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INTEGRATED MINED-AREA RECLAMATION AND LAND-USE PLANNING

Volume 2

Methods and Criteria for Land Use and Resources Planning in Surface Mined Areas

Prepared for the

Resource and Land Investigations (RALI) Program
U. S. Department of the Interior
U. S. Geological Survey

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ENERGY AND MINERAL RESOURCES

ARGONNE NATIONAL LABORATORY

Energy and Environmental Systems Division

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INTEGRATED MINED-AREA RECLAMATION
AND LAND-USE PLANNING

Volume 2

Methods and Criteria for Land Use and
Resources Planning in Surface Mined Areas

by

Edgar A. Imhoff,* William J. Kockelman,*
Joseph T. O'Connor,* and James R. LaFevers

Energy and Environmental Systems Division

April 1978

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FOREWORD

This report is one in a ten-volume series prepared by the Energy and Environmental Systems Division of Argonne National Laboratory and the Resource and Land Investigations (RALI) Program of the U.S. Department of the Interior under the sponsorship of the U.S. Geological Survey. Because of the close interrelationship of the ten documents in the series, each volume will be most useful only when its relationship to the other products of the program is considered.

The reports in this series are designed primarily to familiarize professional land use and resource planners with the range of possibilities and effective procedures for achieving integrated mining, reclamation, and land use planning. These reports are based on a research program which included an extensive literature review, the compilation and analysis of case study data, and close coordination and interaction with related government programs.

The first volume in the series, *A Guide to Integrated Mined Area Reclamation and Land Use Planning*, summarizes the information in the other volumes and presents conclusions and observations drawn from analyses of that information. Volume 2, *Methods and Criteria for Land Use and Resource Planning in Surface Mined Areas*, examines planning procedures used in several mineral industries and mining regions and discusses problems facing professional planners who must consider surface mine areas in their planning programs.

In Volume 3, *A Guide to Mined Area Reclamation Technology for Reclamation and Land Use Planners*, the methods used to reclaim land in each of several mineral industries are discussed in relation to the physical and cultural constraints that must be considered in planning a reclamation program. Much of the information for this document was obtained from case studies conducted in several mining districts. The case study sites were chosen after consideration of the following: (a) coverage by commodity of those surface mining activities that disturb the greatest acreages, (b) coverage of a variety of cultural and land use settings, (c) evidence of integration of mining, reclamation, and land use planning, (d) cooperation on the part of operating companies and appropriate planning entities, (e) coverage of a variety of surface mining and reclamation methods, and (f) coverage of a variety of physical settings (geology, physiography, climate, hydrology). After the preliminary case study selection, some sites were changed and others dropped because of a lack of company cooperation. The remaining six case studies all meet the criteria listed above. They are not intended to be perfect examples of reclamation and planning procedures. Rather, they illustrate a variety of procedures utilized in different physical and cultural settings to achieve planning goals under a variety of technological, legal, and economic constraints.

Since the case studies are intended to be used as appendices to Volume 3, they are numbered accordingly. The case study reports include:

Volume 3A: *A Case Study of Surface Mining and Reclamation Planning: South Boulder Creek Park Project, Sand and Gravel Operations, Boulder, Colorado.*

Volume 3B: *A Case Study of Surface Mining and Reclamation Planning: International Minerals and Chemical Corporation, Phosphate Operations, Polk County, Florida.*

Volume 3C: *A Case Study of Surface Mining and Reclamation Planning: Georgia Kaolin Company, Clay Mines, Washington County, Georgia.*

Volume 3D: *A Case Study of Surface Mining and Reclamation Planning: Area Strip Coal Mining, Peabody Universal Mine, Universal, Indiana.*

Volume 3E: *A Case Study of Surface Mining and Reclamation Planning: ASARCO Open Pit Copper Mine, Casa Grande, Arizona.*

Volume 3F: *A Case Study of Surface Mining and Reclamation Planning: Cannelton Mountain-Top Removal Coal Mine No. 9-S, Cannelton, West Virginia.*

Volume 4, *A Bibliography of Integrated Mined Area Reclamation and Land Use Planning, with Annotations*, includes primarily references pertinent to reclamation planning and plan implementation.

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INTEGRATED MINED-AREA RECLAMATION AND LAND-USE PLANNING

Volume 2: Methods and Criteria for Land Use and
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ABSTRACT

The concept of the integration of reclamation planning with land-use planning is traced historically through this report. Examples are given of successful efforts to integrate these two types of planning in various extractive industries. The processes of land-use planning and plan implementation are described as they relate to resource protection, extraction regulation, and site reclamation. In addition, a model for integrating land-use planning and reclamation planning is developed to illustrate procedures for achieving, and factors which might prevent, effective integration of the various planning processes.

1 INTRODUCTION

The concept of integrating land-use planning with surface mining operations emerged in the 1950s from the continuing conflicts between the construction materials and mining industries due to the increasing expansion of urban areas and requirements. The sand and gravel industry, most commonly assailed by such conflicts, has found that its reclaimed lands are more marketable when community needs are taken into account during the mining and reclamation efforts. However, most of the rest of the mining industry has been slow to accept the concept.

This report addresses the past history of mined-area reclamation and land-use planning and presents some devices for implementing resource-protective planning legislation, as well as a model by means of which a state or local government can organize its reclamation/land use planning efforts. Mr. E. Imhoff is primarily responsible for the section on perspectives, W. Kockelman for the section on land-use plans and plan implementation, and J. O'Connor for the section on a model for integration of land use and reclamation planning; all three are of the U.S. Geological Survey. Contributions to the text in all sections, along with insightful criticism, were made by J. LaFevers of Argonne National Laboratory.

2 PERSPECTIVES

2.1 ORIGIN AND GROWTH OF A CONCEPT

The reclamation of surface-mined areas in the United States began in the 1920s (Carter, 1974) as a voluntary activity directed largely at revegetating mined land to stabilize slopes, reducing erosion, and improving the esthetic appearance of abandoned mine sites. Early reclamation practices consisted largely of planting tree seedlings or sowing grass seeds on ungraded mined lands. Such reclamation tended to occur as an unplanned event, aimed more at mitigation of problems than at development of productive lands.

Early notable successes in reclamation occurred at Meadowlark Farms in Indiana where grazing lands resulted from mined-area reclamation, demonstrating the kind of benefits that could derive from even casually planned reclamation (Sawyer, 1940). The concept of preplanning of mined-area reclamation arose from these early successes at mitigation.

Beginning in 1939 in West Virginia, state government, in a regulatory role, joined the landowner and the mine operator as an interested third party. Along with state regulation of mined-area reclamation came the inevitable requirements for paperwork -- for a formal description of the proposed mining and the mandatory reclamation. By the 1960s the concept of preplanned contemporaneous mining and reclamation was expressed in several state mined-area reclamation programs -- in Appalachia and in the Midwest.

In the late 1960s, the idea that land-use planning should be linked to mine and reclamation planning emerged as a result of increasing environmental awareness and increasing pressures for multiple-purpose land use by a burgeoning population. But, it was the materials industries, principally sand and gravel operators and the crushed stone suppliers, who pioneered in developing the plan of integrated mining-reclamation/land use. These private industries were encountering intense competition for land, discord between onsite mining and offsite land uses, and narrow profit margins from their extractive and processing operations. Thus, out of necessity, an industry such as sand and gravel mining developed techniques for planned, coordinated activities at a mine site, so that after the mining and reclamation activities the land would be marketable. Innovations by the industry were enhanced by familiarity with public planning, for the economics of sand and gravel production dispose the industry to locate within a planning jurisdiction.

2.2 EXAMPLES OF PERSPECTIVES AND PERFORMANCES (Key Literature)

Mining Industries

The National Sand and Gravel Association (NSGA) (1958) published a booklet to help sand and gravel producers understand the zoning aspects of plan implementation (or land-use control) in the absence of comprehensive planning). This was the first of several NSGA publications on land-use planning as related to mining, the noteworthy being: Ahearn (1964), Bauer (1965), Johnson (1966), and Jensen (1967). The following statements by Ahearn (p. 2) express the orientation of industry spokesmen:

It is no longer possible for the sand and gravel producer to view planning in his community from afar and to take an active interest in it only on an emergency basis and in a negative manner....

Only by the combined assistance of all elements in the community can a plan be developed which reflects foresight and imagination, which is reasonably designed to protect and promote both the interests of the public and of aggregate producers, and which shows a proper regard for private rights not inconsistent with the protection of the health, safety, and welfare of the community.

Ahearn's work is the first authoritative discussion of public planning as related to surface mining. He discusses the following subjects in useful detail: general principles of public planning; limitations and exclusions of planning; the role of the industry (sand and gravel) in land-use planning; planning and zoning theories and methods; performance standards for both mining and reclamation; and administration and enforcement of plans.

The construction aggregate industries have also been innovative in the development of site plans for integrated mining, reclamation, and land use. A report by the Nello Teer Company, Angster et al. (1970), for example, is directed toward producing a workable plan which will "... facilitate the integration of abandoned quarry sites into the urban fabric."

The early literature of the coal industry is omissive or brief on the relationship of surface mining to land use. This slack has been taken up, in specific detail, by recent site plans and, in general comment, in environmental impact assessments and statements. In short, the coal industry has yet to produce publications that might be considered parallel to those of the National Sand and Gravel Association.

