SUMMARY

RESOURCE AND POTENTIAL RECLAMATION EVALUATION

OJO ENCINO STUDY AREA

REPORT 19 - 78

November 1981

U.S. Department of the Interior

of Land Management - Bureau of Reclamation - Geological Survey

Ojo Encino Study Area Report
Published November 1981

The Federal Coal Management Program has been designed as an interagency cooperative effort to meet national energy objectives.

"Ojo Encino" Study Area Report was prepared through the efforts of the U.S. Department of Interior, principally the Bureau of Land Management, Geological Survey, and Bureau of Reclamation. The study effort began in 1978 and was concluded in 1981 with the publication of this report.

The area described in this report has been tentatively determined to be a potential Federal coal development area. The purpose of this report is to provide information on the area's reclamation potential should coal development occur. This report will assist managers in making final Federal coal leasing decisions.

Limited copies of this report are available from:

Bureau of Land Management
New Mexico State Office
U.S. Post Office and Federal Bldg.
P.O. Box 1449
Sante Fe, NM 87501
505-988-6511

Please reference the title and report number 19-78 when making a request for this report.

Other reports available through Technical Investigations in Support of the Federal Coal Management Program are:

Report Name	Number	Report Name	Number
Otter Creek, MT	1-75	Garrison, ND	37-80
Hanna Basin, WY	2-75		
Taylor Creek, CO	3-75	Characterization of Major	
Alton, UT	4-75	Soils Found in Proposed Oil	
Bisti West, NM	5-76	Shale and Coal Development	
Foidel Creek, CO	6-76	Areas of Northwest Colorado	23-76
Red Rim, WY	7-76		
Bear Creek, MT	8-76	Hydrologic Consideration in	
Horse Nose Butte, ND	9-76	Coal Activity Planning	33-80
Beulah Trench, ND	10-77		
Hanging Woman, MT	12-77	Chromo 4, MT	46-75
White Tail Butte, WY	13-77	Otter Creek East, MT	47-77
Henry Mountain, UT	15-77	Dam Creek, MT	48-77
Emery, UT	16-77	Shy/6, MT	49-78
		Newell/23, MT	50-78

For more information on these reports, contact:

Bureau of Land Management
Reclamation Data Group
DFC, Bldg. 50, D-450
Denver, CO 80225
303-234-2374

50272-101

REPORT DOCUMENTATION PAGE	1. REPORT NO. BLM-YA-PT-81-010-3420	2.	3. Recipient's Accession No.

4. Title and Subtitle
Ojo Encino Study Area Report: Resource and Potential Reclamation Evaluation Summary

5. Report Date
November 1981

6.

7. Author(s)
Bureau of Reclamation, Dick Griese (ED)

8. Performing Organization Rept. No.
19-78

9. Performing Organization Name and Address
Bureau of Reclamation
Commerce Bldg. Suite 201
714 S. Tyler
Amarillo, TX 79101

10. Project/Task/Work Unit No.

11. Contract(C) or Grant(G) No.
(C)
(G)

12. Sponsoring Organization Name and Address
BLM, New Mexico State Office
U.S. Post Office and Federal Bldg.
P.O. Box 1449
Santa Fe, NM 87501

13. Type of Report & Period Covered
Summary 1978-1981

14.

15. Supplementary Notes
Prepared jointly by Bureau of Land Management, Bureau of Reclamation and Geological Survey.

16. Abstract (Limit: 200 words)

Report provides information on reclamation potential (and on coal resources) of 4,120-acre study area (SA) should coal development occur. SA is located in McKinley County, New Mexico. Restoration of existing levels of vegetation is recommended. Irrigation required for 2 years. Forty-two percent of surface of SA has suitable planting media. Many soils are saline or sodic. Bedrock generally not suitable planting media in present state. Revegetation will be difficult because of low precipitation. Coal ranges from subbituminous to bituminous and beds average 6.3 feet in thickness. Measured, indicated, and inferred coal with less than 300 feet of overburden are 19.7, 88.1, and 25.0 million short tons. Average Btu/lb value, ash content, and sulfur content is 8,953, 21.0 percent, and 0.55 percent. Considering geochemical factors, bedrock should not adversely affect ground water element concentrations. SA has limited vegetative diversity. Hydrology or water quality considerations may pose problems for mining or reclamation. Surface and ground water supplies suitable for irrigation may not be available.

