DEVELOPING PERFORMANCE STANDARDS FOR PLACER MINING RECLAMATION: CONCEPTUAL FRAMEWORK AND RESEARCH NEEDS[1]

by

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Abstract. The lack of a legally-recognized definition of reclamation and the absence of reclamation performance standards together represent a key constraint for the hardrock mining industry, land managers, and those agencies responsible for environmental protection compliance. The development of environmental standards and reclamation objectives for hardrock mining is inevitable. Placer mining, with its attendant disturbance of stream channels, floodplains, and riparian systems, requires unique reclamation objectives and approaches. Two different types of standards have been used by regulatory agencies: performance standards and restrictive standards. Reclamation performance standards should be based on broad reclamation goals, adequate scientific data, clear definitions of operational variables, and acceptable thresholds of resource condition or environmental quality. The standards-setting process must integrate societal values toward environmental protection and scientific knowledge of landscape processes. The role of research is to define the scientific basis for reclamation standards. An institutional framework is proposed from which performance standards may be set for placer mining.

Additional Key Words: hardrock mining, mined-land reclamation, riparian zones, floodplains, mining law, regulatory standards, quality thresholds, mineral policy, research needs

Introduction

Mineral resource development concerns have not been fully integrated into the land use planning process on federal lands. Furthermore, mineral law has not kept pace with changes in land policy (Dana and Fairfax, 1980). Although the Congress intended in the Federal Land Policy and Management Act of 1976 (FLPMA) to prevent undue degradation of the public lands from mining operations, both the Forest Service and Bureau of Land Management have very primitive mining regulations that provide a minimal intersection of NEPA with the 1872 Mining Act (Coggins and Van Dyke, 1990).

The federal Surface Mining Control and Reclamation Act of 1977 (SMCRA) contained very specific definitions and performance requirements for the reclamation of surface coal mines. I do not mean to imply that SMCRA is a model piece of legislation. SMCRA and subsequent regulations were overly specific in many areas. In view of the changing societal attitudes toward land use and environmental quality, hardrock mining requires an explicit legislative and regulatory framework in order to avoid further confusion over the intent of Congress. The development of environmental standards and objectives for hardrock mining is inevitable, but that development should benefit from the

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lessons learned from the SMCRA regulations. Mineral development activities must be linked with environmental quality concerns. Environmental goals such as reclamation standards must take into account societal trends, diverse perspectives on land use, and scientific knowledge of ecological systems. In the case of placer mining, reclamation standards should reflect the unique properties and values of riparian and wetland ecosystems. The lack of a legally-recognized definition of reclamation and the absence of reclamation performance standards continue to represent key institutional constraints for placer mining.

The 1872 Mining Law

The General Mining Law of 1872 (30 U.S.C. 22) was intended to promote development of U.S. mineral resources and to induce settlement in the West. One of the major reasons for enacting the 1872 Mining Law was to ratify and substantially adopt as federal law the customs and rules formulated by the miners themselves (Leshy, 1987). According to the U.S. General Accounting Office (1974) the 1872 Mining Law has not effectively encouraged mineral development on federal lands and has adversely affected management and use of those lands. In addition to helping settle the West, the Law reaffirmed the basic mining policy of the early gold rush days, that of rewarding mineral discovery with exclusive mineral rights to the land. Hardrock mining legislation and basic policy have remained unchanged for over 100 years.

Changing societal values have created competing uses for the federal lands and resulted in pressures to regulate mineral development and environmental quality. A major problem today is in applying an ancient law to activities radically different from what Congress contemplated in the mid-1800's. It was basically a pick-and-shovel law and assumed that mineral development was the highest and best use of the land (Dana and Fairfax, 1980; Leshy, 1987). The laws governing mining on public lands need to be integrated with laws providing for land use planning (National Research Council, 1979). The 1872 Mining Law has no provision for protecting or rehabilitating lands covered by mining claims or mineral patents.

Property Rights, Environmental Externalities, and Land Values

Regulation of land uses inevitably leads to a discussion about property rights. The nation's concept of land ownership has evolved to the point where society has asserted a social interest in private land use. Safety and health, efficiency, and equity are the bases for societal controls over private land use. The law recognizes two classes of property—private and public. In reality, an additional class of property is created when a mining claim is filed on federal land. Under the 1872 Mining Law, a mining claimant who locates a claim in compliance with applicable regulations is entitled to the "exclusive right of possession and enjoyment" to the surface area of, and minerals within, the claim. Unless the claim goes to patent, the land remains under federal ownership. This quasi-private property right associated with hardrock mining claims is largely responsible for the lack of definitive reclamation performance standards.