Academia

Universities, too, have played key roles in advancing and in clarifying the concept of integrated planning for mining, mine reclamation, and land use. The research of Friz (1970) at the University of Wisconsin focused on details of the common interest between public planning and the aggregate industries, bringing out steps to be taken jointly and constraints to be recognized in order to achieve an integration. Friz describes the historical interface between surface mining, reclamation, and land use in southeastern Wisconsin.

As in the literature of the coal industry, academic literature is relatively silent on the subject of integration of mining, reclamation, and land-use planning. There are, however, several theses (e.g., LaFevers, 1974) that cover part of the opportunities, problems, and techniques involved in that type of integration. LaFevers pointed out that reclaimed Indiana lands featuring water bodies were up to ten times as attractive for residential development as unmined land in the same area.

A landmark publication on the integrated concept, as applied theoretically to open-pit copper mining has resulted from a multidisciplinary study at the University of Arizona (Matter and others, 1974). With the support of industry, the University of Arizona planners, engineers, and scientists demonstrated in physical models and in analytical reports the alternatives physically available for conversion of copper mine areas and processing wastes into land use compatible with present offsite land uses and directed toward forecasted future needs. Economic, financial, and engineering feasibility were not determined. Nevertheless, the report is monumental in showing how a process that is often viewed as obnoxious by adjacent nonmining landowners and nefarious by environmentalists might well become an organized activity for the production of esthetic communities, with a full range of support facilities and industry. The University of Arizona effort focused on: the need to consolidate land-use patterns (and possibly land ownership); amelioration of the large-scale environmental problems of fugitive dust, eye sores, unstable land and water use; and beneficial land reuse potential achieved through planned deployment of particular kinds of wastes in space and time.

Literature for Public Planners

Although considerable argument exists about whether or not planning is a process or a profession, many thousands of individuals within the United States call themselves, or are called, Professional Planners. In general, these planners are trained and work more in the realm of urban design and function than in environmental areas or in the use of natural resources. Accordingly, planning literature is scant on the subject of mined-area reclamation.

However, Kockelman (a co-author of the present report) prepared a series of resource planning and conservation guides and assisted local Wisconsin communities in the adoption of model ordinances contained in the guides. These guides and ordinances were designed to implement the regional resource conservation and development plans prepared by the Southeastern Wisconsin Regional Planning Commission (SWRPC) and adopted by local units of government.

Provisions are made for the conservation of soil, water, and mineral resources by the creation of exclusive resource conservation zoning districts (SWRPC, 1969, p. 227), shoreland uses and regulations (1968, pp. 159-176), and conditional use regulations and procedures for mineral extraction and site reclamation (1964, p. 121).

The discussion and regulations in these guides and ordinances relating to surface mining and reclamation, however, are necessarily succinct. A more extensive discussion is contained in the Wisconsin Geological and Natural History Survey Circular Number 24 (Preston, Strauss, and Friz, 1974).

A prospectus by Howard M. Landers, AIP, of the firm of Reynolds, Smith, and Hill (1975) illustrates one of the first comprehensive outlines, in trade literature, of the concept of integrated planning. Introducing the term "simultaneous mining and land development," the prospectus sets forth analytical steps that could produce interdependent plans for land-use, reclamation, and

mining, pointing particularly toward the needs of public planners for land and natural resource information. Keefer and Hadley (1976) synthesized and interpreted geologic, hydrologic, geochemical, and related data to predict some of the potential environmental effects of surface mining in Campbell County, Wyoming. A method is displayed for forecasting the probable effects of surface mining and considerations to address in developing and executing land-use and related mine-reclamation plans.

Mining Engineering Literature

A report by consultants Dames and Moore (1976) marks a significant advance in the state of the art of mined-area reclamation. Their report sets forth a rationale for interrelating mine and reclamation planning and stipulates required geotechnical inputs. Mine and reclamation planning subjects are covered in considerable detail.

In reporting on research contracted by the U.S. Bureau of Mines, Robert Young (1976) has shown how legal and political factors might preclude the mining of coal so that the practically recoverable reserves could be far lower than the coal reserves determined by simple formulas such as coal thickness-depth of overburden ratios. In a case study of a surface coal-mined area in West Virginia, Mr. Young has synthesized information on mineral occurrence, land-use controls, and on land and mineral ownership in order to estimate probable recoverability, a quantity significantly less than strippable coal reserves.

2.3 THE ROLE OF REGULATORY ACTIVITIES

Mined-area reclamation is required at federal, state, and local levels, but coverage is spotty and applications are understandably nonuniform. For example, federal regulations apply only to federally-owned lands and minerals, and then only if extant state regulations are judged inadequate. Few of the thousands of counties and incorporated areas have actually adopted and implemented mined-area regulations, although many local governmental planning laws do (or can) affect mining activities. The most active level of government in requiring mined-area reclamation is the state level; by the year 1976 thirty-nine states had established regulatory reclamation programs pertaining to coal and, in some cases other minerals (Imhoff, 1976). Among the major mining states, only Alaska, Arizona, and Nevada are omisive in mined-area reclamation laws and each sets reclamation standards for state-owned lands.

Since an overwhelming majority of states do require mined-area reclamation, it would seem that a search of state statutes and rules and regulations would yield useful examples of how land-use, mine, and reclamation planning can be effectively integrated. Yet, this is not the case.

Each of the various sets of state guidelines given to mine-operator applicants and state inspectors are highly useful in planning mine-related facilities and in carrying out the actual reclamation in accordance with state law, but local governmental land-use planning is scarcely addressed at all. For example, of the 39 states with mined-area reclamation programs, 10 states

do not require the declaration of the proposed postmining land use. The requirement of a predetermined postmining land cover type, usually pasture or forest, can be assumed, however, from state standards set for final slope, backfilling, water and toxicity control, and revegetation. Also, only 12 states require that the mine-operator applicant show that alternative land uses have been considered in the reclamation planning.

A brief overview of the treatment accorded local governmental planning is provided in Table 2.1. Analysis of the full statutes and regulations suggests that only the following states stipulate a positive, important role for local governmental planning in the state mine permitting process: California, Colorado, Illinois, Kentucky, Maryland, Minnesota, Oregon, South Dakota, Vermont, Washington, and Wisconsin. As indicated, state-designated roles for local planning vary in stature and function, providing a picture of sharp contrasts. For instance, the State of Washington requires the mine applicant to show the legality of proposed actions with regard to local zoning, but Indiana reclamation laws do not mention local planning at all.

In the matter of local regulation of mine reclamation -- a step more direct than planning -- there are also wide variances between states, with little common ground on the role of local government. Florida, for example, enables local government to impose stricter standards on surface mining, whereas Alabama has prohibited local regulations in a 1975 act that preempted "... local regulation of coal surface ..." (1).^{*} New York allows stricter local mined-land reclamation standards, but local government is advised that it (not the state) must enforce such standards.

Other statutory impediments exist to thwart the application of an integrated concept of planning for mining and land use. Strauss and Kusler (1976) found that in granting land-use control authority to local government, some states did not transfer as much real authority as that action seemed to provide for it was shown that mining is a land use exempted from specific land-use controls in certain states (see Table 2.2).

Judicial action and case law precedent can also stand as a significant constraint to integration of mine and land-use planning, through the reclamation process. Court cases abound (see Williams, 1975) over the issue of whether or not local controls (including local planning) can be applied unilaterally, bilaterally, or as a substitute for state regulations. As Williams notes (Vol. 1), courts in some states, such as Illinois, tend to be negative about the "intrusion" of local government into mine reclamation -- as regulated by state laws. In other states, such as Kentucky, the opposite situation prevails: local and state courts show sympathy for formal expression of local land-use plans and local reclamation regulations.

^{*}Consecutive numbering within parentheses refers to footnotes listed at the end of the report.

Table 2.1. Briefs of State Assertions of the Role of Local Public Planning in Regulations of Mine Reclamation (Adapted from USGS Circ. 731, Table 1)

State	Role Stipulated
California	Act on mining permits and reclamation plans and mining policy in general plans (of state).
Colorado	Review for conformity with local land-use controls.
Florida	Local government may impose stricter standards (silent on local planning).
Illinois	County board may recommend land use, and may request hearings.
Kentucky	State permits must comply with local zoning laws.
Maryland	State, in acting on applications, takes cognizance of county planning, zoning, and grading permits.
Minnesota	"Rules . . . shall conform with any State and local land-use planning."
New Mexico	Consultation required with soil and water conservation districts. (No word about other types of planning organizations.)
Oregon	Department may approve local governmental permitting or reviewing in lieu of state (local planning involved).
South Carolina	Local soil and water conservation districts review and comment.
South Dakota	Incompatibility with local land plans can be basis for state rejection of mining permit application.
Texas	Local governments are notified of mining-reclamation and their comments comprise input to the decision-making process.
Utah	Local governments are notified and their comments are taken under advisement.
Vermont	State action must accord with local plans.
Virginia	Local soil and water conservation districts advise.
Washington	Applicant must show legality of action with regard to local zoning.
Wisconsin	Mining, reclamation and comprehensive plan (for site development) shall conform to local zoning.
Wyoming	County involved in administration of act.

Table 2.2. States Exempting Mining from Specific
Land-Use Controls of Local Government

State	Control Exempted
Arizona	Subdivision regulations and zoning
Idaho	Building codes and zoning
Missouri	Subdivision regulations and zoning
Montana	Zoning
West Virginia	Zoning (outside of incorporated areas)
Wyoming	Zoning

NOTE: Additional exemptions apply in some states in which mining is classified as an agricultural activity under zoning laws.

