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0121 Strip Mining

Colorado Legislative Council

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Report to the Colorado General Assembly:

STRIP MINING

COLORADO LEGISLATIVE COUNCIL

RESEARCH PUBLICATION NO. ~~113~~ 121

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OF THE

COLORADO GENERAL ASSEMBLY

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The Legislative Council, which is composed of five Senators, six Representatives, and the presiding officers of the two houses, serves as a continuing research agency for the legislature through the maintenance of a trained staff. Between sessions, research activities are concentrated on the study of relatively broad problems formally proposed by legislators, and the publication and distribution of factual reports to aid in their solution.

During the sessions, the emphasis is on supplying legislators, on individual request, with personal memoranda, providing them with information needed to handle their own legislative problems. Reports and memoranda both give pertinent data in the form of facts, figures, arguments, and alternatives.

STRIP MINING

Legislative Council

Report To The

Colorado General Assembly

Research Publication No. 121
December, 1966

COLORADO GENERAL ASSEMBLY

LEGISLATIVE COUNCIL

ROOM 341, STATE CAPITOL
DENVER, COLORADO 80203
222-9911 - EXTENSION 2285

November 29, 1966

To Members of the Forty-sixth Colorado General Assembly:

In accordance with the provisions of House Joint Resolution No. 1024, 1965 regular session, and Senate Joint Resolution No. 6, 1966 session, the Legislative Council submits for your consideration the accompanying report and recommendations relating to strip mining activities and problems in Colorado.

The committee appointed by the Council to conduct this study made its report and recommendations to the Council on November 28, 1966, at which time the Council approved the report for transmission to the members of the Forty-sixth General Assembly, first regular session.

Respectfully submitted,

/s/ Senator Floyd Oliver
Chairman

FO/mp

COLORADO GENERAL ASSEMBLY

LEGISLATIVE COUNCIL

ROOM 341, STATE CAPITOL
DENVER, COLORADO 80203
222-9911 - EXTENSION 2285

November 29, 1966

Senator Floyd Oliver, Chairman
Colorado Legislative Council
Room 341, State Capitol
Denver, Colorado

Dear Mr. Chairman:

Your committee appointed to carry out the studies requested by House Joint Resolution No. 1024, 1965 regular session, and Senate Joint Resolution No. 6, 1966 regular session, relating to strip mining activities and problems in Colorado, submits herewith its final report and recommendations.

Programs for the general preservation of surface soil were reviewed by the committee, which concluded that as long as industry continues to meet a basic program of reclamation, there is little need for the General Assembly to enact legislation to require that which is already being done. The committee believes, however, that the Coordinator of Natural Resources should review the reclamation activities of the coal industry during 1967 and report the results to the second regular session of the Forty-sixth General Assembly.

Respectfully submitted,

/s/ Senator Sam T. Taylor,
Chairman
Committee on Strip Mining

STT/mp

FOREWORD

Pursuant to the provisions of Senate Joint Resolution No. 6, 1966 regular session, the Legislative Council appointed the following committee to continue its study relating to strip mining activities and problems:

Sen. Sam T. Taylor, Chairman
Rep. Bill Gossard, Vice Chairman
Sen. A. Woody Hewett
Rep. T. Everett Cook
Rep. Joseph V. Calabrese
Rep. W. E. Foster
Rep. C. J. Gillaspey
Rep. George Jackson

House Joint Resolution No. 1024, 1965 regular session, called for a study of the "...need for legislation to guarantee that sound reclamation practices be required in the process of strip mining minerals, in order to protect the scenic beauty of the state, eliminate water pollution, and encourage soil conservation." This study was continued by Senate Joint Resolution No. 6, 1966 regular session, with expansion of the study to include the general preservation of surface soil.

The committee held three meetings in Denver and one in Craig, Colorado. The latter meeting enabled the committee to gain first hand understanding of major coal stripping operations and the problems it presents, and provided the committee with an opportunity to view the accomplishments of the coal industry with respect to restoration of stripped land under the voluntary agreement.

Space does not permit listing the large number of representatives of the coal industry, representatives of conservation groups, state and county officials, and other interested persons, who took time to provide the committee with consultation and advice during the course of the study. The committee wishes to take this opportunity to express appreciation for all this help and cooperation.

Assisting the committee in the study were Jim Wilson of the Legislative Reference Office and Dave Morrissey of the Council staff.

November, 1966

Lyle C. Kyle
Director

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On April 16, 1965, a program for the voluntary reclamation of coal strip mines in Colorado was initiated through a memorandum of understanding between the Coordinator of Natural Resources and three major coal strip mining firms -- Energy Coal Company, Pittsburg and Midway Coal Mining Company, and Peabody Coal Company. At the time final consideration was being given to this voluntary agreement, House Joint Resolution Number 1018 was introduced in the Colorado General Assembly, calling for a study of the "...need for legislation to guarantee that sound reclamation practices be required in the process of strip mining minerals, in order to protect the scenic beauty of the state, eliminate water pollution, and encourage soil conservation."

The 1965 interim study of the Committee on Strip Mining concentrated on problems posed by the coal stripping industry. In particular, the committee was concerned with the extent of the reclamation program to be carried out under the voluntary agreement, and in August of 1965, the committee visited Routt County -- the site of three major coal strip operations. This field trip enabled the committee to gain first hand understanding of reclamation problems presented by coal strip mining. Since a major portion of the reclamation program undertaken by the coal industry involved the seeding of spoil banks, the committee believed that results of test plantings conducted by the industry could not be evaluated until the summer of 1966. For this reason, the committee requested continuation of the study, and the recommendation subsequently was approved by the General Assembly in the 1966 session.

The committee visited the coal strip mines in the Craig area again in August of 1966, and, for the most part, members were pleased with the results of the voluntary agreement in achieving a basic reclamation program, despite an unusually dry year which hampered growth of the test plantings. Although various species planted appeared to be doing well in late summer, a question remains as to whether all varieties of vegetation will survive the winter of 1966-67.

What is Strip Mining?

Strip mining simply means the process of extraction of minerals by removal of the overlying earth or rock strata (overburden) and is commonly referred to as "surface mining." The term "open pit" mining frequently is used interchangeably with strip mining; however, open pit mining more commonly applies to quarry type operations in which there is little overburden in relation to the minerals extracted. Another characteristic of open pit mining is that the mineral is extracted from a given site over an extended period of time. For example, copper and iron ore mines have been in operation for as long as a half century. The strip mining of coal, on the other hand,

usually is of short duration because coal seams are relatively thin -- two to five feet on the average.