Natural resource policies continue to be influenced by the concept of the "public land trust." The public land trust is not constitutionally-based, but is recognized as a valid concept of law (Farrell, 1977). The legislative branch retains the power to make land management decisions. The source of public trust law is found in English and Roman law regarding the nature of property rights in rivers, the sea, and the seashore. Specifically, certain interests such as navigation and fishing were to be preserved in perpetuity for the benefit of the public. Under the public trust, three types of restrictions on government authority are thought to be imposed by the public trust doctrine: 1) the property must be used for a public purpose and held available for use by the general public; 2) property may not be sold; and 3) the property must be maintained for particular types of uses. Under the public trust doctrine, the government

has the obligation to act as a trustee of certain public resources. For example, with respect to water it is incumbent upon the government to regulate water uses for the general benefit of the community and to take account of the public nature and the interdependency which the physical quality of the resource implies. The more fugitive or unmanageable the resource, e.g. air or large bodies of water, the more "public" it appears to be under the public trust doctrine.

The historical scope of public trust law is quite narrow—limited to the public domain below the low-water mark of the oceans and Great Lakes, the waters above those lands, and the waters within rivers and streams. The principle of the public trust is broader than its traditional application implies (Sax, 1970). In the view of the public trust doctrine, a mining claim might be considered a usufruct right or the right to use the land and enjoy its "fruits," in this case minerals, without destroying the ability of the land to produce additional public benefits in the future.

Negative externalities, or bearing the cost of someone else's land use decisions or practices, may occur in the form of either economic or aesthetic impacts. A common example is downstream sedimentation resulting from an upstream activity such as channelization. Nuisance laws have arisen in many states because of negative externalities associated with certain land uses. Such "linkages" in ecological systems must be recognized and dealt with in any dialogue about private land rights and uses (Clawson and Dysart, 1989).

According to Baden and Dana (1987), negative environmental externalities stemmed from an imperfect specification of property rights and poor enforcement of liability when federal lands were made available to the private sector (through such programs as homesteading and the 1872 Mining Law). Ironically, the 1872 Mining Law came about in part because hydraulic methods of placer mining in the mid-1800's was blamed for causing excessive stream sedimentation in certain California valleys.

The 19th century concept of property strayed from common law tradition by allowing land owners to manage their resources without regard for externalities. The result was not only a strong flow of raw materials, including extracted minerals, into the economy but also the imposition of major costs to society in general. In order to minimize environmental externalities, property rights must be clearly specified (Baden and Dana, 1987).

Weber (1991) presents a community view of land ownership and property rights in which social responsibility obligates the landowner to be aware of and concerned about the impact of his or her actions on others. Society has the responsibility to see to it that wise stewardship is exercised over the limited available resources, which exist for the benefit of all, and to ensure intergenerational equity, where the same number of choices are passed from one generation to another. Private ownership, which Weber (1991) calls stewardship or trusteeship, is an appropriate way of administering certain resources.

Collins (1991) believes that land ethics depend in part on the time and situation that establish the bounds of choice. Growing populations, increasing demands for outdoor recreation, and increasing appreciation for the existence value of land are factors that might alter ethical judgments about property rights. The land use ethic as currently perceived is where there is a much greater appreciation of the land as more than a commodity. However, this concept conflicts with traditional views of private property rights. Views about land, land use, and property rights are currently in transition. Past assumptions about wildlands policy are being broadly questioned from a number of diverse perspectives (Dana and Fairfax, 1980). The concept of land ownership is now multi-faceted. A land ethic equation requires a decision maker to balance economic, ecological, and aesthetic factors prior to making a land use decision (Karp, 1989). Obviously this calls for land managers, both public and private, to consider diverse attitudes toward property rights and land uses.

Placer mining in valley bottoms directly impacts stream channels, floodplains, and associated riparian ecosystems. Such systems are host to a rich and diverse assortment of biota and recreational values and perform important hydrologic and nutrient cycling tasks. Increasing knowledge about the natural function and role of riverine and wetland ecosystems and an increasing societal recognition of values associated with riparian zones should be reflected in both broad reclamation goals and in specific reclamation performance standards.

