amount of slimes in the tailings produced. By the late 1930s, the entire mill feed was being finely ground and treated exclusively by flotation, jigs and tables being dispensed with entirely. Coarser jig and table tailings could easily be stockpiled or impounded behind wooden dams at Pine and Canyon Creeks and the town of Osborn. Slimes would typically escape inter-

Mill of the Big Creek Mining Co., Big Creek, Yreka Mining District, Coeur d'Alene mining region, 1920. This mill sent tailings i nto Big Creek immediately above the intake for the town of Kellog's water system. Promptly restrained by court order, the compan y built a flume which took its tailings around the water intake. The stockpiles may be concentrates. (Photo 8 -X607A, Barnard-Stockbridge Collection, University of Idaho Library.)

ception, pass over or by dams, and enter the lower reaches of the Coeur d'Alene River more quickly and travel further than the coarser jig and table tailings.[20]

Heavy spring runoff in May, 1917 breached the tailings dams at the town of Osburn and at Canyon Creek, flooding the town of Kellogg. These dams were not repaired because they were already filled when breached. Although it survived the floods, the Pine Creek Dam was also nearly full. In 1919, in *Polack vs Bunker Hill*, some $3,500 in damages were awarded to the plaintiff for the negligence of the defendant in releasing slimes and not maintaining the Pine Creek Dam. Polack was among a minority of landowners who had not sold a pollution easement. As more and more mills converted to flotation, the silt load in the Coeur d'Alene River increased. By the early 1920s, a large plume of slimes extended into Lake Coeur d'Alene from the mouth of the Coeur d'Alene River.[21]

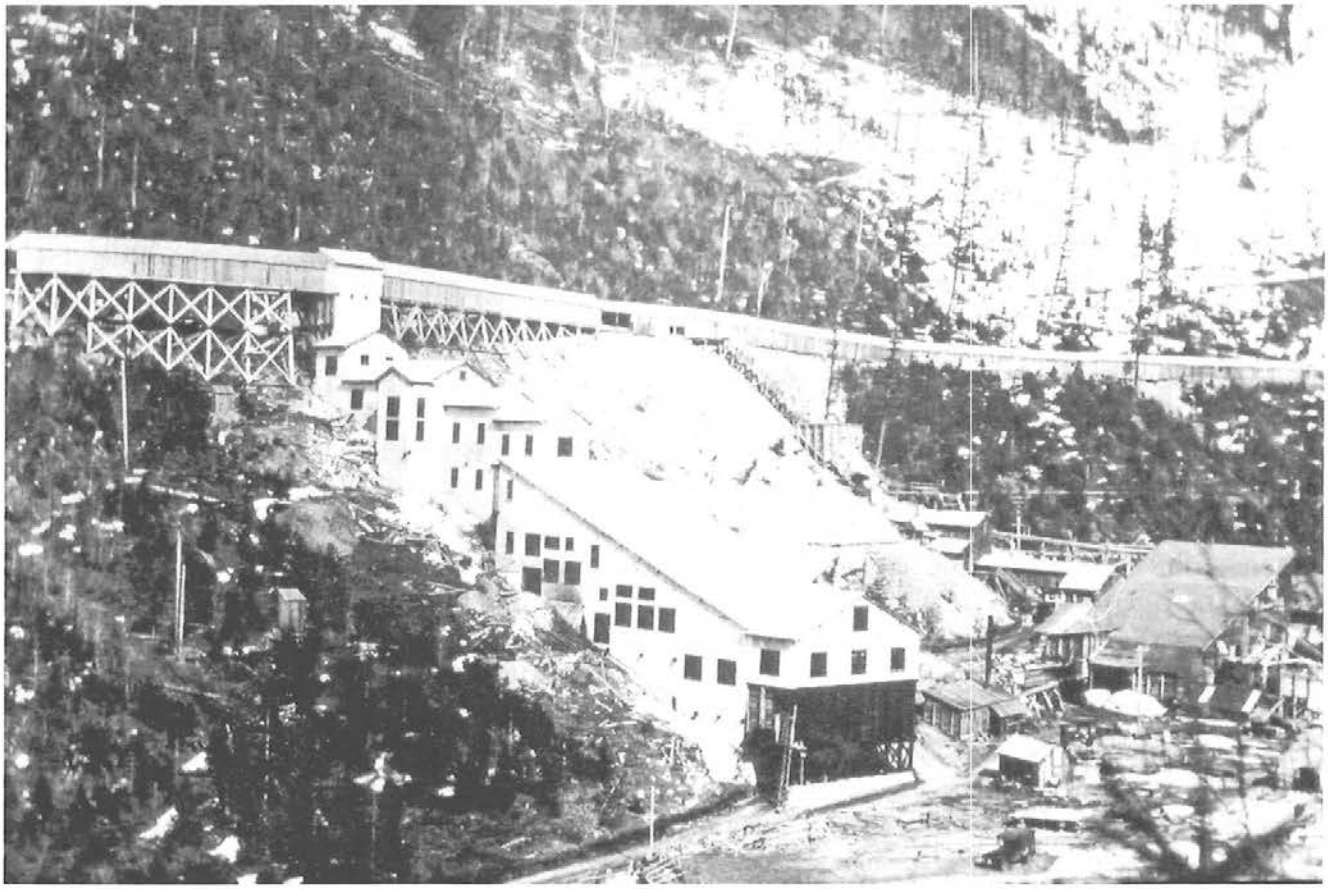
Large corporations were not the only miners caught up in tailings litigation. In 1920, Big Creek Mining Co., Ltd. started its new mill, discharging tailings into Big Creek just above the intake for the town of Kellogg's municipal water supply. The city and the local water company quickly sued and obtained the first injunction ever granted in the mining region against the discharge of tailings into a river. With only 34 employees and processing at most 75 short tons per day, the company could not win a cost–benefit argument against a municipal water supply. The company ceased operations for a few months, during which time it built a tailings flume to bypass Kellogg's water intake, discharging its tail-

ings further downstream.[22]