Basically, there are two types of strip mines: 1) "area" or "boxcut" mines and 2) "contour" mines. The former type is practiced in the three major strip areas in Colorado. Area type mines or boxcut mines are found on more gently rolling terrain. A trench is dug exposing the coal seam, and the overburden is piled to one side. As each cut or trench is made, the overburden is deposited into the preceding cut making rows and rows of spoil piles or ridges. Since there is no overburden to place in the final cut, a trench remains with a vertical highwall. Unless reclamation practices are instituted and the final cut is graded, or in moist climates water is allowed to collect in the trench, a vertical highwall of up to 100 feet remains.

Contour stripping is characteristic of extremely hilly regions and is a common form of mining in the Appalachian coal fields. Often times a coal seam follows the contour of a hill and it is economically feasible to remove a portion of the overburden covering the outcrop of the coal seam. In other words, an excavation is made into the side of a hill, creating a terrace known as a "bench". The coal seam is exposed and the coal is mined until a point is reached when removal of the overburden involves too great a cost to justify continued mining of the seam. Operations may cease either when the seam is exhausted or vertical highwall extending above the bench exceeds 100 feet. Of course, the size of highwalls may increase in the future as industry is able to employ larger equipment. The overburden removed in a contour operation simply is dumped down the adjacent slope.

When removal of the overburden is no longer feasible in a contour operation, occasionally augers are employed to remove the coal from a seam. An auger resembles a giant corkscrew and literally drills the coal out of a seam. An auger may reach depths of up to 200 feet. A serious drawback to auger mining is that as little as 20 per cent of the coal is recovered from a seam, while in most area strip operations it is possible to recover 100 per cent of a coal seam.

Appalachia

In recent years a great deal of national interest has focused on strip mining activities in the Southern Appalachian Mountains extending from Alabama to Pennsylvania. The region is characterized by rugged hills and dense forests, and average rainfall approximates 45 inches per year. These hills are striated with valuable seams of coal which have been mined by underground methods for many decades. The underground mining practices, however, did not recover the valuable outcrops of coal from 50 to 75 feet wide which had been left intact to stabilize the hills so that the minerals deep inside could be recovered by conventional tunnel-and-pillar mining. Contour

mining has been employed as a device for extracting these remnants of the coal veins. In order to mine these outcrops in a contour method, an operator only needs a couple of bulldozers, a power shovel, an air compressor, a pneumatic drill, and hauling equipment. The overlying earth and rocks are blasted and a bulldozer pushes the shattered overburden down the adjacent steep slopes. In this way, a sheet of coal several feet thick and 40 to 50 feet wide may be exposed in a relatively short period. This is the type of mining that has caused so much concern in the Appalachian regions.[1]

Problems Posed by Contour Mining

Contour mining in Appalachia creates a number of disturbances not only to land in the mining areas, but adjacent lands and bottom lands in the agricultural valleys. As previously mentioned, slashing a ridge along the contour of a hill coupled with the practice of dumping spoil down the adjacent slope creates not only an ugly scar, but poses a problem of erosion, landslides, stream siltation and pollution, and flooding. For instance, as the excavation is made into the hillside and the overburden is pushed down the steep wooded slopes, the vegetative cover is destroyed both in the mine cut and where the overburden is dumped. Under these conditions, the hillside previously protected by forest growth is a potential source for stream siltation and even flooding. This is particularly important in a region in which the average annual rainfall is 45 inches.

Also, unless protective measures are taken, the creation of benches on a hillside may actually add to problems of erosion and flooding. For instance, as a contour strip operation develops, the size of the bench increases and the spoil material gradually builds up on the outer shoulder of the bench above the downslope. Thus a depression is formed between the highwall and the shoulder of the bench. The depression in the bench forms a natural catch basin for heavy rain. Unfortunately, as the depression fills with water, low-points in the shoulder of the bench tend to focus direction of the water, accelerating the process of erosion.[2]

Perhaps the most serious problem presented by contour stripping involves mining of unusually steep hillsides in which normal or usual reclamation practices have little chance of success. Area type stripping, on the other hand, presents few problems of erosion and stream siltation. The unvegetated spoil banks are, of course, subject to wearing in the same manner as the talus dumped down the slopes of contour mines, but the relatively flat land coupled with the depressions at the bottom of spoil ridges tend to

1. Caudill, Harry M., Night Comes to the Cumberlands.
2. Study of Strip and Surface Mining in Appalachia, Report of the Secretary of Interior to the Appalachian Regional Commissioner, page 18

catch and hold the water and sediment. Minimum efforts of grading easily seal off the depressions preventing erosion or washouts at the end of spoil ridges.

Extent of Coal Stripping in Appalachia Compared to Colorado

The coal mining region of Appalachia constitutes about 183,000 square miles,[3] a little less than twice the size of Colorado (104,000 square miles). There are seven large coal producing states in Appalachia -- Alabama, Kentucky, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. The population of these seven states totals over 37,000,000.[4] A vast urban population also exists in the neighboring states, and the demand for coal for production of electric power to serve this population in the Appalachians far exceeds the comparable market for coal production in Colorado. Federal estimates reveal that in Appalachia about 31,000 acres of new land are disturbed by coal stripping activities each year.[5] In comparison, based on the first six months of 1966, Colorado's Coal Mine Inspection Department reports that 95 per cent of the coal stripping activities in the state account for about 100 acres of overturned land per year, a little less than three tenths of a per cent of the amount of acreage currently being disturbed in Appalachia.

As the population of the Rocky Mountain Region expands and in view of the fact that potential sources of hydoelectric power for the metropolis of California have been about exhausted, there is evidence that the demand for Colorado coal will increase. Coal production costs, however, must remain competitive with other types of fuel, in particular, atomic power for the generation of electricity. Regarding future development of Colorado's coal stripping activities, the State Land Board reports that as of October of 1966, approximately 73,000 acres of State School Lands are under lease for future coal stripping activities.

Reclamation or Restoration of Strip Lands

Complete restoration of strip lands involves returning the land surface to the condition it was in prior to the strip mining

3. Ibid., page 10.
4. Statistical abstract of the United States 1964, U. S. Department of Commerce, page 11; estimated population for 1963.
5. Op. cit. page 17.

activity. In other words, if the land were utilized for row crops, 100 per cent restoration would call for grading the mined area to the original contour and restoring the soil for planting of crops similar to those sustained prior to surface mining. On the other hand, basic reclamation criteria developed by a federal interagency team, includes the following objectives:[6]

1) control of physical and chemical quality of the water draining from the strip mine area;

2) soil stabilization;

3) elimination of health and safety hazards;

4) conservation and preservation of mineral resources;

5) providing for usability of reclaimed lands and water courses; and

6) restoration of aesthetic values.

In achieving the aforementioned objectives, two basic programs must be adopted: 1) grading the mined area, at least to the degree in which the surface may be utilized; and 2) revegetation of the turned over land. Briefly, revegetation is the least expensive of the two programs and appears to be the least controversial aspect of reclamation. Revegetation is recognized as an essential element of reclamation by both conservationists and coal industry spokesmen.