Existing Reclamation Regulations for Hardrock Mining

Reclamation and other environmental protection considerations were not included in the 1872 Mining Law. Regulations dealing with reclamation and surface protection arose in recent history because of the intersection of mining legislation with FLPMA, the National Environmental Policy Act, the Clean Water Act, and other legislation. Current regulations dealing with reclamation can be traced back to the concept of "unnecessary and undue degradation" of the public lands. The unnecessary and undue degradation clause in FLPMA originated with the Public Land Law Review Commission (1970) and later appeared in a 1975 Senate Interior Committee Report that addressed the reclamation of land disturbed by mining (U. S. Congress, 1975). The wording was changed in FLPMA, but the intent of the Public Land Law Review Commission (1970) was clear:

> "Recommendation 25: Those who use the public lands and resources should, in each instance, be required by statute to conduct their activities in a manner that avoids or minimizes adverse environmental impacts, and should be responsible for restoring areas to an acceptable standard where their use has an adverse impact on the environment." (p. 83)

and:

> "We recommend that there be a statutory requirement that all users be made responsible for maintaining or restoring environmental quality to an acceptable level at their own expense." (p. 84)

In BLM's surface management (surface protection) regulations, reclamation is referred to as follows:

> "Reclamation means taking such reasonable measures as will prevent unnecessary or undue degradation of the Federal lands, including reshaping land disturbed by operations to an appropriate contour and, where necessary, revegetating disturbed areas so as to provide a diverse vegetative cover. Reclamation may not be required where the retention of a stable highwall or other mine workings is needed to preserve evidence of mineralization." [43 CFR 3809.0-5(j)]

And in 43 CFR 3809.1-3(d)(4):

> "Reclamation shall include, but shall not be limited to:
> (i) saving of topsoil for final application after reshaping of disturbed areas has been completed;
> (ii) measures to control erosion, landslides, and water runoff;
> (iii) measures to isolate, remove, or control toxic materials;
> (iv) reshaping the area disturbed, application of the topsoil, and revegetation of disturbed areas, where reasonably practicable; and
> (v) rehabilitation of fisheries and wildlife habitat."

Later in the regulations [3809.1-5(c)(5)], the above listed reclamation requirements are referred to as standards. Note that the regulations are filled with terms such as "appropriate contour," "where reasonably practicable," "reasonable measures," and "reasonable reclamation." In other words, reclamation is neither defined explicitly nor are the requirements spec-

ified in terms of any quantifiable standards (Coggins, 1991). Furthermore, under 43 CFR 3809.0-5(k) it is stated that failure to initiate and complete reasonable mitigation measures, including reclamation of disturbed areas or creation of a nuisance, may constitute unnecessary or undue degradation. Reclamation of disturbed land and posting of a reclamation bond may be required by BLM (Leshy, 1987), but the bonding of hardrock mineral operations has been politically unacceptable in the past. Forest Service regulations covering reclamation of areas disturbed by locatable minerals development are found in 36 CFR 228.8(g) and are nearly identical to the BLM regulations. Consequently, the definition of reclamation in the surface protection regulations covering national forests and BLM lands is vague and reclamation standards are set out only generally (Coggins, 1991). The lack of a definition and performance standards for reclamation has resulted in a considerable amount of "wiggle room" for both the hardrock miner and the regulatory agencies. The intentions of the Public Land Law Review Commission, namely to tie reclamation to acceptable standards, were not fully met.

Reclamation of surface coal mines, covered under the Surface Mining Control and Reclamation Act of 1977 (SMCRA), is a different story. Under SMCRA and subsequent regulations, reclamation was defined in great detail and reclamation performance standards were born. Section 515 of SMCRA defines reclamation as restoring the mined land to a condition capable of supporting the land uses which it was capable of supporting prior to any mining, or higher or better uses of which there is reasonable likelihood. Very specific performance standards follow in Section 515. For example, the revegetation performance standard found in (b)(19) and (b)(20) specifically states the nature of the vegetative cover to be established ("diverse, effective, and permanent;" "same seasonal variety native to the area;" "capable of self-regeneration and plant succession") and provides a measurable objective ("at least equal in extent of cover to the natural vegetation of the area").

