CHAPTER 10

Implications-of Environmental and Reclamation Issues for the Development of Federal Coal

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CHAPTER 10

Implications of Environmental and Reclamation Issues for the Development of Federal Coal

This chapter considers the extent to which environmental and reclamation concerns may affect the production of Federal coal. Primary emphasis is placed on documentation of those cases where mining of recoverable coal reserves has been delayed or prevented. A brief discussion is also included on the effect that environmental and reclamation concerns have on the cost of mining Federal coal. The chapter is not an analysis of the effects of coal mining on the environment, although those issues are briefly discussed in order to provide a context for the chapter. Background information is also provided on the environmental characteristics of Western coal regions and the existing framework for coal mine regulation.

Environmental Overview of Coal= Producing Regions

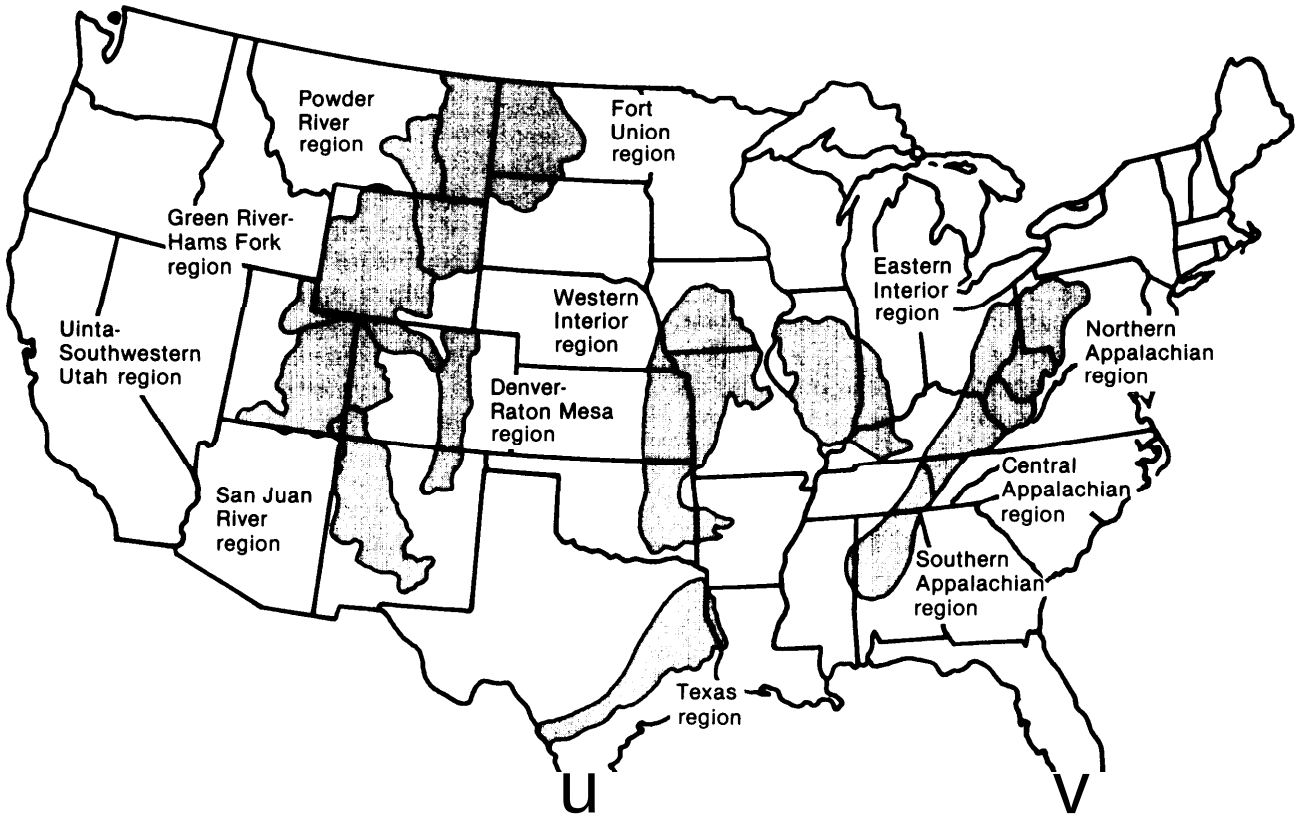
The United States can be divided into 12 major coal-producing regions (fig. 43). Federal coal accounts for a large portion of the coal reserves of the six westernmost regions. In addition, Federal coal reserves are significant in the extreme southern portion of the Western Interior region in Oklahoma. * This section reviews the important environmental characteristics of these seven coal regions, pointing out regional similarities as well as noting differences. Emphasis is placed on discussion of those characteristics that are of most importance to the mining of Federal coal reserves, and on the potential for success in reclaiming mined lands. This section serves as background to the discussion of reclamation and environmental issues later in this chapter.

Because Federal coal reserves are concentrated in the Western United States, the environmental characteristics of mining and reclamation of Federal coal differ from the mining of the other coal reserves of the Nation. Only the Federal coal reserves of Oklahoma in the Western Interior region have environmental characteristics similar to the characteristics of the privately held reserves of the Midwest and Eastern United States.

The Western United States is notably distinct from the rest of the country in its overall lack of available water, its shallow soils, and its high erosion rates. These factors combine to make reclamation more difficult than in other parts of the country. Annual mean precipitation in the West is low, ranging from 4 inches or less per year in some of the hot deserts to over 20 inches in the higher mountains. Droughts are common in the West, and precipitation is more commonly below average than above. Particularly during periods of drought, precipitation may occur in short, intense storms that have the potential to cause severe erosion. Temperatures in the West fluctuate widely, and high summer daytime temperatures can quickly dry out soil and seeds.

*Alaska has substantial coal resources on Federal lands, and there are also scattered areas of federally owned coal reserves in the eastern regions and in Texas. These coal regions are not considered in this report because of the relatively minor amounts of Federal coal there currently under lease compared to leased reserves in the seven States of Colorado, Montana, New Mexico, North Dakota, Oklahoma, Utah, and Wyoming.

Figure 43.—Tweive Coai Suppiy Regions of the United States



SOURCE: U.S. Department of the Interior, Final Environmental Statement, Federal Coal Management Program (Washington, D. C.: U.S. Government Printing Office. 1979), p. 1-4.

Soil is poorly developed in the semiarid and arid West. Rocks weather slowly, and organic matter accumulates slowly. The resulting soil profile is loose and undifferentiated and has little capacity for holding moisture. In much of the West, rates of erosion are among the highest in the country, and soil can be lost because of flash flooding and hillslope erosion.

Vegetative succession is a slow process in the West because of climatic severity. A disturbed site in the Eastern United States may revegetate itself in 5 to 10 years, but decades or centuries maybe needed for natural revegetation in the West. Thus, natural revegetation cannot be relied on to rehabilitate disturbed sites, and careful planning is needed.'

Tables 80, 81, and 82 summarize the environmental characteristics of the seven coal-producing regions with major reserves of Federal coal. The information is separated into three categories: physical characteristics (table 80), environmental resources (table 81), and social characteristics (table 82).

'Previous three paragraphs adapted from National Academy of Sciences, Rehabilitation Potential of Western Coal Lands (Cambrdige, Mass.: Ballinger Publishing Co., 1974),

Table 80.—Physical Characteristics

Region: State(s)	Physical division and subdivision	Topography	Soil orders[b]	Climate[c]
Western Interior: Oklahoma	Central Lowlands Division Upper Missouri Basin Subdivision	Gently sloping hills	Mollisols Inceptisols	Evaporation: 64-80"/lyr. Mild temperatures: 400 winter >800 summer Precipitation: 32-48''/yr. Winds: 11-14 mph Dust storms and tornadoes common
Fort Union: Montana North Dakota	Great Plains Division Upper Missouri Basin Subdivision	Gently undulating land surfaces; relief less than 20 ft. in glaciated areas. Gently sloping, roiling prairie, with isolated buttes, mesas and badlands in unglaciated areas.	Mollisols Entisols	Evaporation: 46-64''/yr. Semiarid continental Long cold winters, short warm summers. Mean annual temperature: 38-45 "F Precipitation: 12-16''/yr. thunderstorms frequent Winds: 10 mph
Powder River: Montana Wyoming	Great Plains Division Upper Missouri Basin Subdivision	Undulating land, Surface highly dissected in some areas.	Aridisols Mollisols Entisols	Evaporation: 48-64''/yr. Semiarid continental Mean annual temperature: 45"F Precipitation: 14''/yr. (75% of ppt. occurs from Apr. -Sept.) Chinook winds: warm, dry, 25-50 mph, Aug. windy-12 mph.
Green River-Hams Fork: Colorado Wyoming	Middle Rocky Mountain Division (Wyoming - Big Horn Basin Subdivision)	Complex mountains and basins, generally a series of parallel ranges. Local relief up 2,000 ft, but generally less than 1,000 ft.	Aridisols Mollisols	Evaporation: 48''/yr. Semiarid continental Mean annual temperature: 37-46 "F Precipitation in NW: 16-32''/yr. in rest of area: 8-16"/yr.
Uinta-Southwestern Utah: Colorado Utah	Colorado Plateau Division and Subdivision	Varied: peaks and plateaus rising from lowlands. Extremely steep slopes and narrow, vertically walled canyons. High plateaus of stratified rock cut by deep canyons in southwestern Utah.	Aridisols Mollisols Entisols Alfisols	Evaporation: North 48-64''/y.; South 64-80"/yr. Arid for most of the regions with varied weather patterns in the mountains (some of which maintain year round snow cover) Precipitation: 30% of area receives 0-8"/yr., rest of area (except mountains): 8-16''/yr. mountains: > 20"/yr.
San Juan River: Colorado New Mexico Utah	Colorado Plateau Division and Subdivision	Basins with mesas, rolling plains, and badlands	Entisols Aridisols	Semiarid Mean annual temperatures: 48-52 'F Mean annual precipitation: less than 10" to 20" Summer thunderstorms. Evapotranspiration exceeds precipitation by a factor of 6:1
Denver-Raton Mesa: Colorado New Mexico	Southern Rocky Mountain Division Rocky Mountain, Piedmont and Southern Rocky Mountains Subdivision	Eastern portion: gentle plains Western portion: Steep slopes and foothills	Alfisols	Evaporation: 64-80''/yr. Semiarid continental Mean annual temp.: 48-520 F Precipitation: 13-18''/yr., low humidity, light rainfall, periodic droughts Winds: 10 mph

[a] Physical division based on classes defined by Nevin Fennemen (National Atlas). Physical subdivisions based on classes defined by Edwin H. Hammond.
[b] Soil types listed in chart in order of dominance, Definitions of soil orders follows:
Arid SOILS: These soils are found in arid regions. They have both a low moisture content and absorb precipitation slowly, thus most precipitation runs off. There is a period of about 3 months during the year when the soil is both warm and moist enough for plant growth. The vegetation which these soils can support without irrigation is limited to ephemeral grasses and cacti.
Entisols: These soils are in early stages of development, and thus lack defined layers down to a depth of 50 cm. They exhibit a wide range of moisture content and temperature. These soils characteristically **develop on steep, actively eroding slopes, and on flood and glacial outwash plains.**
Mollisols: These soils are found throughout the subhumid to semiarid plains of North America. Mollisols retain enough moisture to support perennial grasses and many have been forested or have had grass vegetation. In areas of suitable climatic conditions, they are used to produce grains, sorghum, corn, and soybeans
Alfisols: These soils are characterized by a clay horizon which is capable of holding moderate amounts of water. Their moisture retention is sufficient to sustain plant growth for at least 3 months of the year, provided the soil is warm enough
Inceptisols: These soils have weakly differentiated horizons Materials in the soil may have been altered or removed, but have not accumulated. Although generally moist, these soils tend to dry out in the warm seasons
[c] Evaporation figures are for mean annual evaporation.

SOURCE: Class A pan-National Atlas.

Table 81.—Environmental Resources of Coal-Producing Regions

	Air quality	Water quantity and quality	Vegetation	Wildlife	Agriculture and land use[a]	Carrying capacity livestock[b]
Western Interior	Overall quality: good. Urban areas: moderate NO_2 levels around Tulsa, Okla.	Surface water runoff 7". Surface water quality good.	Transitional areas: eastern forests to prairie grasses.	Species typical of forest and prairies: deer, fox, coyote, whitetail deer, small woodland mammals. Federally protected species: 6 birds, 3 mammals.	supports crops and timber harvesting. Cropland: 52% Pasture: 11% Range: 15% Forest: 10%	2.6 acres/ A.U.M.
Fort Union	Uniformly very good	Annual runoff: 1"/yr. Surface water availability limited except in major streams. Groundwater available in small quantities except in alluvial valleys where more abundant. Major streams: Missouri, Yellowstone, Knife.	Eastern: Wheatgrass, needlegrass. Western: Gramma, needlegrass, wheatgrass.	Varied wildlife: 87 species birds, 70 species reamreals, 200 species fish, 20 species reptiles and amphibians. Federally protected species: 4 birds, 3 mamreals.	Cropland constitutes 75% of N. E., 5% southern area. Elsewhere, Cropland: 37% Range: 54% Principal crops: wheat and grain.	8.2 acres/ A.U.M.
Powder River	Overall quality: generally good. Variations around populated areas, i.e,, Colstrip, Mont. is a nonattainment area for TSP.	Annual surface water run-off: less than 0.5". Surface water limited except along major streams. Quality: variable. Groundwater availability and quality: variable. Major streams: Yellowstone, Big Horn, Powder, Tongue, Belle Fourche, and Musselshell.	Wyoming: Prairie shortgrass, grassland sagebrush. Montana: grassland sagebrush, and ponderosa pine.	Similar to Fort Union. Federally protected species: 3 birds, 1 mammal.	Grazing and ranching. Cropland: 5% Range: 88%	15.5 acres/ A.U.M.
Green River-Ham's Fork	Overall quality very good, however, Craig, Colo. and parts of Sweetwater, Colo., and Wyoming are nonattainment for TSP.	Annual runoff: Western half: 10-30" Eastern half: .1-2" Quality good in mountains and poor in basins. Major streams: Green, Yampa, Sweetwaters, Shoshone, Greybull.	Cold desert biome: sagebrush. Salt brush biome: greasewood, mountain shrub, evergreen forests, broadleaf forests.	53 mammal species. Large numbers of big game animals. Varied game and non-game fish species. Wild horse herds. Federally protected species: 1 fish, 3 birds, 2 mammals.	Cattle and sheep ranching, limited farming. Cropland: 4°/0 Range: 70°/0 Forests: 270/o	9.3 acres/ A.U.M.
Uinta-Southwestern Utah	Rural air quality: very good. Urban areas: occasional problems during temperature inversions.	Annual runoff: 0.1-.5"/yr. Good water quality. Region contains numerous tributaries to the Colorado River: Green, White, Duchesne, Price, Dirty Devil, Paria, Escalante, & Virgin Rivers.	Vegetation varies with climate. Cold desert biome: salt brush and greasewood. Mountain Forest biome: pine, fir, spruce, and sagebrush.	Varied habitat supports many diverse species: 90 species reamreals, 270 species birds, 26 species reptiles, 9 species amphibians Federally protected species: 3 fish, 3 birds, 2 mammals.	Desert shrubland and open woodland grazing. Crops: 3°/0 Range: 62% Forests: 33°/0	8.3 acres/ A.U.M.
San Juan River	Overall quality generally good except around industrial areas. High SO_2 levels near powerplants.	Annual runoff: 0.1-O.5"/yr. Major streams: San Juan, Colorado, and Little Colorado. San Juan River is the only perennial stream in Federal lease block area. Ground waters are generally good, but levels are dropping.	Generally sparse vegetation. Lower elevations: grassland shrub and grasslands. Upper elevations: Pinyon, juniper and coniferous forests.	Habitat supports: 100 species mammals, 116 species birds, 28 species amphibians. Several are unique to region. Federally protected species: 1 fish, 4 birds, 1 mammal.	Cattle and sheep ranching. Range: 50% Forests: 45% Limited crops: corn, hay, wheat, cotton, and sugarbeets.	22 acres/ A.U.M.

Table 81.—Environmental Resources of Coal-Producing Regions—Continued

	Air quality	Water quantity and quality	Vegetation	Wildlife	Agriculture and land use[a]	Carrying capacity livestock[b]
Denver-Raton Mesa	Overall: very good. Urban areas often fail to meet national standards due to inversions and automobile induced pollution.	Annual runoff: 0.5 inches/yr. Surface water: Quantity: 5.4 million acre ft/yr. Quality: good. Major streams: South Platte, Arkansas.	Prairie biome: Buffalo grass and blue gramma. Coniferous forest in S.W.	Typical species: marmot, ground squirrel, wildcat, vole, bobcat, mule deer, elk, porcupine. Federally protected species: 1 fish, 3 birds, 1 mammal.	Agriculture supports sugarbeets and grain. Cropland: 21% Range: 56% Forests: 21 %	16 acres/ A.U.M.

a percentages are of total land area. Only major land uses are listed.
b Refers to the ability of the land to support livestock, A.U.M. stands for animal unit month, which refers to the grazing requirements of an "averaged" livestock animal for 1 month.

SOURCE: U.S. Bureau of Land Management, *Final Environmental Statement, Federal Coal Management Program, 1979.*

Table 82.—Archeological and Cultural Resources of the Western Coal Regions

Region	Archeological resources	Major Federal parklands and forests resources	1975 population	1975 Pop. per sq. mile
Fort Union	Much of the region has some identified archeological value. A few areas have large sites and/or high site density. There is a high probability of disturbance to sites in Custer Co., Mont., and in Mercer, Williams, and Oliver Co's., N. Dak.	•Little Missouri National Grassland •Theodore Roosevelt National Memorial Park •Custer National Forest	324,399	5.4
Powder River	There is a high probability of disturbance to sites in Rosebud, Bighorn and Powder River Co's., Mont, and in Johnson and Campbel Co's., Wyo. Remainder of region considered to have some archeological value.	•Devils Tower National Monument •65 Sites eligible for, or currently enrolled on the National Register of Historic sites. • Thunder Basin National Grassland •Custer National Forest	228,418	4.6
Green River-Hams Fork	The region has some identified archeological value. Many areas have not been surveyed.	•Flaming Gorge National Recreation Area • Dinosaur National Monument	126,938	2.6
Uinta-Southwestern Utah	There is a high probability of disturbance to Fremont and Anasazi sites in Emery, Kane and Garfield Co's., in Utah. Remainder of region considered to have some archeological value.	•Capital Reef, Arches, Canyonlands, Zion, and Bryce Canyon National Parks •Cedar Breaks National Monument •Black Canyon of the Gunnison, and Colorado National Monuments	406,626	7.2
San Juan River	This region has been identified as having both great archeological and historical value. There is a high probability of disturbance to sites in the Chaco Canyon National Monument area.	•Mesa Verde National Park •6 National Monuments	351,143	7.2
Denver-Raton Mesa	This region has some identified archeological value.	•Comanche National Grasslands	1,854,205	77.5

a Based on a survey Performed by the National Academy of Sciences of 69 strippable coal areas in the West. Tables A.1, A.3, Rehabilitation potential of Western Coal *Lands, NAS, 1974.*

SOURCE: Office of Technology Assessment.