17. Document Analysis a. Descriptors

0510 Environmental Surveys
0807 Coal Deposits
1407 Reclamation

b. Identifiers/Open-Ended Terms Mined-land reclamation, New Mexico

c. COSATI Field/Group

18. Availability Statement Release unlimited
BLM, New Mexico State Office, U.S. Post Office and Federal Bldg. P.O. Box 1449, Santa Fe, NM 87501

19. Security Class (This Report) unclassified

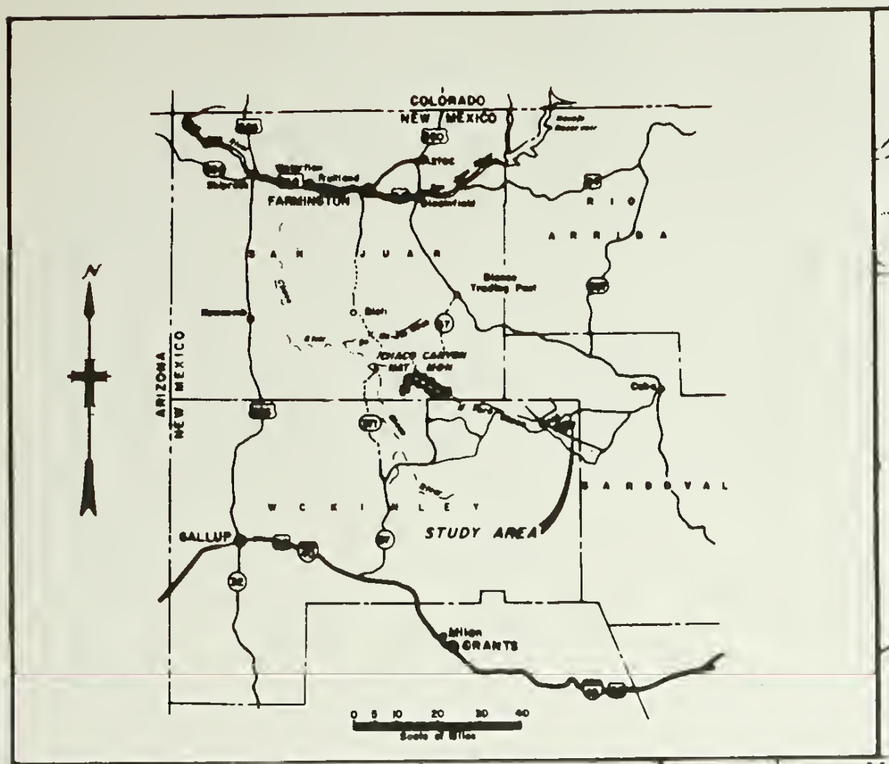
20. Security Class (This Page) unclassified

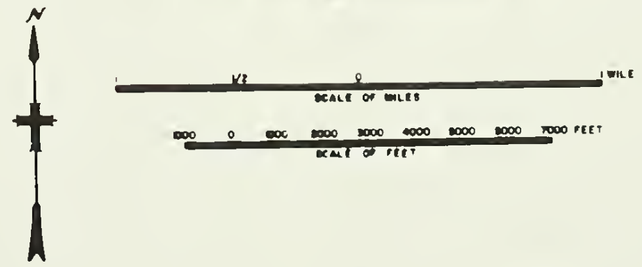
21. No. of Pages

22. Price

(See ANSI-Z39.18) See Instructions on Reverse

OPTIONAL FORM 272 (4-77)
(Formerly NTIS-35)
Department of Commerce





UNITED STATES
DEPARTMENT OF THE INTERIOR
WATER AND POWER RESOURCES SERVICE

EMRIA REPORT 19-78

OJO ENCINO STUDY AREA - NEW MEXICO

LOCATION MAP

FIGURE 1

Photo 1. Typical view of study area. Most of this land is class 1. (Photo taken looking west near profile 50.)