SMCRA in effect provides the overall goals for reclamation and the framework for reclamation performance standards. Specific measurement variables and measurement precision were later stated in the regulations promulgated by the Office of Surface Mining:

> "the ground cover and productivity of the revegetated area shall be considered equal if they are at least 90% of the ground cover and productivity of the reference area with 90% statistical confidence." (Federal Register Vol. 44, No. 50, 13 March 1979)

Thus, the regulations provided the specificity in terms of variable to be measured (ground cover and productivity), the precise standard (90% of the ground cover and productivity of the reference area), and the statistical requirements of measurement (90% statistical confidence).

The Basis for Reclamation Standards

The purpose of a reclamation performance standard is to implement or operationalize broader goals for environmental protection and reclamation. In reviewing the potential application of SMCRA to non-coal surface mining and reclamation, the National Research Council (1979) concluded that five surface mining and reclamation control techniques were available:

1) education and technical assistance,
2) economic incentives,
3) regulation aimed at securing certain results following mining,
4) regulation aimed at controlling the practices that produce those results, and
5) public ownership of surface rights.

Regulation of results is a feasible approach if objectives can be specified operationally. It is difficult in the case of air and water because one may not be able to trace source of pollution or distinguish between operations or between mining and other disturbances. Regulation of practices was adopted by SMCRA because of concerns about air and water pollution control and lack of experience with control techniques.

SMCRA represented a fairly rigid, specialized set of standards tailored to the circumstances of coal mining—a very direct regulatory approach.

Employing Leopold's (1990) concept of a clearly defined ultimate goal for conservation, the broader goal of reclamation must involve a decision on post-mining land use or mix of uses, incorporating the expectations of landowners and resource users, and must reflect societal values toward environmental quality and natural system integrity. In SMCRA the ultimate reclamation goal was expressed as "restoring the mined land to a condition capable of supporting the land uses which it was capable of supporting prior to any mining, or higher or better uses of which there is reasonable likelihood." Obviously, then, reclamation standards must mesh with existing land use plans.

Kusler (1980) presented criteria for designing programs for managing sensitive lands. His criteria also serve as a basis for formulating reclamation performance standards and are listed, with some modification, in Table 1.

It is clear that standards setting must integrate societal values and political realities. It is also clear that variations in topography, geology, vegetation, hydrology, soils must be recognized in the standards-setting process. For example, water quality standards associated with placer mining conducted within the watershed of a wild and scenic river should reflect the river corridor values as well as the physical characteristics of the watershed. Reclamation standards should be based on scientific data and linked to a clearly defined ultimate reclamation goal. They must also reflect the dynamics of natural systems (Leopold, 1990), including the recovery potentials unique to each ecosystem and plant community type and taking into account ecosystem structure, function, and desired health, hydrologic function, and fish and wildlife habitat quality.

Table 1. Design criteria for reclamation performance standards. Based on Kusler's (1980) program design and implementation criteria for managing sensitive lands.

1.	Build on existing land-use and resource management programs, plans, and goals
2.	Consider local, state, and national interests
3.	Balance public interests and private expectations and options
4.	Insure fair treatment of landowners and resource developers, including procedural due process, regulatory consistency, and expeditious review of permits
5.	Comply with statutory and constitutional regulations
6.	Balance interests of competing political groups to achieve political acceptability
7.	Rely on adequate and sound scientific data
8.	Be capable of administration
9.	Be cost-effective
10.	Involve and educate the public through hearings and review opportunity
11.	Lead to priorities for allocation of funds and manpower
12.	Support tangible, incremental approaches to land-use decisionmaking and consider cumulative impacts of development
13.	Require appropriate level of expertise for program administration and enforcement
14.	Ensure certainty for future land uses through specificity while concurrently providing flexibility in the consideration of individual uses and areas
15.	Emphasize monitoring and enforcement to ensure implementation of standards
16.	Coordinate with tax policies and other financial institutions
17.	Combine regulatory and nonregulatory approaches to ensure that reclamation goals are met
18.	Incorporate special resource values and sensitivities and unique environments

Performance Standards vs. Restrictive Standards

Two different types of standards are available to regulatory agencies: performance standards and restrictive standards (Kusler, 1980). In either case the requirements should be no greater than that necessary to achieve established land or resource management objectives. Restrictive standards are standards that restrict activities of the land user or resource developer.

Performance standards are not to be confused with prescriptive standards, which dictate how the user/developer is to meet regulatory requirements. Regulatory agencies like EPA and OSM have based their environmental regulations and performance standards in part on best available technology. These technological or technology-based standards for environmental quality would appear to be a continuing function of regulatory agencies (Mazmanian and Morrell, 1991). On the other hand, technology-based standards have not been well-accepted by the courts (McGarity, 1984). In accordance with Congressional policy, performance standards should be based on what technology can achieve, rather than requiring use of specific technology (Fisher, 1991).