Vegetation of Strip Mines. The vegetation of strip mine areas has been carried on far more extensively than grading. Costs of vegetation depend on spoil bank conditions and survival rates of species planted. The acid condition of the soil (pH factor below 4.0) in strip mines in the Appalachian region poses a problem in many instances in that vegetation cannot be sustained. Either an expensive program of chemical treatment must be initiated to achieve plant growth, or the soil must leach out over a period of years. In Appalachia, reforestation is possible because of the heavy rainfall. A federal study of costs of forest plantings range as high as $106 per acre. For the most part, grasses and other legumes are planted at costs of between $25 and $45 per acre, with an average of $33 per acre for 5,843 acres studied. In general the cost of grass seed is about $7.00 per acre, soil conditioner $12 to $13 per acre and sowing about $15 to $20 per acre, with a total of $35 to $45 per acre. Soil testing and preparation may cost an additional $30 to $40 per acre. In summary, federal estimates for an effective program of vegetation in Appalachia range from $30 per acre up to $300 per acre in areas where acid or toxic spoils must be treated.

6. Study of Strip and Surface Mining in Appalachia, Report of Secretary of Interior, page 24.

Grading -- Key Factor in Cost of Reclamation. Estimating average costs for reclamation programs is exceedingly difficult. Each coal strip site may pose special problems, and based on experiences in Appalachia, the costs of reclamation of contour strips exceed expenses for area type mines. To a large extent, reclamation costs depend on the extent of grading necessary to accomplish land use objectives. For instance, area strip mined lands may be restored for grazing purposes (little grading is necessary to make the land useful for grazing) at far less cost than land which is reclaimed for row crops. In the latter event, the land would have to be graded to original contours in order that the site could be traversed by farm machinery. To accomplish this end, complete backfilling, as required under certain conditions in some states, probably would be necessary.

Although average grading costs are not too meaningful, the following excerpt from a recent federal publication may be helpful:

"In Pennsylvania, 108 projects in the bituminous coal fields involved 3,736 acres in 21 counties, and cost a total of $1.8 million. The average cost per acre was $486. About 47.4 million cubic yards of earth were moved at an average cost of $.38 per yard. The cost per acre was high in Pennsylvania because the state requires extensive grading. In West Virginia, 22 projects for which grading costs could be obtained involved 269 acres ranging from $7 to $315 per acre, with an average of $71. For 94 projects in Ohio, an average grading cost of $75 was reported. This figure represents grading conducted by the state in the past when only $100 per acre was available from bond forfeitures for all reclamation, including vegetation. Revisions in the Ohio law have since increased the bonding requirements to $300 per acre."[7]

Because of the lack of information on grading, the federal report also developed a hypothetical example of grading expenses. It was assumed that grading spoil on a contour bench would require that the spoil be backed against the highwall to a height of at least ten feet in order to cover the exposed seam of coal. The bench also would need to be covered to a minimum of three feet and graded to low points every quarter mile to allow for development of drainage channels. Grading on this basis would cost about $200 per acre or ten cents per yard. On the other hand minimum grading of area lands effectively entraps silt and sediment and could be accomplished for as little as $100 per acre.

Average Industry Expenses for All Reclamation. A survey of coal industry expenditures in Appalachia for all reclamation performed reveals that costs were reported averaging $131 per acre in Maryland to $361 per acre in Pennsylvania. The average costs in Kentucky, Maryland, Pennsylvania, Ohio, and West Virginia in 1964 was $302.

7. Ibid., page 43.

In Appalachian states without legislation, little reclamation was reported by the coal industry according to the federal study. Business Week also has reported on the costs of strip mine reclamation and its impact on coal operators. For example: "...In Western Pennsylvania, Harmon Creek Coal Corp., a medium sized operator, last year spent $640 per acre to reclaim 50 acres that yielded 322,000 tons of coal. Rising labor costs boosted reclamation expenses to about 10 cents per ton from 8.5 cents in 1962. ..." This particular operation is mining a four foot thick coal seam on gently rolling terrain which reduces the over-all reclamation costs.[8]

The reclamation costs of a small operator mining a two foot seam ran from 30 to 35 cents per ton according to Business Week. This particular mine recovered only two-thirds as much coal as the aforementioned example and needed twice the acreage to accomplish extraction of this amount of coal. This is a clear example that efficient operations are in a far better position to perform reclamation than marginal mining activities.[9]

According to the federal Appalachia study of strip mining, reclamation is more easily accomplished on nearly level area-strip lands. Boxcut mines are less costly to reclaim than contour stripping, and the federal study reported that in the event a slope exceeds 28 degrees, reclamation efforts were unsuccesssful in each case. In the opinion of the federal appraisal team, about 72 per cent of the strip sites examined were in need of additional reclamation work, indicating a need for expanded research and wider application of existing knowledge. In some states, reclamation simply consists of nothing more than planting trees and grasses. Although this practice restores the natural beauty to some degree, the federal study questions the adequacy of these programs. In particular, added attention needs to be given to safety hazards; erosion; and water quality control.[10]

One particular concern of the federal study team is the need for authority to prevent strip mining in areas where reclamation is not practicable. It was the concensus of the federal field appraisal team that reclamation efforts in the coal-producing states of Appalachia have been only partially successful because of: 1) the failure to recognize water quality control; 2) the extremely steep terrain, particularly in Eastern Kentucky; 3) lack of authority to prevent mining where reclamation is impracticable; 4) absence or inadequacy of legislation in some states; 5) inadequate knowledge to meet solutions to problems; and 6) variations in enforcement.[10]

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8. Business Week, "Strip Mining Heals Its Own Scars," November 13, 1965, page 144.
9. Ibid., page 146
10. Study of Strip and Surface Mining in Appalachia, page 29.

Integration of Reclamation With the Mining Process

The cost of reclamation conducted by the coal industry in the process of mining is far less than the costs of moving in equipment and reclaiming land long after the mining operation has ceased. In other words, if reclamation is integrated with the actual mining process, the costs of reclamation in these circumstances is minimized. An integrated plan for reclaiming strip mines has been employed in Germany for many years. A four step approach is used: 1) pre-planning of future land use; 2) soil management and restoration by surface mining equipment; 3) reforestation or agricultural cultivation of the new land; and 4) setting up of a permanent program of land use for agriculture and recreation. Reclamation is regarded as an integral part of mining; hence laws in Western and Mideastern Germany require the pre-planning of reclamation.[11]

Strip Mining Laws and Court Decisions

The West Virginia legislature enacted the first reclamation statute in 1939. This act called for the reclamation of sand, clay, and coal mines and quarries. The most recent legislation applicable to strip mines includes the complete revision of the Kentucky Strip Mining Act and adoption of a coal strip mining law by the Virginia legislature. Both of these laws were enacted in 1966 sessions. Historically, there is no question that strip mining laws have been enacted to meet problems posed by coal surface mining. Kentucky, Maryland, Ohio, Pennsylvania, and Virginia strip mining laws apply to the coal industry only. Indiana's law applies to coal, clay, and shale, while the laws of Illinois and West Virginia now apply to all minerals. Initially, the Illinois act was limited to strip mining but the act was found unconstitutional.