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3 LAND-USE PLANS AND PLAN IMPLEMENTATION

Most mineral deposits and their surface mining have characteristics that result in the creation of special land-use problems. These problems include:

1. Loss of scarce or unique minerals by intensive or incompatible development occurring over, or adjacent to, their site.
2. Lack of locational flexibility requiring that mineral resources be extracted where they occur. The proximity of a market for common, abundant, and bulky minerals, such as sand and gravel, determines transport cost, a large part of the operating expense of materials production.
3. Extraction and processing of minerals, a heavy-industrial land use, can create hazards to neighboring land uses, and are more disruptive to the land surface and drainage pattern than most other land uses.
4. Surface-mining operations obliterate natural resources, supplant other land uses during extraction and processing, and create a depleted site that can be very costly to reclaim.

Surface-mining and reclamation problems are not unique to the United States. The consequences of "mineral-getting," including toxic fumes, drainage interference, and waste dumping in Scotland and England as well as in Tennessee, Kentucky, and Maine were discussed by Darling (1968) and others at a UNESCO intergovernmental conference.

Recognizing the consequences of "mineral-getting," the U.S. Congress made the following finding and declaration in enacting the Surface Mining Control and Reclamation Act of 1977. (Public Law 95-87, 30 USC 1201 et seq.)

... many surface mining operations result in disturbances of surface areas that burden and adversely affect commerce and the public welfare by destroying or diminishing the utility of land for commercial, industrial, residential, recreational, agricultural, and forestry purposes, by causing erosion and landslides, by contributing to floods, by polluting the water, by destroying fish and wildlife habitats, by impairing natural beauty, by damaging the property of citizens, by creating hazards dangerous to life and property, by degrading the quality of life in local communities, and by counteracting governmental programs and efforts to conserve soil, water, and other natural resources; ...

The generally stated purpose of implementing both land-use plans and regulations is usually "to promote the health, safety, prosperity, and general

welfare" of a state or community. For many plans and regulations relating to minerals and surface mining, the intent and objectives are more specifically set down; for example:

1. Protect and conserve mineral resources.
2. Promote economic growth and local employment.
3. Provide for contemporaneous, integrated or simultaneous potential uses after extractive operations are complete.
4. Avoid the creation of a sacrifice site having few potential uses after extractive operations are complete.
5. Minimize the offsite effects and environmental impacts on neighboring lands and waters.
6. Reclaim the depleted site so that it becomes marketable for a use specified in the local land-use plan.

The purpose and intent of Orange County's Sand and Gravel Extraction Zoning District Regulations (1976, Sec. 79.104.1) includes phrases such as recovery of mineral resources in a "responsible manner," in a manner that is "both environmentally sensitive and compatible with existing and future land uses," and "in a safe and reasonable manner with progressive reclamation to a natural appearing or otherwise usable condition compatible with adjacent areas."

Three aspects of land use should be considered by state and local planning and regulatory agencies well in advance of the extraction of minerals and the use of their depleted sites. These are the protection and conservation of known mineral deposits, the regulation of the extractive and processing operations, and the reclamation and use of the site upon completion of operations.

3.1 PROTECTION OF THE MINERAL DEPOSITS

Once the major mineral deposits have been inventoried, evaluated, classified, and ranked, land-use plans that provide for the conservation and management of the resources can be prepared and adopted by the appropriate state and local planning and regulatory agencies.

These plans would show the location, depth, extent, character, and estimated quantity of those mineral deposits that can be economically extracted to meet future market demands with minimum damage to the environment and existing development. The plan could be part of a state critical-areas plan or a local general plan.

Properly prepared state or local plans include forecasts and analyses of future needs, development of objectives and standards, comparison and evaluation of alternative plans, selection and detailing of one of the alternative plans, and specific implementation recommendations.

Some states and local units of government have addressed the mineral resources loss problem and have made recommendations and enacted legislation providing for the protection of mineral resources. For example, the state of California in its Urban Geology, Master Plan for California (California Division of Mines and Geology, 1973, pp. 54-56) recommends:

1. Updating of maps of all known deposits of useful minerals within 100 miles of urban areas.
2. Completion of a standard economic analysis, including demand projections, on the loss of mineral resources.
3. Adoption of the practice of using mineral resource information in the land-use planning, zoning, and permit procedure of local governments and land-custody agencies.
4. Strengthening local conservation plans that incorporate a long-range approach to mineral resource utilization.
5. Adoption of mineral resource zoning ordinances, and procedures and practices for making them effective.

Section 65302(d) of the California Government Code (1976) provides that every city and county shall adopt a conservation plan for the conservation, development, and utilization of natural resources, including minerals. The plan may also cover the reclamation of land, erosion prevention, and the location, quantity, and quality of the rock, sand, and gravel resources.

In the preparation of such a plan, consideration should be given to accessibility, electric power, processing plants, market proximity, and the existing, interim, and future land uses of the mineral deposit sites.

Depending upon state enabling legislation, several devices can be used for the implementation of land-use plans, such as zoning ordinances, special land-use regulations, or public acquisition. Any of these plan implementation devices, if properly designed and firmly enforced, would serve to protect and conserve the mineral resources until needed.

Interim use of the mineral deposit sites could be made until needed for mineral extraction; for example, mineral conservation districts can be designed to permit numerous nondevelopment type uses such as crops, floriculture, hay, livestock, orchards, paddocks, parklands, pasturage, plant nurseries, poultry, recreation, soil or sod removal, truck farming, and vineyards.

Proposals for extraction of the mineral resource would require an application for, and rezoning to, a mineral extraction district. Any extraction or separating of mineral resources would be a conditional use in such a district and require a special permit to which conditions of operation, reclamation, and sureties would be legally binding.

Manufacturing and processing not attendant upon, or related to, the extractive and separation operations would not be permitted in the mineral extraction district but would require an application for, and rezoning to, an industrial district.

3.2 REGULATION OF THE EXTRACTIVE OPERATION

Numerous environmental problems can accompany the extraction and separation of mineral resources. These problems vary with the type and location of the deposit and may include destruction of plants and animals, erosion, siltation, and turbidity of streams and lakes, landslides, disruption of drainage patterns, flooding, ground-water depletion and contamination, air and water pollution, odors, waste or leaching of desirable minerals, damage to roads and other property, noise, clogging of aquifers, bittern disposal, isolation of land and water areas, disruption of animal migration routes, unsightly operations, toxic-waste storage, fires, traffic congestion, adverse effects on neighboring developments and land values, and other losses and hazards. A general discussion of the types and extent of surface mining and site reclamation by Rosemary E. Walikis (Coates, ed., 1973, pp. 79-76) includes specific examples of the kinds of environmental problems that occur.

Many of these problems can be prevented or mitigated by careful design and strict enforcement of performance standards, conditions, and financial sureties attached to the conditional use permit or the public lease agreement. For example, performance standards for mineral extractive operations may be adopted as part of a state's or community's extractive and reclamation regulations or incorporated into a public lease agreement. Such performance standards may include specific controls on emissions, fire and explosive hazards, glare and heat, liquid and solid wastes, drainage, sound levels, odors, water withdrawal, radioactivity, dust, electric disturbances, and vibrations. An example of several minimum performance standards may be seen in Polk County's "Limerock Ordinance" (Imhoff, 1976a, Appendix D).

Applications for a conditional use permit or public lease agreement for the extraction and separation of minerals would include at least the following:

1. Names and addresses of the land owner and mining operator.
2. Description of the proposed operation, including the disposition of used water, erosion control, ingress, egress, parking areas, and loading areas.
3. Location of proposed equipment, machinery, structures, roads, setbacks, and fences.
4. Source, quantity, and depth or location of needed ground and surface waters.
5. Legal description and survey of the site showing boundaries drainage, existing contours, vegetation, adjacent rights-of-way, existing uses, neighboring uses, and adjacent owners.
6. Depth and location of proposed excavation or stripping.
7. Proposed reclamation program, including time schedule, estimated costs and suggested land uses.

After a public hearing, pervasive conditions may be attached to the permit or agreement, depending upon the type of extractive operation. These conditions may specify hours of operation, sign posting, degree of slope, lighting control, safety fencing, drainage, traffic routes, off-street parking, erosion control, spoil storage, screening, settling ponds, buffer zones, commencement and completion dates, deed restrictions, increased setbacks, filing of engineering maps, energy conversion, type of construction, special pollution control equipment, and the stripping and stockpiling of topsoil, nutrient-rich rocks, and marginal ore. An example of various operational controls may be seen in Orange County's "Sand, Gravel, and Mineral Extraction Code" (1973). An example of technical guides for erosion control prepared by the Milwaukee and Waukesha Soil and Water Conservation Districts in cooperation with the U.S. Department of Agriculture Soil Conservation Service may be seen in the Southeastern Wisconsin Regional Planning Commission's Soils Development Guide (1969, Appendix I).

Another important condition to be attached to a conditional use permit or a public lease agreement is that of the reclamation of the site and financial sureties to ensure such reclamation. Although this subject is addressed below, it must be considered before the operation commences and must be included as a part of any permit or agreement. Great savings in reclamation costs may be obtained if the earthmoving work is accomplished concurrently with the extractive work while heavy equipment is on the site. Simultaneous extraction and reclamation of sand and gravel sites, along with two case studies, are discussed and illustrated by Anthony M. Bauer (1965).