Kusler (1980) favors balancing preservation and development needs through the establishment of performance standards rather than prohibition of uses. The use of performance standards promotes multiple uses and minimizes impacts of development on important resources.

Any technique for controlling impacts of mining must include steps to

a) define goals and standards that must be met in achieving the goals;
b) validate the data used to judge whether or not the standards are being met
c) monitor impacts; and
d) provide for enforcement.

Quality Thresholds

Wargo (1988) explores the concept of thresholds of natural system quality. According to him, environmental regulation is a collectively-defined acceptable level of system quality and is based more on interest group values than on scientific data. He believes that our objective in land management should be the attainment of a certain level of quality. Quality thresholds then become management objectives and may be thought of as numerically-expressed acceptable levels of resource condition. The drawback is that acceptable condition or acceptable degradation limits are a function of which interest group is asked to define the limits. Thresholds may vary according to interest group even though based on the same scientific evidence. Thus, standards become dynamic in that they reflect the dominant values and attitudes of society. The standards-setting process must begin to integrate both the scientific basis and the predominant environmental values. Another view is to use law to distribute authority to define quality thresholds.

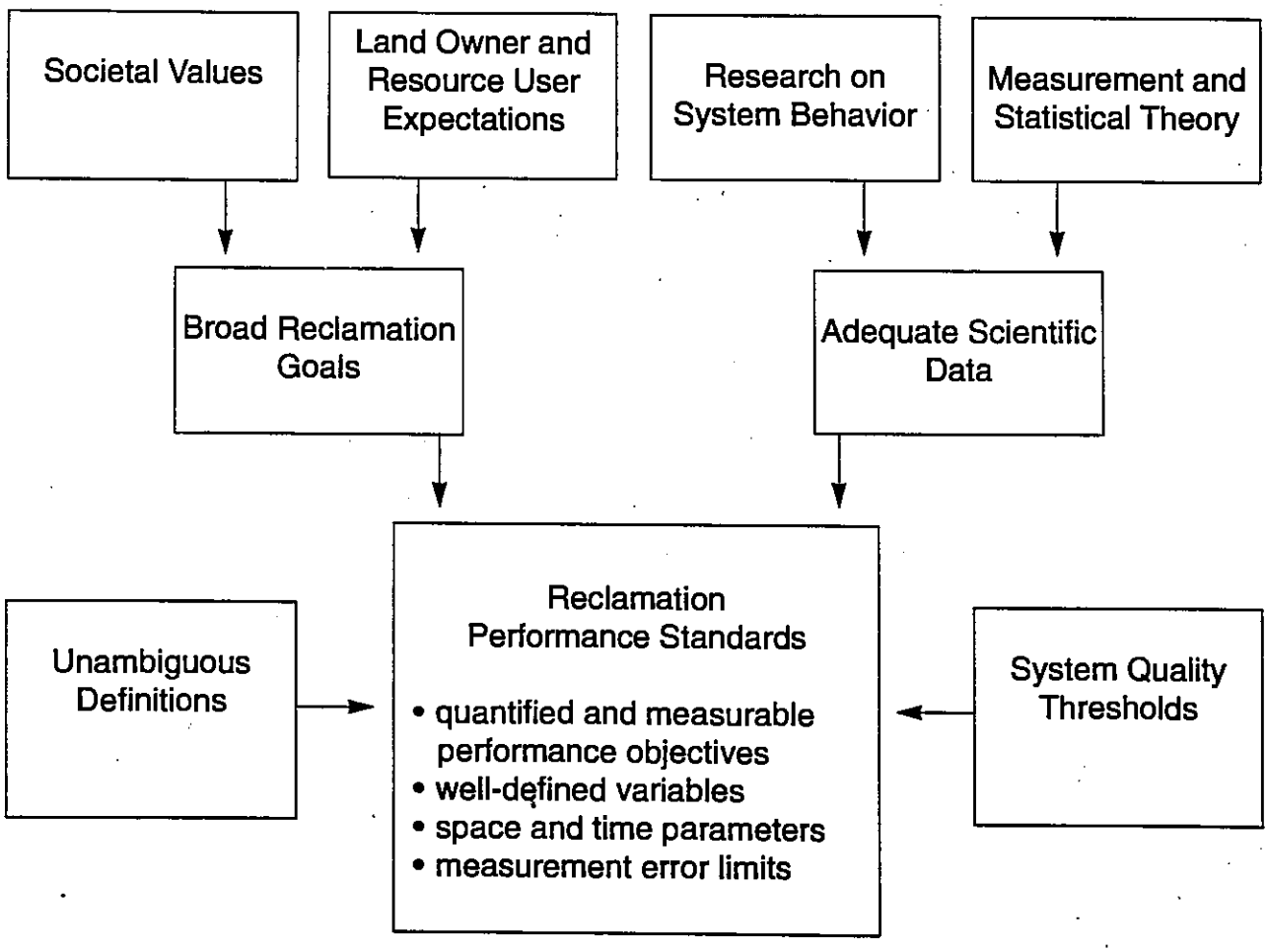
Anatomy of a Reclamation Performance Standard