Physical Characteristics. Table 80 contains information on physiographic subdivisions, topography, soil orders, and climate. The topography of the Federal lease areas is varied. The Western Interior region is typified by a gently undulating prairie landscape. The northern regions (Fort Union and Powder River) are also generally characterized by low overall relief and an undulating grassland, but selected areas include badlands, ponderosa pine forests, and rocky cliffs and outcrops. The central western regions (Green River-Hams Fork and Uinta-Southwestern Utah) are located in mountainous terrain. The San Juan River region is characterized by mesas and badlands. Topography in the Denver-Raton Mesa region varies from gentle plains to rugged slopes and foothills. As noted earlier, the Western areas tend to be either semiarid or arid in climate. There are some exceptions in the mountainous areas, which tend to create localized weather patterns of higher precipitation. In all the Western regions, evaporation exceeds precipitation. The ratio of evapotranspiration* to precipitation ranges from 2 to 1 in the Fort Union region to 6 to 1 in the San Juan River region. The evaporation rates in the region range from 48 to 64 inches in a year in the northern coal regions and generally increase to a high of 80 to 96 inches a year in the southern San Juan River region, Low rainfall and high evaporation creates moisture stress throughout the coal lease areas. The moisture stress generally increases from north to south for similar elevations. Soil types reflect the topography, geology, and climate of the regions. Most of the soils have a low moisture content, but usually hold enough water to sustain plant growth for 3 months of the year.

Environmental Resources. Table 81 summarizes air quality, water resources, vegetation, wildlife, agriculture and land use, and livestock carrying capacity of the coal lease regions. Overall, the air quality of all the regions is good to very good, although atmospheric inversions are common in all the areas for parts of the day in both summer and winter. The exceptions to good air quality are in areas with extensive urban or industrial development. Areas with air quality problems include Billings and Colstrip, Mont.; portions of Sweetwater County, Wyo.; Craig, Colo.; areas around powerplant generating stations in the San Juan River region; and in the urban Colorado Front Range corridor.

Annual surface water runoff ranges from 0.5 to 2 inches for most of the coal lease regions, with most areas falling within the lower part of the range. The major exception is in the mountainous areas of the Green River-Hams Fork and Uinta-Southwestern Utah regions. Water availability in all regions is greatest in the major river valleys. The water quality of the regions' streams is difficult to generalize and ranges from variable to good. High sediment loads are common.

The coal regions are characterized by sparse growth in the lower elevations. Prairie grasses and sagebrush are the predominant species. The mountainous forests are generally characterized by coniferous tree species. Large mammals—antelope and mule deer—range throughout the regions, with the Green River-Hams Fork and Uinta-Southwestern Utah regions containing the largest number of big game animals. The San Juan River area contains a number of animal species that are unique to only that region. The number of federally protected fish, bird, and mammal species varies from four to nine in each region.

Except for the fertile Western Interior region, the predominant land use is grazing. The semiarid conditions of the West limit croplands to areas with above-average rainfall or to irrigated or subirrigated areas generally found in stream valleys. Table 81 indicates the percent of land devoted to both farming and grazing use. In addition, table 81 summarizes the average regional carrying capacities for livestock, which range from 2.6 acres per animal unit month in Oklahoma, to 22 acres per animal unit month in the San Juan River region.

*Evapotranspiration means loss of water from the soil both by evaporation and by transpiration from the plants growing in the soil.

Social Characteristics. Table 82 contains information on population, population density, and features of archeological significance in the coal lease areas. In general, the population density of the Western regions is low, except in the Denver-Raton Mesa region which reflects the significant growth that has occurred in the Denver region.

The archeological history of most of the Western region dates back to the Paleo-Indian big game hunting tradition of the pre-8000 B.C. period, and to the Desert Culture of the period from 9000-4000 B.C. The regions also contain remains of early Indian cultures, the most significant of which is the Anasazi people and the remains of their multistoried pueblos in the Southwest that date back to 1000 A.D. Although all of the regions are considered to have some archeological significance, the San Juan River region has the greatest archeological value.

Regulatory Framework

Federal regulation of the environmental effects of surface coal mining operations, including the surface effects of underground mining, was initiated on August 3, 1977 when President Carter signed into law the Surface Mining Control and Reclamation Act (SMCRA) (Public Law 95-87).[2]

In brief, the Surface Mining Act establishes a detailed national program for addressing environmental effects of coal mining. Of particular importance is the act's establishment of environmental protection performance standards (sec. 515) and provisions for designation of lands as unsuitable for coal mining (sec. ***522).*** The performance standards of section 515 are minimum standards applicable to various aspects of the mining and reclamation process. Under SMCRA, the States may, if they choose, impose standards that are more stringent. Among other things, the standards require:

- maximum utilization and conservation of the coal being recovered;
- restoration of disturbed land to original or better conditions;
- restoration of the approximate original contour of the land surface;
- stabilization and protection of all surface areas;
- protection of prime farmlands through specific reclamation techniques;
- minimization of disturbances to the existing hydrologic balance; and
- limitation of mining on steep slopes.

Section 522 of the act establishes a procedure to designate lands as unsuitable for all or certain types of coal mining operations. The Secretary of the Interior determines unsuitability for Federal lands, while States have authority over non-Federal lands. Areas may be designated unsuitable if, upon petition, it is determined that reclamation of disturbed lands is not economically or technologically feasible. Areas may also be designated unsuitable if mining operations will:

- be incompatible with existing land use plans;
- significantly affect important fragile or historic lands;
- result in substantial loss or reduction in the productivity of renewable resource lands which produce food or fiber; or
- substantially endanger life and property in natural hazard lands.

The act requires that the Department of the Interior (DOI) obtain the consent of certain private surface owners before Federal coal underlying their lands can be leased. The act restricts mining activities affecting alluvial valley floors. Section 510(b)(5) of the act allows the Secretary of the Interior to trade unleased Federal coal reserves for existing leases or non-Federal lands that cannot be mined because of alluvial valley floor des-

[2]91 Stat. 445, 30 U.S,C. 1201 et. seq.

ignations provided that coal is not yet being produced from the mine and the operator had made a substantial legal or financial commitment to develop a mine before January 1, 1977. The act also requires the Secretary to exchange non-Federal coal lands in alluvial valley floors that cannot be mined for available Federal coal lands of comparable value; these exchanges are not subject to the requirement of substantial legal and financial investments.

The act also created the Office of Surface Mining Reclamation and Control (OSM) within DOI to implement the statute's various programs. The act mandates compliance with detailed technical performance standards by operators on private as well as on Federal and State lands. The act originally provided for slightly less than 3 years of Federal enforcement of State-issued operating permits implementing the most stringent of the act's performance standards (known as the "interim regulatory program") followed by implementation of the remaining standards (known as the "permanant regulatory program"). At the end of 3 years (June 3, 1980), primary regulatory responsibility for the program was to have shifted to those States who had their proposed program for assuming regulatory primacy approved by DOI. In those States in which primacy was not achieved, a Federal program was to have been implemented and administered by OSM. Three and one-half years after enactment of the statute, all mining operations were to have been in compliance with permits issued in accordance with the full range of regulatory requirements, as administered by either the States or OSM.

Litigation brought in the District Court for the District of Columbia by several of the major coal companies and trade associations, as well as by several States, has resulted in significant changes to this schedule. The result of these changes has shifted the latest date for transfer of primacy or implementation of a Federal program from June 3, 1980 to January 3, 1981, and on-the-ground compliance from February 3, 1980 to September 3, 1981. Litigation pending in eight States (Pennsylvania, Virginia, Ohio, Tennessee, Kentucky, Alabama, Indiana, and Illinois) enjoining implementation of a Federal program in those States that did not gain primacy according to the schedule, has further delayed the implementation schedule. Although the full surface mining regulatory program was to have gone into effect on Federal lands 1 year after enactment of the statute (i.e., Aug. 3, 1978), the Secretary of the Interior, exercising his discretion, shifted the effective date of the permanent program requirements to coincide with the date on which primacy is transferred to a State or a Federal regulatory program is implemented for the State (Jan. 3, 1981).

Several other environmental statutes also affect the manner and method of mining coal on Federal leases. The most significant of these are the Clean Air Act and the Clean Water Act. Others, such as the Endangered Species Act of 1973, Bald Eagle Protection Act of 1969, as amended, Migratory Bird Treaty Act of 1918, as amended, the National Forest Management Act of 1976, and the National Historic Preservation Act of 1966, as amended, may act to prevent mining in certain locations at the mine plan approval stage. These acts are discussed separately later in this chapter. The DOI, in implementing the coal leasing process in accordance with the Federal Lands Policy and Management Act of 1976, has applied most of these statutory requirements to the process of selecting tracts for leasing during the land planning process, i.e., at the earliest stage in the lease development process. Because of the preliminary nature of the data available at this early point in the development process, decisions on certain criteria cannot be made concerning the suitability of a given tract for leasing, and these decisions are considered in the actual mine plan approval process.

In the West, because much of the coal reserve underlies Federal lands, OSM has had direct responsibility not only for enforcing the act's regulatory requirements, but also for issuing operating permits on specific

mines. The responsibility for overseeing mining activities on Federal lands is shared by the U.S. Geological Survey (USGS), the Bureau of Land Management (BLM), and the U.S. Forest Service as well as with those Western States with Federal lands within their boundaries that have gained regulatory primacy and have signed cooperative agreements with DOI. USGS has jurisdiction over exploration on Federal lands outside mine permit areas, as well as responsibility for resource conservation, diligence, and royalties under the Mineral Leasing Act as discussed in greater detail in chapter 9 of this report, BLM is the leading agency for Federal minerals and, under a variety of Federal statutes, is responsible for the management and protection of surface resources on Federal lands. BLM can set postmining land use performance bond limits to assure protection of these resources. The Forest Service performs a similar role for National Forest System lands. Thus, USGS, BLM, and the Forest Service, together with OSM, submit recommendations to the Secretary of the Interior concerning the approval or disapproval of mine plan applications. The U.S. Department of Agriculture, acting through the U.S. Forest Service, must concur in the issuance of mine plan approvals for mines within the boundaries of any national forest. Applicable Federal, State, and local agencies retain similar authority with respect to mines that might adversely affect any public park or site included in the National Register of Historic Sites.

Each of the Western States with significant coal reserves had enacted surface mining legislation in the 1970's prior to passage of the Surface Mining Act. The stringency of the State programs varied significantly, with Wyoming and Montana generally recognized as having had the most stringent programs, and Utah and New Mexico the least stringent. All of the Western States have received approval of their permanent regulatory programs and have qualified for assumption of primary regulatory jurisdiction under SMCRA. Thus, the States have assumed primary responsibility for mine plan compliance and enforcement with the act's requirements. Those States with approved permanent plans that have entered into a cooperative agreement with the Secretary of the Interior acquire the authority to regulate mining on Federal lands within their boundaries. The Secretary of the Interior, however, retains the authority to approve or disapprove mining plans on Federal lands and to designate Federal lands unsuitable for mining.

The OSM regulatory program is in the process of undergoing changes. Secretary of the Interior James Watt has ordered major organizational and staff revisions for OSM. Proposed budgetary cuts for fiscal year 1982 decrease funding for oversight inspections of mines. Extensive review of existing regulations is expected to result in a significant decrease in the extent of current regulations and is expected to increase the use of guidance documents and handbooks to clarify SMCRA. Reliance on State enforcement programs is expected to increase significantly. In announcing a plan to reorganize the number of OSM offices outside of Washington, Secretary Watt said:

> As the States move closer to achieving primary responsibility for enforcing the Surface Mining Control and Reclamation Act of 1977, the role of the Office of Surface Mining is shifting to one of assistance, advice and review of state efforts to assure that the environmental protection standards of the Act are met. [3]

The reorganization plan and regulatory review has been critized by conservation and some agricultural groups and supported by the coal industry, The ultimate effect of these changes in the OSM regulatory program is uncertain at this time,

Selected Environmental Issue Areas and Their Relationship to the Development of Federal Coal

The following sections discuss several environmental issue areas: air resources,

[3]U.S. Department of the Interior Press Release, May 21, 1981.

water resources, alluvial valley floors, topsoil and spoil handling, revegetation, wildlife, and cultural resources, and analyze how the enforcement of statutory controls may affect the production of Federal coal. Each section reviews the specific statutes important to that issue area, outlines the environmental concerns, and discusses the likely effect of these concerns on coal production. Emphasis is placed on limitations to recovery of coal reserves or on the rate of recovery. The general effect of environmental controls on mining costs is considered in the last section of this chapter.

Air Resources

Laws and regulations protecting air quality affect coal mining activities in three ways. First, mines must comply with national air standards as established by the Clean Air Act and various State implementation programs. Second, undeveloped leaseblocks whose development is contingent on mine-mouth* power generation or synthetic fuels development are affected if those facilities cannot comply with applicable local air quality standards. Lastly, changes in requirements for controlling sulfur emissions at powerplants in the market area for Western coal may affect the competitive cost advantages of low sulfur Western coal.** Issues related to direct emissions from mining activities are focused on fugitive dust and its effect on total suspended particulate (TSP). No other emission from coal mines is important to national or State air standards. Standards for sulfur dioxide ($S0_2$) and nitrogen dioxide (NO_2), as well as for TSP affect emissions from powerplants or synthetic fuel plants.

To date, air quality concerns related to direct mine emissions have had only a minor effect on Western coal mine development. In portions of the Powder River coal basin, fugitive dust emissions have exceeded or are nearing national ambient air standards, and mining activities in these areas may have to adopt better dust control measures. However, the level of production in this region is not expected to be constrained by air standards.

Some mine-mouth powerplants may experience difficulty in receiving permits because of their inability to meet air quality regulations. Expanded development of some Federal mines in North Dakota may be delayed because of the projected impacts of new powerplants and synfuels projects on the pristine air of the Theodore Roosevelt National Memorial Park, a Class I clean air area. Similarly, powerplants or synthetic fuel plants may have difficulty meeting air standards in parts of the Powder River basin and in southern Utah. In some cases, notably in North Dakota, the quality of the coal that would fire the mine-mouth plants is too low to transport any distance. Thus, failure to gain air permits for major facilities could preclude development of some coal reserves. However, a final decision on permitting the proposed facilities in North Dakota has not yet been made.

The potential impact of changes in national sulfur emission standards on the development of Western coal is discussed in chapter 5, Markets. Generally, the requirement to control emissions regardless of the sulfur content of the coal decreases the competitiveness of low sulfur Western coal in market areas where local high sulfur coal is also available.

Statutory Control

Surface Mining Control and Reclamation Act

SMCRA requires that an operator: "stabilize and protect all surface areas including spoil piles affected by the surface coal mining

*Mine-mouth powerplant is a term that refers toa coal-fired electrical generating facility located at or near the supplying coal mine.

**This issue is examined in ch. 5.

and reclamation operation to effectively control erosion and attendant air . . . pollution" (sec. 515(b)(4)). Regulations adopted by OSM pursuant to this section required that an operator "plan and employ dust control measures as an integral part of site preparation, coal mining, and reclamation operations" (30 CFR 816.95(a) and 817.95(a)). These regulations listed 19 different control measures that might be employed by an operator to achieve the best available control of fugitive dust. However, these regulations were remanded to OSM by the decision of Judge Flannery of the district court of the District of Columbia.[4] The regulations, as promulgated, were said to be too encompassing and beyond statutory mandate. OSM has not proposed a revision of these performance standards and at this time is deferring to State regulatory agencies decisions about coal mine fugitive dust emissions. No date is available for reissuance of these OSM regulations.

Subsequent to this decision, each Western State except Montana remanded its State regulations that had mirrored the Federal regulations (30 CFR 816.95, 817.95). In each of these States, air resource issues are being handled by the State agency responsible for State implementation of the Clean Air Act Amendments and not by the mine reclamation agency. In Montana, coal mine related air resource issues are being handled jointly by the State reclamation agency and the State air quality agency. Even in Montana, where surface mine regulations are the strictest in the West, the standards of the Clean Air Act still take precedence. Thus, State implementation and enforcement of the Clean Air Act is the foundation of regulation of air impacts of coal mining.

Clean Air Act

The Clean Air Act establishes a national system of air quality regulation. Regulations and standards under this act are implemented at the Federal level by EPA and at State levels in conjunction with additional regulations and standards imposed by individual States. The following discussion highlights provisions of the act of significance to coal mining. Brief mention is also made of provisions of importance to mine-mouth facilities.

National Ambient Air Quality Standards (NAAQS)[5]

Regulation under the act focuses on six criteria pollutants: particulate, sulfur dioxide ($S0_2$), carbon monoxide (CO), nitrogen oxides (NO_x), ozone (O_3), and lead. Two types of ambient air quality standards are designated: primary standards, which were designed to protect human health; and secondary standards, which were designed to safeguard aspects of public welfare, including plant and animal life, visibility, and buildings. The Nation is divided into 247 air quality control regions (AQCRs) so that pollution control programs can be locally managed. Each AQCR is classified as to whether it meets the national standards.

The classification of an area with respect to ambient air quality has important consequences. Regions that are found by EPA to be in nonattainment status are subject to a particular set of restrictions under the act. On the other hand, nondegradation regions, where air is cleaner than the standards, are subject to a different set of regulations, which are intended for "prevention of significant deterioration" (PSD). Regardless of an area's classification, almost every new major source of emissions is required to undergo a preconstruction review. (A major source of emission is defined for PSD purpose at 40 CFR 52.2.l(b)(l)(i).)

To achieve air quality goals, areas with air cleaner than NAAQS were divided into classes I, II, and III. Certain national parks,

[4]In re Surface Mining Litigation, civil action No. 79-1144 (District of Columbia).

[5]The following discussion draws heavily from An Assessment of 011 Shale Technologies, OTA-M-118, June 1980. See also Final Rules on Requirement for State Implementation Plans for Prevention of Significant Deterioration, 45 F.R. 52676, Aug. 7, 1980. The rules implement major changes in Clean Air Act regulations required by the decision in Alabama Power Co. v. Costle, 13 E.R.C. 1225 (D.C. Cir. 1979]; 13 E.R.C. 1993 (D.C. Cir. 1979).

wilderness areas, and monuments that existed when the act was passed were immediately designated as class I areas where air quality is to remain virtually unchanged. All other clean air areas were designated class II—areas in which some additional air pollution and moderate industrial growth were allowed. Individual States or Indian Tribal governing bodies can redesignate some class II areas to class III areas in which major industrial development is foreseen and air pollution up to one-half the level of the secondary standards would be permitted. The States or Indian Tribes can also redesignate class II areas as class 1. Either type of redesignation is subject to hearings and consultations with the managers of affected Federal lands, or States in the case of Indian action.