Discharge of slimes into rivers could only be prevented by using large settling ponds. The first of these was built by Bunker Hill in 1928 within a large impoundment built from old jig tailings at what is now known as the Central Impoundment Area. Once this pond was in commission, Bunker Hill ceased discharging any of its tailings into the South Fork of the Coeur d'Alene River. Another settling pond was built at the junction of Tributary and Eagle Creeks to handle tailings from the newly developed Jack Waite Mine. Complaints from the Forest Service and local landowners had forced the company to suspend its milling operations and river disposal of tailings on 1 July 1930 and to undertake corrective measures.[23]

Casner describes in detail a campaign started by John Knox Coe, city editor of the *Coeur d'Alene Press*, to have additional settling ponds built in order to put an end to tailings discharges into the river. The issue became political, pitting Kootenai County Republicans against pro–mining Shoshone County Democrats. Progressive Republicans sought legislation banning river disposal of tailings, but the State Legislature responded by creating the Coeur d'Alene River and Lake Commission to study and report on the issue. A series of public meetings yielded much contradictory anecdotal evidence, some of which was readily impugned. With a pressing need for reliable scientific information, the commission obtained the cooperation of several federal scientific agencies in its investigations.[24]

While the Federal Bureau of Fisheries, the Bureau of Mines, and the Army Corps of Engineers conducted their investigations, mine owners installed a dredge near Cataldo, at slack water fifteen miles below the mining region, to excavate fine tailings from the river and pump them to a storage area



Mill of the Jack Waite Mining Co., Tributary Creek, Eagle, Mining District, Coeur d'Alene mining region, about 1932. This was one of the first mills in the region to store tailings in a settling pond (not shown). (Photo 8 -X984, Barnard-Stockbridge Collection, University of Idaho Library.)

in swampy ground at Mission Flats. Dredging operations began in July, 1932, and continued until 1968, when newly–constructed settling ponds at the surviving mines made them redundant. Mine owners had also considered a proposal to pipe tailings to the impoundment at Mission Flats, but this idea was rejected as both too costly and unnecessary.[25]

In 1932, the several federal scientific agencies involved completed their reports. Physical damage by tailings was obvious and well documented. Damage to wildlife and threats to public health were examined by regional sampling and experiments. The reports concluded that the dredging operations helped to some extent, that total exclusion of tailings from the Coeur d'Alene River was required, and that a system of settling ponds would be effective in treating the water released into the river.[26]

The Coeur d'Alene River and Lake Commission accepted these recommendations, commended mine owners for their dredging operations, and made a majority recommendation to the state legislature that tailings discharge into settling ponds be mandated. A minority report held that this recommendation was unnecessary, would be too costly to implement, and violated the miners' right to pollute. Although the last allegation should have been readily dismissed, imposing such a great cost on northern Idaho's largest employers at the bottom of the Great Depression was unpalatable and the legislature did nothing.

In a 1939 case from outside the Coeur d'Alene mining region, the Idaho Supreme Court reaffirmed its previous decisions. The justices found that "the constitutional provision that in organized mining districts those using water for mining purposes or milling purposes connected with mining shall have

Dredge built and operated by the Mine Owners' Association at Mission Flats, just below the Coeur d'Alene mining region on the Coeur d'Alene River, about 1935. The dredge operated until 1968. (Photo 8 -X1016B, Barnard-Stockbridge Collection, University of Idaho Library.)

preference over those using the water for manufacturing or agricultural purposes does not authorize parties engaged in mining to fill up the natural channel of a public stream to the injury of another user of the stream." The court further concluded that "while a proper use of the water of a stream for mining purposes necessarily contaminates the water to some extent, such contamination or deterioration of the quality of the water cannot be carried to a degree inflicting substantial injury upon another user of the waters of the stream." These decisions meant that those mining companies still using river disposal of tailing were legally vulnerable, but no one rose to challenge them.[27]

Regulation

In 1948, the U.S. Congress passed the Water Pollution Control Act, which required that each state establish a water pollution control authority. In Idaho, that authority was given to the state's Department of Public Health. The act also mandated regional studies of water quality, in compliance with which the Army Corps of Engineers released a report on the Columbia River Basin in 1951. This report identified the pollution by mining wastes of Lake Coeur d'Alene and the Coeur d'Alene River as the most significant water pollution problem in the basin. The Corps recommended that a solution be found and that the mining companies be required to implement it.[28]