Northern Illinois Coal Corporation v. Medill. The Illinois Supreme Court, in Northern Illinois Coal Corporation v. Medill (1947), 72 N.E. 2d 844, 397 Ill. 98, held a coal strip mine law unconstitutional on the grounds that the act singled out the coal industry and did not apply to other mining activities creating the same problems as those posed by the coal industry. The Illinois General Assembly originally adopted an "Open Cut or Strip Mining Act" -- House Bill Number 527 -- in 1943.[12] This act concerned itself with only one aspect of strip mining, that is, back filling or leveling of coal surface mining operations. This provision is spelled out in section 1 of the act as follows:

11. Knobe, Wilhelm, Ohio Journal of Science, "Methods and Results of Strip-Mine Reclamation in Germany,"
12. Illinois Session Laws of 1943, Vol. I, page 912.

"Any person, firm, corporation or association engaged in 'open cut' or 'strip' mining in which the soil over or covering any bed or strata of coal is removed shall spread such soil so that the contour of the land is approximately the same as before the mining operation was begun. Such levelling operations shall be done progressively following the opening of each new open cut or strip so that no more than three spoil ridges shall be left unlevelled behind the actively used open cut for coal removal. When the mining of coal on any tract of land is completed, the remaining spoil ridges shall be levelled by the operator before leaving the tract with his or its machinery used for that purpose; provided, however, that the operator shall not be required to totally fill the last open cut where the adjacent spoil ridge will not fill such cut."

There are at least two serious failings with respect to the content of this original Illinois strip mining act. The first omission is that the act in no way indicates the reason for requiring coal operators to level the spoil banks. The act does not indicate whether this is a measure to protect the public health or safety or a conservation measure. Secondly, the act is not a reclamation act. There is no provision for vegetation or restoration of the land. Thus, levelling, by itself, may not be conducive to providing the best means of restoration.

In Northern Illinois Coal Corporation v. Medill, the court held:

"Conceding the plenary power of the legislature to enact laws for the preservation of the public health, it does not appear that the act here involved was intended to accomplish that purpose. The act requires the coal strip-mine operator to restore the property to approximately the original contour. If the land originally contained ponds or swamps, presumably they too must be restored. Furthermore, the act permits the leaving unfilled of the final cut, if the adjacent spoil ridge will not fill it, and yet this final cut is the chief place where the pools of water collect. If the legislature was attempting to remedy the evil of mosquito and bacteria breeding ponds, the act does not so indicate. If intended as a measure to protect health, the act should have been directed against the evil which threatens to introduce sickness or disease. The rights of property cannot be invaded under the guise of a regulation for the preservation of health when such is clearly not the object and purpose of the regulation... ."

The court conditioned the aforementioned statement by pointing out that if the act clearly spelled out the need for the requirement on the basis of public health, the constitutionality of the act might have been upheld.

"...If the act required the elimination, by draining or filling, of all ponds or pools of water left behind in the strip mining process, it might reasonably be assumed that it was intended

for the protection of the public health, but the requirements of the present act do not appear to have a reasonable relation to that purpose."

The attorney supporting the validity of the act contended that the legislature as a conservation measure may determine the chief economic value of the land which is to preserve the land for cultivation -- the legislature may make a choice between cultivated or row crops. The court pointed out that there was no mention of this in the legislation and concluded:

"...the restoration of the land to its original contours is not conclusive that it will be suitable for cultivation of row crops. The evidence indicates that most of the acreage presently being strip mined is marginal land, suitable only for intermittent cultivation, and some is submarginal and not susceptible of cultivation. Restoration of such land to its original contours will not make it suitable or valuable row-crop land. As in the case of the public health contention, the method here employed does not bear any reasonable relation to the object sought, if we assume, as appellant does, that object to be the creation of lands suitable for row-crop farming. Secondly, the State has no authority, under the guise of a conservation theory, to compel a private owner, at his own expense, to convert his property to what it considers to be a higher or better use. ..."

Finally, the court concluded that act was discriminatory against the coal companies:

"But even if the act were valid as a measure designed to protect the public health, or as a conservation measure, it is fatally defective as an unreasonable discrimination against coal strip-mine operators. This court has repeatedly held that where statutes are enacted in the exercise of the police power, only those statutory classifications are valid which are based on reasonable grounds of distinction with reference to the object of the legislation. ... If the public health is endangered by changing the contours of the land so that pools of water will form, then anyone who so changes the contours is menacing the public health, whether he is removing coal, clay, stone, sand or gravel. Similarly, if the object desired is the conversion of land to 'row' crop cultivation, then any person who so changes the contours as to make such cultivation impossible is acting contrary to the public policy and should be ordered to desist. There is no reasonable ground for distinguishing between the strip-mine operator who mines coal and any other strip-mine operator, when considered with reference to the object sought to be attained, whether that object is public health or conservation of 'row' crop land. It is the method of mining employed, not the nature of the product removed, which produces the undesirable result from a health or conservation standpoint, and the object of the legislation is to prevent the use of that method. The act, by attempting to distinguish between operators on the basis of the mineral produced, thereby sets up

an unreasonable classification and is, for that reason, invalid. ..."

In viewing the discriminatory aspects of the Illinois Act, it must be pointed out that the act failed to spell out the characteristics of the coal industry which necessitate legislation applying to this industry. Also, an act limited to mere grading does not attempt to meet the problems posed by strip mining of coal. This contention of the Illinois court was not supported in a Pennsylvania Supreme Court case handed down the following year.

In 1961, the Illinois General Assembly enacted legislation to include all open pit mining. (Section 93-180.4, Illinois Annotated Statutes, as amended) The law provides that all operators engaged in open cut mining, in an area where the overburden exceeds 10 feet in depth, must first obtain a permit. The law provides for grading under certain conditions, vegetation, etc.

Dufour v. Maize. One year after the Illinois decision, the Supreme Court of Pennsylvania ruled on the constitutionality of limiting strip mining legislation to bituminous coal. The court upheld the constitutionality of Pennsylvania's "Bituminous Coal Open Pit Mining Conservation Act." The Pennsylvania legislature adopted the "Bituminous Coal Open Pit Mining Conservation Act" in 1945. Briefly, the act provides for the backfilling of strip mines within one hundred feet of the boundry of any public highway, and within 225 feet of any occupied dwelling unless released by the owner.