Photo 2. Picture shows class 2 land in foreground, class 6 land in middleground (barren area), and vegetated ridge in far background. (Photo taken looking northeast near profile 75.)

OVERVIEW OF RECLAMATION

Potential for Reclamation

Lands of the Ojo Encino study area */ will provide a limited quantity of material suitable as planting media (when placed on shaped spoils). There is enough suitable material to allow postmining revegetation approximating existing levels of vegetative cover provided the Recommendations for Reclamation presented below are followed. Other recommendations in this summary should also be followed for successful reclamation.

Most suitable materials are found on the surface both at higher elevations and (as eolian deposits) in the valley lands. These materials are generally coarse, moderately coarse, or moderately fine; have adequate permeability; and are usually nonsaline and nonsodic. About 42 percent of study area lands were identified as having suitable planting media. Figure 2 shows the results of the land classification survey made to determine the extent and location of lands with material suitable for use as planting media. Lands in classes 1 (good) and 2 (fair) have strippable quantities of suitable material; lands in class 6 have materials which are unsuitable in their present condition but which may be suitable under special management (including mixing with better quality materials).

Because of salinity and restricted permeability resulting from sodium and swelling-type clays, bedrock overburden is generally not suitable as planting media. There is a possibility of limited use of such overburden under special management.

Although the study area is in a semiarid region, precipitation at the study area is typical of arid regions and rainfall occurs in erratic patterns. This low precipitation and erratic rainfall will contribute heavily to the difficulty in revegetating the study area.

Obtaining a firm supply of irrigation water may be difficult and costly.

Recommendations for Reclamation

Four alternatives regarding postmining reclamation were considered--no mining, natural recovery, total revegetation, and restoration of existing levels of vegetation. Of these, restoration of existing levels of vegetation is recommended. Under this alternative, the entire study area would be carefully graded, and existing levels (at least) of vegetation would be restored. Areas not revegetated would be reclaimed so as to minimize erosion and then allowed to revegetate naturally. The recommendations that follow apply to the restoration of existing levels of vegetation alternative.

---

*/ The study area covers a 4,120-acre area (about 6.4 square miles).

Before mining, a detailed study should be made to more precisely establish the nature and location of soils and bedrock suitable for planting media. During mining, these materials should be carefully stockpiled and protected. Any toxic materials found during mining should be buried below the root zone during reclamation. Soils and bedrock classed as unsuitable are not recommended for use as planting media in their present conditions but should be further investigated for such use under special management.

