RESOURCE AND POTENTIAL RECLAMATION EVALUATION

OJO ENCINO STUDY AREA

REPORT 19 - 78

November 1981

U.S. Department of the Interior

Bureau 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.

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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.

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RESOURCE AND POTENTIAL RECLAMATION EVALUATION

OJO ENCINO STUDY AREA

REPORT NO. 19-78

U.S. Department of the Interior
Bureau of Land Management--Bureau of Reclamation--U.S. Geological Survey

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In May of 1981, the Secretary of the Interior approved changing the Water and Power Resources Service back to its former name, the Bureau of Reclamation. All references in this publication to the Water and Power Resources Service should be considered synonymous with the Bureau of Reclamation.

RESOURCE AND POTENTIAL RECLAMATION EVALUATION
OJO ENCINO STUDY AREA

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SECTION A

INTRODUCTION

SECTION A

INTRODUCTION

A growing and affluent society is creating an ever increasing need for energy. Attention has focused on the energy fuel sources of the Western States, primarily the Rocky Mountains and the Northern Great Plains Coal Provinces, due to the abundance, ease of extraction, and quality of the resources in these areas. It is the responsibility of the Bureau of Land Management (BLM) to assist in meeting these energy demands and, at the same time, provide sound reclamation and rehabilitation guidelines so that disturbed lands are returned to a useful state.

Objectives

The principal objective of this report is to assure adequate baseline physical and chemical data for choosing reclamation goals and for establishing lease stipulations for energy mineral exploration, mining, and reclamation. */

Other objectives include:

A. Provide data to minimize environmental impacts from surface mining of energy minerals on public lands administered by the BLM.

B. Provide environmental resource information needed to implement effective reclamation programs.

C. Provide resource and impact information for:

1. Preparation of Environmental Analysis Reports (EAR) and Environmental Impact Statement (EIS).

2. Use during site selection within the Secretary's energy leasing programs.

3. Support of State and local regional development and land use planning efforts.

Authority

Public Land Administration Act of July 14, 1960 (74 Stat. 506), and The Surface Mining Control and Reclamation Act of 1977 (Public Law 95-87).

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*/ The abbreviation EMRIA (Energy Mineral Rehabilitation Inventory and Analysis) is used often in this report. EMRIA is the old name of the program under which this report was prepared. Preparation of the report was too advanced to delete the term.

Responsibilities */

Bureau of Land Management

A. Selects reclamation study areas for coordinated investigation of vegetation, soil, geological structure, surface water, and ground water.

B. Acts as contracting officer in the coordination, establishment, and execution of work orders (contracts).

C. Reviews and consolidates work order and field office data and prepares information for reports published by the Bureau of Reclamation.

D. Distributes technical data, reports, and reclamation and rehabilitation recommendations to BLM field offices.

Bureau of Reclamation (BR)

A. Evaluates land and overburden **/ as a source of suitable planting media in a revegetation program.

B. Prepares soil inventories.

C. Recommends to BLM district office suitable plant species for areas to be revegetated.

D. Obtains core samples of bedrock overburden, coal, and bedrock immediately below coal.

E. Installs casing in holes selected for ground water observation wells.

F. Prepares a written and graphic description of pertinent geologic aspects of the study area.

G. Advises BLM district office on reclamation techniques.

H. Publishes resource and potential reclamation evaluation.

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*/ Because different authors prepared different parts of this report, conclusions in one part of the report may not completely agree with those in another part.

**/ Overburden is the consolidated material (bedrock) and unconsolidated material (surficial materials, such as soils, usually overlying the bedrock) overlying the coal.

Geological Survey (GS)

A. Assesses reclamation potential based on available water, on effects of surface mining on area hydrology, and on measures required to prevent adverse effects on area hydrology.

B. Estimates annual runoff and peak flows.

C. Collects and interprets data to predict alternative solutions to ground water problems encountered during mining and reclamation.

D. Implements monitoring system to define baseline conditions and to document ground water flow and quality changes caused by mining and reclamation.

E. Prepares potentiometric maps.

F. Prepares geophysical well logs.

G. Estimates coal resources.

H. Performs laboratory tests on coal resources.

I. Presents results of laboratory tests on coal resources.

Ojo Encino Study

Fieldwork for the study was conducted from June 1978 to November 1979. Laboratory work and office evaluations were conducted from February 1979 to May 1981.

Location and Setting */

The study area is located about 70 miles southeast of Farmington, New Mexico (see report cover and figure A-1).

Coal deposits west of the study area have been under lease since August 1961. Areas to the northwest are under preference right lease application. Present and future energy demands have provoked increased interest in the strippable coal in the study area and surrounding areas. There has also been some drilling for oil near the study area, and oil and gas drilling is beginning to increase in the area.

Coal outcrops are evident on the study area. Local Indians have mined coal outcrops for many years as fuel for cooking and heating.

*/ Taken in part from the Environmental Assessment Report dated 3-21-78 and Land Report dated 2-9-78, both prepared by Timothy Kreager, Farmington Resource Area office, BLM.

Currently, the study area is used for livestock grazing. Indians in the area depend on goats and sheep for income and have horses for herding purposes. Other ranchers in the area raise cattle.

Five archeological sites have been identified in the study area, and other archeological and paleontological sites are known to exist in the surrounding area.

The study area also has value for hunting, rock hounding, and recreation. The present cultural value of the study area would be considered as rancher-recreation related. Education and scientific values would be primarily geological in nature. The study area is not considered to have any wilderness characteristics.

The esthetics of the study area are not exceptional due to heavy grazing in the area.

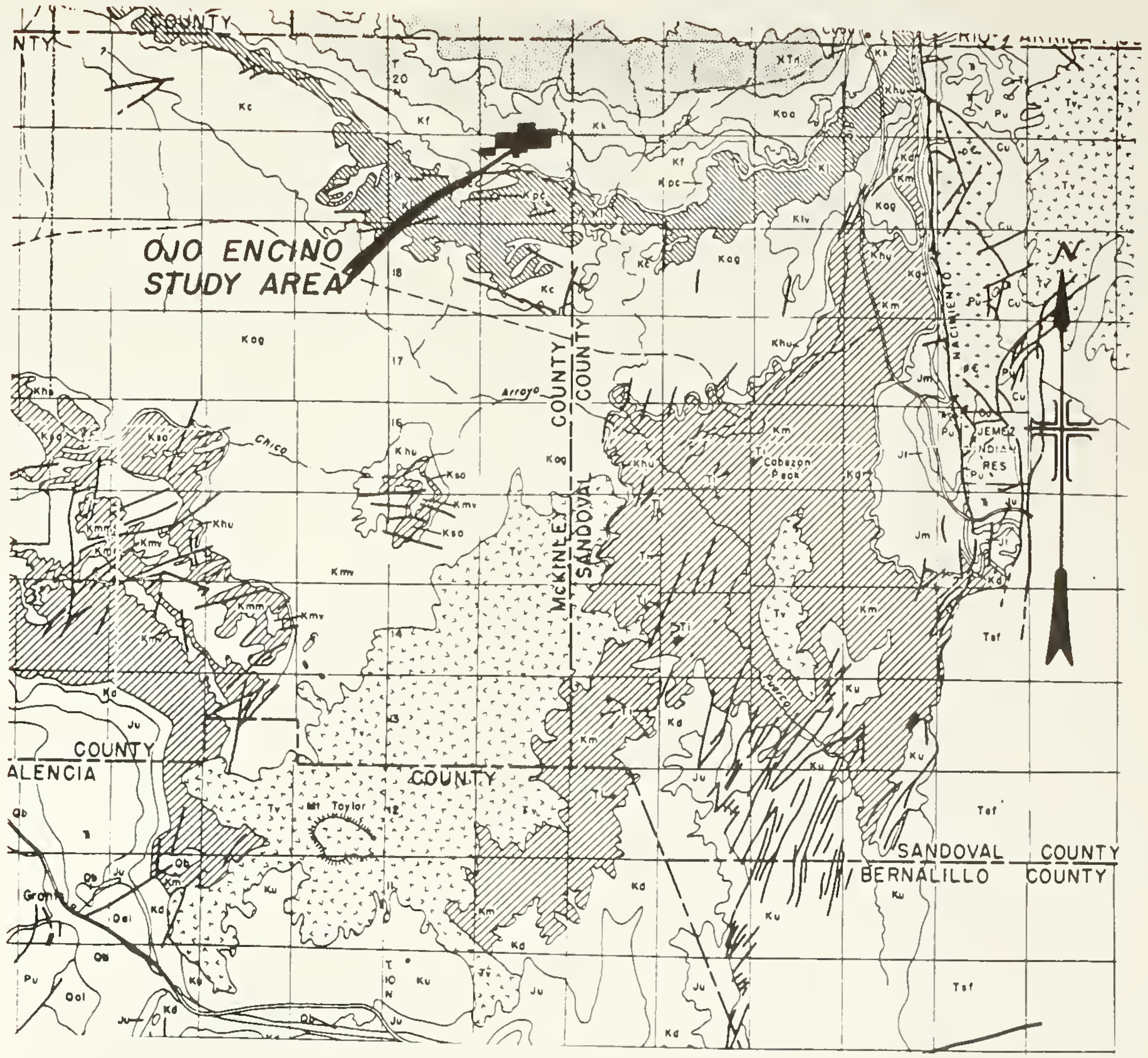
TERTIARY
Non-Marine

Tsj	SAN JOSE FORMATION: Massive, thick-bedded sandstone and interbedded lenticular shale
Ttp	NACIMIENTO FORMATION: Varicolored shale, siltstone, and mudstone with interbedded and lenticular sandstone and conglomeratic sandstone

CRETACEOUS
Marine and Non-Marine

Koa	OJO ALAMO FORMATION: Massive sandstone, conglomerátic sandstone, comglomerate, and minor shale
Kmd	MCDERMOTT FORMATION: Shale, sandstone, and volcanic debris
Kk & Kkf	KIRTLAND FORMATION: Includes upper and lower shale members (Kk), and the Farmington sandstone middle member (Kkf)
Kf	FRUITLAND FORMATION: Massive carbonaceous shale, sandstone, siltstone, and coal.
Kpc	PICTURED CLIFFS FORMATION. Predominantly sandstone with minor shale and siltstone
Kl	LEWIS FORMATION: Predominantly shale with minor thin siltstone and sandstone
Kmv	MESAVERDE GROUP, UNDIFFERENTIATED: Shale, sandstone, siltstone, and coal. Includes Mancos shale (Km) and Dilco coal and Gallup sandstone members (Kgd)

NOTE: Reproduced in part and adapted from: New Mexico Geological Society Guidebook of the San Juan Basin, First Field Conference, 1950, Geologic Map of the San Juan Basin, by Caswell Silver.



5 0 5 10 15 20 25
SCALE OF MILES

EMRIA REPORT NO. 19-78
OJO ENCINO STUDY AREA
NEW MEXICO

REGIONAL GEOLOGY

FIGURE E-3

SECTION B

PRESENT LAND USE, POSTMINING LAND USE, AND LEGAL REQUIREMENTS PERTAINING TO MINED-LAND RECLAMATION

SECTION B

PRESENT LAND USE, POSTMINING LAND USE, AND LEGAL REQUIREMENTS PERTAINING TO MINED LAND RECLAMATION

Present Land Use

Present use of the study area is for livestock grazing, watershed, and wildlife. Production levels of all three land uses are quite low and marginal. Due to poor water distribution, the number of animal species adaptable to the area is small. Birds, reptiles, and some rodents make up the known species of the area. There are five oil/gas leases and several powerlines, pipelines, and telephone rights-of-way in the study area.

Postmining Land Use

According to the Bureau of Land Management District Management Framework Plan, land use of the Ojo Encino study area following mining would be grazing of livestock and protection of watershed and wildlife habitat. The plan may be inspected at the Bureau of Land Management District Office, 3550 Pan American Freeway, N.E., Albuquerque, New Mexico 87107, and at the Farmington Resource Area Headquarters, 900 La Plata Highway, Farmington, New Mexico 87401.

Legal Requirements Pertaining to Mined-Land Reclamation

If the Ojo Encino study area is leased for coal mining, because it is Federal land, the operator of the mine must comply with Federal regulations. Furthermore, because the operator will not be an instrumentality or agent of the Federal Government, he must comply with State regulations. There do not appear to be at present any local regulations concerning mined-land reclamation.

Federal regulations

Major Federal coal mining operating regulations were published in the Federal Register, vol. 41, No. 96, May 17, 1976 (part II, pages 20253-20273). Selected passages of the regulations are presented in section O, some in modified form. Also presented in section O is the proposed regulation Title 30, Chapter VII, Part 700, Section 700.1. Other pertinent Federal regulations were published in the Federal Register in vol. 41, No. 90, May 7, 1976 (pages 18845-18848) and in vol. 41, No. 105, May 28, 1976 (pages 21779-21781).

The Surface Mining Control and Reclamation Act was enacted on August 3, 1977; Office of Surface Mining final rules were published on December 13, 1977, in 30 CFR 700; and BLM final rules were published on July 19, 1979, in 43 CFR 3400.

State regulations

Presented in section O, some in modified form, are selected passages from the regulations of the State of New Mexico, Coal Surface Mining Commission (effective date--February 9, 1973), pursuant to New Mexico Coal Surface Mining Act, Chapter 68, Laws 1972.

SECTION C

CONCLUSIONS ON STUDY AREA RECLAMATION POTENTIAL

SECTON C

CONCLUSIONS ON STUDY AREA RECLAMATION POTENTIAL

Alternatives

Four alternatives relative to postmining reclamation were considered and are discussed below: (1) no mining, (2) natural recovery, (3) total revegetation, and (4) restoration of existing levels of vegetation. Alternative (4) was jointly selected by BLM, GS, and BR as being the most reasonable. This alternative is disussed in detail below.

No mining

An alternative to reclaiming the study area following mining is not to mine in the first place. A main purpose of this report, however, is to study the reclamation potential of the study area following mining. The report, therefore, assumes that mining will take place. However, the decision whether to mine has not been made and will not be made until an environmental impact statement studying the economic and environmental impacts of strip mining at the study area is completed. Therefore, the no-mining alternative is not discussed further in this report.

Natural recovery

This alternative assumes that Federal or State regulations would allow the alternative, which is very unlikely.

Under this alternative, materials suitable for planting media would not be separated from unsuitable materials. Spoil piles would simply be shoved back into the pits after the coal has been removed, minimally graded, and left for natural revegetation. Natural revegetation would be a slow process, at best, in this semiarid region, although the time required for it has not been determined. Indeed, these spoil piles, consisting mostly of materials unsuitable for revegetation, might never become revegetated. Through wind and water erosion, unvegetated spoil piles could contaminate adjacent unmined land areas and downstream water supplies. Local wildlife and domestic stock would be deprived of vegetation for cover and grazing until vegetation is reestablished. Whatever esthetic value the study area now has would be lost because the existing land forms would be destroyed and the new ones would be haphazard and subject to wind and water erosion until revegetation occurs.

For these reasons, this alternative is deemed unrealistic and is not considered further in the report.

Total revegetation

At present, the study area is only partially vegetated. Revegetation of the entire surface-mined area could be very difficult because this would require that the entire study area have a covering layer of planting media of adequate thickness and that a larger supply of irrigation water be available. If there is insufficient planting media within the study area, the additional planting media would have to be borrowed from outside the study area. This would require another land classification survey to properly identify suitable soils. If planting media were found and transported to the Ojo Encino study area, a revegetation program would have to be conducted at the borrow site.

Therefore, if the Ojo Encino study area is entirely revegetated, the revegetation program would be similar to that for restoration of existing levels of vegetation, except that it would be considerably more extensive and costly, and the two major limiting factors in the study area--available planting media and irrigation water--would assume greater importance.

In light of the difficulty of restoring existing levels of vegetation at the study area, total revegetation of the study area may be unrealistic. In addition, restoration of existing levels of vegetation is consistent with understood BLM guidelines specifying that, for planning purposes, EMRIA study areas will be returned as nearly as possible to their premining condition or to a condition suitable for alternative uses identified by BLM.

For these reasons, the alternative of total revegetation of the study area is not considered further in this report.

Restoration of existing levels of vegetation

Under this alternative, the entire area would be carefully graded and existing levels (at least) of vegetation would be restored; grading and location of vegetation would not necessarily be the same as at present. Areas not revegetated would be reclaimed so as to minimize erosion and then allowed to naturally revegetate. The plans presented in detail below (Land and Overburden Conclusions (Reclamation by Restoring Existing Levels of Vegetation)) for implementing this alternative could be carried out with or without irrigation, as indicated. Since revegetation of semiarid areas such as the Ojo Encino study area is difficult, this alternative appears to be the most logical of those presented and is recommended accordingly. Recommendations in other "conclusions" subsections of section C should also be followed for successful reclamation.

Land and Overburden Conclusions* (Reclamation by Restoring Existing Levels of Vegetation)

Actions during the premining and mining periods

Selection of planting media. Classes 1 and 2 of the surface soils of the Ojo Encino study area appear to be the only source of planting media.

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* Because different authors prepared different parts of this report, conclusions in one part of the report may not completely agree with those in another part.

These soils have some organic matter content and adequate physical characteristics, are easier to physically handle, and probably already contain native seeds which would aid in vegetation establishment.

The soils usually occupy upland areas consisting of mesas, ridges, and elevated benches of the study area. Just before starting the mining operation, a detailed study area inventory should be completed, however, to pinpoint the location of and to more carefully evaluate the planting media of the study area.

Laboratory analysis of study area bedrock overburden indicates that it is unsuitable (as defined in table H-1) as planting media in its present condition (see table N-8 for results of laboratory analysis). However, reclamation (in the same geologic material) at the Navajo Coal Mine near Farmington indicates that revegetation of overburden material that includes this bedrock may be possible. Therefore, further studies should be made of bedrock overburden at the Ojo Encino study area to determine if it is suitable as planting media.

A comprehensive test-plot program should be conducted at the study area before mining begins. The program should include use of bedrock overburden as a planting media; simulation of growing conditions and techniques appropriate to the study area; and use of commercial developments for erosion control and revegetation.

Handling and placement of soil and bedrock

Stockpiling of soil or bedrock to be used on surface--Existing suitable surface soils should be stockpiled in a readily identifiable way during mining so that they can be properly placed on the surface during final forming of a reconstructed landform. Both residual clay and wind-blown sandy soil materials occur over some of the surface of the study area. It is essential that each of these soil materials be removed and stockpiled separately. During stockpiling, the suitable planting media must be separated from the unsuitable, and contamination kept to a minimum. All stockpiles must be protected from erosion. Long axes of the stockpiles should approximate the prevailing wind direction to minimize wind erosion. Undue compaction of planting media should be avoided during handling.

Probable resulting soil profile--Since suitable planting media may be limited, the reconstructed soil profile may be somewhat shallow. Some of the vegetation at the study area is found on areas with less than 18 inches of soil material. There are also partially barren areas where sparse vegetation grows on very shallow eolian deposits, sometimes less than 12 inches thick. These examples of existing vegetation indicate that a large amount of planting media is not needed for the growth of some plant species.

Almost all the planting media will have some coarse textures with variable hydraulic conductivity, but some of the planting media will have medium to fine textures with limited permeability. The planting media should be spread in strata so that a foot or more of the finer textured soils are near the bottom (to impede permeability); on top of that layer should be placed 12 to 16 inches (8 inches minimum) of sandy material composed of particles of various sizes.

Some sodic and saline soils will be included in the planting media but will be within the suitable category. Indeed, the sodic soils may be an asset in establishing and maintaining vegetation because sodic conditions impede moisture movement in soils, reducing the rapid permeability of the coarse-textured soils. Some materials classed as 6 because of high sodicity could be used as a barrier and planting media distributed over this barrier. Moisture would accumulate in the planting media and be more readily available to vegetation.

Placement and isolation of toxic materials. A major factor to be considered during handling of overburden will be the proper disposition of toxic materials. Laboratory analyses and greenhouse studies of the overburden material sampled in 1978-79 provide information on toxic materials at the study area. This information and field observations reveal that much of the soil and bedrock overburden at the Ojo Encino study area, while not toxic, is sodic or saline. A detailed inventory of the study area may reveal toxic elements not disclosed in these first analyses, but this is not likely.

All materials identified as toxic before and during mining should be stockpiled; isolated; protected to prevent contamination of water supplies and potential planting media; and placed after mining below root zones so as to preclude contamination of water supplies.

Grading. One objective of replacing overburden and reshaping topography should be (a) the creation of final topography which will blend with the form of the adjoining undisturbed landscape and (b) the reestablishment of a positive surface drainage pattern. Reshaping to blend may not always be desirable, however. It should be possible to reduce the steeper slopes, which are usually of relatively short reach. This reduction of slopes would lessen erosion hazard, increase the chances of successful revegetation, and reduce operational problems.

Well-planned grading will promote full use of local precipitation for establishing and maintaining vegetation. This could be accomplished by constructing a series of shallow depressions and diversion structures and by contour furrowing. If the landscape is arranged for natural rainfall collection, plants may take advantage of the rainfall to increase their chances of survival after irrigation (if used) is discontinued.

Slopes should not be steeper than 3 to 1, and wherever possible, should be 4 to 1 or 5 to 1. Final grading should assure that no flat areas are created which will pond water unless temporary ponding is a part of the precipitation collection plan or erosion control program. Thus, if sand is not available for planting media in some areas, it would be advisable to surface these areas with finer-textured materials graded so that the surface is almost flat. Runoff could be reduced by treating the surface with an Arcadia furrower so that all the water falling on a site is retained until it infiltrates the soil. Water would be stored at shallower depths than in sandy soils, and a higher proportion of this water would be evaporated instead of transpired. Xerophytic shrubs and possibly certain short grasses could survive under these conditions.

Drainageways should be provided with grades flat enough to prevent gullying and excessive channel erosion. Flow retarding structures may be desirable. Resulting stream channels should have slopes equal to or less than those occurring before mining. Contour furrowing or some other practice should be done to temporarily minimize runoff until a grass cover has been established.

Grading plans should provide for permanently conducting drainage from escarpments across the reclaimed area or for permanently diverting the drainage around the unclaimed area.

Topographic plans for the finished areas should maximize north- and east-facing slopes. South- and west-facing slopes are traditionally drier and hotter in this area, thus making them more difficult to revegetate.

Sculpturing (excessive manipulation or grading) of the planting media should be avoided. A test-plot program should provide information on effective grading techniques. Placement of planting media should be avoided during windy periods.

Actions during the postmining period

Evaluation of surface material for revegetation. This subject was introduced above in "Actions during the premining and mining periods." The surface material used for planting media would be predominantly coarse textured. Some mixing of classes may be desired in order to acquire a more suitable texture, although doing so may lower the overall quality. Also, combining of classes into layers to promote utilization of irrigation or rainwater will be desirable. All planting media classed as suitable will support sufficient vegetation for reclamation with proper management.

Although most bedrock materials do not appear suitable as planting media, this should be confirmed by a test-plot program and by the reclamation program at the Navajo Coal Mine.

Selection of plant species

Native species (first priority)--Some of the soils of the study area have low moisture storage capabilities, yet some vegetation grows at the study area. This indicates that revegetation may be accomplished with plant species adapted to semiarid areas. Other species may require more water than prevailing climate patterns provide. If possible, seeds should be obtained from local growers in order to be more climatically adapted and capable of survival at the study area.

The study area will probably continue to be used for grazing of domestic animals, watershed, and wildlife following mining. For this reason, a variety of both herbaceous and woody species should be seeded following shaping of the land surface and placement of planting media. Federal regulations require that species native to the study area be used for reseeding. The species tabulated below (from table I-1) exist at the study area.

Scientific name	Common name
Grasses	
*Bouteloua gracilis**	blue grama
*Hilaria jamesii**	galleta
Muhlenbergia pungens	sand hill muhly
*Oryzopsis hymenoides**	Indian ricegrass
*Sporobolus airoides**	alkali sacaton
Forbs	
Atriplex obovata (=*A. jonesii*)	
Atriplex powellii	
Atriplex saccaria	
Salsola paulsenii Litv. (=S. *kali*)	Russian thistle
Shrubs	
*Artemisia tridentata**	big sagebrush
*Atriplex canescens**	four-wing saltbush
Chrysothamnus greenei	
Chrysothamnus nauseosus subsp. *bigelovii*	Bigelow rabbitbrush
Eriogonum leptophyllum	
Gutierrezia sarothrae	snakeweed
Sarcobatus vermiculatus	greasewood
Yucca angustifolia	soapweed yucca
*Lycium pallidum**	pale wolfberry
Trees	
Juniperus osteosperma	Utah juniper
Populus wislizenii	Rio Grande cottonwood

Some of the above species are not necessarily the most suitable for revegetation in the study area because their presence is a result of overgrazing. In some instances, more suitable species which previously existed at the study area have been replaced with less desirable invading species. Those species in the above tabulation which are considered to be suitable for revegetation are marked with an asterisk. A list of additional species which were likely present in the general area in the past and which are thought to be suitable for revegetation considering projected postmining land use is tabulated below.

Scientific name	Common name
Grasses	
Bouteloua hirsuta	Hairy grama
Muhlenbergia torreyi	Ring muhly
Sporobolus cryptandrus	Sand dropseed
Shrubs	
Artemisia nova	Black sagebrush
Ephedra sp.	Mormontea
Atriplex confertifolia	Shadscale

Federal regulations also require that postmining distribution of species be the same as premining distribution. Figures I-1 and I-2 show vegetation patterns at the study area. Other data required in order to conform to federal postmining species distribution requirements would be obtained when the mining plan is prepared.

Site appropriate seed mixes and seeding rates should be determined by BLM. Seed availability may be questionable for some of the above species. A test-plot program should provide information about successful species, mixes, and seeding rates.

Adapted introduced species (second priority)--Because of the climate of the study area, no introduced plant species are recommended for seeding. However, research by other agencies and mining companies and a test-plot program may reveal suitable introduced species for the study area.

Nutrient deficiencies--additives. Fertility analysis of the planting media was not performed. Replacement of suitable soils should allow existing plant growth of the study area to be reestablished. Use of fertilizer (N_1P_1K) and additives (H_2SO_4, Gyp., etc.) should enhance plant growth, but tests are required to confirm this and to establish the fertility of other overburden materials. A test-plot program should provide information.

Irrigation. Obtaining sufficient irrigation water at the Ojo Encino study area may be a critical consideration. Because of the semiarid climate, postmining establishment of vegetation at the study site without irrigation will be difficult. Without irrigation, timing of seeding will be crucial and will have to occur when moisture from rain or snow is present; but precipitation at the study area is erratic. Moisture may not be present when most needed to support newly seeded areas. With no moisture or vegetation to hold the soil, wind erosion could carry off the soil and the seeds or leave the seeds exposed. The seeds could be planted again; but the soil would be lost. The erratic precipitation patterns might produce too much moisture--a cloudburst (not uncommon at the study area) that could sluice off the valuable unprotected soil. If there is moisture at the right time and in the right amount, the seeds would germinate. Then, if the next rain is too hard, the seedlings will be carried off with the eroded soil; or if the rain is inadequate, the seedlings will wither and die. In either event, the topsoil would again be susceptible to wind erosion.

If irrigation is practiced as recommended by some authorities, seeding would not be so subject to the study area's erratic rainfall patterns. Germination and young-plant growth would be quickly established and securely supported. The chance of wind or water erosion would be considerably less. A denser plant population would become established. If some plants died when irrigation was removed, the denser population should increase the chances that some plants will survive. The shock of removal of irrigation would be lessened by gradual withdrawal of irrigation.

Some authorities hold that the shock of removing regular fertilization and irrigation will seriously weaken or kill new plants, and that revegetation should accordingly be accomplished without irrigation. At the nearby Navajo Coal Mine, irrigation is being used to grow vegetation on spoil material. This irrigation program should be investigated to learn whether success has been achieved.

Although additional research is needed to resolve this controversy, the authors of this report believe that temporary irrigation has the best chance of producing quick, successful revegetation at the Ojo Encino study area. A test-plot program should confirm the effectiveness of irrigation.

Another question concerns economics. Assuming water supplies for irrigation are technically feasible, it should be determined whether it is economically feasible to irrigate at the study area: One approach to such a determination would be to compare the cost of irrigation for 2 years to the cost of 10 successive years of seeding (including the cost of erosion control). The latter alternative might be required in order to establish vegetation without irrigation because of the erratic rainfall patterns and other harsh climatic and soil conditions at the study area.

Use of irrigation does not affect the plans for revegetating the study area presented in this report. The only difference would be that revegetation under irrigation should occur sooner and more successfully. If irrigation is chosen, plants would be irrigated for their entire first year, receiving 15 inches of water. The following year they would receive one spot irrigation of about 2 inches during the growing season to wean them from irrigation.

Alternative irrigation systems would be "solid set" (best); "hand move" (next best); and "side roll" or "center pivot" (next best).

About 1/3 of the planting media are coarse textured with a low available water-holding capacity (about .75 to 1.75 inches of water per foot of media). However, placing finer textured soils or weathered bedrock (both having limited permeability) under the coarse-textured planting media will increase the amount of water the latter can hold to about 2.2 inches per foot of media. With a recommended average depth for the coarse-planting media of about 14 inches, the average amount of available water should be about 2.5 inches. Light and frequent irrigations keeping the surface few inches of planting media moist should keep all of it moist, and enable germination, young-plant growth, and maintenance of vegetation.

Mechanical manipulation of in-place planting media will be necessary only if nonsandy planting media are used.

In areas where drainageways collect water in sufficient quantities to cause erosion, water spreaders should be considered. Water spreaders are systems of dikes designed to divert floodwater from a gully onto adjacent rangeland. Because of the normal low rainfall in this area, it can be expected that water spreaders would come into play only during rains of high intensity and during periods of rapid snowmelt.

A test-plot program should provide information on the above techniques.

Seeding methods. Test plots and fertility tests should provide information about seeding methods. More than one seeding may be required, especially if irrigation is not practiced. The time of year when seeding should take place will depend on the particular seed mix being planted. Reclamation should be scheduled so that seeding takes place soon after final grading in order to avoid surface erosion. The species to be planted at the study area will have optimum seeding depths. Selection of the manner of seeding (see below) should be based on these depths. Seed may be planted by drilling with either an approved disk or shoe-type grass drill; by using an approved hydroseeder; or by mechanical or hand broadcasting. Drilling is the preferred method.

Drill seeding--Sowing the seed mixture with either an approved disk or shoe-type grass drill is acceptable. If this method is used, the drill shall be regulated to uniformly distribute the seed at the rate specified for the site. Where possible, drilling shall be done on the contour or parallel with the slopes being seeded. The drill shall be regulated so that the seed is properly placed in the soil and covered with soil to the specified depth. If fertilizer is to be applied during seeding, the drill could be equipped with an approved fertilizer attachment for distributing fertilizer at a specified rate simultaneously with the drilling of the seed.

Hydroseeding--Seeding with an approved hydroseeder will be acceptable provided wind velocities permit uniform distribution of seed and nitrogen fertilizer slurry on the areas to be seeded. In hydroseeding operations, the mixture of seed and the fertilizer specified shall be properly mixed with water to form a slurry. The slurry mixture shall be prepared immediately prior to application and shall be promptly applied on the areas to be seeded and fertilized. Slurry mixtures prepared more than 1 hour prior to application are not acceptable. The hydroseeder shall be designed to assure that seed and fertilizer are uniformly applied at the recommended rates per acre. The hydroseeder shall be equipped with a paddle-type agitator and recirculation pump that will continually stir and mix the slurry to prevent settling of solids in corners and at the bottom of the tank and to maintain a uniform mixture of seed, fertilizer, and water at all times during the entire seeding operation. Immediately after the slurry mixture is applied to the soil surface, the seed shall be properly covered with soil to the specified depth.

Mechanical broadcasting--A mechanical broadcaster of either the centrifugal type or pull type similar to fertilizer spreaders are acceptable. Any equipment of this type used for broadcast seeding shall be designed and regulated to assure that the proper seeding rate per acre is uniformly applied on areas to be seeded. When this method is used, seed and fertilizer may not be applied in the same mixture simultaneously; each shall be broadcast separately.

Hand broadcasting--Hand broadcasting may be performed on small, inaccessible areas. Seed application may be performed by using an approved hand broadcaster or by broadcasting the seed by hand from a sack or other suitable container. Whichever means is used, the seed shall be uniformly applied at the specified rate. When using this method, the seed and fertilizer shall be broadcast separately. Hand broadcasting is the preferred method for areas where drill seeding is impractical.

Additional seeding procedures--Monocultures should be avoided in grass stand selection. A good mix of adapted species which are drought resistant and have good sod-forming characteristics should be selected. When a range mixture is used, determination of the recommended seeding rates should include the results of test plots. Some seeds may be planted by mixing them with mulch (see below). The BLM's Farmington office can provide references to assist in choosing seeding methods.

Fertilizer application. Fertility tests and a test-plot program should provide applicable information. If required, fertilization during seeding may be done as indicated above. Later in the growing season or in subsequent growing seasons, additional light applications of fertilizer may be desirable. Timing and rate of fertilizer application should be determined by the local manager, since they will have to be based on local observation and experience.

Surface soil protection. Selected mulch material should be properly applied immediately after seeding and fertilization, and shall be anchored as appropriate. Mulching is used to stabilize critical areas and enable plants to become established quickly in the surface material. Mulching nearly always shortens the time required to establish a suitable plant cover by reducing evaporation, moderating soil temperatures to promote germination and seedling growth, preventing crust, and controlling wind and water erosion. Any substance spread, formed, or left on the surface may act as a mulch. There is a large variety of available mulching materials, including: straw, native hay, hay and other crop residues, sawdust, woodchips, wood fiber, bark, manure, brush, jute or burlap, uniform-sized coarse sand, gravel, mulch stones, peat, paper, leaves, plastic film bits, bottom ash, and various organic and inorganic liquids. In additions, commercial products and systems for protection of surface soils are available and should be considered.

Gravel or crushed rock can also be selected from overburden material and used successfully as a surface mulching material. These types of mulches have advantages over most other mulches because they are permanent if the individual pieces are no smaller than 1/8 inch in diameter. If the gravel or crushed stone pieces are no smaller than this in size, the mulch cover will withstand a surface wind velocity of 85 mi/h. To control wind erosion, the pieces must almost cover the soil surface (not less than 95 percent). The finer the gravel or crushed rock, the less material is required to cover the ground surface.

Before a mulch is selected, systematic evaluation of the advantages and disadvantages of each type should be made considering factors such as transportation problems, application problems, resistance to erosive forces, insulating and evaporation-retarding capacity, etc.

Following the mulching operation, wind barriers (snow fences) may be installed. Wind barriers will provide essential protection of the surface soils and seedlings from sustained high winds. One type of wind barrier consists of wooden-slat snow fencing material 5 to 6 feet in height. These fences should be installed perpendicular to the prevailing winds during the winter and spring seasons and should be located about 100 yards apart, or closer, if needed. The snow fence can be constructed with steel fence posts that can be driven into the soil or with wood posts that are hand set. Because of their cost and possible interference with irrigation activities, it may be desirable to limit placement of snow fences to only those areas which develop wind erosion problems after the 2-year irrigation period.

A test-plot program should provide information on mulching and fencing techniques. The BLM's Farmington office can provide references to assist in choosing mulching techniques.

Management. Grazing management is a necessity during revegetation. The new seedlings must be protected from grazing for at least three growing seasons; on the harsher sites, four or more growing seasons may be necessary. The young seedlings should not be grazed until they are firmly rooted. Adequate fencing will be required to prevent grazing by livestock during the establishment period.

Undesirable weeds may present harmful competition to seeded perennial species during the first two or three seasons after planting. It may be desirable to control these weeds through the use of selected herbicides during at least the first year of development.

Overburden Geochemistry Conclusions

Summary of area characteristics in relation to reclamation potential

The various Ojo Encino overburden rock types are congruous in their bulk chemical composition with the same rock types at other sites in the Western United States where Cretaceous age rocks overlie coal. The single major exception is higher sodium content in Ojo Encino overburden. The rocks are also generally similar in bulk chemical composition to the native soils of the San Juan Basin. 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 element concentrations in ground water. However, for determining the immediate suitability of the rock as a replacement for the soils of the study area, other factors must also be considered. These other factors were the basis for the suitability determinations previously discussed in this section under the heading Selection of Planting Media and in section H.

Reclamation potential of the area based on anticipated post-mining use as designated by BLM (livestock production, watershed, and wildlife habitat)

There is no reason associable with bulk chemistry of the overburden rocks that the area should not be restorable to a condition which would allow its designated postmining use.

Major reclamation problems and measures necessary to establish conditions suitable for anticipated postmining use

It may be necessary to stockpile rocks in a segregated manner, by distinct lithic types, in order to allow replacement of rocks in the refill column in positions best suited to their particular chemical character: it would likely be desirable to place sandstone, with its potential loamy texture and comparatively low trace- and minor-element concentrations, near the top where it would have most contact with plant roots and would permit absorption of intense rain showers; it would likely be desirable to place claystone, with its higher elemental concentrations, either deep in the refill column where the reducing electrochemical potential would retard weathering and release of elements to ground water, or else in the middle of the refill column where it would be physically distant from either roots or ground water and could form an impermeable barrier to downward movement of elements from the surface and to downward loss of soil moisture.

Vegetation Conclusions

The Ojo Encino study area is located within the Fruitland Formation which is of the Upper Cretaceous Age. A general description of the formation is given by the U.S. Geological Survey (1963) and Northup (1973) as follows:

> The Fruitland Formation consists of laterally and vertically intercollated sandstones, sandy shales, clayey sandstone, gray, black and brown shales and coal seams of varying thicknesses. Scattered iron carbonates concentrations are present in the formation. This formation lies conformably on and intertongues with Pictured Cliffs Sandstone and is overlain conformably and gradationally by Kirtland Shale.

The topography for the study area and the general area is variable. Broad, gently sloping valleys are intermingled with moderately steep and rolling uplands. Deep soils are dominant in the valley bottoms and often on the valley sideslopes. Shallow soils with occasional outcrops of shales and sandstone are more common in the upland areas.

The plants present at the study area are described in section I. This, along with climatic information and soils present, gives a good indication of what the area will support in terms of plant species. Star Lake average annual precipitation is 7.97 inches. While approximately 40-50 percent of the precipitation falls during July, August, and September, nearly equal amounts fall during each of the remaining months. Mean maximum temperatures at Star Lake are 65° F, while the mean minimum temperatures are 30° F. Snowfall is common during the winter. Because of these climatic conditions, the study area is placed in a resource region represented by cold, moist winters, with winter moisture approximately equal to that of summer moisture (New Mexico Interagency Committee, 1973 b). (However, actual winter moisture (precipitation) at the study area is about one-half the summer moisture (see section D).)

Climatic conditions, with cool temperatures and moisture available throughout the year, along with observations of vegetation present on the study area indicate a mixture of warm- and cool-season plant species are capable of growing in the area. Aggregation of species dominants will occur throughout the area as a result of the soils present at a specific location.

Soil associations throughout the northwest portion of New Mexico are quite varied. The intermingling of many of these soils results in subtle, minor shifts of potential dominant plant species with no distinct patterns for potential vegetation classification having been determined (Donart et al. 1978). Similarly deterioration of the vegetation through mismanagement generally results in even more similarity of vegetation across even greatly differing soils with different potentials.

The Ojo Encino study area is located in a harsh environment and successful reclamation will be a result of skill, careful judgement, and close evaluation of soil and spoil conditions from the premining period through establishment. Virtually no published research exists for reclamation in the Four Corners area. The only organized field research studies for similar conditions have been conducted at the San Juan Power Plant (Western Coal Company) and Four Corners Power Plant (Utah International, Inc.). Evaluations on overburden properties have been conducted at the Consolidation Coal Company - El Paso Natural Gas Company location. Field-scale reclamation efforts have been undertaken by several coal companies in the area. Utah International, Inc. has probably reclaimed more acreage under similar environmental conditions than any other company.

In addition to limited knowledge, regulations regarding reclamation may not be finalized. The Surface Mining Commission of New Mexico established reclamation procedures several years ago in the absence of any substantial Federal legislation. However, the Surface Mining Control and Reclamation Act was enacted on August 3, 1977; Office of Surface Mining final rules were published on December 13, 1977, in 30 CFR 700; and BLM final rules were published on July 19, 1979, in 43 CFR 3400. New Mexico legislation will likely follow this Federal format if the State considers it adequate. If the Federal legislation is considered too lenient, more strict regulations may occur for specific situations. Because of the wide variation in surface mining situations as a result of type of mining activity and regional differences in reclamation response, specific legislation affecting New Mexico may be necessary.

As a result of environmental conditions, poor soil development is common under natural conditions. Overburden material when repositioned as spoil, may not differ substantially from the original soil. Properties of overburden material, like original soils, may vary substantially from one location to another (Rai et al. 1974; Gould et al. 1977). While substrata from sandy surface soils might be heavy in clay materials, substrata from barren, or badland, situations may actually have better properties for vegetative growth. Throughout the mining procedure, shaping, and seedbed preparation, the substrata materials are subject to mixing and relocation to the extent that site specific evaluations over the original location of the overburden may become meaningless. For these reasons, it is wise to approach reclamation as a reseeding venture in a harsh environment as related to the spoil properties of the finished seedbed.

Following mining, spoil shaping and seedbed preparation are the first steps of concern. Outslope shaping is recommended to be at least 1v:2h as per proposed Federal legislation. Other recommendations are for slopes of 1v:3h. Such slopes should not be intrusive and should allow for access of mechanical equipment for revegetation. Interior slopes have been suggested at a slope of 1v to 6.5h. Proposed Federal legislations calls for interior slopes in harmony with surrounding topography, which will likely be a similar slope ratio. Following slope preparation, final shaping to allow for access of mechanical equipment for seeding must follow.

Soil amendments for the purpose of increased water infiltration should be considered as the rule rather than an exception. Amendments may include single or combinational treatments of the overburden with repositioned topsoil, straw-mulch, or bottom-ash residue from coal processing. True topsoiling properties from the soils present in the study area are limited. Most of the suitable topsoil, in terms of amount and desirable properties, would be found in the sagebrush vegetation zone. Soils supporting vigorous growth of sagebrush generally have suitable properties for revegetation. However, at the study area, the soils present do not support vigorous growth of sagebrush and have erosive characteristics, which make a topsoiling-by-layer application questionable. Upon chemical and physical analysis of these soils, it may be determined that they are quite suitable for amendment properties through incorporation with the top 6 to 12 inches of spoil material. Straw or bottom ash, when incorporated in the surface layer of the spoil material, provides amendment properties improving water-holding capacity and revegetation response.

Because of limited water for plant growth, a cover crop of annuals for seedbed preparation is generally not recommended. If a straw mulch is used, volunteer plants from the straw usually are prolific and may create competition with the seeding mixture. Light controlled grazing is generally selective to the volunteer plants and may be beneficial.

Generally, fertility of the spoil material is not a limiting factor to plant establishment. More important may be the sterility of spoil material to soil microbes. Usually wind action after 1 to 3 years will inoculate spoil material to an acceptable level. Application of fertilizer, especially nitrogen, at the time of seeding may cause fertilizer burn to new seedlings. Topdressing following establishment has not been investigated but might have value for specific locations.

In an 8-inch rainfall region, water for germination of seeded plants will be the most limiting factor. In years of high spring and early summer precipitation, establishment under natural conditions may be possible. Situations such as this are limited in occurrence, and for insurance of germination and establishment, considerations for supplemental watering are in order. Application of 6 to 10 inches of additional water in three to four application treatments during the first growing season, followed by 2 to 3 inches in the spring of the second season, appears to be satisfactory for plant establishment.

Planting techniques should use native or introduced plants suited for the area (table C-1). Under irrigation, planting can be effectively implemented from early June through the middle of August. Seed should be planted with a deep furrow type rangeland drill, capable of withstanding moderate abuse and strain from the undulating terrain. Seed should be placed as close to 0.5 inches below the spoil surface as possible and weights used to firm the surface. Indian ricegrass, an important component of the vegetation, requires slightly different seeding. Ideally, it should be seeded alone to a depth of 1.5 to 2 inches. Even with irrigation, seeding in late August or early September appears to increase establishment.

Table C-1

Species suitable , most adaptable soil types and recommended seeding rate for single species application in pounds of pure live seed (PLS) per acre for reclamation purposes

Species	Soil Type	Recommended seeding rate, lbs PLS/Ac.
Crested wheatgrass (*Agropyron desertorum*)	Loam	7
Indian ricegrass (*Oryzopsis hymenoides*)	Sand, loam	7
Pubescent wheatgrass (*Agropyron trichophorum*)	Loam, clay, salty	18
Siberian wheatgrass (*Agropyron sibericum*)	Loam	7
Thickspike wheatgrass (*Agropyron dasystachum*)	Loam	6
Alkali sacaton (*Sporobolus airoides*)	Loam, clay, salty, wet	1
Blue grama (*Bouteloua gracilis*)	Sandy, loam, wet	3
Western wheatgrass (*Agropyron smithii*)	Loam, clay, salty, wet	12
Galleta* (*Hilaria jamesii*)	Sandy, loam, clay, salty	6
Sand dropseed (*Sporobolus cryptandrus*)	Sandy, loam	1
Sideoats grama (*Bouteloua curtipendula*)	Sandy, loam	10
Spike muhly (*Muhlenbergia wrightii*)	Sandy, loam	1
Fourwing saltbush (*Atriplex canescens*)	Sandy, loam, clay, salty, wet	10
Shadscale* (*Atriplex confertifolia*)	Clay, salty, loam	6
Winterfat* (*Ceratoides lanata*)	Loam, sandy	10

* Seed not commonly available, or in very limited supply.

Broadcast application of seed is not advisable. Should broadcast seeding be necessary in specific locations, an increase in the recommended seeding rate (table C-1) by 60 percent is recommended.

Seeding recommendations (table C-1) are for single species application rates. To create a mixture and the proper amount of each species, the percentage of each species in the mixture is established and multiplied by the single species rate indicated. Thus, the information provided in table C-1 allows for creating different species combinations for the soil conditions present.

Hydrology and Water Supply Conclusions

Effects of surface mining and subsequent reclamation on hydrology

Potential changes in runoff and sediment yield. The mining companies are required by Public Law 95-87, the Surface Mining Control and Reclamation Act of 1977 (SMCRA), and subsequent enforcement provisions, to reclaim the spoil piles in mined areas. During the mining and reclamation phase, runoff from the spoil piles would probably exceed the suspended-sediment discharge effluent limitations. The runoff exceeding effluent limitations could not be discharged downstream except when resulting from precipitation having a frequency greater than that expected from a 24-hour storm with a 10-year recurrence interval. These structures would reduce peak discharges and runoff volumes from storms with recurrence intervals greater than 10 year. The sediment yield during mining and prior to complete reclamation would be zero except during runoff resulting from a 10-year storm during which the sediment yeild would probably be greater than under natural conditions for an individual storm. Total sediment yield during the mining and reclamation phase should be less than would have occurred under natural conditions.

The mining companies are required by the enforcement provisions of SMCRA to grade the spoil piles to approximate premining or lesser slopes as specified by the regulatory authority. Next, the graded spoil piles are covered with topsoil which is saved for this purpose and revegetated to equal or better than premining conditions. 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 difference in runoff characteristics and sediment yield from reclaimed spoil-pile areas caused by mining. Peak discharges and sediment yields may even be less if the slopes are reduced.

Flood plains. The flood plains of the streams within the Ojo Encino study area have been delineated by the Federal Insurance Administration (U.S. Department of Housing and Urban Development, 1978). All of the streams within the study area are ephemeral and the flood plains are undeveloped.

Compliance with water-quality regulation of Public Law 95-87. Public Law 95-87 (SMCRA) and subsequent Surface Mining Reclamation and Enforcement Provisions prohibit the discharge of water from mined areas with maximum values greater than 7.0 milligrams per liter (mg/L) total iron, 4.0 mg/L total manganese, or 70 mg/L suspended sediment unless the discharge results from a precipitation event larger than a 24-hour event with a 10-year recurrence interval. The average daily values for 30 consecutive discharge days can be only one-half these amounts. Water resource information collected on surface runoff near the study area and ground water in the zones that would be distributed at the study area indicate these waters cannot meet the manganese or suspended-solids effluent limitations of the enforcement provisions for SMCRA under natural conditions. Meeting the requirements for pH may not be a problem because all samples at the streamflow gaging sites near the Ojo Encino study area have been within the allowable range of 6.0 to 9.0.

Probable impacts on hydrologic budget. Surface mining for coal and subsequent reclamation may have some impact on the hydrologic budget at the Ojo Encino study area, but the effect would probably be small. The study area does not directly recharge any major water-bearing information. However, about one square mile along the east side of the study area provides some runoff and potential recharge to the alluvium of Torreon Wash. All other streams draining the study area are tributary to Torreon Wash some distance downstream.

Surface mining for coal will fracture the stratified overburden, water-bearing coal seams, and all confining layers above the Pictured Cliffs Sandstone within portions of the study area, replacing them with crumbled shale and sandstone rubble having a porosity greater than the original stratified material. The water quality in the coal seams is variable, but may be better in general than either the water-bearing portions of the overburden or underlying water-bearing Pictured Cliffs Sandstone formation. At present, no known use is being made of these three water-bearing units within the study area. The greatest probable impact to the porous crumbled shale and sandstone rubble may be the potential for upward leakage and recharge from the underlying Pictured Cliffs Sandstone, which is more saline than the waters within the coal seams at some locations. A confining layer of shale is above the deepest coal seam at DHOE3. The potentiometric surface is about 60 feet above the top of the Pictured Cliffs Formation at drill hole DHOE2. Another possible impact may be recharge to the porous rubble from piping. Piping, which is occurring in some areas nearby with the same surficial geology, may deprive downstream water users.

There is a potential for recharge to the crumble shale and sandstone rubble from channels that will be constructed after mining to replace the existing ephemeral streams traversing the Ojo Encino study area. The amount of recharge depends on the volume of runoff and the extent to which the bed and sides of the constructed channel will retard leakage. The precipitation on reclaimed areas will probably remain in the root zone to be utilized by vegetation, except when excess precipitation occurs. Assuming the leakage from the constructed channels and the surface material and topography are similar to premining conditions, there may be no long-term adverse effects from surface mining and reclamation at the Ojo Encino study area.

Water supply

Suitable supplies for reclamation. The SMCRA requires mined areas to be restored to equal or better than premining conditions. Assuming the Ojo Encino study area would be restored for domestic livestock grazing and wildlife habitat (present use), reclamation of vegetation within a reasonable period of time may require irrigation at this low precipitation area.

Water for reclamation may be developed from surface-runoff and ground water supplies. Although surface runoff has the best water quality at the study area, this supply may not be reliable because of the unavailability during drought periods when the need is greatest. A reliable supply in terms of quantity could probably be developed from any of four deep aquifers. The quality appears questionable for a reclamation supply because of high salinity and high sodium-adsorption-ratio (SAR) values. The Cliff House Sandstone and Morrison Formation may have lower sodium and slaine concentrations than the Menefee Formation and Entrada Sandstone. Wells would have to be drilled, developed, tested, and analyzed for water quality to determine the yields and quality of this supply at the Ojo Encino study area.

Water-quality characteristics of supply for reclamation need to be considered at the Ojo Encino study area. The effect of high salinity on vegetation is to retard water availability by increasing the affinity of moisture to the soil, whereas high SAR values decrease water infiltration into the soil by dispersion and swelling of the soil (Ayre, 1976). The U.S. Salinity Laboratory has classified water with a specific conductance greater than 4,000 micromhos per centimeter at 25 degrees celsius as a very high salinity hazard or an SAR value greater than 18 as a high sodium hazard for irrigation (Boyko, 1966). Water with adjusted SAR values ranging from 9 to 24 represent a severe problem for irrigation depending on the dominant clay in the soil (Ayers, 1976). These classifications of water are based upon continued irrigation for domestic crops. The use of water with higher specific conductance and SAR values than those specified by Boyko or Ayers during short-term irrigation may be endured by salt-tolerant native vegetation used for reclamation purposes. The specific conductance of the Cliff House Sandstone is estimated to be 2,000 to 4,000 micromhos and 3,000 to 5,000 micromhos for the Westwater Canyon Member of the Morrison Formation at the study area. Based on limited information, the SAR and adjusted SAR values for the Cliff House Sandstone and Morrison Formation may be greater than 18.

Other water-quality characteristics which need to be considered to determine a reclamation supply include bicarbonate and trace-element concentrations. Bicarbonate with calcium tends to reduct the permeability of soil by chemical precipitation of calcium carbonate. This decreased permeability is taken into account in the adjusted SAR value. Trace elements at the study area such as boron, which most domestic crops are sensitive to, and selenium, which may be concentrated to levels toxic to foraging livestock, are not at levels regarded as being detrimental to plants or livestock.

Since the quantity of surface runoff is questionable and the quality of ground water is marginal as reclamation supplies at the Ojo Encino study area, there may be a need to investigate revegetation experiments without supplemental irrigation.

Suitable supplies for the mining operation. An adequate and reliable supply of water can be developed from a number of deep aquifers available at the study area since the water-quality requirements for the mining operation are not stringent. The primary uses of water are for coal washing and dust control.