Reclamation standards must have certain elements in order to be fully successful. These elements are summarized and shown as a conceptual framework in Figure 1.

Broad reclamation goals derive from landowner and resource user expectations and from societal values in general. Specific reclamation objectives or performance standards are composed of 1) broad reclamation goals, 2) adequate scientific data, 3) thresholds of acceptable resource quality and sustainability, and 4) unambiguous definitions of operational variables.

Performance standards must represent clear performance objectives which are scientifically acceptable and technically and economically achievable. They should be capable of being monitored and therefore must be measurable and expressed quantitatively. The units used to express the standard must be understood by all parties. The operational variable used to judge standard attainment must be measured using established methods and subjected to tests of sample size adequacy. Standard should include terms of desired limits of measurement error (Hofmann and Ries, 1990). The requirements of SMCRA for measuring vegetative cover and production led to a great deal of discussion over appropriate measurement methods. It may be necessary for the reclamation discipline to

Figure 1. Derivation and necessary elements for reclamation performance standards.



establish standard methods of measurement and analysis, similar to what has been done for water analysis. Sample size adequacy became an issue with the SMCRA revegetation performance standards. The variability of cover combined with the statistical requirement (90% confidence) resulted in large sample sizes and a concern on the part of miners and regulatory agencies that the requirement was difficult to meet. The sample sizes required should be reviewed to make sure they are not unreasonable (Hofmann and Ries, 1990). According to Hofmann and Ries (1992), sample size requirements could be omitted from reclamation standards criteria because other statistical tests such as confidence intervals, t-tests, or analysis-of-variance are more appropriate for comparing reclaimed and reference areas.

Performance standards must also include spatial and temporal dimensions. How much of the area must meet the standard? How much time is allowed for standards attainment?

Reclamation performance standards must be supported by clear definitions of reclamation and other operative terms, e.g. those terms used to operationalize the standards. A good example is "cover," which was not explicitly defined in SMCRA.

Time and cost are mutually dependent tradeoffs in reclamation. Given unlimited funds, any area disturbed by mining can be restored to its original condition in a minimal amount of time. Conversely, if funds were provided only for reshaping topography and application of salvaged topsoil and revegetation was left to natural plant colonization processes, considerably more time would elapse before the pre-disturbance ecosystem characteristics were restored. Thus, a time element should be included in performance standards. SMCRA regulations, for example, allowed for a 10-year reclamation bonding period for coal surface mines in the western U.S. and a 5-year bonding period in the eastern states.

In most land disturbance scenarios, temporal externalities are created. Disturbed systems experience a recovery lag, which includes both institutional response time and natural system response time. A standards program should minimize institutional response time and create incentives to reduce natural system response time (accelerate recovery).

Research Needs

Effective control of environmental impacts depends on good information (National Research Council, 1979). The role of research is to define the scientific basis for reclamation standards. A paucity of technical information was cited by Van Haveren and Dworsky (1993) as a limitation to the effective long-term resolution of placer mining issues in interior Alaska. Technical information relating placer mining activities and geomorphic/hydrologic characteristics to impacts on the environment is particularly needed to better understand the total system. Research is also needed to define causal relationships between specific mining practices and associated impacts.

Long-term ecological monitoring of ecosystem recovery from past disturbances should be initiated for representative ecosystems and mining regions. Revegetation and plant material research that focuses on riparian species, especially shrubs and trees, is critically needed. Also needed is research on new mining technology that reduces the environmental impacts of placer operations.