3.3 RECLAMATION OF THE SITE

Numerous environmental problems can occur after the mineral extractive operation has been completed and the mineral deposits are depleted. The problems vary with the type of extractive operation and the character of the depleted site. They may include safety hazards from abandoned sites, spoil storage, and separating plants; ground-water contamination from percolation, gas migration and leachate infiltration; barriers to urban utilities and services; air pollution from volatilization; esthetically displeasing wastelands; surface-water pollution from seepage; leaching of desirable minerals; and fire hazards. Many of the impacts on the environment after an operation has been completed are discussed and vividly illustrated in the U.S. Department of the Interior's Surface Mining and Our Environment (1967).

Many of these problems can be prevented or mitigated by careful design and strict enforcement of a reclamation program. Such a program for the depleted site requires selecting a future land use that is compatible with the local land-use plan. Numerous potential uses may be considered, depending upon the site, proposed reclamation, final contours, and surrounding terrain and land uses. Some of these potential uses are lakes, waste-disposal sites, bomb-proof storage, ground-water recharge areas, and residential, recreational, institutional, commercial, industrial, and even agricultural uses. Some potential land uses for depleted sand and gravel sites are discussed and illustrated by David R. Jensen (1967). The types, planning, and management of real-estate lakes are discussed by David A. Rickert and Andrew M. Spieker:

After a public hearing, the reclamation program can be attached as a condition to the conditional use permit or the public lease agreement. The program depends upon the characteristics of the depleted site and the selected future use. The program may specify final contours to which the site must be returned, replacement of topsoil, revegetation, removal of spoil materials, disposition of machinery and structures, provisions for proper drainage, soil and water conservation practices and structures, treatment of any exposed harmful materials, and commencement and completion dates. Some site improvements, including grading standards, plant materials, and planting procedures, are described by Kenneth L. Schellie and David A. Roger (1963).

Strict enforcement is necessary for successful reclamation. The most effective way to ensure compliance is to require the applicant to provide financial sureties before the permit is granted or agreement executed. The sureties should be adequate for the regulatory agency or local unit of government to repair any damage and to complete the reclamation if the applicant defaults. An example of an ordinance specifying one type of surety may be seen in Orange County's Sand, Gravel, and Mineral Extraction Code (1973, Sec. 79.016.11).

Fees adequate to provide for the inspection, engineering, legal, and administrative costs incurred by the agency or unit of government may also be required of the applicant.

Depending upon the characteristics of the site and the type, size, and duration of the extractive operation, staged operations and staged reclamation may be required. Staging reduces the sureties required, allows modification of the conditions and reclamation program as experience is gained, and ensures that the first stage is restored before the second or third stage is permitted to begin. An example of an ordinance specifying the commencement time and completion period of each stage of a mineral extraction operation and its reclamation may be seen in the City of Boulder's Ordinance No. 4070 (Imhoff, 1976b, pp. 24 and 27).

3.4 FEASIBILITY

The feasibility of reclaiming depleted sites to produce marketable land has been demonstrated by the American Aggregates Corporation in their booklet Project/Parklands (1967). It is interesting to observe what other democratic countries do in the way of reclamation. For example, Great Britain has very strong reclamation laws. Caudill (1973, p. 85-90) reports that:

The National Coal Board requires the land to be carefully surveyed, photographed, and topographically mapped. Buildings and forests are cleared away; then the topsoil is scraped off and preserved in grass-grown heaps. One by one the strata are lifted out and segregated. All nutrient-rich rocks are identified and set aside to be crushed and applied to the surface. After the coal has been hauled away, the layers go back into the pit in their natural order. Each is compacted with heavy rollers. The surface is sculptured to an approximation of its original shape; then the topsoil is

spread over it. Grass is sowed and trees are brought from national forests and planted where others once grew. Then walls, roads, and houses are rebuilt. Restoration extends over five years and costs about \$5,000 an acre, but even these stringent measures leave the land sunken and maimed and the ground water charged with enormous quantities of minerals.

An example of extensive regulations of a mineral extractive operation, including performance standards, daily operations, and special conditions, may be seen in the City of Boulder's (1976) Ordinance No. 4070. Pertinent excerpts from the ordinance have been included in A Review of Selected Laws and Governmental Programs in Colorado, as Related to Mineral Resource Management and Surface Mining (Imhoff, 1976b, Appendix B).

Reclamation of depleted surface-mined sites is not a new practice in the United States nor unique to one state. Case histories of the reclamation of depleted sand and gravel sites located in Illinois, Nebraska, Ohio, Michigan, South Dakota, New York, and Texas have been published by the National Sand and Gravel Association (1961).

Efforts to provide surface-mining operators with background information on, and an understanding of, community planning and decision-making affecting their operations have been undertaken by some of the extractive industries. For example, a booklet entitled Land-Use Planning and the Sand and Gravel Producer (Ahearn, 1964) introduces certain concepts and aspects of planning and plan implementation such as police power, enabling legislation, zoning ordinances, nonconforming uses, performance standards, and reclamation practices.

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4 A MODEL FOR INTEGRATION OF LAND USE AND RECLAMATION PLANNING

4.1 PRINCIPLES

Land-use planning of mine sites is a step beyond the reclamation planning that is required by law in most states. Reclamation planning assures only that the reclamation work will be carried out in an efficient manner, and is usually a necessary step in securing mining and reclamation permits. While no universal authority exists that would require the use of long-term land-use planning procedures or the utilization of the services of public sector planners to determine the uses to which reclamation will be planned, the existence of almost ubiquitous state authority and the enactment of the SMRCA (U.S. PL 95-87, 1977) on mined-area reclamation should be an indication of how planning concepts can be implemented with minimal new legislation, as well as some creative adaptation of existing statutes.

Ideally, integrated planning would be performed jointly by government regulators, private entrepreneurs, and public planners who would coordinate related activities and would share information -- with the objective of reducing conflict and enhancing the total social benefits to be derived from a given land and environmental area. In order to set the stage for a joint coordinated effort, several basic conditions would pertain. These conditions are stated as follows:

1. The principal factors present for the planning effort would include: a local planning organization representing public interests in all aspects of the site and the potentially impacted environs; an official body representing the police power of the state in mandating reclamation; and representatives of the private interests in mineral extraction and land development.

Land and mineral resource owners cannot be expected, reasonably, to act as surrogates for public planning organizations. Similarly, a state pollution control agency (alone) cannot be expected to guide the land conversion process that occurs during the time between the opening of a mine and the eventual creation of a nonpolluting site and a beneficial land use. Where they do not exist, planning organizations and state regulatory agencies would have to be formed to complete the required personnel. If the planning is to be done on an ad hoc or voluntary basis, some agreement should be drawn that gives the representative of the public interest a vested right of the same legal weight as the private property right or lease rights of the developer.

2. With the principal cooperators in the integrated process sharing equal legal standing, neither the private entrepreneur, the local planning body, nor the state regulatory agency need enter into the joint planning activity handicapped by repressive legislation or by an absence of supportive mandates. Examples of fetters on private activity include moratoria on mining, or an unreasonable number of required permits.

An outstanding example of special privileges that a few states have granted to the mineral industries embody the exemption of mining activities from local zoning and subdivision regulations. On the other hand, the setting

aside of lands for public use without serious consideration of recoverable mineral potential is an act equally as selfish as a developer's disregard of planning forecasts and community plans. Unequal legal protection is apparent in the 10 states that have not established a mined-area reclamation regulatory program to enhance expression of public objectives.

3. Money and manpower needs would be met for the accomplishment of the complex technical exercises that encompass integrated mining reclamation and land-use planning.

As a general rule, coordinated action is costlier than unilateral action; multipurpose planning costlier than single purpose planning. The technical staffs of the cooperators -- private, state, local -- must be capable not only of performing the tasks undertaken as a matter of interest or responsibility, but also of evaluating the work of other cooperators in order to create a basis for agreement on reclamation steps to achieve selected end use. This means that mining companies should have some expertise in public planning; public planning agencies should know something about mine planning; and regulatory agencies should understand the full progression of activities that ensue when a mineral deposit is exploited for private profit but with impacts on the public. Private groups and state agencies need to be aware of and exploit the avenues of fiscal support and technical assistance available for aiding the planning process.

4. There must be a legislative imperative and an institutional means that compels and assures that the principal interested parties will, in fact, engage in joint coordinated planning. Accomplishment of this principle would require the amendment of several existing state statutes to require coordination and to stipulate incentives and penalties as does PL 95-87.

5. Research and management studies will be required to derive technical methods not now available for pursuing joint coordinated planning for mined-area reclamation in an efficient fashion. As indicated previously, there is need for immediate applied research contemporaneous with actual reclamation practice.

4.2 STRUCTURAL VARIATIONS IN STATE GOVERNMENT

Structural variations among the state governments preclude the direct application of any single model of integrated surface mining and land-use planning to all states. These variations, which are traditionally sources of difficulty in interstate planning efforts, include differences in jurisdictional setting, variation in authority, and inconsistency of enforcement practices. Of the jurisdictional differences, the first and largest variation would be that of the administrative structure and extent of authority of the state agencies responsible for mined-area reclamation and/or land-use planning (2).

The development of regional governments to handle problems that do not fit conveniently into the jurisdiction of established governmental units has received support in recent years from the successes of a number of efforts in this direction (3). Additional regional authorities may be set up, or have

their authority enlarged, to handle the land-use planning and associated problems that arise with the strip mining of coal in a broad geographic area. Should such regional agencies emerge, their jurisdiction will have to be specially recognized by legislation on surface mining or they will become merely another layer of paper insulation between a problem and its solution.