SECTION D

CLIMATE

SECTION D

CLIMATE

Distant high mountains shield this area from shallow intrusions of extremely cold air in winter. Mountains also block the area from much Pacific air precipitation, and before reaching northwestern New Mexico, air from the Gulf of New Mexico loses most of its moisture. This lack of precipitation is an important aspect of the climatic picture which emerges from the data that follows. The Ojo Encino study area is in an area where all climatic factors typical of the semiarid plains grasslands are found. *

Chaco Canyon National Monument is the nearest long-term meteorological station to the Ojo Encino study area. It is located about 30 miles northwest of the study area at an elevation of 6,175 feet. All climatological data from this weather station is assumed to be applicable to the study area which is at an altitude averaging 6,650 feet.

Temperature

Based on data from this station, the Ojo Encino study area has an average annual temperature of 49.7. Average monthly temperature (° F) for the study area were as follows:

January	27.5	July	73.1
February	33.5	August	70.8
March	39.5	September	62.8
April	48.0	October	51.3
May	57.0	November	37.6
June	66.5	December	29.0

Extreme temperatures in San Juan County are 110° F and -35° F. Temperatures rarely reach 100° F, however, and on only a few days a year fall to zero or below. The average daily range of temperatures is about 33° F. Frequent freezing and thawing of the surface takes place in December through March, when nighttime temperatures average below freezing.

Freeze data for the Ojo Encino study area were based on the 1966-1975 records for Chaco Canyon, which are summarized in table D-1.

* Note that the average annual precipitation of 8.8 inches for Chaco Canyon is typical of arid areas.

Table D-1
Study Area Freeze Data
Chaco Canyon (elevation 6,175)
(degrees F)

	Date last spring minimum of			Date first fall minimum of			No. of days between dates		
	24°	27°	32°	32°	28°	24°	24°	28°	32°
Earliest	4/12	4/30	5/16	8/21	8/24	8/29			
Latest	5/23	6/26	6/26	10/9	10/15	10/16			
Average	5/11	5/29	6/5	9/19	9/26	10/2	145	120	106

Precipitation

Average annual precipitation at Chaco Canyon is about 8.8 inches. Monthly precipitation for the study area in inches is as follows:

January	0.39	July	1.19
February	0.52	August	1.41
March	0.60	September	1.15
April	0.40	October	1.04
May	0.60	November	0.47
June	0.38	December	0.61

As can be seen, half of the annual precipitation occurs in late summer and early fall, when thunderstorms are most active. These are localized, often intense storms, which can cause flash flooding and heavy erosion.

Some variations are expected in these average values. Near the study area, annual precipitation ranges from about 3 to 14 inches.

The amount of total precipitation which is effective can be directly related to intensity of precipitation. Generally, effective precipitation is determined on a monthly basis with the first inch considered 95 to 100 percent effective. Determining effective precipitation this way, on an average basis, the annual precipitation of 8.8 inches at the Ojo Encino study area appears to be close to 7 inches of effective precipitation. Under certain soil and slope conditions--such as soils with low infiltration rates and steep slopes--this figure will be much less.

The snowfall season is November through April, with an annual average total of about 9 inches. Hail occurs occasionally in association with the late summer and early fall thunderstorms.

Other Climatic Characteristics

While winds at higher altitudes move generally from west to east, surface winds are greatly modified by local topography. During much of the year, high-pressure systems and fair weather are dominant; calms are frequent but usually short in duration. Surface winds move up the valley slopes during the day and down the slopes at night. Spring is the windiest season, with winds averaging 10 miles per hour. Wind speed is highest, however, during the summer months. Strong winds up to 25 miles per hour are most common from the west. Very strong winds, occasionally up to 70 miles per hour, are associated with local thunderstorms and thus are of short duration. In the San Juan Basin, particularly in the Chaco River drainage area, the dry exposed topsoil, scanty vegetation, and turbulent winds cause much blowing dust during the dry months from November to April. Dust devils, vertical vortexes of rapidly moving dust-laden air, are common in the summer.

Average relative humidity is nearly 50 percent, ranging from 70 percent in early morning to 30 percent in the afternoon. In late spring and early summer, afternoon relative humidities are 15 to 20 percent.

Pan evaporation at Farmington is 49 inches annually. It may be as much as 25 percent greater at higher plateau locations where there is greater wind movement.

Effect of Weather on Study Area Revegetation

Several weather-related factors will definitely have adverse effects on revegetation of the Ojo Encino study area. Low annual precipitation rates compounded with erratic distribution patterns and high summer storm intensities create unfavorable conditions for unadapted species seed germination and plant growth. The effectiveness of the incoming precipitation is further reduced by the occurrence of shallow soils over some of the area and by relatively low soil infiltration rates. Strong spring winds tend to remove soil moisture that could otherwise be utilized in seed germination, seedling establishment, and general plant growth. Dry, cold, windy winters may also result in relatively high percentages of winter-kill among recently established vegetation.

Climate and Aspect (Exposure)

South-facing slopes at the study area will characteristically be subjected to more droughty conditions than slopes with northern aspects or exposures. These droughty conditions result primarily from the prevailing dry west and southwest winds and from higher temperatures due to greater amounts of incoming solar radiation. Soil movement due to wind erosion may expose the tender roots of plant seedlings or bury the seedlings entirely.

Evapotranspiration Demand

The Ojo Encino study area has an estimated annual pan evaporation rate of about 55 inches and an annual precipitation rate of only 8.8 inches. High temperatures, low precipitation rates, low humidities, and regular winds result in plant moisture deficits far exceeding available annual moisture levels. This is especially true during the summer growing season. Therefore, revegetation of the study area must be accomplished using native plant species characteristic of the immediate area, which have shown the adaptations or inherent abilities to withstand the high summer moisture deficits.

SECTION E

PHYSIOGRAPHY, RELIEF, AND DRAINAGE; GEOLOGY

SECTION E

PHYSIOGRAPHY, RELIEF, AND DRAINAGE; GEOLOGY

Physiography, Relief, and Drainage

The study area is situated in the Navajo Physiographic Section of the Colorado Plateau Physiographic Province, which in turn is the Intermontane Plateau, a major physiographic division of the United States.

The Navajo Physiographic Section comprises a large region of northwestern New Mexico and northeastern Arizona. The bold contrasts of the section's landforms are characterized by young plateaus, mesas, hogbacks, retreating escarpments, and debris-choked dry wash canyons. Though there are numerous cliffs and escarpments, talus accumulations are rare. Precipitation is low to moderate, the latter at the higher elevations. The section's San Juan River is the only stream which collects runoff from outside the section. Vegetation consists mostly of sagebrush, bunch grasses, and their associates. In places, vegetation gives way to bare soil, bare rock badlands, or active sand dunes.

The physiographic subdivision of the Navajo Section which contains the study area is the Chaco Plateau. Boldly scarped, rolling, broad plains and mesas characterize the Chaco Plateau. Youthful canyons of badland topography indent the abrupt escarpments bordering the uplands. Wide swales trenched by sand-choked dry wash canyons are starkly cut into the plains. The effects of erosion by wind and water are graphically evident, and landforms are determined by the relative resistance and attitude of the rock formations.

The study area is located on the southeast side of the Continental Divide between Ojo Encino Mesa and Little Blue Mesa. The low hills and gently rolling terrain are almost barren except for sparse grass cover. (Figure E-1 shows the topography of the study area.)

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. Several dry washes in the north-central portion of the study area near the toe of Ojo Encino Mesa have gradients of 100 feet per mile. Thin to nonexistent soil cover and vegetation, the poorly pervious nature of some soils and underlying rock formations, and relatively steep gradients are primary factors which could result in high runoff. Infrequent but sometimes intense rainstorms change the otherwise dry sand-choked channel of Torreon Wash to a raging sediment-laden torrent.

Elevations in the north-central portion of the study area range from 6,620 to 6,720 feet, the eastern portion ranges from 6,600 to 6,682 feet, and the hill in the far western portion ranges from 6,630 to 6,701 feet. The remainder is gently rolling terrain with elevations ranging from 6,600 to 6,640.

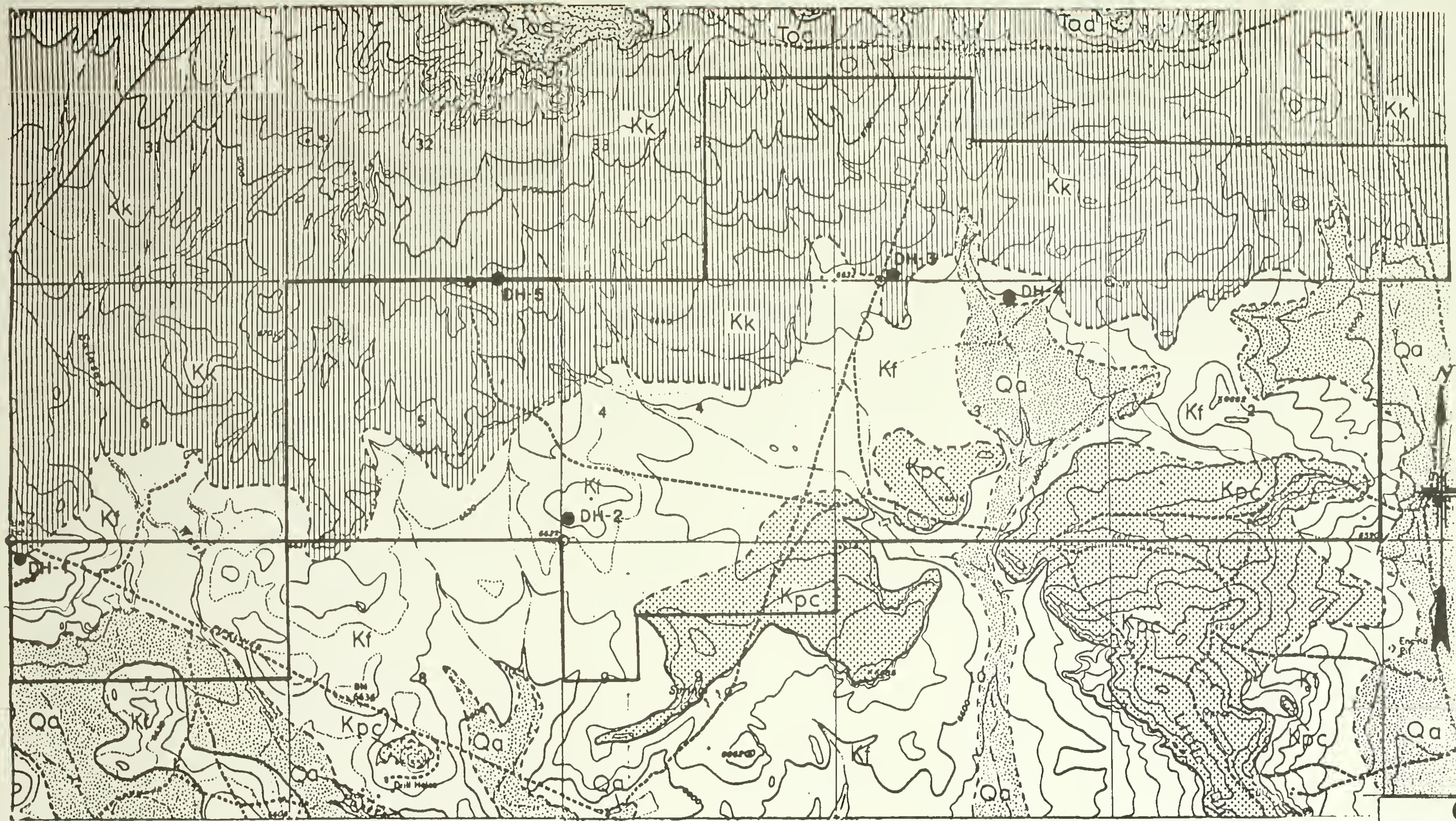
Geology

Regional geology

The major structural element of the region which includes the study area is the San Juan Basin--a circular, intermontane, structural element encompassing a large region of northwestern New Mexico and southwestern Colorado. Structural elements of the basin are shown on figure E-2. The basin is one of several interspersed or embayed into the ranges of the Rocky Mountains between New Mexico and Canada. The boundaries of the basin are in places sharply defined by monoclinal folding and associated hogbacks, or by faulting, while in other places the basin merges into adjoining depressions or uplifts. The basin is asymmetric, its axis being located in the northeast quadrant of its Central Basin. The Central Basin has a broad south limb dipping gently northward, on which the study area is situated, and a narrower, more steeply dipping north limb. Thus, the study area is in ths southeastern quadrant of the Central Basin of the San Juan Basin. The rocks within the Central Basin and study area are clastic sedimentaries of Late Cretaceous age. They are undistrubed by faulting, though a few broad folds with gentle dips are reported. Gas production within the Central Basin is largely from stratigraphic traps.

The San Juan Basin contains clastic and minor chemical sedimentary rocks ranging in age from Cambrian to Quaternary, having a maximum total thickness exceeding 14,000 feet in the deepest or axial northeastern part of the basin. The nomenclature, ages, and surface distribution of the rocks pertinent to the study area are shown on figure E-3.

The varied rock sequence of the San Juan Basin reveals many epochs of marine and nonmarine deposition. A complex sequence of Paleozoic sandstone, conglomerate, limestone, shale, gypsum, and a number of unconformities attest to alternating cycles of submergence and emergence. During the Mesozoic Era, the San Juan Basin was primarily an emergent area at which time fluviatile sediments of sandstone and shale were deposited. During the early part of the Late Cretaceous Epoch, however, seas advanced across the area, depositing the transgressive Dakota Sandstone and marine Mancos and Lewis Shales. The onset of the Laramide orogeny in the Late Cretaceous Period resulted in a retreat of the sea and deposition of the regressive Pictured Cliffs Sandstone. The superjacent Fruitland Formation contains carbonaceous shale, sandstone, siltstone, and coal which were laid down in swamp and flood plain environments on coastal lowlands adjacent to the westward-retreating Cretaceous sea. The Kirtland Shale, which overlies the Fuitland Formation, consists of Upper and Lower Shale Members and a Middle Sandstone Member which represent swamp, flood plain, and channel deposits. As the Cretaceous Period closed, increasing orogenci activity and vulcanism flooded the San Juan Basin area with detritus, which constitutes the McDermott Member and other parts of the Animas Formation and parts of the Ojo Alamo Sandstone. Orogenic and volcanic activity continued well into Paleocene time in the Cenozoic Era, as evidenced by andesitic detritus of the Animas Formation and fluviatile sands and silts of the Nacimiento Formation. A late



EXPLANATION

QUATERNARY

Qa Alluvium. Includes fine silty sand in De-Na-Zin Wash, Coal Creek, and tributary drainages, clayey-silty-sandy residual soils, and sandy slopewash accumulations. Also includes local areas of sandy eolian deposits.

CRETACEOUS

Kk Kirtland Formation. Predominantly shale with lesser amounts of interbedded sandstone and siltstone.

Kf Fruitland Formation. Predominantly shale, organic shale, and coal with interbeds of sandstone and siltstone.

Kpc Pictured Cliffs Formation. Predominantly sandstone with minor interbeds of shale.

Approximate Geologic Contact

1000 0 1000 2000 3000 4000 5000

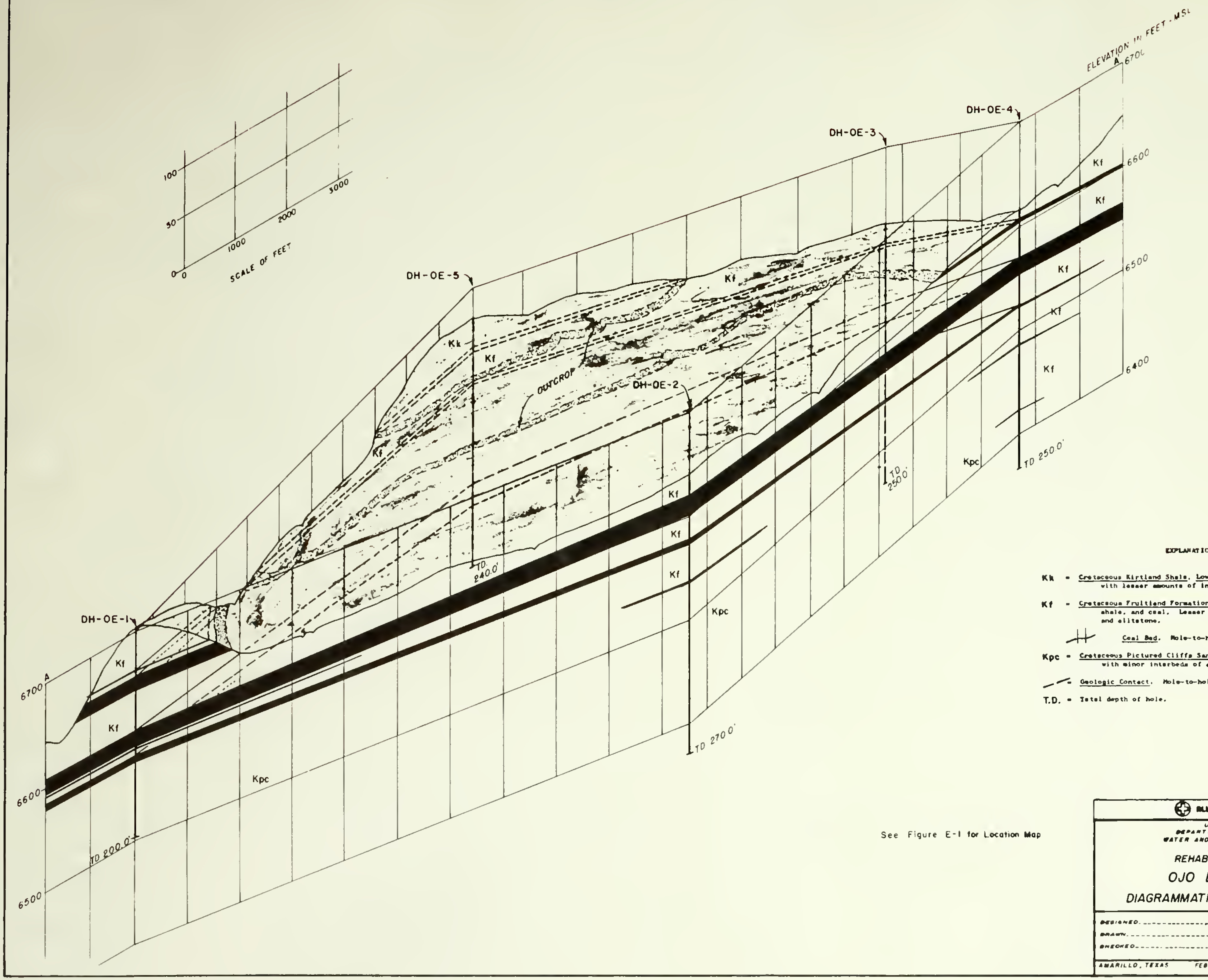
SCALE OF FEET

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
WATER AND POWER RESOURCES SERVICE
STRIP MINE REHABILITATION STUDY
OJO ENCINO SITE
GEOLOGIC MAP

DRAWN.......... SUBMITTED..........
TRACED.......... RECOMMENDED..........
CHECKED.......... APPROVED..........

AMARILLO, TEXAS FEBRUARY 1980 FIGURE E-4



EXPLANATION

Kk = Cretaceous Kirtland Shale, Lower Member, Predominantly shale with lesser amounts of interbedded sandstone and siltstone.

Kf = Cretaceous Fruitland Formation, Predominantly shale, organic shale, and coal. Lesser amounts of interbedded sandstone and siltstone.

Coal Bed. Hole-to-hole correlations are interpretive.

Kpc = Cretaceous Pictured Cliffs Sandstone, Predominantly sandstone with minor interbeds of shale.

Geologic Contact. Hole-to-hole correlations are interpretive.

T.D. = Total depth of hole.

See Figure E-1 for Location Map

ALWAYS THINK SAFETY

UNITED STATES
DEPARTMENT OF THE INTERIOR
WATER AND POWER RESOURCES SERVICE
STRIP MINE
REHABILITATION STUDY

OJO ENCINO SITE

DIAGRAMMATIC GEOLOGIC SECTIONS

DESIGNED .... SUBMITTED ....
DRAWN .... RECOMMENDED ....
CHECKED .... APPROVED ....

AMARILLO, TEXAS FEBRUARY 1980

FIGURE E-5

episode of this orogenic activity is evidenced by the Eocene San Jose Formation, a "basin-filling" sequence of sandstone and shale derived from rising fold belts to the east, north, and west. During this episode, the prominent structural features of the basin rim were formed, including the Gallup Basin, Defiance Uplift, Hogback Monocline, Archuleta Anticlinorium, and Nacimiento Uplift. In Late Cenozoic time, the San Juan Dome was formed by volcanic activity and emplacement of intrusive igneous bodies contemporaneous with elevation of the San Juan Basin area. In relatively recent geologic time, erosion by water, wind, and glaciation has developed the present landscape, characterized by buttes, mesas, and drywash canyons in the basin, and by hogbacks, ridges, and mountains on the rims.

Study area geology

Investigations. Five Nx-size (3-inch-diameter) core holes, designated DH-OE-1A through DH-OE-5, were drilled at the Ojo Encino study area. 1/ Locations of the holes are shown on figure E-1. DH-OE-1 was abandoned at 170 foot depth when the driller lost, and was unable to retrieve, the core barrel and string of rods.

DH-OE-2 was deepened from 125.5 to 270.5 feet by drilling without coring for ground water studies by the Geologic Survey. A geologic log was not prepared for the hole below 125.5 feet; however, geophysical logging of the hole to 200 feet depth was done by the Geological Survey (GS). Two-inch-diameter perforated plastic pipe was installed in all five drill holes.

Continuous Nx-size coring was done from top of formation rock to depths sufficient for penetration of all beds of coal in the Fruitland Formation and into the underlying Pictured Cliffs Formation, except DH-OE-4 in which coring started at 19.8 feet depth. Air was used as a drilling medium in each of the five drill holes until poor core recovery required the contractor to use water. Overall core recovery was good, and was generally excellent where water was used as the drilling medium. Core recovery was excellent for all beds of coal except DH-OE-4 between depths 27.5 and 30.0 where there was no recovery and DH-OE-5 between depths 1.0 and 19.8 where a 2.0-foot coalbed was probably lost. All coal core samples were sealed in plastic bags immediately after removal from the core barrel and were shipped to the GS, Denver, for testing and analysis. The remainder 2/ of the core was shipped to the Bureau of Reclamation laboratory, Lower Missouri Region, Denver, Colorado, for physical and chemical analysis.

The study area geologic map, figure E-4, was compiled by GS using 7.5 minute quadrangle topographic maps for base.

1/ DH-1 shown on figures = DH-OE (Ojo Encino) -1A cited in text and logs.
2/ Less some core which was provided to GS for geochemical analysis.

Geology. Surficial materials in the study area consist predominantly of aeolian silty sand on gently sloping areas between Encino Mesa and Little Blue Mesa. Inactive sand dunes in the northwest portion of the study area have sparse grass and brush cover. Thin accumulations of sandy-silty-clayey slope wash derived from adjacent steep terrain occur locally within the study area. The development of residual soils and vegetative growth has been retarded over relatively large areas due to unfavorable chemical constituents in some of the underlying formation rock, moisture infiltration rates, and moisture retention capabilities of the soils.

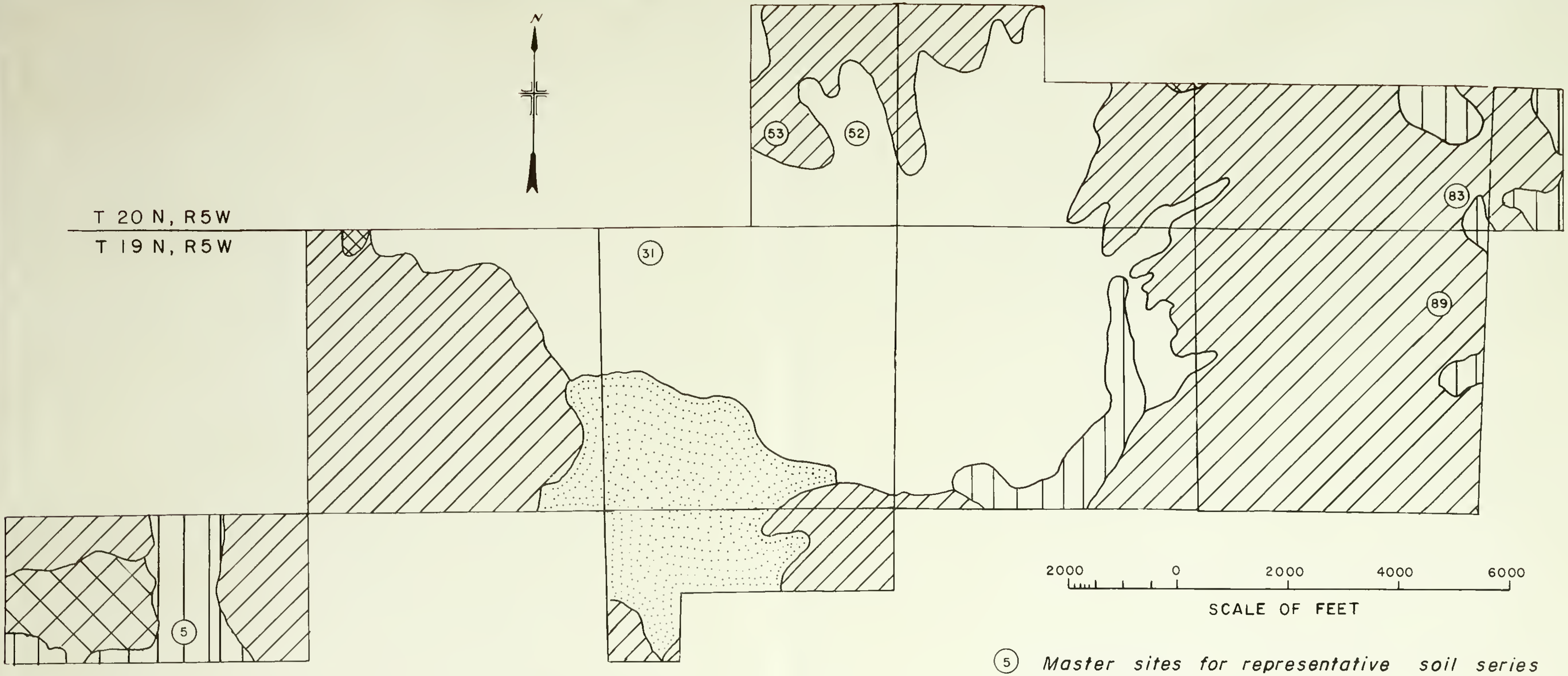
The Late Cretaceous age sedimentary rock formations outcropping over much of the region belong, in ascending order, to the Pictured Cliffs Sandstone, Fruitland Formation, and Kirtland Shale. The formations dip to the northwest, toward the axis of the San Juan Basin, at angles of less than 2 degrees; consequently, the Pictured Cliffs Sandstone which outcorps in the southeastern portion of the region is succeeded successively northward in the region, or downdip, by the outcrop belts of the younger Fruitland Formation and Kirtland Shale. Outcrops of the formations are delineated on figure E-4. Depth intervals in which the formations were cored or drilled in DH-OE-1A through DH-OE-5 are identified in interpretive notes on the geologic logs (section K).

The Pictured Cliffs Sandstone is underlain by the Lewis Shale of Late Cretaceous age, which consists of beds of clayey, silty shale and minor thin sandstone, ranging from 200 to 500 feet in thickness. The Lewis Shale in turn rests on sedimentaries of shale, sandstone, coal, limestone, gypsum, salt, and quartzite more than 10,000 feet in total thickness that range in age from Cambrian to Late Cretaceous.

The Pictured Cliffs Sandstone in the region consists predominantly of fine-to-medium grained sandstone which is silty and slightly clayey, weakly cemented and friable, massively bedded, and light gray to gray. Minor thin beds of siltstone and shale are reported in the literature. The lithology and fossils of the formation indicate the rocks were deposited in littoral and offshore marine environments at a time when the shoreline of the Cretaceous sea was regressing northeast across the region. The Pictured Cliffs Sandstone is considered one of the most important gas-producing formations in the central and northern parts of the San Juan Basin.

The contact between the Pictured Cliffs Sandstone and the overlying Fruitland Formation is arbitrarily placed at the top of the uppermost massive sandstone in the Pictured Cliffs below the lowermost coal in the Fuitland Formation. Coring at drill holes DH-OE-1A through DH-OE-5 penetrated 24.4 to 125.7 feet of the upper part of the Pictured Cliffs Sandstone. Drilling without coring in DH-OE-2 deepened the hole for ground water observation well completion.

Overburden materials in the Fruitland Formation and Kirtland Shale and materials separating the Fruitland coalbeds consist of shale, sandstone, and siltstone. The shales are clayey to silty, locally bentonitic and gypsiferous,



(5) *Master sites for representative soil series in study area*

MAJOR LAND CATEGORIES		% of Area	Acres
VALLEYS		12	480
UPLANDS		49	2020
VALLEY SIDESLOPES		30	1230
FLATS		7	300
BADLANDS		2	90
TOTAL		100	4120

NOTE: *Due to the limited acreages of same soil units, some do not have a master site location (No typical profile)*

OJO ENCINO STUDY AREA

MAJOR LAND CATEGORIES

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FIGURE H-1

carbonaceous in part, firm to soft, earthy and crumbly, fissile or laminated to massive bedded, gray, dark gray, black, or brown. Slickensided fractures are common. The sandstones are fine grained, silty, slightly clayey to locally clayey, limy, carbonaceous in part, laminated to massive bedded, soft to weakly cemented and friable, gray to light gray. Hard ferruginous-cemented concretions up to 2 feet in diameter occur in the Kirtland Shale.

The Fruitland Formation consists predominantly of shale, sandstone, siltstone, and coal. Thin beds of limestone are reported in the geologic literature to occur from place to place in the lower part of the formation; however, none were cored in drill holes at the Ojo Encino study area. The formation was laid down in flood plain and swamp environments; consequently, most rock units are discontinuous. Individual beds thicken, thin, and pinch out laterally, often within a few hundred feet. The coalbeds are the most continuous lithologic units and in places can be traced for several miles. Sandstone is usually more abundant in the lower part of the formation, while shale and siltstone are more abundant in the upper part. Based on the gologic logs for DH-OE-1A through DH-OE-5 sandstone makes up an average of roughly 44 percent of the formation, shale about 26 percent, coal about 18 percent, and siltstone about 12 percent.

The contact of the Fruitland Formation with the overlying Kirtland Shale is arbitrarily placed at the top of the highest coal or carbonaceous bed. The Fruitland Formation was found to have the following thicknesses (feet): DH-OE-4, 176.1; DH-OE-5, 162.5; DH-OE-1A, 119.6; DH-OE-3, 111.8; and DH-OE-2, 100.1. The upper part of the formation has been removed by erosion in all drill holes except DH-OE-5.

The Kirtland Formation in the San Juan Basin has been divided into three members--the Lower Shale, the Farmington Sandstone or Middle Member, and the Upper Shale. Only the Lower Shale is evident in the study area, where most of the formation has been removed by the erosion or was not deposited. According to the defined contacts, the Kirtland Formation was cored between depths 20.0 and 27.5 feet at DH-OE-5.

Interpretive stratigraphic hole-to-hole correlations of the various formational contacts and coalbeds are shown on Figure E-5, Diagrammatic Geologic Sections.

Aquifers. No recognizable aquifers or other significant ground water bodies were noted during coring. Moreover, the generally fine-grained nature of the formation rock and paucity of fracture or other types of permeability would generally preclude the presence of significant aquifers to the explored depths. Minor quantities of perched ground water occur in the Central Basin of the San Juan Basin in some areas in relatively shallow sandstone bodies. Low annual precipitation, high runoff, high evaporation, and terrain consisting of mesas, narrow ridges, high cliffs, and deep canyons usually limit infiltration to these bodies. A well with hand pump was noted in T. 19 N., R. 5 W., sec. 9, where springs are shown on the Ojo Encino Mesa Quadrangle Map. More discussion on ground water bearing units at the study area is in the Hydrology and Water Supply section of this report.

Engineering geology. The shale, sandstone, and siltstone constituting both overburden in the lower Kirtland Shale and overburden and material separating coalbeds in the Fruitland Formation are similar in engineering properties. Rock in both formations is firm to only weakly cemented, except for minor ferruginous-cemented concretions and thin beds. All excavation would be classed as common; however, blasting would facilitate excavation.

Excavations in the Kirtland Shale and Fruitland Formation would stand on near-vertical slopes for several months. Minor ravelling of slopes could be expected as the materials dry and air slake. Stability of slopes is expected to decrease with the increased moisture of wet weather (see Results of Laboratory Weathering Tests and Outdoor Exposure Tests Conducted on Core Samples, section N).

Haul roads surfaced with soil material would be unusually slick and difficult to travel during periods of wet weather. Haul roads would be unusually soft during period of alternate freezing and thawing, particularly in the spring, and would require continuous maintenance.

Some overburden materials are excessively high in sodium and salts and, therefore, may be dispersive; and some of the shales are known to be expansive. Consequently, these materials should not be used to impound large quantities of water without special treatment or design.

Table H-2

Land Class and Major Subclass Characteristics 1/

Ojo Encino Study Area

Land class or subclass 2/	Approximate acres	Major Chemical deficiency	Major Physical deficiency	Important soil and land characteristics	Suitability, stockpiling, placement, and management characteristics
All classes				All soil overburden can be stripped easily. Topography will not hinder reclamation (except on class 6, last row).	Strip, transport, and stockpile carefully to prevent unplanned mixing. Mix soils carefully as necessary to improve poorer soils. Prevent poorer soils from directly or indirectly contaminating better soils. Protect from erosion during and after stockpiling and (as applicable) after revegetation. Protect revegetated areas from grazing until vegetation is well established.
1	861	None	None	Soils are deep, have good permeability, adequate water-holding capacity, some susceptibility to wind erosion, and are nonsaline and nonsodic.	Lands are best source of planting media. Manage revegetated areas normally.
Total class 1	861				
$\frac{2s}{2_3}$ v	250	None	Coarse texture	Soils have moderately coarse texture, vary in depth, have good permeability, and adequate water-holding capacity for their class, and are susceptible to wind erosion. No major saline or sodic problems.	Lands are a good source of planting media Manage revegetated areas normally. In stockpiling, take care to prevent wind erosion.
$\frac{2s}{2_3}$ a	139	Sodicity	None	Soils are saline-sodic affected. Permeability may be poor, resulting in higher rates of runoff and erosion.	Lands are a good source of planting media. Precautions need to be taken when stockpiling that erosion and runoff do not contaminate nearby soil material with sodium.
$\frac{2s}{2_3}$ vs/$\frac{2s}{2_3}$ va $\frac{2s}{2_3}$ sa/$\frac{2s}{2_3}$ vsa 3/	157/110 123/74	Sodicity, salinity	Coarse texture	Soils are saline-sodic affected. Permeability may be poor, resulting in higher rates of runoff and erosion. Wind erosion may be a problem. Surface sealing will probably result from a combination of the sodicity and sandy surface textures.	Lands are a good source of planting media When stockpiled, soils should be protected against wind erosion and should be prevented from contaminating nearby areas with saline-sodic materials.
Total class 2	853				
$\frac{6s}{6_3}$ a	74	Sodicity	None	Saline-sodic affected soils. Permeability is slow and erosion hazard high. Surface sealing is prevalent.	Lands are not a good source of planting media. However, if mixed with better materials, these soils could provide suitable planting media. When handling, take care to avoid contaminating nearby better materials. Place unsuitable materials at lowest level in the reconstructed soil profile. Surface sealing will cause increased runoff which should be managed to prevent contamination of adjacent lands.
$\frac{6s}{6_3}$ p	208	None	Impermeable	Soil materials are impermeable and greatly subject to water erosion.	Although not recommended as a planting media, careful mixing with sandy materials could provide suitable media. When stockpiling, take care to keep runoff and erosion to a minimum. Mixing with coarse material will provide for better surface infiltration and reduced erosion.
$\frac{6s}{6_3}$ ph/$\frac{6s}{6_3}$ pha $\frac{6s}{6_3}$ psa	74/292 77	Sodicity, salinity	Impermeable, fine texture	Soil materials are saline-sodic affected, fine textured, and impermeable.	These soil materials are a very poor source of planting media. The fine textures, in conjunction with high salinity and sodicity, create a very impermeable surface, resulting in excessive runoff and erosion. When stockpiling, take care to prevent contamination of nearby lands. Place the materials as low as possible in the reconstructed soil profiles.
$\frac{6s}{6_3}$ pa/$\frac{6s}{6_3}$ vpa	950/62	Sodicity	Coarse, impermeable	Soil materials are sodic affected, coarse textured, impermeable, and susceptible to wind erosion.	Not a good source of planting media. The high sodicity causes sealing of surface materials, resulting in impermeability, high runoff, and erosion. Wind erosion may also be a problem due to the sandy surface material. When stockpiling, take care to prevent wind erosion and contamination of surrounding soils. Place the materials low in the reconstructed profile.
$\frac{6s}{-6SH}$ -pa/$\frac{6s}{-6SH \& coal}$	585/84	Sodicity, salinity	No soil; rock	Impermeable geologic material. Rapid runoff occurs. Topography is often rough and highly eroded.	Cannot be used as a source of planting media unless geologic material is crushed and graded into suitable smaller size fractions. Due to the highly erosive character of these materials, take extreme care when stockpiling and placing to avoid contaminating nearby materials.
Total class 6	2,406				
Grand total all classes	4,120				

1/ This table applies to about the top 36 inches of overburden at the study area. Lands were classed for their suitability as a source of planting media as follows:

Class	Suitability (based on top 36 inches of material)
1	Good
2	Fair
6	Unsuitable in present condition

2/ $\frac{2s}{2_3 -6SH}$ v-p

- Land class
- Letter s indicates soil deficiency (land subclass)
- Major subclass deficiency above geologic material
- Major deficiency of geologic material
- Type of geologic material (shale)
- Suitability of top 3 feet
- Suitability of geologic material
- Separates soil from geologic material

Deficiencies

v = Very coarse texture
p = Permeability
h = Very fine texture
a = Sodic
s = Saline

3/ When 2 or more subclasses are combined, they are very similar in characteristics and in the handling required during and after mining.

SECTION F

COAL RESOURCES

SECTION F

COAL RESOURCES*

Introduction

The Ojo Encino study area is located in the south part of the San Juan Basin in northwest New Mexico. The area was selected by the U.S. Bureau of Land Management to be included in the EMRIA (Energy Minerals Rehabilitation Inventory and Analysis) program in order to evaluate the reclamation potential of sediments from the Upper Cretaceous Fruitland Formation in this part of the basin.

The Ojo Encino EMRIA study area is an area of about 6.5 square miles (17 km^2) located 2 miles (3.2 km) east of the Star Lake Trading Post within the Star Lake and Ojo Encino Mesa 7-1/2 minute quadrangles. Five holes were cored by the Bureau of Reclamation (figure E-1).

Geologic Setting

The Fruitland Formation consists of a highly varied sequence of interbedded lenticular nonmarine claystone, silty and sandy shale, crossbedded sandstone, and coal; the overlying Upper Cretaceous Kirtland Shale is of similar lithology but lacks commercial coal. The Fruitland is underlain by, and intertongues with, the marine Pictured Cliffs Sandstone, also of Late Cretaceous age. Coal-bearing rocks below the Pictured Cliffs were not evaluated in this study. A geologic map is shown on figure E-4.

The coal evaluated for this study comprises a series of as many as three major lenticular beds as thick as 21 feet (6.4 m) thick (figure F-1), Most of the coal is in the lower 200 feet (61 M) of the Fruitland Formation. Maximum overburden on the uppermost mineable coal measured in a drill hole is 160 feet (49 m). All of the estimated coal resources in the study area are overlain by 300 feet (91 m) or less of overburden.

Characteristics of Study Area Coal

For this study area eight samples analyzed by the Department of Energy show Btu/lb values that range from 7,888 to 9,990 on the as-received basis. On the basis of these data, the apparent rank of the coal ranges from subbituminous A to high volatile C bituminous. For the purposes of this report, coal resources were estimated using an apparent rank of subbituminous A.

In common with most of the U.S. coals, Ojo Encino study area coal falls largely in the humic series.

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*/ For a discussion of coal in general and of the terms used in this section, see section L.

Classification of coal by grade, or quality, is based largely on the content of ash, sulfur, and other constitutents that adversely affect utilization. According to Fieldner and others (1942), the ash content of 642 U.S. coal samples ranges from 2.5 to 32.6 percent, averaging 8.9 percent; and sulfur content ranges from 0.2 to 7.7 percent, averaging 1.9 percent. The ash content of the eight coal samples from the Fruitland coal, on an as-received basis, ranges from 11.6 to 28.3 percent, averaging 21.0 percent; the sulfur content ranges from 0.5 to .6 percent, averaging .55 percent.

Table F-1 presents the results of chemical analyses of eight coal samples of the Fruitland Formation from the Ojo Encino EMRIA study area.

With regard to thickness of beds, about 79 percent of the estimated resources of the study area is in the thick category (more than 10 feet); about 21 percent is in the intermediate category (5 to 10 feet); and none is in the thin category. By way of comparison, Averitt (1975, figure 5 and page 37) showed the distribution of the estimated resources of 21 states as 42 percent in the thin category; 25 percent in the intermediate category; and 33 percent in the thick category.

Quantity of Study Area Coal

Coal resource estimates have been prepared for the Fruitland coal within the Ojo Encino EMRIA study area using standard procedures, definitions, and criteria established by the U.S. Geological Survey and U.S. Bureau of Mines for making coal resource appraisals in the United States. The term "coal resources" as used in this report means the estimated quantity of coal in the ground in such form that economic extraction is currently or potentially feasible.

Tables F-2 and F-3 summarize the estimated coal resources of the Ojo Encino study area.

Summary of resources

Total estimated identified original resources in the Ojo Encino area are 132,850,000 tons (120,490,000 metric tons). The coalbed thickness class of 2.5-5 feet contains no significant measurable resources. The coalbed thickness class of 5-10 feet contains 28,090,000 tons (25,480,000 metric tons) of the estimated resources. The coalbed thickness class of greater than 10 feet contains 104,760,000 tons (95,020,000 metric tons) of the estimated resources.

The estimated resources presented in this report are original resources; that is, resources in the ground before the beginning of mining operations.

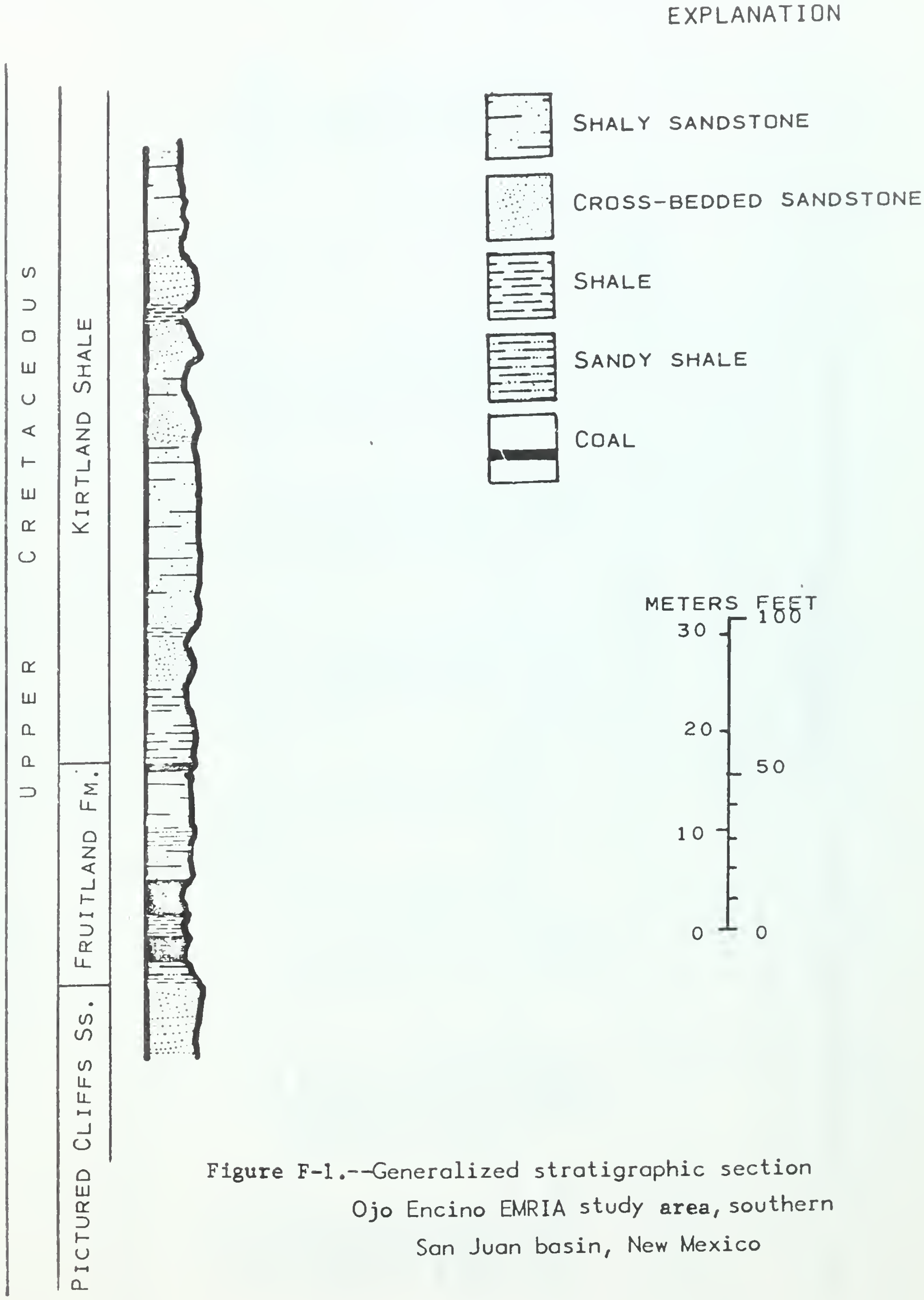

Figure F-1.--Generalized stratigraphic section Ojo Encino EMRIA study area, southern San Juan basin, New Mexico

Table F-1.--Chemical Analyses of 8 coal samples of the Fruitland Formation from the Ojo Encino EMRIA study site

[All analyses are in percent except Btu/lb; to convert feet to meters multiply by 0.305; to convert Btu/lb to Kcal/kg multiply by 0.556.]

			Proximate				Ultimate	
Laboratory number	Drill hole number	Depth interval in feet	Moisture	Volatile matter	Fixed carbon	Ash	Sulfur	Btu/lb (as received)
K96421	DH-OE-1A	47.9- 61.6	12.6	31.6	33.9	21.9	0.6	8835
K96422	DH-OE-1A	101.0-115.6	12.8	28.2	30.7	28.3	.5	7888
K96423	DH-OE-1A	124.4-129.6	13.1	32.1	36.0	18.8	.5	9343
K96424	DH-OE-5	159.7-180.0	13.1	32.2	31.8	22.9	.6	8670
K96425	DH-OE-2	16.0- 37.6	12.3	33.0	34.0	20.7	.5	9012
K96426	DH-OE-2	56.2- 64.2	15.8	32.4	40.2	11.6	.5	9990
K96430	DH-OE-3	77.2- 95.2	12.5	31.0	34.8	21.7	.6	8943
K96433	DH-OE-4	46.6- 63.4	12.2	31.1	34.7	22.0	.6	8943
range			12.2-15.8	28.2-33.0	30.7-40.2	11.6-28.3	0.5-.6	7888-9990
average			13.1	31.4	34.5	21.0	.55	8953

Table F-2.--Estimated identified subbituminous coal resources of the Fruitland Formation, Ojo Encino EMRIA study area, McKinley County, New Mexico, as of July 1, 1980

[Leaders (---) indicate not present. In millions of short tons.
1 foot = 0.305 meters; 1 short ton = 0.907 metric ton]

Location	0-300 ft overburden								Section Total
	5-10 feet				10 ft or more				
	Measured*	Indicated*	Inferred*	Total	Measured*	Indicated*	Inferred*	Total	
T. 19 N., R. 5 W.									
sec. 2	---	2.35	5.75	8.10	0.26	2.52	0.09	2.87	10.97
sec. 3	---	1.33	1.39	2.72	3.06	1.24	.63	4.93	7.65
sec. 4	0.67	1.83	---	2.50	2.05	15.84	1.27	19.16	21.66
sec. 5	1.44	5.76	.86	8.06	4.98	21.36	3.99	30.33	38.39
N 1/2 sec. 7	.28	.74	.54	1.56	2.31	6.66	3.24	12.21	13.77
N 1/2 sec. 9	.22	1.11	.36	1.69	.87	6.98	1.15	9.00	10.69
Township Total	2.61	13.12	8.90	24.63	13.53	54.60	10.37	78.50	103.13
T. 20 N., R. 5 W.									
SE 1/4 sec. 33	---	---	---	---	---	5.37	2.40	7.77	7.77
S 1/2 sec. 34	---	---	---	---	3.43	11.12	---	14.55	14.55
S 1/2 sec. 35	---	0.42	1.88	2.30	.13	3.50	.31	3.94	6.24
SW 1/4 sec. 36	---	---	1.16	1.16	---	---	---	---	1.16
Township Total	---	.42	3.04	3.46	3.56	19.99	2.71	26.26	29.72
Total for Area	2.61	13.54	11.94	28.09	17.09	74.59	13.08	104.76	132.85

*Defined in section L.

Table F-3.--Summary of estimated identified subbituminous coal resources of the Fruitland Formation, Ojo Encino EMRIA study site, as of July 1, 1980

[Leaders (---) indicate not present. In millions of short tons. 1 foot = 0.305 meters.]

	T. 19 N., R. 5 W.	T. 20 N., R. 5 W.	Total
Coal beds 5 to 10 feet thick			
Measured resources	2.61	---	2.61
Indicated resources	13.12	0.42	13.54
Inferred resources	8.90	3.04	11.94
Total	24.63	3.46	28.09
Coal beds more than 10 feet thick			
Measured resources	13.53	3.56	17.09
Indicated resources	54.60	19.99	74.59
Inferred resources	10.37	2.71	13.08
Total	78.50	26.26	104.76
Total identified resources	103.13	29.72	132.85

SECTION G

OVERBURDEN GEOCHEMISTRY

SECTION G

OVERBURDEN GEOCHEMISTRY

Samples from the column of overburden rock above the coal at the Ojo Encino site were analyzed for bulk* chemcial composition. The purpose was to find out whether any of the rock material had unusually high contents of potentially troublesome chemical elements, especially in comparison to rocks that overlie coal in other parts of the Western Energy Regions.

A second goal was to find out whether benign rock material could be distinguished in some clear and simple way from potentially troublesome material (if any) without expensive analysis.

Sampling Scheme

Samples were taken from drill holes DH-OE-1A and DH-OE-3, which are about a mile apart. The holes were sampled to depths of 131 feet and 147 feet, respectively. Choosing a random depth near the top as a starting point, a 6-inch segment of the "Nx" core was taken every 10 feet. About every fifth sample, an extra "companion" sample was taken with only a 6-inch gap from the adjacent sample at the regular 10-foot spacing: this was to aid in determining the relation between chemical variability and spatial separation of samples.

Classification of Samples into Rock Types

Samples were classified by lithic type, as identifiable by quick, simple tests and by appearance in hand specimens. This classification was done to determine whether the different rock types had distinctive chemistry; if so, it might be possible to predict the chemistry from hand specimen observation in future work, thereby avoiding considerable delay and analytical expense.

The samples were classified into the followin groups:

1. sandstone
2. siltstone
3. claystone (shale and other very fine-grained rocks)

Analytical

The samples were analyzed for total concentrations of a suite of major, minor, and trace elements, by spectrographic techniques (emission and X-ray fluorescence). Results of "availability" (chemical leach) determinations will be available later.

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* The term "bulk" may also be expressed as "whole-rock."

Chemical Distinctiveness of Rock Types

Overburden rocks at Ojo Encino show a general relationship between chemistry and rock type. Coarse- and fine-grained rocks have characteristic chemical properties, but there is considerable overlap in chemical nature. The data are presented in table G-1, not only for the Ojo Encino site but also for the nearby San Juan Basin EMRIA site called Kimbeto; also for a broader sampling of overburden rocks of similar age (Cretaceous) throughout the Western Energy Regions; also for soils and mine spoils of the San Juan Basin. Table G-1 presents selected elements, a subset of all those analyzed, that are of the greatest geological and environmental interest. It shows that, with few exceptions, the sandstones have the lowest concentrations of trace elements of potential environmental concern (boron, cobalt, chromium, copper, molybdenum, lead, vanadium, and zinc), and that the siltstone (single sample) has intermediate concentrations and claystones the highest concentrations.