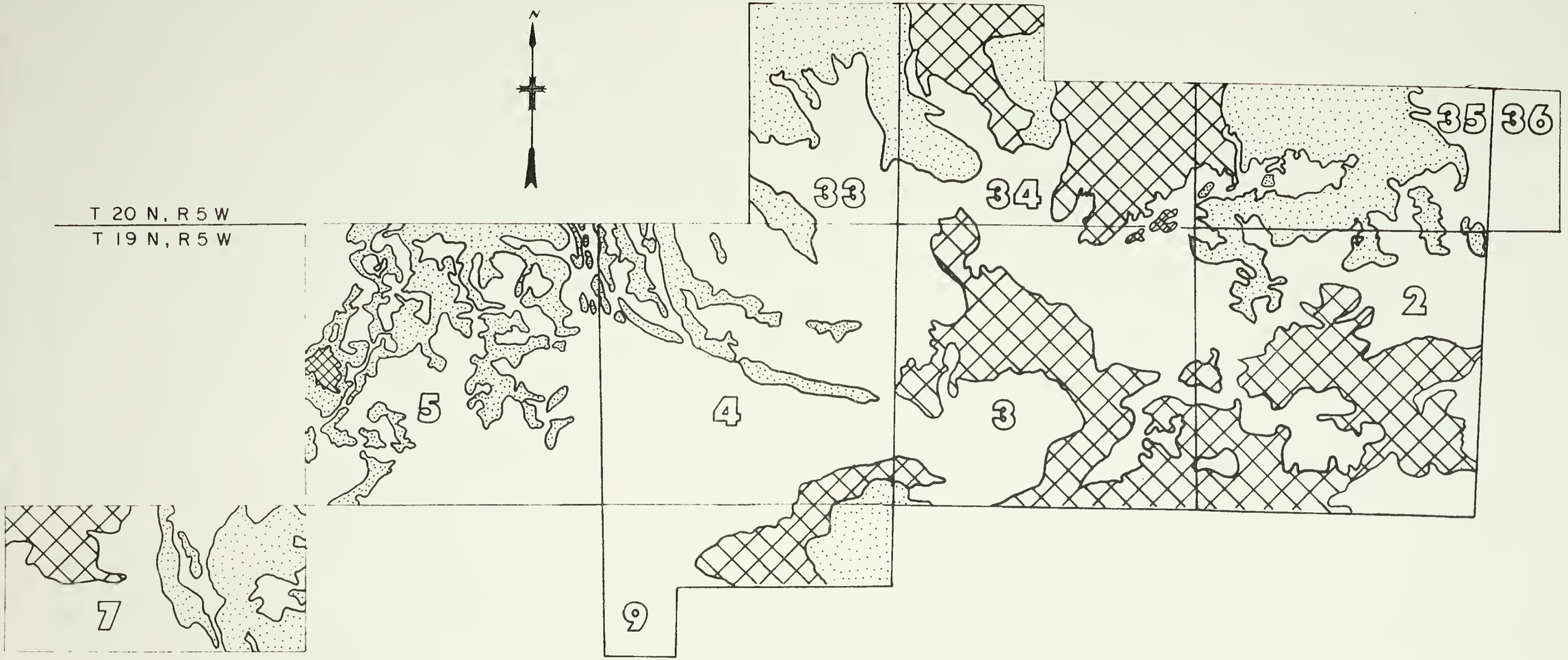
After mining, the study area should be carefully graded to blend with surrounding land forms, utilize rainfall, promote revegetation, provide drainage, and minimize erosion. In order to reduce erosion and sediment yield, wide, flat drainageways should be constructed in the reshaped topography to accommodate flows that originate on the reclaimed area and upstream.

Selected graded areas should be covered first with about a foot of moderately fine-textured soil; then about 16 inches of suitable coarse-textured soil should be placed over the finer material. The lower layer will promote water retention and the upper layer will promote permeability. Soil types could also be mixed as appropriate to improve the poorer materials. The use of fertilizer before, during, and after seeding may be desirable. Seeding should be done carefully, preferably with the drill method. Species (native and of local origin), seed mixes, seeding rates, and seeding times determined by the reclamation manager as appropriate to local conditions should be used.

Irrigation is recommended for about 2 years following seeding in order to establish vegetation. A firm water supply for irrigation should be established. After seeding, soil surfaces should be protected by mulches and wind barriers. Vegetation should be protected from grazing of domestic livestock until established.

CLIMATE

The Ojo Encino study area has an average annual temperature of 49° F, ranging from 27.5° F in January to 73.1° F in July. The frost-free season is about 106 days. Average annual precipitation, usually in the form of localized intense thunderstorms, is about 8.8 inches, with July, August, September, and October each averaging over 1 inch. The remaining months each average about 0.5 inches. The 8.8-inch average includes years with 3 inches and years with 14 inches. Up to 7 inches of the 8.8-inch total precipitation is effective. Average humidity is about 50 percent, and average annual pan evaporation is 49 inches.