State Implementation Plan (SIP)

Each State must submit an implementation plan for complying with primary and secondary standards. A State can decide how much to reduce existing pollution to allow for new industry and development. State plans must also include an enforceable permit program for regulating construction or operation of any new major stationary source in nonattainment areas, or significant modification to an existing facility. New processing plants and power stations must also satisfy emission standards set forth in the State implementation plan.

Each of the Western States has adopted its own ambient air quality standards (table 83). For particulate, Colorado has the strictest standards. For sulfur, important for powerplant emissions, Montana, North Dakota, and New Mexico have the strictest standards.

The Prevention of Significant Deterioration

All SIPS must specify emission limitations and other standards to prevent significant air quality deterioration in each region that has air quality better than primary or secondary NAAQS or cannot be classified with regard to compliance with primary standards because of insufficient information.

Under these PSD standards, maximum allowable increases in concentration of SO_2 and particulate are specified for each class (table 84). For the other criteria pollutants, maximum allowable concentrations for a specified period of exposure must not exceed the respective primary or secondary NAAQS, whichever is stricter.

A State can redesignate a class I or II clean air area with respect to PSD to allow greater increases in emissions under procedures set

Table 83.—Federal and State Ambient Air Quality Standards Pertinent to Coal Mine and Related Facility Development

Pollutant	Concentration in micrograms per cubic meter							
	Federal (primary)	Federal (secondary)	Colorado	Montana	New Mexico	North Dakota	Utah	Wyoming
SO_2								
Annual arithmetic mean	80	—	80	53.3	53	53.3	80	60
24-hr maximum	365	—	365	267	267	267	365	260
3-hr maximum	—	1,300	700	1,334 (1 hr standard)	—	747 (1 hr standard)	—	1,300
Particulate:								
Annual geometric mean	75	60	45	75	60		75	60
24-hr maximum	260	150	150	200	150	1%	260	150
NO_x (as NO_2)								
Annual arithmetic mean	100	100	100	100 600 (3 hr standard)	100 200 (24 hr standard)	100 200 (1 hr standard)	100	100

[a] Standards for oxidants, CO, lead, and nonmethane hydrocarbons omitted.

SOURCE: Off Ice of Technology Assessment.

Table 84.—National Standards for Prevention of Significant Deterioration of Ambient Air Quality (concentration in micrograms per cubic meter, µg/m³)

	Maximum allowable increase		
Averaging time	Class I	Class II	Class III
Particulates:			
Annual	5	19	37
24 hour	10	37	75
SO_2:			
Annual	2	20	40
24 hour	5	91	182
3 hour	25	512	700

SOURCE Office of Technology Assessment.

forth in the act. These include an assessment of the impacts of the redesignation, public notice and hearings on such a redesignation, and approval by EPA. However, certain Federal areas cannot be redesignated.

If a facility's construction began after January 1, 1975, a special preconstruction review must be undertaken if it is located in a nondegradation area. To obtain a permit for such a facility, an applicant must demonstrate that it will not cause air pollution in excess of NAAQS or PSD standards more than once per year in any AQCR. Best available control technology (BACT) must be used for all pollutants regulated by the act, and the effects of the emissions from the facility on the ambient air quality in the areas of interest must be predicted. Impacts on air quality that could result from any growth associated with the facility must also be analyzed.

Although coal mines are not subject to PSD review under Federal regulation, State PSD permits are required for most coal mines in North Dakota and Montana. Under proposed State rules, PSD permits for coal mines in Wyoming may be required, but final administrative action has not yet been taken.

Implications of the Clean Air Act for Federal Coal Development

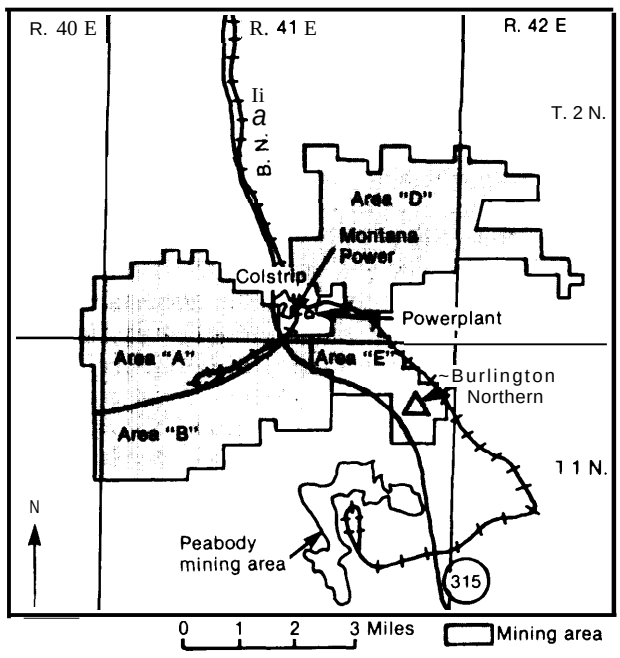
Fugitive dust emissions are the only type of coal mine emission that has the potential for violating national or State ambient air quality standards. Annual mean TSP concentrations have exceeded standards at Colstrip, Mont. in 5 of the last 6 years. Prior to 1974, the primary standard was not exceeded. In 1977, when the annual mean concentration for TSP at Colstrip was 92µg/ms, the next highest concentration was 48.1µg/ms, at Ekalaka in eastern Montana, A 120-mi^2 area surrounding Colstrip was designated as a nonattainment area in 1978 (fig. 44). Surface mining activities surrounding the town are considered the primary source of fugitive dust.

Ambient air quality standards have not yet been violated at Gillette, Wyo. However, the Wyoming standard for maximum 24-hour TSP concentration is reportedly being exceeded at some mines.[6]

Roads are the major source of fugitive dust from surface coal mining operations and generally are responsible for twice as many emissions as the next most important source. Other sources of fugitive dust include unit trains, coal storage and processing facilities, spoil piles, and reclamation areas. Options

'Personal communication with the Wyoming Department of Air Quality, Sheridan Office.

Figure 44.—Colstrip TSP Nonattainment Area



SOURCE: U.S. Geological Survey and Montana Department of State Lands, *Draft Environmental* Statement *for Proposed Expansion of Mining and Reclamation Plan, Big Sky Mine, 1978,* fig, 11-11

for controlling fugitive dust emissions include:

1. periodic watering of unpaved roads;
2. chemical stabilization of unpaved roads;
3. paving of roads;
4. enclosing, covering, watering, or otherwise treating haul trucks and railroad cars;
5. substituting conveyor systems for haul trucks;
6. minimizing the area of disturbed land;
7. prompt revegetation of regraded lands; and
8. covering coal storage areas.

Some of these options are employed at each surface mine in the West. Most mines in Campbell County, Wyo. pave their haul roads. Closed conveyor systems replace truck haulage at Gulf's McKinley Mine near Gallup, N. Mex., and at AMAX Coal's Belle Ayr Mine south of Gillette. All mines water haul roads and revegetate topsoil stockpiles. Many mines now enclose their coal storage areas.

Operations in Nonattainment Areas

The Colstrip, Mont. area has been designated a nonattainment area for TSP. In December 1979, Western Energy filed a petition against the nonattainment designation with the Montana Department of Health and Environmental Sciences and EPA. Monitoring data indicate that the TSP problem exists only in the immediate vicinity of Colstrip and not in the entire 120-mi^2 area. However, no redesignation has yet been made. T Criteria for approval of new facilities in nonattainment areas are subject to careful regulatory review. Sources of fugitive dust, most notably Western Energy's Rosebud Mine, must develop plans to limit emissions so that TSP concentrations will eventually meet standards. Also, no new facilities may be approved unless it can be shown that the new facility will not add to emissions in the area.

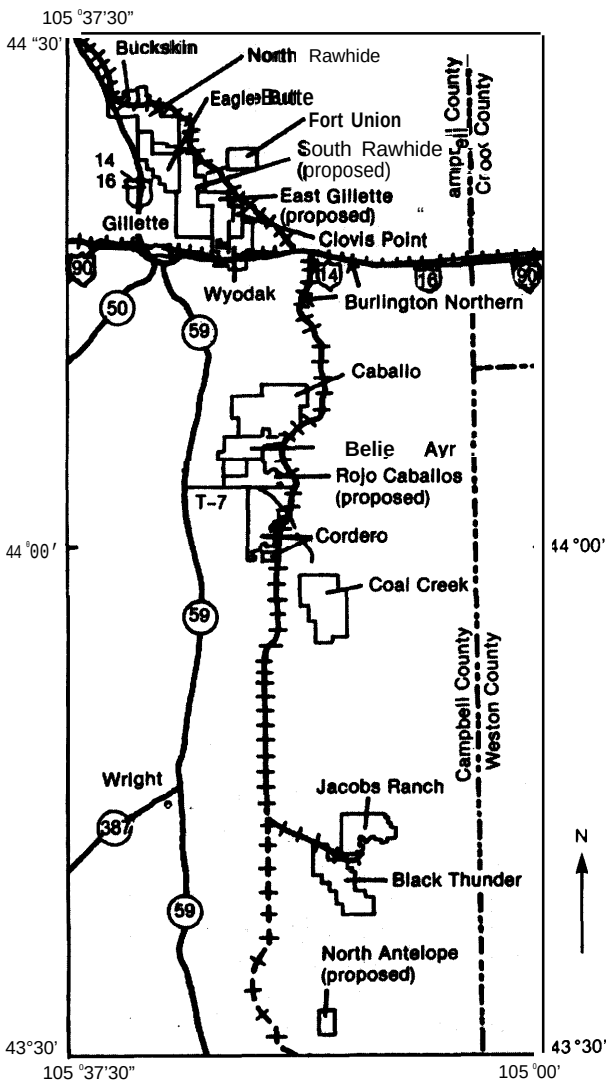
[7]Montana Department of State Lands, Final Environmental Impact Statement, Western Energy Company's Rosebud Mine, Area B Extension, 1980.

Western Energy has initiated measures to reduce emissions, including seeding of lawns in the town, paving of some roads, and chemical treatment of some haul roads. However, construction of two new powerplants in the town makes future compliance with TSP standards uncertain. As long as neither Peabody Coal, which operates the Big Sky Mine, also in the nonattainment area, nor Western Energy proposes increasing their current capacities, their future applications for extending their mines will probably not be affected. However, increasing capacities and construction of new facilities cannot be approved under SIP unless Western Energy can demonstrate reduction of other emissions such that emissions from expanded production will not increase total area emissions, Because Western Energy plans on extending capacity by 5 million tons per year in 1984, the company will have to either achieve other emission reductions by that time or gain a favorable decision on redesignation of the nonattainment area.

Operations in the Wyoming Portion of the Powder River Coal Basin

As noted, TSP levels in portions of the Powder River coal basin in Wyoming are approaching the limits set by State ambient standards. Already, mines are installing controls, including paving of many roads. However, the magnitude and concentration of mines make compliance difficult (fig. 45). In particular, north of Gillette, where the Buckskin, Rawhide, and Eagle Butte Mines are adjacent to one another, as well as to the undeveloped South Rawhide, Dry Fork, and East Gillette leaseholds, compliance with TSP standards at higher than existing production rates is of increasing concern. South of Gillette, the Caballo, Belle Ayr, Rojo Caballos, and Cordero Mines are adjacent to one another. Total 1979 production at these four mines was 20.1 million tons, but may expand to about 30 million tons in 1985 (see ch. 7). Although modeling of TSP concentrations has indicated compliance with standards at permitted production levels, OSM and Wyo-

Figure 45.— Lease Blocks in the Vicinity of Gillette, Wyo.



SOURCE' U S. Office of Surface Mining, *Draft Environmental Statement Proposed Mining and* Reclaimation Plan, Rojo Caballos *Mine, 1980,* fig. 1-1.

ming Air Quality officials have expressed uncertainty about the accuracy of these modelling projections.[8] Expansion of mining at the Jacobs Ranch and Black Thunder Mines in southern Campbell County may increase local TSP concentrations in that area, as well.

'Personal communication to OTA, Wyoming Air Quality Bureau Staff, Sheridan.

If air quality standards are not met, portions of Campbell County could be designated nonattainment areas, despite prior issuance of air quality permits. Such designation would require development of mitigation programs and reevaluation of each operation's fugitive dust control plan. Although production rates would probably not be affected, additional control measures might be required.

Some new mines in Campbell County have not obtained approval of their proposed maximum production rate. For example, the Black Thunder Mine received a permit for a maximum production level of 20.5 million tons per year although it applied for a 30 million tons per year maximum rate. Modeling had indicated that production greater than 20.5 million tons per year would have resulted in emissions exceeding TSP standards. Black Thunder's planned production for 1991 is 20.5 million tons per year; it currently has to supply contracts 16.5 million tons per year in 1991. (See ch. 7.)

To date, Wyoming has issued permits for existing and proposed mines in Campbell and Converse counties that could accommodate over 250 million tons per year (table 85), This is three times total production from the entire Powder River basin in 1979 and is higher than OTA's high scenario estimate for coal production from all Federal mines in the entire Powder River basin, including the Montana portion, in 1991. Only three undeveloped Federal lease blocks in these two counties considered by OTA to have favorable production prospects for 1991 have not yet gained air permits (table 85). Each of these leases is expected to receive a permit for some level of production. Six Federal lease blocks have air permits in excess of their expected 1991 capacity and three lease blocks will have 1991 capacities in excess of air permits (table 85).

Under OTA's low demand scenario for the Powder River basin, only the Rochelle and Antelope lease blocks would need to acquire air permits to meet projected production levels. Permits are expected to be issued for both lease blocks. Under OTA's high demand scenario, the Buckskin, North Rochelle, South

Table 85.—Air Permits and Production Scenarios for Mines in Campbell and Converse Counties, Powder River Basin, Wyo.

Mine	Approved air permit	1991 capacity	1991 OTA high demand scenario production	1991 OTA low demand scenario production
Developed-Federal				
Buckskin	6	6.2	6.2	5.5
Rawhide	24	24	30.7	14.2
Eagle Butte	29	25	35.2	29.2
Wyodak	5	5	4.9	4.0
Caballo	12	12	included in Rawhide estimates	
Belle Ayr.	25	11	included in Eagle Butte estimates	
Rojo Caballos	20	15	12.5	5.0
Cordero	24	24	20.5	9.7
Coal Creek	18	12	10.1	4.2
Jacobs Ranch	16	16	15.3	11.7
Black Thunder.	20.5	20.5	19.4	14.6
Dave Johnston.	[a]	3.8	3.8	3.3
Developed—non-Federal				
Fort Union	1.2	0	—	—
Clovis Polnt	4.0	5.0	—	—
Undeveloped-favorable development prospects Federal				
North Rochelle	—	8	5.9	0
Wildcat	10	7	5.1	0
South Rawhide	7	12	8.8	0
Dry Fork	15	8	5.9	0
East Gillette	11	15	11	0
Rochelle	—	6	6.0	5.3
North Antelope	5	5	5	4.4
Antelope	12[b]	8	8	7

[a] Air Quality permit is not required for this mine.
[b] Application under review.

SOURCE: Office of Technology Assessment. (Values for approved air permits are from the Wyoming Air Quality Bureau records. See ch. 7 of this report for mine capacities and a discussion of the OTA high and low demand scenarios)

Rawhide, Rochelle and Antelope blocks are expected to need air permits to accommodate higher production; between them, Buckskin and South Rawhide would need permits for 2.0 million tons per year of additional production under the OTA high demand scenario. Permits for capacities in excess of the expected capacity of 22 million tons per year at North Rochelle, Rochelle, and Antelope are expected to be issued.

implications for Onsite Powerplants and Synfuels Facilities

Lignite in North Dakota will be mined for consumption by local powerplants or synthetic fuel plants. Because of its low heat content and tendency to combust during transport, lignite is, with one exception, not shipped long distances. Future expansion of lignite mining in North Dakota is contingent on continued development of mine-mouth powerplants and synthetic fuel plants.

However, the prevention of significant deterioration (PSD) provisions of the Clean Air Act may delay or limit the future development of new power or synthetic fuels facilities in western North Dakota. Although there are no nonattainment areas in the State, the Lostwood Wilderness Area and the Theodore Roosevelt National Memorial Park are mandatory Federal class I areas.