The rocks from the Ojo Encino and Kimbeto sites in the San Juan Basin have less chemical difference from one rock type to another than is the case at other Cretaceous age sites. The chemical data suggest that this is so because in the San Juan Basin the sandstones are arkosic (contain sand grains of feldspar rather than of quartz) and because there is an appreciable amount of clay in rocks of all types. At some other locations, sandstones are much more purely quartz; and clay minerals are concentrated in the claystones (shales) to a greater extent: quartz is a mineral that is nearly barren of trace elements, feldspar contains modest amounts of many trace elements, and clay contains larger amounts. To repeat, the differences in element concentrations of these contrasting rock types are smaller in the San Juan Basin than elsewhere.

Chemistry of Ojo Encino (and Kimbeto) Rocks Compared to Other Overburden Rocks of the Same and Different Ages

In order to assess the value of Ojo Encino rocks for use in reclamation after mining, it is useful to know how their detailed chemistry compares with that of other overburden rocks that have been investigated, rocks of both similar and different ages (Hinkley and others, 1980; Hinkley and others, 1978) and from both nearby and distant sites. In this respect, each of the chemcial parameters in table G-1 is discussed in turn below.

The basis of the discussion are the data in table G-1, where only average concentration values are given. For all chemical species except SiO_2, the type of average used is the geometric mean rather than the arithmetic mean. The geometric mean tends to minimize the effect of the extreme (very high) values which may appear in the data set; it tends to increase the likelihood that the average value will fall in the range of the more common central values that are really most typical of the set of data.

To give an idea of the dispersion (variance) of the data, a table of geometric deviations is presented in table G-2. This information gives information about

Table G-1

Bulk chemical composition of overburden rocks at Ojo Encino and other sites where coal is overlain by Cretaceous age rocks; also soils and mine spoil material from the San Juan Basin

Values are geometric means* (except for SiO_2)

"Sand" indicates sandstone, "Silt" indicates siltstone, "Clay" indicates shale and other very fine grained rock, as used in the text

	Ojo Encino, NM				Kimbeto, NM				Other sites with Cretaceous overburden †				San Juan Basin Soils & Mine Spoil**		San Juan Basin Soils ***	
	Sand n=26	Silt n=1	Clay n=4	Total n=31	Sand n=27	Silt n=4	Clay n=15	Total n=46	Sand n=110	Silt n=25	Clay n=77	Total n=212	Topsoil n=12	Spoil n=12	A horiz. n=30	C horiz. n=30
SiO_2%	68	70	65	68	70	70	63	68	79.6	67.4	59.8	71.1	75	64	73	73
Al_2O_3%	13.4	15.8	16.3	13.8	13.2	15.0	16.4	14.3	6.1	10.4	13.7	8.7	4.9	11.5	8.3	8.3
CaO%	1.3	0.5	0.55	1.1	1.4	0.78	0.81	1.1	0.56	1.7	1.4	0.90	1.8	2.0	0.9	1.4
Na_2O%	1.5	1.6	1.3	1.5	1.8	1.8	1.3	1.5	0.13	0.27	0.20	0.16	1.4	2.0	1.3	1.3
K_2O%	2.3	2.1	2.6	2.3	2.1	2.6	2.7	2.3	1.5	2.0	2.1	1.7	1.8	1.2	2.5	2.5
B ppm	12	11	24	14	13	18	19	15	14	23	28	19	7	13	16	11
Co ppm	8	11	11	8	8	10	12	9	4	8	9.3	5.8	6	8.5	5	4
Cr ppm	12	22	35	14	19	30	30	22	16	36	43	25	22	14	20	13
Cu ppm	10	26	37	12	14	37	39	21	7	22	30	13	10	18	8.8	6.3
Mo ppm	2.2	1.7	3.7	2.3	2.3	3.4	2.8	2.5	1.8	2.1	2.3	2.0	1.8	2.7	1.0	2.9
Pb ppm	10	10	19	11	10	19	16	12	5.8	9	13	8	11	11	11	10
V ppm	51	73	93	56	60	80	92	71	37	79	91	56	45	56	28	28
Zn ppm	55	64	94	59	61	86	80	69	35	85	105	58	41	56	31	26

*SiO_2 values are arithmetic means. If the element was below the detection limit for some samples, Cohen's technique was used to estimate the probable average.

**Severson & Gough, Table 6

***Severson & Gough, Table 4

Dispersion of data on bulk chemical composition of overburden rocks at Ojo Encino and other sites

where coal is overlain by Cretaceous age rocks;

also soils and mine spoil material from the San Juan Basin

[Values are Geometric Deviations (except for SiO_2 for which the values are Standard Deviations). Leaders are used in place of any statistics for Ojo Encino siltstone because only a single sample was analyzed]

"Sand" indicates sandstone, "Silt" indicates siltstone, "Clay" indicates shale and other fine grained rock, as used in the text

	Ojo Encino, NM				Kimbeto, NM				Other sites with Cretaceous overburden †				San Juan Basin Soils & Mine Spoil*		San Juan Basin Soils **	
	Sand n=26	Silt n=1	Clay n=4	Total n=31	Sand n=27	Silt n=4	Clay n=15	Total n=46	Sand n=110	Silt n=25	Clay n=77	Total n=212	Topsoil n=12	Spoil n=12	A horiz. n=30	C horiz. n=30
SiO_2%	8.3	--	2.5	7.7	7.0	5.1	4.6	7.0	12.1	11.5	10.4	14.8	1.1	1.1	1.1	1.0
Al_2O_3%	1.2	--	1.0	1.2	1.4	1.1	1.0	1.3	1.6	1.3	1.3	1.8	1.1	1.1	1.1	1.2
CaO%	5.9	--	1.2	5.2	3.8	2.2	1.9	3.1	8.6	3.9	3.8	6.3	1.3	1.2	1.3	1.7
Na_2O%	2.0	--	1.1	1.9	1.7	1.2	1.2	1.5	2.8	2.5	3.0	2.9	1.0	1.2	1.2	1.3
K_2O%	1.3	--	1.0	1.3	1.3	1.5	1.3	1.3	1.5	1.2	1.5	1.5	1.1	1.1	1.1	1.2
B ppm	1.6	--	1.2	1.6	1.4	1.2	1.4	1.5	1.6	1.4	1.6	1.7	1.8	1.5	1.4	1.8
Co ppm	1.4	--	1.6	1.6	1.5	1.6	1.3	1.9	2.1	1.4	1.7	2.1	1.1	1.2	1.3	1.4
Cr ppm	2.0	--	1.1	2.1	1.6	1.3	1.5	1.6	2.0	1.3	1.7	2.1	1.4	1.3	1.5	1.5
Cu ppm	2.1	--	1.0	2.3	2.1	1.2	1.2	2.2	2.8	1.6	1.6	2.9	1.5	1.6	1.4	1.7
Mo ppm	1.5	--	1.2	1.5	1.4	1.3	1.3	1.4	1.5	1.4	1.6	1.5	1.3	1.1	1.2	1.8
Pb ppm	1.4	--	1.3	1.5	1.5	1.7	1.6	1.7	1.7	1.5	6	1.9	1.2	1.2	1.2	1.3
V ppm	1.5	--	1.2	1.5	1.8	1.2	1.3	1.7	2.1	1.2	1.4	2.1	1.1	1.3	1.2	1.4
Zn ppm	1.4	--	1.3	1.5	2.2	1.1	1.4	1.7	2.2	1.3	1.4	2.3	1.1	1.5	1.2	1.4

*Severson & Gough, Table 6

**Severson & Gough, Table 4

†Danforth Hills, N.W. Colorado; Corral Canyon, S.E. Central Wyoming; Henry Mountains and Emery, Utah

how closely the whole body of data is grouped about the average, or how broadly dispersed it is, with extreme values far from the average. The geometric means and deviations are used in the following way to assess the spread of the data: about two thirds of the values fall between a lower limit of GM/GD and an upper limit of GM•GD; about 95 percent of the values fall in the broader range defined by $GM/(GD)^2$ and $GM \cdot (GD)^2$. In an actual example from the tables, zinc in claystone from "Other sites with Cretaceous overburden" has a geometric mean of 105 ppm and a geometric deviation of 1.4; 95 percent of samples of such material should have values between $105/(1.4)^2 = 54$ ppm and $105 \times (1.4)^2 = 206$ ppm.

SiO_2--Ojo Encino rocks fall into the middle part of the total range in SiO_2 concentration seen in the larger group of sites that have the same age rock (Cretaceous) overlying coal. This indicates that the New Mexico rocks are less pure as lithic types--there is more clay and feldspar in the sandstones, and more sand in the claystones than is common elsewhere.

AL_2O_3-There is more aluminum in the Ojo Encino and Kimbeto rocks than in other Cretaceous overburden, indicating, in complement to the SiO_2 data, that there is a lot of clay and feldspar in the sandstone and siltstone.

CaO---Ojo Encino and Kimbeto sandstone and siltstone are high in calcium relative to other Cretaceous overburden, whereas the claystones are low in calcium relative to the other rocks. This is probably because of compositional differences between species of feldspar and clay.

Na_2O--All three rock types are distinctly higher in sodium at Ojo Encino and Kimbeto than in other Cretaceous overburden. Their concentrations are closer to those for corresponding rock types in overburden of Tertiary Ft. Union Formation material, but the New Mexico rocks are higher by up to a factor of 2.

K_2O---Ojo Encino and Kimbeto rocks are slightly higher in potassium than other Cretaceous overburden.

B-----Ojo Encino and Kimbeto rocks are similar to other Cretaceous overburden rocks in boron concentration. However, some suites of Tertiary overburden samples have concentrations 2-5 times higher for both sandstone and claystone.

Co----Ojo Encino and Kimbeto rocks, especially sandstones, are higher in cobalt concentration than other Cretaceous overburden rocks but are about comparable to Tertiary rocks.

Cr----Ojo Encino and Kimbeto rocks are comparable in chromium content to other Cretaceous overburden sites, with New Mexico sandstones slightly higher, siltstone and claystones slightly lower. Tertiary overburden rocks may be 2-5 fold higher.

Cu----Ojo Encino and Kimbeto rocks are higher in copper than other Cretaceous overburden rocks but comparable to Tertiary overburden rocks.

Mo----Ojo Encino and Kimbeto rocks are comparable to or slightly higher than other Cretaceous rocks in molybdenum concentration, but they apparently have only about half (or less) as much as Tertiary overburden rocks. In areas of Tertiary overburden, molybdenum toxicity is widely regarded as a potential problem in mine spoil reclamation (Erdman and others, 1978).

Pb----Lead concentrations are slightly higher in Ojo Encino and Kimbeto rocks than in other Cretaceous overburden. They are comparable to lead values in Tertiary rocks, but in Tertiary rocks there is much greater difference between sandstone (high) and claystone (low) than in Cretaceous rocks.

V-----Vanadium concentrations in Ojo Encino and Kimbeto rocks are similar to those in Cretaceous overburden rocks from other areas. They are similar to concentrations in studied Tertiary overburden rocks.

Zn----Zinc concentrations in Ojo Encino and Kimbeto rocks are similar to those in Cretaceous rocks from other areas, but in the other areas there is a greater contrast in concentrations between sandstone (low) and claystone (high) than is seen at the New Mexico sites. Concentrations are similar to those in Tertiary overburden rocks.

Similarity of Ojo Encino Overburden Rocks to Natural San Juan Basin Soils

In bulk composition, Ojo Encino overburden rocks are similar to natural soils of the San Juan Basin. The data are summarized in table G-1. With respect to sodium, probably the single element of most concern in reclamation considerations, the rocks are very similar to the soils in bulk composition. There is, to varying but moderate degrees, more of the following elements in the Ojo Encino overburden than in the soils: aluminum, cobalt, copper, lead, vanadium, and zinc. Of those elements, it is probably favorable that there should be extra copper and zinc in the rocks should they ever be used as soil replacement material. Except for very unusual geochemical and climatic settings, the elements cobalt, lead, and vanadium are seldom present in sufficiently high levels to be toxic hazards.

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 section H of this report.

Relative Abundance of Rock Types

At Ojo Encino the ratio of sandstone: siltstone: claystone in drill cores sample was about 6 : 1/4 : 1 (31 samples taken at Ojo Encino). At Kimbeto it was about 2 : 1/4 : 1 (46 samples); and at the other four Cretaceous sites from other states, it was about 1 1/3 : 1/2 : 1 (112 samples). In New Mexico, sandstone was more dominant over claystone (shale) than at other Cretaceous sites, although there is a big difference between the two San Juan Basin sites (3-fold more sand at Kimbeto). Rock classified as siltstone is not very abundant anywhere.

SECTION H

LAND AND OVERBURDEN

SECTION H

LAND AND OVERBURDEN

Major Land Categories

There are five major land categories encompassing the landforms and soil bodies of the study area. These are: valleys (about 12 percent of the study area); valley sideslopes (30 percent); uplands (49 percent); flats (7 percent); and badlands (2 percent). Figure H-1 shows the approximate location and distribution of the categories.

Valleys

This category is dominated by valley floors, but includes flood plains. The topography is level to nearly level. The soils are primarily formed from recent alluvium, or there is no real soil formation due to the recency of the deposition. Because of the physiographic position (i.e., overland runoff accumulates in these areas in times of heavy precipitation), the lands in this category support some of the best vegetation at the study site.

Regarding the entire soil profile, soil above bedrock is usually 60 inches or more deep. Permeability is moderate to moderately rapid and water-holding capacity is low to moderate. Soils are generally moderately saline and highly sodic. Harmful accumulations of other chemicals were not detected. Colors of the surface soils range from black to light-yellowish brown. Textures generally range from silt loam to sandy clay loam. Structure is usually blocky, granular, or single grain. Subsoil textures and colors range from clay loam to loamy sand and very dark brown to yellow brown, respectively. Structure is generally single grain or granular, with some blocky. Accumulations of calcium carbonate were found in the majority of the subsoils.

Approximately half of the lands in this category appear to be suitable sources of planting media (see Land Suitability in section H for definition of suitable and unsuitable planting media).

Soil profiles 3, 4, 6, 7, 8, 67, 76, and 85 are representative of this category (see figure N-10). The dominant soil series are Beebe and Notal (see Soil Inventory in section N for more information on soil series at the study area).

Valley sideslopes

This category consists primarily of level to gently sloping lands on valley filling sideslopes. The soils formed in mixed alluvial and eolian deposits. This category is approximately 30 percent of the study area.

Regarding the entire soil profile, the majority of the land category has soil depths of 5 to 10 feet or greater over sandstone or shale bedrock. However, there are small, scattered areas having soil that is less than 3 feet in depth. Permeability and water-holding capacity are both moderate. Soils are generally fair in relation to salinity hazard but are highly sodic. No other chemical accumulations, other than calcium carbonate, were detected in field and laboratory investigations. Colors of the surface soils are typically brown, pale brown, and yellowish-brown. Textures range from fine sand to clay loam, clay loam being the most prevalent. Structure is usually granular, single grain, or crumb. Subsoil textures and colors range from loamy sand to clay (sandy loam and loamy sand are dominant) and light grayish-brown to brown. Structure is primarily granular or blocky.

Most of the soils in this land category are unsuitable as sources of planting media. Areas that are suitable are generally small and widely separated.

Soil profiles 20, 21, 26, 27, 29, 30 through 37, 48 through 52, 56, 57, 58, 60, 61, 62, 66, 68, 69, 70, 71, and 74 belong to this category. Dominant soil series are Blancot and Azfield.

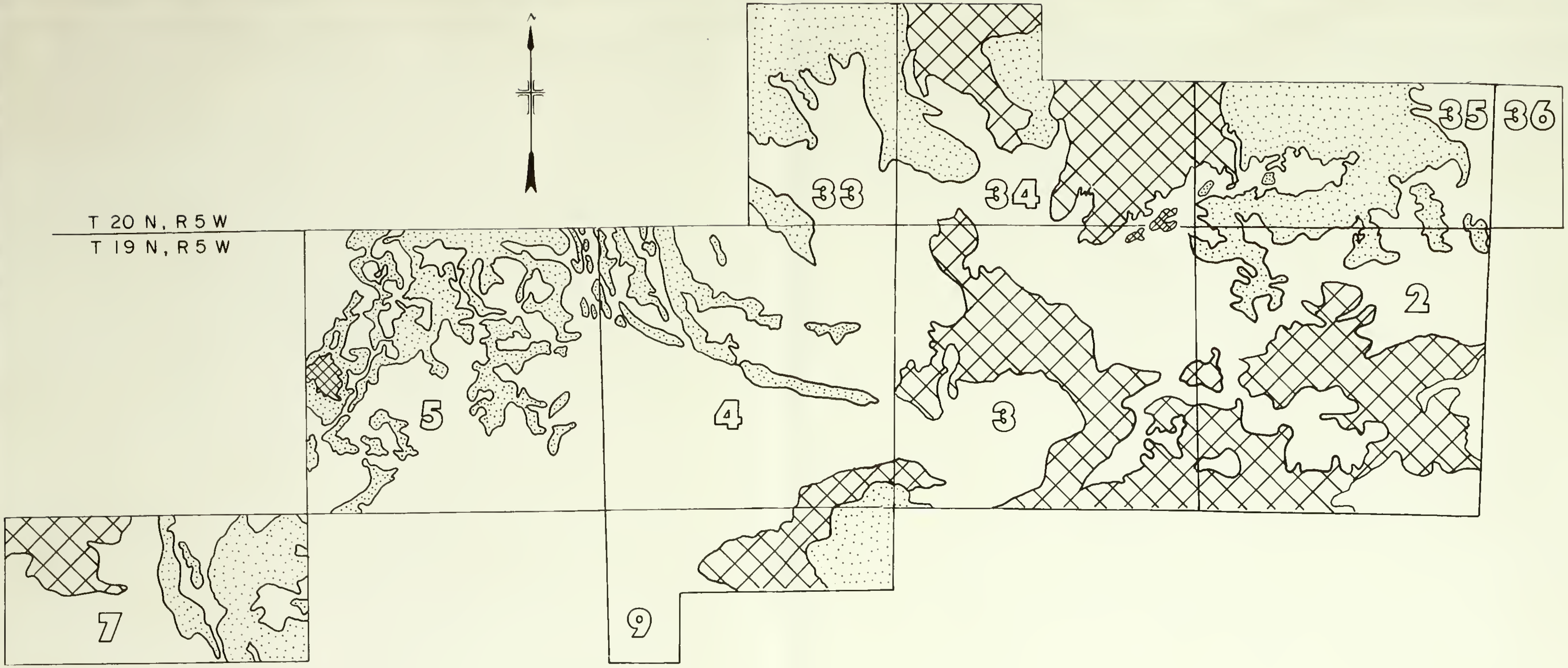
Uplands

These lands are level to moderately sloping. Depth to bedrock varies from less than 12 inches to over 10 feet. Approximately 20 percent of this category consists of soils that are less than or equal to 12 inches in depth. Small, dispersed areas of rock outcrops are found throughout the uplands. Areas adjacent to this category are generally characterized as breaks, leaving uplands slightly elevated in relation to the surrounding lands. Shallow, irregularly-shaped depressions are found in this category.

Regarding the entire soil profile, soil above bedrock is usually 60 inches or more deep. However, there are areas where there is virtually no soil or less than 2-1/2 feet of soil; these areas are small in area and number. Permeability is moderate to slow, with relatively low water-holding capacity. Soils are generally highly sodic (which is the cause of the limited permeability) and moderately saline. Toxic levels of other chemicals were not detected. Colors of the surface soil are light grayish-brown to dark brown. Textures are generally fine sand, sandy loam, or clay loam. Structure is usually granular, single grain, or blocky. Subsoil textures and colors range from clay loam to fine sand, and light brownish-gray to brown. Structure is mainly granular, blocky, or less frequently single grain. There are considerable amounts of calcium carbonate in the subsoils.

Much of the soil in this category is marginally suitable or is unsuitable as a source of planting media, but more than half of these soils are suitable.

Soil profiles 1, 4, 9 through 19, 22, 23, 24, 38, 39, 53, 54, 55, 59, 63, 64, 72, 73, 75, 77 through 84, and 86 through 93 are in this category. The dominant soil series are Doak, Shiprock, Fruitland, Uffens, and Huerfano.



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 H-3

Flats

This land category is characterized by flat landscapes nearly devoid of vegetation. It includes exposures of shale, sometimes covered with small, thin areas of eolian sands and small areas of badlands.

Regarding the entire soil profile, the few existing soils are usually 4 to 5 feet in depth, but some pockets are 10 feet or more. Permeability is slow to rapid, and water-holding capacity varies from moderate to low. These soils are generally highly sodic and moderately saline. As with the other categories, no harmful accumulations of chemicals were detected. Surface soil colors are brown, light gray, and dark gray. Texture is predominantly clay loam; however, a small number of areas are loamy fine sand or fine sand. Structure is usually blocky, with some granular, single grain, or platy. Subsoil textures and colors range from clay loam (predominant) to loamy fine sand and very dark grayish-brown to very pale brown. Structure is mainly blocky with some platy and granular. Buildup of calcium carbonate was evident in the subsoil. Because of high salinity and sodicity, and lack of soil material, virtually all of this land category is unsuitable as a source of planting media.

Soil profiles 25, 28, and 40 through 46 are included in this category. The soils series of the few areas having soil are Farb and Sheppard.

Badlands

This land category consists of eroded shale knobs, ridges, and the lower portions of escarpments. It is moderately sloping to rolling. There is very little vegetation, and it is of poor vigor and quality. There is little of this category at the study area. The category includes only soil profile 2.

Regarding the entire soil profile, soil depth of soil profile 2 was 42 inches. Permeability is moderately rapid to rapid, and water-holding capacity is low. The few areas of soil present are saline and sodic. The surface soil was a dark yellowish-brown loamy sand with granular structure. The subsoil, also a loamy sand, was pale brown with granular structure. Calcium carbonate accumulations in the subsoil are common.

Virtually all of this category is unsuitable as a source of planting material because soils are few, scattered, erodable, and chemically unsuitable.

Soil series that may be found in this category include Farb, Persayo, Sheppard, and Fluvents. Fluvents consist of many closely-related alluvial materials that cannot be separated into specific soil series. They are deep, generally stratified, and widely varied in textures.

Land Suitability

Study area lands were surveyed and evaluated in order to classify them for their suitability as a source of planting media for resurfacing the study area for revegetation (if surface mined). The survey provided data on the quality, quantity, and ease of stripping and stockpiling the surface material, and on other factors which affect suitability of the lands as a source of planting media.

Specifications were developed in order to classify the study area lands for their suitability as a source of planting media. The specifications are the characteristics of the three land suitability classes--1, 2, and 6--established for the study area. The class numbers correspond to those in the Bureau of Reclamation's classification system. The specifications include quality considerations such as texture, salinity, sodicity, permeability, infiltration rate, available-water-holding capacity, and erodibility. The main quantity consideration was depth of suitable material. Stripping and stockpiling considerations included indurated bedrock exposures and excessive slope. The specifications are shown in table H-1.

Class 1 lands, the best source of planting media, should supply a large amount of highly suitable material relatively easy to stockpile. If not surfaced mined (due to depth of coal), class 1 lands could probably be used as borrow areas for resurfacing areas with insufficient planting media.

Class 2 lands have planting media; but the media are lower quality, difficult and expensive to handle, and limited in quantity.

Class 6 lands generally do not have suitable or sufficient planting media. Disturbance of these lands by surface mining or other operations will require, if the lands are to be revegetated, that planting media be borrowed or class 6 materials be improved by processing.

Procedures

Study area lands were evaluated in the following manner for suitability as a source of planting media. Physical and chemical soil characteristics, topography, and internal drainage were considered. Land forms were examined in sufficient detail to determine their effect on ease of stripping. Field observations were confirmed by laboratory tests of representative soil samples.

Land classes and mapping units (see Soil Inventory, section N) were delineated in the field on aerial photographs (about 1 inch = 660 feet). Geological Survey quadrangles, 7.5 minute series, were used for location and reference when mapping the land.

Many soils were bored, examined, sampled, and recorded to 10 feet. However, many borings were limited to less than 10 feet by shale or sandstone underlying most of the area. Additional soils were examined to determine texture and depth to bedrock. All soil profiles were located and recorded on the aerial photographs.

Table H-1
Land Suitability Specifications 1/
For Lands Used as Source of Planting Media for Reclamation
of Surface-Mined Areas
BLM-BR Coopertive EMRIA Program
Ojo Encino Study Area - New Mexico

	Land class	
Soils 2/	1	2
Texture or rock type	lfs - cl	fs - c
Available water-holding capacity	1.25 in/ft	0.75 in/ft
Permeability (Internal drainage)	Adequate to provide a well-drained and aerated root zone and an infiltration rate which prevents serious erosion.	Restricted to the extent that internal drainage may limit choice of vegetation and that limited infiltration will require special practices to control erosion.
Salinity (at equilibrium)	≤ 4 millimhos	≤ 12 millimhos
Sodicity (at equilibrium)	≤ 10 ESP - may be higher if permeability meets limits for class 1.	≤ 15 ESP - may be higher if permeability meets limits for class 2.
Erodibility	May be subject to slight erosion.	May be susceptible to moderate to severe erosion but can be controlled with proper management.
Weatherability 3/	Will break down readily soon after exposure to weather.	May require extended period to break down into optimum particle size distribution for planting media, but can be used in less desirable state in reasonable time period.
Depth	A minimum of 36 inches of usable and strippable material.	A minimum of 6 inches of usuable and strippable material. 4/
Topography 5/		
Slope	≤ 20 percent	≤ 35 percent
Surface rocks	Not a factor on study area.	
Bedrock outcrops	Will not affect stripping or quantity of suitable material appreciably.	Numerous enough to reduce quantity of suitable material appreciably and make stripping expensive.
Drainage	Because of land disturbance by surface-mining, present drainage conditions, except the permeability of the material, are not a factor in the classification. Permeability limits are covered under Soils.	
Class 6	All areas are not meeting the minimum requirements for class 2. These lands, in their present state, will not provide adequate planting media for reclamation purposes.	

1/ Specifications are based on rainfed conditions or a minimum of irrigation for starting plantings and maintenance through dry periods.
2/ The limitations under Soils are applicable to the evaluation of both soil and the remaining overburden material between the coal and soil.
3/ Weatherability is applicable only to bedrock or consolidated material.
4/ Six inches is considered as the minimum strippable depth.
5/ Topographic factors considered are related primarily to stripping conditions.

A tile spade was used to examine the surface layers (topsoil). The lower soil profile was exposed for examination and sampling with a truck-mounted power soil auger.

Genetic soil horizons and the underlying substratum were studied in detail. Color, structure, texture, consistency, and soil-moisture relationships (permeability and water-holding capacity) were observed, the last being the primary concern. The number and location of soil samples selected for laboratory analyses and greenhouse studies varied according to the particular conditions of the area.

Laboratory tests were performed to evaluate the land classification done in the field. Screenable tests (as defined by the Bureau of Reclamation) were made on all soil and bedrock samples. Additional tests were made when more data were needed to support classification (see Description of and References for Laboratory Procedures, section N).

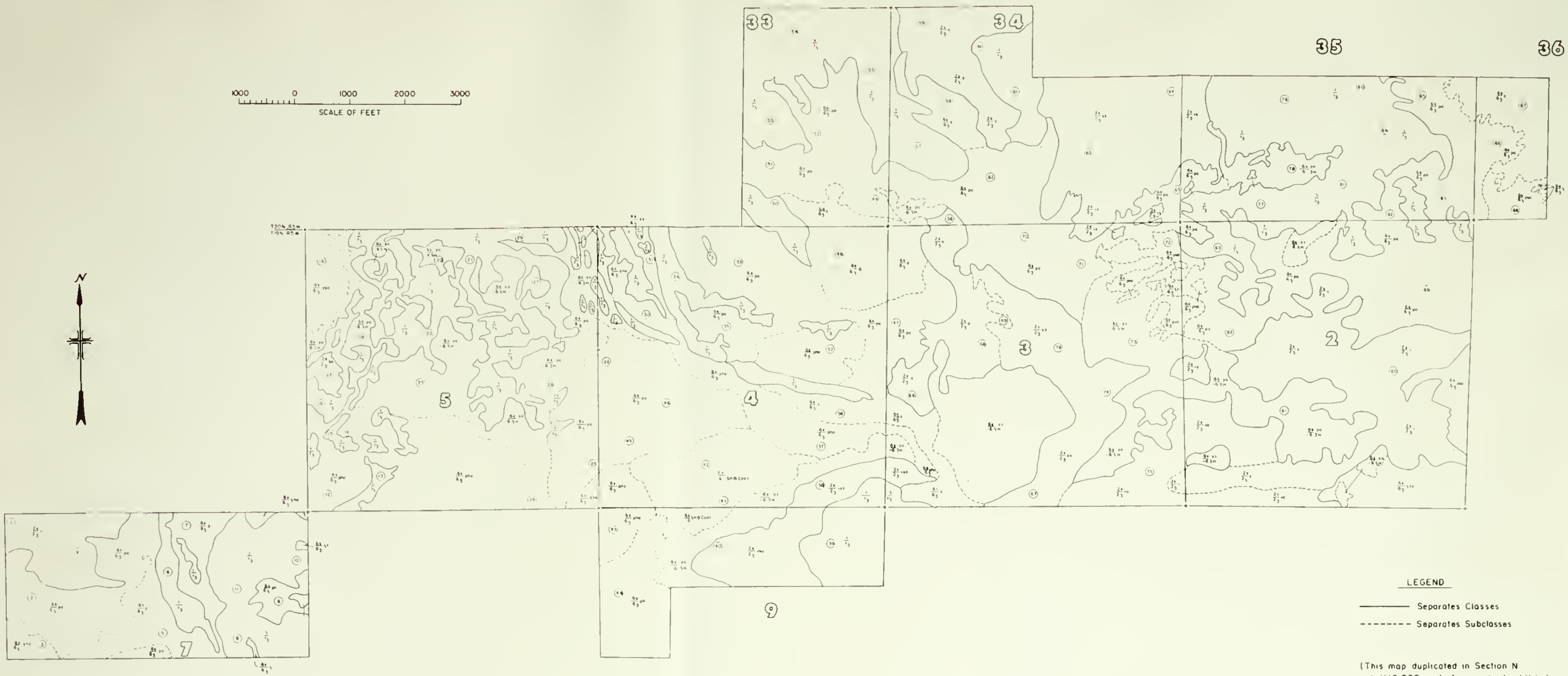
Many areas assigned certain classes may contain small amounts of soils of other classes, primarily near area margins where classes often grade into others. Because the soils in both classes 2 and 6 have deficiencies, each class is divided into subclasses equivalent to certain deficiencies or combinations of deficiencies. Table H-2 describes the characteristics of class 1 and the major subclasses of classes 2 and 6. For the reason presented in the following paragraph, table H-2 represents only about the top 3 feet of overburden.

Because areal projection of soil profiles based on test holes is less accurate below 3 feet, only the top 3 feet of material were considered in the evaluation of lands as a source of planting media and in the assignment of corresponding land classes. Therefore, table H-2, which presents this evaluation, covers only the top 3 feet of material and, therefore, all land classification maps in this report also cover only the top 3 feet of material. However, the land classification symbols on figure H-2 can describe both the top 3 feet of material and the complete soil profile, both of which descriptions are given in the profile descriptions of figure N-10.

<u>Summary of land classification results</u>

Class 1 lands (21 percent of study area) are primarily located on uplands in the study area. Soils are generally medium to coarse textured and deep. They have no harmful accumulations of soluble salts or sodium and are permeable. Topographic features will not hinder stripping.

Class 2 lands (21 percent of study area) are located on uplands, valley sideslopes, and in the valleys. Soils are generally medium to coarse textured and shallow to deep. Generally, salinity or sodium levels are acceptable and permeability is good but a few areas do have harmful accumulations of chemicals and/or restricted permeability. Topography will not hinder stripping.



ACRES*

LAND CLASS	SECTION										TOTAL
	T19N, R5W						T20N, R5W				
	2	3	4	5	7	9	33	34	35	36	
1	47	4	88	197	97	35	128	75	190	0	861
2	259	249	18	8	47	49	0	202	21	0	853
TOTAL	306	253	106	205	144	84	128	277	211	0	1714
6	334	387	534	435	176	116	112	123	109	80	2406
GRAND TOTAL	640	640	640	640	320	200	240	400	320	80	4120

* For complete acreages of each individual land classification see Table N-14

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

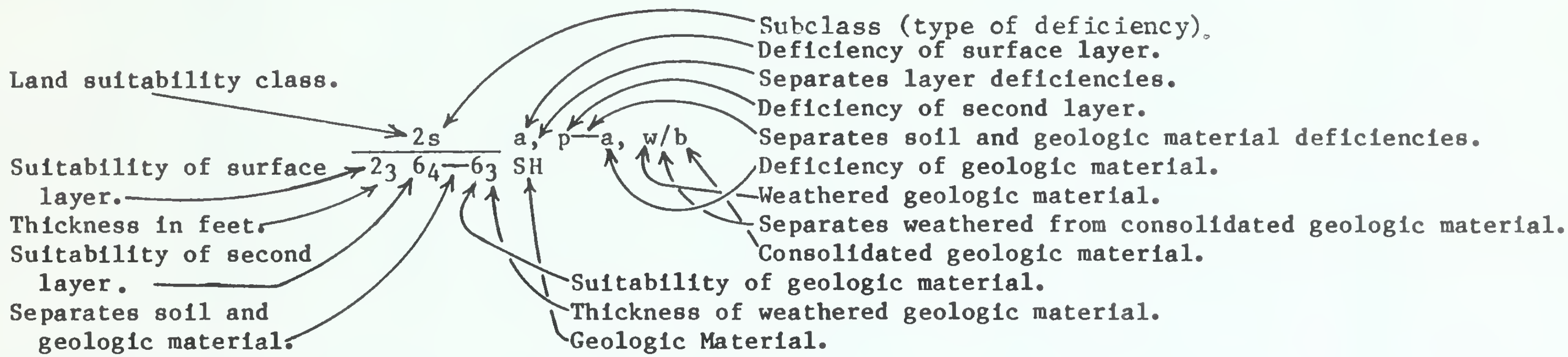
OJO ENCINO STUDY AREA, NEW MEXICO

DETAILED LAND CLASSIFICATION

EMRIA REPORT NO 19-78

FIGURE H-4

LAND CLASSIFICATION MAPPING SYMBOLS
FOR COMPLETE PROFILE EVALUATION



Land suitability class
- 1 good
- 2 fair
- 6 unsuitable

Subclass (type of deficiency)
- s - soils

Subclass deficiencies (soil & geologic material)
- s - salinity
- a - sodicity
- h - very fine textures
- v - coarse textures
- p - restricted permeability
- d - shallow depth of suitable material
- w - weathered geologic material
- b - consolidated geologic material

Figure H-2

Class 6 lands (58 percent of study area) are located in all areas of the study area. Soils range from fine to coarse textures and from shallow to deep. Most have harmful accumulations of salinity and sodium and very restricted permeability. In some locations, bedrock outcrops occur.

The location of the classes is shown on figure H-3; the location of classes and subclasses is shown on figures H-4 and N-10. A complete tabulation of land class and subclass acreages is presented in table N-14. Figure N-11 shows the location and acreage of suitable and unsuitable soils. Additional information is recorded on this figure to help identify potential problems that could affect stripping and revegetation.

Bedrock Suitability

Bedrock materials at the Ojo Encino study area are in three geologic formations--the Pictured Cliffs, Fruitland, and Kirtland. The materials in these formations are discussed in the previous section on geology (especially the Study Area Geology subsection).

The results of selected physical and chemical tests performed on bedrock samples (and on soil samples) are summarized in tables N-8 and N-9. The bedrock samples were obtained from cores from drill holes DH-1 through DH-5 located as shown on figure E-1 (DH-1 = DH-1A).

Weathering tests indicate that breakdown of the materials after 20 laboratory cycles and 1 year of outdoor exposure varied greatly from no change to complete breakdown. Of a total of 8 samples subject to freeze-thaw tests (laboratory cycles), the range of breakdown was: zero-20 percent - 3 samples; 20-50 percent -4 samples; above 50 percent - 1 sample. One sample (DH-4) had 100-percent breakdown. Of those samples subjected to 1 year of outdoor weathering, 60 percent showed some slight breakdown; 20 percent showed little to no change; and 20 percent had complete breakdown. */

If not topsoiled and properly managed, smoothed spoil piles may develop a surface crust and be relatively impermeable to infiltration from precipitation. Results from the disturbed hydraulic conductivity tests indicate limited moisture penetration in any of the bedrock samples (table N-8). Wind erosion and blowing dust from unvegetated smoothed spoil piles could be worse than under premining conditions.

Leaching of chemicals from the surfaces of smoothed spoil piles by runoff could be higher than under premining conditions.

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*/ See Results of Laboratory Weathering Tests and Outdoor Exposure Tests Conducted on Core Samples from Ojo Encino, New Mexico, in section N.

The swell factor of excavated rock from the Kirtland, Fruitland, and Pictured Cliffs formations is unknown but is expected to be relatively high because of the presence of appreciable amounts of montmorillonite in the shales as is indicated by the cation exchange capacity (CEC) (table N-8). CEC for 87 samples ranged from 3.8 to 46.2, averaging 21.6 milliequivalents per 100 grams.

Hydraulic conductivity (in inches per hour) ranged from 0.01 to 1.3, averaging .06. The hydraulic conductivity determinations are not a measure of in-place permeability but indicate expected infiltration rates for disturbed bedrock material.

The total of 60 chemical analyses of saturated paste extracts (table N-8) show consistently high concentrations of sodium in most of the bedrock samples. Sodium concentrations ranged from 8.4 milliequivalents per liter (meq/L) to 134.0 meq/L, averaging 42.3 meq/L. Electrical conductivity (EC x 10^3 @ 25° C) ranged from .94 to 12.3 millimhos per centimeter (mmhos/cm), averaging 4.2. High levels of sodium (above 4.0 mmhos/cm) can adversely affect plant growth and soil permeability.

The above tests and others* and field investigations indicate that most bedrock materials are unsuitable as planting media. Revegetation of overburden spoil piles at the Navajo Coal Mine (which has similar geology) indicates, however, that germination and young plant establishment on some bedrock material are possible under irrigation. Therefore, it may be possible at the Ojo Encino study area to mix some class 1 or class 2 materials with selected bedrock and obtain suitable planting media. The levels of sodium and clay in the bedrock thus may be reduced. This must remain speculation until research identifies usable types of bedrock.

Bedrock must be properly stripped, transported, and stockpiled to prevent contamination of planting media.

Toxic Materials

Selected laboratory and greenhouse studies* of samples from the study area indicate no significant accumulations of toxic materials other than sodium. If a more detailed soil survey is conducted prior to mining (see Additional Studies Before Mining below), additional toxic or other materials unfavorable for plant growth may be found. These materials must be properly identified and disposed of so that planting media and water supplies are not contaminated.

Additional Studies Before Mining

Before soils of the study area are disturbed, the land classification conducted for this report should be refined to assure more accurate identification and proper disposition of all soils.

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* See section N, table N-8, and Laboratory and Greenhouse Evaluation of Soil and Geologic Materials as Plant Growth Media on the Ojo Encino, New Mexico, site.

The field investigations, weathering tests, greenhouse studies, and laboratory analyses of study area bedrock were all performed on selected core (DH)

materials. Data derived from these investigations, etc., represent only specific drill hole sites and should not be projected without additional investigations of the study area.

Because of the study area's severe climatic and soil conditions, its postmining reclamation will be very challenging, allowing only a moderate chance of success. To improve the chances of successful reclamation, additional research should be conducted, including the use of on-site test plots and covering considerations such as soil treatment (as with gypsum), irrigation, erosion control, plant species, and management of revegetated areas.

Quality of Irrigation Water Supplies

Please refer to section J and the Hydrology and Water Supply Conclusions subsection of section C for an evaluation of the quality of water supplies to be used in revegetating the study area.

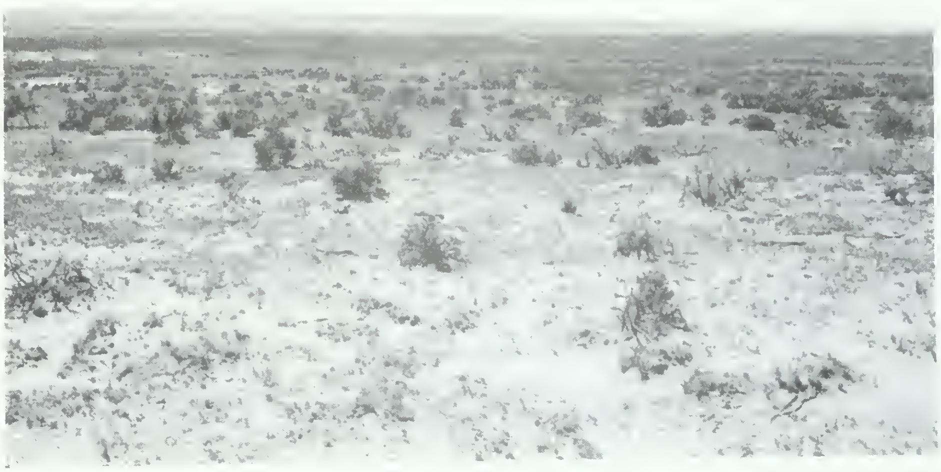


Photo H-1. Looking southwest from north of profile 64.
Picture shows class 1 and class 2 lands.
(See figure H-4 for profile locations.)

Photo H-2. Looking northeast near profile 4 at class 1
and class 2 lands.

Photo H-3. Looking northwest near profile 22 at class 1 land in foreground, class 1 and class 6 lands in middleground, and badlands in far background.

Photo H-4. Looking northeast near profile 63 at large area of class 2 land.

Photo H-5. Looking northwest near profile 28 at class 6 land in foreground, class 1 land in far middleground (shrubs), and badlands in background.

Photo H-6. Looking southeast near profile 73 at class 6 land in foreground and middleground and class 2 land in far background.

Photo H-7. Looking north near profile 24 at large area of class 6 land in foreground and middleground, vegetated sandy ridge in near background, and badlands in far background.

Photo H-8. Coal outcrop mined by local residents and located near study area south of profile 40.

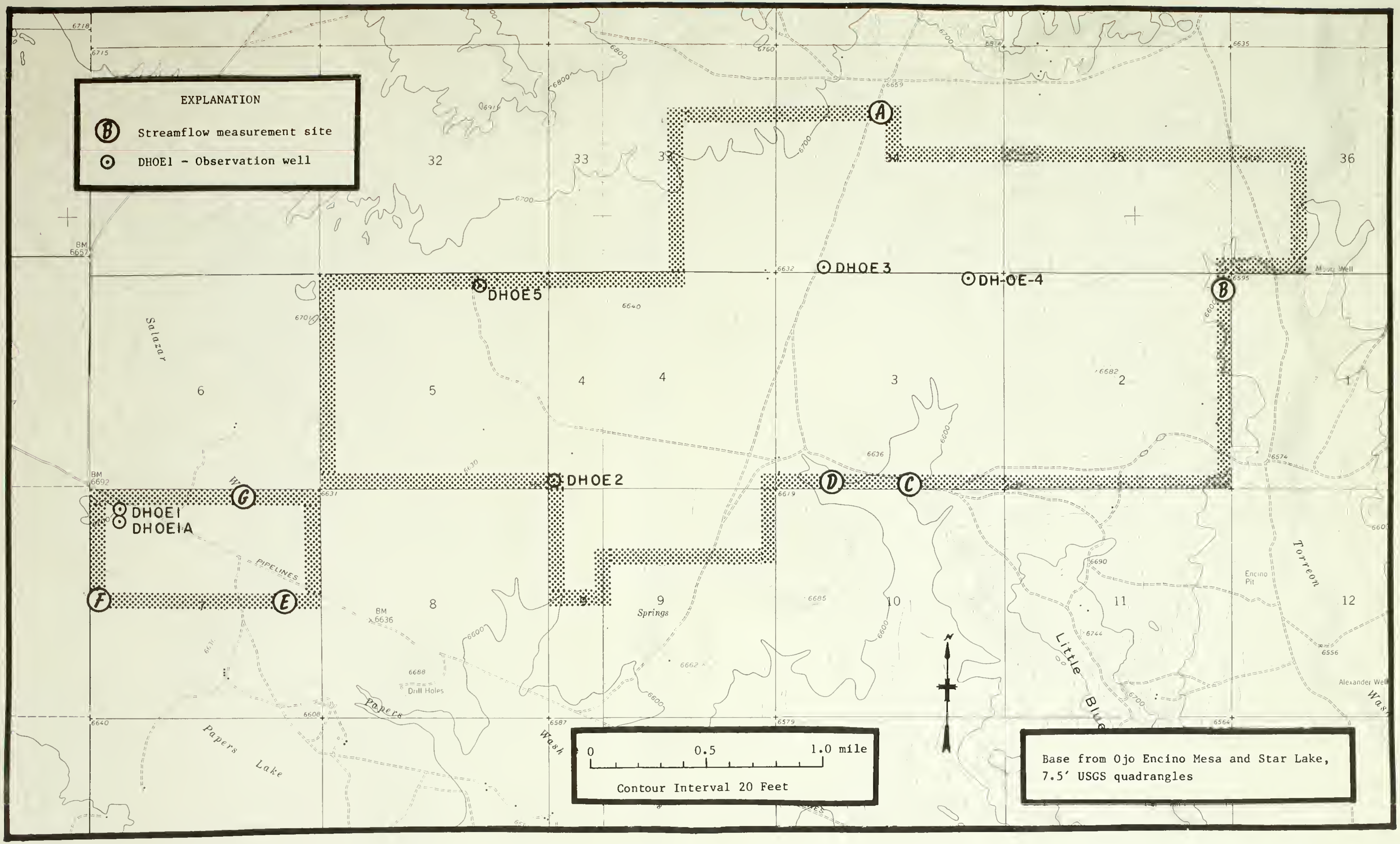
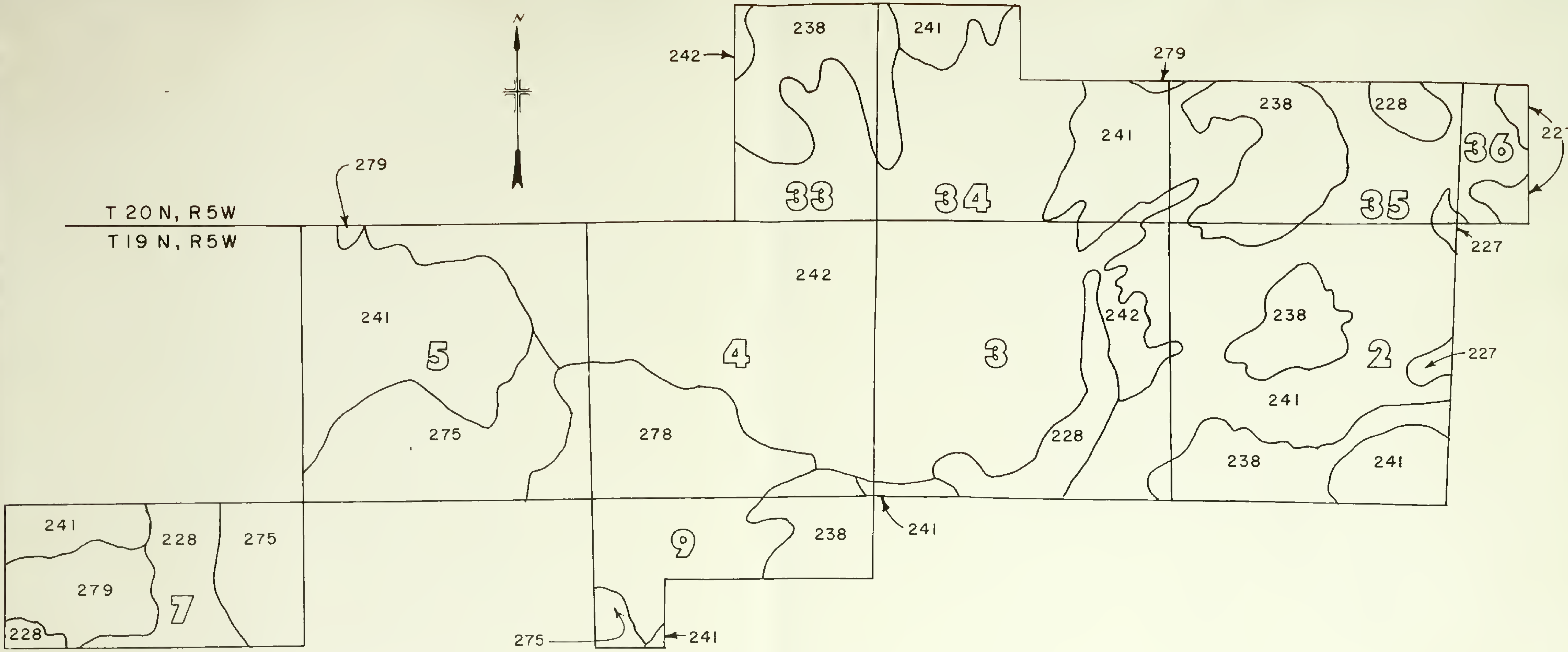
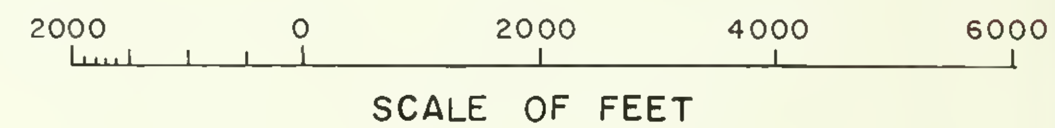


Figure J-1. Topographic map showing location of estimated streamflow characteristics and observation wells at the Ojo Encino study area.



UNIT	SOIL MAPPING UNITS	% of Area	Acres
7002	BADLAND (279 ✱)	1	108
7016	BEEBE - NOTAL ASSOCIATION (227)	4	40
7017	NOTAL ASSOCIATION (228)	13	185
7018	DOAK - SHIPROCK LOAM (238)	30	526
7019	FRUITLAND - DOAK COMPLEX, ERODED (241)	35	1262
7020	BLANCOT - FRUITLAND COMPLEX, (242)	6	1447
7021	UFFENS - HUERFANO COMPLEX (275)	8	240
7022	ROCK OUTCROPS, SHALE (278)	3	312
	TOTAL	100	4120

✱ - SCS SOIL ASSOCIATION / COMPLEX NUMBER



OJO ENCINO STUDY AREA

SOIL MAPPING UNITS

EMRIA REPORT NO. 19-78

FIGURE N-1

SECTION I

VEGETATION

SECTION I*

VEGETATION

Introduction

The three principal investigators spent one day at the Ojo Encino study area. Virtually all portions of all sections in the study area were covered by the investigators. USGS maps and aerial photos were used in the field to facilitate the accurate placement of vegetation-type lines.

The Ojo Encino study area has little topographic relief with an elevational range of 2,003 m (6,570 feet) near a large wash in the northeast corner of the area (SW corner section 36) to 2,042 m (6,700 feet) in the northwest corner of the area (NW corner section 5).

A number of arroyos run into and through the study area in a generally NNW to SSE direction. Many of the drainages spread out into broad playa-like flats. This water-spreading pattern often isolates island-like areas of elevated soil blocks. These raised areas appear to have deeper more friable soil and less clay than the surrounding flats and support vegetation similar to that of the dissected mesas.

In the western portion of the study area, primarily in section 5, these raised islands are sometimes rocky benches which appear to be the result of erosion (water and blowouts) between the benches.

There are occasional clay mounds which are quite pronounced and are virtually devoid of plants. They resemble miniature badland buttes. The most striking of these lie outside the study area north of section 5 in section 32.

Vegetation

The entire study area appears to have had heavy grazing, and there is little vegetative or species diversity. We have recognized only three vegetation types on the area and one of these types is merely a mosaic of the other two. The types are: Sagebrush Steppe, Riparian-Flats, and Mixed Sagebrush-Riparian. Vegetation patterns are shown on figures I-1 and I-2. Photos of the vegetation types follow the figures. Plants observed at the study area are listed in table I-1.

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*/ This section, the Vegetation Conclusions in section C, and section P were prepared by Ecological Assessments, Inc., Route 2, Box 252, Las Cruces, New Mexico 88001, in 1979.