LAND CLASSIFICATION		ACRES
	CLASS 1	861
	CLASS 2	853
	TOTAL	1714
	CLASS 6	2406
	GRAND TOTAL	4120

NOTE: Only the top 3 feet of material were evaluated and classified for suitability as a source of planting media.

2000 0 2000 4000 6000

SCALE OF FEET

OJO ENCINO STUDY AREA

GENERAL LAND CLASSIFICATION

EMRIA REPORT NO. 19-78

FIGURE 2

PHYSIOGRAPHY, RELIEF, AND DRAINAGE

The study area is in the Navajo section of the Colorado Physiographic Province. Landforms in the Navajo section are in the early stage of dissection, characterized by young plateaus, mesas, hogbacks, retreating escarpments, and debris-choked dry-wash canyons.

Located on the southeast flank of the Continental Divide, the study area is characterized by low hills and gently rolling terrain. Elevations range from 6,600 to 6,720 (feet above sea level) over most of the study area. Most of the drainage in the area forms a dendritic pattern south and southeast toward Papers Wash, a right tributary to Torreon Wash. Encino Wash is tributary to Torreon Wash just north of the study area. Torreon Wash, a major dry-wash drainage located east of the study area, is tributary to Rio Puerco.

GEOLOGY

The dominant structural element of the region that includes the study area is the San Juan Basin, an asymmetrical structural and topographical depression roughly 125 miles long (north-south) and 100 miles wide (east-west). Differential uplift in the region resulted in the basin's great, shallow, bowl-like form. The perimeter of the basin, except on the south, is marked by sharp monoclinal flexures, or faulting, adjacent to the surrounding mountains. The basin contains sediments ranging in age from Cambrian to Quaternary and having a maximum total thickness exceeding 14,000 feet in the deepest, or northern, part. Successively younger strata outcrop going from the margins of the basin toward its interior--the Central Basin. The study area is situated in the southeastern quadrant of the Central Basin, where rock formations dip gently northwest.

The rock formations outcropping in the study area are of Late Cretaceous age and, in descending order, are: the lower part of the Kirtland Shale, consisting predominantly of shale; the Fruitland Formation consisting of shale, sandstone, coal, and siltstone; and the Pictured Cliffs Sandstone, consisting predominantly of sandstone. All of the formations are weakly to only moderately lithified. "Hard rock" does not occur, except for scattered ferruginous-cemented concretions in sandstone and siltstone beds in the Kirtland Shale and ferruginous-cemented thin sandstone beds in the Fruitland Formation.

Coal beds in the study area are confined to the Fruitland Formation, and are thicker and more persistent in the middle part of the formation. The upper coal bed has been removed by erosion in the southern part of the study area. Coal beds range from 0.3 to 22.6 feet in thickness, averaging about 6.3 feet in thickness. Depth of overburden above the upper coal beds ranges from 0 feet where the beds outcrop to 32.5 feet in Drill Hole OE-4.

Some overburden materials should not be used, without special treatment or design, to impound large quantities of water.

COAL RESOURCES

The Ojo Encino study area, is located on the south margin of the San Juan Basin on the gently northward dipping strata of the Upper Cretaceous Kirtland Shale, Fruitland Formation, and Pictured Cliffs Sandstone. The coal beds are mainly in the lower 200 feet of the Fruitland Formation.

Coal resources at the study area--measured, indicated, and inferred--with less than 300 feet of overburden are 19,700,000 short tons, 88,130,000 short tons, and 25,020,000 short tons, respectively.

The apparent rank of the coal ranges from subbituminous A to high volatile C bituminous. For eight study area core samples, on an as-received basis, the average Btu/lb value is 8,953, average ash content is 21.0 percent, and average sulfur content is 0.55 percent.