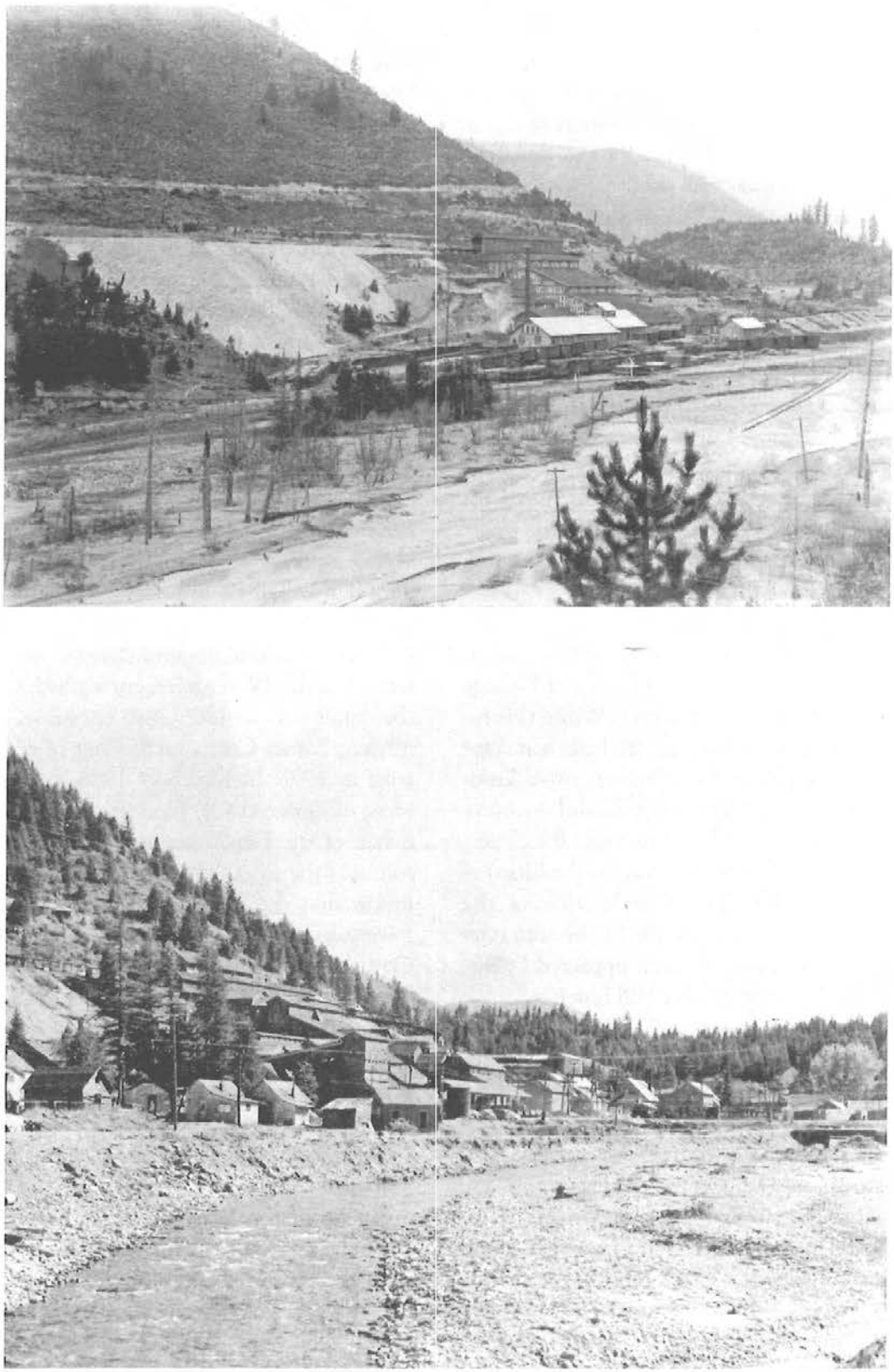
The Dayrock Mine adopted a partial solution in 1949, when the company implemented the first sand–fill system in the region, using the sand fraction of its mill tailings. An earlier form of cut–and–fill mining, using waste rock as fill, had long been a method of choice in the region. Using sand fill had many practical and cost advantages and the idea was adopted by most other mines in the area from 1954 to 1961. The original sand–fill method placed about half of the tailings produced back in the mine. With half of the usual tailings remaining to be disposed, constructing settling ponds in the confined spaces available in the region became more realistic.[29]

Political pressure to solve the problem of tailings and raw sewage disposal into the Coeur d'Alene River resumed in 1960 with the formation of the Coeur d'Alene Lake Anti–Pollution Committee. In time, the Idaho Department of Public Health also approached the mining companies and local municipalities on these issues. Mining companies, the Bunker Hill in particular, responded positively. By 1967 they had built modern tailings impoundments and settling ponds at several places in the mining region to serve all of the remaining mines. Local voters were less cooperative, rejecting a proposal to issue bonds to finance a regional sewer district. With raw sewage still entering the river, the Coeur d'Alene Lake Property Owners' Association appealed to the Idaho Department of Public Health to ask the mining companies to continue discharging tailings into the river, since the tailings would destroy bacteria from the sewage. This appeal was denied, and in 1968 all mills in the Coeur d'Alene mining region permanently ceased river disposal of tailings. The Idaho Department of Public Health began posting signs along the South Fork warning of sewage contamination. These signs were removed by unknown persons, to which the department responded by resorting to billboards and threatening legal action.[30]

Finally, in 1969, the Idaho Department of Public Health secured a promise from the mining companies to join the regional sewer district and bear sixty percent of its costs. This made assuming the remaining costs palatable to the area's voters. It took several years to build the necessary infrastructure, but by 1972 disposal of sewage and tailings had ceased everywhere along the Coeur d'Alene River. In 1969, the State Board of Health awarded area mining companies a citation for their persistence in meeting Idaho water quality standards. The citation notes that these voluntary efforts, costing over a million dollars, set a valuable example for other Idaho industries.[31]

Clean Water Act and Superfund

For over eighty years, tailings issues were settled within a familiar framework of common law, local politics, and a cooperation among stakeholders fostered by the State of Idaho. Mining companies sought to minimize both costs and exposure to liabil-



Morning Mill on the South Fork of the Coeur d'Alene River near Mullan, 1904 (by F.L. Ransome) and 1951 (by R.E. Wallace). In 1904, the river channel was choked with course jig tailings. In 1951, long after all of the mills had converted to flotation, all t ailings have been washed further downstream. (U.S. Geological Survey Photographic Collection, Denver, Colorado).

ity, acting forcefully in the legal and political arenas to ensure a favorable weighing of the benefits and costs of their milling operations to the region. All of this changed with direct federal regulation of water pollution and federal management of the remediation of contaminated industrial sites.