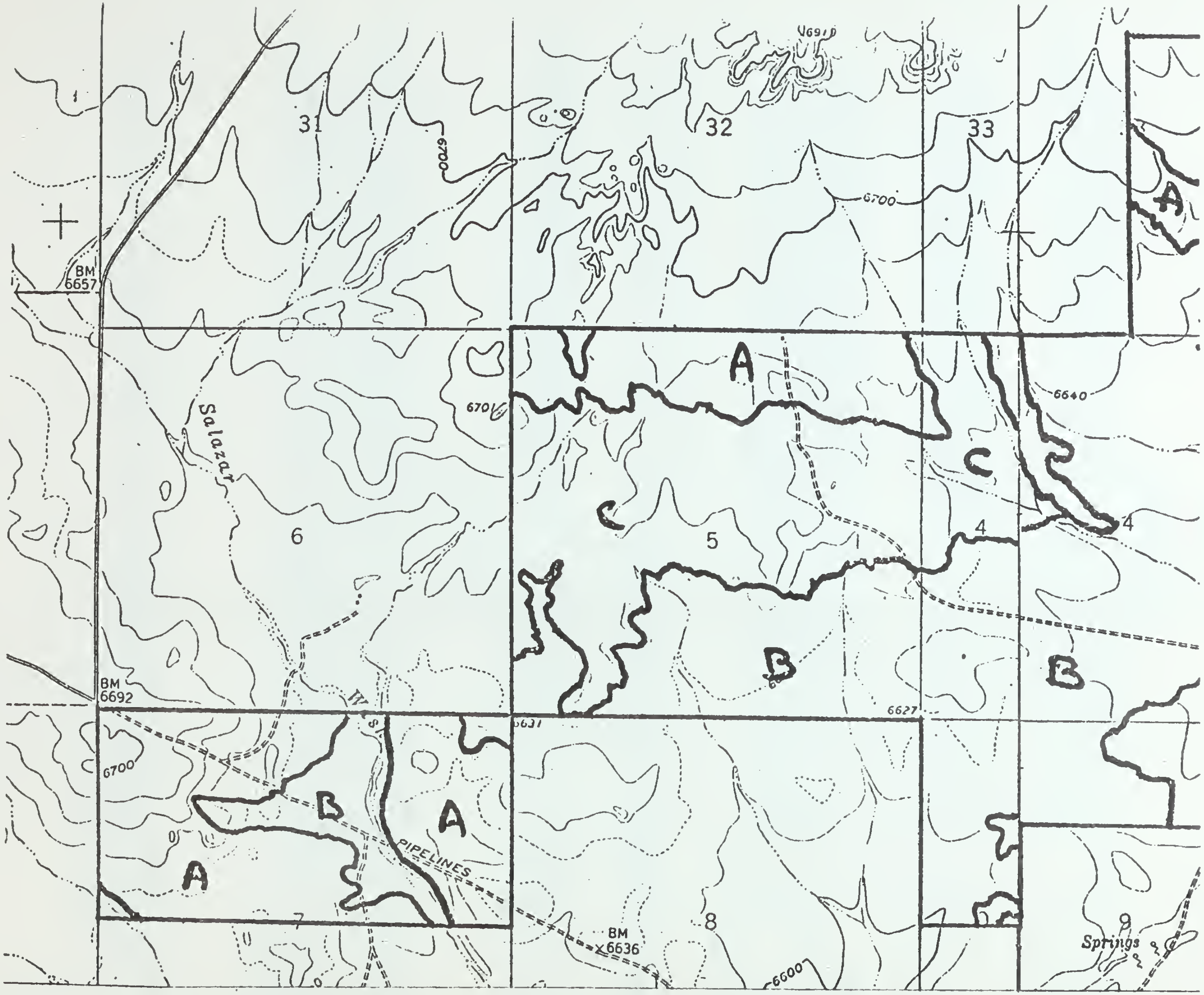


Figure I-1--Vegetation Types on the West Part of the Ojo Encino Study Area
(A = Sagebrush Steppe B = Riparian-Flats C = Mixed Sagebrush-Riparian)

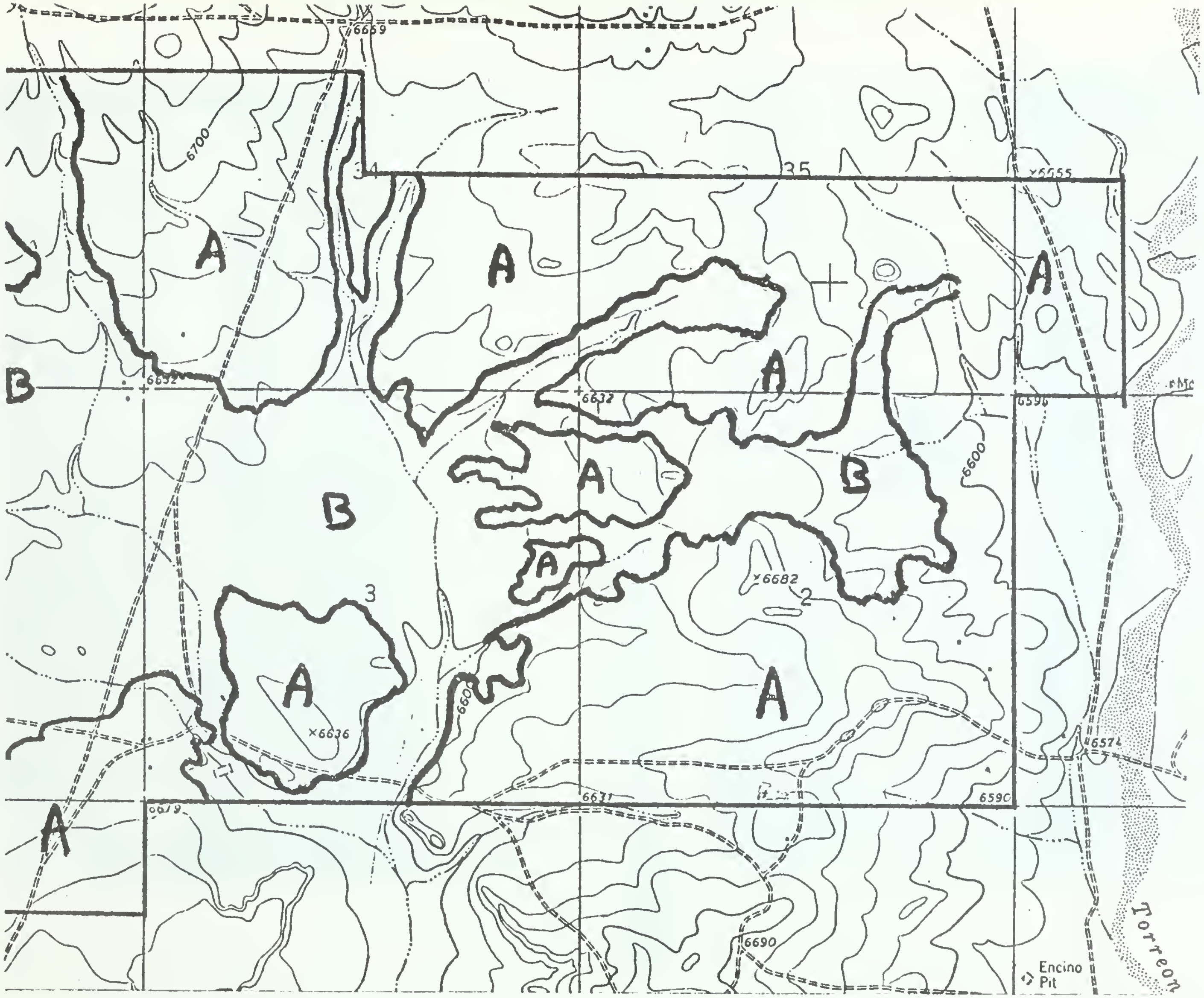


Figure I-2--Vegetation Types on the East Part of the Ojo Encino Study Area
(A = Sagebrush Steppe B = Riparian-Flats C = Mixed Sagebrush-Riparian)

Photo I-1. Easterly view from eastern portion of section 2 showing sagebrush steppe in center and riparian flat in background. Note raised elevation of sagebrush steppe in relation to riparian flat.

Photo I-2. Northerly view from southern edge of section 3. Photo taken from top of low hill showing sagebrush steppe on side slope with riparian flat in background.

Photo I-3. General view of expansiveness of riparian flat vegetation pattern on Ojo Encino area.

Photo I-4. Westerly view of riparian flat vegetation pattern from section 4 showing limited, isolated "mottes" of sagebrush steppe vegetation on elevated soil locations.

Photo I-5. Immediate foreground shows Atriplex vegetation growth, middle foreground supporting more grass vegetation of the riparian flat pattern with a long narrow band of the sagebrush steppe in an elevated position immediately behind the grass area.

Photo I-6. Riparian flat with more uniform vegetation pattern of grass in foreground with sagebrush steppe in long narrow bands across the background.

Table I-1
Plants observed at Ojo Encino Study Area*

Life forms: T = tree, S = shrub, F = forb, G = grass

Plant	Common Name	Life Form
ASTERACEAE		
Artemisia tridentata Nutt.	big sagebrush	S
Chrysothamnus greenei (Gray) Greene		
Chrysothamnus nauseosus (Pall.) Britt. subsp. *bigelovii* (Gray) H. & C.	Bigelow rabbitbrush	S
Gutierrezia sarothrae (Pursh.) Britt & Rusby	snakeweed	S
CHENOPODIACEAE		
Atriplex canescens (Pursh.) Nutt	four-wing saltbush	S
Atriplex obovata Mog. (=*A. jonesii* Standl.)		F
Atriplex powellii Wats.		F
Atriplex saccaria Wats..		F
Salsola paulsenii Litv. (=*S. kali* L. of authors)	Russian thistle	F
Sarcobatus vermiculatus (Hock.) Torr.	greasewood	S
CUPPRESSACEAE		
Juniperus osteosperma (Torr.) Little	Utah juniper	T
LILIACEAE		
Yucca angustifolia Pursh.	soapweed yucca	S
POACEAE		
Bouteloua gracilis (H.B.K.) Lag.	blue grama	G
Hilaria jamesii (Torr.) Benth.	galleta	G
Muhlenbergia pungens Thurb.	sand hill muhly	G
Oryzopsis hymenoides (R.&.S.) Ricker	Indian ricegrass	G
Sporobolus airoides Torr.	alkali sacaton	G

Table I-1 (con.)
Plants observed at Ojo Encino Study Area*
Life forms: T = tree, S = shrub, F = forb, G = grass

Plant	Common Name	Life Form
POLYGONACEAE		
Eriogonum leptophyllum (Torr.) Woot. & Standl.		S
SALICACEAE		
Populus wislizenii (Wats.) Sarg.	Rio Grande cottonwood	T
SOLANACEAE		
Lycium pallidum Miers.	pale wolfberry	S

* Names are derived from A Checklist of Gymnosperms and Angiosperms of New Mexico (Wm. Martin, E. F. Castetter, 1970, privately published), published floras of Arizona and of Texas, and from technical literature. Those few plants not recognized to species in the field were collected and have been deposited as vouchers in the New Mexico State University Herbarium.

Sagebrush Steppe

This upland type is dominated by big sagebrush (Artemisia tridentata). Scattered grass is dominated by blue grama (Bouteloua gracilis), galleta (Hilaria jamesii), and occasional tufts of Indian rice grass (Oryzopsis hymenoides). Utah junipers (Juniperus osteosperma) are scattered on rocky outcrops. A shrubby wild buckwheat (Eriogonum leptophylum) may also be found on rocky sites. Sand depressions have yucca (Yucca angustifolia), four-wing saltbush (Atriplex canescens), and pale wolfberry (Lycium pallidum).

Riparian-Flats

This type has two extremes--typical arroyo situations and large flats where shallow water may stand for prolonged periods (the evidence of standing water can be seen as a dark area on an aerial photo used in the vegetation study. The arroyo vegetation is dominated by the shrubs bigelow rabbitbrush (Chrysothamus nauseosus subsp. bigelovii) and greasewood (Sarcobatus vermiculatus). At the edges of broad arroyos, a few Rio Grande cottonwoods (Populus wislizenii) are sometimes found. Alkali sacaton (Sporobolus airoides) is common in the drainages. On the drainage flats, a group of Atriplex forbs are common. These are: A. obovata, A. powellii, and A. saccaria. Russianthistle (Salsola paulsenii) is frequent. A small rabbitbrush (Chrysothamnus greenei) is also mixed with the Atriplex species. Four-wing saltbush and snakeweed (Gutierrezia sarothrae) are scattered in this type.

Mixed Sagebrush-Riparian

As indicated earlier, this type is a mosaic of the Sagebrush Steppe and Riparian-Flats units. The individual stands of these types are so small and intermixed that mapping at the scale used for this study would be impractical and of no benefit to management or manipulation.

SECTION J

HYDROLOGY AND WATER SUPPLY

SECTION J

HYDROLOGY AND WATER SUPPLY

Surface Water

Quantity

The streams in the Ojo Encino study area are classified as ephemeral streams; that is, flow occurs only in direct response to storm runoff and channels are always above the water table. Much of the surface runoff, probably due to melting snow, occurred during December through March of water years 1978-80. This information is based on data collected at two stream-flow gaging stations located in the vicinity of the study area (table Q-1).

The average annual runoff volume during the period October 1, 1977 to September 30, 1980 from 20.3 square miles at the streamflow gaging station at Papers Wash, located at the extreme southwest corner of the study area, was 130 acre-feet per year (acre-ft/yr) and the maximum instantaneous peak discharge was 24 cubic feet per second. During this same period, the average annual runoff volume from 49.0 square miles at the gaging station at Chaco Wash located 8 miles west of the study area, was 676 acre-ft/yr and the maximum instantaneous peak discharge was 97 cubic feet per second. The average monthly runoff volumes at the two streamflow gaging stations during the three-year period are shown in table Q-1.

During water years 1978-80, flow occurred on 11 percent of the days at the Papers Wash streamflow gaging station and 19 percent of the days at Chaco Wash streamflow gaging station. The duration of flow from a single thunderstorm at these gaging stations typically lasted only a few hours while diurnal flow from melting snow lasted up to two weeks.

The estimated average annual runoff volumes and estimated flood frequency discharges at specified recurrence intervals of the larger streams flowing through the Ojo Encino study area are shown in table J-1. The locations of the sites are shown in figure J-1.

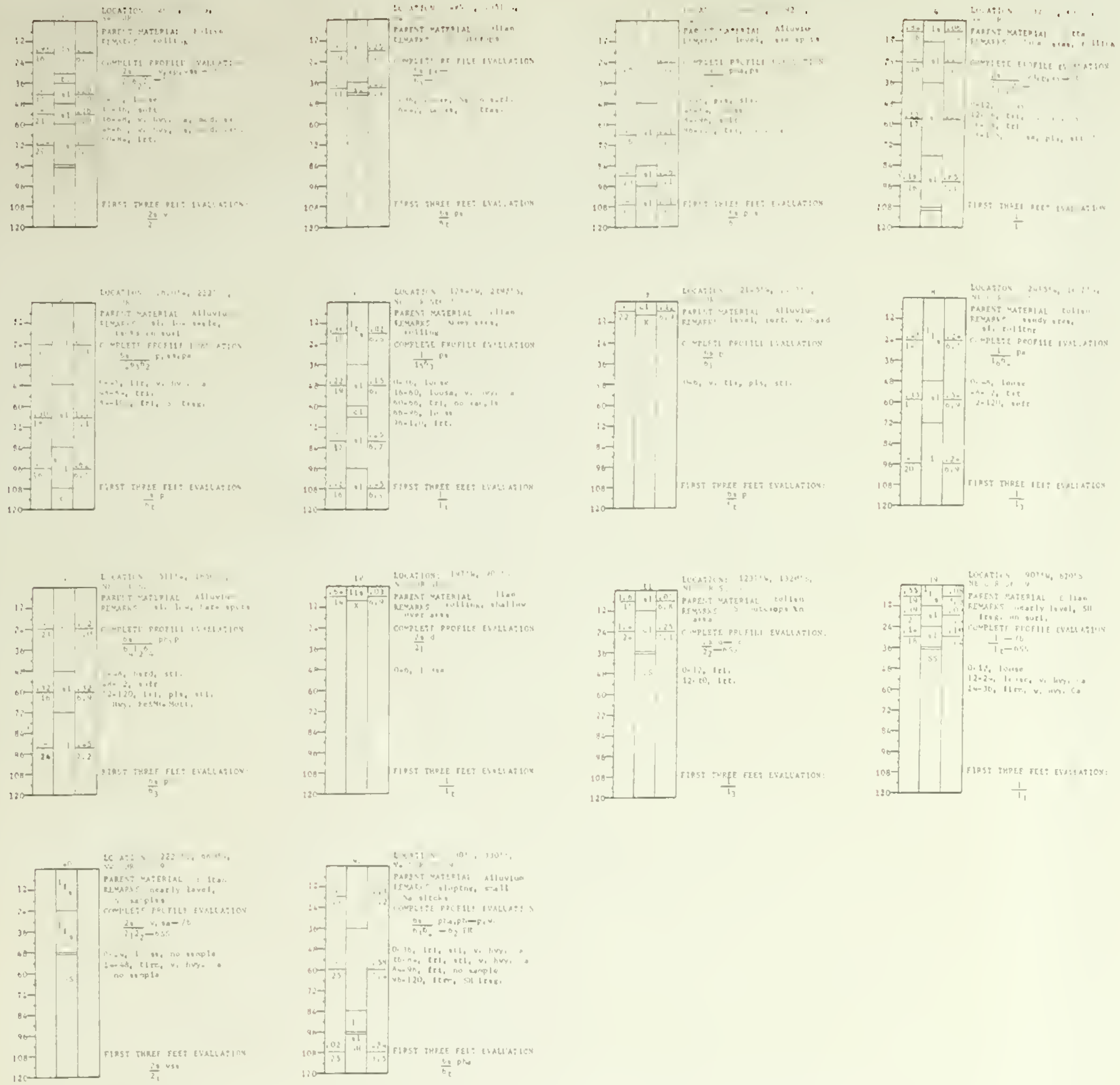
Table J-1. Estimates of annual runoff volumes, flood discharges at 10- and 100-year recurrence intervals, and annual suspended-sediment loads at selected locations in the Ojo Encino study area.

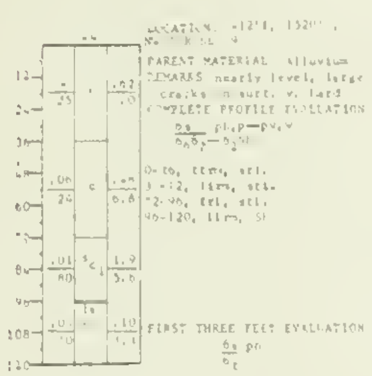
Site Location	Drainage area (square miles)	Annual runoff volume (acre-ft)	Flood Discharge 10-yr (cubic feet per second)	Flood Discharge 100-yr (cubic feet per second)	Annual Suspended sediment loads (tons)
A	3.1	20	920	2,320	400
B	.4	3	570	1,500	51
C	5.1	33	1,000	2,600	650
D	3.2	20	930	2,300	410
E	5.6	36	1,100	2,600	720
F	20.3	130**	1,400	3,400	2,600**
G	4.7	30	1,000	2,500	600

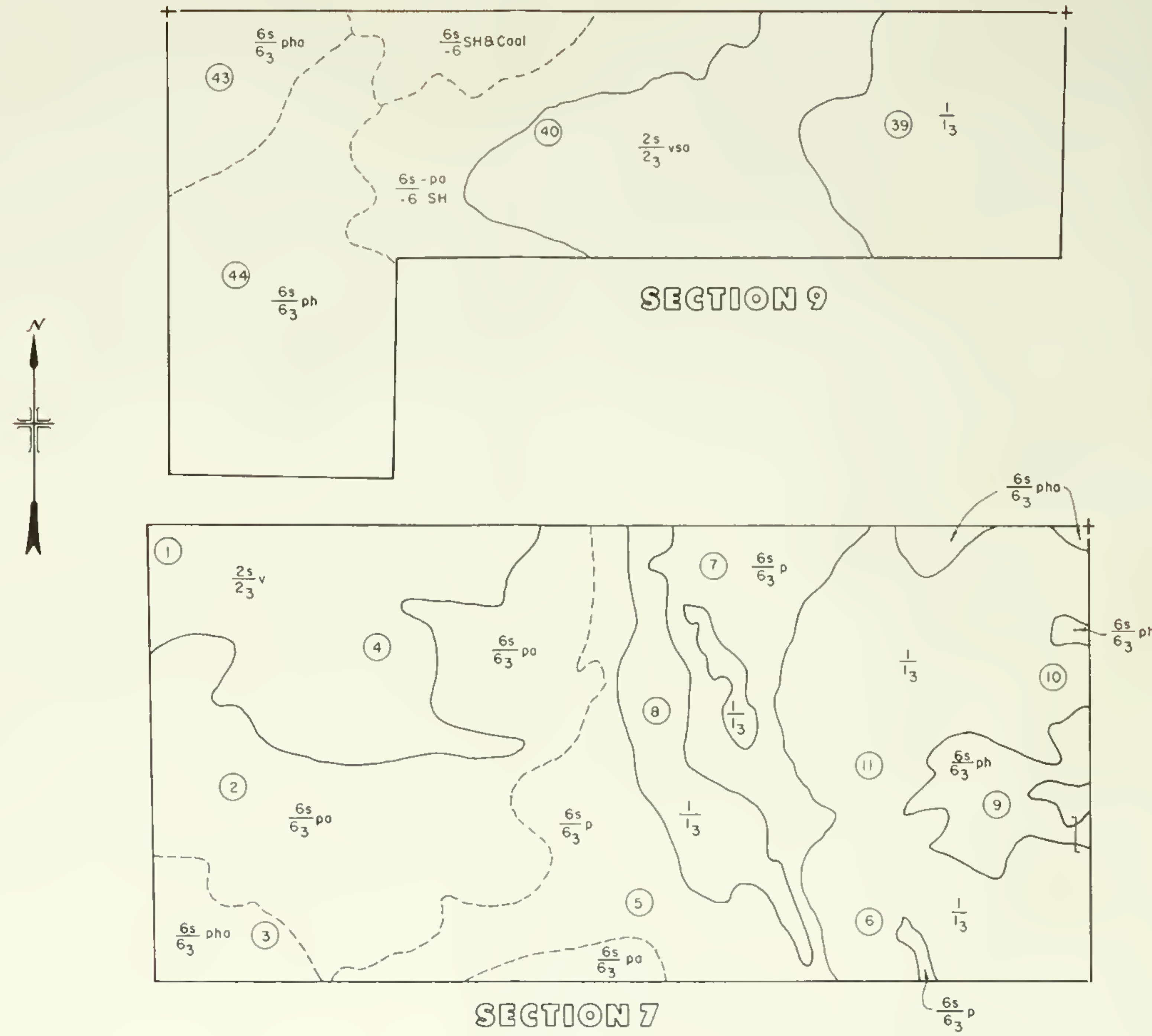
*Locations shown in figure J-1.

**Average annual runoff volume and suspended-sediment load observed during water years 1978-80 at the streamflow gaging station at Papers Wash (location F in figure J-1).

The average annual runoff volumes in table J-1 were estimated on the basis of unit runoff from data collected during water years 1978-80 at the streamflow gaging station at Papers Wash (location F in figure J-1). The flood-frequency discharges at the 10- and 100-year recurrence intervals in table J-1 were estimated from correlations using drainage area (Hejl, 1981).





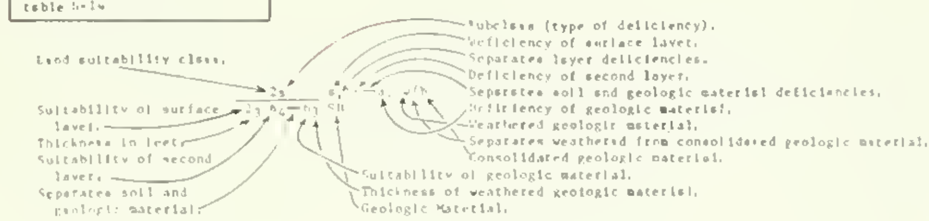


LAND CLASS	ACRES**
1	132
2	96
TOTAL	228
6	292
GRAND TOTAL	520

** for complete acreages of each individual land classification, see table below

500 0 500 1000 1500
SCALE OF FEET

<u>Land Classification Mapping Symbols for Complete Profile Evaluation</u>

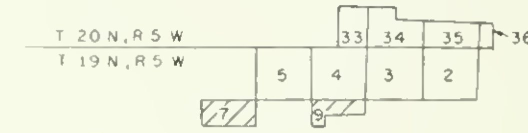


Land suitability class:
1 good
2 fair
6 unsuitable

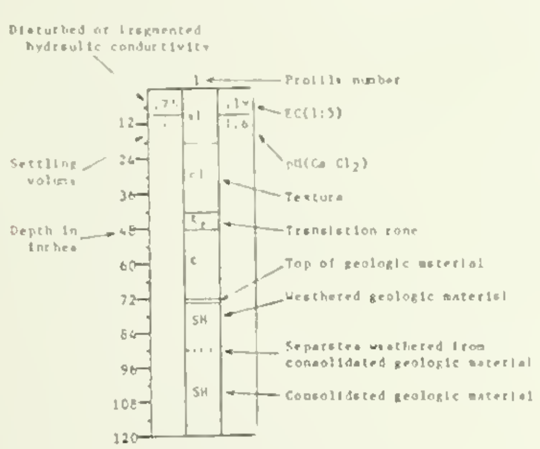
Subclass (type of deficiency)
s - soils

Subclass deficiencies (soil & geologic material)
s - salinity
a - sodicity
h - very fine textures
v - coarse textures
p - restricted permeability
d - shallow depth of suitable material
w - weathered geologic material
b - consolidated geologic material

(·) Profiles
——— separates classes
- - - - separates subclasses



<u>Land Classification Profile Symbols for Complete Profile Evaluation</u>



Textures

s	sand
ls	loamy sand
vfs	very fine sand
fs	fine sand
lfs	loamy fine sand
sl	sandy loam
vfsl	very fine sandy loam
l	loam
sil	silty loam
cl	clay loam
sicl	silty clay loam
scl	sandy clay loam
c	clay
sic	silty clay
sc	sandy clay
SS	sandstone
SH	shale
X	terminated augering

<u>Complete Profile Evaluation</u>

$\frac{2s}{2_1 2_1 - 2_3 SS}$ v, ss—ss, v/b

<u>First Three Feet Evaluation*</u>

$\frac{2s}{2_3}$ vss

*Only the first three feet was evaluated and classified for suitability as a source of planting media.

OJO ENCINO STUDY AREA, NEW MEXICO

PROFILE DESCRIPTION AND LAND CLASSIFICATION

EMRIA REPORT NO 19-78

Sheet 1 of 7

FIGURE N-10

Chemical Quality

Chemical quality of the surface water near the Ojo Encino study area is shown in tables Q-2 to Q-7. The tables include major chemical and physical properties and trace element values. The streamflow gaging stations at which the water samples were collected for analysis during the period October 1, 1977 to September 30, 1980, are located at Papers Wash (southwest corner of study area) and Chaco Wash (8 miles west of the study area). The statistical summaries presented in tables Q-2 to Q-7 include all water-quality constituents for which analyses have been made. When 10 or more analyses have been made for a particular constituent, a computation of the mean, standard deviation, and percent of samples less than or equal to a specified value is made for the constituent.

Analyses for total iron and manganese were available only at the Chaco Wash gaging station. The total iron from five analyses ranged from 120 to 220 milligrams per liter (mg/L). The total manganese from seven sample analyses ranged from 1.1 to 4.0 mg/L.

The pH was measured for 72 samples at the gaging stations at Papers Wash and Chaco Wash. The pH value ranged from 7.0 to 8.9 with a mean of about 7.7 for the 72 samples.

The sodium-adsorption-ratio (SAR) ranged from 2.8 to 11.0 for 8 sample determinations made from samples collected at the Papers Wash and Chaco Wash gaging stations.

Suspended sediment

The suspended-sediment concentrations of water samples collected at the streamflow-gaging station at Papers Wash (F in figure J-1) during the period October 1, 1977, to September 30, 1980, ranged from 566 to 19,800 milligrams per liter. (Table Q-3). The estimated average annual suspended-sediment load during this period was 2,600 tons per year (tons/yr) with an average concentration of 15,000 mg/L. The suspended-sediment concentrations of the water samples collected at the streamflow-gaging station at Chaco Wash between October 1, 1977 and September 30, 1980, ranged from 706 to 26,100 mg/L (table Q-6). The estimated average annual suspended-sediment load was 11,000 tons/yr with an average concentration of 12,000 mg/L.

The estimated average annual suspended-sediment loads at selected locations shown in figure J-1 (A-G) are listed in table J-1. These loads are estimated on the basis of unit loads (tons per square mile) computed for the ephemeral streamflow-gaging station at Papers Wash during the period October 1, 1978 to September 30, 1980.

Ground Water

Pictured Cliffs Sandstone

The Pictured Cliffs Sandstone (Late Cretaceous) directly underlies the Fruitland Formation which contains the coal seams. Its lithology is characterized by dominantly fine-to medium-grained sandstone interbedded with layers of shale. Sufficient information was not available to determine direction of flow.

Coring to obtain geologic logs at five wells shows the upper part of the Pictured Cliffs Sandstone was penetrated to depths from 25 to 126 feet without reaching the underlying formation. Of these five wells, only well DHOE2 was developed in the Pictured Cliffs Sandstone. The perforated interval in this well is from 101 to 233 feet below land surface (figure J-1). The water in the Pictured Cliffs is confined as indicated by water levels that are 60 feet above the top of the formation. Sometimes the confining layer of shale is above the deepest coal seam, as is the case at DHOE3. Water within the formation is saline with an average specific conductance from two measurements of 4,700 micromhos per centimenter at 25 degrees Celsius. A water-quality analysis is shown in tables Q-8 to Q-11. The computed transmissivity for the well was 0.2 feet squared per day. This well would have an estimated yield of less than 10 gallons per minute (gal/min).

Coal seams

The coal seams within the Ojo Encino study area are part of the Fruitland Formation (Late Cretaceous). This formation is composed of lenticular sandstone, siltstone, shale, and coal with ground-water contained in the sandstone and coal seams. Most of the recharge is probably from topographically higher areas north of the study area and upward leakage from the underlying Pictured Cliffs Sandstone. The Pictured Cliffs Sandstone is in contact with the deepest coal seam at some locations. The ground-water flow within the coal seams appears to be towards the southeast, based on the ground-water level in three observation wells within the study area. Because of the nearby Continental Divide and possibility of coal seams being discontinuous, the direction of flow within the coal seams is difficult to assess. The coal seams dip to the north at the study area.

To determine site-specific conditions, wells DHOE1A, DHOE4, and DHOE5 were drilled in the Fruitland Formation coal seams at the Ojo Encino study area (figure J-1). Well DHOE1A has two coal seams that are located 48 to 62 and 100 to 130 feet below the land surface. Water levels for this well were below the upper coal seam and fluctuated in the deeper coal seam. Wells DHOE4 and DHOE5 each have one main coal seam located 47 to 63 and 160 to 181 feet below the land surface, respectively. Both of these coal seams are saturated, with water levels always above the coal seams.

Water samples were collected for wells DHOE4 and DHOE5. Water-quality analyses for both wells are shown in tables Q-8 to Q-11. Well DHOE4 has alkaline water with an average specific conductance from two measurements of 6,450 micromhos. Water for well DHOE5 is less alkaline and has an average specific conductance of 1,980 micromhos.

Wells DHOE4 and DHOE5 have transmissivities of 0.6 and 50 feet squared per day, respectively. A separation of the casing in well DHOE1A prevented testing of its water-bearing properties. For the study site, transmissivities between 1 to 10 feet squared per day can be expected. These transmissivity values equate into estimated yields of less than 20 gal/min.

<u>Overburden</u>

The overburden materials within the Ojo Encino study area are part of the lower member of the Kirtland Shale (Late Cretaceous) and the underlying Fruitland Formation (Late Cretaceous). The lithologies are dominantly interbedded layers of siltstone, shale, and sandstone. In general, these formations have limited water-bearing capacity.

Wells DHOE1 and DHOE3 were drilled into the overburden to depths of 60 and 71 feet, respectively (figure J-1). Well DHOE3 has been dry since it was initially drilled in September of 1978. Overburden well DHOE1 has had water in the bottom of the well to a depth of two and one-half feet. The water is alkaline with a specific conductance of 4,600 micromhos. A water quality analysis for well DHOE1 is given in tables Q-8 to Q-11.

No aquifer tests were conducted on these two overburden wells.

Alluvium

The alluvium of the Torreon Wash borders the eastern edge of the study site. These alluvial deposits consist of a heterogeneous mixture of gravel, sand, silt, and clay. The flow of groundwater in the alluvium is toward the south. Recharge is due to infiltration of thunderstorm and snowmelt runoff. Discharge is by evapotranspiration, infiltration to lower bedrock layers, and movement downstream (Lyford, 1979).

Selected chemical properties and constituents for three shallow alluvial wells in Torreon Wash, within a mile of the eastern border of the study area, are shown in table J-2. The pH ranges from 8.0 to 8.3, bicarbonate ranges from 443 to 586 mg/L, the SAR values range from 7.3 to 17, and the specific conductance ranges from 923 to 1,180 micromhos. Trace element values range from 60 to 100 micrograms per liter for boron, 0 to 70 micrograms per liter for iron, and 0 to 3 micrograms per liter for selenium.

Deep aquifers

There are four principal aquifers beneath the Ojo Encino study area. In ascending order these formations are the Entrada Sandstone, the Westwater Canyon Member of the Morrison Formation, and the Menefee and Cliff House Members of the Mesa Verde Group. The ground-water flow directions within these aquifers (except the Entrada Sandstone, which was not assessed) are within a transition zone at the study area (Lyford, 1979). More detailed information is needed to determine the direction of flow at the study area. All of the aquifers are separated by units of shale.

The Entrada Sandstone (Middle Jurassic) is between 5,800 and 6,500 feet below the land surface and is 100 to 300 feet thick. The Entrada consists of fine to medium-grained silty to quartzose sandstone exhibiting eolian crossbedding. Recharge is from high outcrop areas at the boundary of the San Juan Basin. The aquifer is known to have a potentiometric surface close to the land surface and should yield approximately 400 gal/min from properly constructed wells. Water from the formation can be expected to be highly saline with specific conductance in the range of 10,000 to 15,000 micromhos. Table J-2 lists selected chemical properties and constituents for two wells in the region of the study area. Included in the table are specific conductance, bicarbonate, iron (Fe), manganese (Mn), boron (B), selenium (Se), and sodium-adsoption ratio (SAR). Gallo well #2 is located 25 miles to the northwest.

Table J-2. Selected Chemical Constituents for Alluvial and Deep Aquifer Wells in Vicinity of Ojo Encino Study Area.

Formation/ Observation Well	Township and Range	Latitude/ Longitude	Spec. Cond. (μmhos/ cm)	pH	Bicarbonate (mg/L)	Fe Total (μg/L)	Fe Diss. (μg/L)	Mn Total (μg/L)	Mn Diss. (μg/L)	B (μg/L)	Se (μg/L)	SAR	Adj. SAR
Entrada													
Filon	NW 1/4,Sec 13 T 19 N,R 04 W	355302 1071305	11,300	7.5	343	2,400	800	100	90	1,900	-	67	147
Gallo #2	SE 1/4,Sec 16 T 21 N,R 09 W	360249 1074716	12,600	7.8	230	-	30	-	100	1,500	0	102	194
Morrison													
C&P Gallo	NE 1/4,Sec 16 T 21 N,R 09 W	360313 1074734	4,420	8	60	-	30	-	300	180	0	12	21.6
C&P #1	NE 1/4,Sec 32 T 20 N,R 06 W	355521 1072934	3,950	-	615	-	170	-	-	-	-	27	62
Menefee													
Star Oil	SW 1/4,Sec 07 T 20 N,R 05 W	355822 1072446	4,080	8.6	1,240	-	30	-	-	1,000	0	110	176
Elkins #5	SW 1/4,Sec 04 T 18 N,R 06 W	354855 1072847	3,090	8.9	1,224	-	-	-	-	340	-	156	156
Sandoval	NE 1/4,Sec 21 T 18 N,R 04 W	354655 1071525	7,000	8.5	1,720	-	-	-	-	-	-	90	198
Cliff House													
19K-33	SW 1/4,Sec 23 T 19 N,R 05 W	355125 1072017	3,540	8.9	543	-	0	-	-	280	1	21	50
Star Lake	NE 1/4,Sec 10 T 19 N,R 06 W	355356 1072735	3,130	8.6	1,250	-	10	-	-	450	0	116	139
M Tanner	NE 1/4,Sec 24 T 19 N,R 06 W	355213 1072458	2,130	8.3	1,270	-	-	-	-	290	-	41	70
Elkins #6	SW 1/4,Sec 35 T 19 N,R 06 W	354950 1072634	2,920	8.7	237	-	0	-	-	210	0	47	56
CCR #22	SE 1/4,Sec 29 T 20 N,R 06 W	355558 1072933	3,590	8.4	1,150	3,200	0	20	10	450	0	111	166
Alluvium													
#1	NW 1/4,Sec 01 T 19 N,R 05 W	355444 1071910	1,180	8.3	586	-	70	-	-	70	0	17	30.6
#2	SW 1/4,Sec 01 T 19 N,R 05 W	355406 1071923	1,010	8.0	499	-	0	-	-	100	3	7.3	15.3
#3	SW 1/4,Sec 12 T 19 N,R 05 W	355320 1071911	923	8.2	443	-	0	-	-	60	3	8.8	16.7

The Filon well is five miles to the east and should serve as a better indicator of the Entrada Sandstone water quality for the study area.

The Westwater Canyon member of the Morrison Formation (Late Jurassic) is 200 to 300 feet thick and located at 4,500 to 5,500 feet below the surface. The Westwater Canyon member consists of massive beds of fine-to course-grained sandstone with locally interbedded claystone. The potentiometric head is well above the formation, being only 180 feet below the land surface. Ground water is recharged from distant high outcrop areas. Based on data from a well six miles to the northwest, the yield for the aquifer was calculated at 250 gal/min (Shomaker, 1975). Specific conductance values at the study site would range from 3,000 to 5,000 micromhos based on regional trends. Table J-2 lists selected chemical properties and constituents for three wells in the vicinity of the study area. C & P Gallo well is 25 miles to the northwest of the study area. Well C & P #1 is located six miles to the northwest and should serve as a better indicator of the chemical quality at the study area.

The Menefee Formation (Late Cretaceous) is at 700 to 2,300 feet below the land surface with a thickness of over 1,000 feet. The Menefee consists of interbedded shales and claystone with thin beds of coal, carbonaceous shale, and sandstone. Recharge to the Menefee is from outcrops to the south. Estimated yield is approximately 50 gal/min. Water in the formation is saline with specific conductance values ranging from 3,000 to 7,000 micromhos at the study area. Table J-2 lists selected chemical properties and constituents for three wells in the vicinity of the study area. Star oil well is located five miles to the north, which is down gradient from the study site. Lower levels for the selected chemical constituents can be expected at the study site. Elkins #5 and Sandoval well are located up gradient about ten miles to the south. Expected values for the selected chemical constituents should be higher for water at the study area.

The Cliff House Sandstone (Late Cretaceous) is 150 to 250 feet thick and is located 500 to 1,000 feet below the land surface. The Cliff House is dominantly a fine-to medium-grained silty sandstone. Recharge to this formation is from outcrops to the south. Expected yield is approximately 100 gal/min. Water in the formation is saline with expected specific conductance values ranging from 2,000 to 4,000 micromhos. Table J-2 lists selected chemical properties and constituents for five wells in the study area. All the wells are within six miles to the south and west of the study area. Since this is up gradient of the study area, water with concentrations higher than the selected parameters can be expected in the Cliff House Sandstone at the study site.

The information above was derived from Water-Resources Investigations 79-73 (Lyford, 1979), and from measurements in wells located in the region surrounding the Ojo Encino study area. The deeper aquifers are not penetrated by any wells within the study area.

Water Supply

Availability for Reclamation

The surface runoff has the best water quality at the study area and the alluvium at Torreon Wash has the second best water quality. The surface runoff is highly variable from year to year and the alluvium is probably low yielding and limited in quantity.

Ground water from deep aquifers identified in this report are available for an irrigation supply. Water quality of the deep aquifers may be a critical factor in determining the best aquifer for reclamation. The information presented is speculative since there are no wells in deep aquifers at the Ojo Encino study area.

Availability for Mining Operation

An adequate and reliable water-supply may be developed from any of several deep aquifers at the study area.

SECTION JJ

REFERENCES

SECTION JJ

REFERENCES

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SECTION K

GEOLOGY APPENDIX

SECTION K

GEOLOGY APPENDIX

Geologic Logs

GEOLOGIC LOG OF HOLE NO DH-OE-1A

PROJECT: EMRIA	FEATURE: OJO ENCINO STUDY SITE
AREA: OJO ENCINO COAL FIELO	STATE: NEW MEXICO
COORDS. N 1,782,468.5 E 624,182.5	GROUND ELEV 6701.2
ANGLE FROM HORIZ 90.0 DOWN	BEGUN 8-18-78
FINISHED 8-27-78	DEPTH TO BEDROCK 10.0
TOTAL DEPTH 200.9	BEARING
DEPTH TO WATER 112.0 8-20-78	LOGGED BY W. L. WITT
REVIEWED BY J. L. JACKSON	

FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL): DEPTH (FEET) FROM (P, Cs, or Cm) TO; DIAMETER (INCHES); LOSS (GPM); DIFFERENTIAL PRESSURE (FEET); LENGTH OF TEST (MIN); PERMEABILITY (K) FEET/YEAR — no entries.

NOTES

CONTRACTOR:
ENTERPRISE DRILLINO OF TULSA

DRILL RIO:
MAYHEW 500 AND 427 W.C.Q. COMPRESSOR

DRILLINO METHODS:

0.0 FT-10.7 FT: 3 INCH THIN-WALL PUSH TUBE SAMPLER.

10.7 FT-193.9 FT: COREO WITH 10 FT NX BARREL, DIAMOND BIT AND AIR.

193.9 FT-200.9 FT: CORED WITH WATER.

HOLE COMPLETION:

REAMED HOLE TO 4-3/4 INCH.

PUMPEO (6 SACKS) CEMENT SLURRY THROUOH RODS TO BOTTOM OF HOLE. LET SET OVERNIGHT. DRILLEO OUT PLUG FROM 120.5 FT TO 126.6 FT. SET 80 FT OF PERFORATEO 2 INCH PVC PIPE TOPPEO BY SHALE CATCHER, BENTONITE BALLS AND 42.1 FT OF 2 INCH PVC WITH CAP. BACKFILLED WITH AEOLIAN SAND 15 FT ABOVE SHALE CATCHER AND GROUTED TO SURFACE THROUOH 1 INCH PVC PIPE.

NOTE:
OVERBURDEN INCLUDES ALL SURFICIAL MATERIALS AND BEDROCK OVERLYINO FIRST COAL BED.

PERCENT CORE RECOVERY (in order down the hole, depth scale 0–100 ft)

60, 100, 11, 100, 86, 100, 92, 81, 0, 95, 27, 99

ELEVATIONS (FEET)

6691.2, 6672.5, 6662.8, 6659.4, 6658.2, 6657.2, 6653.3, 6646.0, 6639.2, 6628.9, 6627.4, 6622.3

CLASSIFICATION AND PHYSICAL CONDITION

0.0 FT-10.0 FT: SURFICIAL MATERIAL.
AEOLIAN SILTY SAND, TAN TO MEDIUM ORAY, COMPACT BELOW 2.0 FT. SM

10.0 FT-129.6 FT:
FRUITLAND FORMATION.
PREOOMINANTLY SHALE, SANDSTONE, SILTSTONE, AND COAL.

10.0 FT-38.4 FT: SANDSTONE.
FINE TO MEOIUM-GRAINED.

10.0 FT-28.7 FT: MODERATELY WEATHERED, LIGHT TAN, IRON OXIDE STAINS ON MOST JOINTS, DRY.

28.7 FT-38.4 FT: LIGHTLY WEATHEREO, LIGHT ORAY, IRON OXIDE STAINS ON SOME JOINTS, DRY.

38.4 FT-41.8 FT: SHALE.
LIOHTLY WEATHERED TO 39.7 FT, IRON OXIDE STAINS ON SOME JOINTS, SILTY, MOSTLY LAMINATEO, ORY, LIGHT TO DARK GRAY.

41.8 FT-42.6 FT: CARBONACEOUS SHALE.
FRESH.

42.6 FT-44.0 FT: COAL.

43.0 FT-43.2 FT: SHALE.
FRESH.

44.0 FT-44.7 FT: CARBONACEOUS SHALE.
FRESH.

44.7 FT-73.8 FT: SHALE.
FRESH, SILTY, MOSTLY LAMINATED, DRY, LIGHT TO OARK ORAY.

47.9 FT-55.2 FT: COAL.

48.7 FT-48.8 FT: SHALE SEAM.

55.2 FT-62.0 FT: CARBONACEOUS SHALE.

55.4 FT-61.6 FT: COAL.

72.3 FT-72.6 FT: SANDSTONE.
FRESH, MEDIUM-GRAINEO.

73.8 FT-126.9 FT: SANDSTONE.
FRESH, FINE TO MEDIUM-GRAINED, LIGHT GRAY TO LIGHT OREENISH GRAY, DRY. SLIGHT REACTION TO HCL.

78.9 FT-79.1 FT: CALCITE VEINLET.

100.9 FT-116.0 FT: CARBONACEOUS SANDSTONE.

101.0 FT-115.6 FT: COAL.
WATER AT 112.0 FT.

116.6 FT-117.4 FT: CARBONACEOUS SANDSTONE.

116.8 FT-117.1 FT: COAL.

120.0 FT-120.5 FT: CARBONACEOUS SANDSTONE.

122.6 FT-124.4 FT: CARBONACEOUS SANDSTONE.

122.7 FT-123.2 FT: COAL.

123.6 FT-123.9 FT: COAL.

124.4 FT-129.6 FT: COAL.

129.6 FT-200.9 FT:
PICTURED CIFFS FORMATION.
PREDOMINANTLY FINE TO MEDIUM-ORAINED SANDSTONE, SILTY AND SLIOHTLY CLAYEY, WEAKLY CEMENTED AND FRIABLE, MASSIVELY BEODEO, LIGHT ORAY TO LIGHT GREENISH GRAY.

129.6 FT-130.6 FT: CARBONACEOUS SHALE.

130.6 FT-154.1 FT: SANDSTONE.
FRESH, FINE TO MEOIUM-GRAINEO, LIGHT ORAY TO LIGHT OREENISH ORAY, DRY. SLIOHT REACTION TO HCL.

137.8 FT-139.4 FT: CARBONACEOUS SANDSTONE.

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASINO CM = CEMENT

GEOLOGIC LOG OF HOLE NO DH-OE-1A

PROJECT EMRIA FEATURE OJO ENCINO STUDY SITE AREA OJO ENCINO COAL FIELD STATE NEW MEXICO

COORDS. N. 1,782,460.5 E 624,162.5 GROUND ELEV 6701.2 ANGLE FROM HORIZ 90.0 DOWN

BEGUN 8-18-78 FINISHED 8-27-78 DEPTH TO BEDROCK 10.0 TOTAL DEPTH 200.9 BEARING

DEPTH TO WATER 112.0 8-20-78 LOGGED BY W. L. WITT REVIEWED BY J. L. JACKSON

NOTES	FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL) — DEPTH (FEET) FROM (P, Cs, or Cm)	TO	DIAMETER (INCHES)	LOSS (GPM)	DIFFERENTIAL PRESSURE (FEET)	LENGTH OF TEST (MIN)	PERMEABILITY (K) FEET/YEAR	PERCENT CORE RECOVERY	DEPTH SCALE (FEET)	CLASSIFICATION INTERVALS — ELEVATIONS (FEET)	SAMPLES FOR TESTING
										6600.3	
								100			
								88			
									110		
										6585.2	
								94		6583.8	
									120	6581.2	
										6578.6	
										6576.8	
								92		6574.3	
									130	6571.6	
										6570.6	
								107			
										6563.4	
								95	140	6561.8	
								109		6554.0	
									150	6551.7	
								100		6547.1	
									160		
								98		6537.7	
								95	170		
										6527.0	
								98			
									180		
								100		6517.5	
								53	190		
								100		6502.2	

CLASSIFICATION AND PHYSICAL CONDITION

139.4 FT-140.1 FT: CARBONACEOUS SHALE.

147.2 FT-148.0 FT: CARBONACEOUS SANDSTONE.

149.5 FT-149.8 FT: CARBONACEOUS SANDSTONE.

154.1 FT-163.5 FT: SILTSTONE.

163.5 FT-174.2 FT: SHALE.

174.2 FT-200.9 FT: SANDSTONE.
FRESH, THINLY BEDDED, FINE TO MEDIUM-GRAINED, LIGHT GRAY.

183.7 FT: CARBONACEOUS SANDSTONE.
THIN (1/32 INCH) CARBONACEOUS LAMINAE, 20 PCT.

199.0 FT-199.5 FT: SHALEY SANDSTONE.
40 PCT SHALE, LAMINAE 1/4 INCH-0.1 FT.

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASING CM = CEMENT

GEOLOGIC LOG OF HOLE NO DH-OE-1A

PROJECT EMRIA FEATURE OJO ENCINO STUDY SITE AREA OJO ENCINO COAL FIELD STATE NEW MEXICO

COORDS. N 1,782,468.5 E 624,162.5 GROUND ELEV 6701.2 ANGLE FROM HORIZ 90.0 DOWN

BEGUN 8-18-78 FINISHED 8-27-78 DEPTH TO BEDROCK 10.0 TOTAL DEPTH 200.9 BEARING

DEPTH TO WATER 112.0 8-20-78 LOGGED BY H. L. HITT REVIEWED BY J. L. JACKSON

NOTES	FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL) DEPTH (FEET) FROM (P, Cs, or Cm)	TO	DIAMETER (INCHES)	LOSS (GPM)	DIFFERENTIAL PRESSURE (FEET)	LENGTH OF TEST (MIN)	PERMEABILITY (k) FEET/YEAR	PERCENT CORE RECOVERY	DEPTH SCALE (FEET)	CLASSIFICATION INTERVALS GRAPHIC DEPTHS	ELEVATIONS (FEET)	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
								100			6500.3		
									210				
									220				
									230				
									240				
									250				
									260				
									270				
									280				
									290				

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASING CM = CEMENT

GEOLOGIC LOG OF HOLE NO DH-OE-2

PROJECT: EMRIA | FEATURE: OJO ENCINO STUDY SITE | AREA: OJO ENCINO COAL FIELD | STATE: NEW MEXICO

COORDS. N 1,783,258.8 E 834,668.4 | GROUND ELEV 6638.6 | ANGLE FROM HORIZ 90.0 DOWN

BEGUN 11-12-78 | FINISHED 11-20-78 | DEPTH TO BEDROCK 1.0 | TOTAL DEPTH 270.5 | BEARING

DEPTH TO WATER 47.0 11-20-78 | LOGGED BY LOUIS CABRERA | REVIEWED BY W. L. WITT

NOTES	FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL): DEPTH (FEET) FROM (P, Cs, or Cm) / TO; DIAMETER (INCHES); LOSS (GPM); DIFFERENTIAL PRESSURE (FEET); LENGTH OF TEST (MIN); PERMEABILITY (K) FEET/YEAR	PERCENT CORE RECOVERY	DEPTH SCALE (FEET)	CLASSIFICATION INTERVALS: GRAPHIC DEPTHS; ELEVATIONS (FEET)	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION

NOTES

CONTRACTOR:
ENTERPRISE DRILLING OF TULSA

DRILL RIG:
MAYHEW 500 AND W.C.Q. COMPRESSOR

DRILLING METHODS:

0.0 FT-12.0 FT: USED 4-3/4 INCH DRAG BIT AND AIR.

SET 12.0 FT OF 5 INCH SURFACE CASING.

12.0 FT-125.5 FT: CORED WITH 10 FT SPLIT -TUBE NX BARREL, AND DIAMOND BIT.

- 12.0 FT-35.0 FT: AIR.
- 35.0 FT-125.5 FT: WATER.

125.5 FT-270.5 FT: USED 4-3/4 INCH TRI-CONE ROCK BIT.

FLUSHED HOLE WITH CLEAR WATER AND BAILED, 2 GPM.

SET 165.0 FT OF 2 INCH PERFORATED PVC TOPPED BY 5 FT SHALE CATCHER, BENTONITE BALLS, AND 102.0 FT OF 2 INCH PVC WITH 1.5 FT STICKUP, AND CAP.

GROUTED HOLE FROM 105.0 FT TO 70.0 FT (2 SACKS OF CEMENT). BACKFILLED HOLE TO SURFACE WITH DRILL CUTTINGS.

PULLED SURFACE CASING.

OFFSET 10 FT AND REDRILLED 0.0 FT-21.0 FT WITH AIR, TO CONFIRM TOP OF COAL.

NOTE:
OVERBURDEN INCLUDES ALL SURFICIAL MATERIALS AND BEDROCK OVERLYING FIRST COAL BED.