In Dufour v. Maize (1948) 56 A2d 675, 358 Pa. 309, the Pennsylvania Supreme Court did not support the contention of the coal industry that the act was special legislation and unconstitutional. In part, the court held:

"We can find no sound basis for plaintiff's objection to the classification made by the act. ... 'Legislation for a class distinguished from a general subject, is not special, but general; and classification is a legislative question, subject to judicial revision only so far as to see that it is founded on real distinctions in the subjects classified, and not on artificial or irrelevant ones, used for the purpose of evading the constitutional prohibition. If the distinctions are genuine, the courts cannot declare the classification void, though they may not consider it to be on a sound basis. The test is not wisdom, but good faith in the classification.

"...The record in this case shows that the strip mining of the bituminous coal produces certain results not produced by the drift or deep mining methods of recovering such coal. The pit mining method produces a spoil bank over all of the surface mined. It creates an irregular surface which affects its utility for the production of fruits of the soil. In many cases the spoil bank contains material which is not only unsuitable for agricultural use,

but which washes into streams and upon adjoining property. This method is also invariably used in the vicinity of deep mines. There is danger of flooding such mines, which either causes them to be abandoned or necessitates the pumping of the water therefrom. This water is invariably acid, and when it reaches the streams of the Commonwealth it is destructive to fish and various aquatic life, and in some cases ruins sources of water supply utilized by individuals and communities. There is also a danger of cutting into a deep mine and thereby interrupting the ventilating systems with attendant danger to the miners there employed. Also, this method of producing bituminous coal always leaves exposed, at the foot of the high wall, a vein of coal. This coal may be ignited by intent or carelessness and burn into a deep mine, causing great expense, loss and destruction of natural resources. The mining of other materials by the stripping method does not produce all of these results. It does produce a spoil pile, but no evidence has been produced of any case where there was water in a cut, where the operation adjoined a deep mine, or where a vein of coal was left exposed at the bottom of the cut. Consequently in this type of mining there is not the same danger of fire, flooding or interruption of ventilating systems of deep mines, as exists in the strip mining of bituminous coal. Also, anthracite coal has a higher combustion point than bituminous coal. These are substantial and real differences which, in our opinion, justify the classification made by the act. It may be true, that other evils exist in the strip mining of other products which should be corrected by the legislature. However, a start has been made, and there is authority for the proposition that when an evil is conspicuously in need of correction, action may be taken, although other evils exist which are not corrected."

The strip mining of anthracite coal is covered under a separate act. The provisions of the anthracite coal act are similar to the bituminous coal act.

Reclamation Standards. The General Assembly of Kentucky adopted the most stringent strip mining law of any state in 1966.[13] In particular, the Kentucky act requires complete backfilling of all area strip mines as well as reduction and backfilling of highwalls of contour strip mines. With respect to the contour mines, the steepest slope of the reduced or backfilled highwall and of the outer slope of the fill bench must not be greater than forty five degrees from horizontal; provided that if the highwall is composed of solid rock and not suitable for vegetative cover, modification of this requirement may be made. Backfilling also is required under Pennsylvania's "Anthracite Strip Mining Act." All pits 100 feet or less in depth must be completely backfilled, and pits exceeding 100

13. Kentucky General Assembly, Regular Session 1966, House Bill No. 36.

feet in depth must be backfilled to a degree determined by the land restoration board. However, if a pit is within 250 feet of any dwelling or 100 feet of a right-of-way of any highway, the pit must be backfilled completely.[14]

Indiana and Ohio laws require leveling of ridges to a rolling contour or topography; the Illinois Statute provides for the grading of ridges adjacent to highways to a 10 foot width at the top; the Maryland act also requires leveling of spoil peaks to permit planting of vegetation; and the West Virginia law provides that reclamation deposit of $150 per acre satisfies the requirement set by the conservation district.

Bonding requirements also are contained in all state laws for reclamation. Pennsylvania law provides "...The bond shall be at the rate of five hundred dollars ($500) per acre, unless it has been determined by the secretary that a bond in excess of five hundred dollars ($500) per acre is required. The bond shall not be less than five thousand dollars ($5,000) and shall be accompanied by an annual report..."[15] Bond requirements of other states follow:

State	Minimum Bond Required
Kentucky	$2,000 minimum and $100 to $500 per acre
Illinois	$200 per acre with $1,000 minimum
Indiana	$1,000 plus $200 per acre
Maryland	$2,000 minimum and $500 per acre
Ohio	$1,000 minimum and $220 per acre
West Virginia	$1,000 minimum and $150 per acre
Virginia	$2,500 minimum and $75 per acre

In summary, state reclamation laws usually require a permit to engage in strip mining, execution of a performance bond to insure completion of reclamation activities, reports on extent of operations, and grading and revegetating of affected areas.

Colorado's Voluntary Agreement

In April of 1965, the three major coal strip operators in Colorado -- Energy Coal Company, Pittsburgh and Midway Coal Mining Company and Peabody Coal Company -- entered into an agreement with the Coordinator of Natural Resources. This memorandum of understanding is voluntary and by no means binding upon coal strip operators in Colorado. A copy of the agreement is continued in Appendix A.

14. Pennsylvania Statutes, 52 § 681.11.
15. Pennsylvania Statutes, 52 § 681.8.

Under the memorandum of understanding, the coal industry has complete latitude to determine the best method of reclamation, the degree of reclamation needed, and whether reclamation is feasible at all. Specifically, Provision IV B of the agreement provides:

Provision IV B -- "On any affected land whose chemical and physical characteristics are toxic, deficient in moisture or plant nutrients or composed of sand, gravel, shale, or stone to such an extent as to seriously inhibit plant growth, planting shall be held in abeyance for a period of ten (10) years after the mining is completed. If, during this ten (10) year period, natural weathering and leaching of such affected lands fails to remove the toxic and physical characteristics inhibitory to plant growth the affected land will be considered unplantable."

In order to insure the success of the voluntary program in the years ahead, the Coordinator of Natural Resources, in conjunction with the various resource agencies concerned with problems of strip mining, will need to keep abreast of new procedures and activities of strip mining in the state to insure that the memorandum of understanding meets reclamation problems that may arise. For example, where vegetation or basic reclamation is not feasible (in areas of extremely steep slopes or where spoil is highly toxic or unplantable) strip mining may need to be discouraged.

With industry bearing the entire cost of a reclamation program, consideration also needs to be given to economic costs of reclamation. Marginal operations simply can not be expected to provide the degree of reclamation under a voluntary agreement that the more prosperous mine operations are able to accomplish, suggesting that if coal strip operations in the state continue on a rather limited basis, and only the most profitable seams developed, the greater the likelihood for continued cooperation on the part of industry.