Amendments to the Water Pollution Control Act (also known as the Clean Water Act) in 1972, gave the Environmental Protection Agency (EPA) the authority to set limits on the discharge of water pollutants. Two years later, the EPA set limits on discharges of lead, zinc, cadmium, and other metals into the Coeur d'Alene River. To meet these limits, mines began to treat effluent from their settling ponds. EPA regulations ended the use of the Coeur d'Alene River for disposal of toxic wastes. What remained to be determined was how to manage existing contamination resulting from the recently abandoned river disposal of tailings.[32]

A report released by the Federal Public Health Service in 1974 showed dangerous levels of lead in the blood of children living in the town of Kellogg adjacent to the Bunker Hill Smelter. While this report recommended immediate action, little was done until after the passage of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), better known as the Superfund. Concern over the levels of lead in the blood of children contributed to EPA's declaration of the Bunker Hill Superfund Site in 1983. This site covered the 54–square–kilometer area impacted by airborne pollution from the Bunker Hill Smelter.[33]

A lesser–known provision of CERCLA is the authority it grants governments to recover damages for injuries to publicly–owned natural resources. Under this law, trusteeship of Idaho's public resources resides with the State of Idaho. In 1984, the state filed a Natural Resources Damage (NRD) lawsuit for $50 million against the surviving mining companies in the Coeur d'Alene mining region. Two years later, the state settled with the area's mining companies, which agreed to pay $4.5 million into a Silver Valley Natural Resources Trust Fund to finance cleanup efforts. In return, the State of Idaho relinquished any future natural resource damage claims against the companies.[34]

Meanwhile, the EPA continued studies and planning for remediation of the Bunker Hill Superfund Site. A "fast track" cleanup plan began in 1986, followed by completion of a Remedial Investigation and Feasibility Study Work Plan in January, 1987. In 1989, EPA ordered the "immediate" cleanup of hazardous materials at the Bunker Hill smelter complex and central impoundment area. The Bunker Hill Mining Company declared bankruptcy in January, 1991, leaving the other surviving mining companies and taxpayers to pick up the tab. Those companies, the EPA, and the State of Idaho completed an agreement to share the cleanup costs in 1994.[35]

On July 31, 1991, the Coeur d'Alene Indian Tribe filed suit in U.S. District Court seeking a declaratory judgment that the Tribe had five years to file natural resource damage claims against the surviving mining companies. The defendants challenged the Tribe's ownership of natural resources and its standing as trustee for those resources, asserting that all natural resource damage claims had been settled in the 1986 agreement with the true trustee, the State of Idaho. One company, the Coeur d'Alene Mines Corp., settled out of court with the tribe in 1992. In March of 1996, the U.S. Department of Justice (DOJ) filed another NRD lawsuit on behalf of the Departments of Interior and Agriculture and the EPA. The government sought a declaration that the defendant mining companies were jointly and severally liable for the restoration of the Coeur d'Alene's damaged resources, at a cost then estimated to be from $500 million to $1 billion. In May of that year, the defendants counter sued, alleging federal involvement in the production and disposal of tailings. In October, the Justice Department's lawsuit was consolidated with the previous NRD lawsuit brought by the Coeur d'Alene Indian Tribe.[36]

In an action parallel to the NRD lawsuit, the EPA renewed Superfund investigations in the region with the goal of a basin–wide cleanup. The agency ordered the surviving mining companies to hand over, by July of 1997, all relevant records dating back to 1880. In March of 1997, the defendants filed a motion for a partial summary judgment on the issue of trusteeship, alleging that the federal govern-

ment has no authority to sue for damages to natural resources it does not own. That motion is still pending. In March 1998, the EPA started a Remedial Investigation and Feasibility Study to assist in developing a comprehensive remediation plan. Late in 1998, U.S. District Court Judge Edward Lodge ruled that U.S. attorneys must establish the extent of mining–related damage in the Coeur d'Alene River Basin in court, rather than requiring the court to rely upon a determination made by EPA. He later ruled that the natural resource damage claims must be confined to the original Bunker Hill Superfund Site, based on the technicality that EPA failed to expand the Superfund site prior to the Justice Department's initiation of its NRD lawsuit. This last decision was overturned on appeal, but it may yet reach the U.S. Supreme Court.[37]

Much public sentiment in northern Idaho is strongly opposed to expanding the limits of the Bunker Hill Superfund Site. The state of Idaho has pushed hard to reach an out–of–court settlement to the NRD lawsuits, and to put future cleanup planning and activity under state control. To press its case, in early 1999 the state presented its own twenty–year plan to clean up historic mining pollution in the Coeur d'Alene River Basin. In December of that year, the EPA gave the state six months to broker a settlement with the mining companies that would pay remediation costs. Failing that, the EPA would go ahead with its plans to designate a large part of Idaho a Superfund site.