PERCENT CORE RECOVERY (top to bottom)

0, 50, 80, 0, 84, 106, 98, 100, 95, 98, 86, 120, 79, 98

DEPTH SCALE (FEET)

10, 20, 30, 40, 50, 60, 70, 80, 90

ELEVATIONS (FEET)

6635.6, 8832.1, 6629.8, 8623.1, 6621.6, 6620.1, 6608.6, 6805.8, 6599.0, 6580.8, 6579.5, 6572.1, 6570.1, 6562.0, 6552.3, 6550.9, 6549.0, 6545.4, 6544.4, 8542.3, 8536.8

CLASSIFICATION AND PHYSICAL CONDITION

0.0 FT-1.0 FT.
SURFICIAL MATERIAL.

0.0 FT-1.0 FT: FAT CLAY.
BENTONITIC, HIGH PLASTICITY, TOUGH, DRY, TAN, CH

1.0 FT-101.1 FT:
FRUITLAND FORMATION.
PREDOMINATELY SHALE, SANDSTONE AND COAL.

1.0 FT-4.5 FT: SHALE.
WEATHERED, BENTONITIC, COMPACT, BLOCKY, DRY, GRAY TO DARK GRAY.

4.5 FT-7.0 FT: SILTSTONE.
WEATHERED, CLAYEY TO SANDY, BENTONITIC, DRY, TAN TO OLIVE GRAY LAMINAE.

7.0 FT-13.5 FT: SHALE.
WEATHERED, CLAYEY TO SILTY, BENTONITIC, CARBON SPECKS, DRY, OLIVE TO DARK GRAY.

13.5 FT-14.0 FT: COAL.
CONTAINS SHALEY LAMINAE.

14.0 FT-15.0 FT: SHALE.
CARBONACEOUS, MOIST, DARK GRAY.

15.0 FT-16.5 FT: COAL.
CONTAINS THIN CARBONACEOUS SHALE AND SILTSTONE LAMINAE, MOIST, BLACK TO DARK GRAY.

16.5 FT-37.6 FT: COAL.

30.0 FT-30.5 FT: SILTSTONE.
ASHY TO SANDY.

31.0 FT-31.3 FT: SILTSTONE.
ASHY TO SANDY.

37.6 FT-57.1 FT: SANDSTONE.
FINE-GRAINED, SILTY, BENTONITIC, FEW CARBONACEOUS SPOTS AND LAMINAE.

55.8 FT-56.5 FT: CARBONACEOUS LAMINAE 1/2 INCH CLOSELY SPACED.

56.5 FT-57.1 FT: MANY COAL LAMINAE AND STREAKS.

57.1 FT-64.5 FT: COAL.

64.5 FT-66.5 FT: SHALE.
CLAYEY, SILTY, CARBONACEOUS AND SILTY LAMINAE 1/8 INCH FROM 64.5 FT-66.5 FT, MODERATELY HARD, BLACK TO DARK GRAY.

66.5 FT-74.6 FT: SANDSTONE.
VERY FINE TO FINE GRAINED, IRREGULARLY LAMINATED WITH CLAYEY SHALE AND CARBONACEOUS SEAMS, OLIVE GRAY.

73.9 FT-74.6 FT: CLOSELY SPACED CARBONACEOUS LAMINAE.

74.6 FT-84.3 FT: SANDSTONE.
FINE-GRAINED, SILTY, WEAKLY TO MODERATELY CEMENTED, FEW SCATTERED CARBONACEOUS SEAMS TO 0.3 FT, LIGHT GRAY.

84.3 FT-85.7 FT: SHALE.
CLAYEY, SILTY, SILTSTONE, INCLUSIONS AND IRREGULAR LAMINAE, LOW ANGLE SLICKENSIDES TO 30 DEGREES, DARK GRAY.

85.7 FT-86.4 FT: SANDSTONE.
VERY FINE TO FINE-GRAINED, GRADES TO SLIGHTLY CLAYEY, WEAKLY CEMENTED, LIGHT GRAY.

86.4 FT-87.6 FT: SHALE.
CLAYEY WITH MANY SILTY LAMINAE, BLACK TO LIGHT GRAY.

86.4 FT-87.3 FT: SLAKES.
87.3 FT-87.5 FT: LIMY VEINLETS.

87.6 FT-91.2 FT: SILTSTONE.
SANDY TO SLIGHTLY CLAYEY, WITH MANY FINE CARBONACEOUS SHALE LAMIANE, LIGHT OLIVE GRAY.

91.2 FT-92.2 FT: SHALE.
CLAYEY, SLIGHTLY CARBONACEOUS, MODERATELY HARD, SLAKES, DARK GRAY.

92.2 FT-92.7 FT: SANDSTONE.
VERY FINE TO FINE-GRAINED, SILTY, WEAKLY CE-

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASING CM = CEMENT

GEOLOGIC LOG OF HOLE NO DH-OE-2

PROJECT EMRIA FEATURE OJO ENCINO STUDY SITE AREA OJO ENCINO COAL FIELD STATE NEW MEXICO

COORDS. N. 1,783,258.8 E. 834,866.4 GROUND ELEV. 6636.6 ANGLE FROM HORIZ 90.0 DOWN

BEGUN 11-12-78 FINISHED 11-20-78 DEPTH TO BEDROCK 1.0 TOTAL DEPTH 270.5 BEARING

DEPTH TO WATER 47.0 11-20-78 LOGGED BY LOUIS CABRERA REVIEWED BY H. L. WITT

NOTES	FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL)							PERCENT CORE RECOVERY	DEPTH SCALE (FEET)	CLASSIFICATION INTERVALS		SAMPLES FOR TESTING
	DEPTH (FEET)		DIAMETER (INCHES)	LOSS (GPM)	DIFFERENTIAL PRESSURE (FEET)	LENGTH OF TEST (MIN)	PERMEABILITY (K) FEET/YEAR			GRAPHIC DEPTHS	ELEVATIONS (FEET)	
	FROM (P, Cs or Cm)	TO										
											8535.5	
								98				
											8530.1	
								100	110		8528.4	
											8528.1	
								100	120			
											8511.1	
									130			
									140			
									150			
									160			
								0				
									170			
									180			
									190			

CLASSIFICATION AND PHYSICAL CONDITION

MENTED, MODERATELY HARD, LIGHT OLIVE GRAY.

92.7 FT-94.3 FT: SHALE.
CLAYEY, BENTONITIC, SLIGHTLY CARBONACEOUS, NUMEROUS SILTY SANDSTONE LAMINAE, LOW ANGLE TO 30 DEGREE SLICKENSIDES, BLACK TO LIGHT GRAY.

94.3 FT-95.2 FT: SANDSTONE.
SIMILAR TO 92.2 FT-92.7 FT.

95.2 FT-99.8 FT: SHALE.
CLAYEY, CARBONACEOUS STREAKS AND SPECKS, LOW ANGLE PARTINGS AND SLICKENSIDES.

99.8 FT-101.1 FT: COAL.

101.1 FT-125.5 FT:
PICTURED CLIFFS FORMATION.
PREDOMINATELY FINE TO MEDIUM-GRAINED SANDSTONE, SILTY AND SLIGHTLY CLAYEY, WEAKLY CEMENTED AND FRIABLE, MASSIVELY BEDDED, LIGHT GRAY TO GREENISH GRAY.

101.1 FT-106.5 FT: SHALE.
CLAYEY TO SILTY, BENTONITIC, CARBONACEOUS LAMINAE AND SPOTS, LIGHT TO OLIVE GRAY.

106.5 FT-125.5 FT: SANDSTONE.
VERY FINE-GRAINED, SILTY, BENTONITIC, SCATTERED CARBONACEOUS LAMINAE, LIGHT TO OLIVE GRAY.

110.2 FT-110.5 FT: SHALE.
CLAYEY, BLACK, COMPACT AND SLICKENSIDED.

125.5 FT-270.5 FT: NO CORE RECOVERED.

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASING CM = CEMENT

GEOLOGIC LOG OF HOLE NO DH-OE-2

PROJECT EMRIA FEATURE OJO ENCINO STUDY SITE AREA OJO ENCINO COAL FIELD STATE NEW MEXICO

COORDS. N 1,783,258.8 E 634,686.4 GROUND ELEV 6838.6 ANGLE FROM HORIZ 90.0 DOWN

BEGUN 11-12-78 FINISHED 11-20-78 DEPTH TO BEDROCK 1.0 TOTAL DEPTH 270.5 BEARING

DEPTH TO WATER 47.0 11-20-78 LOGGED BY LOUIS CABRERA REVIEWED BY W. L. WITT

NOTES	FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL) DEPTH (FEET) FROM (P, Cs, or Cm)	TO	DIAMETER (INCHES)	LOSS (GPM)	DIFFERENTIAL PRESSURE (FEET)	LENGTH OF TEST (MIN)	PERMEABILITY (K) FEET/YEAR	PERCENT CORE RECOVERY	DEPTH SCALE (FEET)	CLASSIFICATION INTERVALS GRAPHIC DEPTHS	ELEVATIONS (FEET)	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
									210				
									220				
									230				
								0					
									240				
									250				
									260				
									270				
									280				
									290				

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASING CM = CEMENT

GEOLOGIC LOG OF HOLE NO DH-OE-3

PROJECT EMRIA FEATURE OJO ENCINO STUDY SITE AREA OJO ENCINO COAL FIELD STATE NEW MEXICO

COORDS. N 1,787,999.5 E 840,851.9 GROUND ELEV. 6625.9 ANGLE FROM HORIZ 90.0 DOWN

BEGUN 8-28-78 FINISHED 9-27-78 DEPTH TO BEDROCK 1.0 TOTAL DEPTH 250.0 BEARING

DEPTH TO WATER 60.0 9-21-78 LOGGED BY LOUIS CABRERA REVIEWED BY H. L. WITT

NOTES	FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL): DEPTH (FEET) FROM (P, Cs, or Ce)	TO	DIAMETER (INCHES)	LOSS (GPM)	DIFFERENTIAL PRESSURE (FEET)	LENGTH OF TEST (MIN)	PERMEABILITY (K) FEET/YEAR	PERCENT CORE RECOVERY	DEPTH SCALE (FEET)	CLASSIFICATION INTERVALS: GRAPHIC DEPTHS	ELEVATIONS (FEET)	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION

NOTES

CONTRACTOR:
ENTERPRISE DRILLING OF TULSA

DRILL RIG:
MAYHEW 500

DRILLING METHODS:

0.0 FT-2.0 FT: USED 3 INCH THIN-WALL PUSH TUBE.

2.0 FT-7.5 FT USED 4-3/4 INCH FISHTAIL BIT AND AIR TO GET CORE BARREL STARTED.

7.5 FT-75.3 FT: CORED WITH 10 FT NX SPLIT-TUBE BARREL, DIAMOND BIT, AND AIR.

75.3 FT-250.0 FT: CORED WITH WATER.

REAMED HOLE TO 4-3/4 INCH WITH FISHTAIL BIT AND AIR.

9-22-78: CEMENTED PLUG IN BOTTOM OF HOLE.

9-23-78: CEMENT DID NOT SET - RECEMENTED.

9-27-78: SET PVC TO 152.0 FT. HOLE CAVED AT 75.0 FT, LOST 40.0 FT OF PVC IN HOLE.

11-20-78: OFFSET HOLE AND DRILLED 0.0 FT-69.0 FT WITH 4-3/4 INCH ROCKBIT AND AIR.

HOLE COMPLETION:

SET 71.0 FT OF 2 INCH PVC, LOWER 59.2 FT PERFORATED, SHALE CATCHER AT 9.8 FT. SEALED HOLE WITH 1/2 SACK OF BENTONITE, GROUTED HOLE TO 2 FT OF SURFACE.

NOTE:
OVERBURDEN INCLUDES ALL SURFICIAL MATERIALS AND BEDROCK OVERLYING FIRST COAL BED.

PERCENT CORE RECOVERY (top to bottom)

3, 51, 76, 64, 90, 96, 89, 80, 76, 97, 83, 79, 100

DEPTH SCALE (FEET)

10, 20, 30, 40, 50, 60, 70, 80, 90

ELEVATIONS (FEET)

6624.9, 6621.9, 6613.4, 6606.2, 6603.9, 6602.9, 6599.6, 6597.1, 6590.9, 6587.3, 6580.0, 6578.7, 6573.9, 6572.4, 6570.2, 6562.2, 6556.3, 6554.3, 6553.1, 6551.2, 6548.7, 6530.7

CLASSIFICATION AND PHYSICAL CONDITION

0.0 FT-1.0 FT:
SURFICIAL MATERIAL.

0.0 FT-1.0 FT: CLAYEY SAND.
APPROXIMATELY 80 PCT PREDOMINATELY FINE-GRAINED SAND. APPROXIMATELY 20 PCT MEDIUM PLASTICITY FINES, MEDIUM TOUGHNESS, MEDIUM DRY STRENGTH, LIMY WITH A FEW LIMY NODULES, BROWN. SC

1.0 FT-124.3 FT:
FRUITLAND FORMATION.
PREDOMINATELY SHALE, SANDSTONE, SILTSTONE, AND COAL.

1.0 FT-4.0 FT: SANDSTONE.
INTENSELY WEATHERED, CLAYEY, LIMY, VERY FIRM, FRIABLE, LIGHT GRAY.

4.0 FT-12.5 FT: SHALE.
WEATHERED, CLAYEY TO SILTY, BENTONITIC, MANY IRON OXIDE STAINS, LAMINATED BROWN AND OLIVE COLORED.

12.5 FT-19.7 FT: SILTSTONE.
WEATHERED, CLAYEY TO FINE SANDY LAMINAE, LIMY 18.7 FT-19.7 FT, FEW BLACK CARBONACEOUS LAMINAE, BADLY BROKEN ALONG JOINTS AND BEDDING PLANES.

19.7 FT-22.0 FT: COAL.

22.0 FT-23.0 FT: SANDSTONE.
VERY FINE TO FINE-GRAINED, SILTY, FEW COAL SPECKS AND CARBONACEOUS LAMINAE, FRIABLE, LIGHT GRAY.

23.0 FT-69.6 FT: SHALE.
WEATHERED TO 45.9 FT, CLAYEY, CONTAINS SILTSTONE LAMINATIONS AND BEDS, BENTONITIC, IRON OXIDE STAINS ALONG BEDDING AND JOINT PLANES, SOME BEDS SLAKE AND SHELL UPON WETTING, OLIVE, LIGHT BROWN AND LIGHT GRAY COLOR LAMINATIONS.

26.3 FT-28.8 FT: SILTSTONE.
WEATHERED, SLIGHTLY CLAYEY, LIGHT GRAY.

35.0 FT-38.6 FT: SILTSTONE.

45.9 FT-47.2 FT: SILTSTONE.

52.0 FT-53.5 FT: SILTSTONE.

55.7 FT-63.7 FT: SILTSTONE.

69.6 FT-71.6 FT: SANDSTONE.
VERY FINE TO FINE-GRAINED.

71.6 FT-77.2 FT: CARBONACEOUS SILTSTONE.

71.7 FT-72.8 FT: COAL. FREE WATER.

73.1 FT-74.7 FT: SILTSTONE. AIR SLAKES.

77.2 FT-95.2 FT: COAL.

95.2 FT-122.9 FT: SANDSTONE.
FRESH, VERY FINE TO FINE-GRAINED, SILTY, SCATTERED SLIGHTLY CARBONACEOUS LAMINAE, LIGHT OLIVE GRAY.

117.4 FT-117.5 FT: SHALEY LAMINAE.

117.5 FT-119.5 FT: SCATTERED SHALEY LAMINAE.

121.0 FT-122.9 FT: CARBONACEOUS LAMINAE, CLOSELY SPACED.

122.9 FT-124.3 FT: COAL.

124.3 FT-250.0 FT: PICTURED CLIFFS FORMATION.
PREDOMINANTLY FINE TO MEDIUM-GRAINED SANDSTONE, SILTY AND SLIGHTLY CLAYEY, WEAKLY CEMENTED AND FRIABLE, MASSIVELY BEDDED, LIGHT GRAY TO LIGHT GREENISH GRAY.

124.3 FT-250.0 FT: SANDSTONE.
FRESH, VERY FINE TO FINE-GRAINED, WEAKLY CEMENTED, LIGHT GRAY.

145.3 FT-145.5 FT: CARBONACEOUS LAMINAE, CLOSELY SPACED.

146.2 FT-148.5 FT: CALCITE VEINLET.

148.3 FT-148.8 FT: THIN SHALEY LAMINAE.

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASING CM = CEMENT

GEOLOGIC LOG OF HOLE NO DH-OE-3

PROJECT EMRIA FEATURE OJO ENCINO STUDY SITE AREA OJO ENCINO COAL FIELD STATE NEW MEXICO

COORDS. N. 1,787,999.6 E 840,851.9 GROUND ELEV 6625.9 ANGLE FROM HORIZ 90.0 DOWN

BEGUN 8-28-78 FINISHED 9-27-78 DEPTH TO BEDROCK 1.0 TOTAL DEPTH 250.0 BEARING

DEPTH TO WATER 80.0 9-21-78 LOGGED BY LOUIS CABRERA REVIEWED BY H. L. WITT

NOTES	FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL): DEPTH (FEET) FROM (P, Cs, or Cm)	TO	DIAMETER (INCHES)	LOSS (GPM)	DIFFERENTIAL PRESSURE (FEET)	LENGTH OF TEST (MIN)	PERMEABILITY (K) FEET/YEAR	PERCENT CORE RECOVERY	DEPTH SCALE (FEET)	CLASSIFICATION INTERVALS: GRAPHIC DEPTHS	ELEVATIONS (FEET)	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
								100					154.0 FT-171.0 FT: SCATTERED CARBONACEOUS LAMINAE.
								100	110				184.0 FT-190.0 FT: SCATTERED CARBONACEOUS LAMINAE.
											6508.5		206.6 FT-207.4 FT: SCATTERED CARBONACEOUS LAMINAE.
											6506.4		219.5 FT-223.0 FT: SHALE. CLAYEY, SILTY, FEW CARBONACEOUS SPECKS, SLICKENSIDED, DARK OLIVE GRAY.
								100	120		6504.9		223.0 FT-231.0 FT: SILTSTONE. SANDY TO SHALEY, SCATTERED CARBONACEOUS LAMINAE, LIGHT TO DARK GRAY.
											6503.0		242.0 FT-243.4 FT: CARBONACEOUS LAMINAE, CLOSELY SPACED.
											6501.6		244.0 FT-244.2 FT: CARBONACEOUS LAMINAE, CLOSELY JOINTED.
								99	130				
								100	140				
								100			6480.6		
											6479.4		
											6477.6		
								100	150				
											6471.9		
								100	160				
								96	170		6454.9		
								98	180				
											6441.9		
								100	190		6435.9		
								100					

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASING CM = CEMENT

GEOLOGIC LOG OF HOLE NO DH-OE-3

SHEET 3 OF 3

PROJECT EMRIA FEATURE OJO ENCINO STUDY SITE AREA OJO ENCINO COAL FIELD STATE NEW MEXICO

COORDS. N 1,787,999.6 E 840,851.9 GROUND ELEV 6625.9 ANGLE FROM HORIZ 90.0 DOWN

BEGUN 8-28-78 FINISHED 9-27-78 DEPTH TO BEDROCK 1.0 TOTAL DEPTH 250.0 BEARING

DEPTH TO WATER 60.0 9-21-78 LOGGED BY LOUIS CABRERA REVIEWED BY W. L. WITT

NOTES	FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL) DEPTH (FEET) FROM (P, Cs, or Cm)	TO	DIAMETER (INCHES)	LOSS (GPM)	DIFFERENTIAL PRESSURE (FEET)	LENGTH OF TEST (MIN)	PERMEABILITY (K) FEET/YEAR	PERCENT CORE RECOVERY	DEPTH SCALE (FEET)	CLASSIFICATION INTERVALS GRAPHIC DEPTHS	ELEVATIONS (FEET)	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
								100					
								100			6419.3		
									210				
								100					
									220		6406.4		
											6402.9		
								100					
									230		6394.9		
								100					
									240				
											6383.9		
											6382.5		
								97			6381.7		
									250		6375.9		
									260				
									270				
									280				
									290				

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASING CM = CEMENT

GEOLOGIC LOG OF HOLE NO DH-OE-4

PROJECT EMRIA FEATURE OJO ENCINO STUDY SITE AREA OJO ENCINO COAL FIELD STATE NEW MEXICO

COORDS. N 1,787,544.7 E 643,119.6 GROUND ELEV 6614.4 ANGLE FROM HORIZ 80.0 DOWN

BEGUN 9-29-78 FINISHED 10-11-78 DEPTH TO BEDROCK 1.0 ? TOTAL DEPTH 250.0 BEARING

DEPTH TO WATER 33.9 10-6-78 LOGGED BY LOUIS CABRERA REVIEWED BY H. L. WITT

Column headings: NOTES | FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL): DEPTH (FEET) FROM (P, Cs, or Cm) / TO; DIAMETER (INCHES); LOSS (GPM); DIFFERENTIAL PRESSURE (FEET); LENGTH OF TEST (MIN); PERMEABILITY (K) FEET/YEAR | PERCENT CORE RECOVERY | DEPTH SCALE (FEET) | CLASSIFICATION INTERVALS: GRAPHIC DEPTHS; ELEVATIONS (FEET) | SAMPLES FOR TESTING | CLASSIFICATION AND PHYSICAL CONDITION

NOTES

CONTRACTOR:
ENTERPRISE DRILLING OF TULSA

DRILL RIG:
MAYHEW 500

DRILLING METHODS:
0.00 FT-2.0 FT: USED 3 INCH THIN-WALL PUSH TUBE.

2.0 FT-7.5 FT: DRILLED WITH FISHTAIL BIT AND AIR.

7.5 FT-19.0 FT: CORED WITH 10 FT NX SPLIT-TUBE BARREL, DIAMOND BIT AND AIR.

19.0 FT-250.0 FT: CORED WITH WATER.

REAMED HOLE TO 4-3/4 INCH.

HOLE COMPLETION:
GROUTED (14 SACKS OF CEMENT) HOLE THROUGH RODS BACK TO 47.0 FT. DRILLED OUT TO 60.0 FT. HOLE CAVED AT 55.0 FT. SET 30.0 FT OF 2 INCH PERFORATED PVC, SHALE CATCHER AT 25.0 FT. 25.0 FT OF 2 INCH PVC ON TOP GROUTED IN PLACE WITH 2 SACKS OF CEMENT.

NOTE:
OVERBURDEN INCLUDES ALL SURFICIAL MATERIALS AND BEDROCK OVERLYING FIRST COAL BED.

PERCENT CORE RECOVERY / DEPTH SCALE / ELEVATIONS

Percent Core Recovery	Depth Scale (Feet)	Elevations (Feet)
		6613.4
	10	
87	20	6594.6
100		
		6587.4
94		
	30	
80		6581.9
		6580.7
		6579.4
63	40	6574.9
		6572.4
		6567.8
85		
	50	
100		
	80	
98		6551.0
	70	
100		
	80	
100		
	90	
100		6521.1
100		

CLASSIFICATION AND PHYSICAL CONDITION

0.0 FT-1.0 FT:
SURFICIAL MATERIAL.

0.0 FT-1.0 FT: SANDY CLAY.
APPROXIMATELY 65 PCT MEDIUM PLASTICITY FINES. APPROXIMATELY 35 PCT FINE GRAINED SAND, MEDIUM TOUGHNESS, HIGH DRY STRENGTH, SOFT TO VERY FIRM, BROWN. MODERATE REACTION TO HCL. CL

1.0 FT-195.9 FT:
FRUITLAND FORMATION.
PREDOMINATELY SHALE, SANDSTONE, SILTSTONE, AND COAL.

1.0 FT-19.8 FT: NOT CORED OR LOGGED.

18.8 FT-27.0 FT: SILTSTONE.
WEATHERED, CLAYEY TO SANDY, FEW SHALEY LAMINAE AND SLIGHTLY CARBONACEOUS LAMINAE, APPROXIMATE 45 DEGREE JOINT AT 32.5 FT, TAN AND LIGHT TO DARK GRAY.

27.0 FT-32.5 FT: SANDSTONE.
WEATHERED, FINE TO MEDIUM GRAINED, SILTY TO SLIGHTLY CLAYEY, NUMEROUS SLIGHTLY CARBONACEOUS SEAMS. FEW NEAR VERTICAL, IRON STAINED JOINTS. LIGHT TO DARK GRAY.

32.5 FT-33.7 FT: COAL.

33.7 FT-46.6 FT: SHALE.
CLAYEY, SILTY, WITH A FEW THIN CARBONACEOUS LAMINAE, SOME BEDS SLAKE IN AIR, LIGHT TO DARK GRAY.

34.1 FT-35.0 FT: SILTSTONE.
FINE SANDY TO SLIGHTLY CLAYEY, SHALEY LAMINAE 34.6 FT-34.7 FT, OLIVE GRAY.

39.5 FT-42.0 FT: SANDSTONE.
VERY FINE GRAINED, SILTY, LIMY, LIGHT TO DARK GRAY.

46.6 FT-63.4 FT: COAL.

63.4 FT-194.4 FT: SANDSTONE.
VERY FINE TO FINE GRAINED, SILTY, FEW SCATTERED CARBONACEOUS LAMINAE AND SPECKS, LIGHT GRAY TO LIGHT GREENISH GRAY.

93.3 FT-93.6 FT: COAL.

93.6 FT-93.8 FT: CARBONACEOUS LAMINAE IN SANDSTONE.

128.0 FT-130.0 FT: CARBONACEOUS SHALE.

128.3 FT-128.7 FT: CARBONACEOUS LAMINAE.

129.2 FT-130.0 FT: CARBONACEOUS LAMINAE.

130.0 FT-131.7 FT: COAL.
CONTAINS MANY SULFUR STREAKS AND FEW SANDY LAMINAE.

131.7 FT-135.8 FT: CARBONACEOUS SILTSTONE.
CONTAINS SANDY LAMINAE.

161.7 FT-163.0 FT: CONTAINS APPROXIMATELY 35 PCT BENTONITIC SHALE LAMINAE.

163.0 FT-165.5 FT: WIDELY SCATTERED CARBONACEOUS LAMINAE TO 1 INCH.

188.2 FT-188.5 FT: SCATTERED CARBONACEOUS LAMINAE.

191.0 FT-191.4 FT: SCATTERED CARBONACEOUS LAMINAE.

191.4 FT-191.8 FT: LIMY.

194.4 FT-195.0 FT: SHALE.
CLAYEY, SILTY, COMPACT, FISSILE, DARK GRAY.

195.0 FT-195.9 FT: COAL.

195.9 FT-250.0 FT:
PICTURED CLIFFS FORMATION.
PREDOMINATELY FINE TO MEDIUM GRAINED SANDSTONE, SILTY AND SLIGHTLY CLAYEY, WEAKLY CEMENTED AND FRIABLE, MASSIVELY BEDDED, LIGHT GRAY TO LIGHT GREENISH GRAY.

195.9 FT-201.9 FT: SHALE.
CLAYEY, SILTY LAMINAE, LIGHT TO DARK GRAY.

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASING CM = CEMENT

GEOLOGIC LOG OF HOLE NO DH-OE-4

PROJECT EMRIA FEATURE OJO ENCINO STUDY SITE AREA OJO ENCINO COAL FIELD STATE NEW MEXICO

COORDS. N 1,787,544.7 E 843,119.8 GROUND ELEV 6614.4 ANGLE FROM HORIZ 90.0 DOWN

BEGUN 9-29-78 FINISHED 10-11-78 DEPTH TO BEDROCK 1.0 ? TOTAL DEPTH 250.0 BEARING

DEPTH TO WATER 33.9 10-8-78 LOGGED BY LOUIS CABRERA REVIEWED BY W. L. WITT

NOTES	FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL): DEPTH (FEET) FROM (P, Cs, or Cm)	TO	DIAMETER (INCHES)	LOSS (GPM)	DIFFERENTIAL PRESSURE (FEET)	LENGTH OF TEST (MIN)	PERMEABILITY (K) FEET/YEAR	PERCENT CORE RECOVERY	DEPTH SCALE (FEET)	CLASSIFICATION INTERVALS: GRAPHIC DEPTHS	ELEVATIONS (FEET)	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
								100					201.9 FT-205.1 FT: SILTSTONE. CLAYEY TO SANDY, 1/8 INCH CARBONACEOUS LAMINAE AT 202.8 FT. 205.1 FT-250.0 FT: SANDSTONE. VERY FINE TO FINE GRAINED, SILTY, WIDELY SCATTERED CARBONACEOUS LAMINAE AND SPECKS, WEAKLY CEMENTED, FRIABLE, LIGHT GREENISH GRAY TO OLIVE COLORED.
								100	110				
								100	120				
											6486.4		
								100	130		6484.4		
											6482.7		
											6478.6		
								100	140				
								100	150				
								100	160				
											6452.7		
											6451.4		
											6448.9		
								100	170				
								100	180				
											6426.2		
								95	190		6423.4		
											6420.0		
											6418.5		
								98					

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASING CM = CEMENT

GEOLOGIC LOG OF HOLE NO DH-OE-4

PROJECT EMRIA FEATURE OJO ENCINO STUDY SITE AREA OJO ENCINO COAL FIELD STATE NEW MEXICO

COORDS. N 1,787,544.7 E 843,119.8 GROUND ELEV 6614.4 ANGLE FROM HORIZ 90.0 DOWN

BEGUN 9-29-78 FINISHED 10-11-78 DEPTH TO BEDROCK 1.0 ? TOTAL DEPTH 250.0 BEARING

DEPTH TO WATER 33.9 10-6-78 LOGGED BY LOUIS CABRERA REVIEWED BY W. L. WITT

NOTES	FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL) DEPTH (FEET) FROM (P, Cs, or Cm)	TO	DIAMETER (INCHES)	LOSS (GPM)	DIFFERENTIAL PRESSURE (FEET)	LENGTH OF TEST (MIN)	PERMEABILITY (K) FEET/YEAR	PERCENT CORE RECOVERY	DEPTH SCALE (FEET)	CLASSIFICATION INTERVALS GRAPHIC DEPTHS	ELEVATIONS (FEET)	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
								96			6412.5		
								84			6409.3		
									210				
								76					
									220				
								93					
									230				
								100					
									240				
								91					
									250		6364.4		
									260				
									270				
									280				
									290				

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASING CM = CEMENT

GEOLOGIC LOG OF HOLE NO DH-OE-5

PROJECT EMRIA FEATURE OJO ENCINO STUDY SITE AREA OJO ENCINO COAL FIELD STATE NEW MEXICO

COORDS. N 1,787,835.3 E 833,293.2 GROUND ELEV 6668.7 ANGLE FROM HORIZ 90.0 DOWN

BEGUN 10-13-78 FINISHED 11-11-78 DEPTH TO BEDROCK 20.0 ? TOTAL DEPTH 240.0 BEARING

DEPTH TO WATER NOT DETERMINED LOGGED BY LOUIS CABRERA REVIEWED BY M. L. WITT

NOTES	FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL): DEPTH (FEET) FROM (P, Cs, or Cm)	TO	DIAMETER (INCHES)	LOSS (GPM)	DIFFERENTIAL PRESSURE (F.C.T)	LENGTH OF TEST (MIN)	PERMEABILITY (K) FEET/YEAR	PERCENT CORE RECOVERY	DEPTH SCALE (FEET)	CLASSIFICATION INTERVALS: GRAPHIC DEPTHS	ELEVATIONS (FEET)	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION

NOTES

CONTRACTOR:
ENTERPRISE DRILLING OF TULSA

DRILL RIG:
MAYHEW 500

DRILLING METHODS:

0.0 FT-20.0 FT: USED FISHTAIL BIT AND AIR.

34.0 FT-240.0 FT: CORED WITH WATER.

HOLE COMPLETION:

HOLE CAVED DURING GEOPHYSICAL TESTING. CLEANED OUT HOLE TO 223 FT, GROUTED THROUGH RODS FROM 178.5 FT-223.0 FT. HOLE STILL CAVING. OFFSET 7 FT NORTH, REDRILLED 0.0 FT-179.5 FT WITH DRAG BIT AND AIR, FLUSHED HOLE WITH WATER.

SET 2 INCH PVC TO 179.5 FT WITH 2.5 FT STICKUP, LOWER 16.5 FT PERFORATED. SHALE CATCHER AT 162.0 FT WITH 3 FT OF BENTONITE BALLS. GROUTED PIPE IN PLACE.

NOTE:
OVERBURDEN INCLUDES ALL SURFICIAL MATERIALS AND BEDROCK OVERLYING FIRST COAL BED.

PERCENT CORE RECOVERY: 0, 100, 70, 92, 78

DEPTH SCALE (FEET): 10, 20, 30, 40, 50, 60, 70, 80, 90

ELEVATIONS (FEET): 6648.7, 6647.2, 6641.2, 6638.7, 6635.2, 6633.0, 6631.5, 6629.7, 6628.7, 6627.4, 6626.0, 6624.2, 6620.9, 6617.9, 6616.2, 6609.3, 6607.6, 6603.9, 6601.9, 6595.1, 6593.4, 6586.7, 6585.7, 6576.2, 6575.2, 6573.2, 6571.7

CLASSIFICATION AND PHYSICAL CONDITION

0.0 FT-20.0 FT:
SURFICIAL MATERIAL.

0.0 FT-20.0 FT: DRILLED WITHOUT CORING. NOT LOGGED.

20.0 FT-27.5 FT:
KIRTLAND FORMATION.
INCLUDES UPPER AND LOWER SHALE MEMBERS, AND THE FARMINGTON SANDSTONE MIDDLE MEMBER.

20.0 FT-21.5 FT: SANDSTONE.
INTENSELY WEATHERED, FINE-GRAINED, SILTY, BENTONITIC, MOIST, LIGHT GRAY AND BROWN.

21.5 FT-27.5 FT: SHALE.
WEATHERED, CLAYEY, SILTY, WITH SILTY TO SLIGHTLY CARBONACEOUS LAMINAE, COMPACT, DARK BROWN TO GRAY AND LIGHT GRAY TO GREENISH GRAY.

27.5 FT-190.0 FT:
FRUITLAND FORMATION.
PREDOMINATELY SHALE, SANDSTONE, SILTSTONE, AND COAL.

27.5 FT-30.0 FT: COAL.
CONTAINS CARBONACEOUS LAMINAE.

30.0 FT-190.0 FT: SHALE.
WEATHERED, CLAYEY, SILTY, WITH SILTY TO SLIGHTLY CARBONACEOUS LAMINAE, COMPACT, DARK BROWN TO GRAY AND LIGHT GRAY TO GREENISH GRAY.

30.0 FT-33.5 FT: SOME LOW ANGLE TO 50 DEGREE JOINTS, SLAKES EASILY.

33.5 FT-35.7 FT: SILTSTONE.
WEATHERED, CONTAINS SANDY TO SHALY LAMINAE, TAN, BROWN, AND LIGHT TO DARK GRAY. SLICKENSIDED JOINTS AT 33.5 FT AND 34.7 FT.

37.2 FT-39.0 FT: SILTSTONE.
WEATHERED, FEW SANDY AND SHALY LAMINAE, YELLOWISH BROWN.

39.0 FT-40.0 FT: SANDSTONE.
WEATHERED, VERY FINE GRAINED, SILTY, BENTONIC, TRACED OF GYPSUM ALONG BEDDING, LIGHT OLIVE GRAY.

40.0 FT-41.3 FT: SILTSTONE.
SLIGHTLY SANDY, BENTONITIC, LAMINATED.

41.5 FT-42.7 FT: SHALE SLAKES.

44.5 FT: 1/8 INCH SATIN SPAR SEAM.

45.4 FT-47.8 FT: SILTSTONE.
WEATHERED, CONTAINS SANDY AND CLAYEY LAMINAE, FEW GYPSUM LAMINAE, JOINTED, LIGHT OLIVE GRAY AND TAN.

47.8 FT-50.8 FT: BRECCIATED SHALE, FEW CARBONACEOUS LAMINAE.

52.5 FT-59.4 FT: SANDSTONE.
FINE-GRAINED, SILTY, SLIGHTLY CLAYEY, MANY CARBONACEOUS LAMINAE FROM 54.6 FT-57.8 FT, COMPACT, MODERATELY HARD.

59.4 FT-61.1 FT: COAL.
ASHY LAMINAE 61.0 FT-61.1 FT.

61.1 FT-64.8 FT: SILTSTONE.
WEATHERED, SANDY, FEW CARBONACEOUS LAMINAE, MANY CLAYEY LAMINAE, BENTONITIC, COMPACT, LIGHT GRAY AND TAN.

64.8 FT-66.8 FT: SHALE.
CLAYEY, BENTONITIC, SILTY LAMINAE, HARD, GRAY.

66.8 FT-73.8 FT: SILTSTONE.
FINE SANDY TO CLAYEY LAMINATIONS, SLIGHTLY LIMY, COMPACT.

73.1 FT-73.3 FT: GYPSUM.
VEINLET, LEACHED.

73.8 FT-75.3 FT: SANDSTONE.
VERY FINE-GRAINED, BENTONITIC, SLIGHTLY CARBONACEOUS.

75.3 FT-181.7 FT: SHALE.
SILTY, BENTONITIC, SANDY LAMINAE, TRACES OF GYPSUM, FEW COMPACTION JOINTS, LIGHT

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASING CM = CEMENT

GEOLOGIC LOG OF HOLE NO DH-OE-5

PROJECT EMRIA FEATURE OJO ENCINO STUDY SITE AREA OJO ENCINO COAL FIELD STATE NEW MEXICO

COORDS. N 1,787,835.3 E 833,243.2 GROUND ELEV 6668.7 ANGLE FROM HORIZ 90.0 DOWN

BEGUN 10-13-78 FINISHED 11-11-78 DEPTH TO BEDROCK 20.0 ? TOTAL DEPTH 240.0 BEARING

DEPTH TO WATER NOT DETERMINED LOGGED BY LOUIS CABRERA REVIEWED BY H. L. WITT

NOTES	FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL) DEPTH (FEET) FROM (P, Cs, or Cm)	TO	DIAMETER (INCHES)	LOSS (GPM)	DIFFERENTIAL PRESSURE (FEET)	LENGTH OF TEST (MIN)	PERMEABILITY (K) FEET/YEAR	PERCENT CORE RECOVERY	DEPTH SCALE (FEET)	CLASSIFICATION INTERVALS GRAPHIC DEPTHS	ELEVATIONS (FEET)	SAMPLES FOR TESTING
											6568.7	
								99				
											6560.2	
									110		6557.7	
											6556.7	
											6555.3	
								87				
									120		6548.9	
											6544.4	
								100				
									130		6538.7	
								100	140			
											6526.9	
											6524.2	
											6519.7	
									150		6517.9	
											6515.3	
								82				
									160		6509.2	
								96				
									170			
								97				
									180		6487.0	
								17				
									190		6478.7	
								100				

CLASSIFICATION AND PHYSICAL CONDITION

GRAY TO GREENISH GRAY.

82.0 FT-83.0 FT: SANDSTONE. VERY FINE GRAINED, SILTY, LIGHT TO DARK GRAY.

92.5 FT-93.5 FT: CARBONACEOUS LAMINAE AND SPECKS IN SHALE.

95.5 FT-97.0 FT: SANDSTONE. VERY FINE-GRAINED, SILTY, BENTONITIC, LIGHT OLIVE GRAY.

100.0 FT-108.5 FT: MANY RANDOM COMPACTION JOINTS.

108.5 FT-111.0 FT: FEW CARBONACEOUS LAMINAE, RANDOM COMPACTION JOINTS 108.5 FT-110.0 FT.

112.0 FT-113.4 FT: SILTSTONE. LIMY FROM 112.9 FT-113.4 FT, OLIVE GRAY AND BROWN.

113.4 FT-144.5 FT: SHALE SLAKES.

119.8 FT-124.3 FT: SILTSTONE. CLAYEY TO SANDY LAMINAE.

130.0 FT-141.8 FT: FEW LOW ANGLE TO 60 DEGREE COMPACTION JOINTS.

144.5 FT-149.0 FT: SANDSTONE. VERY FINE-GRAINED, SILTY, LIGHT OLIVE GRAY.

150.8 FT-153.4 FT: SANDSTONE. SIMILAR TO 144.5 FT-149.0 FT.

159.5 FT-159.7 FT: CARBONACEOUS LAMINAE IN SHALE.

159.7 FT-181.4 FT: COAL.

181.4 FT-181.7 FT: CARBONACEOUS.

181.7 FT-190.0 FT: NO CORE.

190.0 FT-240.0 FT: PICTURED CLIFFS FORMATION. PREDOMINATELY FINE TO MEDIUM-GRAINED SANDSTONE, SILTY AND SLIGHTLY CLAYEY, WEAKLY CEMENTED AND FRIABLE, MASSIVELY BEDDED, LIGHT GRAY TO LIGHT GREENISH GRAY.

190.0 FT-240.0 FT: SANDSTONE. VERY FINE GRAINED, SILTY, BENTONITIC LAMINAE, WEAKLY CEMENTED, FRIABLE, LIGHT GREENISH TO OLIVE GRAY.

203.9 FT-204.1 FT: FEW CARBONACEOUS LAMINAE.

205.6 FT-207.9 FT: CARBONACEOUS LAMINAE.

210.0 FT-212.8 FT: CARBONACEOUS.

218.5 FT-229.4 FT: CARBONACEOUS LAMINAE.

232.5 FT-235.2 FT: CARBONACEOUS LAMINAE.

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASING CM = CEMENT

GEOLOGIC LOG OF HOLE NO DH-OE-5

PROJECT EMRIA FEATURE OJO ENCINO STUDY SITE AREA OJO ENCINO COAL FIELD STATE NEW MEXICO

COORDS. N 1,787,635.3 E 833,293.2 GROUND ELEV 6668.7 ANGLE FROM HORIZ 90.0 DOWN

BEGUN 10-13-78 FINISHED 11-11-78 DEPTH TO BEDROCK 20.0 ? TOTAL DEPTH 240.0 BEARING

DEPTH TO WATER NOT DETERMINED LOGGED BY LOUIS CABRERA REVIEWED BY H. L. WITT

NOTES	FIELD PERMEABILITY TEST (DESIGNATION E-18, EARTH MANUAL) DEPTH (FEET) FROM (P, Cs, or Cm)	TO	DIAMETER (INCHES)	LOSS (GPM)	DIFFERENTIAL PRESSURE (FEET)	LENGTH OF TEST (MIN)	PERMEABILITY (K) FEET/YEAR	PERCENT CORE RECOVERY	DEPTH SCALE (FEET)	CLASSIFICATION INTERVALS GRAPHIC DEPTHS	ELEVATIONS (FEET)	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION
											6464.8		
								100			6463.1		
											6460.8		
									210		6458.7		
											6458.1		
								93					
											6450.2		
									220				
								95					
									230		6439.3		
											6436.2		
								93			6433.5		
									240		6428.7		
									250				
									260				
									270				
									280				
									290				

COMMENTS:

EXPLANATIONS:

P = PACKER CS = CASING CM = CEMENT

SECTION L

COAL RESOURCES APPENDIX

SECTION L

COAL RESOURCES APPENDIX

Coal Origin

Coal has been defined as "a readily combustible rock containing more than 50 percent by weight and more than 70 percent by volume of carbonaceous material, formed from compaction or induration of variously altered plant remains similar to those of peaty deposits. Differences in the kinds of plant materials (type), in degree of metamorphism (rank), and range of impurity (grade) are characteristics of the varieties of coal" (Schopf, 1966, p. 588). Inherent in the definition is the specification that the coal originated as a mixture of organic plant remains and inorganic mineral matter that accumulated in a manner similar to that in which modern-day peat deposits are formed. The peat underwent a long, complex process called "coalification," during which diverse physical and chemical changes occurred as the peat changed to coal and as the coal assumed the characteristics by which members of the series are differentiated from each other. The factors that affect the composition of coals have been summarized by Francis (1961, p. 2) as follows:

1) The mode of accumulation and burial of the plant debris forming the deposit.
2) The age of the deposits and their geographical distribution.
3) The structure of the coal-forming plants, particularly details of structure that affect chemical composition or resistance to decay.
4) The chemical composition of the coal-forming debris and its resistance to decay.
5) The nature and intensity of the plant-decaying agencies.
6) The subsequent geological history of the residual products of decay of the plant debris forming the deposits.

These factors, are discussed in greater detail by Moore (1940), Lowry (1945), Tomkeieff (1954), Francis (1961), and Lowry (1963).

Coal Classification

Coals are classified in many ways (Tomkeieff, 1954, p. 9; Moore, 1940, p. 113,; Francis, 1961, p. 361), but the classification by rank, that is, by degree of metamorphism in the progressive series that begins with peat and ends with graphocite (Schopf, 1966), is the most commonly used system. Classification by types of plant materials is commonly used as a descriptive adjunct to rank classification when sufficient megascopic and microscopic information is available, and classification by type and quantity of impurites (grade) is also frequently used when utilization of the coal is being considered. Other categorizations are possible and are commonly employed in discussion of coal resources. Factors such as weight of the coal, thickness and areal extent of individual coal beds, and the thickness of overburden are generally considered.

Rank of Coal

The position of a coal within the metamorphic series, which begins with peat and ends with graphocite, is dependent upon temperature and pressure to which the coal has been subjected and the duration of time of subjection. Because it is, by definition, largely derived from plant material, coal is mostly composed of carbon, hydrogen, and oxygen along with smaller quantities of nitrogen, sulfur, and other elements. The increase in rank of coal as it undergoes progressive metamorphism is indicated by changes in the proportions of the coal constituents, e.g., the higher rank coals have more carbon and less hydrogen than the lower rank coals.

Two standardized forms of coal analyses--the proximate analysis and the ultimate analysis--are generally used, though sometimes only the less complicated and less expensive proximate analysis is made. The analyses are described as follows (U.S. Bureau of Mines, 1965, p. 121-122):

> The proximate analysis of coal involves the determination of four constituents: (1) water, called moisture; (2) mineral impurity, called ash, left when the coal is completely burned; (3) volatile matter, consisting of gases or vapors driven out when coal is heated to certain temperatures; and (4) fixed carbon, the solid or cokelike residue that burns at higher temperatures after volatile matter has been driven off. Ultimate analysis involves the determination of carbon and hydrogen as found in the gaseous products of combustion, the determination of sulfur, nitrogen, and ash in the material as a whole, and the estimation of oxygen by difference.

Most coals are burned to produce heat energy so the heating value of the coal is an important property. The heat of combustion (calorific value) is commonly expressed in British thermal units (Btu) per pound: one Btu is the amount of heat required to raise the temperature of 1 pound of water 1 degree fahrenheit (in the metric system, heat of combustion is expressed in kilogram-calories per kilogram). Additional tests are sometimes made, particularly to determine the caking, coking, and other properties, such as tar yield, which affect classification or utilization.

Figure L-1 compares, in histogram form, the heat of combustion and moisture, volatile matter, and fixed carbon contents of coals of different ranks.

Various schemes for classifying coals by rank have been proposed and used, but the most commonly employed is the scheme adopted by the American Society for Testing and Materials (1977), which is presented in table L-1.

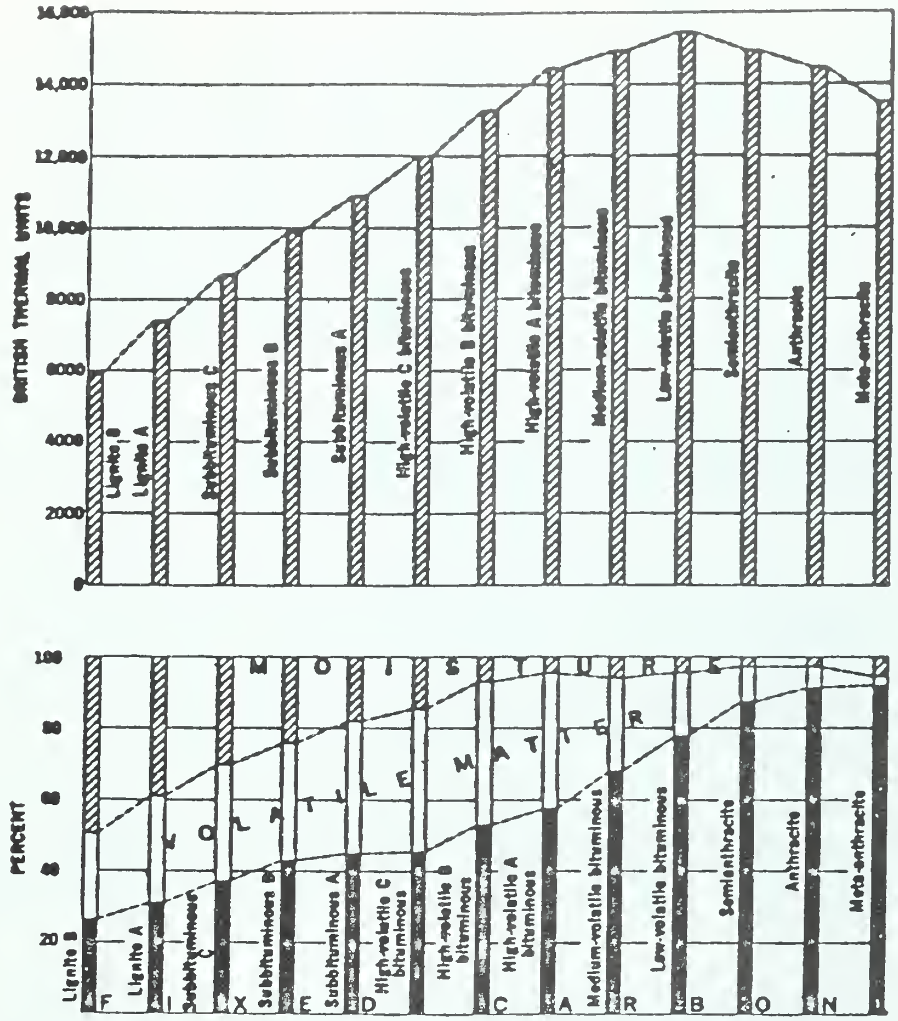


FIGURE L-1--COMPARISON (ON MOIST, MINERAL-MATTER-FREE BASIS) OF HEAT VALUES AND PROXIMATE ANALYSES OF COAL OF DIFFERENT RANKS

(Averitt, 1975, p.17)

Table L-1.—Classification of coals by rank[1]

[American Society for Testing and Materials Standard D388-66; (Reapproved 1972); 1 Btu equals 0.252 kilogram-calories. Leaders (--) indicate category is not used in rank determination of group]

Class	Group	Fixed carbon limits, percent (dry, mineral-matter-free basis): Equal or greater than	Fixed carbon limits, percent (dry, mineral-matter-free basis): Less than	Volatile matter limits, percent (dry, mineral matter-free basis): Greater than	Volatile matter limits, percent (dry, mineral matter-free basis): Equal or less than	Calorific value limits, Btu per pound (moist[2], mineral-matter-free basis): Equal or greater than	Calorific value limits, Btu per pound (moist[2], mineral-matter-free basis): Less than	Agglomerating character
I. Anthracitic	1. Meta-anthracite	98	--	--	2	--	--	
	2. Anthracite	92	98	2	8	--	--	nonagglomerating
	3. Semianthracite[3]	86	92	8	14	--	--	
II. Bituminous	1. Low volatile bituminous coal	78	86	14	22	--	--	
	2. Medium volatile bituminous coal	69	78	22	31	--	--	
	3. High volatile A bituminous coal	--	69	31	--	14,000[4]	--	commonly agglomerating[5]
	4. High volatile B bituminous coal	--	--	--	--	13,000[4]	14,000	
	5. High volatile C bituminous coal	--	--	--	--	11,500	13,000	
						10,500	11,500	agglomerating
III. Subbituminous	1. Subbituminous A coal	--	--	--	--	10,500	11,500	
	2. Subbituminous B coal	--	--	--	--	9,500	10,500	
	3. Subbituminous C coal	--	--	--	--	8,300	9,500	
								nonagglomerating
IV. Lignitic	1. Lignite A	--	--	--	--	6,300	8,300	
	2. Lignite B					--	6,300	

[1]This classification does not include a few coals, principally nonbanded varieties, that have unusual physical and chemical properties and that come within the limits of fixed carbon or calorific value of the high-volatile bituminous and subbituminous ranks. All of these coals either contain less than 48 percent dry, mineral-matter-free fixed carbon or have more than 15,500 moist, mineral-matter-free British thermal units per pound.

[2]Moist refers to coal containing its natural inherent moisture but not including visible water on the surface of the coal.

[3]If agglomerating, classify in low-volatile group of the bituminous class.

[4]Coals having 69 percent or more fixed carbon on the dry, mineral-matter-free basis are classified according to fixed carbon, regardless of calorific value.

[5]It is recognized that there may be nonagglomerating varieties in these groups of the bituminous class and that there are notable exceptions in the high-volatile C bituminous group.

The ASTM classification system differentiates coals into classes and groups on the basis of mineral-matter-free fixed carbon or volatile matter and the heat of combustion, supplemented by determination of agglomerating (caking) characteristics. As pointed out by the ASTM (1977, p. 216), a standard rank determination cannot be made unless the samples were obtained in accordance with standardized sampling procedures (Snyder, 1950; Schopf, 1960). However, nonstandard samples may be used for comparative purposes through determinations designated as "apparent rank."

Type of Coal

Classification of coals by type--that is, according to the types of plant materials present--takes many forms, such as the "rational analysis" of Francis (1961) or the semicommercial "type" classification commonly used in the coal fields of the eastern United States (U.S. Bureau of Mines, 1965, p. 123). However, most of the type classifications are based on the same, or similar, gross distinctions in plant material as those used by Tomkeieff (1954, Table II and p. 9), who divided the coals into three series: humic coals, humic-sapropelic coals, and sapropelic coals, based upon the nature of the original plant materials. The humic coals are largely composed of the remains of the woody parts of plants and the sapropelic coals are largely composed of the more resistant waxy, fatty, and resinous parts of plants, such as cell walls, spore-coatings, pollen, resin particles, and coals composed mainly of algal material. Most coals fall into the humic series, but some coals are a mixture of humic and sapropelic elements and, therefore, fall into the humic-sapropelic series. The sapropelic series is quantitatively insignificant and, when found, is commonly regarded as an organic curiosity.