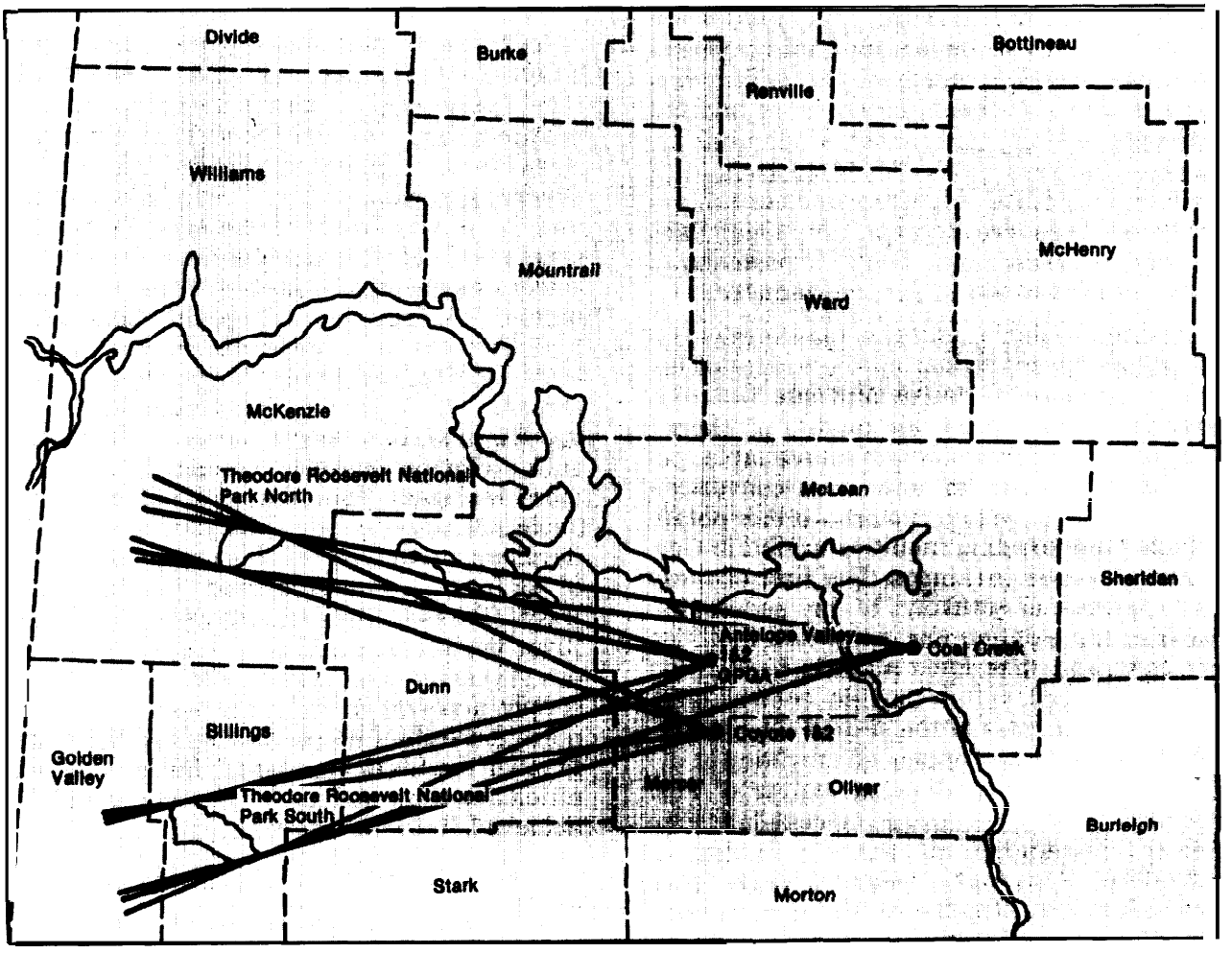
Air quality monitoring and modeling conducted by the North Dakota State Department of Health suggests that available air quality increments of SO_2 at Theodore Roosevelt National Park may be exceeded if additional powerplants or synfuels facilities are permitted in west-central North Dakota. In 1978, using a model developed by EPA, the Department of Health obtained results that

indicated that the operation of seven coal conversion units under review at that time would result in SO_2 concentrations that would exceed allowable standards for the national park.

These permit applications included United Power Association's Coal Creek units 1 and 2, Montana Dakota Utilities' Coyote No. 1 facility, Great Plains Gasification Associates' coal gasification plants, phase I and II, and Basin Electric's Antelope Valley Station units 1 and 2 (fig. 46). Because Basin Electric was the last organization to file a building permit application, the company had to redesign its plants to reduce SO_2 emissions. Basin Electric resubmitted its application and was subsequently granted permission to build. According to the model, the Basin Electric project left no room for additional concentrations of SO_2 at the park.

Based on the results of their modeling, the North Dakota State Department of Health has not granted any additional permits, beyond the seven listed above, for construction of new coal conversion facilities east of the park. Although powerplant operators have maintained that the EPA model used to estimate remaining SO_2 increments at Theodore

Figure 46.—Relationship of Recently Permitted (1979) Sources to the Theodore Roosevelt National Park (wind flow vectors indicated)



SOURCE: U.S Bureau of Land Management, Final *West-Central North Dakota Regional Environmental Impact Statement* on *Energy Development, 1978.*

Roosevelt National Park is not reliable beyond distances of 50 to 70 kilometers, no alternative modeling data has yet been found acceptable by the State. Most of the development in Mercer and Oliver Counties is taking place more than 150 kilometers from the park. Work on improving modeling techniques is currently underway at the North Dakota Department of Health.

The coal industry must also compete with expansion of oil and gas production for air quality increments. Because North Dakota's Western oil and natural gas resource areas overlap the Fort Union lignite region, gas extraction and refining facilities located near Theodore Roosevelt National Park would compete directly with coal development for any available sulfur dioxide increments. In general, oil and natural gas production would not involve major air quality considerations; however, much of the gas in this area is sour (i.e., contains up to 24 percent hydrogen sulfide) and presents potential air quality problems when flared or treated in sweetening plants. If additional class I increments at Theodore Roosevelt National Park become available, some could be assigned to the expansion of the natural gas industry.

At some point, additional lignite development may be dependent on the ability of lignite consumers to design and site facilities that do not affect the air quality of class I areas. If increments remain unavailable, potential developers of new coal conversion facilities will have two choices—either obtain offsets from existing facilities or obtain Government-issued variances. The first of these two options is unlikely to be successful. Most of the existing and permitted facilities are new and thus have already been fitted with advanced sulfur dioxide control techniques. In the case of the second alternative, the State so far has appeared unwilling to exercise its authority allowing waiver of PSD requirements under certain circumstances to permit degradation of the air quality of Theodore Roosevelt National Park. Proposed facilities affected by the situation are listed in table 86, However, the situation remains unresolved. Considerable uncertainty stems from the fact that five permitted facilities have not yet been built and therefore their effect on air quality can only be estimated.

Table 86.—North Dakota Department of Health Pending Air Emissions Permits

Company	Operation	Type	Capacity
Nakota	Unnamed	Coal to methanol	96,000 bbl/d
Basin Electric	AVS III	Powerplant	500 MW
Basin Electric	Sunrise	Powerplant	1,000 MW
Warren Petroleum		Sour gas treatment	30 MCF/d
AMOCO		Sour gas treatment	100 MCF/d
Minnesota Power & Light		Powerplant	1,000 MW

SOURCE: Office of Technology Assessment.

In Wyoming, class I designations and State sulfur standards may also affect onsite facilities construction. Class I areas have been proposed both for the Cloud Peak Primitive Area in the Bighorn Mountains west of the Wyoming portion of the Powder River basin and for Devils Tower to the east. State governments and Tribal governing bodies are solely responsible for making such a redesignation determination. Air quality considerations may constrain the eventual level of synfuels development in the Powder River basin and southern Wyoming, but probably not during the next 10 years. However, Wyoming's sulfur dioxide emission standard, which is more stringent than the national standard (table 83) could create difficulties for onsite development of coal reserves with high levels of sulfur. Two undeveloped Federal lease tracts (the Belco tract in the western Powder River basin and the Cherokee tract in southern Wyoming) that have reserves sufficient to supply a power or synfuels plant would require more than 95 percent sulfur reduction to meet the State standard. * Sulfur removal efficiencies exceeding 95 percent could be achieved, but would be expensive.

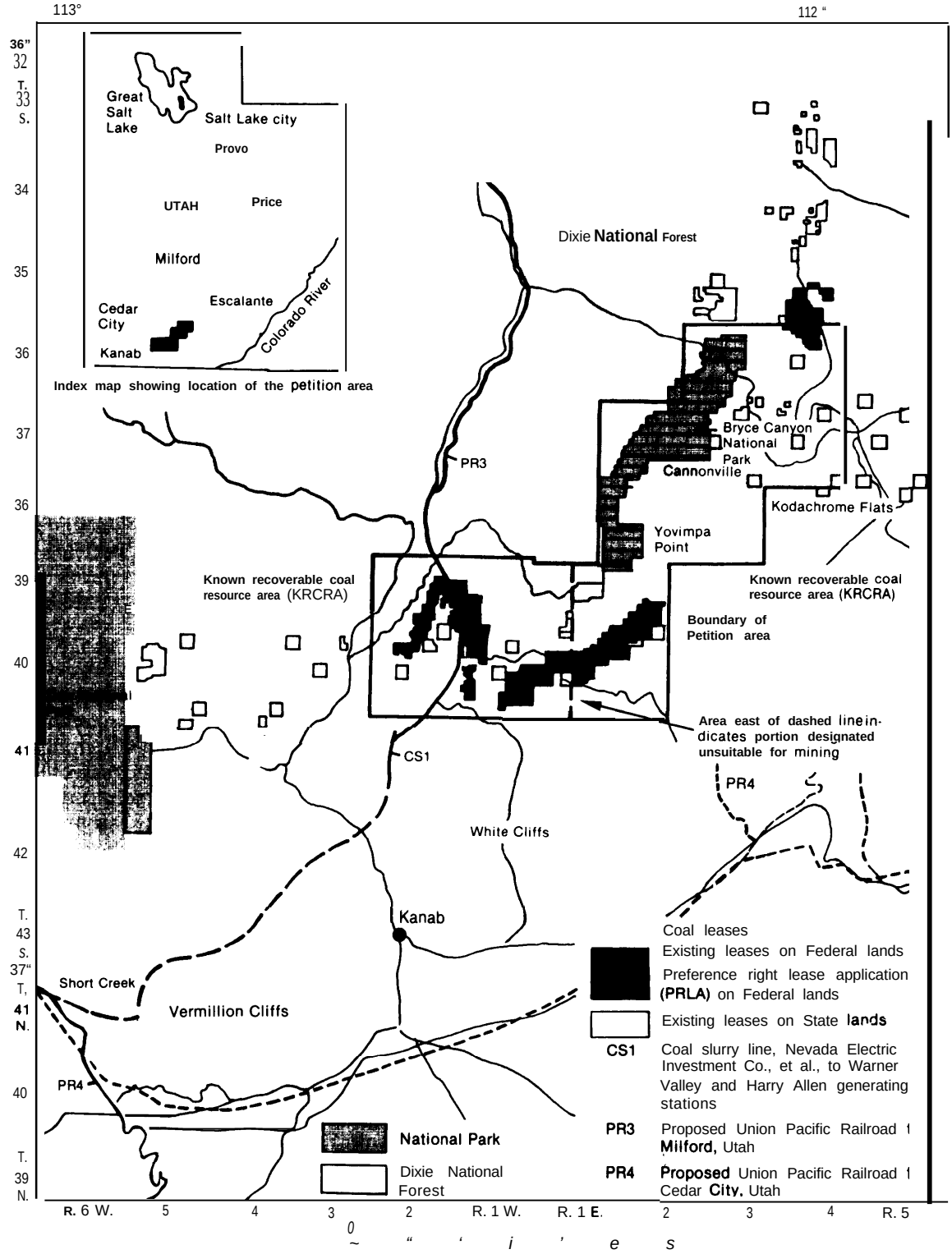
*The Belco tract is expected to be traded for other Federal coal lands under provisions of Public Law 95-554.

Air Quality Issues and the SMCRA Unsuitability Petition Process

Under the SMCRA unsuitability petition process, areas may be designated unsuitable for coal mining if it can be shown that mining operations will "affect fragile . . . lands with significant damage to important. . . aesthetic values or natural systems" (30 CFR 762.11(b)(2)). In the Alton coalfield of southern Utah, an area including 28 undeveloped Federal leases covering 26,693 acres (fig. 47), several petitioners, including local landowners and three national conservation groups, alleged, among other things, that the visibility and air quality values from and within Bryce Canyon National Park would be threatened by coal mining. (The park is a mandatory class I attainment area under the Clean Air Act.) The OSM's analysis of these allegations used PSD standards as an evaluative benchmark.[9] OSM found that 24-hour PSD class I increments could be exceeded one or two times a year in a small portion of the park. OSM also found that visibility would be locally reduced by dust plumes from mining and coal trucks. There was conflicting data from other sources that PSD increments would not be exceeded. The final decision by the Secretary of the Interior to designate 9,049 Federal lease acres of the proposed petition area as unsuitable was based on the finding that mining in part of the area would impair scenic vistas visible from the park and that high noise levels would occur in some areas within the park, thus damaging the values for which the park was established.

[9] See U.S. Department of the Interior, Statement of Reasons Supporting Secretarial Decision on Petition to Designate Certain Federal Lands in Southern Utah Unsuitable for Surface Coal Mining operation, Jan. 13, 1981, OSM ref. No, 79-5-001, pp. 13-14.

Figure 47.—Map of Southern Utah Petition Area Showing Federal and State Coal Leases, Coal-Slurry Pipeline Route, and Proposed Coal Haul Railroad Routes



SOURCE: U.S. Office of Surface Mining, *Southern Utah Petition Evaluation Document,* 19S0, fig. 1A-1.

Water Resources

Water is a scarce and valuable commodity in the West and concern for the water resource is indicated in detailed Federal and State regulations. Ground and surface water hydrology data required of proposed coal mine operators is more extensive than any other type of data.

Several aspects of the water resource issue could affect Federal coal development. However, none has yet resulted in disapproval of a mine plan. Potential for selected prohibitions exists in cases where water supply diminution or degradation becomes unavoidable, and alternative supplies cannot be identified. Conflicts with other water users exist in virtually every coal region; this study has not attempted to analyze these conflicts in any detail.

Water resource concerns could result in the prohibition of mining in some areas under the unsuitability petition process. These concerns were part of the Alton coalfield petition but were not critical to the final secretarial decision, because insufficient information was available on which to make a determination. The decision noted that the hydrological impacts of proposed mining operations would be reviewed when a mine plan was submitted for approval under SMCRA.[10] Water resource concerns are central to a recently filed petition for a part of the Tongue River drainage basin in southeastern Montana (see also ch. 9).

The availability of water for use by mines, particularly where irrigation is necessary for reclamation in the Green River-Hams Fork and San Juan River regions may ultimately constrain coal development. However, OTA did not identify any areas where such a constraint was imminent.

The extent of regulatory control over water resource issues has been the subject of criticism from the coal mining industry. These criticisms are identified and summarized in this section; however, a detailed study of increased costs and time delays attributed to these regulations is beyond the scope of this report.

General Impact of Coal Mining on Water Resources

Coal mining activities affect water both directly through disturbance by mining, indirectly through powerplant facility development, and potentially through transportation by coal slurry pipelines. Primary attention has centered on the direct impact of surface mining, particularly on disruption of ground water flow and quality. Recently, research has begun on the impacts of underground mining and related subsidence on water resources.

The opening of a pit for surface mining affects the level and flow of ground waters. The mine pit will intercept all ground waters that are found above the pit floor. Directions of ground water movement may change and even reverse as water surrounding the pit in all directions flows toward the pit. As water flows into the pit, water levels in surrounding areas, as evidenced in wells, will fall. Ultimately, an equilibrium condition is established based on the characteristics of the water-transmitting rocks (aquifers) and the length of time the pits are open. Monitoring studies have measured the offsite extent of drawdown, as the lowering of the ground water level is termed, 2 miles from an active pit.[11]

Water quality can also be affected. Ground water moving through backfilled

[10] Ibid, The Alton lessees submitted a mine plan for the Project before SMCRA regulations were implemented. The mine plan has not been updated to incorporate additional surface mining permit requirements.

[11] Van Voast and Hedges, Hydrologic Aspects of Existing and Proposed Strip Coal Mines Near Decker, Southeastern Montana: Montana Bureau of Mines and Geology Bulletin **97.1975.**

surface mines is known to have substantially increased concentrations of total dissolved solids and other constituents. Generally, the average concentration of dissolved solids is two to three times greater in spoil waters than in the waters in undisturbed coal aquifers.

The overall potential changes are such that Congress, OSM, and the various States have developed comprehensive requirements for the prediction and monitoring of ground water impacts from surface mines.

Impacts of sedimentation and pollution on surface waters are more easily understood and monitored. The primary impact, increased sediment loads in streams caused by erosion of mine and reclamation areas, can effectively be controlled by construction of sedimentation ponds at drainage outlets from mines. Surface waters can also be affected by seepage of polluted ground waters into receiving streams. Although not observed to date, this possibility is the basis of the Northern Plains Resource Council unsuitability petititon for the Tongue River area. The petition is partly based on a published modeling study predicting this impact.

Subsidence from underground coal mining has been documented to impact water resources and the subject is receiving increasing study. Subsidence cracks have caused interception of spring flow, ground water flow, and stream flow at locations in the Uinta-Southwestern Utah coal region.[13] Since subsidence is an expected aspect of all underground mining, regulatory concern over associated environmental impacts is growing. Subsidence monitoring has been required at several underground mines as a condition of permit approval.

Powerplants and synthetic fuel plants are affected by Clean Water Act provisions relating to discharge limitations. Effluent standards are not a significant impediment to construction of these facilities, however. The availability of water and restrictions on water usage under interstate water use compacts and State law have affected the construction of coal slurry pipelines and, to some extent, the construction of powerplants,

Statutory Control

Major regulatory review of the water resource impacts of mining proposals is conducted under the mandate of the SMCRA and the Clean Water Act. Water resource data is a major component of a mine permit application and compliance with several water resource performance standards must be demonstrated before an application can be approved. Mines must also obtain a permit to discharge effluents from an operation under provisions of the Clean Water Act. Thus, the agencies most responsible for review of water resource impacts are OSM and companion State reclamation agencies and EPA and companion State water quality agencies. The following section reviews some Federal statutes and regulations over water resources. Implementation in each of the Western States varies slightly and may be more stringent than outlined here. No State has less stringent provisions.

The SMCRA establishes conditions for permit approval or denial:

> No permit or revision application shall be approved unless the application affirmatively demonstrates and the regulatory authority finds in writing , . . that:
>
> (3) the assessment of the probable cumulative impact of all anticipated mining in the area on the hydrologic balance . . . has been made by the regulatory authority and the proposed operation thereof has been designed to prevent material damage to hydrologic balance outside the permit area (sec. 510b.)

[12] Woessner, Osborne, Heffern. Whitman. Spotted Elk, and Morales-Brink, *Hydrologic Impacts* from *Potential Coal Strip* Mining, Northern Cheyenne Reservation. report to the EPA Industrial Environmental Research Laboratory. Cincinnati, Ohio, 1980.

[13] Dunrud, Some Engineering Geologic Factors *Controlling Coal* Mine Subsidence in *Utah and Colorado*. USGS Professional Paper 969, 1976.

Section 515(b) of SMCRA also establishes performance standards related to water resource impacts. A permit application must demonstrate, among other things, that these standards can be complied with before approval is obtained:

> General performance standards shall be applicable to all coal mining and reclamation operations and shall require the operation, as a minimum to—
>
> (2) restore the land affected to a condition capable of supporting the uses which it was capable of supporting prior to any mining, or higher or better uses of which there is reasonable likelihood, so long as such use or uses do not . . . pose any actual or probable threat of water dimunition or pollution . . . .
>
> (4) stabilize and protect all surface areas including spoil piles affected by the surface mining and reclamation operation to effectively control erosion and attendant . . . water pollution , . .
>
> (8) create, if authorized in the approved mining and reclamation plan and permit, permanent impoundments of water on mining sites as part of reclamation activities , . .
>
> (lo) minimize the disturbances to the prevailing hydrologic balance at the mine-site and in associated offsite areas and to the quality and quantity of water in surface and ground water systems both during and after surface coal mining operations and during reclamation by—
>
> (A) avoiding acid or other toxic mine drainage . . .
>
> (B)(i) conducting surface coal mining operations so as to prevent, to the extent possible using the best technology currently available, additional contributions of suspended solids to streamflow, or runoff outside the permit area, but in no event shall contributions be in excess of requirements set by applicable State or Federal law;
>
> (ii) constructing any siltation structures . . . prior to commencement of surface coal mining operations . . .
>
> (C) cleaning out and removing temporary or large settling ponds or other siltation structures from drainways after disturbed areas are revegetated and stabilized; and depositing the silt and debris at a site and in a manner approved by the regulatory authority;
>
> (D) restoring recharge capacity of the mined area to approximate premining conditions;
>
> (E) avoiding channel deepening or enlargement in operations requiring the discharge of water from mines , . .
>
> (G) such other actions as the regulatory authority may prescribe . . .