In May of 2000, the EPA granted the state a one–month extension, and at the last moment Idaho Governor Dirk Kempthorne announced an agree-

The lower Coeur d'Alene River as it is today. Effects of tailings deposition on plants and animals are not immediately obvious. Overbank sediments on the bank from which this photograph was taken in 1997 assay 0.4 to 0.7 percent lead (Arthur Bookstrom, U.S. Geological Survey, 2000, oral communication). Photo by the author.

ment whereby the surviving companies will pay $250 million over twenty years. Although this amount is considerably less than some estimates of the eventual cleanup costs, it is the most that the companies—some of them in perilous economic circumstances—claim that they can possibly afford. Representatives of the Coeur d'Alene Indian Tribe have expressed cautious approval, noting that they never intended that the surviving mining companies be required to pay all of the remediation costs. The EPA had not made its opinion of the agreement known by the time of this writing, and was proceeding with its intention to designate an expanded Superfund site.[38]

Conclusion

The history of tailings disposal in the Coeur d'Alene River Basin is a classic study in how society handles what economists call externalities. Externalities are costs which persons impose on others through activities which may be legal and otherwise desirable. The basic legal problem of externalities is summarized by another authority on mining law, Wilson I. Snyder:

> So, as a rule, every one must so enjoy his own property as not to offend his neighbor's equal right to enjoy his own unmolested. But this rule cannot be enforced, in its strict letter, without impeding rightful progress, without hindering industrial enterprise. Hence, minor individual interest is sometimes made to yield to a larger and paramount good. To deny this principle would be to withhold from the world the inestimable benefits of discovery and progress in all great enterprises of life. The rough outlines of natural right or natural liberty must submit to the chisel of the mason, that it [sic] may enter symmetrically into the social structure.[39]

Common law allows injured parties to seek redress through tort law, the kind of lawsuits largely derided today as wasteful, more lucrative to lawyers than productive for society. In the era before comprehensive federal environmental regulation, state and federal courts balanced the rights of claimants and defendants so as to not cause more harm than good to the general welfare through the use of injunctions. Hence the preference for damage awards rather than injunctions in the resolution of litigations over the Coeur d'Alene mining region.[40]

The call to supercede tort law with government regulation began as early as 1929 in northern Idaho. To an economist, the actual exercise of tort law seems efficient. Mining companies were forced to bear the full cost of their tailings disposal methods by paying court–awarded damages, purchasing land and pollution easements, building dams and dikes, and undertaking other costly measures. Facing these costs, conventional environmental economic theory predicts that the firms will correctly balance benefits and costs of mitigation measures from a social point of view. In retrospect, we can see that some costs, such as those for future remediation, could not be foreseen, and we may legitimately ask if tort law would have provided any mechanism for recovering those future external costs from the companies, had they been known. It is possible that had they known these future costs, mining companies would have found the expense of settling ponds justified.[41]

Injured parties are not easily mollified by economically efficient solutions that leave them with costs even after compensation. Politics provides a way around the courts and their cost–benefit considerations. The appeal of regulation is that non–economic solutions can be mandated. The economic theory of environmental regulation does rest on justifications of efficiency, chiefly the "polluter pays" principle. But it must be understood that this principle, as articulated in CERCLA and other environmental legislation, differs from an economist's understanding of proper restitution in such cases.[42]

In environmental economics, the polluter pays principle asserts that polluters should face the full cost to society of their pollution at the exact moment they pollute. Under CERCLA, the polluter or its legal descendant pays well after the fact, thus many of the efficiency–inducing incentives of the principle, and even its deterrent value, are lost. Members of the Mine Owners' Association in 1910

or 1929 had no idea that their corporate descendants would be liable for costs they could never imagine. Even had they known, they might not have cared about things which would not happen until long after that generation of managers and stockholders had passed from the scene. It should come as no surprise that the main incentive CERCLA provides past polluters is to seek any means to minimize, avoid, and delay liability. These tendencies are reinforced when polluters are held jointly and severally liable, particularly when they are required to assume liability for pollution caused by companies and persons which no longer exist.

In the face of its ethically troubling aspects, the chief argument for CERCLA is that it works. Under tort law, courts were concerned with balancing long–standing principles of justice with the costs and benefits of alternative remedies. Under CERCLA, following procedure is the goal, with procedure defined legislatively almost entirely on grounds of expediency. Thus, although some Coeur d'Alene mining firms, particularly the Bunker Hill, took active steps to minimize their liability and cooperated with public efforts to mitigate current and past pollution, none of that could prepare them for a major change in the rules of the game. The Superfund system helped bankrupt the Bunker Hill, and may yet do so to other surviving mining companies in the Coeur d'Alene and elsewhere.[43]

Notes

1. *The Engineering and Mining Journal* (hereafter *E&MJ*), 37:18 (3 May 1884): 335. Keith R. Long, "Production and Disposal of Mill Tailings in the Coeur d'Alene Mining Region, Shoshone County, Idaho," *U.S. Geological Survey Open-File Report* 98-595 (Reston, Virginia: U.S. Geological Survey, 1998), 2. I use the expression Coeur d'Alene mining region to refer to an area comprised of the officially defined and contiguous Beaver, Coeur d'Alene, Evolution, Hunter, Lelande, Placer Center, and Yreka Mining Districts. These are usually collectively referred to as the Coeur d'Alene District which may sometimes lead to confusion between the region as a whole and the much smaller, and not very productive, official Coeur d'Alene Mining District.
2. Long, "Production and Disposal of Mill Tailings in the Coeur d'Alene," 2.
3. Pauline Battien, *The Gold Seekers: A 200-Year History of Mining in Washington, Idaho, Montana & Lower British Columbia* (Colville, Washington: Statesman-Examiner, 1989), 19-21. *E&MJ* 41 (1886): 272; and 42 (1880): 209.