Classification of Strip Mine Spoils

Strip mine reclamation in the Eastern United States has provided valuable reclamation research on tree planting and vegetation of mine spoil banks, and as a result adequate growth can now be established under many different soil conditions. There are indications, however, that additional study is needed for soil stabilization and water quality control. A recent report in the Ohio Journal of Science also suggests the need for developing a national system of classifying strip mine spoils with respect to pH factor (acidity or alkalinity), stoniness, and slope. Classification of spoils with respect to vegetation would provide information as to possible land utilization. For instance, cropland is limited to spoils in which toxic material and stones are buried, the surface is leveled, the topsoil is returned, and slopes do not exceed 12 per cent. Under these conditions the land use and conservation practices needed are the same as for the original soil type. On spoil material that has a pH factor of 5.5 or more, has been graded, is not stony, and has

slopes of more than 12 per cent, the land could be used for hayland. Under these conditions seed mixtures similar to those used for ordinary agricultural land may be used, but preferably at slightly higher rates. Where the surface is stony, such land or soil is limited to pastureland, woodland, wildlife, or recreational uses. When the pH factor can be corrected to 6.0 or 6.5 by the application of lime, a seed mixture of orchard grass, broome grass, or timothy with alfalfa can be used. Soils with a pH factor below 4.0 are not considered suitable for hay or pastureland.

With the exception of work conducted by the coal mine industry in conjunction with the Colorado State Forest Service, very little information is available concerning vegetation of mine spoils of the arid West. It is interesting to note that mine spoils in the West tend to be alkaline, while in the Eastern United States an acidic condition exists. For these reasons, the State Forester is requesting additional funds to establish a research program involving a study of the feasibility of vegetating all mine spoils in the state, that is, the vegetation of surface mine areas and the mine dumps of underground mines. The following excerpt of a budget request prepared by Tom Borden, State Forester, illustrates the need for research of the problems of establishing plant growth on mine spoil:

"Little research has been conducted to determine methods to establish plants on the mine-spoil dumps of Colorado that may remain barren after many years of exposure. Grubb (M. S. Thesis, 1965) studied methods to reclaim the mine tailing spoils at Climax. A preliminary examination of oil shale residues at Anvils Point near Rifle (Ray Cogburn, Garfield County Agent, Glenwood Springs) and with coal strip mining wastes near Steamboat Springs (Scott Brundage, Peabody Coal Co., and K. Kilborn, Colorado State Forest Service) have been made. Limited preliminary investigations have been conducted on wastes from other isolated locations. No systematic research program has been established to investigate the possibility of plant colonization of mine spoils of Colorado in relation to the physical and chemical properties of the spoils, the climatic environment and the topographic features. Such a research program is needed in order to establish general procedures required to vegetate the many kinds of spoils scattered throughout the state.

"Fertility analysis of a few isolated mine-spoil areas has shown that the wastes range in pH from strongly acid (pH 3) to strongly akkaline (pH 10). The salt content may be so high that few plant species will grow on them without reclamation. Soil fertility analysis has shown that most of the waste materials are low in available plant nutrients. Some spoil materials may contain radioactive materials.

"Physical properties of the mine waste material varies greatly, also. The texture ranges from silt and clay material, through sands to gravels and even large boulders. The water-holding capacity and aeration characteristics of such materials are important to the maintenance of plant growth.

"Colorado differs considerably from the eastern United States where extensive studies have been conducted with strip mine spoils. Most of the eastern spoils are acid and are in climatic zones of high rainfall which favors the establishment of plants. Some mine spoils in Colorado are located where rainfall is less than 10 inches annually and a few spoils are located in areas where rainfall is over 17 or 18 inches.

"Research is needed to characterize the mine spoil debris resulting from the various mining operations in Colorado. This includes processed as well as non-processed residues. After the mine spoils are characterized, methods to grow plants on the spoils will be determined. This will include the investigation of physical and fertility treatment and the use of adapted and tolerant species required to establish plant cover on the spoil or to screen the area under the various environmental conditions of Colorado where mine spoils occur.

"The general research plan consists of three phases: first, a survey and mapping of the mine spoil areas of Colorado; second, physical and chemical analysis of selected types of mine-spoil materials; third, studies of methods to colonize or to screen typical classes of spoils with plants. The plan in more detail follows:

1. The mine-spoil areas in Colorado will be surveyed, mapped and categorized: (a) by location and type of operation, including whether chemically processed or not; (b) size, topography and slope of spoil; (c) time of exposure to weathering; and (d) climatic environment. The survey will include a summary of attempts to reclaim mine spoils in Colorado and a literature review of studies conducted elsewhere. This phase of the project may require 6 to 12 months.

2. Physical properties significant to plant growth on the mine spoils will be determined. This will include temperature characteristics of the spoil as related to color and slope, water-holding and drainage properties, and susceptibility to wind and water erosion.

3. Chemical properties of the spoil material will be determined. The fertility status will be evaluated by chemical soil tests and greenhouse experiments. In addition, identification of possible toxic substances or conditions will be made. These include excessive acidity, alkalinity, or salinity, or the presence of ions toxic to plant growth.

4. Plant species that will grow in the mine-spoil residues will be determined. This will involve first, the minimum physical and chemical treatment

required to grow plants in controlled environments (greenhouse and/or growth chamber) and secondly, the treatment required to grow the plants under conditions as they exist at the site, with and without aging. Plant species to be investigated include those adapted as well as species new to the area. Emphasis will be placed on species that come nearest to meeting the recommended use for the spoil area.

5. Spoil materials in Colorado will be classified as to type of treatment required to colonize or to screen with various species in relation to the climatic environments at the site of the spoil."

In order to carry out the aforementioned program, the State Forester is requesting additional funds in conjunction with the Agronomy Department of Colorado State University:

Item	1st Year	2nd Year	3rd Year	4th Year	5th Year
Agronomist	$ 11,000	$ 11,770	$ 12,594	$ 13,476	$ 14,419
PERA	660	706	756	809	865
Technician	6,500	6,955	7,442	7,963	8,520
PERA	390	417	447	478	511
Operating expense	6,250	4,800	6,720	7,100	7,100
Capital outlay	2,500	2,500	2,000	1,000	-
	$ 27,300	$ 27,148	$ 29,959	$ 30,826	$ 31,415

Surface Mining of Minerals Other than Coal

Sand and Gravel Industry

On May 25, 1966, the Committee on Strip Mining met with representatives of the sand and gravel industry, as well as local planning officials, to review problems posed by the surface mining of sand and gravel. In Colorado, the sand and gravel industry represents a $20,000,000 [16] per year industry. Sand and gravel is a basic material for the construction of homes, churches, schools, surfaced highways, commercial buildings, dams, etc. Sand and gravel is truly a local industry since the nature of the product and the economics of transportation require that the industry be located in close proximity to markets. At the May 25 meeting, it was pointed out to the committee that the base cost of sand and gravel of $1.00 per ton increases from five to six cents for each mile transported. Thus the price of gravel doubles for every 17 miles transported. [17]