The purpose of these requirements is to ensure that long- and short-term adverse changes in the hydrologic regime that might be caused by coal mining and reclamation activities will be prevented or minimized.

OSM promulgated comprehensive regulations pursuant to these statutory provisions. The major subject areas of the regulations of concern to Western mining are:

- water quality standards and effluent limitations,
- diversions, sediment control, and sedimentation ponds,
- impoundments,
- protection of ground water and ground water recharge capacity,
- monitoring,
- water rights, and
- stream buffer zones.

Additional regulations concern alluvial valley floors; these provisions are discussed in a later section.

Water Quality Standards and Effluent Limitations

Control of discharges from mining and reclamation activities is jointly controlled by OSM and the agency responsible for implementation of the Clean Water Act in each State. Under sections 301, 304, and 401 of

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the Clean Water Act, mining operations must obtain discharge permits and comply with EPA, or State effluent, limitations for point source discharges of pollutants to surface waters. However, the Clean Water Act permit system applies only during the active phase of mining; it does not extend to reclamation, nor does it cover nonpoint pollution sources, nor does it consider discharges to ground water. However, under SMCRA all water discharged as a result of coal mining and reclamation activities which could materially damage the hydrologic system is regulated. Thus, coal mines must obtain a permit to discharge from EPA, or administering State water quality agency, for all point source discharges. These discharges include effluents from plant facilities and discharge of ground waters intercepted in a mine pit. OSM, or State reclamation agency, review also considers other types of discharges such as those from reclamation areas, as well as providing input in the review of point source discharges.

Effluent limitations established by OSM are generally similar to those adopted by EPA (table 87). In each State, any stricter standards supersede these Western regional standards. For instance, the Montana State implementation program of the Clean Water Act includes a provision that no discharge may degrade the quality of receiving waters, regardless of conformance with specific effluent limitations. At most Montana coal mines, the necessity to meet this criterion is a stricter one than are the direct effluent limitations.

Table 87.—Effluent Limitations for Western Coal Mines in Milligrams per Liter (mg/l)[a]

Effluent characteristics	Maximum allowable	Average of daily values for 30 consecutive discharge days
Iron, total	7.0	3.5
Manganese, total	4.0	2.0
Total suspended solids	45.0	30.0

[a]EPA has proposed a relaxation of these effluent standards (46 F.R. 28873, May 29, 1961). OSM has proposed to adopt these relaxed standards (46 F.R. 34764, July 2, 1961).

SOURCE: 30 CFR 616.42(a)(7).

Diversions, Sediment Control, and Sedimentation Ponds

Sedimentation ponds in conjunction with other sediment control measures, are considered by OSM to be the "best technology currently available" to prevent offsite sediment increases, as required by SMCRA. Generally, OSM and State reclamation agencies require that ponds be constructed on drainages below all mining and reclamation disturbance areas. Regulations establish many of the design characteristics of these ponds, including their sediment storage volume, detention time, dewatering devices, methods to prevent short circuits, * spillway design, sediment removal, freeboard,** and engineering characteristics of the retaining dam.

In conjunction with sedimentation ponds, OSM regulations require sediment control measures within and around disturbed areas. These measures include:

- disturbing the smallest area practicable at any one time during mining,
- stabilizing pit backfill material,
- diverting runoff away from disturbed areas,
- use of mulches, and
- chemical treatments

Many of the design specifications of diversions are also outlined in regulation.

Impoundments

Regulations also establish minimum standards for permanent and temporary impoundments. These impoundments include any lakes or ponds proposed to become part of a reclamation landscape. Section 515(b)(8) of SMCRA establishes that permanent impoundments may only be constructed if six criteria are met:

- that the impoundment size is adequate for its intended purpose;

*Short circuiting: a process which transports sediment through a pond in less than the detention time necessary for the sediment to settle out.

**Freeboard: the height above the water surface level when the spillway is operating at design capacity.

- that the impoundment dam is designed to achieve necessary stability;
- that the quality of impounded water will be adequate for its intended use;
- that the impoundment water level will be reasonably stable;
- that water users will be provided adequate safety and access; and
- that adjacent landowners will not be adversely-affected by the impoundment.

Adopted regulations establish design criteria for impoundments and dams, and require inspections, maintenance, and initial certification.

Protection of Ground Water and Ground Water Recharge Capacity

SMCRA requires that the ground water portion of the hydrologic system be protected along with the surface water portion. Regulations have been adopted which generally require that backfilling and alinement of excavations be conducted so as to protect ground water outside the permit area.

SMCRA also requires that the recharge capacity of the mined area be restored to the approximate premining condition. Conceptually, recharge capacity is the ability of the soil and rock materials to receive water, store it for a period of time, and slowly release it, either to a topographically lower stream or lake, or to a well. Primarily, the movement of precipitation and surface water into the soil or rock materials is controlled by the infiltration capacity of those materials. Mining and reclamation have the potential of changing infiltration capacity, primarily through compaction.

Monitoring

Operators are required under SMCRA to monitor ground water and surface water quantity and quality on the permit area and in the surrounding area before, during, and after mining. The extent of the required monitoring varies, but must be sufficient to describe the premining environment and to provide enough data for evaluating the effects of mining and reclamation activities. Monitoring is required of all ground or surface waters which may be disrupted or degraded by mining.

Water Rights

Water rights issues are considered in the context of the State laws applicable in each State. OSM had developed regulations on the water rights issue; however, these were remanded in the Flannery decision (see p. 283), Generally, in each State, coal mining operations must replace any water supplies expected to be degraded or diminished by those activities.

Stream Buffer Zones

Disturbance of a perennial stream must be specifically approved under SMCRA. The regulatory authority must find that the stream channel will be restored and that undisturbed portions of the channel will not be affected.

Implications of Water Resource Issues for Federal Coal Development

Although no mine has yet been prohibited from operating because of conflicts with other water users, the potential for conflicts with municipal, domestic or agricultural water users exists. Conflicts may be acute in the Uinta-Southwestern Utah region. In all Western States, water supplies diminished or degraded by mining are required to be replaced by the operator. In many cases, mines choose to redrill nearby wells to deeper aquifers if impacts from mining are expected. The following discussion gives several illustrative examples of existing or potential conflicts.

Municipal and Domestic Impacts

Surface and ground water originating in the Wasatch Plateau of central Utah is used by several municipalities. Local water users are concerned that these waters may be intercepted or contaminated by underground

coal mining along the eastern edge of the plateau. For instance, the town of Huntington, located near an active mining area, uses spring flow for its water supply. This spring flow may be affected by nearby underground coal mining. In the nearby Emery coal field, the town of Emery uses ground water that could be affected by Consolidation Coal's Emery underground mine and proposed surface mine. The effects of this mining are being studied by the company and USGS.[14] If mining were demonstrated to adversely affect municipal water supplies, mining companies would be required to replace these supplies or limit their mining areas.

In North Dakota, some lignite seams are significant aquifers. The Falkirk Mine is mining such a seam, which is also the water source for the nearby town of Underwood. Little data are yet available on the impacts of continued mining; however, the operator has made a commitment to provide alternative supplies should disruption occur.

Agricultural Impacts

The North Fork Gunnison River Valley of west-central Colorado is an area where underground coal mining may affect the availability of water for agricultural irrigation. Projected subsidence at the proposed Mt. Gunnison Mine may divert enough surface and ground water flow to adversely affect downstream water users.[15] The State reclamation agency and OSM are advising the operator that if this occurs, the company will have to purchase or replace the affected senior water rights in the valley. Otherwise, the mining company may have to leave recoverable coal in place in order to avoid subsidence and undesired water loss. Other mines in the Somerset coal field may face similar situations if projections of subsidence indicate diversion of significant surface flow.

Concern about the effect of underground mine-induced subsidence on springs is widespread in the Wasatch Plateau. A landowner above Utah Power & Light's Deer Creek Mine has expressed concern about subsidence effects on his springs, and the company has instituted a subsidence monitoring program to evaluate impacts. All operating or proposed mines in this area are developing monitoring programs to measure subsidence and impacts to springs and surface waters.

At the non-Federal Absaloka Mine in southeastern Montana in the Powder River basin, controversy about the projected destruction by surface mining of several seeps and springs has caused the operator, Westmoreland Coal, to delay proposing mining of the presumed source area of most of the springs. The State reclamation agency hopes that continued monitoring will result in a better understanding of the hydrologic system before mining is proposed for the recharge area itself.

Throughout the Fort Union region and Powder River coal basin, numerous domestic and stock wells obtain water from shallow aquifers. For example, 60 to 70 percent of western North Dakota's domestic and stock wells tap shallow lignite aquifers. Each of these water sources, if destroyed, diminished, or degraded by mining activities, is required to be replaced.

Empire Energy Co. is proposing to mine several seams below the Yampa River in northwestern Colorado in the Green River-Hams Fork coal region. Regulatory review is focused on the projected effect of mine-induced subsidence on the river, both in terms of environmental, and health and safety impacts.

Water Resource Issues and the SMCRA Unsuitability Petition Process

The effects of projected mining on water availability were part of the Alton coalfield unsuitability petition. The petitioners alleged that water development necessary to mine and transport coal, and to help reestab-

[14] Morrissey, Lines, and Bartholoma, Three-Dimensional Digital-Computer Model of the Ferron Sandstone Aquifer near Emery, Utah, USGS open file report.

[15] Personal Communication to OTA, Technical Analysis Division, Regional Director, Region V, OSM, 1981.

lish vegetation, would result in the drying of springs and stream recharge critical to agricultural water users in the same area. OSM found that "present users of . . . water . . . would be adversely affected.''[16] In making his final decision on the petition, however, the Secretary of the Interior found that insufficient information was available on this issue on which to exclude areas from mining and that the issue would be reexamined at the time of mine plan permit review.

The Northern Plains Resource Council and several affiliates have filed a petition for designation of lands unsuitable for mining for a portion of the Tongue River drainage basin in southeastern Montana. Unleased Federal coal, as well as fee and State coal reserves, are affected by the petition. In part, the petitioners claim that large-scale mining would have significant regional impacts on water resources. They claim that large-scale mining would have long-term degrading effects on the stream, adversely affecting stock and irrigation water uses. Because the effects would be experienced over a long time period, they fear that significant degradation could take place and not be identified until it was too late to initiate remedial measures. The petition is presently under review and a decision is expected by the State of Montana in late 1981.[17]

Other Water Resource Issues

Most of the water resource issues outlined in the discussion on statutory control have had no effect on the amount of Federal coal permitted for mining. Although some of the provisions have received substantial criticism from industry as being needlessly detailed and requiring unnecessary environmental protection, no Federal reserves have been prohibited from recovery because of these regulations. The issues of cost and time delay in collecting required information are briefly considered at the end of this chapter, although a detailed examination of these issues was not undertaken in this report.

Water quality standards and effluent limitations have not had an effect on the outcome of the permitting process. EPA and OSM limitations are able to be met at all Western mines. Some controversy has continued over the standard for total suspended solids, which industry has claimed to be too stringent. These standards are being revised to control total settleable solids, but the new standards have not yet been released. Industry has criticized the number and size of sedimentation ponds required of coal mines. These criticisms center around issues of increased costs. Construction of these ponds, particularly in steep canyons of the Uinta-Southwestern Utah region, has caused extensive disturbance at some areas.

To date, no permanent impoundment has been proposed under OSM regulatory program in the West. This may be because of regulatory constraints or because no impoundment has been needed for reclamation. The requirement to reestablish recharge capacity has not caused any regulatory denials; however, permit approval has been delayed in some cases because the data submitted was found to be insufficient. Monitoring requirements have been criticized as being overly demanding. However, in general, companies have apparently been able to bear these costs. The impact of these requirements on small operators is discussed in the final part of this chapter, Mining near perennial streams is generally approved under special conditions. Mining of perennial streams themselves has not generally been approved.

Water Availability: Primary and Secondary Impacts

Limited water supplies, and competition for those supplies, may ultimately affect the extent of coal mining development in por-

[16] U.S. Office of Surface Mining, Southern Utah Petition Evaluation Document, Document Nos. OSM-PE-1 and OSM-EIS-4, 1980.

[17] "Northern Plains Resource Council, *Petition for* Designation *of Certain Lands Unsuitable for Mining, 1980.*

tions of the Green River-Hams Fork region and in the San Juan River region. In these water-deficit areas, mines need water not only for dust control and use in the facilities, but also for irrigation of vegetation on reclaimed areas. Irrigation is presently used at some mines in the Green River-Hams Fork region and all mines in the San Juan River region. Recent studies in southern Wyoming of expanded coal leasing indicate that water shortages are possible as mines, growing municipalities, and agriculture compete for the same water sources.[18]

Expansion of mining in the San Juan River region may also be affected by limited water availability. Essentially, surface water is nonexistent in this area and wells must supply all water needs. However, the Fruitland formation aquifer is expected to be the primary water supply for the uranium mining industry in the area, as well as for municipalities. According to the OTA New Mexico task force, if both industries expand in the 1980's, available water supplies may not be able to meet demands.

Water availability may also affect coal development where coal development is dependent on onsite powerplants, synthetic fuel plants, or slurry pipelines. See table 88 for water requirements for these facilities. Scarcity of water in the Gillette area of the Powder River basin justified the expense of constructing the first dry-cooling tower in the United States at the Wyodak Power Plant east of Gillette. Proposed sources of water for slurry pipelines have been the Madison Limestone aquifer and the Little Bighorn River. Controversy surrounds the use of either source. Although Energy Transportation Systems, Inc. (ETSI) has a permit from the State of Wyoming to withdraw about 20,000 acre-ft/yr from the Madison for its pipeline, the State of South Dakota is considering bringing suit against such a water use, claiming adverse impact to its existing uses of the same aquifer. The State of Montana has decided that use of water for slurry pipelines is specifically not a beneficial use of water and water use permits therefore cannot be granted for use of Montana water in coal slurry pipelines.

Table 88.—Total Water Requirements for Various Major Facilities, Northern Great Plains

Facility	Water need (acre-feet/yr)
Water-cooled 1,000 MW powerplant (about 4 million tons per year)	10,000-15,000
275 million scf/d coal gasification plant	4,500- 8,000
Slurry pipeline (35 million tons per year)	13,000-20,000

SOURCE: Office of Technology Assessment.

[18] U.S. Bureau of Land Management. Final Green River-Hams Fork Regional Coal Environmental Impact Statement, 1980.

Alluvial Valley Floors

Under provisions of SMCRA, alluvial valley floors in the Western United States are given special protection because of their agricultural and hydrologic importance. The more important alluvial valley floors are protected from coal mining and its associated disturbance. The less important alluvial valleys may be mined, but standards for reclamation are higher than for other types of mined areas. The impact of the alluvial valley floor statutory provisions, adopted regulations, and guidelines have been the subject of continued debate among industry and regulating Government agencies. Industry has claimed that the alluvial valley floor provisions are overly complex, lead to significant delays in processing permits, and may ultimately lead to significant loss of recoverable reserves.

Analysis by OTA has found that:

1. To date, for Federal mines, only one stream valley in the West (Squirrel Creek Valley in Montana) has been identified as having the characteristics that will probably lead to absolute prohibi-

tion of mining activities in a portion of the valley. The affected companies have asked that this decision be reconsidered.

2. Numerous stream valleys in the Powder River coal basin have been, or are likely to be, identified as having characteristics that will allow mining, but under stringent alluvial valley floor reclamation standards.
3. Neither OSM, nor any State reclamation authority, has approved a proposed reclamation plan for an alluvial valley floor under the permanent regulatory program. Thus, no regulatory decisions have yet been made on which to analyze the detail and expense that reclamation of alluvial valley floors will necessitate. The general perception of both industry and Government officials is that most alluvial valley floors are reclaimable under existing technologies. Subirrigated alluvial valley floors pose the greatest difficulties for reclamation.
4. Alluvial valley floors have been identified under formal regulatory processes in the Powder River coal basin, and most leaseblocks in that basin are expected to include some areas of designated alluvial valley floor, Alluvial valley floors are also important in the Fort Union coal region. In the Green River-Hams Fork coal region and the Uinta-Southwest Utah coal region few alluvial valley floors have been identified,
5. The alluvial valley floor issue has the potential to affect more tonnage of recoverable coal than any other environmental factor. However, in relation to the total Federal recoverable coal base under lease, and the market supply relationships anticipated to exist until 1991, no adverse production effects are expected in the next 10 years.
6. Alluvial valley floor issues are likely to affect non-Federal coal reserves to a greater degree than Federal reserves because of the concentration of non-Federal coal in major river valleys, the sites of initial homesteading in the West.

Background and Statutory Control

As a general description, alluvial valley floors are those stream valleys in the western United States which: 1) are underlain by unconsolidated gravel, sand, silt, and clay; 2) have a stream flowing through them; 3) have a generally flat valley floor topographic surface; and 4) have an agricultural importance (fig. 48). The relative importance of these valleys is a function of the water supplies available in the specific valley area. The agricultural activities generally include irrigated or subirrigated hay lands, developed pasture lands, critically important grazing areas, or lands that could be developed for any of these purposes.