Literature Cited

Baden, John and Andrew Dana. 1987. Toward an Ideological Synthesis in Public Land Policy: The New Resource Economics. Pp. 1-20 in Foss, Phillip O. (Ed.), Federal Lands Policy. Westport, Connecticut: Greenwood Press. 205pp.

Clawson, Marion and Benjamin C. Dysart III. 1989. Public Interest in the Use of Private Lands: An Overview. Pp. 1-8 In Dysart, Benjamin C. III and Marion Clawson, eds. Public Interest in the Use of Private Lands. New York: Praeger. 187pp.

Coggins, George C. 1991. Public Natural Resources Law. New York: Clark Boardman.

Coggins, George Cameron and Jane Elizabeth Van Dyke. 1990. NEPA and Private Rights in Public Mineral Resources: The Fee Complex Relative? Environmental Law 20(3):649-680.

Collins, Richard C. 1991. Land Use Ethics and Property Rights. Journal of Soil and Water Conservation 46(6):417-418.

Dana, Samuel T. and Sally K. Fairfax. 1980. Forest and Range Policy: Its Development in the United States. New York: McGraw-Hill. 2nd Edition. 458pp.

Farrell, Charles S. 1977. Proprietary Duties of the Federal Government under the Public Land Trust. Michigan Law Review 75(3):586-626.

Fisher, Allison. 1991. Air and Water Quality. Environmental Law 21(3):1117-1140.

Hofmann, L., and R.E Ries. 1990. An Evaluation of Sample Adequacy for Point Analysis of Ground Cover. Journal of Range Management 43(6):545-549. http://dx.doi.org/10.2307/4002361

Hofmann, L., and R.E. Ries. 1992. Reply to Ortiz and Ames' Viewpoint: Sample Adequacy for Point Analysis Depends on the Objectives. Journal of Range Management 45(6):596. http://dx.doi.org/10.2307/4002580

Karp, James P. 1989. Aldo Leopold's Land Ethic: Is an Ecological Conscience Evolving in Land Development Law? Environmental Law 19(4):737-765.

Kusler, Jon A. 1980. Regulating Sensitive Lands. Environmental Law Institute. Cambridge, Massachusetts: Ballinger Publishing Company. 248pp.

Leopold, Aldo. 1990. Standards of Conservation (publication of a manuscript written ca. 1922). Conservation Biology 4(3):227-228. http://dx.doi.org/10.1111/j.1523-1739.1990.tb00281.x

Leshy, John D. 1987. The Mining Law: A Study in Perpetual Motion. Washington, DC: Resources for the Future. 521pp.

Mazmanian, Daniel A. and David L. Morrell. 1991. EPA: Coping with the New Political Economic Order. Environmental Law 21(4):1477-1491.

McGarity, Thomas O. 1984. Judicial Review of Scientific Rulemaking. Science, Technology, & Human Values 9(1):97-106.

National Research Council. Committee on Surface Mining and Reclamation. 1979. Surface Mining of Non-Coal Minerals: A Study of Mineral Mining from the Perspective of the Surface Mining Control and Reclamation Act of 1977. Washington, DC: National Academy of Sciences. 339pp.

Public Land Law Review Commission. 1970. One Third of the Nation's Land. Washington, DC: U.S. Government Printing Office. 342pp.

Sax, Joseph L. 1970. The Public Trust Doctrine in Natural Resource Law: Effective Judicial Intervention. Michigan Law Review 68:473-566.

U. S. Congress. Senate Committee on Interior and Insular Affairs. 1975. Report on National Resource Lands Management Act. Washington, DC: United States Congress. Senate Report No. 94-583. 118pp.

U. S. General Accounting Office. Comptroller General of the United States. 1974. Modernization of 1872 Mining Law Needed to Encourage Domestic Mineral Production, Protect the Environment, and Improve Public Land Management. B-118678. Washington, DC: U.S. General Accounting Office. 52pp.

Van Haveren, B. P. and R. W. Dworsky. 1993. Placer Mining in Interior Alaska: A Study of Land Use Conflicts in the Extreme. Land Use Policy, in preparation.

Wargo, John. 1988. A Property Theory of Land Use Behavior. Society and Natural Resources 1:189-203.
http://dx.doi.org/10.1080/08941928809380652

Weber, Leonard J. 1991. The Social Responsibility of Land Ownership. Journal of Forestry 89(4):12-15,17,25.