Grade of Coal

Classification of coal by grade, or quality, is based largely on the content of ash, sulfur, and other constituents that adversely affect utilization. Most detailed coal resource evaluations of the past do not categorize known coal resources by grade; however coals of the United States have been classified by sulfur content in a gross way (DeCarlo and others, 1966).

Weight of Coal

The weight of the coal ranges considerably with differences in rank and ash content. (In areas such as the Ojo Encino study area, where true specific gravities of the coal have not been determined, an average specific gravity value based on many determinations in other areas is used to express the weight of the coal for resource calculations). The average weight of subbituminous coal is taken as 1,770 tons per acre-foot at a specific gravity of 1.30.

Thickness of Beds

Because of the important relationship of coal-bed thickness to utilization potential, most coal resource estimates prepared by the U.S. Geological Survey are tabulated according to three thickness categories. The thickness categories used for subbituminous coal are thin, 2.5 to 5 feet (0.75 to 1.5 m); intermediate, 5 to 10 feet (1.5 to 3 m); and thick, more than 10 feet (3 m).

Estimation of Coal Resources

The resources in an area are classed as measured, indicated, and inferred according to the degree of geologic assurance of the estimate:

Measured - Resources are computed from thicknesses revealed in outcrops, trenches, mine workings, and drill holes. The points of observation and measurement are so closely spaced and the thickness and extent of coals are so well defined that the tonnage is judged to be accurate within 20 percent of true tonnage. Although the spacing of the points of observation necessary to demonstrate continuity of the coal differs from region to region according to the character of the coal beds, the points of observation are no greater than 1/2 mile (0.8 km) apart. Measured coal is projected to extend as a 1/4 mile (0.4 km) wide belt from the outcrop or points of observation or measurement.

Indicated - Resources are computed partly from specific measurements and partly from projections of visible data for a reasonable distance on the basis of geologic evidence. The points of observation are 1/2 (0.8 km) to 1 1/2 miles (2.4 km) apart. Indicated coal is projected to extend as a 1/2 mile (0.8 km) wide belt that lies more than 1/4 mile (0.4 km) from the outcrop or points of observation or measurement.

Inferred - Quantitative estimates are based largely on broad knowledge of the geologic character of the bed or region, because few measurements of bed thickness are available. The estimates are based primarily on an assumed continuation from measured and indicated coal for which geologic evidence exists. The points of observation are 1 1/2 (2.4 km) to 6 miles (9.6 km) apart. Inferred coal is projected to extend as a 2 1/4-mile (3.6 km) wide belt that lies more than 3/4 mile (1.2 km) from the outcrop or points of observation or measurement.

All of the estimated resources in beds thicker than 5 feet (1.5 m) and at depths of 1,000 feet (305 m) or less fall into a category called reserve base, which is defined as that portion of the identified coal resource from which reserves are calculated. Reserves are that portion of the identified coal resource that can be economically mined at the time of determination. The reserve is derived by applying a recovery factor to that component of the identified coal resource designated as the reserve base. On a national basis the estimated recovery factor for the total reserve base is 50 percent. More precise recovery factors can be computed by determining the total coal in place and the total coal recoverable in any specific locale.

SECTION M

OVERBURDEN GEOCHEMISTRY APPENDIX

SECTION M
OVERBURDEN GEOCHEMISTRY APPENDIX

Complete Tabulation of Bulk Chemical Data for Ojo Encino Overburden Rock Drill Core Samples

The first 10 columns in table M-1 (SiO_2% through MnO%) are determinations by x-ray fluorescence spectrography, a precise technique good for many such major and minor (not trace) elements. "LOI%" (11th column) means "loss on ignition"; this is the water and other volatile components driven off when the sample was fused into a ceramic disc. The remaining columns "B ppm-s" through "Zr ppm-s" are determinations by emission spectrography, a less accurate and precise but more sensitive method good for many trace elements ("-s" means "spectrographic"). Where elements are reported by both methods, the x-ray results are generally to be preferred.

Explanation of the coded eight-character sample identifier:

First character--O denotes Ojo Encino.

Second character--1 means sample was from hole 1, 3 means sample was from hole 3.

Third and fourth characters--these identify the position of the sample in the sequence of 10-foot intervals down the hole: 01 would denote the sample nearest the surface, 02 the next one down, etc.

Fifth character--0, denotes that sample is on the usual 10-foot spacing; 1 denotes that sample is a "companion" sample to another at the regular 10-foot spacing, separated by a 6-inch gap.

Sixth character--x indicates that sample is split from another sample (otherwise coded the same) and analyzed separately to test for reliability of analytical methods. Eight samples were split in this manner.

Seventh and eighth characters--the seventh character is the basic rock type into which the sample was classified, by hand-specimen inspection and by simple tests, as follows:

S--sandstone
T--siltstone
C--claystone (shale and very fine-grained rocks)

The eighth character is a "modifier" or adjective which further characterizes the basic rock type, as follows:

A--pure
S--sandy
T--silty
C--clayey

Example--the ninth sample listed in table M-1, 01070XSC, is from hole 1, is the seventh sample from the top taken in the sequence of 10-foot spacings, is exactly on the 10-foot pattern (not a companion sample with a 6-inch gap), is an "analytical split" (made by dividing, after grinding and mixing, sample 010700SC, listed immediately above in the table), was called a "clayey sandstone" during description and classification.

Table M-1

Complete tabulation of bulk chemical data, Ojo Encino overburden rock, dry weight basis

Sample	Latitude	Longitude	SiO2%	Al2O3%	T-Fe2O3%	MgO%	CaO%	Na2O%	K2O%	TiO2%	P2O5%
					Sandstones						
010110SA	35 53 49	107 24 42	53	11	1.8	.4	14.9	2.10	2.3	.3	<.1
01011XSA	35 53 49	107 24 42	54	11	1.8	.3	14.3	2.10	2.2	.2	<.1
031100SA	35 54 49	107 21 29	78	13	1.0	.4	.3	1.80	2.5	.3	<.1
031300SA	35 54 49	107 21 29	82	11	.9	.3	.1	1.40	1.9	.3	<.1
010000SC	35 53 49	107 24 42	66	14	1.7	.4	5.8	2.50	2.5	.4	<.1
01000XSC	35 53 49	107 24 42	66	14	1.6	.4	5.9	2.40	2.5	.3	<.1
010610SC	35 53 49	107 24 42	76	13	1.0	.5	.8	2.30	2.1	.3	<.1
010700SC	35 53 49	107 24 42	71	13	1.0	.5	4.1	2.00	1.9	.3	<.1
01070XSC	35 53 49	107 24 42	71	13	1.1	.5	4.1	2.00	1.9	.3	<.1
010800SC	35 53 49	107 24 42	77	14	1.2	.6	.8	2.10	2.0	.5	.1
011000SC	35 53 49	107 24 42	79	12	.7	.2	.1	1.10	2.0	.5	<.1
011310SC	35 53 49	107 24 42	78	9	1.5	.4	.7	1.20	1.9	.3	<.1
030000SC	35 54 49	107 21 29	71	14	2.2	.5	2.6	2.90	2.4	.4	<.1
030100SC	35 54 49	107 21 29	69	15	3.6	1.0	.4	1.70	3.7	.7	.2
030200SC	35 54 49	107 21 29	55	13	2.7	.9	11.0	1.30	3.0	.5	.2
030600SC	35 54 49	107 21 29	64	15	2.7	1.0	4.3	1.50	2.5	.6	.1
030700SC	35 54 49	107 21 29	62	14	2.5	.8	6.8	1.60	2.4	.5	.1
03070XSC	35 54 49	107 21 29	62	14	2.4	.8	6.7	1.70	2.4	.5	.1
031000SC	35 54 49	107 21 29	78	13	.7	.2	.0	<.20	1.9	.3	<.1
03100XSC	35 54 49	107 21 29	80	14	.7	.2	.0	<.20	2.0	.3	<.1
031200SC	35 54 49	107 21 29	63	18	3.6	1.0	.7	2.30	1.6	.4	<.1
03120XSC	35 54 49	107 21 29	63	18	3.6	1.0	.7	2.30	1.6	.4	<.1
031210SC	35 54 49	107 21 29	72	15	2.7	.9	.5	2.20	1.9	.4	<.1
03121XSC	35 54 49	107 21 29	72	14	2.7	.9	.5	2.20	1.9	.4	<.1
030300ST	35 54 49	107 21 29	64	16	3.0	1.0	3.0	1.50	4.2	.7	.2
030310ST	35 54 49	107 21 29	65	16	2.4	.8	3.3	1.70	4.3	.7	.2
					Siltstones						
010500TC	35 53 49	107 24 42	70	16	3.2	1.5	.5	1.60	2.1	.7	<.1
					Claystones						
030400CA	35 54 49	107 21 29	66	18	4.7	1.1	.4	1.20	2.7	.7	<.1
030500CA	35 54 49	107 21 29	61	15	4.5	1.4	.6	1.40	2.5	.6	<.1
010200CT	35 53 49	107 24 42	66	16	5.2	1.3	.6	1.40	2.6	.7	.1
01020XCT	35 53 49	107 24 42	66	16	5.1	1.3	.6	1.40	2.5	.7	.1

Table M-1 (con.)

Complete tabulation of bulk chemical data, Ojo Encino overburden rock, dry weight basis

Sample	MnO%	LOI%	Ag ppm-S	Al%-S	B ppm-S	Ba ppm-S	Be ppm-S	Ca%-S	Cd ppm-S	Ce ppm-S	Co ppm-S	Cr ppm-S
						Sandstones						
010110SA	.23	12.4	<.46	5.1	15.0	1,100	1	9.2	<10.0	110	6	7
01011XSA	.23	12.2	<.46	5.3	16.0	800	1	9.6	<10.0	110	7	9
031100SA	<.02	2.9	<.46	5.8	11.0	630	1	.3	<10.0	78	5	8
031300SA	<.02	2.3	<.46	5.4	9.6	450	3	.2	<10.0	<46	6	10
010000SC	.12	6.3	<.46	4.5	<5.0	520	2	1.8	<10.0	87	5	8
01000XSC	.12	6.7	<.46	5.8	6.2	640	1	1.6	<10.0	100	5	8
010610SC	<.02	2.8	<.46	6.6	8.6	570	3	.8	<10.0	77	9	11
010700SC	<.02	5.2	<.46	6.6	8.4	1,800	2	1.6	<10.0	76	8	14
01070XSC	<.02	5.2	<.46	5.7	6.0	1,700	2	1.7	<10.0	56	7	12
010800SC	<.02	2.6	<.46	6.6	6.8	1,800	2	.6	<10.0	81	12	14
011000SC	<.02	3.8	<.46	4.6	12.0	410	3	.1	<10.0	74	6	12
011310SC	<.02	6.3	<.46	4.3	10.0	890	1	.5	<10.0	<46	7	10
030000SC	.03	3.7	<.46	6.3	14.0	1,200	1	1.4	<10.0	97	9	15
030100SC	<.02	4.1	<.46	9.0	19.0	750	2	.5	<10.0	91	12	36
030200SC	.32	11.6	<.46	4.4	14.0	450	1	1.9	<10.0	95	6	19
030600SC	.06	7.6	<.46	7.2	23.0	530	1	1.9	<10.0	89	13	25
030700SC	.15	8.3	<.46	6.3	17.0	430	2	1.8	<10.0	84	11	14
03070XSC	.15	8.4	<.46	8.3	21.0	790	3	6.3	<10.0	130	14	18
031000SC	<.02	4.3	<.46	5.5	12.0	320	2	<.1	<10.0	<46	5	6
03100XSC	<.02	4.1	<.46	3.8	12.0	270	2	<.1	<10.0	<46	5	<1
031200SC	<.02	9.8	<.46	6.4	21.0	350	2	.5	<10.0	81	6	14
03120XSC	<.02	9.6	<.46	5.5	15.0	370	1	.5	<10.0	98	6	13
031210SC	<.02	4.3	<.46	8.7	15.0	550	2	.6	<10.0	56	8	22
03121XSC	<.02	4.4	<.46	7.0	22.0	560	2	.6	<10.0	94	8	15
030300ST	.03	6.2	<.46	6.6	20.0	680	2	1.3	<10.0	110	17	22
030310ST	.05	5.3	<.46	9.1	12.0	850	2	1.5	<10.0	99	9	37
						Siltstones						
010500TC	<.02	6.2	<.46	5.6	11.0	220	2	.4	<10.0	90	11	22
						Claystones						
030400CA	<.02	5.8	<.46	7.3	20.0	300	3	.4	<10.0	80	7	35
030500CA	<.02	11.7	<.46	8.3	29.0	320	4	.6	<10.0	100	9	36
010200CT	<.02	5.6	<.46	9.6	29.0	500	3	.6	<10.0	120	18	30
01020XCT	<.02	6.0	<.46	8.5	21.0	420	3	.6	<10.0	98	15	38

Table M-1 (con.)

Complete tabulation of bulk chemical data, Ojo Encino overburden rock, dry weight basis

Sample	Cu ppm-S	Dy ppm-S	Er ppm-S	Eu ppm-S	Fe%-S	Ga ppm-S	Gd ppm-S	Ge ppm-S	K%-S	La ppm-S	Li ppm-S
					Sandstones						
010110SA	9	<10	<4.6	1.9	1.4	14	<10	2.0	2.2	64	<100
01011XSA	10	<10	<4.6	1.2	1.1	12	<10	<1.0	2.2	57	<100
031100SA	4	<10	<4.6	<1.0	.6	9	<10	1.5	1.7	42	<100
031300SA	4	<10	<4.6	<1.0	.4	7	13	<1.0	1.2	23	<100
010000SC	5	<10	<4.6	1.2	.7	9	10	<1.0	1.7	44	<100
01000XSC	6	<10	<4.6	1.1	.9	11	<10	<1.0	1.6	49	<100
010610SC	6	<10	<4.6	1.8	.9	14	<10	1.9	1.6	30	<100
010700SC	10	<10	<4.6	<1.0	.7	12	<10	<1.0	1.5	31	<100
01070XSC	6	<10	<4.6	1.1	.7	11	<10	<1.0	1.3	26	<100
010800SC	6	<10	<4.6	1.3	.8	10	17	<1.0	1.3	33	<100
011000SC	6	<10	<4.6	<1.0	.4	8	10	2.1	1.3	30	<100
011310SC	5	<10	<4.6	<1.0	.8	6	18	4.3	1.2	21	<100
030000SC	23	<10	<4.6	1.4	1.3	15	<10	1.5	1.9	41	<100
030100SC	34	12	<4.6	<1.0	2.8	18	26	1.8	3.1	48	<100
030200SC	23	<10	<4.6	<1.0	1.2	9	<10	<1.0	2.1	46	<100
030600SC	25	<10	<4.6	<1.0	1.6	15	16	1.6	2.0	47	<100
030700SC	22	<10	<4.6	<1.0	1.4	15	11	1.6	2.0	35	<100
03070XSC	27	<10	<4.6	1.5	1.9	20	16	2.3	2.7	51	<100
031000SC	4	<10	<4.6	<1.0	.4	8	15	<1.0	1.1	18	<100
03100XSC	4	<10	<4.6	<1.0	.3	7	<10	1.6	1.0	22	<100
031200SC	7	<10	<4.6	<1.0	2.4	12	<10	1.5	1.4	40	<100
03120XSC	6	<10	<4.6	1.1	1.5	11	<10	1.2	1.2	42	<100
031210SC	10	<10	<4.6	<1.0	2.5	15	18	1.5	1.4	40	<100
03121XSC	11	<10	<4.6	1.4	1.6	17	11	1.3	1.9	41	<100
030300ST	29	<10	<4.6	1.1	1.6	15	17	<1.0	2.8	51	<100
030310ST	27	<10	<4.6	1.0	2.0	22	19	1.6	3.1	49	<100
					Siltstones						
010500TC	26	<10	<4.6	<1.0	1.5	11	<10	1.2	1.7	42	<100
					Claystones						
030400CA	35	<10	<4.6	<1.0	2.8	15	19	<1.0	2.4	40	<100
030500CA	36	<10	<4.6	<1.0	3.3	17	<10	3.1	2.2	51	<100
010200CT	37	<10	<4.6	<1.0	4.4	19	22	2.2	2.9	55	<100
01020XCT	38	<10	<4.6	<1.0	3.8	15	21	1.2	2.3	51	<100

Table M-1 (con.)

Complete tabulation of bulk chemical data, Ojo Encino overburden rock, dry weight basis

Sample	Mg%-S	Mn ppm-S	Mo ppm-S	Na%-S	Nb ppm-S	Nd ppm-S	Ni ppm-S	Pb ppm-S	Pr ppm-S	Sc ppm-S	Si%-S
					Sandstones						
010110SA	.16	1,800	2.4	1.1	16	<46	6	9	<68	6	32
C1011XSA	.17	1,700	2.9	1.1	11	<46	7	10	<68	5	28
031100SA	.16	19	1.5	.8	13	<46	7	8	<68	6	27
031300SA	.16	20	2.6	.5	11	<46	9	8	<68	4	32
010000SC	.20	710	1.4	.9	8	<46	7	8	<68	6	21
01000XSC	.18	820	1.5	.9	10	<46	7	9	<68	6	25
010610SC	.25	77	1.2	1.0	13	<46	10	11	<68	8	>37
010700SC	.32	290	2.0	1.8	13	<46	12	7	<68	10	28
01070XSC	.23	230	1.5	.9	13	<46	9	8	<68	8	29
C10800SC	.31	33	1.7	.9	14	<46	12	9	<68	9	30
011000SC	.07	24	1.2	.4	11	<46	8	9	<68	5	>37
011310SC	.15	68	1.2	.4	14	<46	15	18	<68	3	31
030000SC	.27	330	2.2	1.2	14	<46	11	10	<68	7	29
030100SC	.59	200	3.7	1.0	22	<46	27	17	<68	12	>37
030200SC	.42	1,800	2.7	.6	15	<46	10	6	<68	9	19
030600SC	.51	520	3.2	.7	21	<46	23	12	<68	12	27
030700SC	.43	1,100	3.6	1.4	18	<46	17	14	<68	8	25
03070XSC	.44	1,300	4.2	1.2	18	<46	22	20	<68	10	34
031000SC	.07	12	2.7	.1	11	<46	6	7	<68	3	30
03100XSC	.07	10	1.6	.1	11	<46	4	5	<68	2	24
031200SC	.46	93	2.2	.9	16	<46	9	12	<68	8	23
03120XSC	.44	98	2.4	.9	12	<46	9	11	<68	8	20
C31210SC	.45	240	3.8	1.7	16	<46	16	13	<68	9	35
03121XSC	.46	230	3.0	1.0	19	<46	14	11	<68	9	29
030300ST	.47	290	2.6	.7	17	<46	23	11	<68	12	24
C30310ST	.49	540	2.1	.9	18	<46	17	17	<68	12	36
					Siltstones						
010500TC	.64	46	1.7	.6	19	<46	18	10	<68	12	25
					Claystones						
030400CA	.56	50	3.3	.5	18	<46	19	16	<68	13	25
030500CA	.74	85	3.3	.6	21	<46	23	16	<68	16	29
010200CT	.76	190	4.9	.7	23	<46	29	26	<68	14	36
01020XCT	.68	88	3.6	.5	18	<46	25	19	<68	12	29

Table M-1 (con.)

Complete tabulation of bulk chemical data, Ojo Encino overburden rock, dry weight basis

Sample	Sn ppm-S	Sr ppm-S	Ti%-S	Tm ppm-S	V ppm-S	Y ppm-S	Yb ppm-S	Zn ppm-S	Zr ppm-S	Lab. No.
Sandstones										
010110SA	<4.6	290	.16	<5	35	54.0	3	81	160	215,162
01011XSA	<4.6	310	.13	<5	32	44.0	4	90	100	215,252
031100SA	<4.6	120	.13	<5	36	23.0	2	29	110	215,059
031300SA	<4.6	95	.12	<5	37	13.0	1	52	190	215,341
010000SC	<4.6	200	.13	<5	44	31.0	3	56	110	215,115
01000XSC	<4.6	240	.15	<5	37	32.0	3	66	160	215,190
010610SC	<4.6	200	.26	<5	66	28.0	3	34	110	215,155
010700SC	<4.6	220	.19	<5	63	28.0	2	63	120	215,302
01070XSC	<4.6	220	.14	<5	55	22.0	2	49	99	215,215
010800SC	<4.6	190	.22	<5	48	19.0	2	49	110	215,078
011000SC	<4.6	110	.22	<5	40	15.0	2	37	260	215,259
011310SC	<4.6	120	.13	<5	33	18.0	2	46	100	215,175
030000SC	<4.6	510	.24	<5	63	25.0	3	42	170	215,125
030100SC	<4.6	190	.49	<5	97	35.0	3	72	430	215,283
030200SC	<4.6	140	.15	<5	66	33.0	3	73	220	215,101
030600SC	<4.6	230	.35	<5	92	34.0	3	89	290	215,195
030700SC	<4.6	180	.23	<5	61	27.0	2	76	220	215,295
03070XSC	<4.6	280	.39	<5	65	38.0	3	99	320	215,156
031000SC	<4.6	27	.10	<5	28	12.0	1	30	130	215,052
03100XSC	<4.6	25	.06	<5	25	9.8	1	31	99	215,096
031200SC	<4.6	200	.15	<5	47	28.0	3	35	180	215,057
03120XSC	<4.6	230	.15	<5	51	30.0	3	54	170	215,116
031210SC	<4.6	200	.27	<5	66	28.0	3	54	200	215,322
03121XSC	<4.6	220	.22	<5	53	29.0	3	50	220	215,213
030300ST	<4.6	210	.28	<5	92	32.0	3	82	290	215,226
030310ST	<4.6	200	.47	<5	100	35.0	5	72	390	215,284
Siltstones										
010500TC	<4.6	220	.22	<5	73	36.0	4	64	270	215,118
Claystones										
030400CA	<4.6	200	.24	<5	77	27.0	3	83	200	215,338
030500CA	<4.6	230	.35	<5	110	33.0	3	71	270	215,318
010200CT	<4.6	250	.42	<5	100	38.0	5	130	320	215,254
01020XCT	<4.6	220	.34	<5	90	33.0	3	100	200	215,306

SECTION N

LAND AND OVERBURDEN APPENDIX

SECTION N

LAND AND OVERBURDEN APPENDIX

Taxonomic Classification of Soils

Soils are classified so that the significant soil characteristics can be remembered. Classification is an assemblage of knowledge about soils and their relationships to one another and to the whole environment. Classification facilitates the development of principles that help in the understanding of the behavior of soils and their response to manipulation. Through classification and then through use of soil maps, the knowledge of soils can be applied to specific tracts of land.

The narrow categories of classification allow the application of soil knowledge to the management of range, watershed, woodland, wildlife, mined-land reclamation, and other engineering works.

The classification system has six categories. Beginning with the broadest, the categories are order, suborder, great group, subgroup, family, and series. In this system the criteria used as a basis for classification are soil properties that are observable and measurable. The properties are chosen, however so that soils of similar genesis, or mode of origin, are grouped. In table N-1 the major soil series at the study site are placed in the classification system. For further information about the system see Soil Taxonomy, USDA-SCS Agricultural Handbook No. 436, 1975.

Table N-1

Taxonomy of Soil Series at the Ojo Encino Study Area

Series	Family	Subgroup	Order
NOTAL	Fine, mixed, mesic	Typic Camborthids	Aridisols
DOAK	Fine-loamy, mixed, mesic	Typic Haplargids	Aridisols
SHIPROCK	Coarse-loamy, mixed mesic	Typic Haplargids	Aridisols
FRUITLAND	Coarse-loamy, mixed (calcareous) mesic	Typic Torriorthent	Entisols
SHEPPARD	Mixed, mesic	Typic Torrepsamments	Entisols
BLANCOT	Fine-loamy, mixed, mesic	Typic Haplargids	Aridisols
UFFENS	Fine-loamy, mixed mesic	Typic Natrargids	Aridisols
HUERFANO	Clayey, mixed, mesic, shallow	Typic Natrargids	Aridisols
BEEBE	Sandy, mixed mesic	Typic Torrifluvent	Entisols

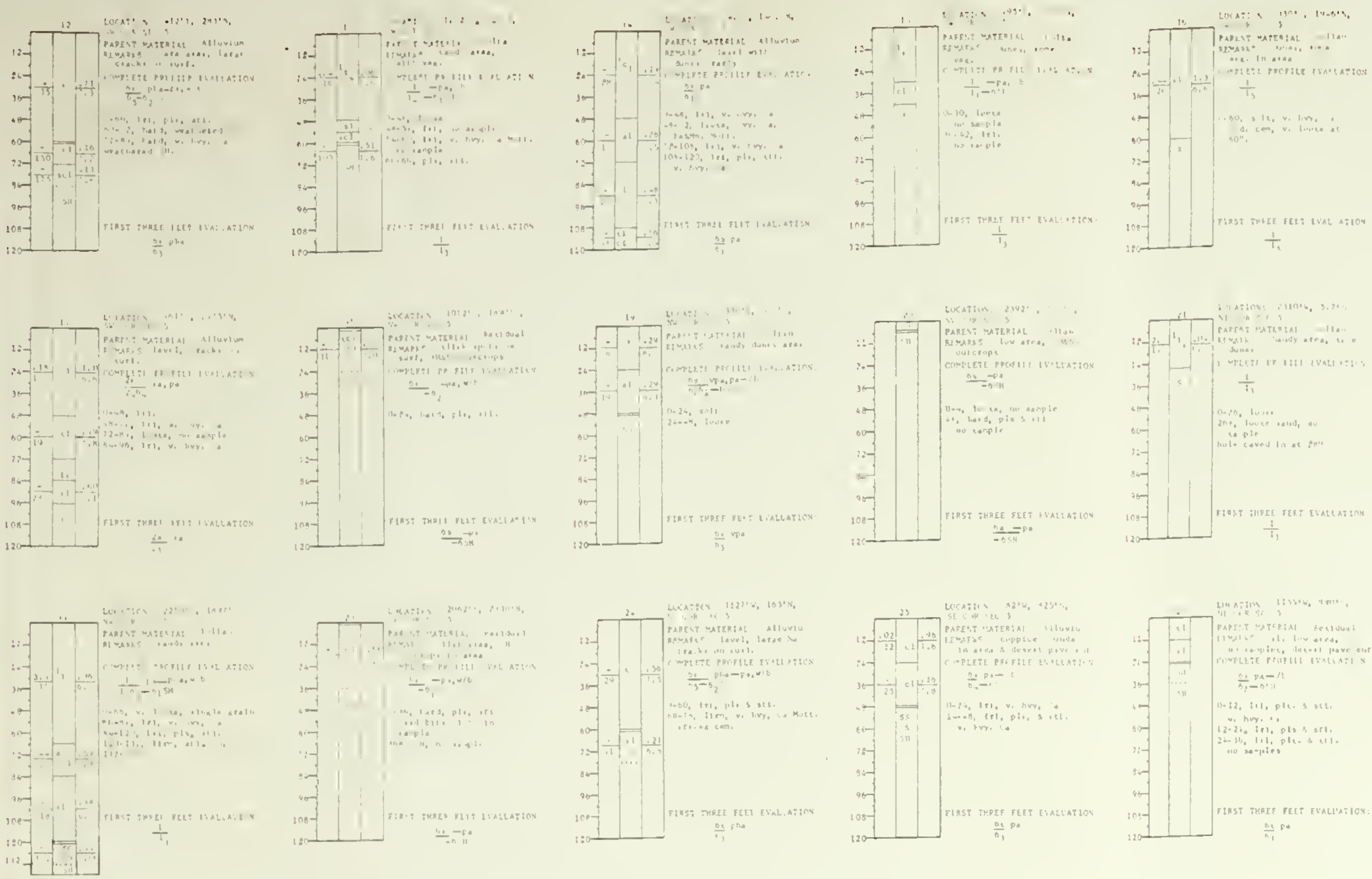
Soil Inventory

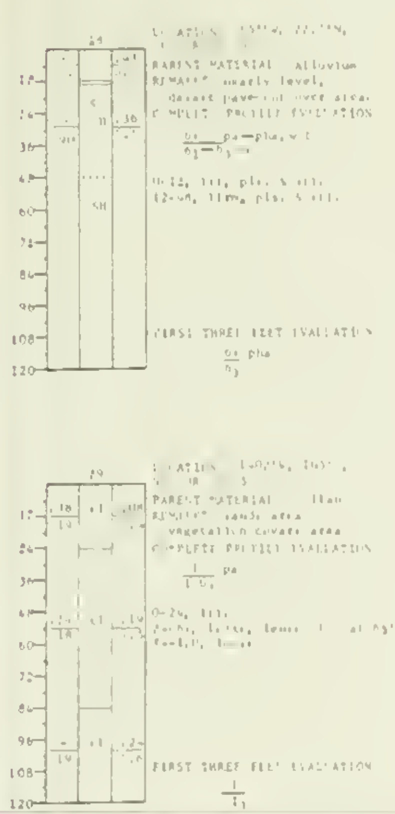
A soil inventory was conducted to obtain basic soil and environmental data. This enables limited prediction of soil behavior and projection of soil information outside the study area.

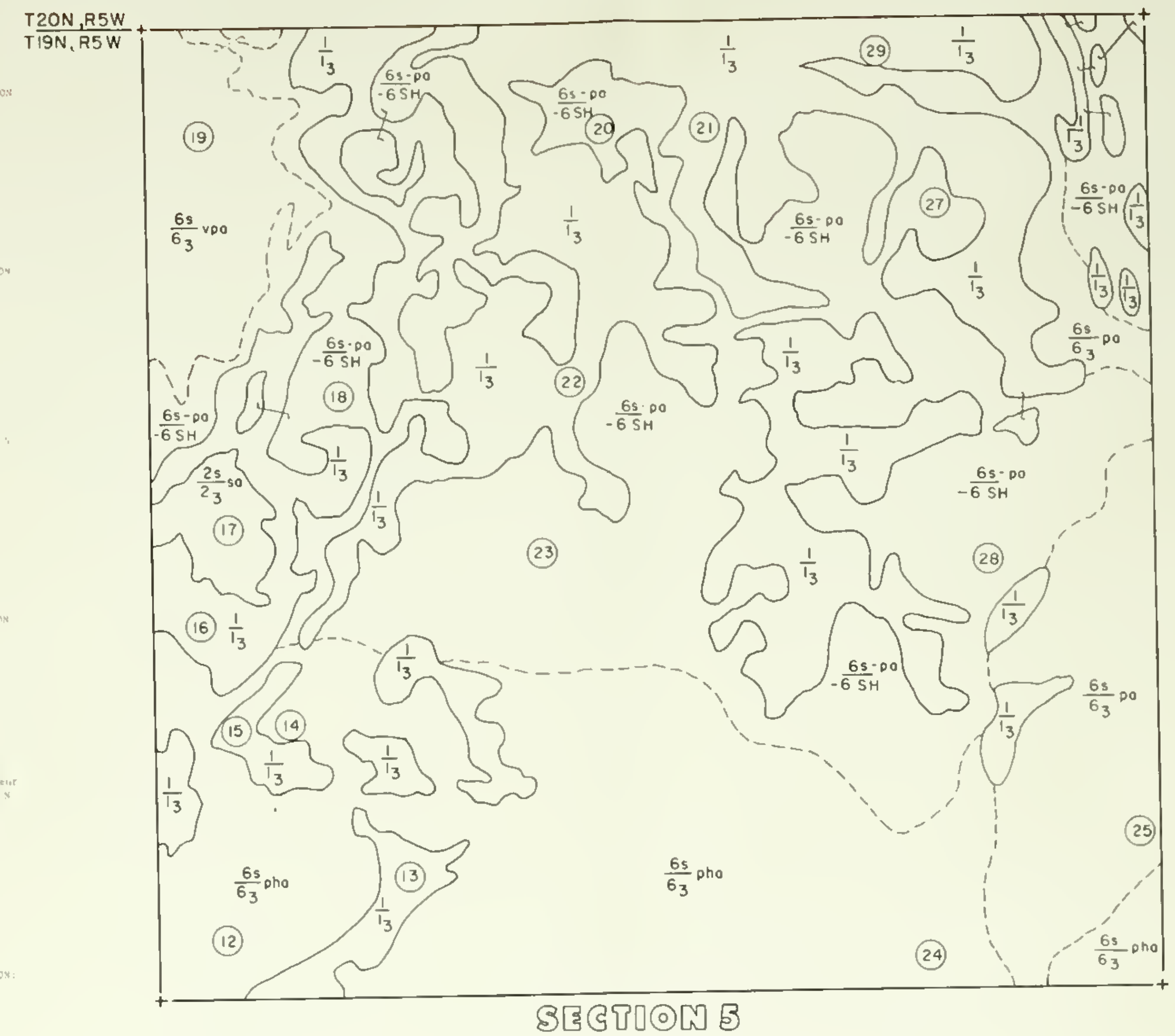
To facilitate the inventory, eight soil mapping units were delineated (figure N-1) with assistance from the Soil Conservation Service (SCS) at Aztec, New Mexico. For the Energy Minerals Rehabilitation Inventory and Analysis (EMRIA) program, these soil mapping units within the State of New Mexico are numbered for ease in identification starting at 7001 and running consecutively for each new soil unit thereafter. In the first two EMRIA study areas (Bisiti-West (report 5-1976) and Kimbeto (report 17-77) in New Mexico, these units were numbered from 7001-7015. For this third EMRIA report (Ojo Encino) in New Mexico), some of the same soil units were found plus those numbered to 7022. These units are not the equivalent of individual soil series but are soils grouped together to form a unit consisting of similar or contrasting characteristics. The major soil series are: Doak, Shiprock, Blancot, Notal, Huerfano, Beebe, and Fruitland. Table N-1 gives the taxonomy of these soil series. Minor series, types, phases, and variations occur throughout the study area but are counted as inclusions of the major series.

The following additional soils information is included in the Detailed Soil Inventory Tables subsection of section N: Soil Interpretations Record (table N-10), Point Site Land Characterization (table N-11), Determination of Erosion Condition Class (table N-12), and Vegetation-Soil Description (table N-13).

Included in these soil mapping units are master sites (see figure H-1). These master sites represent a profile of the dominant soil series (phase or variation) of a given unit. Complete description, locations, and other pertinent data are given in tables N-8, N-9, N-11, N-12, and N-13 for all master sites.

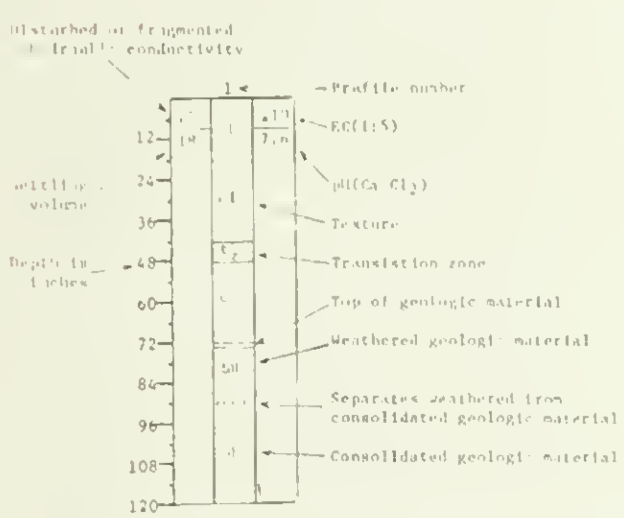






500 0 500 1000 1500
SCALE OF FEET

Land Classification Profile Symbols for Complete Profile Evaluation



Textures

s	sand
ls	loamy sand
vfs	very fine sand
fs	fine sand
lfs	loamy fine sand
sl	sandy loam
vfsl	very fine sandy loam
l	loam
sil	silty loam
cl	clay loam
sicl	silty clay loam
scl	sandy clay loam
c	clay
sic	silty clay
sc	sandy clay
SS	sandstone
SH	shale
X	terminated augering

Complete Profile Evaluation

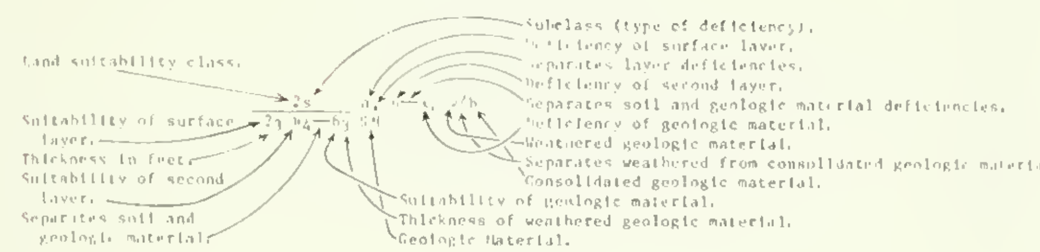
$\frac{2s}{2_1 2_2}$ v, sa—sa, w/b —2_3SS

First Three Feet Evaluation

$\frac{2s}{2_3}$ vsa

*Only the first three feet was evaluated and classified for suitability as a source of planting media.

Land Classification Mapping Symbols for Complete Profile Evaluation



Land suitability class
- 1 good
- 2 fair
- 6 unsuitable

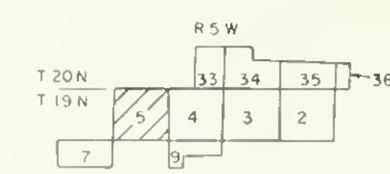
Subclass (type of deficiency)
- s - soils

Subclass deficiencies (soil & geologic material)
- s - salinity
- a - sodicity
- h - very fine textures
- v - coarse textures
- p - restricted permeability
- d - shallow depth of suitable material
- w - weathered geologic material
- b - consolidated geologic material

④ Profiles
—— separates classes
- - - - separates subclasses

LAND CLASS	ACRES**
1	197
2	8
TOTAL	205
6	435
GRAND TOTAL	640

** for complete acreages of each individual land classification, see table N-14



OJO ENCINO STUDY AREA, NEW MEXICO

PROFILE DESCRIPTION AND LAND CLASSIFICATION

EMRIA REPORT NO 19-78

FIGURE N-10

7016-227* - Beebe-Notal association (42 acres, 1 percent of study area)

This association consists of level and nearly level soils on valley floors. The Notal soil is in the lower portion of the landscape, and the Beebe soil will be slightly higher on the landscape. Elevations are 6,600 to 6,700 feet. The average annual precipitation is about 9 inches, and the mean annual air temperature is about 50° F. The average growing season is about 125 days. The Beebe soil makes up about 45 percent, and the Notal soil makes up about 30 percent.

Included with this association in mapping are small areas of Turley, Azfield, Fruitland, Doak, and Sheppard soils. These inclusions make up about 25 percent of this unit.

The Beebe soil is deep and well drained. It formed in recent alluvium. In a typical profile of the Beebe soil, the surface layer is light yellowish brown silt loam about 8 inches thick. The substratum is yellowish brown and pale brown, fine sandy loam and loamy sand to 60 inches or more.

Permeability is moderately rapid. The available water capacity is moderate. Exchangeable sodium ranges from 15 to 50 percent. The effective rooting depth is about 60 inches. The average annual wetting depth of the soil under native vegetation is about 20 inches. Surface runoff is slow, and the erosion hazard is slight from water and moderate from wind.

* 7016 = Soil mapping unit number; 227 = SCS soil association/complex number.

The Notal soil is deep and well drained. It formed in recent alluvium. In a typical profile of the Notal soil, the surface layer is pale brown, sandy clay loam about 7 inches thick. The substratum is brown heavy silty clay loam about 26 inches thick over pale brown stratified loam, very fine loam and loamy very fine sand to 60 inches or more. Permeability is very slow. The available water capacity is high. Exchangeable sodium content ranges from 15 to 50 percent. The effective rooting depth is 60 inches or more. The average wetting depth of the soil under native vegetation is about 15 inches. Surface runoff is slow, and erosion hazard is slight.

The Beebe and Notal soils will support a potential native plant community of alkali sacaton, western wheatgrass, fourwing saltbush, and galleta.

Under continuous year-long grazing and prolonged heavy use, plants such as alkali sacaton, western wheatgrass, and fourwing saltbush are replaced by others such as blue grama, galleta, greasewood, perennial and annual forbs.

Livestock pipelines and fences are feasible. Earthen structures are not feasible due to a high sodium content. Salting and livestock trails into areas of relatively light utilization should be considered.

Flexible grazing management systems which allow varied seasons of use and deferment from year to year are needed in order to achieve a balanced plant community and to provide high-quality forage throughout the year.

7017-228 - Notal silt loam (191 acres, 4.6 percent of study area)

This deep, well drained, nearly level soil formed in alluvial sediments on the floodplain at elevations of 6,400 to 7,000 feet. The average annual precipitation is about 9 inches, and the mean annual air temperature is about 50 degrees. The average growing season is about 125 days.

Small areas of Beebe, Blancot, Sheppard, and Uffens soils were included in mapping.

In a typical profile of the Notal soil, the surface layer is pale brown sandy clay loam about 7 inches thick. The substratum is brown heavy silty clay loam about 26 inches thick over pale brown loam, very fine sandy loam and loamy very fine sand to 60 inches or more.

Permeability is very slow. The available water capacity is high. Exchangeable sodium content ranges from 15 to 50 percent. The effective rooting depth is 60 inches or more. The average annual wetting depth of the soil under native vegetation is about 20 inches. Surface runoff is slow, and the erosion hazard is moderate from water and moderate from wind.

The Notal soil will support a potential native plant community of alkali sacaton, bottlebrush squirreltail, fourwing saltbush, western wheatgrass, galleta, and blue grama.

Under continuous year-long grazing or prolonger heavy use, plants such as alkali sacaton, western wheatgrass, fourwing saltbush, and bottlebrush squirreltail will decrease in abundance; and other plants such as blue grama, shadscale, galleta, and annual forbs will replace them. Greasewood will increase in abundance as the soil becomes gullied. Range improvements such as livestock pipelines and fences are feasible. Earthen structures are usually not feasible due to high sodium content of the soil. Management practices such as salting and livestock trails into areas of relatively light grazing patterns should be considered.

Flexible grazing management systems which allow varied seasons of use and deferment from year to year are needed in order to achieve a balanced plant community and to provide high-quality forage throughout the year.

7018-238 - Doak-Shiprock association (404 acres, 9.8 percent of study area) This association consists of level and nearly level soils on the uplands. The Doak soil is on lower mesa depression position areas, and the Shiprock soil is on the more sloping areas and near the breaks. Elevations are 6,400 to 7,000 feet. Slopes are 0 to 3 percent. The average annual precipitation is about 9 inches, and the mean annual air temperature is about 50° F. The average growing season is about 125 days. The Doak fine sandy loam makes up about 55 percent of the mapping unit, and the Shiprock fine sandy loam makes up about 30 percent. Included with this association in mapping are small areas of Fruitland, Sheppard, Farb, and Turley soils. These inclusions make up about 20 percent of this unit.

The Doak soil is deep and well drained. It formed in wind and water-laid sediments. In a typical profile of the Doak soil, the surface layer is light brown, fine sandy loam about 3 inches thick. The subsoil is brown sandy clay loam about 16 inches thick. The substratum is light brown to pink sandy loam and loamy sand to 60 inches or more. Permeability is moderately slow. The available water capacity is moderate. The effective rooting depth is 60 inches or more. The average annual wetting depth of the soil under native vegetation is about 20 inches. Surface runoff is slow, and erosion hazard is slight from water and moderate from wind.

The Shiprock soil is deep and well drained. It formed in wind and water-laid sediments. In a typical profile of the Shiprock soil, the surface layer is brown fine sandy loam about 3 inches thick. The subsoil is brown sandy loam about 14 inches thick. The substratum is pale brown and light gray sandy loam and loamy sand to 60 inches or more. Permeability is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. The average annual wetting depth of the soil under native vegetation is about 20 inches. Surface runoff is slow, and erosion hazard is slight from water and moderate from wind.

The Doak and Shiprock soils will support a potential native plant community which includes Indian ricegrass, needle-and-thread, galleta, bottlebrush squirreltail, dropseeds, and blue grama.

Under continuous year-long grazing or prolonged heavy use, needle-and-thread and Indian ricegrass decrease. These plants are then replaced in importance by red threeawn, blue grama, big sagebrush and forbs.

Livestock pipelines and fences are feasible. Big sagebrush control would benefit the rangeland.

Flexible grazing management systems which allow varied seasons of use and deferment from year to year are needed in order to achieve a balanced plant community and to provide high-quality forage throughout the year.

7019-241 - Fruitland-Doak complex, eroded (1,330 acres, 32.3 percent of study area)

This complex consists of gently sloping to moderately sloping soils on the uplands at elevations of 6,400 to 7,000 feet. The average annual precipitation is about 9 inches, and the mean annual air temperature is about 50° F. The average growing season is about 125 days. The Fruitland fine sandy loam makes up about 30 percent of the mapping unit; the Doak sandy loam makes up about 25 percent; and the Sheppard loamy sand makes up about 20 percent.

Included with this complex in mapping are small areas of Azfield and Shiprock soils, and Rock outcrop. These inclusions make up about 25 percent of this unit.

The Fruitland soil is deep and well drained. It formed in mixed alluvial and eolian sediments.

In a typical profile of the Fruitland soil, the surface layer is dark brown fine sandy loam about 5 inches thick. The substratum is brown and yellowish brown sandy loam and fine sandy loam to 60 inches or more.

Permeability is moderately rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. The average annual wetting depth of the soil under native vegetation is about 25 inches. Surface runoff is slow, and the erosion hazard is moderate from water and wind.

The Doak Soil is deep and well drained. It formed in mixed alluvial eolian sediments. In a typical profile of the Doak soil, the surface layer is light brown sandy loam about 3 inches thick. The subsoil is brown sandy clay loam about 16 inches thick. The substratum is light brown sandy loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is medium. The effective rooting depth is 60 inches or more. The average annual wetting depth of the soil under native vegetation is about 20 inches. Surface runoff is slow, and the erosion hazard is slight from water and moderate from wind.

The Sheppard soil is deep and well drained. It formed in eolian sands. In a typical profile of the Sheppard soil, the surface layer is light grayish brown loamy sand about 4 inches thick. The substratum is pale brown and light brownish gray loamy sand and loamy fine sand to 60 inches or more.

Permeability is very rapid. The available water capacity is moderate. The effective rooting depth is 60 inches or more. The average annual wetting depth of the soil under native vegetation is about 30 inches. Surface runoff is slow, and the erosion hazard is slight from water and severe from wind.

The Fruitland and Doak soils will support a potential native plant community of needle-and-thread, New Mexico feathergrass, little bluestem, blue grama, dropseeds, galleta, and fourwing saltbush. The Sheppard soil in this complex will have little bluestem, New Mexico feathergrass, and needle-and-thread as the principal vegetation.

Under continuous year-long grazing or prolonged heavy use, needle-and-thread, New Mexico feathergrass, little bluestem, Indian ricegrass, and fourwing saltbush become less important in the plant community and are slowly replaced by blue grama, dropseeds, galleta, big sagebrush, and red threeawn. Sandhill muhly will occur on the Sheppard soils.

Livestock pipelines and fencing are feasible. Earthen stock tanks are feasible only after on-site soils investigation. Disturbances of the vegetation should be kept to a minimum due to the erosiveness of these soils. Management practices such as salting and stock trails into areas with relatively light grazing distribution patterns are feasible.

Flexible grazing management systems which allow varied seasons of use and deferment from year to year are needed in order to achieve a balanced plant community and to provide high-quality forage throughout the year.

7020-242 - Blancot-Azfield complex (1,426 acres, 34.6 percent of study area)

This complex consists of level to gently sloping soils on the valley filling side slopes, at elevations of 6,400 to 7,000 feet. Slopes are 0 to 5 percent. The average annual precipitation is about 9 inches, and the mean annual air temperature is about 50° F. The average growing season is about 125 days. The Blancot loam makes up about 40 percent of the mapping unit, and the Azfield fine sandy loam makes up about 30 percent.

Included with this complex in mapping are areas of Huerfano, Uffens, Fruitland, Sheppard, Shiprock and Doak soils. The inclusions make up about 30 percent of this unit.

The Blancot soil is deep and well drained. It formed in mixed alluvian and eolian sediments. In a typical profile on the Blancot soil, the surface layer is light gray loam about 3 inches thick. The subsoil is brown and light grayish brown clay loam and sandy clay loam about 9 inches thick. The substratum is brown and light grayish brown sandy loam over loamy sand and very fine loamy sand to 6^ inches thick.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. The average annual wetting depth of the soil under native vegetation is about 23 inches. Surface runoff is slow, and the erosion hazard is moderate from water and moderate from wind.

The Azfield soil is deep and well drained. It formed in mixed alluvial and eolian sediments. In a typical profile of the Azfield soil, the surface layer is light brownish gray fine sandy loam about 4 inches thick. The substratum is brown sandy clay loam and light clay loam about 14 inches thick over pale brown fine sandy loam and loamy fine sand to 60 inches or more.

Permeability is moderate. The available water capacity is moderate. The effective rooting depth is 60 inches or more. The average annual wetting depth of the soil under native vegetation is about 25 inches. Surface runoff is moderate, and the erosion hazard is moderate from water and wind.

The Blancot and Azfield soils will support a potential native plant community of galleta, Indian ricegrass, bottlebrush squirreltail, alkali sacaton, and western wheatgrass. Alkali sacaton is only found in small areas which receive a run-in.

Under continuous year-long grazing or extended heavy use, western wheatgrass and Indian ricegrass are slowly replaced in importance by blue grama, big sagebrush, and forbs.

Range improvements such as pipelines, fencing, and erosion control structures are feasible. On-site investigation for earthern stock tanks is needed due to underlying sandy layers in these soils.

Flexible grazing management systems which allow varied seasons of use and deferment from year to year are needed in order to achieve a balanced plant community and to provide high-quality forage throughout the year.

7022-275 - Uffens-Huerfano complex (308 acres, 7.5 percent of study area)

This complex consists of level and nearly level soils intermingled on the uplands at elevations of 6,600 to 6,800 feet. Slopes are 0 to 3 percent. The average annual precipitation is about 9 inches, and the mean annual air temperature is about 50° F. The average growing season is a about 125 days. The Uffens silty clay loam makes up about 50 percent of the mapping unit, and the Huerfano silty clay loam makes up about 30 percent. Most of the vegetated areas are areas which have 4 to 12 inches of sandy loam and loamy sand blown on to them.

Included with this complex in mapping are small areas of Notal and Sheppard soils and a moderately deep sodic soil. These inclusions make up about 20 percent of this unit.

The Uffens soil is deep and well drained. It formed in moderately fine and fine-textured alluvial sediments derived from shale. In a typical profile of the Uffens soil, the surface layer is absent. The subsoil is light brownish gray to brown silty clay loam about 8 inches thick. The substratum is pale brown to grayish brown clay loam and silty clay loam to 60 inches or more.

Permeability is moderately slow. The available water capacity is high. Exchangeable sodium ranges from 15 to 80 percent. The effective rooting depth is 60 inches or more. The average annual wetting depth of the soil under native vegetation is about 20 inches. Surface runoff is medium, and erosion hazard is slight from water and moderate from wind.

The Huerfano soil is shallow and well drained. It formed in fine-textured alluvial sediments and shale. In a typical profile of the Huerfano soil, the surface layer is grayish brown silty clay loam about 1 inch thick. The subsoil is olive brown silty clay about 7 inches thick. The substratum is olive brown and very dark grayish brown silty clay loam about 3 inches thick. Shale is at 11 inches. Black gravel is common on this soil.

Permeability is slow to very slow. The available water capacity is low. Exchangeable sodium ranges from 15 to 50 percent. The effective rooting depth is 11 inches. The average annual wetting depth of the soil under native vegetation is about 11 inches. Surface runoff is medium, and the erosion hazard is moderate from water and moderate from wind.

The Uffens and Huerfano soils contain areas which are highly affected by sodium and have a 2 to 3 percent ground cover. Other areas contain a wind-deposited sandy layer 4-12" thick overlying the sodic soil. The potential vegetation for this soil includes alkali sacaton, galleta, Indian ricegrass, dropseeds, shadscale, and blue grama.

Under continuous year-long grazing or extended heavy use, alkali sacaton and Indian ricegrass decrease. These plants are replaced by shadscale, blue grama, dropseeds, and forbs.

Fences are feasible on the Huerfano soil but not livestock pipelines or earthen stock tanks due to its shallow depth. All these practices are feasible on the Uffens soil. Salting and stock trails into areas of relative light distribution patterns should be considered.

Flexible grazing management systems which allow varied seasons of use and deferment from year to year are needed in order to achieve a balanced plant community and to provide high-quality forage throughout the year.

7021-278 - Rock outcrop, shale (318 acres, 7.7 percent of study area)

This unit occurs as flat landscapes nearly devoid of vegetation.

It consists of exposures of black.shale, except for small areas with 4 to 8 inches of wind-deposited sandy material on the surface.

Included with this unit during mapping are small areas of Farb and Sheppard soils, and Badland.