The authority of the controlling governmental unit depends initially upon the extent of the enabling legislation establishing the unit, but to a great degree as well upon the interpretation of the legislation accepted in that state. Much of the delegation of local control stems from state constitutional provisions and from adoption of a Standard State Planning Enabling Act published by the Department of Commerce in 1928. Williams (1974) (4) points out that the states tend to set up specific kinds of agencies with some differences in authority to handle problems of different scopes. Single purpose statutes, such as those protecting wetlands or shorelands, are usually administered by a line agency in the state government; multipurpose statutes are generally handled by special statewide commissions, such as has been done in Hawaii, Vermont, and Maine; regional intra- or inter-state problems are most often handled by a special regional commission with attention given to local representation.

The authority of a commission may be extended by court action beyond that which may have been conceived for it initially. Further, courts tend to change the scope of review of various statutes with time (5), thus narrowing or broadening the basis on which the agency was originally set up and often causing consequent staffing inequities.

The planning authority of an agency may be compromised, however, by the consequences of political development. Williams points out that the official system of land-use planning (zoning, subdivision control, land-use plans, maps, etc.) must share actual effectiveness with two other land-use management procedures -- property taxation and the timing and location of investment in public works (6). Thus the land-use plan drawn up by one agency, particularly a local or regional agency, may fail because it intercepts the power plant siting requirements of another agency or because it conflicts with a third agency's tax base.

Whatever the official structure of a state government, variations in application of land-use planning policy or reclamation statutes may occur because of enforcement practices that stem from custom or from economic pressures upon it.

4.3 IMPACTS OF VARIATIONS

The size and technical background of the staff of the appropriate land-use planning/reclamation agency will, of course, affect the requirements for detail in the technical information demanded of the mineral developer. Other factors, which appear as variations in the state management scheme, will also affect these requirements. The type and sophistication of the information system utilized by the state agency will put limits on the minimum and maximum amounts of data acceptable, thus circumscribing both the detail and the extent (areal) of information demands. The format of such requirements may vary from simple lists of possible impacts, through detailed maps and overlays, to digital

representations of predicted consequences of mining, reclamation, and land use. For some typical data base requirements in the state and federal surface mining programs, see Table 4.1.

In addition, the nature of the regulating agency will largely determine the background data requirements necessary for the planning function of the reclamation effort. A well-organized, fully-staffed agency may be quite demanding of technical data from the mineral developer while collecting, organizing, and analyzing most of the demographic, socioeconomic, and even regional technical information itself. A smaller county level staff within a large state program, might be less critical about the detail of the technical data but be forced to rely upon the developer for data not related directly to extraction of coal. Another small local agency without the backing of a large state program may be quite undemanding of the developer on most levels, yet may allow, by default, other state or federal agencies to impose their diverse restrictions on the reclamation process.

Although the role of the mineral developer as land-use planner in mined-area reclamation programs is generally a passive one, the wording of new federal legislation could broaden that role under certain circumstances (7). A requirement for the developer to demonstrate that the use to which the reclamation is directed must conform to extant land-use plans is intrinsically different from a requirement for the developer to formulate the higher and best uses for the land. If, however, the state planning function is weak, the mineral developer may be forced into the position of supplying the interpretive analysis of the planning data, as well as the background and mitigation data, in order to meet technical requirements of environmental legislation.

State reclamation plans that are parallel to the federal Surface Mining Control and Reclamation Act (SMCRA) and rely largely upon technical performance standards for their regulation may establish a set period of time for which the mineral developer is responsible for the reclaimed land after mining. Reclamation statutes that are directed toward land-use planning applications may not be as specific on the period of responsibility but fit the timing to the use (8). There is certainly a possibility of conflict between periods of responsibility set up by the states and the federal programs under the current scheme (9). The new SMCRA would not tend to ameliorate this situation significantly (10).

The administrative difficulties that exist in the process of obtaining a surface mining permit are considered by some to be monumental (11). Under an ideal system of integrated reclamation and land-use planning, it would seem appropriate to lessen the burden of administrative requirements.* Even without the spectre of agency struggles to maintain a power structure, the elimination of paperwork is a task to which all parties will need to devote energy if it is to succeed.

*One proposal for lightening that burden is consideration of all aspects of a permit as a unit. This path may be imperiled by the need for expertise within one agency and the charter for that expertise within another.

Table 4.1. Reclamation Data Base Requirements for Seven Western Coal-Producing States and Current and Proposed Federal Surfacing Mining Regulatory Programs

Sources	Location and Sur. Config.	Earth Sci. Data	Engineering Data	Technical Meas.	Biol. Sci. Data	Socioecon. Data	Legal Data	Misc.
Colorado	Topo. (1:7,920), affected lands, phys. features, operations, facilities, phased reclamation map	Soils map	Mining and reclamation methods		Revegetation map	Proposed land use	Certification by local government plan	Timetable
Montana	Topo. 7½' quad, affected lands, phys. features, operations, facilities	Geol. cross section, min., soil, and hydrology surveys	Blasting data, mining method, water quality treatment plants	Climate specifics	Vegetation and wildlife surveys	Proposed land use effects on adjacent land use	Explanation of critical areas effect	Land history and features Timetable
Wyoming	Topographic, affected lands, phys. features, operations, facilities, post reclamation topo.	Geologic map	Mining and reclamation methods		Vegetation and proposed	Present and proposed land use		Reclamation timetable
North Dakota	Topo (1:24,000) phys. features, operations, facilities	Geologic, hydrologic, and soil studies		(Water) tot. dis. sol. hardness, Na, Fe HCO ₃ , VO ₃ SO ₄ , Cl, pH, SAR.	Vegetative map	Premining, current and proposed land use		Archelological and historical survey
Utah	Topographic, phys. features, operations, facilities	Geological map, soil data	Mining and reclamation methods			Prior, current proposed land use, alternative use capability		Timetable

Table 4.1 (Contd.)

Sources	Location and Sur. Config.	Earth Sci. Data	Engineering Data	Technical Meas.	Biol. Sci. Data	Socioecon. Data	Legal Data	Misc.
New Mexico	Topographic, operations, phys. features, (pre- and post-mining)	Hydrologic and soil studies	Reclamation method	Climatological meas.	Wildlife and agricultural studies, revegetation inventory	Prior, current, proposed land use		Detailed timetables
Oklahoma	Description operations and reclamation extent				Revegetation schedule	Proposed land use		
SMCRA (proposed HR-2)	Topo(1:24,000), affected area, phys. features, operations, facilities, slope	Geologic (bedrock and surficial) map, hydrology survey	Mining and reclamation methods, maximum recovery potential, test, hazards, borings	Coal (unspecified claims of overburden and water), climate	None specified (implied vege- tation, habitat, R and E species, wildlife and animal dist.)	Premining and existing land uses, proposed uses and alter- natives, surface owner- ship	Steps to conform to AQ and WQ, steps to conform to LUP.	Timetable
CFR 3041 (preliminary plan)	Topographic, location of phys. features, operations, facilities.		Mining methods and scope, measures taken to control impacts				Steps to meet applicable laws	Brief description of current and known features of interest, timetable
CFR 211	Topographic, phys. features, operations, facilities, current oper. map	Hydrologic survey, geologic map cross section	Mining and reclamation methods	(Overburden) N, P, K, pH, p. conduct, Na and Na observe ratio; (water) dis. sol., susp. sol., climate	Vegetation survey, habitat, R and E species	Current land use capa- bility for alternative proposed use	Steps to meet applicable AQ and WQ laws	Timetable
BLM Planning System	Topographic or relief facilities operations	Soils, geologic and hydro. maps, mineral resource areas	AQ maps, fire hazard, erosion sus., hazards and nuisances	None specified climate maps	Vegetation, animal dist., habitat poten., ecol. qual.	Land owner- ship/current land use, state land use and controls; land quality (capacity), water needs, land manage- ment oppor- tunities, income employ- ment attitudes, sociocultural values, housing investment, ton base	Law Enforcement	

4.4 SETTING FOR INTEGRATED RECLAMATION/LAND-USE PLANNING MODEL

For the purpose of establishing a model for integrated reclamation and land-use planning, we will assume a state governmental organization with a planning agency that has both permit and enforcement authority. The agency may be an arm of a state agency, a separate regional board, or a local or county governmental unit. It would necessarily have wide enough jurisdiction to do significant integrated reclamation and land-use planning in the area of interest. The mere ability to set site-specific technical reclamation standards for mining without the concurrent charter to interact with the other aspects of land-use planning would not be considered a sufficient planning authority for the purposes of this report. No comprehensive land-use planning legislation is contemplated for this model, nor is any considered necessary.

4.5 STRUCTURE AND FUNCTION OF THE PLANNING MODEL

The model we suggest for integrated reclamation and land-use planning, and therefore the agency that actually accomplished the function, would have a tripartite structure. Disregarding necessary internal administration, this structure would consist of an executive or decision-making core supported by two branches, one devoted to gathering, storing, interrelating, and transmitting information, and the other devoted to utilization of this information in the development of alternative scenarios (Fig. 4.1). The decision-making process by which the alternative reclamation procedures, land-use mixes, and technical information from monitoring and research programs are blended into a useful reclamation and land-use plan is the planning process itself. It is perforce a reiterative process, relying heavily on feedback from all its component parts to operate. Of the feedback mechanisms, the most difficult to formulate effectively and also the most important to have operable is that of public involvement. This model attempts to include public involvement at all stages of its implementation in an open but structured fashion.