   Actual metallurgical recoveries were a matter of controversy. Edward S. Wiard in his "Ore Dressing in the Coeur d'Alene District - IX," (*E&MJ*, 89:17 (23 Apr. 1909): 877), brings a lengthy critique of milling practice in the Coeur d'Alene mining region to this conclusion: "It may be asked what average figure would represent the saving in the Coeur d'Alene mills. I might guess, but I do not know. If there are any reliable figures from any of the properties, I am not cognizant of them." These terse comments stem from his poor opinion of sampling and assay practices, the deficiencies of which he thoroughly documented. Wiard's comments were published just as Gelasio Caetani introduced recognizably modern metallurgical accounting practices at the Bunker Hill mills from 1906 to 1909. (See Robert Peck, *Gelasio Caetani: A Biographical Memorial* (New York: privately published, 1936), 60 pp.) Details of what Caetani accomplished may be found in Gelasio Caetani, "Milling of Lead-Silver Ore," *Mining Magazine* 2 (1910): 361-8, 441-6; and 3 (1911): 48-56.

   I have examined mill records for the Bunker Hill Mine from 1893 to 1900, and the Gold Hunter Mill from 1889 to 1900. These show a recovery of 70 to 80 percent for lead and 67 to 72 percent for silver at the Bunker Hill, and a recovery of from 28 to 87 percent for lead and 32 to 75 percent for silver at the Gold Hunter. In *Hecla; A Century of Western Mining* (Seattle: University of Washington Press, 1990, 13) John Fahey reports that the Morning Mill lost as much as 45 percent of its metal values to tailings in the 1890s. Mill records for the Bunker Hill are recapitulated in: F. M. Bradley, *Manager's Report of the Bunker Hill & Sullivan Mining & Concentrating Co. for the fiscal year ending May 31*. Typescript copies of this report for 1893, 1894, 1896, 1899, and 1900 may be found in Folder 19, Box 5, Bunker Hill Mining Co. Collection, Manuscript Group 367, Special Collections and Archives, University of Idaho. Original records for the Gold Hunter Mill, held by Hecla Mining Co., were displayed at the Northwest Mining Association meeting in December, 1998.
4. Edward S. Wiard, "Location of Mills," Chapter 3 in *The Theory and Practice of Ore Dressing* (New York: McGraw-Hill, 1915), 42-56. The multifaceted role of topography in the history of the Coeur d'Alene mining region is given a more thorough treatment by George Domijan in, "Land Status and Mining Development in the Coeur d'Alene Mining District of Northern Idaho," (M.S. Thesis, University of Idaho, 1986, 125 pp) and in George N. Bennett's

unpublished "Report on Black Bear Consol. Mng. Co. Property," for Butte & Superior Mining Co., (7 pp., undated, File 1, Box 21704, Anaconda Geological Documents Collection, International Archive for Economic Geology, American Heritage Center, University of Wyoming). The Butte & Superior Copper Co., Ltd. was renamed Butte & Superior Mining Co. in April, 1916 [see entry for the same in *The Mines Handbook* 18:1 (New York, Stevens Copper Handbook Co., 1931)]. This after the Black Bear Consolidated Mining Co. announced plans, never fulfilled, to build a new mill in the spring of 1915. See *Mining & Scientific Press* (hereafter *M&SP*), 109:26 (26 Dec. 1914): 1008.