This miscellaneous area has low potential for most uses because of lack of soil, severe erosion hazard, and high sodium content

7002-279 - Badlands (101 acres, 2.5 percent of study area)

This is a miscellaneous area of steep to very steep, nonstony barren land, dissected by many intermittent drainage channels entrenched in soft shale. Local relief varies from 25 to 500 feet. Sediment and pollution potentials are high due to the high surface runoff and active geological erosion taking place in these areas. This miscellaneous land type occupies upland canyons, valleys, ridges, hills and breaks.

Permeability is very slow, and AWHC is very low. This land type has a shallow root depth, is low in natural fertility and O.M. content, and also SSF is over 81 with a critical erosion condition class.

Native vegetation is sparse if any at all. Some alkali sacaton, shadscale, or Russian thistle can be found in isolated areas.

Badland areas are unsuitable as planting media because of high saline and/or sodic conditions of the geologic material.

Huerfano, Stumble, Sheppard, Uffens, and Turley with various phases of Turley, Sheppard and Stumble occur as inclusions in this land type. They make up less than 15 percent of this unit.

Results of Laboratory Weathering Tests Conducted on Core Samples from Ojo Encino, New Mexico*

Laboratory weathering and outdoor exposure*tests were conducted on overburden core samples from the Ojo Encino, New Mexico, study area. The purpose of these tests was to determine which materials would break down sufficiently to allow for their possible use as planting media in revegetation of strip-mined areas.

Test Procedures

Specimens for the laboratory weathering and outdoor exposure tests were cut from core samples submitted by Mr. Tony Cappellucci, LM Region, on July 6, 1979.

The purpose of including outdoor exposure tests was to determine if any correlation could be drawn between this type of weathering and the laboratory weathering conditions.

A laboratory weathering cycle consisted of the following conditions:

1. 8 hours at 23.9 °C (75 °F), 100 percent relative humidity (wetting/thawing)
2. 16 hours (64 hours on weekends) at 37.8 °C (100 °F), 10 percent relative humidity (drying)
3. 8 hours at 23.9 °C (75 °F), 100 percent relative humidity (wetting)
4. 16 hours (64 hours on weekends) at -17 °C (0 °F) (freezing)

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*/ Partial results from Outdoor Exposure Tests are also included.

In this study, core specimens about 50 mm (2 in) in diameter by 50 mm (2 in) in length were used. For testing and handling, the core specimens were placed on a No. 10 mesh screen in 400-ml plastic beakers.

Laboratory weathering tests were started on July 16, 1979, and 20 laboratory weathering cycles were completed on September 19, 1979. Outdoor exposure tests commenced on July 13, 1979, and will continue for one year.

Test Results

Test results are summarized in table N-2 and shown visually in figures N-2 through N-5.

At the completion of the laboratory weathering tests, a percent breakdown value (%BD) was determined for the specimens. This value listed under the remarks column in the table was derived as follows:

$$\%BD = \frac{(TW - IW)}{TW} \quad (100)$$

where

TW = total specimen weight

IW = weight of original specimen remaining intact after testing

Of the eight samples tested, only one material appeared to have broken down sufficiently to be considered for possible use as planting media. This was sample OE-4, a shale/siltstone material.

It was noted that a number of the shale and siltstone samples from this site exhibited severe swelling characteristics when wetted and consequently would be difficult to handle and place during earth moving operations.

One sample, a sandstone material (OE-8), exhibited little or no breakdown at all.

With regard to the outdoor exposure tests, the samples exhibited very little change during the three months of summer weathering. These samples will be evaluated and photographed after one year of exposure (July 1980) and the results furnished at that time to code D-737.

Table N-2

WEATHERING TESTS

Core Samples From Ojo Encino, New Mexico

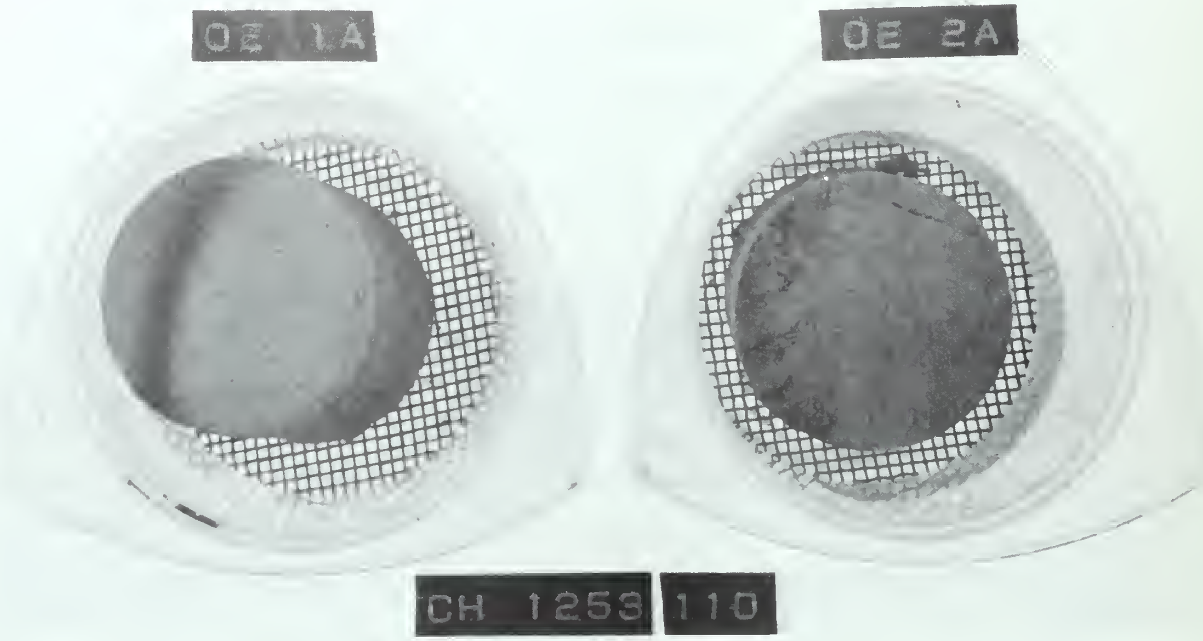
Sample I.D.	Remarks
Sandstone DH OE-4-8** Depth (ft) 63.4-77.2 (OE-1)*	See figure N-2 Laboratory weathering: Specimen friable at 15 cycles. Some cracking at 20 cycles. %BD = 11 Outdoor: No change at 3 months.
Siltstone DH OE-4-16 Depth (ft) 201.9-205.1 (OE-2)	See figure N-2 Laboratory weathering: Slaking and slight swelling at 5 cycles. Continued slaking and swelling at 20 cycles. %BD = 39 Outdoor: Surface cracking and peeling at 3 months.
Sandstone DH OE-4-18 Depth (ft) 220.0-240.0 (OE-3)	See figure N-3 Laboratory weathering: Some swelling and cracking at 5 cycles. Sample friable at 20 cycles. %BD = 19 Outdoor: Very slight cracking at 3 months.
Shale/Siltstone DH OE-5-7 Depth (ft) 32.5-51.0 (OE-4)	See figure N-3 Laboratory weathering: Slaking and swelling at 5 cycles. Severe slaking and swelling at 20 cycles. %BD = 100 Outdoor: Surface cracking and peeling at 3 months.
Siltstone DH OE-5-9 Depth (ft) 61.1-81.0 (OE-5)	See figure N-4 Laboratory weathering: Swelling and cracking at 5 cycles. Swelling and slaking at 15 cycles. %BD = 43 Outdoor: Slight surface cracking at 3 months.

* Laboratory sample number ** Sample 8 from DH-OE-4 (DH-4); compare table N-8.

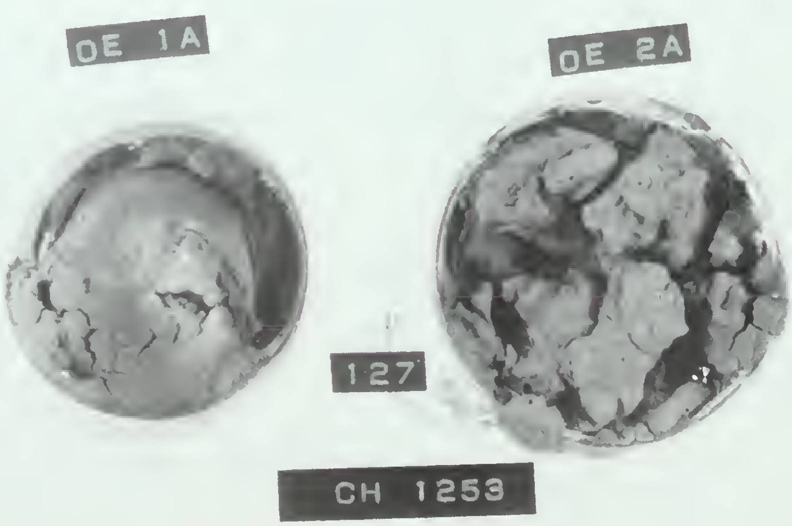
Table N-2 (con.)

WEATHERING TESTS

Shale DH OE-5-11 Depth (ft) 91.0-110.0 (OE-6)	See figure N-4 Laboratory weathering: Severe swelling at 5 cyles. Slaking at 15 cycles %BD = 44 Outdoor: Surface cracking and peeling at 3 months.
Shale DH OE-5-14 Depth (ft) 130.0-140.0 (OE-7)	See figure N-5 Laboratory weathering: Swelling and slaking at 5 cycles. Severe swelling and continued slaking at 15 cycles. %BD = 50 Outdoor: Very slight surface cracking at 3 months.
Sandstone DH OE-5-18 Depth (ft) 225.0-240.0 (OE-8)	See figure N-5 Laboratory weathering: No change at 20 cyles. %BD = 0 Outdoor: No change at 3 months.

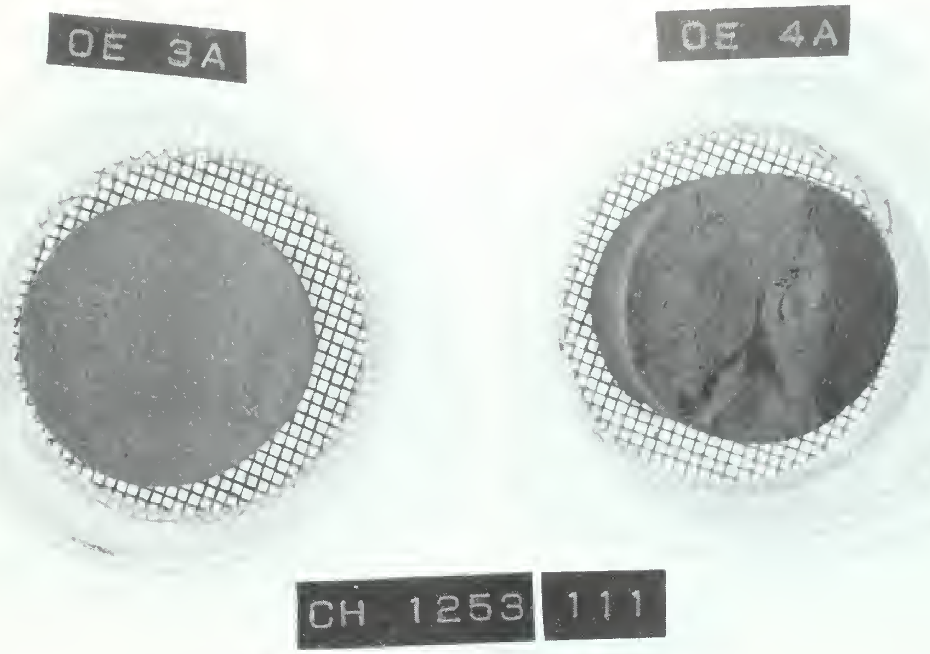


a. Original condition of test specimens.

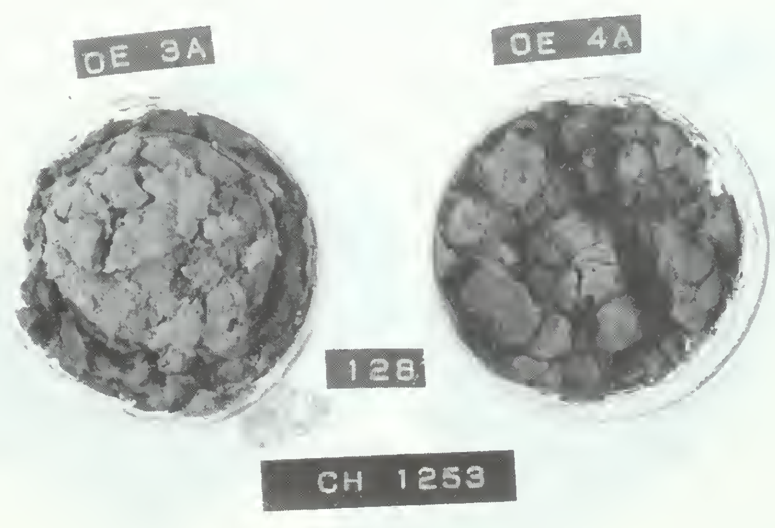


b. Condition of test specimens after weathering.

Figure N-2. Results of weathering tests for sandstone sample OE-1 and siltstone sample OE-2 subjected to 20 laboratory weathering cycles.

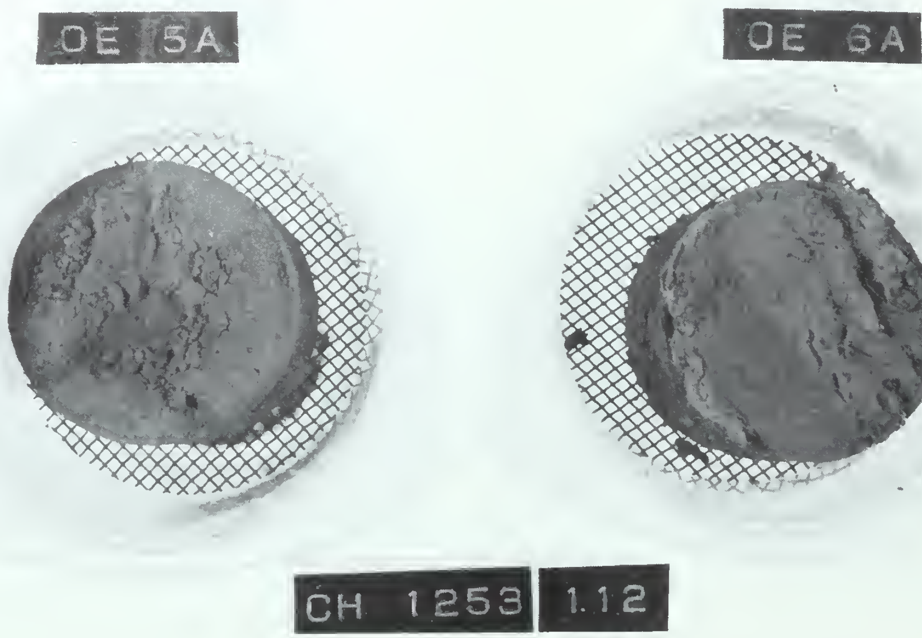


a. Original condition of test specimens.

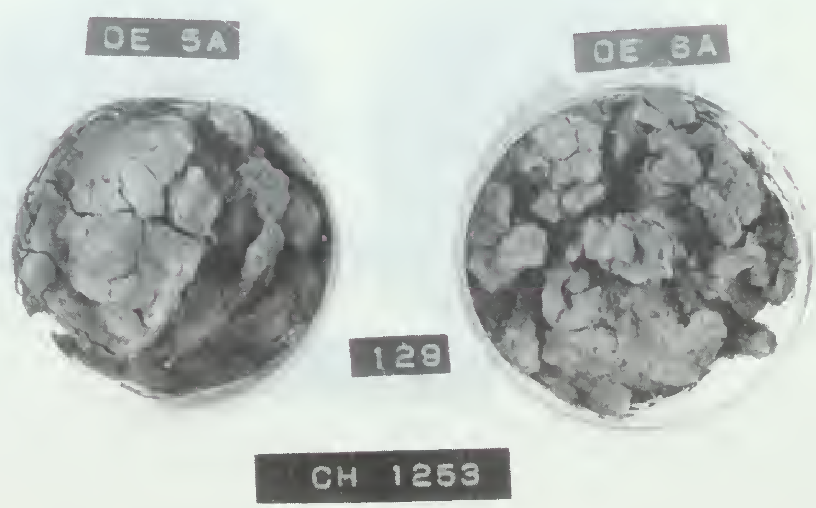


b. Condition of test specimens after weathering.

Figure N-3. Results of weathering tests for sandstone sample OE-3 and shale/siltstone sample OE-4 subjected to 20 laboratory weathering cycles.

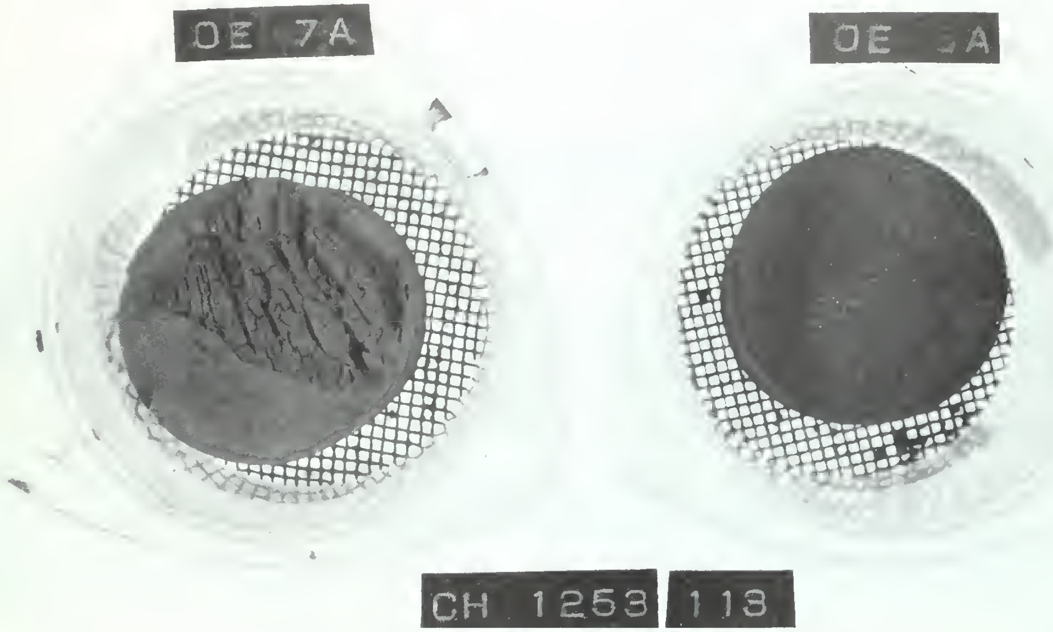


a. Original condition of test specimens.

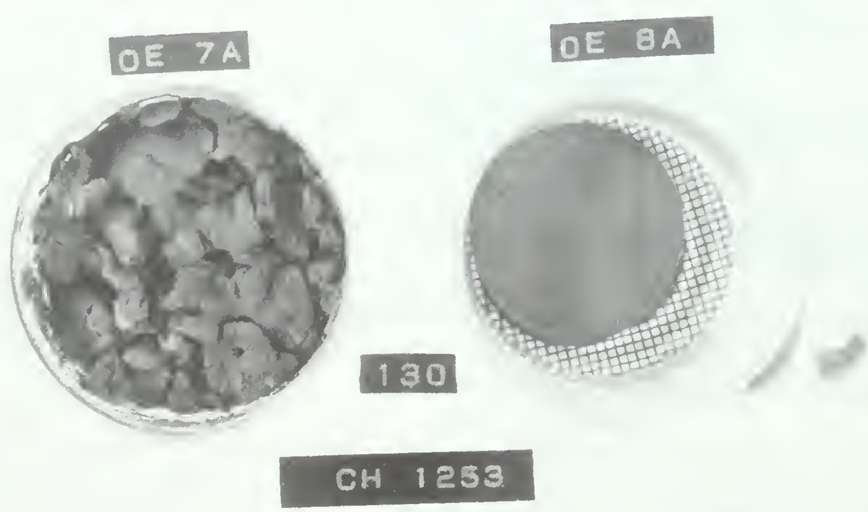


b. Condition of test specimens after weathering.

Figure N-4. Results of weathering tests for siltstone sample OE-5 and shale sample OE-6 subjected to 20 laboratory weathering cycles.



a. Original condition of test specimens.



b. Condition of test specimens after weathering.

Figure N-5. Results of weathering tests for shale sample OE-7 and sandstone sample OE-8 subjected to 20 laboratory weathering cycles.

Results of Outdoor Exposure Tests Conducted on Core Samples from Ojo Encino, New Mexico

One-year outdoor exposure tests were completed on overburden core samples from the Ojo Encino, New Mexico, study area. The testing period was from July 13, 1979 through July 13, 1980. During this period of time the specimens were subjected to about 356 mm (14 inches) of precipitation.

The purpose of including outdoor exposure tests was to determine if any correlation could be drawn between this type of weathering and accelerated laboratory weathering previously reported.

Test Results

Test results are summarized in table N-3 and shown visually in figures N-6 through N-9.

At the completion of the outdoor exposure tests, a percent breakdown value (%BD) was determined for the specimens. This value listed under the remarks column in the table was derived as follows:

$$\%BD = \frac{(TW - IW)}{TW} (100)$$

where

TW = total specimen weight

IW = weight of original specimen remaining intact after testing

In addition, the percent by weight passing a No. 10 mesh screen was determined for the specimens.

All eight specimens exhibited various degrees of weathering, but none attained the soil texture necessary as a planting medium (minimum of 30 percent by weight passing a No. 10 screen.)

With regard to the correlation between laboratory and outdoor weathering, the same type of breakdown of the specimens was observed in both cases. However, based upon the percent breakdown value (%BD), the outdoor weathering was slightly more severe.

Table N-3

Results of 1-Year Outdoor Weathering for Core Samples from Ojo Encino, New Mexico

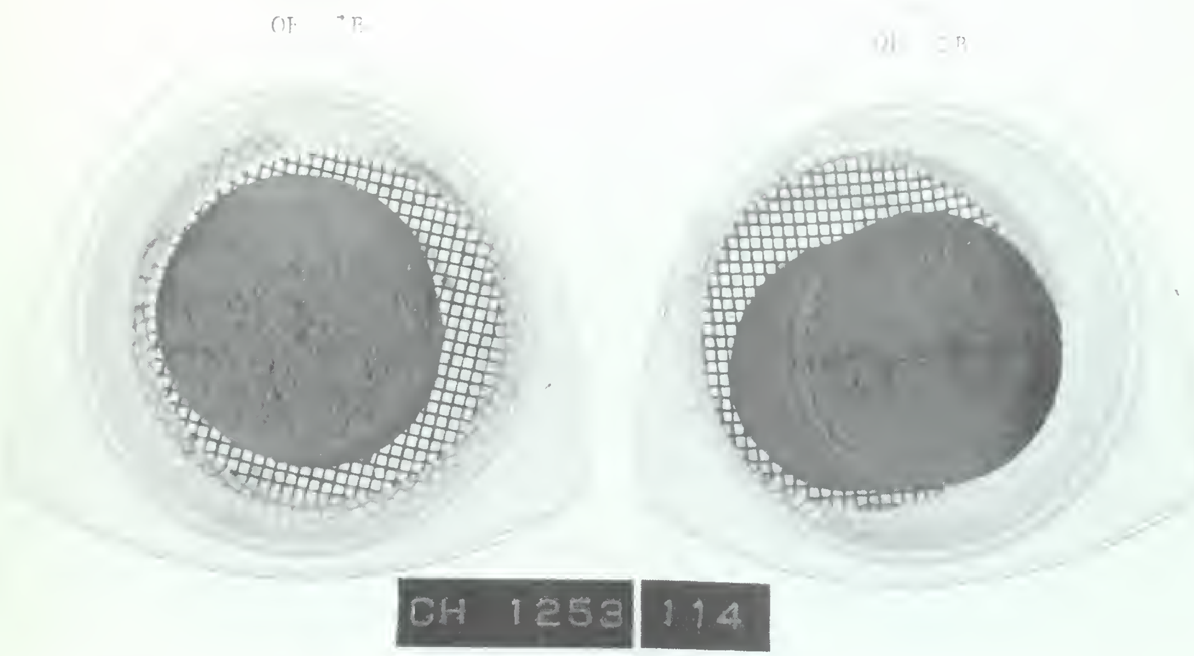
Sample I.D.	Remarks
Sandstone DH OE-4-8 Depth (ft) 63.4-77.2 (OE-1)*	See figure N-6 Specimen friable and some swelling at 1 year. %BD = 60 % Passing No. 10 screen = 7
Siltstone DH OE-4-16 Depth (ft) 201.9-205.1 (OE-2)	See figure N-6 Considerable weathering at 1 year %BD = 100 % Passing No. 10 screen = 12
Sandstone DH OE-4-18 Depth (ft) 220.0-240.00 (OE-3)	See figure N-7 Specimen very friable at 1 year %BD = 100 % Passing No. 10 screen = 7
Shale/Siltstone DH OE-5-7 Depth (ft) 32.5-51.0 (OE-4)	See figure N-7 Slaking and swelling at 1 year %BD = 100 % Passing No. 10 screen = 4
Siltstone DH OE-5-9 Depth (ft) 61.1-81.0 (OE-5)	See figure N-8 Considerable swelling and cracking at 1 year %BD = 56 % Passing No. 10 screen = 5

* Laboratory Sample Number

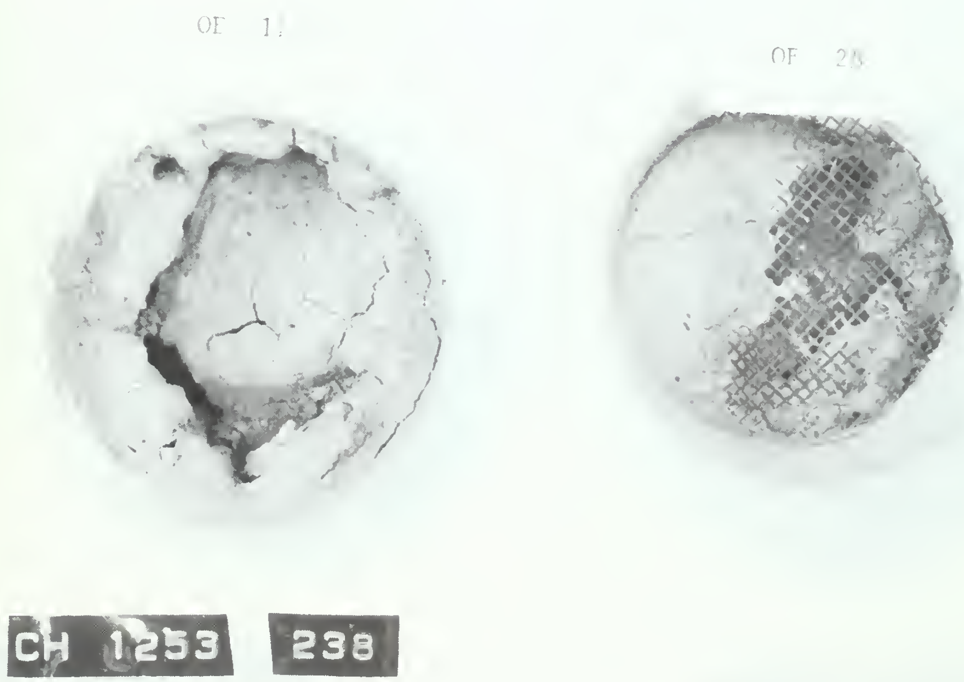
Table N-3 (con.)

Results of 1-Year Outdoor Weathering for Core Samples from Ojo Encino, New Mexico

Sample I.D.	Remarks
Shale DH OE-5-11 Depth (ft) 91.0-110.0 (OE-6)	See figure N-8 Slaking and some swelling at 1 year. %BD = 67 % Passing No. 10 screen = 3
Shale DH OE-5-14 Depth (ft) 130.0-140.0 (OE-7)	See figure N-9 Swelling, cracking and slaking at 1 year %BD = 37 % Passing No. 10 screen = 5
Sandstone DH OE-5-18 Depth (ft) 225.0-240.0 (OE-8)	See figure N-9 Some swelling and slight breakdown at 1 year. %BD = 36 % Passing No. 10 screen = 9



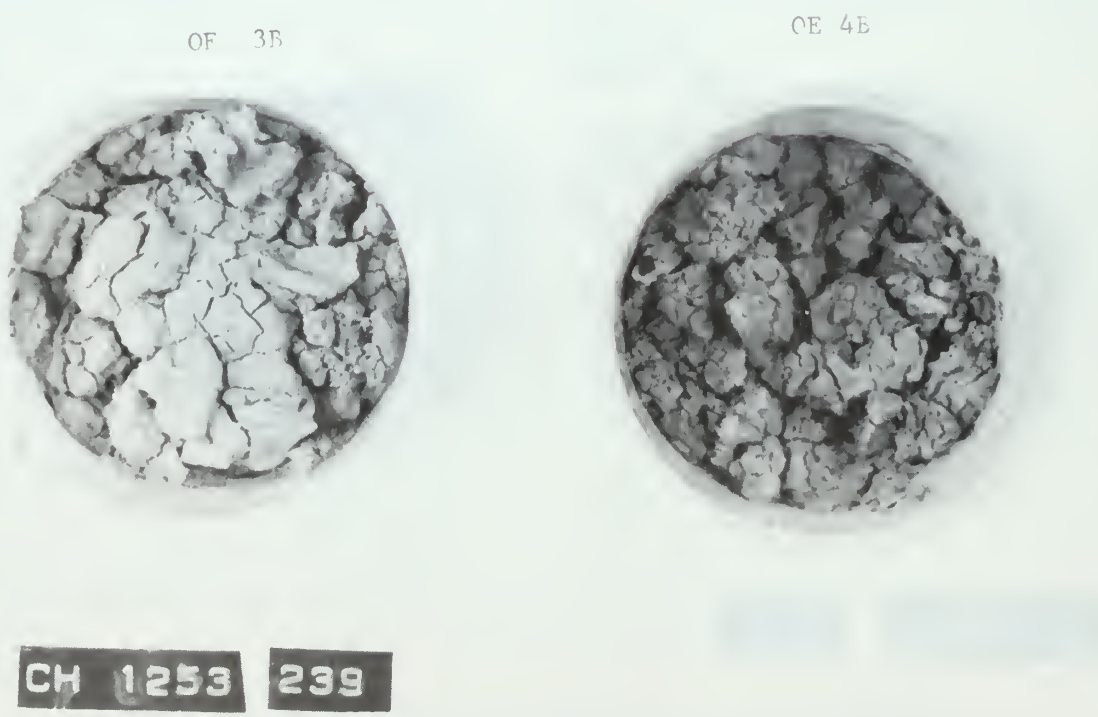
a. Original condition of test specimens



b. Condition of test specimens after weathering

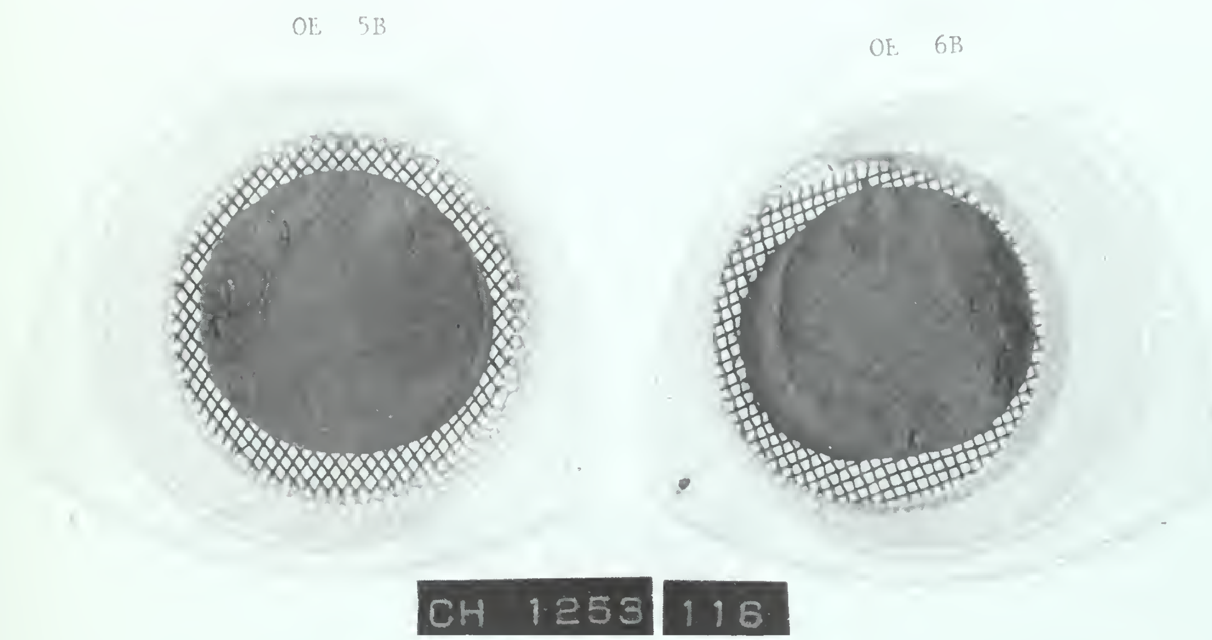
Figure N-6. Results of weathering tests for sandstone sample OE-1 and siltstone sample OE-2 subjected to 12 months of outdoor exposure.

a. Original condition of test specimen

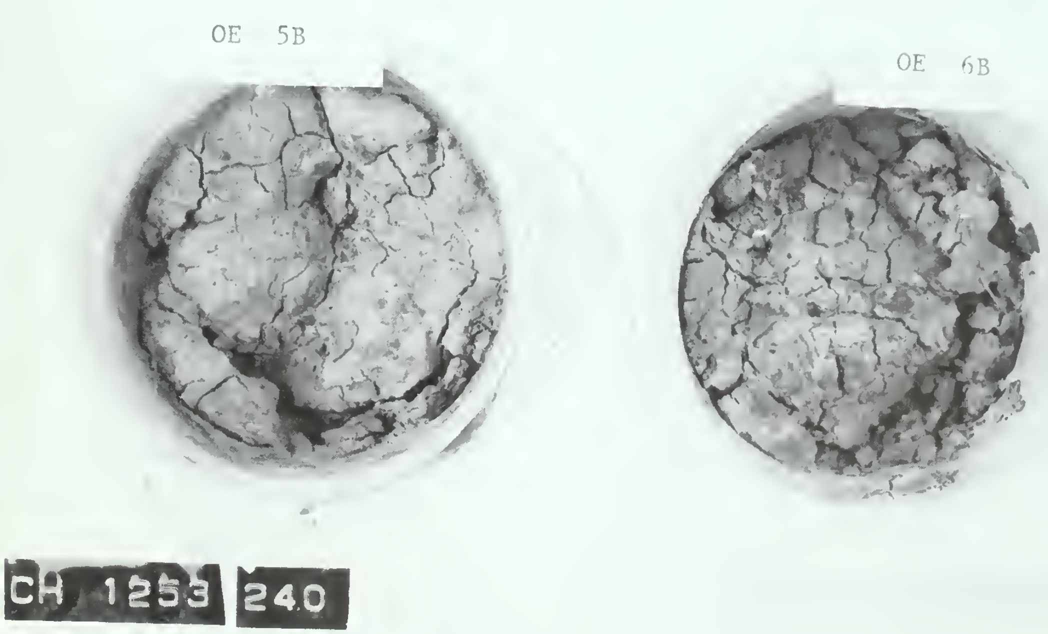


b. Condition of test specimens after weathering

Figure N-7. Results of weathering tests for sandstone OE-3 and shale/siltstone sample OE-4 subjected to 12 months of outdoor exposure.

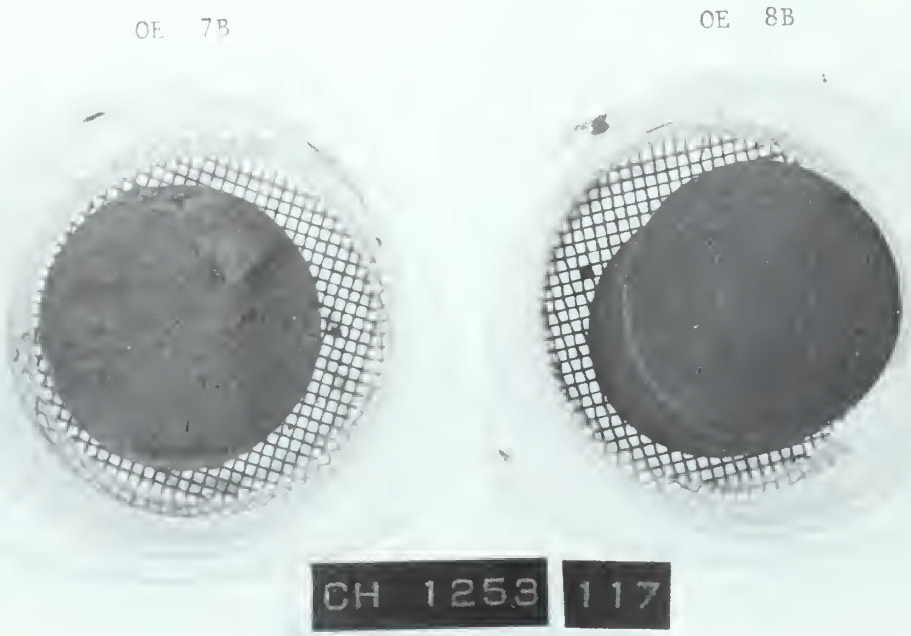


a. Original condition of test specimens

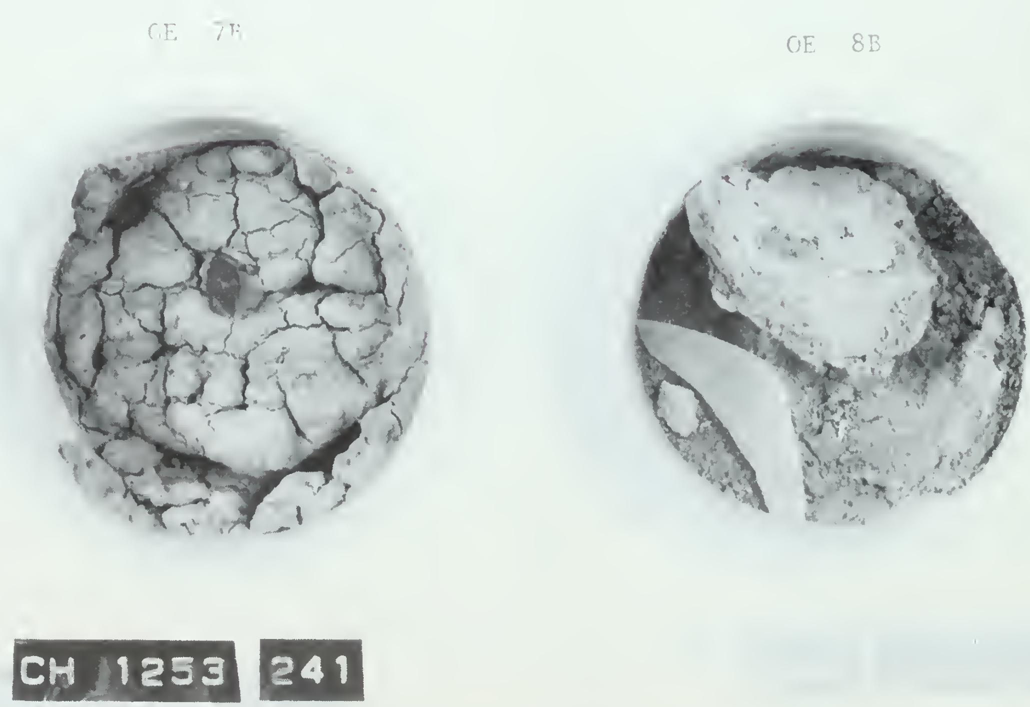


b. Condition of test specimens after weathering

Figure N-8. Results of weathering tests for siltstone sample OE-5 and shale sample OE-6 subjected to 12 months of outdoor exposure.



a. Original condition of test specimens



b. Condition of test specimens after weathering

Figure N-9. Results of weathering tests for shale sample OE-7 and sandstone sample OE-8 subjected to 12 months of outdoor exposure.

FINAL REPORT

on

. LABORATORY AND GREENHOUSE EVALUATION OF SOIL AND GEOLOGIC MATERIALS AS PLANT GROWTH MEDIA ON THE OJO ENCINO, NEW MEXICO SITE

Submitted to: U.S. Department of the Interior
Water and Power Resources Service
Denver, Colorado

Submitted by: Robert D. Heil and Paul C. Deutsch
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August, 1980

INTRODUCTION

This report includes our final evaluation of the greenhouse and laboratory studies of soil and geologic materials submitted from the Ojo Encino EMRIA site.

Included in this report are:

1. Yield data and observations from the greenhouse study.
2. Laboratory data on selected soil and geologic material.
3. Evaluation of the suitability of materials as plant growth media.

PART I

PROCEDURES

Laboratory Procedures

Following are the laboratory methods used to analyze the soil and geologic material for those properties selected as a basis for determining plant growth suitability.

Extractable Phosphorous

Determined on a spectrophotometer from a sodium bicarbonate extract. The values are reported in parts per million P and are an index of available P.

Exchangeable Potassium

Determined on the atomic adsorption spectrophotometer from an ammonium acetate extract. The values are reported as parts per million K.

Organic Matter

Determined by wet oxidation with spontaneous heat of reaction. The results are determined colorimetrically and reported as percent organic matter (% O.M.).

Plant Available Zinc, Iron, Manganese and Copper

Determined on the atomic adsorption spectrophotometer from an extracting solution of diethylenetriamine pentaacetic acid (DTPA). The results are reported in parts per million of Zn, Fe, Mn, and Cu.

Salinity (Electrical Conductivity)

Determined by a solu-bridge from a saturation extract. The results are reported as electrical conductivity in millimhos per centimeter (mmhos/cm).

Exchangeable Sodium Percentage (ESP)

Determined by atomic adsorption spectrophotometer and calculated by:

$$\text{ESP} = \frac{\text{Exchangeable sodium meq/100 gm}}{\text{CEC}} \times 100$$

Cation Exchange Capacity (CEC)

Determined by:

$$\text{CEC meq/100g} = \frac{\text{Exchangeable Na meq/l} \times 10}{\text{weight of sample in grams}}$$

pH

Determined with a combination electrode pH meter on a saturated soil paste.

Greenhouse Procedures

Soil and geologic material received from the Water and Power Resources Service lab had been ground to approximately 2 mm size for greenhouse and additional chemical analyses. One kilogram of soil was used per pot and each pot was replicated. Each sample was placed in a plastic bag in a round container and assigned a greenhouse identification number.

Fertilizer Treatment

Before planting, fertilizer was applied at a rate of 150 ppm nitrogen as reagent grade NH_4NO_3; 80 ppm of phosphorus as a combination of KH_2PO_4 and $CaH_4(PO_4)_2 \cdot H_2O$ and 80 ppm potassium as KH_2PO_4. This was done along with preplant watering.

Before the fertilizer was added, 50-100 g of soil was removed from each pot after which the fertilizer and water was put on. Additional N was applied at 50 ppm rate 21 days after seed emergence.

Planting

The pots were planted with 75 seeds of western wheatgrass (Agropyron smithii var. arriba). The seeds were evenly distributed in the pots and covered with the soil that was removed before fertilization.

The pots were covered with plastic to reduce evaporation and were checked daily to assure that the soil remained moist.

After planting, unseasonably hot weather was experienced with temperatures in the greenhouse being well over $100^{o}F$. This seemed to deter germination almost 100%. After a 20-day period with virtually no germination, we replanted, placing 60 seeds on top of the soil and covering with vermiculite. This new planting was successful.

In this experiment, we did not thin the plants, hoping to have an average of 60 plants per pot. After consulting other researchers involved in similar work as well as from our own experience, we felt that 60 plants would not put undue stress on the pot and our yields would show more significant differences. This would also give us more plant material for plant analysis. An average of 58 plants per pot was calculated for the complete experiment.

Daily Management

All pots were weighed every other day and brought to field capacity with distilled water. The greenhouse lights were set to allow 15-16 hours of daylight.

Pots were rotated on a regular basis to allow for changes in temperature and lighting within the greenhouse. All pots were randomly arranged on the table.

Seven days after germination, the plants were infected with a fungus and some kill-back occurred. We treated this for a two-week period by burning sulfur at night. After the two-week treatment, the plants outgrew the fungus problem.

Harvest

Generally, we harvest at approximately 48 days after planting, but due to germination and fungus problems combined with a week of cloudy weather, we allowed these plants to go 57 days before harvesting.

The plants were cut at about 2 cm above the soil surface. Plants were then placed in brown paper bags and dried at 60°C for 48-60 hours in a forced air oven. After drying, the plants were weighed and weights recorded.

Criteria for Evaluation

The chemical and physical properties used for making suitability interpretations for the soil materials which had complete laboratory data are shown in Table N-4.

Table N-4. Suitability Evaluation Criteria 1/

Texture 2/

Texture Class		Rating
very fine sandy loam	(vfsl)	good
fine sandy loam	(fsl)	good
sandy loam	(sl)	good
loam	(l)	good
silt loam	(sil)	good
loamy fine sand	(lfs)	fair
loamy sand	(ls)	fair
clay loam	(cl)	fair
sandy clay loam	(scl)	fair
silty clay loam	(sicl)	fair
sand	(s)	poor
clay	(c)	poor
sandy clay	(sc)	poor
silty clay	(sic)	poor

pH

6.0-8.4	good
5.0-6.0; 8.4-8.9	fair
5.0; 8.9	poor

1/ This criteria differs somewhat from the Bureau of Reclamation (Bureau) criteria presented in table H-1; therefore, suitability ratings resulting from the two sets of criteria may be somewhat inconsistent. The Bureau has not attempted to resolve this difference for this EMRIA report. The reader is, therefore, advised to remember the above difference in criteria when using the suitability ratings arrived at by the Bureau and by Colorado State University.

2/ Criteria are bsed on guidelines developed by the Western Regional Soil Survey Work Planning Committee: "Guidelines for Evaluating Soil and Overburden Characteristics in Strip-mine Reclamation.."

Table N-4. (continued)

Available Zinc[2]

Soil Test - ppm Zn	Availability Status
0-0.5	potentially deficient
>0.5	adequate

Available Iron[2]

Soil Test - ppm Fe	Availability Status
0-2.0	potentially deficient
>2.0	adequate

Available Copper and Manganese[2]

Soil Test - ppm Cu or Mn	Availability Status
0-0.5	potentially deficient
>0.5	adequate

Available Phosphorous[2]

Soil Test - ppm P	Soil Phosphorous Fertility Status
0-7	deficient
>7	adequate

Available Potassium[2]

Soil Test - ppm K	Soil Potassium Fertility Status
0-60	deficient
>60	adequate

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[2]Criteria are based on current Colorado State University Soil Testing Laboratory soil interpretation guidelines.

Table N-4. (continued)

Salinity[3]	
Soil Test - mmhos/cm	Rating
0-4	acceptable
4-8	marginal
>8-12	poor to unsuitable

Sodium[4]	
Exchangeable Sodium Percent	Rating
0-10	acceptable
10-15	marginal
>15	non-acceptable

[3]Based on Water and Power Resource Service Land Suitability Classification Salinity Evaluation.

[4]From "Procedures Recommended for Overburden and Hydrologic Study of Surface Mines" (Heil, Deutsch, et al, 1979)

PART II

PLANT GROWTH SUITABILITY EVALUATION BASED ON LABORATORY CHARACTERIZATION

Soil Materials

This portion of the evaluation and characterization study was performed in order to identify chemical and/or physical problems associated with the soil materials that influence plant growth.

Following is a plant growth suitability analysis based on the data shown in Table N-5.

Sample Number*		Evaluation
P-67-S-4 P-67-S-2 P-67-S-1 P-71-S-2	Suitable --	Sodium, salinity and particle size data are lacking for these samples. Acceptable pH values suggest that sodium is not a problem and high yields suggest that no apparent problem exists. Adequate N and P fertility and possibly zinc are the major management considerations identified from this study.
P-73-S-1 P-73-S-2	Suitable --	Same comments as above except that zinc levels are adequate but P levels are extremely low. P fertility management would be very essential on these materials.
P-12-S-1 P-69-S-3	Unsuitable --	Moderate to high sodium, marginal salinity and poor texture indicates that these materials should not be utilized as plant growth media. Although these materials performed well in the greenhouse, the low infiltration potential associated with the fine texture and subsequent potential high runoff in addition to the Na and salinity levels renders these materials as undesirable.

* P-67-S-4 = Profile (auger hole)-67-Sample-4. Compare table N-8.

P-29-S-3	Questionable due to marginal sodium level. Texture is favorable which no doubt accounts for the high performance in the greenhouse. With proper management planning this material could be utilized and is rated questionable to flag potential problems.
P-63-S-1	Suitable to Questionable due to sandy nature of the material. Low available water holding capacity would be the major restriction. Zinc level is very low.
P-69-S-1	Suitable -- Sodium, salinity and particle size data are not available. High organic matter level and high yield indicate that this material is suitable. pH is borderline for indicating the presence of high Na. Zinc level is marginal.
P-86-S-2 P-71-S-1	Suitable -- Although sodium, salinity and particle size data are not available, the pH levels and yield suggest that no major problems are associated with these materials. N, P and Zn fertility appear to be the factors to consider in the management of these materials.
P-63-S-3	Questionable--Na, salinity and particle size data are not available for this material. High pH suggests a Na problem. Further evaluation will be required if this material is considered for use.
P-29-S-2	Suitable to Questionable due to marginal sodium level and fair performance in greenhouse. Zinc and P levels are low with P extremely low. This material could be utilized if N, P and Zn fertility were made adequate and if used on a well-drained site.
P-69-S-4	Suitable to Questionable - Questionable due to insufficient data and fair greenhouse performance.
P-37-S-1	Questionable due to sodium, salinity and poor texture quality. Yield performance fair. P and Zinc levels are low.
P-71-S-3	Questionable due to lack of adequate data. pH is acceptable. Further analysis of this material is required.

P-37-S-4	Unsuitable due to Na and salinity.
P-69-S-2	Questionable due to insufficient lab data and fair greenhouse performance.
P-12-S-2	Unsuitable due to high Na.
P-86-S-3	Questionable due to insufficient lab data and fair greenhouse performance.
P-67-S-3	Questionable due to insufficient lab data. pH level suggests a high Na level.
P-86-S-1	Questionable due to insufficient lab data.
P-8-S-3	Unsuitable due to high Na. Salinity moderately high.
P-47-S-2	Questionable due to insufficient lab data and relatively poor greenhouse performance.
P-8-S-2	Questionable due to relatively poor greenhouse performance. Particle size and other chemical data, except for fertility, suggest that this material could be considered but is not as suitable as other materials.
P-8-S-1	Questionable due to low available water holding potential. Material could be droughty and leaching could be excessive.
P-27-S-2 P-47-S-1	Unsuitable due to Na and salinity.
P-29-S-1	Questionable due to relatively poor greenhouse performance. Particle size and chemical characteristic data, except for very low zinc and low N status indicate that this material may have potential as plant growth media. Fertility may have been the major limiting factor in greenhouse productivity.
P-69-S-5 P-32-S-1	Unsuitable due to high Na.
P-12-S-3	Questionable due to poor greenhouse performance and moderate Na level. Fertility and moderate Na level may have accounted for the poor greenhouse performance.
P-32-S-2	Unsuitable due to moderate to high Na level and poor textural quality.

P-37-S-3 Unsuitable due to high Na and salinity.

P-63-S-2 Unsuitable due to high Na and poor textural quality.

. . . .

A summary of the suitability ratings indicate the following kinds of limitations exist in terms of the potential use of these materials as a plant growth media.

1. Phosphorous deficiencies are common to nearly all samples. Low organic matter levels suggest low N availability. Potassium levels generally are adequate.
2. Micronutrient deficiencies are common with deficiencies in zinc being the most common. It is important to point out that the criteria used for evaluating micronutrient deficiencies are based on deficiencies associated with agronomic crops sensitive to these elements. However, in an associated research study on geologic materials from McCallum, Colorado, soil materials with available zinc levels less than .29 produced deficiency symptoms in western wheatgrass. Thus it appears that micronutrient deficiencies, especially zinc, must be considered in reclamation planning.
3. Sodium problems are common to many materials. Salinity levels are marginal to poor on a few samples. Both problems may restrict plant growth and affect environmental quality if used as plant growth media in a reclamation effort.