4.6 STRUCTURE OF THE DECISION-MAKING FRAMEWORK

As well as showing the framework of the model we are using in this report, Fig. 4.1 shows the infrastructure of the executive section of the model, that sector responsible for decision-making in the integrated reclamation and land-use planning system. The array of boxes and arrows should not deter the reader. They are designed to illustrate the direction and type of information transfer; many of the different functions would be accomplished by a single office or individual in a small mining reclamation project.

Problem Definition

The problem definition stage of decision-making is the crucial, complex, initial stage of the process. The definition of the problem embraces the proposed surface mining and reclamation as well as ongoing mining operations, lease renewal, planning for reclamation of abandoned operations, and protection of potential mine sites where reserves are known. The definition should include all foreseeable problems to be addressed by the planning process, such

Fig. 4.1. Structural Framework of the Decision-Making Process Suggested as an Integrated Mined-Area Reclamation and Land-Use Planning Model

as community growth, change of land uses, and the public needs served by the mining and the proposed land uses. The need for professional planning capability should be quite evident at this stage.

4.7 BACKGROUND AND RESEARCH

This stage of integrated reclamation and land-use will be the most time-consuming and expensive stage of the effort. As part of the background, historic land uses of the areas should be established and the potential of the land for other uses assessed. Even in rural areas where grazing and farming are the only uses of the land to date, a simple selection of those uses will generally not be adequate for reasonable planning purposes. Climatic variations, hydrologic, and geologic conditions, engineering properties, and social, economic, and political variables should all be considered in detail and all should have information on file for use in the planning process. A detailed examination of the technical requirements for reclamation and land-use information will not be attempted in this report. There is considerable conflict in the literature as to the necessary extent of information required for reclamation (12). A brief summary of data needs explicitly or implicitly contained in the texts of selected references on reclamation of lands, surface mining, and land-use planning and mining activity is given in Table 4.2.

Several common elements in the suggested data needs in the literature and the requirements from different state and federal regulations indicate data collection directions that may be taken by most integrated reclamation and land-use planning programs. These elements include:

1. Depiction of most data on large-scale (1:24,000 or larger) topographic base maps.
2. Time sequencing of mining and reclamation and historic time-series of data such as climatic variations.
3. Planning agency creation and analysis of land-use data.
4. Compilation and analyses of pertinent legal material.

As well as gathering technical information, decision makers at this stage of the planning process should receive direction from advisory panels on the legal setting of potential land-uses on reclamation plans, on the technical direction of the mineral developers, on state or federal programs that could influence the area (e.g., Critical Environmental Areas or Parklands), and on economic influences.

Public involvement in the integrated reclamation land-use planning process should extend beyond the simple establishment of public hearings (13). Proposals, reclamation, and land-use plans should be drawn up in an understandable format and presented to both general and special segments of the public in a forum in which the public will be able to make useful contributions to the plan. Much of the preservation of the way-of-life aspect of land-use planning will emerge from public involvement in the planning process at an early stage.

Table 4.2. Suggestions from the Literature as to the Extent of Mined-Area Reclamation Data Needs Summarized by General Technical Areas

Source	Location and Sur. Config.	Earth Sci. Data	Engineering Data	Technical Meas.	Biol. Sci. Data	Socioeconomic Data	Legal Data	Misc.
Behrens and Bauer	Location slopes	Hazards, permeability, engineering and soil properties				Land use		
Ahearn	Topographic, slope drainage							
Ballou						Assessed valuation tax rates		
Friz (1970 & 1975)	Topographic, drainage	Geologic (bed-rock and surficial), mineral resources and deposits, isopacks of overburden	Status of new mining, dust, noise, meteorological			Political boundaries, population dist., supply/demand maps, land uses, econ. analyses, aesthetics	Zoning bound	
Grim & Hill	Topographic or aerial survey	Stratigraphy, weathering characteristics, hydro. and soils surveys	Physical properties of overburden.	Water pH, total or pyritic S, neutralization potential, toxic levels of Fe, Zn, Cu, Na, shortages of essential nutrients	Overburden ability to support plant life			
Packer		Soil productivity and stability	Precipitation amount/dist.		Suitability and availability of local vegetation types			

Table 4.2 (Contd.)

Source	Location and Sur. Config.	Earth Sci. Data	Engineering Data	Technical Meas.	Biol. Sci. Data	Socioeconomic Data	Legal Data	Misc.
EPA (Coal Mining)				(Water) pH, total & dis. FE, total Mn, total susp. sol.				
EPA (logging)		Geologic map, soils survey, surface erosion hazard, mass wasting hazard, recovery poten- tial of land, stream recovery potential, flow and channel stability	Climate	Temperature dissolved O ₂ , nutrients, chemical avail.				
EPA (Technology Transfer)	Extent of affected area, topo.	Geologic map, soils survey, hydro. studies	Type of opera- tion, site preparation, mining reclama- tion, abandonment.		Vegetative map	Land use anal.	Compliance with state, local law	Schedule of events
EPA	Aerial photo, topographic.	Geologic and hydrologic maps, soil survey, erosion hazard.				Health and sanitation records	General comprehen- sive, policy plans, subdivision maps, zoning, floodplains, spec. dists., comms., brds.	Assessors policy, transportation studies, capital improve- ment programs
Franch	Resource evaluation					Urban growth plan, supply/ demand anal.	Relevant legal control	

Table 4.2 (Contd.)

Source	Location and Sur. Config.	Earth Sci. Data	Engineering Data	Technical Meas.	Biol. Sci. Data	Socioeconomic Data	Legal Data	Misc.
Poyser et al.		Soils survey, overburden, analysis	Climate		Vegetation inventory, animal use.			
HUD/CPD						Population, employment, land use plan, housing impacts, economics of financing changes, public service plan.		
Dames & Moore	Multiscale	Geologic studies, hydro. and soils surveys, cross section (extensive detail).	Engineering properties of materials	Air Quality meas. of C, H, O, N, S, P, Cl, As, other toxic elements.	Vegetative comm. (biomass map), wildlife habitat, R&E species, classification of fisheries, terrestrial and aquatic ecol.	Land use (onsite and adjacent), cultural unique- ness, diversity, recreation access, quality, local/ state tax base revision, health dist. of income, transportation, employment, services demand.	Local plans.	Cultural, archeo., historic sites; land, features (visual)
Thurrow et al.	Topographic (aerial photo) slope maps, flood inunda- tion maps.	Geol. hazards, hydro. maps, sedimentation and soils surveys.			Vegetation and wildlife inven- tories, habitat			

4.8 PLANNING AND COORDINATION

The hub of the decision-making process is the stage of planning and coordination. At this stage the background and research material, advice from the various panels and from the public, technical information from the information system, scenario options from the scenario support branch, impact information on the scenarios, and general planning expertise are blended together into a series of optional reclamation/land-use subplans. This series of optional subplans may range in number, from one to many. One option only might be expected when a planning choice is clear -- for example, when obvious hazards exist. Many options could occur if several economical levels of mining were possible and if the area has many potential land uses. The output of this stage should be a careful description of the possible land-use and reclamation options and their potential impacts. It should include the no-action alternative and should be in a format capable of wide distribution and comprehension. Costs and benefits should be documented whenever possible as decisions made at this stage may bear the brunt of attacks in the courts if they are to be forthcoming.

Option Selection

The options chosen will be the parts and segments of reclamation and land-use plans and will require deep public involvement and clear public notification. Some method of showing the results of public feedback should be included in the process.

Implementation

Implementation will involve primarily the publishing of a land-use plan and regulations that apply to various aspects of the plan. Reclamation practices required, activities permitted under the plan, and levels of activities allowed without permitting would be set out. Any legal institutions necessary for this implementation should be developed at this stage. Sanctions for violations of the plan should be developed and put into effect. Enabling legislation and zoning ordinances, where applicable, should be enacted. Most of the legal framework is anticipated to be in place in many states and modifications and adaptations will be necessary only during the initial implementation. Any public funding necessary for completion of the program should now be approved.

Permits for surface mining would issue at this point. Permits for prospecting for other exploration should also issue after this kind of analysis, but streamlining of the process should be accomplished so as to minimize the adverse effects of delay on this nonrenumerative and, generally, low impact activity.

Monitoring and Enforcement

These two active stages of integrated reclamation and land-use planning may be effected by any level of government from local to federal. A

model for a federal/state/regional/local cooperative program may be found in the Pennsylvania program for sediment control (14).

Future Development

The integration of reclamation and land-use planning should help to minimize adverse effects of postmining development on the mined area. A planner would have to be naive to believe that a plan or planning process could omnisciently provide for all possible occurrences. However, continued attention to the development of the resources of the area should leave the public and the government in a good position to anticipate many changes and to respond in a rational manner to unexpected changes.

4.9 SCENARIO DEVELOPMENT

The purpose of developing a set of scenarios for reclamation and land-use planning purposes is that of answering "what if?" questions before irretrievable commitments to courses of action are made. The scenarios are groups of optional courses of action along with anticipated impacts of those actions. The development of scenarios allows a public look at a wide range of possible actions and potential impacts. It should allow focusing of public attention on problems that will ultimately rely upon public solution for their resolution. The alternatives selected by this procedure should take into account social, economic, environmental, and political information as well as the technical data directly applicable to the mining activity. Thus, differences between varied interest groups will be delineated and exposed to the political process for resolution before final decisions are made.