5. *M&SP*, 89:20 (12 Nov. 1904): 332. *E&MJ* 77:18 (5 May 1904): 735. Domijan, *Land Status*, 87. *M&SP*, 89:13 (24 Sep. 1904), 214; 99:20 (12 Nov. 1909): 332; 95:26 (24 Dec. 1907): 430. As an example of litigation resulting from upstream pollution, in 1908 Stanley Consolidated Mining Co. sued the Hercules Mining Co. to restrain the Hercules from dumping tailings on land owned by the Stanley company. *E&MJ* 86:6 (8 Aug. 1908): 297. *Wallace Democrat*, 29 Dec. 1892. On 26 July 1890, The *Wallace Free Press* noted that "Although the belief is quite general that the disciples of Izaak Walton have lost their fishing preserve on the South Fork [of the Coeur d'Alene River] by reason of the large amount of lead and silver ore tailings and sawdust which are allowed to flow into the waters, yet it is occasionally demonstrated that the members of the finny tribe continue to come up the stream." This report, less than five years after milling operations began, shows how quickly tailings made an environmental impact.
6. Unpublished letter, Stanley A. Easton to F.W. Bradley, 25 Sep. 1909, Folder 24, Box 10, Bunker Hill Mining Co. Collection, Manuscript Group 367, Special Collections and Archives, University of Idaho Library.
7. Curtis H. Lindley, *A Treatise on the American Law Relating to Mining and Mineral Lands Within the Public Land States and Territories, 3rd Edition* (San Francisco, Bancroft-Whitney, 1914; 3 vols., 2,813 pp. [hereafter *Lindley on Mines*]), §839. Idaho Supreme Court, *Reports of Cases Argued and Determined* 1 (St. Paul: West Pub. Co., 1866-80), 595 [hereafter *Idaho Reports*].
8. *Lindley on Mines*, §841.
9. *The Constitution of the State of Idaho*, Article 1, Section 14, "Right of Eminent Domain;" Article 15, Section 3, "Water of Natural Streams, etc." With the power of eminent domain, mining companies could condemn privately owned land to obtain access, space for facilities, waste storage, etc.
10. Nicholas A. Casner, "Leaded Waters: A History of Mining Pollution in the Coeur d'Alene River in Idaho, 1900-1950," (M.A. Thesis, Boise State University, 1989), 25-50. Part of Casner's thesis is recapitulated in Nicholas A. Casner, "Toxic River; Politics and Coeur d'Alene Mining Pollution in the 1930's" *Idaho Yesterdays* 35:2 (1991): 2-19. Casner based his thesis on legal research done to support litigation by the Coeur d'Alene Indian Tribe. He marshals the best evidence he can for demonstrating negligence by the mining companies.
11. Casner, "Leaded Waters," 35-36. *Mining Reporter*, 55:2 (10 Jan. 1906), 42.
12. *Idaho Reports* 12 (1906B7), 223-45. *Pacific Reporter* 85 (1906), 907-14.
13. Casner, "Leaded Waters," 25-50.
14. *Mining World* 27:8 (24 Aug. 1907), 327.
15. *Federal Reporter* 164 (1908-9), 927.
16. Casner, "Leaded Waters," 36. *E&MJ* 90:9 (27 Aug. 1910): 427.
17. W. L. Zeigler, ("Tailings and Mine-Dump Reclamation in the Coeur d'Alenes During World War II," *American Institute of Mining and Metallurgical Engineers Technical Paper 2145*, published in *Mining Technology* 11:2 (Mar. 1947): 6-7.) explains the effect of differential oxidation of galena, sphalerite, and other minerals on recovering lead and zinc from tailings. *M&SP* 89:21 (19 Nov. 1904): 348.
18. *M&SP* 92:7 (17 Feb. 1906): 114. The U.S. Geological Survey (USGS) began an annual survey of metal mine production in the United States in 1901. The author has used these production records, compiled as Permanent Individual Mine Records, to aid in historical research and to compile the aggregate statistics on production of ores and tailings released in Long *op. cit.* Victoria E. Mitchell and Earl H. Bennett, ("Production Statistics for the Coeur d'Alene Mining District, Shoshone County, Idaho, 1884-1980," *Idaho Geological Survey Technical Report 83-3* [Moscow, Idaho, Idaho Geological Survey, 1983, 33 pp.]), report cumulative ore production for each mine in the Coeur d'Alene mining region, drawing on Permanent Individual Mine Records and other proprietary records with the permission of the surviving mining companies.

    Zeigler (Tailings and Mine-Dump Reclamation," 9) reports that flotation mills were able to recover 65 percent of silver, 50 percent of lead, and 75 percent of zinc values in tailings. Gravity mills would have done no better or worse. Lower lead recovery was due to greater oxidation of galena. Unpublished letter, Pope Yeatman to John Hays Hammond, Chairman Executive Committee, Guggenheim Exploration Co., New York, 16 p., Folder 189, Walter G. Swart File, American Zinc, Lead and Smelting Company Records, Collection R10, Curtis Law Wilson Library, University of Missouri, Rolla.
19. "McQuiston Tubes in Idaho," *M&SP* 102:20 (20 May 1911): 693-694. "Recovers Mill Losses," *Northwest Mining Truth* 2:12 (1 Aug. 1917): 7. Mitchell and Bennett ("Production Statistics," 21), report that from 1917 to 1928 the Hayes Co. treated 261,122 short tons of tailings, recovering 534,655 troy ounces of silver and 11,939,013 pounds of lead.
20. Christos Ioannou, "Distribution, Transport and Reclamation of Abandoned Mine Tailings Along the Channel of the South Fork of the Coeur d'Alene River and Tributaries, Idaho," (M.S. Thesis, University of Idaho, 1979, 149 pp.). R. S. Handy, "Is Flotation the Last Word in Milling Practices?," *Mining Congress Journal* 22:10 (Oct. 1936): 53-5.
21. *M&SP* 118:22 (31 May 1919): 757-8. The Mine Owners' Association reimbursed the City of Kellogg $2,806 for its costs. Zeigler, "Tailings and Mine-Dump Reclamation," 3. Casner, "Leaded Waters," 46, 52.
22. *E&MJ* 109:26 (26 June 1920): 1432 ; 110:6 (7 Aug. 1920): 281; 110:12 (18 Sep. 1920): 592-3. Stewart F. Campbell,

"Twenty-Third Annual Report of the Mining Industry of Idaho for the Year 1921," (Boise, Idaho, State Inspector of Mines, 1922), 90.