The supply of sand and gravel in the Denver area is rapidly being depleted through urban development. For example, the highest grade of sand and gravel deposits in the metropolitan area are found along Clear Creek. Originally some 330 million tons were available; [18] over 200 million tons have been lost to urban development. The total value of sand and gravel deposits lost in the Denver Metropolitan area exceeds the entire assessed valuation of Jefferson County. Of the known remaining deposits of sand and gravel in the Denver Metropolitan area, approximately 100,000,000 tons are located in the water impoundment area of the Chatfield Dam. If the sand and gravel deposits of the Chatfield Dam are not conserved, the known reserves in the Denver area will be exhausted in ten years. Although sand and gravel is in abundant supply outside of the area, the cost of sand and gravel will skyrocket with the increase in transportation costs.

As pointed out by Lee Wolsey, Arapahoe County Planning Director, a threefold problem is presented by sand and gravel mining:

1) need to protect known deposits of sand and gravel from encroachment of urban development;

2) sand and gravel operations may be in conflict with or incompatible with surrounding uses (for example, the noise, dust, traffic, etc., of a sand and gravel operation often conflicts with residential surroundings); and

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16. Annual Report, 1964, Colorado Bureau of Mines.
17. "Minutes of Meeting," Committee on Strip Mining, May 25, 1966
18. Sand and Gravel Resources, Inter-county Regional Planning Commission.

3) following completion of a sand and gravel operation, reclamation of the area is needed. With this in mind, Mr. Woolsey presented the following remarks to the committee:

"...Within one-half hour's drive from this building (State Capitol) it is possible to see the scars of sand and gravel excavation and the resulting deterioration of surrounding properties. Too often the land owner, having realized an income from the sale of sand and gravel, writes off the property as unusable. Pits where wet operations have been conducted become an attractive nuisance for children. All of us are aware of the tragedies that occur in these areas. Dry operations initially become a source of dust and, at best, become overgrown with weeds which contribute to respiratory ailments and general discomfort in the neighborhood. All too often the worked-out pits are converted into dump grounds which provide excellent breeding places for vermin. From studies that have been done it is obvious that the land can be reclaimed and can, in fact, become a valuable asset to the community. But, in order to accomplish this, plans must be developed and approved before excavation begins. Assurance must be given government that the plans will be executed and restoration will be completed. We are all aware of the problems and the potential solutions, but it is up to the legislature to delegate the authority to provide local control to assure that there is a conservation of sand and gravel deposits, that there can be utilization of these deposits and that restoration proceeds in an orderly fashion to eliminate the problems that we have experienced in the past." [19]

As pointed out by J. K. Smith, Director of the Inter-county Regional Planning Commission, there is no specific legislation authorizing local government to require sand and gravel operators to comply with minimum standards for the reclamation of sand and gravel mines. However, sufficient authority for the control of new sand and gravel mining activities may exist under the general zoning powers of the county commissioners. This authority, of course, would not provide a means for enforcing reclamation standards on existing gravel operations. Nevertheless, Mr. Smith recommended that local government be given an opportunity to provide for the regulation of sand and gravel mining under existing zoning laws.[20]

Enforcement of health, safety, and reclamation standards by local zoning authorities could be accomplished through a permit and bond system. As a condition for obtaining authorization for sand and gravel mining, an operator must file a bond to insure compliance with the county zoning resolution. Forfeiture of the bond results in the event an operator fails to meet the standards outlined in the resolution.

19. "Minutes of Meeting," May 25, 1966, Appendix B.
20. Ibid., page 5.

Oil Shale

The Green River Formation of oil shale is located in a 16,500 square mile area, covering parts of Colorado, Wyoming, and Utah. There are 2,592 square miles of the Green River Formation in Colorado containing some of the thickest and richest seams in the entire formation. The Green River Formation is by far the world's largest known reserve of oil shale, containing approximately two trillion barrels of oil or about 60 per cent of the principal known reserves.[21] Table I lists countries with the principal known reserves. Approximately 90 per cent of the oil shale reserves of the United States are owned by the federal government.[22]

The production of oil shale was achieved as early as 1838 in France. The current free world production of oil shale is approximately three to four million long tons. Total world production is estimated at 45 to 50 million long tons. The largest producers are China, U.S.S.R., and Sweden. Sweden entered into oil shale production during World War II when petroleum was needed to supply the country's fishing fleet. The production of oil shale in Sweden has continued under government aid.[23]

Processing of Oil Shale. Heating is the only known commercially feasible method of extracting oil from shale. The solid organic substance in oil shale, known as kerogen, decomposes at about 900 degrees fahrenheit, forming oil (Colorado's Green River Formation may yield an average of 25 gallons per ton at mineable sites), a gas, and spent shale. Separation of oil from shale may be accomplished by a surface retort or by an underground procedure known as the "in-situ" method. Present indications are that surface retorting will be used in the initial development of the shale oil industry. To supply a surface retort, underground mining (room-and-pillar method) or surface mining may be employed. Surface retorting provides some serious reclamation problems. The spent shale or residue constitutes a volume almost as great as the original oil shale. Since the spent shale is pulverized to a large degree during the crushing and retorting processes, a tremendous dust problem also

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21. Geological Survey reported in Mineral Facts and Problems, Bureau of Mines, U. S. Department of Interior, 1965 edition, page 638.
22. Remarks made by the Commander O. R. Butterfield, U.S.N. to Third Symposium on Oil Shale, Quarterly of the Colorado School of Mines, Volume 61, 1966.
23. Oil-Shale Mining, Rifle Colorado, 1944-56, Bureau of Mines, U. S. Department of Interior, Bulletin 611, 1964.

TABLE I

ESTIMATES OF THE MAJOR KNOWN SHALE-OIL RESOURCES OF THE WORLD IN OIL SHALES ASSAYING 10 GALLONS PER TON OR MORE

Country or area	Oil in place, million 42-gallon barrels	Per Cent of total
Brazil	800,000	23.95
Burma	2,000	.06
Canada (Albert shale in New Brunswick)	50,000	1.50
China:		
Fushun, Manchuria	2,100	.06
Other deposits	26,000	.78
England	1,000	.03
Germany, West	2,000	.06
Sicily	35,000	1.05
Luxembourg	700	.02
New Zealand	560	.02
Republic of the Congo	100,000	2.99
Scotland	580	.02
Sweden	2,500	.07
Thailand	800	.02
United States:		
Colorado, Utah, and Wyoming	2,000,000	59.88
Central and Eastern States	200,000	5.99
U.S.S.R:		
Estonia and adjacent Leningrad Area	22,000	.66
Other European U.S.S.R.	13,000	.39
Siberia	80,000	2.40
Other*	1,930	.05
	3,340,170	100.00%

* Countries having less than 500,000,000 barrels omitted in table but included in total.