OVERBURDEN GEOCHEMISTRY

In principle and on the basis of their bulk chemistry, the overburden rocks could be used as acceptable soil replacement material and should not be expected to have long-term unfavorable effects on ground water element concentrations. The only apparent qualification on this general conclusion is that the sodium content of the rocks at the Ojo Encino study area is distinctly higher than at other sites in other states where Cretaceous Age rock overlies mineable coal, and slightly higher than at sites in other states where Tertiary Age (Paleocene) rock overlies mineable coal.

As indicated above, the bulk chemistry of Ojo Encino overburden rock is generally favorable with respect to postmining reclamation of the study area. However, for determining the immediate suitability of the rock as a replacement for the soils of the study area, other factors, such as texture, water-holding capacity, permeability, salinity, sodicity, and weatherability must also be considered. These other factors were the basis for the suitability determinations discussed in the following section, LAND AND OVERBURDEN.

It may be necessary to stockpile rocks in a segregated manner, by distinct rock types, in order to allow replacement of rocks after mining in positions best suited to their particular chemical character and to reclamation needs.

LAND AND OVERBURDEN

Land Suitability

Study area lands were surveyed in order to class them for their suitability as a source of material for resurfacing and revegetating the area following surface mining. The survey provided data on the quantity and quality of the material and ease of stripping and stockpiling the material. Assignment of classes was based on field observations, laboratory analyses, and greenhouse studies. Three

land classes were mapped at the study area--class 1 (good, 21 percent of study area); class 2 (fair, 21 percent); and class 6 (presently unsuitable, 58 percent). Land classes 1 and 2 have material usable as planting media; class 6 has material presently unusable because of severe limitations. Figure 2 shows the extent and location of the three land classes. For figure 2, only the top 3 feet of material were evaluated and classified for suitability as a source of planting media. (However, information characterizing the entire depth of soil at the study area is provided in the main report.)

Bedrock Suitability

Field investigations, greenhouse studies, laboratory analyses, and weathering tests indicate that most bedrock materials are presently unsuitable for use as planting media. Although bedrock materials should not be used in their present state, their use for reclamation purposes may be possible in conjunction with better materials, or after additives (such as gypsum or cinders) are applied, or with good postreclamation management. The usability of bedrock overburden for reclamation purposes needs researching.

Major Land Categories

Five major land categories encompass the landforms and soil bodies of the study area:

Valleys

About 12 percent of the study area consists of valleys and flood plains. These areas generally have vegetation. Soil depth is usually 60 inches or more; soil textures range from sandy, clay loam to silty loam; and soil-moisture relationships (permeability and available-water-holding capacity) are poor to good. Often, exchangeable sodium percentages are high in both surface and subsoils (15 to 50 percent). Saline and sodic conditions prevail in some areas. Approximately half of these lands are suitable as a source of planting media.

Valley sideslopes

About 30 percent of the study area consists of sideslopes adjacent to the valley areas. Soil depth is usually 60 inches or more; soil textures range from clay to fine sand; and soil-moisture relationships are moderate. The majority of this category is unsuitable as a source of planting media. There are some areas in this category that are up to 30 acres in size, but they are irregularly shaped and widely separated.

Uplands

About 49 percent of the study area consists of upland areas (small mesas, breaks, and long, gentle slopes). Portions of this category (more than

20 percent) have bedrock contacts at depths less than 12 inches. The rest of the category has soil depths of 10 feet or more. Soil textures range from fine sand to clay loam. Soil-moisture relationships are poor to moderate. Usually sodicity and salinity are problems. The majority of this category is suitable as a source of planting media.

Flats

About 7 percent of the study area consists of flat lands devoid of vegetation. These lands consist of exposed black shale and small interspersed eolian sand deposits 4 to 8 inches deep. Most flats are not suitable as a source of planting media because they are highly saline and sodic, are lacking in soil material, and consist of materials with severe erosion hazard. The few pockets of soil present range in texture from clay loam to fine sand; moisture relationships are low to moderate.