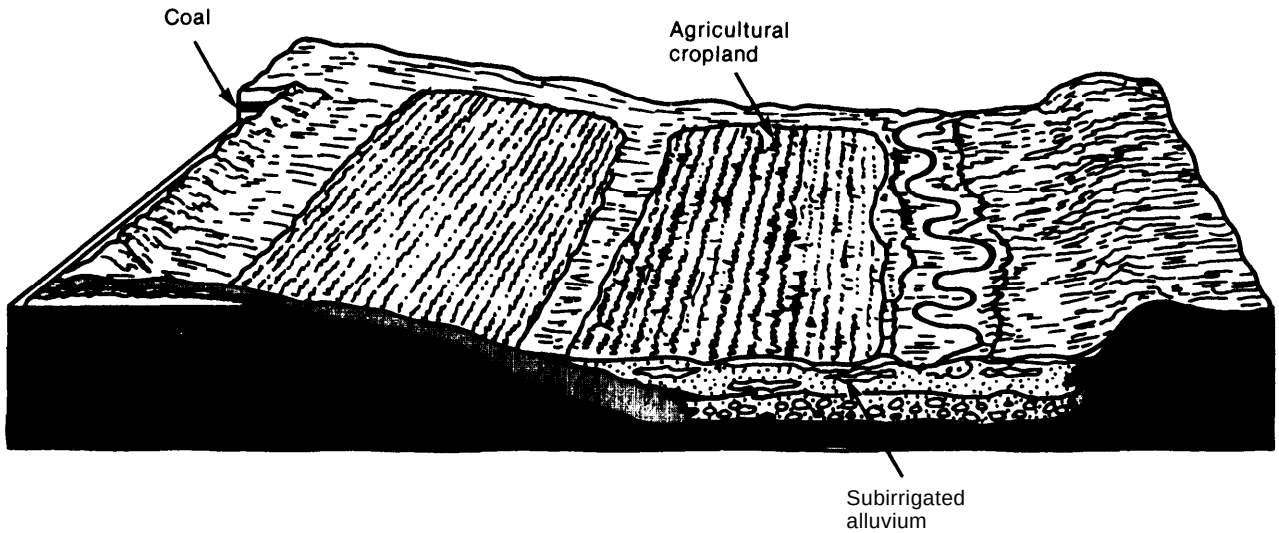
Alluvial valley floors were one of the more controversial portions of SMRCA, and were extensively debated in Congress prior to passage of the act in 1977. The special role that alluvial valley floors play in Western agriculture was central to the debate:

> Of special importance in the arid and semiarid coal mining areas are alluvial valley floors, which are the productive lands that form the backbone of the agricultural and cattle ranching economy in these areas, For instance, in the Powder River basin of eastern Montana and Wyoming, agricultural and ranching operations which form the basis of the existing economic system of the region could not survive without hay production from the naturally subirrigated and flood-irrigated meadows located on the alluvial valley floors.[19]

The provisions passed in the act included specific prohibition from mining certain alluvial valley floors, and stringent reclamation standards for those alluvial valley floors that could be mined. The prohibitions to mining are outlined in section 510(b)(5) of the

[19] U. S. House of Representatives, Committee on Interior and Insular Affairs, Report Accompanying H.R. 2, the Surface Mining Control and Reclamation Act of 1977, House Report 95-218, 95th Cong,, 1st sess., 1977, p, 116.

Figure 48.—Stylized Diagram of an Alluvial Valley Floor



SOURCE: Dollhopf, Wendy, Goering, and Hedsberg, "Hydrology of a Watershed With Subirrigated Alluvial Materials in Crop Production," Montana Agricultural Experiment Station Bulletin 715, 1979.

act. This section generally states that no coal mining operation may "interrupt, discontinue, or preclude farming" on alluvial valley floors, unless the lands that would be disturbed are "of such small acreage as to be of negligible impact on the farm's agricultural production. " Alluvial valley floors used as "undeveloped range lands" are not prohibited from mining.

Section 510(b)(5)(B) also states that coal mining must be prohibited if it would "materially damage the quantity or quality of water in surface or underground water systems" that supply those important alluvial valley floors that are prohibited from mining. Thus, mining in areas near important alluvial valley floors would be prohibited if material damage were projected.

For those alluvial valley floors not excluded from mining under the provisions of section 510(b)(5), reclamation standards are established under section 515(b)(10)(F). This section states that a coal mine must "minimize the disturbances to the prevailing hydrologic balance . . . by . . . preserving throughout the mining and reclamation process the essential hydrologic functions of alluvial valley floors. " This requirement to "preserve" both during and after mining "the essential hydrologic functions" is a regulation unique to alluvial valley floors.

Regional Studies of Alluvial Valley Floor Occurrences and Their Relationship to Recoverable Coal Reserves

The first studies of the regional pattern of alluvial valley floor occurrence were conducted prior to passage of the act.[20] The results of these studies are summarized in table 89. Generally, these studies concluded that less than 5 percent of the recoverable coal reserves of the West would be affected by alluvial valley floor provisions. Reexamination of these studies indicates that about 1 percent of the reserves studied in the above investigations would likely be affected by the prohibition provisions of section 510 (b)(5), BLM, in 1980, estimated that almost 60 percent of the available unleased Federal coal in the Gillette, Wyo. area was overlain

[20] Malde and Boyles, 1976; Schmidt, 1977; Hardaway, et al., 1977. See table 89 for full citations.

Table 89.—Alluvial Valley Floor Studies

Study	Study area	Study area underlain by strippable coal or amount of strippable coal considered	Amount or area of strippable coal overlain by AVF
Malde and Boyles, 1976	Southeastern Montana	392,000 acres	10,500 acres
Schmidt, 1977	East-central Montana		
	Burns Creek-Thirteenmile Creek KCLA	2,640 mt	39.2 mt
	Weldon-Timber Creek deposit	657 mt	15.9 mt
	Redwater River	582 mt	46.4 mt
Hardaway, et al., 1977	Existing and proposed mines, Western United States	914,000 acres	27,000 acres

SOURCES **Jack Schmidt. "Alluvial Valley Floors in East-Central Montana and their relatlon to strippable coal reserves, " Denver, Environmental Protection Agency Off Ice of Energy Activities, report No. 8908-4-77-001, 1977.**

H. E, Malde and J. M, Boyles. "Maps of Alluvial floors and strip. pable coal in forty-two 7½ minute quadrangles, Big Horn, Rosebud, and Powder River Counties, Southeast Montana", U.S. Geological Survey Open File 73, Report No. 76-162, 1976,

John E. Hardaway, Dan B. Kimball, Shirley F. Lindsay, Jack Schmidt and Larry Erickson. "Sub-Irrigated Alluvial Valley floors – A reconnaissance of their properties and occurrence on coal resource lands in the Interior Western United States: Louisville, " *Proceedings of Natoinal Coal Association/Bituminous Coal Research Symposium, 1977,* **p. 61-135,**

by potential alluvial valley floors. BLM made no attempt to distinguish between areas likely to be prohibited from mining and areas where special reclamation standards would be required. Examinations of this study by OSM indicate that BLM has also identified areas that will not be classified as alluvial valley floors.[21] Thus, the BLM study almost certainly greatly overestimates alluvial valley floor occurrence.

OSM identified alluvial valley floors in the Alton, Utah coalfield.[22] No attempt was made to distinguish between areas likely to be prohibited from mining and areas where mining would be allowed. Of the 325,000-acre area considered under the Alton unsuitability petition, less than 5 percent of the area was designated as alluvial valley floor of either type.

[21] "Personal communication: OSM Region V, Chief, Branch of Earth Sciences and Geot echnics.

[22] U.S. Office of Surface Mining, Southern Utah Petition *Evaluation* Document, 1980.

Determinations Made by Federal and State Reclamation Agencies in the Powder River Coal Basin

The Montana Department of State Lands, with the concurrence of OSM, has determined that Squirrel Creek valley in Big Horn County is an alluvial valley floor, portions of which are being actively farmed and are significant to agriculture. The stream is a intermittent tributary of the Tongue River and crosses portions of Federal coal leases held by the Rosebud Coal Sales Co. (lease No. M-061686) and the Consolidation Coal Co. (lease No. M-46292). Areas with significant farming activities total about 250 acres; however, the total alluvial valley floor, which contains Federal and non-Federal coal reserves, is more than 1,250 acres. Alluvial valley floors, although not necessarily significant to farming activities, cover about 35 percent of the Consolidation Coal proposed mine plan area and over 40 percent of the Rosebud Coal Sales proposed mine plan area. [23]

At this time, it is not known what effect the alluvial valley floor determination will have on mining in this area. Areas considered significant to farming cannot be mined, even if they are reclaimable. On the one hand, it is possible that no mining of either lease will take place, particularly if the Montana DSL determines that mining of adjacent areas would result in "material damage to the Squirrel Creek Valley. " On the other hand, mining might still be able to take place on the surrounding uplands. Consolidation Coal intends to submit a proposed mine plan for nonalluvial valley floor areas in early 1982. The companies have estimated that a total of 100 million tons of Federal and non-Federal coal under both leases would be affected by the alluvial valley floor decision.[24]

State regulatory authorities, with the concurrence of OSM, have identified alluvial valley floors that are considered not to be

[24] Nimick, personal communication, Montana Department of Stale Lands hydrologist, 1981.

[23] "Ibid.

significant to farming at the Buckskin, Rawhide, Eagle Butte, and Coal Creek mines, all located in the Powder River coal basin of Wyoming (see table 90). The Coal Creek mine, operated by the Thunder Basin Coal Co. (a subsidiary of Atlantic Richfield Co.), obtained approval for its mine in early 1979 and began coal shipments in late 1981. Regulatory authorities designated 846 acres of the total proposed mine plan area, or about 9 percent, as alluvial valley floors. Although initial approval was obtained for the first 5 years of mining, the regulatory agencies have stated that Thunder basin coal must demonstrate compliance with section 515 (b)(l0)(F) of the act before any additional mining will be approved. As discussed earlier, section 515(b)(10)(F) requires an operator to demonstrate that the "essential hydrologic functions" of the designated alluvial valley floors will be protected by minimizing offsite impacts and restoring the alluvial valley floors proposed to be mined.

Although only 9 percent of the total mine plan area has been designated as alluvial valley floors, Thunder Basin Coal would be seriously constrained in mining the Coal Creek if the company could not demonstrate compliance with section 515(b)(60)(F).[25] East Fork Coal Creek crosses the middle of the mine plan area. The company maintains that

[25] Smith personal co$_{mmun}$i$_{ca}$tion, President, Thunder Basin Coal, 1980.

Table 90.—Alluvial Valley Floor (AVF) Summary Table Developed Coal Reserves in the Powder River Basin

Mine	Federal lease area (acres)	Acres of designated AVF significant to farming	Acres of designated AVF not significant to farming	Acres of stream valley under study as potential AVF	Name of stream
Rosebud	8,226	—[a]	—	386	East Fork Armells Creek
Big Sky (g)[b]	4,307	0[c]	0	0	Emile (Coal bank)
					L & Miller Coulee
		—	—	275	Lee Coulee
Spring Creek	2,347	0	0	0	Spring Creek
		—	—	257	South Fork Spring Creek
West Decker (g)	4,961	0	0	0	Spring & Pearson Creek
East Decker (g)	9,410	—	—	386	Deer Creek
Buckskin	599	—	358	0	Rawhide Creek
		—	—	o	Spring Draw
Rawhide(g)	5,697	0	143	0	Rawhide Creek
		0	52	0	Little Rawhide Creek
Eagle Butte (g)	3,520	0	126	0	Little Rawhide Creek
		—	—	10	Dry Fork Powder River
Wyodak (g)	1,880	—	—	240	Donkey Creek
Caballo	5,360	0	0	0	Tisdale Creek and Gold Mine Draw
Belle Ayr (g)	2,401	0	0	365	Cabal lo Creek
Rojo Caballos	3,959	0	0	0	Clabaugh and Desmet Draw
Cordero (g)	6,560	—	—	640	Belle Fourche River
				non-Federal	
Coal Creek	5,806	0	116	0	Coal Creek
		0	616	0	E. Fork Coal Creek and Tributary
		0	70	0	Middle Fork Coal Creek
		0	44	0	Dry Creek Tributary
Jacobs Ranch (g)	4,352	—	—	240	Little Thunder Creek
					Burning Coal Draw
Black Thunder(g) .,	5,884	—	—	545	N. Prong Little Thunder Creek and Little Thunder Creek
David Johnston(g)	9,662	0	0	0	—
Totals:					
Federal lease acres	84,931	0	1,525	2,704	
Federal recoverable reserves (million tons)	5,300	0	97	299	

[a] —: Indicates no determination made.
[b] Refers to So-called "grandfathered mines;" that is, those mines which were operating prior to passage Of SMCRA.
[c] o: Indicates determination by regulatory agency that no AVFS are along indicated streams.

SOURCE: Off Ice of Technology Assessment; mine plan review.

prohibition from mining East Fork Coal Creek would render the entire operation uneconomic. The entire mine area contains several hundred million tons of recoverable reserves. Despite the uncertainty of the future regulatory decision, Thunder Basin Coal has proceeded with its development, and anticipates that mining approval will be obtained. Even if approval were not obtained for mining the stream valleys, examination of mine plan maps suggests that the ultimate economic impact of a regulatory prohibition could be less than predicted by the company, Individual pits might be developed on either side of the main stream: however, at least 30 million tons underlying the stream would be lost.

Several regulatory decisions concerning alluvial valley floors are pending, and have affected the orderly development of mine plans. Alluvial valley floor studies are underway, with decisions pending, at 10 mines in the Powder River coal basin. OSM does not anticipate that any of the stream valleys in question will be designated significant to farming, and thus be subject to prohibition from mining.[26] At those mines operating prior to passage of the act, mine planning has proceeded under the assumption that mining of alluvial valley floors will be approved. However, formal regulatory approval has not yet been obtained. Plans for mining and reclamation of valleys were submitted by each mine in January 1981, as part of each mine's permanent regulatory program submittal. As of late March 1981, review was proceeding but no State agency had had sufficient time to approve these plans.

At two mines approved after passage of the act, Spring Creek and Buckskin, uncertainty about alluvial valley floor status and reclaimability has led each operator to avoid proposing the mining of areas of uncertain alluvial valley floor status. Studies are underway in each case that may show that the streams can be reclaimed. However, at least temporarily, 59 million tons at Spring Creek and 36 million tons at Buckskin are not proposed for mining.

The position that State and Federal regulatory agencies take toward compliance with section 515(b)(10)(F) will have a significant effect on the quantity of coal reserves affected by alluvial valley floor provisions. If industry is able to demonstrate that the essential hydrologic functions can be protected or restored during or after mining, then only those alluvial valley floors with significant agricultural activities on them will be prohibited from mining. In that case, it is likely that only the Consolidation Coal and Rosebud Coal Sales leases referred to above, affecting about 100 million tons of Federal and non-Federal reserves, will ultimately be prohibited from mining,

Table 91 summarizes potential alluvial valley floor occurrences on all undeveloped Federal leaseblocks in the Powder River coal basin. Total estimated area of potential alluvial valley floors is about 2,800 acres, which may include about 219 million tons of Federal recoverable reserves. Thus, about 5 percent of the Federal recoverable reserve base of undeveloped lease blocks in the Powder River basin is overlain by potential alluvial floors. Another 2 percent of Federal recoverable reserves in undeveloped lease blocks in the Powder River basin could be prohibited from mining because of the significant to farming provisions. Although the potential for affecting additional reserves through inability to develop orderly mine plans might increase the affected reserves somewhat, the increase is not expected to be substantial.

The impact of alluvial valley floor designations, and the likelihood of identifying areas significant to farming, is of greater concern to private coal owners in the Powder River basin than to Federal lessees. This situation results from the fact that private coal ownership is often concentrated in major stream valleys where significant farming operations are found. This pattern of ownership exists because the earliest homesteaded lands in the West obtained mineral as well as surface ownership rights upon compliance with the

[26]Kimball, personal communication, OSM, 1981.

Table 91.—Alluvial Valley Floor (AVF) Summary Table
Undeveloped Coal Leases

Lease block	Lease block area (acres)	Acres of designated AVF significant to farming	Acres of designated AVF not significant to farming	Acres of stream valley under study as potential AVF	Name of stream
C X Ranch (Consolidated Coal)..	674	245	300	—[a]	Squirrel Creek
C X Ranch (Rosebud Coal Sales)	524			—	
Pearl	541	—	—	40	Little Youngs Creek
Armstrong.	80	0[b]	0	0	None
Bass .,	20.701	0	0	200	Clear Creek Powder River Deadman Creek several tributaries
Arvada.	4,366	0	0	750	Powder River Robinson Draw Wild Horse Creek North Prong Wild Horse Creek
Lake DeSmet	9,417	0	0	1O[c]	Boxelder Creek and Tributary
Belco.	4,551	0	0	240	Negio and Dry Creek
Wildcat	1,571	—	—	120	Jamison Prong and Soukup Draw
Blue Diamond.	40	—	—	0	None
Dry Fork	3,580	—	—	300	Dry Fork Little Powder River Prairie Creek
South Rawhide.	4,782	—	—	180	Dry Fork Little Powder River Tributary Little Rawhide Creek
East Gillette	4,343	—	—	160	Donkey Creek
Federal		—	—	120	Dry Fork Little Powder River Tributary
Gulf (3)	756	—	—	—	None
East Wyodak	2,560	—	—	25	Lee Draw
North Rochelle	2,000	—	—	18	School Creek Tributary
Rochelle	8,821	—	—	120	Porcupine Creek and Tributary Holmes Creek West Fork Creek Tributaries
North Antelope.	320	—	—	—	None
Antelope	4,817	—	—	480	Antelope Creek Logan Draw Spring Creek
Phillips Creek (1) & (2)	4,079	—	—	60	Phillips Creek Dry Fork Cheyenne River
Totals:					
Federal Lease Acres:.	78,523	245	300	2,823	
Federal Recoverable reserves: (million, tons)[d].	4,000	<100[e]	[e]	219	

a—: Indicates no determination made.
[b]o: Indicates determination by regulatory agency that no AVFs are along indicated streams.
[c]There is an estimated 400 million tons of nonfederal coal under a potential alluvial valley floor associated with this lease block.
[d]Tonnage of coal calculated using average coal seam thickness and the assumption that acre ft of coal = 1,800 metric tons. This calculation tends to overestimate reserves in AVFs due to the assumption that the average coal seam thickness covers the whole area of the AVF.
[e]Refers to reserves for entire AVF No estimate available for percentage of reserves under nonsignificant to farming AVF which will be able to be mined

SOURCE: Office of Technology Assessment.

homestead standards. The earliest settlers were attracted to the valleys with perennial streams. Thus, the land and underlying coal reserves located along those major stream valleys with the longest history of agricultural land use are owned by private entities. Only later did the Federal Government begin the practice of transferring surface ownership without transferring mineral ownership. For example, proposed mines such as Montco's, north of Birney, Mont., and Peter Kiewit Sons' Whitney Benefits Mine, north of Sheridan, Wyo., both on or near the Tongue River, face substantial issues related to farming activities on alluvial valley floors.

Alluvial Valley Floor Occurrence in Other States

Alluvial valley floors occur in each of the other Western coal regions. By definition, alluvial valley floors do not occur in Oklahoma or other areas east of the 100th meridian. In Western coal regions outside the Powder River basin, less work has been done on defining alluvial valley floors; however, based on the work that has been done, alluvial valley floors probably occur infrequently in most areas. While only Alderin Creek at the Glenharold Mine in North Dakota is being reviewed for alluvial valley floor status in the Fort Union region, studies by Schmidt (1977) and Hardaway, et al. (1977) indicate that up to 10 percent of the reserve base of that region might be affected by alluvial valley floor concerns.[27] However, the amount of reserves that will be prohibited from mining will probably be much less because most valleys in mine areas are not being actively farmed.