The process of developing scenarios can be complex, detailed, and computer-assisted (Fig. 4.2) or, at the other extreme, it can be a rather rudimentary "eyeball" of the results of activities. The suggested model (Fig. 4.3) is relatively simple in concept, although it incorporates most of the major elements of the more complex scheme. A brief description of the elements of the scenario development procedure is given in Appendix A.

4.10 INFORMATION SYSTEMS

The detailed exposition of the types and varieties of information systems appropriate for integrated reclamation and land-use planning is quite outside the scope of this report (15). It is probable that no single system is appropriate to all the varied conditions that present themselves in a mined-area-reclamation/land-using-planning context. It is certain that some states will (or have) selected different information systems on which to base their mineral resource management and land-use planning. Additionally, several federal agencies (e.g., BLM) are developing land-use management systems (16), and the Office of Surface Mining (OSM) in the Surface Mining Control and Reclamation Act (SMCRA) is charged with a similar task for surface-mine reclamation support (17).

Detailed Flow Diagram for a
Scenario Development Process
Proposal for a Dade County,
Florida, Water Quality
Management Program

Fig. 4.3. Simple Scenario Development Framework

Whether the information system utilized is manual or automated, simple or complex, it should have the following three properties in order to adequately support mined-area reclamation and land-use planning:

1. It must be able to record and store the basic data concerning the land and its physical and environmental features and processes, the mineral resources and their extent and value, and the social aspects of the areas.
2. The information system or the staff using the system should have the capability to develop overlay maps at appropriate scales to display the basic information. (Derivative maps obtained by combining or operating on the basic data would also be an important but optional part of the proposed information system.)
3. The system or support staff should have the ability to perform impact analyses of potential courses of mining and reclamation activity on the elements of a land-use plan. Recognition of the impact of activities on different critical aspects of an area's environment and social pattern should help to focus public attention during the stages of public involvement in the decision-making process.

The information system should be established to support the decision-making process; thus content and format should be determined by the needs of that process. The system can be designed solely for mined-area reclamation or may be part of a larger system with more comprehensive planning aspects. It may be possible or even imperative for future reclamation land-use planning efforts to tie into a federal information system, such as that being developed by BLM, one under the direction of OSM, or another with the synoptic view and resources to sustain planning over a broad area.

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5 ANALYSIS

The justification of resource planning is the recognition and solution, or avoidance, of societal problems in resource development. The degree to which integrated reclamation and land-use planning can solve problems is still an unknown factor, but these problem areas exist and the effect of no planning on exacerbating them is evident everywhere. We take the position that integrated reclamation and land-use planning will be beneficial to society but that some of the specific areas of benefit are difficult to detail in advance.

5.1 AVOIDANCE OF LITIGATION

A reasonable land use-plan should provide the rationale by which governmental regulatory action is justified and upheld; the very cost of attacking a thoroughly developed plan will certainly deter most frivolous attacks.

The returns from integration of land-use planning and mined-area reclamation may include quite large effects on society, but these returns may be difficult to measure and to lay out against more tangible cost figures, such as the cost of reclamation or even cost/benefit analyses of opportunity losses. The benefits from the integrated program may not be easily recognizable as benefits, except in a what if no planning scenario. Thus, program continuity may demand continuing public education on the hazards of nonplanned mining and reclamation.

5.2 FEDERAL ROLE

Conflicts between state prerogatives in land-use planning and the federal ability to apply money and manpower to the process should not be lightly dismissed. Institutional barriers to integrated reclamation and land-use planning should be lowered wherever possible by grant programs, technical assistance, cooperative planning efforts, and careful wording of federal regulations.

Complicating the state/federal roles in integrated reclamation/land-use planning programs is the problem of information formatting. Scale, accuracy, standards, types of data representation grid and cell sizes, and many other format problems need resolution before cooperation can be complete between state and federal agencies or between states. Technical assistance in this effort by the federal government may be the only feasible route for resolving these conflicts.

The establishment of data distribution nets would also aid in the development of more uniform criteria for mined-area reclamation and land-use planning. This task also seems one for which the federal government has the necessary expertise and broad interest.

Methodological studies of integrated reclamation and land-use planning compose a third area where a strong federal interest could be beneficial. In order to prevent a constant reinvention of the reclamation wheel by the separate

states, the federal agency should air in technology transfer from state to state the merging of different programs with each other and the development of new techniques in response to technological changes and the emergence of new problems.

5.3 CONCLUSIONS

The advantages of land-use planning in surface mine areas will accrue to both the mining industry and the local or regional populace. If mined areas are reclaimed to satisfy specific local or regional land-use needs, it is likely that these areas will be of greater value to the community and the mining company than if they were simply reclaimed to satisfy the minimum legal requirements with no consideration of marketability or future community needs. One important aspect of land-use planning in mine areas is that the condition of the land prior to mining may not be the optimum condition to which it can be reclaimed. In actuality, many surface mining operations present opportunities for improvement over premining conditions (LaFevers, 1977).

For the mining industry to create landscapes that will be of the greatest benefit to the community, a need exists for input to the reclamation planning process from local or regional land-use planners. In many cases, public sector planners could provide information on future land-use needs, development criteria, and other factors that could be used in developing marketing strategies for reclaimed sites. Traditionally, however, such input has not been forthcoming. Neither the mining industry nor the planning community has been effective at interacting with one another. For the most part, industry views reclamation as an unprofitable undertaking and has avoided the public planning community for fear that interaction might become mandatory. On the other hand, the planners have generally ignored mining operations until after the fact. Numerous examples exist of areas where abandoned mine sites have been incorporated into revised land-use plans. It is much more difficult, however, to find sites at which public sector planners had input to the postmining use of the site before the mining was conducted. There are several reasons for this lack of input: Planners have no mandate to become involved in such activities, and traditionally they do not have the background for creating new landscapes ex nihilo.

We have suggested a model structure by which a local, state, or regional governmental group could institute a process of integrated mined-area reclamation and land-use planning. Although we do not envision the necessity of massive legislative assistance for this implementation, the authors recognize the need for some modification or adaptation of existing statutes. This legal requirement plus some regional resistance to land-use planning, even by local governmental bodies, could prove a formidable institutional barrier to the concept. In the near term, the development of an amicable working relationship between industry and planners will help to ensure the designation of a higher land-use potential for mined areas. Mine personnel should realize that local planners can provide them with valuable information that can be used to create marketing strategies and to fulfill the development potential for their mined sites. Similarly, public sector planners must make an effort to help mine operators create landscapes, from mined areas, that will be of great benefit to the community. A cooperative attitude by both groups will be the

foundation for achieving land-use planning objectives in the immediate future and for fostering more formal structures within which both industry and society can clearly perceive and attain their needs and goals.

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APPENDIX A

SCENARIO DEVELOPMENT

A.1 LAND USE PLANS

The scenario development scheme assumes that a comprehensive land-use plan for the area exists. If this assumption is not true, such a plan can be developed by this process, and the initial land-use plan would then merely serve as a rough first draft. In general terms and on a practical basis, the plan would outline the uses prescribed for the mine site and surrounding area. While the land use plan would serve as a guide for the different activities selected as options for purposes of scenario development, activities suggested by the mineral developer, the public, or planning staff that modified it would also receive consideration. The land-use plan could exist as a single map showing the information at an appropriate scale, or as a series of computer derived overlays depicting residential, commercial, industrial, public facility, transportation, and other elements of the area's plan, or in other formats.

A.2 PROPOSED RECLAMATION

The proposed reclamation plan will be the trigger that sets the scenario development process in motion. In order to function effectively, reclamation plans should include a number of optional courses of activity. One such course is no reclamation -- generally an unacceptable course, but one which might be allowable if further mining was contemplated or if that condition would serve the approved land use. Other courses of action could be no mining activity, reclamation to substantially the premining condition, or reclamation with specific preplanned goals (such as creation of agricultural areas, parklands, or lakes).

The importance in our suggested model of developing practical scenarios with which rational planning decisions can be made emphasizes the need for public involvement in the consideration of options at this stage. As mentioned under an earlier section, public involvement should be an active process in which assistance from different sectors is encouraged and serious attempts are made to integrate feedback into the scenario development process.

Also supporting the Proposed Reclamation stage is information concerning critical impacts of the proposed plan. In a sophisticated automated planning system such information might be the first order effects of the proposed reclamation plan on known resources of the areas (e.g., areas specifically designated for agriculture, parks, recreation, or residential construction), or predictable effects on certain rare and endangered species (such as the California Condor), or tangible economic gains or losses, or creation of natural hazard conditions. In an automated information system that was programmed to produce overlays depicting elements of a land-use plan, these impacts might appear as additional overlays, derivative maps, or modifications to those already existing.

In a manual system, a series of hand-overlay base maps should exist as a basis for the land-use planning for the area. The suggested reclamation plan can be compared to this series and reasonable estimates made of the

critical impact. In any planning system from the most simple to the most complex, it will be necessary for the critical factors of an area to be well known and for the processes affecting these factors to be understood. The current regulations and environmental legislation are replete with lists of some of them (18). The task of the planning agency that desires to utilize this model will be to sort out the applicable factors, to analyze the potential impacts of change on them, and to design information system components and displays that illustrate the impacts to the planner and to the public.