Source: Geological Survey, reported in Mineral Facts and Problems, Bureau of Mines, U. S. Department of the Interior, 1965 edition, page 638.

exists. In any event, disposition of spent shale coupled with a minimum reclamation program of mined areas presents a significant cost factor in shale oil mining.

In the distant future, shale oil mining may be attempted on a surface basis. Since the overburden in some areas of the Green River Formation is close to 1,000 feet deep, with the shale deposits another 2,000 feet thick, the surface mining of shale would be a tremendous undertaking.[24]

The residue problem of shale oil mining could be resolved through a system of underground retorting. Since shale is not porous like sandstone, the heating of shale alone will not release the oil in a manner in which it can be collected in pools. However, through the use of nuclear explosives, it may be possible to fracture the shale in such a manner that the in-situ process of retorting is feasible. The fracturing of the shale would enable the oil to be collected in a pool or well and be pumped to the surface.

In summary, the economic processing of shale oil has not been solved. In particular, a number of conservation problems are facing the shale oil industry. The shale oil beds contain additional known or potential mineral and nonmineral resources. Among these resources are surface land use, ground water, subsurface oil and gas, and sodium minerals. Strip mining and disposition of spent shale could cause severe disruption of agricultural uses, aesthetic values, wildlife habitat, and recreation. Improper mining practices also could waste large amounts of oil shale, adversely affect the extraction of other minerals, and create problems of air and water pollution. Caving of underground mines also could pose a problem for surface use and safety. The experimental mines at Rifle with ceilings up to 75 feet have already experienced three roof cave ins.[25]

24. Op cit., Mineral Facts and Problems, page 642
25. Op. cit., Oil Shale Mining, Rifle Colorado, 1944-56, page 134.

Summary and Committee Recommendations

In the past few years, coal surface mining in the Southern Appalachian Mountains has received nationwide publicity because of the extensive scarring of these mountains through contour mining activities. Accompanying the loss in aesthetic values surface mining activities have contributed to problems of soil erosion, stream pollution, stream siltation, landslides, and flooding. All in all, the worked out strip areas of Appalachia tended to contribute to the loss in value of adjacent properties, the destruction of fish in streams, the siltation of bottom lands reducing their value for farming purposes, etc. With these problems in mind, the committee embarked on a study of strip mine conditions in Colorado with a view towards preventing a similar occurence in Colorado.

Briefly, a number of basic differences exist between conditions in the coal strip areas of Appalachia, particularly the "contour" mine areas of Eastern Kentucky, and the so-called "area" strip mines in Colorado. A contour mine follows the outcrop of a coal seam around the sides of a mountain or steep slope. The coal seam is exposed by simply blasting or bulldozing the overburden down the slope of the mountain, with the result that vegetation is destroyed not only where the cut is made into the coal seam, but also the area of the slope below the seam. According to federal studies, reclamation of contour mines is much more expensive than restoration of area mines. Past experience shows that in the event a slope exceeds 30 degrees, normal reclamation practices have little chance of success. The mine wastes dumped down the sides of steep slopes are extremely conducive to erosion. Drainage from these mine areas in Appalachia often is high in acid content, with the result that streams may be polluted as well as laden with silt.

"Area" type mines on the other hand are found on relatively flat or rolling terrain. A trench is dug and the overburden piled to one side. The spoil banks are subject to erosion, of course, in the same manner as contour strips; however, the bottom of the spoil piles are much more likely to hold sediment and water than the steep slopes of contour mines. Minimum grading of area-type mines seals off the spoil ridges to a degree that erosion, stream pollution, etc., can be prevented.

Coal surface mining in Appalachia is far more extensive and intense than coal strip mining in Colorado. Whereas approximately 31,000 acres of land are disturbed by coal strip mining in Appalachia each year, only about 100 acres of land will be overturned by coal strip mining in Colorado in 1966. Other major differences in conditions between Colorado and Appalachia include the following:

1) The spoil material in strip areas of the Eastern United States often times is highly acidic, while the spoils in the Craig area of Colorado have been alkaline, for the most part. Thus the problem of neutralizing toxic conditions inhibitory to plant growth may not be as extensive in Colorado.

2) The heavy rainfall of Appalachia provides a far greater problem of erosion and flooding in areas where vegetation has been destroyed in the process of strip mining than conditions in the arid west.

3) The major market for strip coal production is the generation of electric power. The population of the coal producing states of Appalachia alone is about 37,000,000, not including the highly populated urban states in close proximity. Thus the demands for electric power far exceed the potential for coal production in Colorado with its population of less than 2,000,000.

In view of the conditions presented by strip mine activities in Colorado compared to problems presented in Appalachia, the committee is pleased with the progress being made by the coal industry in reclaiming surfaced mined lands in Routt County. In particular, the committee believes that the grading this past summer of spoil ridges on the Osage Mine, which has been inactive for some fifteen years, is indicative of the good faith of the coal industry to continue to reclaim lands under the provisions of the voluntary agreement with the Coordinator of Natural Resources. If a reclamation law were adopted in Colorado, requiring coal strip operators to meet minimum standards of reclamation, this law could not be made retroactive to have forced industry to grade the Osage Mine. Thus, the voluntary agreement has achieved more, in this instance, than could be accomplished by legislation. As long as industry continues to meet a basic program of reclamation, there is little need for the General Assembly to enact legislation to require that which is already being done. The committee believes, however, that the Coordinator of Natural Resources should review very carefully the reclamation activities of the coal industry during 1967 and report the results of his findings to the Second Regular Session of the Forty-sixth General Assembly.

In the very near future, oil shale mining could easily dwarf all other mining activities in the state of Colorado. Although the commercial production of oil shale is a few years away, a multi-million dollar investment already has been made. The Committee on Strip Mining is particularly concerned with the problems of reclamation that are likely to arise from oil shale activities. The oil shale research programs have not developed all the answers with respect to the disposition of spent shale, prevention of air and water pollution, and possible vegetation of spent shale. For that matter, little information is available concerning the vegetation and restoration of mine dumps of all types of underground mines. For this reason, the committee supports the proposed research program outlined by the State Forester, calling for the establishment of a research team (an agronomist and a technician) to study the feasibility of vegetating mine spoils in Colorado.

The committee also believes that in view of the potential growth in the problems of mine spoil restoration, there is need for continued legislative study of the problems of reclamation of disturbed surface lands in Colorado.