In the Green River-Hams Fork region, alluvial valley floors may occur in southwestern Wyoming and in northwestern Colorado. Three blocks in the Kemmerer Field have potential alluvial valley floors covering less than 200 acres. No alluvial valley floors are expected to be designated in the Rock Springs or Hanna fields. In northwestern Colorado, Empire Energy is proposing mining under the Yampa River, in an alluvial valley floor. The impact of other alluvial valley floor areas on mine production is unevaluated at present.

In the Uinta-Southwestern Utah region, alluvial valley floor determinations may affect mine development in the Alton Field as discussed earlier. Elsewhere, effects are expected to be minimal because underground mining generally is not occurring under stream valleys. Alluvial valley floors are not expected to be a significant issue in the San Juan River region because of the general absence of surface water.

[27] see table 89 for full citations.

Topsoil, Spoil Handling, and Recontouring

OTA has identified one mine where recoverable coal reserves have been rendered unrecoverable by regulatory decision in this issue area. That mine, in the Green River-Hams Fork region in Wyoming, estimated that it lost 5 million tons* due to a limitation on the area where spoils** could be disposed. Additional reserves may be affected in the Green River-Hams Fork region at mines with characteristics similar to the mine discussed here. Regulations on this issue have also affected the cost of mining. These increased costs are discussed under the economic impacts section of this chapter.

*OTA estimates that 15 million tons may ultimately be removed from mining a t I his mine if the State continues its pattern of interpretation of these regulations.

* *Spoil is overburden material removed by mining operations in the course of exposing coal seams.

The Mining Process

The first step in developing a mine pit is the removal of topsoil. Topsoil is either stored in stockpiles or replaced on regraded spoils elsewhere in the mine. Decisions concerning the depth of topsoil to be salvaged at any location prior to mining are based on a soil survey for the mining area. Agreement between the operator and the regulatory agency is reached on how much of each soil type must be salvaged.

Overburden is the rock strata between the ground surface and the target coal seam and between the target seams. (Rock strata in the latter case may also be called interburden.) Spoil may be removed by dragline, truck and shovel combination, or scraper and dozer combination. Depending on the geology of the coal seams, an open pit, area,

or terrace pit mine may be developed (ch. 11). Spoil disposal at each type of mine is slightly different. In open pit mines, spoil is stored outside the pit since the entire pit is needed for mining operations. In area or terrace pit mines spoil is disposed in inactive parts of the pit from which coal has already been removed. Requirements to limit out-of-pit spoil disposal or to selectively bury toxic overburden may necessitate different techniques of overburden removal and spoil disposal.

Statutory Control

SMCRA requires that certain standards be adhered to in the handling of topsoil and spoil. Topsoil must be removed prior to mining operations and either stockpiled or immediately placed on a regraded area (sec. 515(b)(5)). If stockpiled, the topsoil must be vegetated in order to protect it from erosion. All mined and regraded areas must be covered with topsoil or "the best available subsoil which is best able to support vegetation" (sec. 515(b)(6)). Since some spoil material may be high in concentration of elements detrimental to vegetation or livestock or may contribute to ground water pollution, spoil must be placed in such a manner as to reduce these effects (sec. 515(b)(10)(A)(19)). The reclaimed land surface must resemble "the approximate original contour of the land." Special exceptions to this requirement are made for areas of very thick and very thin overburden. In those cases, the operator is required to attain the "lowest practicable grade, " to provide drainage, to cover toxic forming materials, and to ensure land surface stability (sec. 515(b)(3)).

SMCRA regulations for topsoil removal require that an operator remove topsoil or other approved plant-growth medium before beginning mining operations, save it in a manner conducive to protecting the primary root medium from contamination and erosion, and redistribute it in a manner that will enhance its productivity. Regulations governing removal and redistribution are defined in 30 CFR 816.21 to 816.24. Removal requirements define the timing for removal as being after vegetation is removed and prior to surface disturbances caused by drilling, mining, blasting, or other such activities. Regulations define which unconsolidated subsoils should also be removed. Certain overburden materials may be used in lieu of, or as a supplement to, topsoil if those materials are approved by the regulatory authority.

Once topsoil is removed, it is desirable to move it only once, placing it where the soil will be permanently part of a new reclamation landscape. When temporary storage of topsoil is necessary, 30 CFR 816.23 defines the procedures to protect the soil from wind and water erosion, and to maintain its physical and chemical composition. Regulations also establish standards to be achieved in replacing topsoil in regraded areas (30 CFR 816.24(b)). Soil tests performed in accordance with regulatory standards are required to determine whether soil nutrients and amendments are necessary for the replaced soil to support the proposed revegetation.

Requirements for backfilling and grading of areas disturbed by surface coal mining are found at 30 CFR 816.101 to 816.105. The focus of these regulations is to "insure the prompt restoration of the disturbed lands to minimize additional damage to the environment, and to return the land to a productive use" (sec. 515(b)(3)). General backfilling and grading requirements consider:

1. the timing of these activities, subsequent to the removal of coal,
2. the contour of the land which must be restored in the final grading process;
3. the procedures to be used when the final thickness is less than 0.8 of the initial thickness* (thin overburden situations); and
4. the procedures to be used when the final thickness is greater than 1.2 of the initial thickness (thick overburden situations).

*InitiaI thickness is the sum of the overburden and coal thicknesses prior 10 the removal of the coal. Final thickness is the product of the initial overburden thickness, prior to coal removal, times a bulking factor,

In order to prevent environmental degradation caused by acid and toxic forming materials, 30 CFR 816.103 requires that "a minimum of four feet of the best available nontoxic and noncombustible material (be placed upon) all exposed coal seams and all acid-forming materials."

Implications of Topsoil, Spoil Handling, and Recontouring Issues for Federal Coal Development

In the Green River-Hams Fork coal region, spoil handling requirements have resulted in the loss of about 5 million tons of recoverable reserves at the Black Butte Mine in Wyoming, following a regulatory decision limiting the area outside the mine pit where spoil can be disposed. Mining methods employed at this mine involve development of several distinct pits, many of which require out-of-pit spoil* disposal areas. OSM, in its technical review of the Black Butte Mine plan, determined that the originally proposed out-of-pit spoil areas conflicted with four regulatory standards: 1) the requirement to minimize the overall disturbed area; 2) the requirement to achieve the approximate original contour of the landscape; 3) the requirement to limit disturbance to wildlife habitat; and 4) the requirement to limit disturbance in stream channels. OSM then limited the out-of-pit spoil disposal area, necessitating mine plan changes that resulted in the loss of recoverable coal[28]

Although no other mine in Wyoming or Colorado in the Green River-Hams Fork region has experienced such a limitation to date, the similarity of the mining method used by Black Butte with that of other mines in the region suggests that some other mines in the region, most of which use out-of-pit spoils disposal methods as part of their mining operations, may experience regulatory decisions similar to Black Butte. Other mines where out-of-pit spoils and approximate original contour considerations may result in loss of recoverable reserves include Rosebud Coal Sales, Seminoe No. 2, Medicine Bow, Colowyo, and the undeveloped South Haystack lease. However, SMCRA allows out-of-pit disposal as part of the special regulations specific to open pit mining in the Kemmerer, Wyo, area (special bituminous coal mine regulations).

Proposed mine methods have been changed because of spoil disposal and spoil handling requirements. These requirements have included limitations on placement of excess spoil (East Decker Mine, Montana), the need to bury spoil high in sodium concentrations (Spring Creek Mine, Montana), and the need to bury spoil high in selected elements (Big Sky Mine, Montana; several mines in the Powder River coal basin, Wyoming). At some of these mines, companies claimed that the regulatory changes in mining method resulted in increased costs which are now being passed to the consumer. These increased costs are examined in the final section of this chapter.

Approximate original contour considerations may have effects in areas of steep topography even where coal seams are flat lying. For example, at the Spring Creek Mine in the Powder River basin, recoverable coal underlies a steeply sloping area of sandstone bluffs. The operator is uncertain whether the approximate original contour can be restored. The effect of this concern is unclear at this time. At the nearby West Decker mine, the Montana State reclamation agency has requested the company to mine into the bluff in order to achieve erosion control at the highwall. Thus, the impact of approximate original contour regulations is still uncertain.

*Out-of-pit spoils are those spoils removed in the course of mining that are not backfilled in the mine pit but rather are left on the natural ground surface.

[28] U.S. Office of Surface Mining, Technical Analysis, Black Butte Coal Co. amendment to spoil handling procedures in Area D, 1979,

Revegetation

Public Law 95-87 establishes a uniform stringent standard for revegetation of mined lands that is particularly challenging in the West. Section 515(b)(19) requires the establishment of a "diverse, effective and permanent vegetative cover of the same seasonal variety that is native to the area of land to be affected and capable of self-regeneration and plant succession at least equal in extent of cover to the natural vegetation of the area. " The standard also makes allowances for use of introduced species where desirable and necessary to achieve the approved post mining land use plan. The use of introduced species in the West generally requires more intensive management to maintain optimum levels of productivity compared to restoration of native vegetation. This is generally not feasible in most areas of the West that will be surface mined because the added costs of intensive management usually do not increase productivity sufficiently to pay off. Consequently, most reclamation in the West involves reestablishment of native ecosystems.

Revegetation of surface mined lands has been the subject of considerable controversy in the West primarily because the arid and semiarid climate makes the establishment and maintenance of vegetation more difficult than in the humid East. A study by the National Academy of Sciences[29] concluded that areas receiving 10 inches or more of annual precipitation can usually be reclaimed* provided that evapotranspiration is not excessive, landscapes are properly shaped, and techniques demonstrated to be successful in rehabilitating disturbed rangelands are used. However, the NAS committee concluded that in drier areas receiving less than 10 inches of precipitation, revegetation will be much more difficult and can probably be accomplished only with major sustained inputs of water, fertilizer and management. The committee used slightly less stringent criteria than in SMCRA for defining successful reclamation, and emphasized that its conclusions were not based on long-term extensive controlled experiments in revegetation.

More recent studies that have evaluated revegetation practices in the West[30] have noted short term success in revegetation, but have concluded that the long term success of revegetation through periods of extended drought have yet to be demonstrated, and that revegetation techniques remain essentially experimental in nature,

There is no dispute about whether vegetation can be established on mine land in the West. This has been accomplished through the use of irrigation and intensive management even in the driest areas such as the San Juan River basin and southern Wyoming, and high levels of productivity have been measured at several reclaimed sites in the Northern Plains that have used fertilization and introduced species. However, disagreement exists as to whether native ecosystems with similar levels of productivity and resilience to the stress of drought can be established. Of particular concern is whether a suitable mix of native species can be established that provides good year-round pasture for livestock in the Northern Plains without requiring continued intensive management and whether desert and foothills-shrub vegetation associations that provide critical winter range for large game in the Rocky Mountain coal areas can be established. Another area of concern is the revegetation of spoils high in sodium concentrations, a problem in the Fort Union and Powder River regions.

[29]National Academy of Sciences, Rehahilitation Potential of Western Coal Lends (Cambridge, Mass.. Ballinger Publishing co., 1974).

*The NAS Committee used the term "rehabilitation'" rather than "reclamation," but in current usage, the two terms are usually used interchangeably.

[30]F. X. Murray (cd.), Where We Agree: Report of the National *Coal Policy* Project, *V.2* (Boulder, Colo.: Westview Press, 1978) and D. P. Wiener, *Reclaiming* the West: The *CoalIndustry and* Surface Mined Land (New York: INFORM, Inc., 1980).

Reclamation experts differ in the degree of optimism or pessimism with which they view the likelihood of success in reclaiming native ecosystems in the West, but there is general agreement that it will be a number of years before the question is resolved. It has been 7 years since Montana passed the first reclamation law in the West that had stringent standards for revegetation, and as yet no land reclaimed under that statute has developed a vegetative cover that qualifies for bond release,[31] A recent study by the Committee on Soil as a Resource in Relation to Surface Mining for Coal of the National Academy of Sciences concluded that the 10-year time period specified in SMCRA for bond liability after reclamation is completed may not be long enough to demonstrate success of revegetation in the arid areas of the West.[32]

The issue of revegetation has not had a significant impact on the availability for development of Federal coal under existing leases. The main reason for this is that while regulatory authorities recognize that uncertainties remain concerning the long-term success of current revegetation practices, they do not feel that the probabilility of serious failure is high enough to justify rejecting a permit application on the basis of difficult conditions for revegetation. This judgment is evident in DOI's decision on the petition to designate the Alton area in southern Utah as unsuitable for mining. One of the arguments made in the petition was that conditions in the area were too difficult for successful reclamation because of the nature of the soil and the arid climate. However, DOI concluded that revegetation would be successful.[33]

Unless there are dramatic failures in revegetation involving state-of-the-art reclamation practices in the next 10 years, it is unlikely that difficult conditions for revegetation will prevent any existing Federal coal leases from being developed, However, concern over revegetation has required, and can be expected in the future to require modification of mining plans. For example, OSM has concluded that the Black Butte Mine in southern Wyoming has very difficult conditions for revegetation and has required the use of a sprinkler irrigation system.

[31]Personal communication with Bruce Hayden, Administrator of the Reclamation Division of the Montana Department of State Lands.

[32]National Research Council, *Surface Mining: Soil, Coal and Society* (Washington D.C.: National Academy Press, 1981).

[33]Supra note 22.

Wildlife Concerns

Concern about the protection of wildlife habitat has resulted in minimal prohibition of mining and production of Federal coal, In southern Wyoming, in the Green River-Hams Fork region, protection of raptor habitat along outcrop areas has resulted in some changes to mining plans, including contributing to the loss of 5 million tons at the Black Butte Mine (previously discussed in the Topsoil, Spoil Handling, and Recontouring section). The inability of a North Dakota operation to demonstrate reclamation of wooded draws that are important wildlife habitat has led to delay in approval of a mine plan. Despite conflicts between proposed mines and designated critical winter range for game, leasing has taken place in southern Wyoming. Unless endangered species are found to reside on a proposed mine site, it is unlikely that significant amounts of recoverable reserves will be lost because of concerns about adverse effects on wildlife.

Statutory Control

Jurisdiction under SMCRA for protection of fish and wildlife is based on a provision which states that an operation must:

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> . . . to the extent possible using the best technology currently available, minimize disturbances and adverse impacts of the operation on fish, wildlife, and related environmental values, and achieve enhancement of such resources where practicable (sec.515 (b)(24)).

OSM, in developing its final regulations (30 CFR 816.97), interpreted the term "related environmental values" to mean habitat for fish and wildlife. Operators are required to: 1) design electric powerlines and other transmission facilities so as to minimize the potential for electrocution of raptors; 2) locate and fence roads in order to minimize impacts; 3) exclude wildlife from hazardous waste areas; **4)** protect or restore riparian areas; and 5) refrain from using persistent pesticides. Where fish and wildlife habitat is to be a primary or secondary postmining land use, an operator must select plant species on reclaimed areas based on their nutritional value and their value as cover, and must distribute these species to optimize habitat. Where cropland is to be established after mining, such as in North Dakota, fields are to be interspersed with "trees, hedges, or fence rows. "

Three important Federal wildlife acts also affect coal mines: the Bald Eagle Protection Act, the Endangered Species Act, and the Migratory Bird Treaty Act. Each of these acts is primarily enforced by the U.S. Fish and Wildlife Service (FWS). The Bald Eagle Protection Act requires, among other things, that bald eagles' and golden eagles' nesting areas not be disturbed. Since many Western coal mines have eagle nests located on them, conflicts with this act have occurred. FWS has permitted the moving of eagle nests in a few selected instances.

The Endangered Species Act requires that a determination be made of the occurrence of endangered species on any proposed mine site. If adverse impacts from mining activities are projected, an operator must mitigate or avoid those impacts. To date, no endangered species, such as the black-footed ferret or the peregrine falcon, have been found to be resident on any proposed mine site. The Migratory Bird Act requires enhancement and prevention of loss of migratory bird habitats. This act, though considered in the mine review process, has not affected mining planning to date. Potential effects include possible requirements to protect wetland habitat used by migratory species in North Dakota.

Implications of Wildlife Concerns for Federal Coal Development

Generally, wildlife concerns have not had a significant effect on the ability to produce coal. However, in selected instances, wildlife concerns are limiting recoverability of reserves and the manner in which coal is mined. Particularly in southern Wyoming, mine plans have had to be adapted for the protection of raptor habitat, especially that related to nesting areas for eagles. In North Dakota, mining is being restricted in wooded draws, a scarce wildlife habitat in the State. In northwestern Colorado, surface mining areas conflict with elk habitat; however, mitigation strategies are being studied so that recoverable coal is not lost.

Green River-Hams Fork Region

Topography in southern Wyoming is more diverse than in the Powder River coal basin or the Fort Union region. Southern Wyoming is characterized by intricate drainage features, expanses of rock outcrop, development of long ridges, and other topographic irregularities that serve as good wildlife habitat. Also, big game migration patterns vary from winter to summer, and certain areas of southern Wyoming serve as critical winter habitat for game. Without such critical winter habitat, game populations would decrease substantially.

Eagles and other raptors favor rock outcrops or dead trees along drainages for nests. Eagle populations, particularly golden eagles, are high in southern Wyoming. Coal mine operators generally begin mine pit excavations at or near the coal outcrop. In many cases, coal outcrops are found in con-

junction with linear sandstone outcrops, Were it not for concern about raptor habitat on these outcrops, mining methods would generally use draglines to open the initial cuts near the outcrop. The boxcut spoil would be cast over the adjoining outcrop. Such spoiling would cover the original outcrop and thus would cover or destroy raptor habitat. State and Federal reclamation agencies have prohibited this kind of mining method. For example, at the Black Butte and South Clock mines, requirements to protect outcrop areas have resulted in the opening of cuts further away from the outcrop than originally planned. Relocation of the opening pits has also necessitated some rehandling of spoils.

In the Hanna Field, at the Seminoe No. 1 Mine, concern about raptor habitat may result in decreased reclamation costs to the company. An eagle established a nest in an abandoned highwall prior to the highwall's scheduled slope reduction. As a consequence, the highwall may not have to be reduced.