A.3 DEVELOP OPTIONS

This stage is the structured formal version of the process of study, analysis, and development described previously. With all sides heard from, alternative courses of action will be chosen that are intended to satisfy the needs of both the mineral developer and society. While this stage, for the sake of brevity, is conceptually an executive one, the choices will again face public scrutiny when they are passed back to the decision-making body; thus any public fears of being cut out of the planning process should be allayed.

A.4 MAJOR IMPACTS

Analysis of the options developed previously must be undertaken with respect to the land-use plan existing for an area. Although most critical factors should have been spotted in the earlier stages, some options may have potential for disturbance of air and water quality standards that were not immediately apparent. For example, mining effects may not be acceptable to established nondegradation policies for an affected State Park area, or strong secondary effects, such as growth potential, may turn out to be equally unacceptable for some prime agricultural areas. This stage is conceived of as a filter, testing the options developed for major flaws, passing on those that do not have unacceptable drawbacks, and returning the infeasible ones for modification or rejection.

A.5 SCENARIO DESIGNATION

A group of alternative courses of action (options) (19) will comprise scenarios for mining and reclamation integrated with land-use planning. These scenarios and their carefully analyzed potential impacts are the tools that the planning and coordinating stage will use in setting an overall program for the areas. As such, they should contain a reasonable breadth of courses of action and indicate as wide a potential for results as is feasible within staffing, budgetary, and time limits.

FOOTNOTES

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1. This statement is not intended to imply that such an act weakens the overall thrust of mine reclamation in Alabama. Conceivably, a situation could arise in which a state action might be required to override a scattering of nonuniform and ineffective local programs.
(11)

2. The extent of variation is illustrated by a selected sketch of agencies that have a land-use planning function related to activities other than surface mining. For state wetlands programs, seven states listed in a recent report have responsibilities delegated to: State DNR, State DEP, Coastal Resources Management Council, Marine Resources Commission, and a Department of Ecology. The annual budgets for these programs ranged from \$15,000 plus salaries to more than \$300,000. Additionally, separate agencies handled land-use planning aspects of: Wild and Scenic Rivers Programs, Coastal Zone Management Programs, Critical Areas Programs, Surface Mining Reclamation, and other special purpose programs. (Information/Data Handling Requirements for Selected State Resource Management Programs, Technical Supporting Report C, for the U.S. Department of the Interior, Office of Land Use and Water Planning and U.S. Geological Survey, Resource and Land Investigations Program, Tables 1, 7, 11, and 14). Additionally, some states, such as Montana, have special land-use agencies charged with preparing or overseeing the development of state land-use plans (84 Montana Rev. Code 7501 et seq, 1975).
(24)

3. The San Francisco Bay Conservation and Development Commission set up to regulate the filling in of San Francisco Bay has served as a model for the development of the California Coastal Zone Commission (California Pub. Res. Code Sec. 27000 et seq) after having its authority upheld against a home rule challenge in the California Courts (*People ex rel Younger v. City of El Dorado*, 5 Cal. ed 4;80, 98 Cal, Rptr. 553, 487 P. 2d 1193, 1971). The Lake Tahoe Planning Commission, the Metropolitan Planning Council of Minneapolis-St. Paul, the Hackensack Meadows Commission, the Adirondacks Park Planning Commission, and others are all viable, if sometimes beleaguered, organizations.
(24)

4. *The Friends of Mammoth v. Board of Supervisors*, 8 Cal. 3d 1, 104 Cal. Rptr. 16, 500 P. 2d 1360, extended the application of the California Environmental Quality Act to approval of subdivision plans, an extension not generally thought about before the litigation.
(25)

5. The history of NEPA, which was treated at first as a mere requirement for reporting but evolved into detailed substantive investigations of potential projects, is most instructive on this point. (Anderson, 1974).
(25)

6. N. Williams, *American Planning Law*, Vol. 5, Supra at Sec. 161.03.
(25)

FOOTNOTES (Contd.)

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7. *Surface Mining Control and Reclamation Act of 1977*, 30 USC § 1201 et seq;
(26) P.O. 95-87; 91 Stat 485; August 1977; hereinafter SMCRA, Sec 508(a)(2-3).
The section concerning reclamation plans treats the information on geology, hydrology, and the extent of ore deposits in the same manner as the information on the use of the land and the impact of the operation on that potential use. However, the first categories are predictive, judgmental, and based on events in adjacent areas as well as in the area under study. Thus, a broad planning familiarity is assumed of the collector and reporter of the information.

8. See e.g., the *Montana Surface and Underground Mine Reclamation Act*,
(26) Montana. Rev. Stat. 50-1042 et seq., which is a strong technical act with a fairly strict five-year period of responsibility for successful reclamation. The Colorado Mined Area Reclamation Act, Colo. Rev. Stat. , 34-32-115(4)(f)(II, III, IV), does not utilize performance standards for reclamation in the same fashion as the Montana Act and, while establishing a five-year basis for completion of reclamation, allows greater flexibility in adapting the reclamation period to proposed land uses.

9. The analysis of Montana's Surface Mine Reclamation Statutes by which
(26) the Department of the Interior found them to be as strict as the federal counterparts did not consider the sections which related to land-use planning (41 Fed. Reg. 39037). If the federal land-use planning requirements still apply to the federal lands, periods of responsibility set up under these provisions could conflict with periods set up under state law on adjacent lands.

10. The SMCRA does not abdicate the federal land-use planning responsibility
(26) under either the Coal Leasing Amendments (P.L. 94-377, 90 Stat. 1083, USC 201-209) or the Federal Land Policy and Management Act of 1976 (P.L. 94-579, 90 Stat. 2743, 43 USC 1701-82), thus the same conflict is possible as exists under present law.

11. Blakely, J. W., *One Ton of Coal Produces One Ton of Paper*, Coal Age,
(26) Vol. 13 (June 1976).

12. A 1974 publication points out semantic problems at the core of
(31) defining technical information requirements. Under *rehabilitation criteria* the authors point out that ". . . Discussion of the problems of rebuilding disturbed land is further confused by vague terminology used to describe the concept of landscape reconstruction." They go on to define three types of rehabilitation we would include under the general aegis of integrated reclamation and land-use planning: restoration, implying that the conditions of the site at the time of disturbance will be replicated after the action; reclamation, implying that the site is habitable to organisms that were originally present or others that approximate the original inhabitants; and rehabilitation, implying that the land will be returned to a form and

FOOTNOTES (Contd.)

12. productivity in conformity with a prior land-use plan including a stable (Contd.) ecological state that does not contribute substantially to environmental deterioration and is consistent with surrounding aesthetic values. National Academy of Sciences, *Rehabilitation of Western Lands*, Balinger Publishing Company, Cambridge, Mass., 1974, pp. 10-11.

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12. Packer, P., *Rehabilitation Potentials and Limitations of Surface Mined Land in the Northern Great Plains*, U.S.D.A., Forest Service, General Technical Report INT-14 (1974).
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- U.S. Department of Commerce, *Development of Pre-mining and Reclamation Plan Rationale for Surface Coal Mines*, Vol. 1 and III, Legal Controls of Surface Mining, Dames and Moore, Denver (n.d.).
13. See e.g., Environmental Protection Agency, *Public Participation Handbook for Water Quality Management*, W.Q.M. Guide 6-65-02 (June 1976).
(31)
14. The Pennsylvania DER has developed a voluntary program with counties and districts to develop and implement sediment control programs in response to Pennsylvania's Clear Waters Act. The local government has the option of doing inspection or not, in lieu of DER, and of doing the enforcement or not, County DA vs. state sanction. SCS (USDA) serves as a technical advisor at most stages of program development.
(36)
15. See e.g., IGU Spatial Data Inventory (others).
(36)
16. Quote FS and BLM act program.
(36)
17. SMCRA of 1977, 94th Congress, 1st Session, HR-2, § 201(c)(8).
(36)
18. Cf. SMCRA of 1977, 95th Congress, 1st Session, HR-2 § 522 (designating areas unsuitable for surface coal mining), which requires knowledge of the nature of fragil or historic lands with important historic cultural, scientific, and esthetic values [§ 522(a)(3)(B)], of renewable resource lands and water supplies for them [§ 522(a)(3)(C)], and of natural hazards [§ 522 (a)(3)(D)].
(46)
- See also, the restrictions on surface mining within the National Park System, the National Wildlife Refuge System, the National System of Trails, the National Wilderness Preservation System, the Wild and Scenic Rivers System, National Recreation Areas, on National Forest Lands and on certain other federal areas [§ 522(e)].
- See also restrictions on mining on state park and recreational lands [Colo. Rev. Stat. , 34-32-115(4)(f)(II,III,IV)].
- See also Environmental Protection Agency, *Locational Controls for Water Quality in Legal and Jurisdictional Approaches to Water Quality Management Planning and Implementation*, Chap. III (March 1977).

FOOTNOTES (Contd.)

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18. *See also Council of State Governments, State of the Art for Designation of*
(Contd.) *Areas of Critical Environmental Concern*, 1-3, Lexington, Ky. (Dec. 1974).

19. Options may include such obvious courses of action as no mining, mining
(46) of a limited number of multiple seams, mining of limited areas, mining
schedules, and reclamation methods, timing, and purpose. It may also
include such elements as modification of facilities, reservation of
certain areas for future mineral development, declaration of critical
environmental areas or areas of unique or statewide concern, or the
formation of new political entities to cope with burgeoning problems.

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