Badlands

This category occupies about 2 percent of the lands at the study area. These lands are bare, eroded shale knobs, ridges, and escarpments. Vegetation is sparse. Suitability of these lands as a source of planting media is low because of insufficient soil material, excessive slope, severe erosion hazard, and high sodicity.

VEGETATION

The Ojo Encino study area shows effects of heavy grazing and has limited vegetative diversity. Only two distinct vegetation units, Sagebrush Steppe and Riparian-Flats, were identified.

Sagebrush Steppe type is dominated by the shrub big sagebrush (Artemisia tridentata), with scattered grass composed mostly of blue grama (Bouteloua gracilis) and galleta (Hilaria jamesii). Riparian-Flats has rabbitbush (Chrysothamnus) and greasewood (Sarcobatus vermiculatus) in the arroyos while the drainage flats are dominated by a number of saltbush (Atriplex) forbs.

A third mapping unit, Mixed Sagebrush-Riparian was recognized as a mosaic of the two distinct units, the units being too intermixed for delineation.

Revegetation of the area is possible, provided care is exercised. Native species suited to the area should be used in reseeding. Seeding techniques should include a well-prepared seedbed and application of seed by drilling. To insure successful revegetation, irrigation should be considered.

Soils of the area are variable and suitability for topsoiling appears limiting. Topsoiling is not mandatory for revegetation success but a form of soil amendment will improve soil permeability. Soil fertility of overburden is not considered a major concern, however, soil microbe level may need to be enhanced.

HYDROLOGY AND WATER SUPPLY

The streams in the Ojo Encino study area are ephemeral; that is, flow occurs only in direct response to storm runoff. Much of the surface runoff, probably from melting snow, occurred during the months of December through March during water years 1978-1980.

The surface runoff has better water quality than any of the water-bearing formations at the study area. However, the water quality of surface runoff cannot presently meet the effluent limitations for iron or suspended solids specified in the Surface Mining Reclamation and Enforcement Provisions of Public Law 95-87 (Surface Mining Control and Reclamation Act (SMCRA) of 1977) and may not meet the provisions during mining and reclamation.

Surface mining for coal and subsequent reclamation may have some impact on the hydrologic budget at the Ojo Encino study area. Within portions of the study area, surface mining will break up the stratified overburden, water-bearing coal seams, and all confining layers above the Pictured Cliffs Sandstone, replacing them with crumbled shale and sandstone rubble having a porosity greater than the original stratified material. At present, no known use is being made of ground water in the overburden or coal seams within the study area. The greatest probable impact may be the potential for upward leakage and recharge to the porous crumbled shale and sandstone rubble from the underlying Pictured Cliffs Sandstone, which contains water that is more saline than the water within the coal seams at some locations.

Several deep aquifers exist at the Ojo Encino study area. In ascending order, these aquifers are the Entrada Sandstone, Morrison Formation, and Menefee and Cliff House members of the Mesa Verde Group. The suitabilities of these aquifers as a supply of water for reclamation are marginal because the salinity concentrations and sodium-adsorption-ratio values may be greater than those recommended for irrigation. Wells would have to be drilled, developed, tested, and analyzed for water quality to determine yields and quality of this supply at the study area. Since the quantity of surface runoff is questionable and the quality of ground water may be marginal as reclamation supplies at the Ojo Encino study area, revegetation experiments without supplemental irrigation may be worthwhile.

Mining companies are required by the SMCRA of 1977 and subsequent enforcement provisions to reclaim mined areas. During mining and reclamation, runoff from spoil piles would probably exceed the suspended-solids effluent limitations of enforcement provisions and could not be discharged downstream. However, the spoil piles would be graded to approximate premining or lesser slopes as specified by the regulatory authority and covered with topsoil saved for planting media. Following a stabilization period at the Ojo Encino study area, and assuming the slopes and vegetative cover are similar to premining conditions, there may be little or negligible differences in runoff and sediment yield from reclaimed spoil pile areas. Sediment yields may even be less if slopes are reduced.