Although not a significant deterrent to lease development in southern Wyoming to date, wildlife values may conflict with future development of Federal coal. With the exception of the Jim Bridger Mine, which is mostly covered by critical habitat for antelope and mule deer, most mine development in southern Wyoming has not been located in areas designated as critical habitat by the Wyoming Game and Fish Department, However, a number of new proposals for the development of coal mining in southern Wyoming could conflict with the preservation of wildlife values, and the Wyoming Game and Fish Department has expressed its opposition to some of these mines. The Red Rim tract, recently leased, includes over 2,000 acres of critical winter range for antelope in Wyoming. Several other proposed mines, such as Red Desert and Atlantic Rim, have significant areas of critical wildlife range, and a competitive lease application by Idaho Power Co. in southern Carbon County, Wyo., was rejected several years ago because of wildlife considerations.

Critics of the Wyoming Game and Fish Department's opposition to these mine development proposals in southern Wyoming have argued that data are insufficient to determine the critical winter range for large game. OTA was not able to evaluate this criticism on a site-specific basis, but did compare areas identified as critical by the Wyoming Game and Fish Department (1979) with data on wildlife presented in the South-central and Southwest Wyoming Environmental Impact Statements (BLM, 1978). This comparison suggests that the Department is rather conservative in identifying areas of concern for large game. For example, the EIS's identified seven leases (Seminoe No. 1, Black Butte, Hanna South, Cherokee, Long Canyon, Twin Creek, and South Haystack) as being partly or completely covered by antelope, elk or mule deer winter range. However, current areas of critical winter range mapped by the Wyoming Game and Fish Department show winter range only on the Long Canyon lease.

Mining may affect wildlife values other than big game herds. Eight developed leases in the Powder River basin and 5 developed leases in southern Wyoming are completely or partly covered by critical habitat for upland game birds. Several black-footed ferret skulls have been found on or near the South Haystack and Rosebud Mines in southern Wyoming. Rare plant species have been found within or adjacent to lease boundaries at the Lake DeSmet Block (Brownish sedge), North Block (Abies lasiocarpa-pinus contorta community), and the South Haystack lease block (malt sagebrush and stemless wild buckwheat).[34]

North Dakota

To date, mining activities have not been affected by the presence of any of the endangered wildlife species that exist in the State. The destruction of woody plants in draws, a scarce woodland resource found in the lignite region of North Dakota, has become a significant issue at Consolidation

[34]Wyoming Natural Heritage Program, 1980.

Coal's Glenharold Mine. The protection of these areas is mandated by State, rather than Federal, statutes. The woody draws, dominated by green ash, box elder, and American elm, are found throughout the Glenharold site in draws, valleys, and along the north- and east-facing slopes of the project area. The understory, consisting of a mixture of shrub species provide habitat for deer and other wildlife. Consolidation Coal's plans to mine across these draws have resulted in opposition from the State Public Service Commission and have delayed approval of Consolidation Coal's mining permit application. Consolidation Coal must demonstrate the ability to successfully reclaim these draws before it can gain regulatory approval for mining these areas. With the exception of the Glenharold Mine, other coal mining operations in the state either contain no woodland areas or have managed to avoid mining these areas.

Other Regions

In northwestern Colorado, surface mines conflict with elk migration and calving areas. At the Energy Fuels Mine, a calving area is being mined. The company, in conjunction with OSM and the Colorado Division of Wildlife, is experimenting with "habitat manipulation." The company is attempting to recreate offsite the type of calving habitat that is being lost due to mining. To date, wildlife concerns in this area are not expected to affect recoverability of coal because of the extensive mitigation strategies available to operators.

Seven of the eight new leasing tracts of the Wasatch Plateau in Utah have critical winter range for big game, Since the tracts involve underground mining, the potential impacts are substantially less than those associated with surface mining,

Cultural Resources

Throughout the Western United States, archeological and historical sites are frequently encountered. Under current statutes and regulations, a comprehensive survey must be undertaken before disturbance. If a site has significant scientific value, it is studied and the artifacts are generally salvaged, Only at sites with significant architectural or recreational value would a site be preserved and prohibited from mining.

However, according to the OSM staff, cultural resource issues are perceived as a "thorn in the side" by industry. Mine operators are frustrated by the rejection of cultural resource surveys determined incomplete by OSM and the subsequent delays in permitting. OSM staff claim that industry has had difficulty taking the cultural resource issue seriously. Often, companies have contracted with firms or universities whose work has been found inadequate by OSM.[35] Future problems may be alleviated if the OSM promulgates guidelines for adequate surveys.

The San Juan basin area has the greatest potential for future conflicts between cultural resources and mining of Federal coal. The Anasazi cultural features of the region are generally recognized by archeologists to have great significance and value. Architectural sites abound and several areas are protected by the National Park Service, Conflicts are likely in the Star Lake-Bisti region where it is likely that coal reserves are found beneath remnant "outlier" communities to Chaco Canyon. Expansion of the Chaco Canyon National Monument to include some of these communities might also affect coal recovery. No attempt has yet been made to quantify these conflicts.

[35]Shafer, OSM staff archeologist, personal communication, 1980.

Statutory Control

Federal requirements for the protection of archeological and historic resources are derived from SMCRA, OSM's authority to protect these resources comes from other Federal laws directed at protecting archeological and historic resources. These include:

1, The Antiquities Act of 1906 (Public Law 59-209, 34 Stat. 225; 16 U.S.C. 431-433);
2. The Historic Sites Act of 1935 (Public Law 74-292, 49 Stat. 666; 16 U.S.C. 461-467);
3. The Reservoir Salvage Act of 1960 (Public Law 86-523, 74 Stat. 220; 16 U.S.C. 469-469 c);
4. The Historic Preservation Act of 1966 (Public Law 89-665, 80 Stat, 915; 16 U,S,C. 470);
5. The National Environmental Policy Act of 1969 (Public Law 91-190, 31 Stat. 852; 42 U.S.C. 4321-4347);
6. Executive Order 11593 (May 13, 1971, 36 F.R. 8921);
7. Archaeological Conservation Act of 1974 (Public Law 93-291, 88 Stat, 174);
8, The Tax Reform Act of 1976; and
9. Archaeological Resources Protection Act of 1979 (Public Law 96-95, 93 Stat. 721: 16 U.S.C. 470).

The more important laws are briefly discussed below.

Under the Historic Preservation Act of 1966, the historic value of any site in the National Register, or eligible for listing in the National Register, must be taken into consideration when any project utilizing Federal funds or under Federal permit might adversely affect such a site. Detailed surveys of proposed mine sites must be undertaken to ensure that all eligible sites are identified prior to mining.

The National Environmental Policy Act of 1969 declares that it is the policy of the Federal Government to use all practical means, consistent with other essential considerations of national policy, to—among other things—improve and coordinate Federal plans, functions, programs, and resources with the objective of preserving nationally important historic, cultural, and natural aspects of our heritage. It directs that the policies, regulations, and public laws of the United States shall be interpreted and administered, to the fullest extent possible, in accordance with the act. Further, it directs all agencies to use a systematic interdisciplinary approach that will ensure the integrated use of the natural and social sciences and the environmental design arts in planning and decisionmaking which may have an impact on man's environment, It further requires that, on all federally sponsored or licensed projects which significantly affect the environment, the responsible official submit an environmental impact statement that assesses the impact of the proposed action and any unavoidable adverse environmental effects (this has been consistently interpreted to include impacts to archeological and historic resources), sets forth the alternatives to the project, identifies the long- and short-term results, and identifies any irreversible and irretrievable commitment of resources required by the project.

The Archaeological Conservation Act of 1974 specifically provides for the preservation of historical and archeological data (including relics and specimens) that might otherwise be irreparably lost or destroyed as a result of alteration of the terrain caused by any Federal construction project or federally licensed activity or program.

Together, these acts require that OSM ensure that all potential archeological or historic sites are identified and salvaged before mining. Actual preservation of sites will probably only be required where significant structures exist.

Economic Impacts of Environmental Regulations on Federal Coal Production

Environmental regulations may have an economic impact on Federal coal production in two major ways: 1) income foregone by the leaseholder in terms of profits, and by the Federal Government in terms of royalties, as a result of leaving coal in the ground that would otherwise be recovered if environmental concerns were not considered; and 2) increased mining costs because of changes in mining methods necessitated by environmental regulations.

Losses of reserves attributable to environmental regulations can be quantified and OTA's evaluation of existing Federal leases has found that most mines currently producing Federal coal have not had to leave reserves in the ground as a result of environmental requirements. Furthermore, losses of reserves at those mines at which environmental requirements have, or will, prevent mining of reserves usually involve small tonnages in comparison to the total reserves in a mine block. In the Powder River basin, 700 million tons of Federal reserves under lease are likely to be under alluvial valley floors, but only a small portion of these Federal reserves (less than 100 million tons) appear to be subject to clear prohibition against mining. Delays of mine plan development at two mines because of alluvial valley floor issues (Buckskin, Spring Creek) have affected another 95 million tons of the potential 700 million tons. Most reserves under alluvial valley floors can be mined if adequate reclamation can be demonstrated; such demonstrations are expected. Regulatory decisions that have resulted in prohibitions have affected a total of 29 million tons (see table 92), and the recovery of perhaps another 200 million tons of Federal reserves may be delayed or otherwise affected by regulatory decisions. In comparison to total leased Federal reserves (16.5 billion tons), these reserves are small.

Analysis of the impact of environmental regulations on the cost of mining coal is difficult because of both conceptual and practical problems in quantifying the impact of such regulations. A recent study that analyzed the economics of reclamation has identified a number of the difficulties involved in quantifying the cost impacts of environmental regulations as follows:[36]

1. A conceptual problem with cost-benefit analysis of reclamation is that costs are relatively easy to consider in monetary terms (i.e., costs imposed on coal operators and consumers of coal), but costs of not reclaiming mine sites (i. e., the benefits of reclamation) are often difficult, if not impossible, to measure in monetary terms.
2. Reclamation costs are highly site-specific. For example, earth-moving costs associated with reclamation may vary by a factor of 3 or 4, and since these costs may be as much as 90 percent of reclamation costs, such variations significantly affect total cost at a site.
3. Inflation and questions of cost allocation, such as the extent to which earth-moving costs should be considered mining or reclamation costs, make precise measurement of reclamation costs difficult.
4. Coal operators are generally unwilling to disclose the detailed costs of mining and reclamation for business reasons, so most cost data available is based on hypothetical information from engineering studies, or publicly financed experimental projects which often do not create optimum conditions for achieving the least cost in production.

[36]National Research Council, Surface Mining: Soil, Coal and Society (Washington, D. C.: National Academy Press, 1981).

Table 92.—Summary of Impacts to Federal Recoverable Reserves From Environmental and Reclamation Considerations

Issue area	Specific issue	Location of affected area	Federal reserves affected (millions of tons)	Effect
Air resources	Expansion of mine production rate in a nonattainment area	Rosebud Mine, Colstrip, Mont.	1.5 ret/y after 1985 or about 30 mt of reserve	U , effect would be to limit production rate, not prohibit any mining areas
	Permitting of additional powerplants near class I area where SO_2 levels for existing and permitted but not constructed facilities are currently predicted to be at maximum PSD level. The additional powerplants would be fueled by lignite mines in the vicinity.	West-central North Dakota	<100	U , improved air quality modeling techniques being developed
Lands unsuitable for mining	Impacts of coal mining will damage important esthetic values of Bryce Canyon National Park	Alton Coalfield, southern Utah	24	Ap -on portion of proposed mine area designated as unsuitable; rest of leasehold unaffected.
Water resources	Subsidence of mine will divert surface and ground water and adversely affect other uses	Mt. Gunnison Mine, west-central Colorado	23	U, approval likely if mine will buy or replace senior water rights affected.
	Alluvial valley floor (AVF) in areas significant to farming	CX Ranch leases Montana portion of the Powder River basin	<100	Ap uncertain
	Developed mines with stream valleys under study as potential AVF where mine plan development has been delayed	Powder River basin Buckskin and Spring Creek mines	95	D, mining of valleys expected
	Designated AVF in developed mines. Valleys not significant to farming. Mine plan development affected	Powder River basin Eagle Butte, Rawhide, Coal Creek mines	61	U, mining of valley expected
	Potential alluvial valley floors which existed in developed mines prior to passage of SMCRA. Reclamation plans must still be approved	Powder River basin Big Sky, East Decker, Eagle Butte, Wyodak, Belle Ayr, Jacobs Ranch and Black Thunder mines	240	U, mining of valleys expected
	Potential AVFS in undeveloped coal lease areas	Powder River Basin	219	U, mining of most valleys expected
Spoil handling and protection of raptor habitat	Limitation on out-of-pit spoil area	Black Butte Mine Green River-Hams Fork region	5	Ap
	Limitation on out-of-pit spoil area	Green River-Hams Fork region	50	Possible problem; resolution uncertain
	Mining in environmentally sensitive woody draws	Glen Harold Mine, west-central North Dakota	29	D

[1]Total Federal reserves under lease are 16,500 million tons,
[2]Ap-absolute prohibition; D-delay in approval; U-unresolved
[3]Jurisdiction lies with the Montana Department of Health and Environmental Sciences.
[4]Jurisdiction lies with the North Dakota State Department of Health
[5]Decision made by the Department of the Inter[or, 1960, Decision under appeal to Federal courts.
[6]Jurisdiction lies with Colorado Department of Natural Resources and U S Office of Surface Mining.
[7]Under sec. 510(b)(5) of SMCRA. Jurisdiction lies with the Montana Department of State Lands. The department has ruled that the alluvial valley floor is significant to farming. The lessee has asked the department to reconsider its decision.
[8]Jurisdiction lies with Montana Department of State Lands (Spring Creek) and Wyoming Department of Environmental Quality (Buckskin)
[9]Jurisdiction lies with Wyoming Department of Environmental Quality
[10]Lead decision made by OSM.
[11]Permit application denied by North Dakota Public Service Commission on grounds that plans for reclamation of wooded draws were Inadequate

Table 93 summarizes "typical" reclamation cost estimates in 1978 dollars in the West, Midwest, and Appalachia, showing costs before and after passage of SMCRA. It is evident that both on a per-ton and a per-acre basis, reclamation costs are significantly less in the West than in the Midwest and Appalachia, The largest part of the cost increases in the West attributable to SMCRA is the 35 cents/ton fee for the abandoned mine reclamation program, which is not strictly an increase in production costs, but rather is a tax to pay for rectifying the environmental costs of past mining practices. When this reclamation fee is subtracted from the estimated total reclamation costs in table 93 to reflect cost increases attributable to changes in mining method, "typical" reclamation costs in the Midwest are 8 times higher than in the West and more than 20 times higher in Appalachia than in the West. The main reason for this large difference in cost is that much thicker coal seams are mined in the West, and the large size of many mining operations allows considerable economy of scale. The main reasons incremental costs in Appalachia and the Midwest are greater with Public Law 95-87 compared to the West is that water pollution control is much more difficult in Appalachia and in the Midwest. Also, prime farmland reconstruction requirements require a larger relative change in materials handling than in the West.

Table 93.—Summary of "Typical Reclamation Cost Estimates (in 1978 dollars)[a]

	$/ton		$/Acre	
	Range	Mid-point[b]	Range	Mid-point[b]
1. Pre-Public Law 95-87 (SMCRA)				
a. Appalachia.	$3.23-7.16	$ 5.19	$2,676-14,915	$9,460
b. Midwest (rowcrop)	1.40-2.73	2.07	7,000-10,000	8,500
c. West	0.08-0.39	0.24	1,899- 8,186	5,043
2. Incremental cost with Public Law 95-87 (SMCRA)				
a. Appalachia.	—	5.24	—	—
b. Midwest (rowcrop)	–	1.80	—	—
c. West	—	0.57	–	—
3. Estimated total reclamation costs with Public Law 95-87 (1 +2)				
a. Appalachia.	—	10.33	–	—
b. Midwest (rowcrop)	—	3.87	–	—
c. West	—	0.81	–	—

[a]Thls table presents **cost estimates developed by the NAS Committee on Soil as a Resource in Relation to Surface Mining for Coal, based on a synthesis of all studies available as of 1980. However, until more experience is gained with the reclamation provisions of Public Law 95-87, cost estimates will remain uncertain. The NAS report notes that these cost estimates are probably higher than costs will be in the long run.**

[b]**The midpoint values for $/ton and $/acre were derived independently from the two sets of ranges and thus are not directly comparable to each other.**

SOURCE: National Research Council, *Surface Mining Soil, Coal and Society* **(Washington, D.C National Academy Press, 1981)**

On a site-specific basis, Federal coal may experience significant cost increases because of environmental regulations, but such situations appear to be the exception rather than the rule. Two areas where such impacts may be significant on a site-specific basis are the extensive hydrologic data collection and analysis that is required in Public Law 95-87 for permit applications, and requirements necessitating changes in spoil handling procedures. The effects of these extensive hydrologic data collection and analysis requirements are greatest on small operators or companies with limited financial backing. Although OSM's Small Operator Assistance Program offsets costs for the smallest size operations, somewhat larger mines may have difficulty conducting the required studies. However, comparison of the detail of mine plan data submittals to OSM indicates that considerable variation exists in the detail of hydrologic information considered acceptable. Mine operations in the Northern Great Plains are required to submit more comprehensive data than mines in other areas.

There are several examples of the impacts of requirements under SMCRA concerning spoil handling. The Decker Coal Co, has claimed that the change in mining methods necessitated by prohibition of placing spoil in an intermittent stream valley adjacent to their East Decker mining area increased the cost of mining by several dollars per ton. These costs were passed on to the consumer in the form of increased coal prices. At present, the city of Austin, Tex., is suing the Decker Coal Co., challenging the validity of the increased prices. The case has not been resolved. At the Black Butte Mine in southern Wyoming, restrictions on placement of out-of-pit spoils has required significant

modifications of the original mining plan, but these modifications apparently have not jeopardized the viability of the mining operation,

In summary, OTA has identified a number of examples on existing Federal coal leases where there are demonstrable economic impacts on mining because of environmental regulations, both in terms of revenues foregone because of the necessity to leave coal in the ground, and through increases in mining costs. However, to date, and in the foreseeable future, total reserves lost through such requirements appear to be relatively small, and OTA has not identified any situations where the overall viability of a mining operation has been jeopardized because of increased costs attributable to environmental requirements. Significant modification of mining plans to accommodate environmental concerns is not uncommon.

The primary reason that environmental regulations appear to have had a relatively small impact on Federal coal production is that costs resulting from these regulations are small when compared to other major coal-producing regions. Current requirements concerning out-of-pit disposal of spoils have the greatest relative impact on mining costs in southern Wyoming, and northwest Colorado, where the mining of dipping multiple coal seams creates difficult conditions for surface mining. Improved spoil handling methods through the reorientation of pits and expanded use of truck-shovel combinations rather than draglines may lead to resolution of many of these problems, but at the present time it appears that SMCRA has reduced the competitive position of coal mined in southern Wyoming compared to coal from the Powder River basin, although this change is difficult to quantify.