23. Lonnie Dale Norman, "The Grain Size Distribution of Tailings and Other Solids in the Bunker Hill Central Impoundment Area and its Relationship to the Occurrence and Control of Leakage and Seepage," (M.S. Thesis, University of Idaho, 1977, 74 pp.). *E&MJ* 130:4 (23 Aug. 1930): 197; 130:6 (25 Sep. 1930): 307.
24. Casner, "Leaded Waters," 52-65.
25. Zeigler, "Tailings and Mine-Dump Reclamation," 3. Casner, "Leaded Waters," 64, 85-87.
26. Casner, "Leaded Waters," 74.
27. Ravndel v. North Fork Placers, *Idaho Reports* 60 (1939-40), 305.
28. Casner, "Leaded Waters," 108-10.
29. Charles F. Jackson, John B. Knaebel, and C. A. Wright, "Lead and Zinc Mining and Milling in the United States; Current Practices and Costs," *U.S. Bureau of Mines Bulletin 381* (Washington, U. S. Government Printing Office, 1935), 123-31. Rollin Farmin and Carville E. Sparks, "Sand-Fill Methods at Dayrock," *E&MJ*, 152:9 (Sep. 1949), 92-7.
30. Casner, "Leaded Waters," 136. "Bond Election for Pollution Control Project is Rescheduled for April 18 in Coeur d'Alenes," *Wallace Miner*, 6 Apr. 1967. "Health Administrator and Attorney General Schedule Local Meetings on Pollution Question," *Wallace Miner*, 24 July 1969. "Lake Property Owners Want River Cleaned Up Before Mine Slimes are Removed from Stream," *Wallace Miner*, 11 July 1968. "Billboards to Warn of Stream Pollution," *Wallace Miner*, 25 June 1969.
31. "Mine Firms O.K. Pollution Program," *Wallace Miner*, 21 Aug. 1969. "Mining Companies Agree to Participate in County Sewer District; Will Reduce Costs for Users," *Wallace Miner*, 18 Sep. 1969. "Reward Mines for Pollution Efforts," *Wallace Miner*, 18 Dec. 1969.
32. Casner, "Leaded Waters," 138.
33. Casner, "Leaded Waters," 139-40. E. H. Bennett, *A History of the Bunker Hill Superfund Site, Kellogg, Idaho* (Moscow, Idaho, Idaho Bureau of Mines and Geology, 1994, 31 pp.).
34. Valerie M. Fogelman, "Natural Resource Damages," Chapter 9 in *Hazardous Waste Cleanup, Liability, and Litigation; A Comprehensive Guide to Superfund Law* (Westport, Connecticut, Quorum Books, 1992), 265-82. W. L. Rice and E. H. Bennett "The Mineral Industry of Idaho," chapter in *U. S. Bureau of Mines Minerals Yearbook 1986*, v. 2 (Washington, Government Printing Office, 1987), 151.
35. R. J. Minarik and V. S. Gillerman, "The Mineral Industry of Idaho," chapter in *U.S. Bureau of Mines Minerals Yearbook 1991*, v. 2 (Washington, Government Printing Office, 1992), 166. Hecla Mining Co., 1997 Form 10-K405, filed with the Securities and Exchange Commission, New York, 52.
36. Hecla Mining Co., 1997 Form 10-K405, 52-3.
37. "EPA Wants Deep Background," *Idaho Spokesman-Review* (Spokane, Washington), 18 June 1997. Hecla Mining Co., 1999 Form 10-K405, 48. "Feds Must Show Harm from Mining," *Pay Dirt* (May 1998): 38. "EPA Mining Pollution Deadline Set to Expire but Agency Threat to Make CDA Basin a Superfund Site May be Moot Point," *Spokesman-Review* (Spokane, Washington), 30 June 2000.
38. Larry Watson, "North Idaho People Can See to Quality of Their Environment," *Idaho Spokesman-Review*, 27 May 1998. Watson was the member of the Idaho House of Representatives for Shoshone County at the time. "20-Year Cleanup Plan for Silver Valley," *Pay Dirt* (Sep. 1999): 42. "EPA Gives State Until July for Mine Deal; Agency Would Then Resume Work on Silver Valley Superfund Listings," *Spokesman-Review*, 16 May 2000. "Mining Firms Make Offer," *Spokane Spokesman-Review*, 6 July 2000. "Cleanup Offer Gets Mixed Reaction," *Spokane Spokesman-Review*, 10 July 2000.
39. Wilson I. Snyder, *Mines and Mining: A Commentary on the Law of Mines and Mining Rights Both Common Law and Statutory*, v. 2 (Chicago, T. H. Flood & Co., 1902), 890.
40. On the continuing importance and controversy over tort law see Jay M. Feinman, *Law 101: Everything You Need to Know About the American Legal System* (New York, Oxford University Press, 2000), 133-69.
41. This prediction is explained in any modern introductory text on economics or environmental economics. The text I inflict on my students is David W. Pearce and R. Kerry Turner, *Economics of Natural Resources and the Environment* (Baltimore, Johns Hopkins University Press, 1990), see especially pages 16-9 and 61-83. The basic idea is clearly explained in George H. K. Schenck, "A Mineral Economics Approach to Environmental Control," *Mining Engineering* 23:9 (Sep. 1971), 52-4.
42. The author learned of a good example from a chance encounter in Bolivia with an Australian exploration geologist. In Australia, where mineral rights are owned by the state, persons with exploration licenses have the right to traverse private property, and may even cut holes in fences to get access, as long as the property owner is compensated. According to the Australian, it was his company's policy to build a gate, at greater expense, rather than pay the landowner to have the fence repaired. The logic was that the payment, quickly spent on other things, was soon forgotten but that the broken fence was long remembered.
43. The principal surviving mining companies are Hecla Mining Co., Coeur d'Alene Mines Corp., and Sunshine Mining and Refining Co. ASARCO, Inc., a major operator in the district since 1904, sold its interests to Coeur d'Alene Mines in 1999 and was subsequently absorbed by Grupo México, a Mexican copper mining firm. Based on figures published in their annual reports, Hecla and Coeur d'Alene have reported a net loss of income for all but one of the last ten years, while Sunshine has posted a net loss for all of the last ten years. The three firms had net assets in 1999 of $299 million. ASARCO, now a subsidiary Grupo México, and negotiating in good faith, posted a net profit in all but two of the years from 1990 to 1998 and had net assets in 1998 of $2,058 million, part of which have since been sold off by its parent. At the time of this writing, Grupo México had not yet released its annual report for 1999.