Table N-5

Yield and Selected Chemical and Physical Data for Soil Materials

Sample No.	Yield gms/pot	pH	ESP	E.C.	% O.M.	---DTPA Extractable - ppm--- Fe	Zn	Mn	Cu	ppm P	ppm K	CEC meq/100 gm.	Depth ins.	% S	% Si	% C	Texture Class
P-67-S-4	3.15	7.1	--	--	1.05	7.3	.34	2.32	1.58	14.0	96.0	--	6-7.5	--	--	--	--
P-67-S-2	3.02	7.6	--	--	1.05	9.2	.28	1.28	1.16	9.0	86.0	--	2.7-4	--	--	--	--
P-67-S-1	2.88	7.8	--	--	2.50	6.8	.28	2.56	1.08	15.0	195.0	--	0-2.7	--	--	--	--
P-71-S-2	2.87	7.6	--	--	.80	6.4	.34	1.68	1.64	7.13	132.0	--	3-6.5	--	--	--	--
P-73-S-1	2.81	8.3	--	--	1.40	17.8	.88	1.60	1.80	1.88	180.0	--	0-2	--	--	--	--
P-73-S-2	2.72	8.3	--	--	.91	12.2	.52	1.36	1.68	1.88	235.0	--	2-4.5	--	--	--	--
P-12-S-1	2.69	8.2	20	6.5	.80	11.4	.40	2.00	.96	6.0	174.0	32.0	0-6	30	29	41	C
P-69-S-3	2.61	7.5	11	5.5	1.90	.4	.40	3.00	1.80	18.0	154.0	49.6	24-60	34.3	17.2	48	C
P-29-S-3	2.59	8.8	15	3.3	.4	5.2	.40	2.40	.7	6.0	64.0	14.0	84-120	75	9.4	15.6	SL
P-63-S-1	2.55	8.2	7	4.9	.3	4.6	.10	1.80	.5	6.0	72.0	9.0	12-48	85.4	7.6	7.0	LS
P-69-S-1	2.45	8.5	--	--	2.51	4.4	.34	2.56	.64	21.50	352.0	--	0-1	--	--	--	--
P-86-S-2	2.44	8.2	--	--	.91	8.5	.34	1.12	1.32	7.13	100.0	--	3-6	--	--	--	--
P-71-S-1	2.40	7.9	--	--	.80	7.7	.22	1.84	1.08	4.00	134.0	--	0-3	--	--	--	--
P-63-S-3	2.28	9.1	--	--	.25	6.7	.22	2.08	.70	11.50	76.0	--	6.5-10	--	--	--	--
P-29-S-2	2.24	8.3	10	3.1	.57	4.5	.30	1.3	.8	10.0	60.0	14.0	24-84	73.2	15.2	11.6	SL
P-69-S-4	2.24	8.3	--	--	--	14.0	.30	2.08	.74	15.0	128.0	--	5-6.5	--	--	--	--
P-37-S-1	2.21	7.9	12	7.0	3.8	9.0	.30	2.3	1.0	0	158.0	44.0	0-24	27.6	30.8	41.6	C
P-71-S-3	2.21	7.8	--	--	1.00	12.6	.58	1.76	1.84	15.0	74.0	--	6.5-10	--	--	--	--
P-37-S-4	2.15	7.8	18	8.3	.83	5.1	.40	1.0	.46	6	50.0	7.2	78-96	68.4	13.	18.6	
P-69-S-2	2.14	8.16	--	--	3.80	8.5	.40	4.08	.81	17.5	186.0	--	1-2	--	--	--	--
P-12-S-2	2.14	8.4	24	1.7	.50	17.4	.60	.80	1.0	5.5	197.5	44.0	60-72	34.6	26.4	39.0	CL
P-86-S-3	2.13	8.1	--	--	.80	8.9	.70	.96	1.40	0	100.0	--	6-10	--	--	--	--

Table N-5 (con.)

Yield and Selected Chemical and Physical Data for Soil Materials

Sample No.	Yield gms/pot	pH	ESP	E.C.	% O.M.	--DTPA Extractable - ppm-- Fe	Zn	Mn	Cu	ppm P	ppm K	CEC meq/100 gm	Depth ins.	% S	% Si	% C	Texture Class
P-67-S-3	2.13	8.8	--	--	1.25	7.7	.20	1.4	1.6	18.5	86.0	--	4-6	--	--	--	--
P-86-S-1	2.12	7.7	--	--	1.10	6.6	.28	3.2	1.32	0	96.0	--	0-3	--	--	--	--
P-8-S-3	2.12	8.0	22	5.7	1.0	10.6	.20	1.6	1.3	12.	84.0	14.0	72-120	51	33.8	15.2	L
P-47-S-2	2.09	7.7	--	--	.75	7.4	.40	.72	1.1	15.	54.0	20.0	36-84	61.8	22.8	15.4	SL
P-8-S-2	2.04	7.7	9	3.8	.80	6.3	.20	1.5	.84	10.	54.0	10.0	48-72	60.2	28.8	11.0	SL
P-8-S-1	2.00	7.1	1.2	.3	.8	4.0	.30	2.6	.4	8.	20.0	6.4	0-48	80.2	14.8	5.0	LS
P-27-S-2	1.97	7.9	20.0	8.0	2.2	9.6	.50	.9	1.4	9.	80.0	22.0	24-60	52.2	31.2	16.6	SL
P-47-S-1	1.93	8.4	22.0	8.3	.62	5.6	.30	1.4	.9	15.	58.0	--	0-36	66.4	16.2	17.4	SL
P-29-S-1	1.91	8.4	4.0	.5	.9	5.6	<.1	2.3	.8	9.	126.0	20.0	0-24	60.3	21.6	17.6	SL
P-69-S-5	1.84	8.4	18.0	1.5	1.1	13.4	.3	0.7	0.9	5.	176.0	--	78-108	39.8	40.6	19.6	L
P-32-S-1	1.77	8.4	20.0	5.3	1.1	4.4	.2	2.5	1.0	15.	106.0	16.0	0-12	61.8	18.6	19.6	SL
P-12-S-3	1.75	8.0	13.0	1.1	.45	11.6	.6	1.2	0.6	5.	154.0	32.4	72-84	66.6	13.4	20.0	SCL/SL
P-32-S-2	1.68	8.9	15.0	3.4	1.0	11.0	.8	0.9	1.9	3.	128.0	46.0	12-72	--	--	--	C
P-37-S-3	1.35	7.5	26.0	10.0	4.1	10.2	.2	1.4	1.0	10.	72.0	14.0	60-78	66.0	20.2	13.3	SL
P-63-S-2	1.28	8.2	18.0	1.5	.20	5.4	.2	1.4	.4	6.	56.0	7.6	48-78	88.0	5.2	6.8	LS

Geologic Material Suitability Evaluation

The following factors severely restricted our ability to evaluate the geologic materials from this site.

1. Due to the extremely high saturation levels of many materials, neither the Water and Power Resources laboratory nor our laboratory were able to obtain soil extracts which would provide meaningful results. Apparent high dispersion properties and fine texture greatly restricted our ability to obtain soil extracts. Thus, laboratory data are minimal for many samples.
2. In addition, due to size of samples, a number of materials were composited to provide sufficient amounts of materials for the greenhouse study. Thus, the laboratory and greenhouse data are provided in two separate tables. Table N-6 includes data for geologic materials which were not composited and Table N-7 shows the data for samples which were composited. Further, Table N-7 shows selected data for individual samples which comprise a composite sample plus selected data for the composite sample as a whole. The individual sample data were provided by the Water and Power Resources laboratory in Denver while the data from the composite samples were provided by the laboratory at Colorado State University.

Following is an evaluation of the suitability of geologic materials based on the data shown in Table N-6.

Table N-6

Selected Chemical and Physical Data on Geologic Materials which were not Composited

Sample Number	Depth ft.	pH	% O.M.	CEC	Texture	% S	% Si	% C	Yield gm/pot
DH-1-1	0-10	7.8	1.18	11.8	SL	67.8	17.0	15.2	1.84
2	13-38.4	7.8	.30	10.0	SL	70.8	16.4	12.8	2.47
3	38.4-47.9	8.9	2.00	24.2	SiC	7.4	48.8	43.8	1.02
4	61.6-73.8	8.9	1.05	30.5	C/CL	23.4	36.6	40.0	1.91
5	154.1-163.5	9.3	.75	46.2	C	30.4	26.4	43.2	.85
10	163.5-174.2	9.2	.75	38.4	C	21.0	34.2	44.8	.80
11	174.2-200.9	8.9	.68	11.2	SL	61.2	22.6	16.2	1.23
DH-2-1	0-2	6.7	1.10	24.0	C	18.2	38.4	43.4	2.20
13	86.4-91.2	9.1	1.18	--	L	31.8	42.2	26.0	1.57
14	91.2-99.8	9.4	1.80	--	LS	77.4	15.8	6.8	1.78
16	106.5-125.5	8.4	.60	--	SL	70.0	17.4	12.6	1.44
DH-3-17	103.1-122.9	7.2	1.80	--	SL	75.6	17.2	7.2	0.66
18	124.3-154.9	8.0	.80	--	L	42.8	48.0	9.2	2.29
19	154.9-170.2	5.9	4.80	--	SiL	42.4	51.4	6.2	.06
21	170.2-189	8.1	.45	--	SCL	69.2	8.6	22.2	1.66
23	220-230	9.2	1.55	21.8	SL	59.2	21.6	19.2	1.96

Table N-6 (con.)

Selected Chemical and Physical Data on Geologic Materials which were not Composited

Sample Number	Depth ft.	pH	% O.M.	CEC	Texture	% S	% Si	% C	Yield gm/pot
DH-4-3	5-10	7.6	.45	20.0	CL/SiCL	20.0	52.6	27.4	1.87
6	28.5-32.5	7.6	.93	19.4	SL	65.6	15.8	18.6	2.47
7	33.3-46.6	8.9	1.33	19.2	SL	64.0	20.4	15.6	1.95
8	63.4-77.2	8.8	.80	9.9	SL	76.0	14.4	9.6	1.23
13	155-173.8	8.1	.60	6.4	LS	78.8	14.6	6.6	2.00
15	195.9-201.9	9.3	1.90	37.0	SiCL	12.4	49.0	38.6	0.73
18	220-250	9.1	.75	18.3	SL	59.2	22.4	18.4	1.40
DH-5-6	20-27.5	7.8	2.20	14.0	L	41.6	32.2	26.2	2.23
7	32.5-51	8.4	1.55	40.0	SiCL	16.6	50.4	33.0	2.51
9	61.1-81	9.1	1.40	25.0	CL	27.6	38.4	34.0	2.79
12	110-120	9.0	1.05	28.5	CL	27.2	33.4	39.4	1.89

Bore Hole Number	Sample Number	Evaluation
DH-1	DH-1-1 DH-1-2	Suitable -- Yield performance, pH and textural properties indicate that this material is suitable.
	DH-1-3 DH-1-4 DH-1-5 DH-1-10 DH-1-11	Unsuitable--High pH values suggest a potential Na problem and except for material DH-1-11, the textural properties are undesirable. The potential for problems to exist is reflected in the overall poor greenhouse performance of these materials. In addition, these materials exhibited very pronounced shrinking and swelling properties.
DH-2	DH-2-1	Questionable, with a caution about potential water infiltration and permeability problems due to high clay content. High shrink-swell was observed both in the greenhouse and laboratory.
	DH-2-13 DH-2-14 DH-2-16	Unsuitable--Relatively poor greenhouse performance suggests that potential Na problems as reflected by the pH, and poor texture quality of materials DH-2-14, renders these materials unsuitable for consideration.
DH-3	DH-3-18 DH-3-21	Suitable -- based on available data.
	DH-3-17 DH-3-19 DH-3-23	Unsuitable--Low greenhouse performance and/or pH indicate that these materials would present major problems in reclamation.
DH-4	DH-4-3 DH-4-6 DH-4-13	Suitable -- based on available data. DH-4-13 is very sandy, available water holding capacity is limited.
	DH-4-7 DH-4-8 DH-4-15 DH-4-18	Questionable--high pH suggests potential Na problem. Further evaluation would be needed to determine suitability.
DH-5	DH-5-6 DH-5-7	Suitable -- based on available data.
	DH-5-9 DH-5-12	Questionable--high pH suggests potential Na problem. Further evaluation needed. In addition these materials exhibited high shrinking and swelling characteristics.

Following is an evaluation of materials which were composited for the greenhouse study. (See Table N-7). Immediately, several factors emerge which restrict our interpretation of these data. First, samples were composited on the basis of drill holes and materials with widely varying textural properties were combined. Secondly, due to the difficulty in obtaining soil extracts, as discussed earlier, available laboratory data are minimal.

As shown in Table N-7, yields obtained on composite samples DH-2-2, DH-2-6, DH-2-10, DH-4-1, DH-4-4 and DH-5-16 were relatively high. The pH of these materials, after compositing, appear to be acceptable. It would appear that these materials are suited as plant growth media. However, this should not be construed to mean that all samples which were composited are suitable. And since pH data were not available, there is little basis for judging the suitability of the individual materials. It is our interpretation that materials with L, SL, SiL, CL, SiCL and SCL textures that comprised the above named composite samples could be considered as potentially suitable. Those materials of SiC of C texture should be considered unfavorable due to poor textural quality.

Yield on composite sample DH-5-10 was high. However, the high pH (9.1) suggests a potential Na problem and should be questioned per its suitability. Also, the textural properties of the two samples which comprised this composite sample are undesirable.

Yields on composite samples DH-3-9, DH-3-11 and DH-3-14 were relatively poor. The high pH levels suggest a potential Na problem and the yields reflect this. Further evaluation of these materials would be required for determining suitability.

Table N-7

Selected Chemical and Physical Data for Composited Geologic Material Samples

Composite Sample No.	Field Sample No. (non-composite)	Depth ft.	pH	Texture	% S	% Si	% C	% O.M.	CEC	Yield gm/pot
DH-2-2		2-7	8.1	--	--	--	--	.60		2.37
	2-2	2-4	--	SiCL	14.6	52.8	32.6	--	22.6	--
	2-3	4-5	--	CL	22.8	45.8	31.4	--	19.4	--
	2-4	5-6	--	CL	32.4	37.0	30.6	--	--	--
	2-5	6-7	--	L	46.0	31.8	22.2	--	--	--
DH-2-6		7-13.5	8.0	--	--	--	--	--	--	2.66
	2-6	7-8	--	CL	34.4	32.2	33.4	--	--	--
	2-7	8-10	--	SiC	13.4	42.2	44.4	--	--	--
	2-8	10-12	--	SiC	16.2	42.6	41.2	--	--	--
	2-9	12-13.5	--	SCL	46.2	25.6	28.2	--	--	--
DH-2-10		37.6-56.5	7.2	--	--	--	--	1.90	--	2.22
	2-10	37.6-47.3	--	SL	72.4	19.2	8.4	--	--	--
	2-11	47.3-56.5	--	L	43.8	33.4	22.8	--	--	--
DH-3-9		23-40.7	8.9	--	--	--	--	.85	--	1.17
	3-9	23-31.5	--	SiC	14.2	43.2	42.6	--	--	--
	3-10	31.5-40.7	--	SiL	22.8	51.6	25.6	--	--	--
DH-3-11		40.7-65.3	9.0	--	--	--	--	1.18	--	1.57
	3-11	40.7-49.9	--	SiCL	17.8	54.6	27.6	--	--	--
	3-12	49.9-59.9	--	CL	30.8	38.6	30.6	--	--	--
	3-13	59.9-65.3	--	SiC	16.2	41.2	42.6	--	--	--
DH-3-14		65.3-77.2	8.8	--	--	--	--	1.80	--	1.46
	3-14	65.3-71.7	--	SL	69.8	15.0	15.2	--	--	--
	3-15	72.8-77.2	--	SL	75.6	16.2	8.2	--	--	--

Table N-7 (con.)

Selected Chemical and Physical Data for Composited Geologic Material Samples

Composite Sample No.	Field Sample No. (non-composite)	Depth ft.	pH	Texture	% S	% Si	% C	% O.M.	CEC	Yield gm/pot
DH-4-1		0-5	7.4	--	--	--	--	.95	--	2.54
	4-1	0-1	--	SL	52.2	28.4	19.4	--	14.8	--
	4-2	1-5	--	SiCL	17.0	55.6	27.4	--	18.5	--
DH-4-4		10-19	8.0	--	--	--	--	.75	--	2.09
	4-4	10-15	--	L	43.6	38.0	18.4	--	26.2	--
	4-5	15-19	--	CL	29.2	41.4	29.4	--	26.6	--
DH-5-3		5-20	7.5	--	--	--	--	.85	--	1.57
	5-3	5-10	--	SL	67.6	18.4	14.0	--	15.4	--
	5-4	10-15	--	SL	60.6	21.4	18.0	--	14.0	--
	5-5	15-20	--	SL	75.0	13.0	12.0	--	19.0	--
DH-5-10		81-110	9.1	--	--	--	--	1.33	--	2.23
	5-10	81-91	--	SiC	12.2	47.8	40.0	--	31.0	--
	5-11	91-110	--	C	17.2	39.8	43.0	--	36.0	--
DH-5-16		190-218	7.8	--	--	--	--	.80	--	1.95
	5-16	190-207	--	LS	79.2	13.4	7.4	--	12.5	--
	5-17	207-218	--	SL	69.6	20.0	10.4	--	--	--

Yields on composite sample DH-5-3 were relatively low, however the pH and textural properties of the materials which comprised this material are desirable. Our conclusion is that these materials are potentially suited as plant growth media.

Regarding the suitability of geologic materials as plant growth media, the following general interpretations are provided:

1. A large percentage of the materials appear to contain large amounts of swelling type clays which appeared to restrict plant growth and inhibit water infiltration. Also, this presented a serious problem in the lab analysis program.
2. High pH values associated with some materials may indicate a serious sodium problem. This situation could seriously affect plant growth as well as local surface water quality within the mined area watershed.
3. Materials with moderately coarse - moderately fine textured materials, such as sandy loam through clay loams, along with the proper mix of coarse fragments, appear to offer the best potential as plant growth media.

In summary, it appears that the geologic materials offer some potential for plant growth media. Extreme care should be taken to avoid materials that are characterized as having clayey textures and high swelling potential.

Description of and References for Laboratory Procedures*

Soil samples from natural horizons and layers were tested in the laboratory. Tests in the following list were performed on soil samples as needed for proper evaluation.

PSA - The procedure is a modification of the pipette method. The soil is not treated with hydrogen peroxide for destruction of organic matter, and is not washed for removal of salts (Kilmer and Alexander, 1949).

Moisture retention - Porous plates are used for moisture retention measurement of soils at all pressures (Richards, 1947 and 1949b and Richards and Weaver, 1944).

Disturbed hydraulic conductivity - Soils are tamped mechanically. City water is used for the test. The temperature of the water is maintained at about 85 degrees F. (Fireman, 1944).

Settling volume - The soil used for the 1:5 dilution measurements is used for this determination. Distilled water and 10 ml of 30% calcium chloride solution are used (U.S.B.R. Reclamation Instructions, 1967).

pH - Measured with Beckman Expandomatic pH meter.

Saturation extract - Samples are mixed by hand and extract removed with a Baroid filter press. No preservative added.

Calcium and Magnesium - Determined by EDTA titration.

Sodium and Potassium - Determined with Baird-Atomic Model KY3 flame photometer and Perkin-Elmer Model 306 atomic absorption spectrophotometer.

Carbonate, bicarbonate, chloride, and sulfate - All are based on U.S. Geological Survey procedures (Brown and others, 1970).

The carbonate end-point is taken as pH 8.2.

Chloride is determined by the Mohr method.

Sulfate is determined by the Thorin method using Bausch & Lomb spectrophotometer Spectronic 20.

Nitrate - Determined by phenoldisulfonic acid method and Bausch and Lomb spectrophotometer Spectronic 20 (U.S. Salinity Laboratory Staff, 1954).

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* For the Bureau of Reclamation Screenable Testing.

Exchangeable sodium and potassium - Based on soluble cations in saturation extract and extractable cations extracted with neutral normal ammonium acetate and measured with Baird Atomic Model KY3 flame photometer and Perkin-Elmer Model 306 atomic absorption spectrophotometer (U.S. Salinity Laboratory Staff, 1954).

Same reference as above

Gypsum - The high moisture percentage is a 1:5 dilution (U.S. Salinity Laboratory Staff, 1954).

Gypsum requirement - Difference between Ca concentration of added gypsum solution and Ca+Mg Concentration in filtrate, as meq/liter, times 2 (U.S.Salinity Laboratory Staff, 1954).

Calcium carbonate equivalent - Back titration with 0.4N NaOH to neutralize 0.4N HCl remaining after boiling period. Two drops of phenolphthalien indicator are used (U.S. Salinity Laboratory Staff, 1954).

Organic carbon - The wet-combustion method of Walkley is used, and diphenylamine is the indicator (Walkley, 1947).

Cation Exchange Capacity - Determined by using 1.0N sodium acetate solution at pH 8.2 and 1.0N ammonium acetate at pH 7.0. Sodium determined by Perkin-Elmer Model 306 atomic absorption spectrophotometer.

Bureau of Reclamation
Screenable Testing Laboratory Results

L-813 (Rev. 12/76)
Interior-Reclamation
Lower Missouri Region

Ojo Encino
12-12-80

Lower Missouri
Regional Laboratory
Soils and Water

Table N-8

Results of Laboratory Tests on Auger Hole/Drill Hole Samples

Lab Number	Site Number*	Depth Inches	Hydraulic Conductivity Ins./hr. 6th Hr.	Hydraulic Conductivity Ins./hr. 24th Hr.	pH 1:5	pH $CaCl_2$ .01M	Settling Volume ML	Lime Qual.	Gyp. Qual.	1:5 Extract ecx10^3 @ 25 c	1:5 Extract Ca+Mg Me/L	1:5 Extract SAR Est.	1:5 Extract Ca+Mg Me/100g
1	1-S1	0-30	1.0	.98	8.3	6.7	16			.083			
2	S2	36-48	-	-	8.3	7.0	17			.209			
3	S3	48-60	-	-	8.6	7.0	21			.163			
4	S4	60-96	.34	.34	8.2	7.0	22			.770			
5	2-S1	0-36	-	-	8.9	7.0	19			.255			
6	S2	36-42	-	-	8.6	6.9	33			.452			
7	3-S1	0-48	-	-	8.1	7.2	28			.599			
8	S2	48-85	-	-	8.4	7.0	16			.217			
9	S3	84-96	-	-	8.5	7.1	20			.367			
10	S4	96-120	-	-	8.6	7.0	20			.410			
11	4-S1	0-12	.96	.84	8.5	7.4	16			.063			
12	S2	12-36	-	-	8.0	7.0	18			.175			
13	S3	36-78	.12	.12	7.6	7.0	17			.532			
14	S4	78-108	.32	.18	7.6	7.1	18			.651			
15	5-S1	0-48	-	-	8.6	7.3	25			.778			
16	S2	48-84	.40	.30	7.9	7.1	18			1.489			
17	S3	84-108	-	-	8.1	6.7	26			.620			
18	6-S1	0-36	.41	.30	7.2	6.6	16			.025			
19	S2	36-60	.18	.22	8.3	6.7	19			.159			
20	S3	66-96	-	-	8.2	6.7	17			.259			
21	S4	96-120	.44	.42	8.0	6.2	16			.456			
22	7-S1	0-6	-	-	7.7	6.9	22			.128			
23	8-S1	0-48	.58	.47	8.0	6.7	14			.248			
24	S2	48-72	.46	.33	8.5	6.9	17			.546			
25	S3	72-120	-	-	7.4	6.9	20			.248			
26	9-S1	0-48	-	-	8.4	7.0	23			.727			
27	S2	48-72	.51	.32	7.4	6.9	16			.321			
28	S3	72-120	-	-	7.6	7.2	24			.452			
29	10-S1	0-6	1.0	.64	8.0	6.9	14			.039			
30	11-S1	0-12	2.2	1.6	7.4	6.8	17			.072			
31	S2	12-30	1.1	1.4	9.1	7.3	24			.257			
32	12-S1	0-60	-	-	8.1	7.3	35			.719			
33	S2	60-72	-	-	8.3	7.2	150			.168			
34	S3	72-84	-	-	8.7	7.6	175			.138			
35	13-S1	0-48	1.9	1.4	9.1	7.6	16			.064			
36	S4	60-66	-	-	8.8	7.6	100			.510			
37	14-S1	0-48	-	-	8.8	7.4	28			.298			
38	S2	48-72	-	-	8.9	7.5	17			.289			
39	S3	72-108	-	-	8.8	7.3	27			.487			
40	S4	108-120	-	-	8.8	7.4	48			.567			
41	16-S1	0-60	.42	.44	7.5	6.6	20			1.356			
42	17-S1	0-48	.18	.18	7.9	6.6	17			1.091			
43	S2	48-72	-	-	9.2	7.8	19			.499			
44	S4	84-96	-	-	8.4	7.1	28			.603			
45	18-S1	0-24	-	-	8.5	7.0	31			.307			
46	19-S1	0-24	-	-	8.7	6.8	16			.291			
47	S2	24-48	-	-	8.6	6.9	19			.291			
48	21-S1	0-26	3.1	2.7	7.5	6.7	14			.043			
49	22-S1	0-66	3.5	3.4	7.7	6.7	15			.065			
50	S2	66-84	-	-	8.7	6.9	21			.596			
51	S3	84-120	-	-	8.8	6.7	18			.383			
52	S4	120-132	-	-	8.7	7.0	175			.444			
53	23-S1	0-36	-	-	8.9	7.6	31			.663			
54	24-S1	0-60	-	-	8.8	7.5	29			.561			
55	S2	60-78	-	-	8.6	6.8	41			.214			
56	25-S1	0-24	.03	.02	8.6	7.6	22			.964			
57	S2	24-48	-	-	9.4	7.8	25			.266			
58	26-S1	0-24	-	-	7.3	6.5	25			1.775			
59	S2	24-36	-	-	8.0	6.4	42			1.093			

Lab Number	Saturation Extract ecx10^3 @ 25 c	Saturation Extract Na Me/L	Saturation Extract Ca+Mg Me/L	Saturation Extract SAR	Saturation Extract Sat %	Saturation Extract Ca+Mg Me 100g	Gyp Me 100g	Na Me/100g Total Na	Na Me/100g Exch. Na	Cation Exchange Capacity	ESP %	% of Moisture	% of Moisture 15 Bars
1	.474	2.8	2.4	2.6	24.9	.06				8.8			4.3
2	1.132	9.5	1.6	10.6	25.3	.04				14.0			7.2
3	1.526	15.0	1.0	21.2	53.1	.05				19.0			11.6
4	6.50	44.0	24.9	12.5	41.2	1.0				16.0			8.3
5	4.380	56.0	2.4	51.1	34.4	.08				14.0			7.4
6	3.435	40.0	2.6	35.1	43.6	.11				19.0			12.7
7	4.417	32.0	2.4	29.2	61.6	1.5				39.2			19.6
8	2.650	24.0	3.4	18.4	26.6	.09				8.8			3.9
9	3.533	31.0	3.2	24.5	35.6	.11				18.0			9.8
10	3.354	42.0	7.0	22.4	38.7	.27				27.0			11.4
11	.420	.70	6.2	.40	25.8	.16				8.6			3.4
12	1.514	14.0	3.2	11.1	27.3	.09				17.0			9.0
13	4.818	40.0	20.8	12.4	31.3	.65				16.0			5.6
14	4.363	40.0	23.8	11.6	33.7	.80				13.0			6.7
15	3.212	37.0	16.8	12.8	56.6	.95				51.0			17.9
16	14.0	145.0	29.6	37.7	27.4	.81				18.0			7.8
17	5.235	65.0	16.2	22.8	32.0	.52				22.0			7.4
18	.233	.60	2.2	.57	30.1	.07				6.4			2.7
19	1.293	10.5	3.0	8.6	31.4	.09				11.0			4.6
20	1.536	19.0	3.8	13.8	34.4	.13				13.0			5.7
21	4.786	35.0	22.8	10.4	31.5	.72				12.0			4.9
22	.741	4.3	.60	7.9	49.7	.03				28.0			17.7
23	.286	1.3	2.0	1.3	28.8	.06				6.4			2.1
24	3.760	32.0	21.8	9.7	31.5	.69				10.0			4.7
25	5.70	50.0	9.2	23.3	40.2	.37				14.0			7.0
26	5.014	41.0	21.4	12.5	53.3	1.1				26.0			18.9
27	3.473	31.0	18.8	10.1	35.9	.67				15.0			5.3
28	3.739	33.0	21.6	10.0	57.4	1.2				60.0			21.9
29	.349	.20	2.8	.17	29.9	.08				7.2			3.0
30	.654	1.4	5.4	.85	34.6	.19				12.0			5.0
31	.969	9.0	2.8	7.6	50.0	.14				38.0			18.9
32	6.50	55.0	13.7	21.0	67.8	.93				32.0			21.8
33	1.716	17.0	0.80	26.9	110.7	.09				44.0			34.0
34	1.105	8.5	0.60	15.5	145.9	.09				32.4			35.0
35	.281	1.1	2.2	1.0	27.7	.06				8.2			4.3
36	6.177	65.0	5.6	38.8	79.6	.45				29.0			22.5
37	1.59	14.5	.41	32.0	58.5	.02				16.0			13.0
38	3.197	26.0	1.6	29.1	40.0	.06				11.0			4.1
39	5.525	49.0	4.2	33.8	46.7	.20				14.0			6.0
40	5.637	47.0	4.4	31.7	61.3	.27				23.0			19.8
41	.495	3.7	.63	2.1	35.7	.02				17.0			5.5
42	7.80	42.0	26.7	11.5	31.2	.83				14.0			6.7
43	8.55	65.0	21.2	19.7	34.6	.73				17.0			7.4
44	8.45	80.0	20.8	24.8	48.5	1.0				11.0			7.9
45	8.00	80.0	17.9	26.7	53.5	.96				32.0			19.4
46	2.23	20.0	.42	13.8	34.5	.01				6.0			4.0
47	3.40	23.0	5.1	14.4	36.1	.18				12.0			7.0
48	.250	.35	1.5	.40	29.1	.04				4.4			1.7
49	.445	1.6	2.1	1.6	33.3	.07				5.0			1.9
50	3.20	30.0	1.8	31.6	49.5	.09				20.8			7.8
51	4.20	40.0	2.3	37.3	34.8	.08				14.8			7.4
52	2.62	26.0	.84	40.1	113.2	.10				24.0			38.8
53	5.65	36.0	17.0	12.3	47.5	.81				42.0			17.4
54	4.90	47.0	12.6	18.7	59.9	.75				32.0			18.4
55	.630	3.8	.08	19.0	78.5	.01				21.2			15.1
56	5.10	43.0	15.8	15.3	45.5	.72				26.0			15.4
57	5.80	47.0	15.5	16.9	53.5	.83				29.0			13.1
58	6.10	50.0	19.1	16.2	48.2	.92				37.0			21.0
59	7.70	70.0	20.2	22.0	58.7	1.2				22.0			13.3

* 1-S1 = Auger Hole (Profile) 1-Sample 1.

LM-813 (Rev. 12/76)
Interior-Reclamation
Lower Missouri Region

Ojo Encino
12-12-80

Table N-8 (con.)

Results of Laboratory Tests on Auger Hole/Drill Hole Samples

Lower Missouri
Regional Laboratory
Soils and Water

GPO 835-360/20

Lab Number	Site Number	Depth Inches	Hydraulic Conductivity Inc./hr. 6th Hr.	Hydraulic Conductivity Inc./hr. 24th Hr.	pH 1:5	pH $CaCl_2$ .01M	Settling Volume ML	Lime Qual.	Gyp. Qual.	1:5 Extract ecx10^3 @ 25 c	1:5 Extract Ca+Mg Me/L	1:5 Extract SAR Est.	1:5 Extract Ca+Mg Me/100g
60	28-S1	0-12	-	-	8.6	6.5	24			.437			
61	S2	12-48	-	-	8.9	7.7	90			.368			
62	29-S1	0-24	.24	.38	8.7	7.4	19			.089			
63	S2	24-84	.50	.24	9.0	7.5	18			.199			
64	S3	84-120	-	-	9.1	7.6	19			.244			
65	30-S1	0-12	-	-	9.5	7.8	27			.490			
66	S2	12-36	-	-	8.3	7.2	43			2.250			
67	S4	48-120	-	-	9.1	7.7	94			.575			
68	31-S1	0-12	-	-	9.1	7.8	19			.323			
69	S2	12-60	-	-	9.1	7.4	17			.349			
70	S3	60-72	-	-	8.7	7.7	21			.741			
71	S4	72-120	.42	.36	8.1	7.5	18			.878			
72	32-S1	0-12	-	-	9.1	7.6	18			.554			
73	S2	12-72	-	-	9.5	7.7	200			.279			
74	33-S2	6-24	-	-	8.9	7.5	20			.405			
75	S4	34-72	-	-	9.0	7.4	20			.213			
76	S5	72-108	.18	.18	7.9	7.4	19			1.325			
77	34-S1	0-24	1.8	1.2	8.1	7.0	14			.026			
78	S2	24-60	-	-	8.8	7.6	16			.323			
79	S3	60-120	-	-	8.3	7.2	21			.390			
80	35-S1	0-36	-	-	9.2	7.8	22			.499			
81	S2	36-66	.05	.02	8.3	7.0	18			.669			
82	S3	66-96	.40	.32	8.0	7.0	17			1.078			
83	S4	96-120	-	-	8.8	7.3	60			.327			
84	36-S1	0-30	.24	.33	7.8	7.2	20			1.085			
85	S2	30-60	.12	.14	7.8	7.2	21			1.418			
86	S3	60-96	-	-	8.9	7.1	60			1.727			
87	S4	96-120	-	-	9.7	7.9	80			1.198			
88	37-S1	0-24	.05	.04	8.1	7.5	500			1.585			
89	S2	24-60	.38	.34	7.8	7.4	17			1.457			
90	S3	60-78	.36	.31	7.6	7.2	22			1.540			
91	S4	78-96	.29	.31	8.1	7.0	25			1.217			
92	38-S1	0-18	.63	.33	7.8	6.9	17			.036			
93	S2	18-30	.12	.16	8.4	7.4	27			.974			
94	S3	30-72	.68	.44	8.2	7.3	18			1.190			
95	39-S1	0-12	.90	.55	8.3	7.3	19			.080			
96	S2	12-24	.58	.39	8.9	7.4	20			.090			
97	S3	24-36	.09	.14	8.8	7.2	18			.104			
98	41-S1	0-12	.92	.58	6.7	5.9	22			.148			
99	S2	12-48	.30	.26	7.0	6.1	26			.158			
100	S3	48-120	.57	.53	5.7	4.0	28			.124			
101	43-S1	0-36	-	-	8.5	7.2	24			.232			
102	S2	36-84	-	-	8.4	7.4	25			.589			
103	S4	96-120	.02	.02	5.0	3.5	25			.247			
104	44-S1	0-36	-	-	7.8	7.0	25			.624			
105	S2	36-72	.09	.06	7.9	6.8	24			.482			
106	S3	72-96	.03	.01	6.7	5.6	80			1.950			
107	S4	96-120	.02	.03	4.3	3.3	70			.108			
108	45-S1	0-36	-	-	9.0	7.3	21			.479			
109	S2	36-84	-	-	9.1	7.4	24			.527			
110	46-S1	0-48	-	-	8.5	7.4	23			.810			
111	S2	48-72	.37	.47	8.9	7.2	21			.268			
112	S3	72-84	-	-	9.3	7.3	22			.112			
113	S4	84-108	-	-	9.4	7.2	19			.148			
114	47-S1	0-36	-	-	9.2	7.4	21			.353			
115	S2	36-84	-	-	8.2	7.2	20			.353			
116	S3	84-108	.05	.05	8.1	7.1	19			.376			
117	S4	108-120	-	-	8.7	7.3	48			.878			
118	48-S2	6-54	-	-	9.1	7.1	22			.197			
119	S3	54-102	-	-	8.8	7.2	29			.558			
120	S4	102-120	-	-	8.8	7.2	24			.353			

Lab Number	Saturation Extract ecx10^3 @ 25 c	Saturation Extract Na Me/L	Saturation Extract Ca+Mg Me/L	Saturation Extract SAR	Saturation Extract Sat %	Saturation Extract Ca+Mg Me 100g	Gyp Me 100g	Na Me/100g Total Na	Na Me/100g Exch. Na	Cation Exchange Capacity	ESP %	% of Moisture	% of Moisture 15 Bars
60	6.60	55.0	13.2	21.4	47.7	.63				39.0			13.8
61	5.64	50.0	6.1	28.6	96.2	.59				45.0			25.6
62	.493	3.4	1.2	4.4	31.3	.04				20.0			8.7
63	3.10	20.5	6.5	11.4	29.8	.19				14.0			6.6
64	3.30	24.0	3.9	17.2	31.0	.12				14.0			6.7
65	2.60	26.0	1.6	29.1	49.8	.08				28.0			17.8
66	9.00	90.0	20.0	28.5	70.9	1.4				52.0			26.9
67	9.00	85.0	17.3	28.9	87.6	1.5				43.0			25.5
68	3.10	25.0	7.8	12.7	34.2	.27				17.0			8.9
69	4.30	34.0	9.4	15.7	30.9	.29				10.0			4.6
70	6.20	55.0	17.8	18.4	38.9	.69				18.0			9.6
71	7.00	55.0	19.6	17.6	36.1	.71				18.0			8.2
72	5.30	47.0	9.4	21.7	35.4	.33				16.0			8.9
73	3.40	30.0	6.1	17.2	125.7	.77				46.0			36.8
74	3.70	30.0	7.3	15.7	130.0	.95				19.0			8.7
75	3.00	20.0	6.9	10.8	37.6	.26				19.0			10.6
76	5.60	46.0	20.6	14.3	40.6	.84				28.0			13.0
77	.350	.90	1.8	.95	29.4	.05				6.0			2.5
78	4.30	34.0	12.0	13.9	27.0	.32				8.6			4.0
79	4.70	35.0	8.8	16.7	39.7	.35				22.0			11.0
80	5.10	38.0	8.8	18.1	45.5	.40				23.0			16.3
81	7.00	60.0	21.8	18.2	36.2	.79				13.0			6.6
82	8.70	75.0	20.8	23.3	30.6	.64				14.0			9.6
83	9.50	85.0	18.4	28.0	67.0	1.2				37.0			27.0
84	7.70	65.0	22.6	19.3	32.6	.74				18.0			8.5
85	15.0	145.0	22.2	43.5	32.5	.72				16.0			9.6
86	14.5	165.0	17.7	55.5	65.9	1.2				32.0			23.9
87	15.5	195.0	16.5	67.9	45.5	.75				23.0			16.3
88	7.00	50.0	22.6	14.9	56.1	1.3				44.0			19.5
89	8.00	70.0	21.0	21.6	37.5	.79				22.0			9.9
90	10.1	100.0	27.5	27.0	35.8	.98				14.0			9.7
91	8.30	70.0	24.5	20.0	30.2	.74				7.2			4.6
92	.400	2.2	1.6	2.5	31.4	.05				9.4			2.6
93	8.00	55.0	28.2	14.6	38.4	1.1				27.0			14.6
94	7.50	50.0	29.6	13.0	26.4	.78				8.4			4.7
95	.580	1.7	3.3	1.3	28.0	.09				14.0			5.6
96	.450	1.0	3.1	.80	112.3	.35				16.0			5.6
97	.690	4.2	1.6	4.7	25.0	.04				12.0			5.7
98	1.60	13.1	13.5	1.2	43.0	.58				25.0			15.8
99	1.65	1.6	13.7	.61	57.4	.79				64.0			25.4
100	1.30	.75	10.4	.33	58.6	.61				37.0			22.1
101	2.75	21.0	5.1	13.2	48.5	.25				42.0			20.1
102	5.20	30.0	27.1	8.2	54.6	1.5				46.0			20.7
103	5.40	29.0	33.0	7.1	72.3	2.4				13.2			9.5
104	5.30	30.0	24.3	8.6	52.1	1.3				54.0			20.7
105	5.00	33.0	30.4	8.5	47.9	1.5				59.0			20.3
106	3.60	25.0	16.3	8.8	43.3	.71				64.0			24.2
107	3.40	18.0	9.8	8.1	68.3	.67				15.0			9.8
108	5.40	49.0	7.8	24.8	43.0	.34				27.0			13.5
109	6.00	55.0	9.2	8.1	42.1	3.9				31.0			20.7
110	8.00	75.0	22.0	22.6	47.2	1.0				34.0			15.1
111	6.50	55.0	19.4	17.7	32.9	.64				18.0			7.5
112	1.85	17.0	1.0	24.0	37.2	.04				14.0			7.5
113	2.15	21.5	1.6	24.0	33.0	.05				15.0			5.8
114	8.30	75.0	21.2	23.0	37.0	.78				17.0			7.4
115	7.40	65.0	18.4	21.4	39.0	.72				20.0			8.4
116	7.90	70.0	16.5	24.4	37.7	.62				16.0			6.7
117	9.50	75.0	20.6	23.4	63.6	1.3				41.0			34.1
118	1.80	15.5	3.3	12.1	45.8	.15				21.0			11.6
119	3.80	30.0	9.4	13.8	68.1	.64				31.0			19.3
120	5.20	37.0	18.4	12.2	57.6	1.1				31.0			19.3

LM-813 (Rev. 12/76)
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Table N-8 (con.)

Results of Laboratory Tests on Auger Hole/Drill Hole Samples

Lower Missouri
Regional Laboratory
Soils and Water

GPO 838-960/29

Lab Number	Site Number	Depth ~~Feet~~ Inches	Hydraulic Conductivity Ins./hr. 6th Hr.	24th Hr.	pH 1:5	pH $CaCl_2$ .01M	Settling Volume ML	Lime Qual.	Gyp. Qual.	1:5 Extract $ecx10^3$ @ 25 c	Ca+Mg Me/L	SAR Est.	Ca+Mg Me/100g	Saturation Extract $ecx10^3$ @ 25 c	Na Me/L	Ca+Mg Me/L	SAR	Sat %	Ca+Mg Me 100g	Gyp Me 100g	Na Me/100g Total Na	Exch. Na	Cation Exchange Capacity	ESP %	% of Moisture	15 Bars
121	49-S1	0-30	-	-	8.1	7.4	23			.335				3.40	31.0	4.0	21.9	48.7	.19				26.0			14.6
122	S2	30-54	-	-	8.3	7.3	18			.157				3.50	41.0	1.3	50.8	33.0	.04				11.0			5.5
123	S3	54-84	-	-	8.6	7.5	24			.248				2.30	21.5	.80	34.0	31.9	.03				11.0			6.0
124	S5	96-120	-	-	8.5	7.6	29			.523				8.20	75.0	19.4	24.1	61.8	1.2				32.0			20.2
125	50-S1	0-60	1.3	.75	9.0	7.8	21			.305				3.70	24.5	15.2	8.9	37.3	.57				18.0			6.9
126	S2	60-84	.01	.01	8.1	7.2	19			.254				5.40	38.0	18.4	12.5	36.4	.67				19.0			7.7
127	51-S1	0-12	-	-	7.4	7.1	28			.784				8.00	70.0	21.0	21.6	63.1	1.3				32.0			24.5
128	S2	12-72	-	-	8.6	7.6	53			.364				7.00	65.0	11.9	26.7	89.9	1.1				55.0			44.6
129	52-S1	0-24	-	-	8.4	7.3	24			.779				8.50	75.0	19.2	24.2	45.5	.87				18.0			9.2
130	S2	24-48	.15	.26	8.1	7.5	23			.909				9.30	90.0	20.0	28.5	48.6	.97				15.0			9.1
131	S3	48-72	.15	.16	9.3	7.5	19			.682				8.50	75.0	16.2	26.4	38.5	.62				10.0			4.9
132	S4	72-108	-	-	7.5	7.3	100			1.098				9.50	85.0	16.8	29.3	105.7	1.8				33.0			20.3
133	53-S2	6-48	1.3	.99	7.9	7.3	19			.124				.800	4.5	1.4	5.4	39.2	.05				19.0			10.5
134	S4	60-120	1.0	.74	8.3	7.8	18			.547				4.30	28.0	22.4	8.4	34.2	.77				10.0			5.8
135	55-S1	0-36	.13	.15	8.9	7.7	20			.160				.990	3.1	4.2	2.1	52.0	.22				26.0			15.3
136	S2	36-60	.86	.46	8.8	7.7	19			.409				3.00	14.5	22.6	4.3	40.7	.92				15.0			10.7
137	S3	60-78	.68	.40	9.2	7.7	17			.185				1.50	6.5	5.5	3.9	31.5	.17				13.0			6.2
138	S5	102-120	.49	.34	8.3	7.1	18			.095				.830	5.0	1.4	6.0	33.2	.05				17.0			7.5
139	57-S2	36-60	.54	.40	9.2	7.6	17			.327				3.50	21.0	18.0	7.0	32.1	.58				13.0			5.7
140	S3	60-84	.24	.30	8.2	7.5	18			.208				1.60	13.0	6.5	7.2	41.2	.27				19.0			9.4
141	S4	84-108	-	-	7.5	6.5	18			.167				1.55	12.5	1.2	16.1	31.5	.04				13.0			6.9
142	58-S1	0-24	.38	.36	8.4	7.2	18			.909				9.00	80.0	21.2	24.6	33.1	.70				11.0			5.9
143	59-S1	0-60	.08	.09	8.7	7.7	21			.216				2.20	17.0	3.0	13.9	38.7	.12				21.0			10.2
144	S2	60-120	.24	.38	9.0	7.8	21			.173				1.50	12.0	1.2	15.5	30.1	.04				12.0			6.7
145	60-S1	0-48	.60	1.1	8.7	7.8	22			.109				.500	5.4	.80	8.5	41.3	.03				24.0			14.2
146	61-S1	0-12	.16	.20	8.9	7.3	16			.126				.550	2.1	1.8	2.2	44.2	.08				23.4			14.9
147	S2	12-24	.08	.10	7.1	6.5	23			.114				1.85	10.5	7.9	5.3	42.9	.34				19.6			6.8
148	S5	72-120	-	-	8.8	7.2	23			.262				1.35	11.0	.61	19.9	53.8	.03				16.6			9.4
149	62-S1	0-48	-	-	8.9	7.5	18			.242				4.30	30.0	6.9	16.2	36.6	.25				15.2			11.0
150	S2	48-90	-	-	9.1	7.5	17			.163				1.80	16.5	.40	36.9	37.4	.01				11.2			9.5
151	63-S3	12-48	.76	.46	8.8	7.6	16			.650				4.90	30.0	26.1	8.3	29.8	.78				9.0			5.7
152	S4	48-78	-	-	8.4	7.6	17			.180				1.50	14.5	1.0	20.5	30.9	.03				7.6			5.6
153	65-S1	0-24	-	-	9.1	7.7	21			.384				3.70	30.0	9.5	13.8	43.1	.41				21.0			14.8
154	S2	24-48	-	-	8.6	7.7	24			.929				6.00	50.0	19.6	16.0	56.8	1.1				26.8			19.1
155	S5	78-96	-	-	8.9	7.5	18			.258				1.90	18.5	1.6	20.7	36.3	.06				10.4			9.9
156	66-S1	0-12	-	-	7.5	7.1	20			.171				.850	6.5	.61	11.8	48.0	.03				27.0			19.7
157	S2	12-36	.31	.32	7.9	7.5	20			.850				4.90	45.0	19.4	14.4	37.8	.73				15.8			10.5
158	S3	36-72	-	-	7.4	7.0	21			.596				6.10	55.0	16.4	19.2	47.8	.78				33.6			15.8
159	S4	72-120	-	-	8.1	6.9	19			.239				6.00	60.0	4.2	41.4	49.6	.21				22.4			13.4
160	68-S1	0-24	.23	.18	5.8	4.9	21			.517				3.20	17.0	22.4	5.1	51.9	1.2				36.6			18.6
161	69-S3	24-60	.20	.20	7.4	6.5	29			1.085				5.50	38.0	19.4	12.2	76.7	1.5				49.6			27.1
162	S5	78-108	-	-	8.6	7.3	27			.319				1.45	13.0	.82	20.3	68.8	.06				35.0			29.3
163	70-S2	12-48	-	-	8.3	7.3	19			.250				1.70	16.5	2.5	14.8	35.6	.09				14.4			9.8
164	S3	48-78	-	-	8.2	7.5	22			.305				2.19	19.5	2.7	16.8	42.2	.11				18.6			14.3
165	S4	78-120	-	-	7.7	7.2	23			.291				3.20	30.0	7.3	15.7	50.4	.11				28.6			20.9
166	72-S1	0-30	-	-	8.3	7.3	17			.395				2.70	26.5	1.4	31.7	32.3	.05				8.4			5.7
167	S2	30-60	.10	.11	8.2	7.6	19			.695				7.10	60.0	17.5	20.3	37.0	.65				10.6			7.5
168	S3	60-102	-	-	8.4	7.8	51			.564				7.40	60.0	6.7	32.8	92.5	.62				57.0			43.7
169	S4	102-120	-	-	8.8	7.7	38			.422				7.00	65.0	10.6	28.2	72.3	.77				37.2			31.2
170	74-S1	0-48	.05	.05	8.0	7.2	25			1.168				5.50	38.0	23.3	11.1	61.7	1.4				47.2			22.5
171	S2	48-84	-	-	8.4	7.4	22			.767				5.00	38.0	18.4	12.5	49.8	.92				30.0			17.9
172	S3	84-120	-	-	8.3	7.4	18			.287				1.80	16.0	1.2	20.7	29.1	.03				13.2			8.1
173	76-S1	0-12	.04	.04	9.0	7.4	21			.073				.480	3.7	.61	2.7	34.2	.02				24.8			17.1
174	S2	12-48	.48	.48	8.3	7.4	21			.904				5.10	37.0	20.4	11.6	40.9	.83				18.6			11.3
175	S3	48-60	-	-	5.8	4.7	22			.642				7.30	65.0	17.5	22.0	39.6	.69				27.6			13.2
176	77-S1	0-42	.95	.62	7.5	7.1	19			.123				.690	4.6	1.2	5.9	34.5	.04				12.8			5.5
177	S2	42-84	.02	.02	8.2	7.3	19			.130				.900	8.0	1.0	11.3	29.9	.03				7.8			3.4
178	78-S1	0-12	-	-	8.3	7.6	24			.416				1.30	12.0	.82	5.9	49.4	.04				30.6			16.8
179	S2	12-40	-	-	8.0	7.4	29			2.098				7.00	60.0	16.5	20.9	75.4	1.2				43.2			25.2
180	S4	50-84	-	-	6.1	4.9	50			.374				5.99	48.0	9.2	22.4	84.5	.78				30.4			34.7

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Table N-8 (con.)
Results of Laboratory Tests on Auger Hole/Drill Hole Samples

Lower Missouri
Regional Laboratory
Soils and Water

GPO 836-360/20

Lab Number	Site Number	Depth ~~Feet~~ Inches	Hydraulic Conductivity Ins./hr. 6th Hr.	Hydraulic Conductivity Ins./hr. 24th Hr.	pH 1:5	pH $CaCl_2$ .01M	Settling Volume ML	Lime Qual.	Gyp. Qual.	1:5 Extract ecx10[3] @ 25 c	1:5 Extract Ca+Mg Me/L	1:5 Extract SAR Est.	1:5 Extract Ca+Mg Me/100g
181	79-S1	0-36	.81	.56	8.6	6.0	27			.068			
182	S2	36-72	.97	.66	8.2	7.5	19			.170			
183	S3	72-120	1.2	.70	7.9	7.3	19			.240			
184	80-S1	0-24	1.8	1.1	8.1	7.5	21			.167			
185	S2	24-60	1.4	.70	7.9	7.6	18			.305			
186	S5	96-120	1.5	.80	8.3	7.3	19			.225			
187	82-S1	0-24	.06	.10	8.2	7.3	24			1.673			
188	S2	24-60	-	-	8.6	7.5	20			.541			
189	S3	60-120	-	-	8.5	7.6	18			.788			
190	83-S1	0-24	-	-	8.5	7.5	22			.223			
191	S2	24-60	.05	.04	8.6	7.5	22			.819			
192	S3	60-84	.12	.11	7.7	7.3	19			.288			
193	S4	84-120	.02	.01	7.7	7.3	19			.353			
194	84-S1	0-36	.28	.40	7.9	7.3	20			.107			
195	S2	36-72	.66	.44	8.0	7.4	19			.254			
196	S3	72-96	-	-	8.5	7.3	18			.227			
197	85-S1	0-24	-	-	8.7	7.5	21			.233			
198	S2	24-48	.02	.01	8.2	7.5	20			.666			
199	S3	48-84	.15	.19	8.2	7.7	20			.855			
200	87-S1	0-24	-	-	9.0	7.6	18			.242			
201	S2	24-36	-	-	9.3	7.7	18			.275			
202	88-S1	0-24	-	-	8.9	8.1	24			1.775			
203	S2	29-60	-	-	8.9	7.9	37			1.540			
204	S5	96-120	-	-	9.3	8.3	21			.539			
292	89-1	0-18	.76	.40	9.6	6.4	16.5			.141			
293	2	18-42	--	--	9.6	6.9	20.5			.450			
294	3	42-58	--	--	9.5	6.9	20.0			.479			
295	4	58-72	--	--	9.8	7.0	17.5			.348			
296	90-1	0-12	.70	.50	9.0	6.8	14.0			.044			
297	2	12-24	1.3	.68	8.8	6.8	15.5			.072			
298	3	24-42	.98	.36	8.9	6.9	14.0			.132			
299	5	42-72	.80	.46	8.4	7.0	16.5			.505			
300	91-1	0-12	.74	.42	7.2	4.1	23.5			.193			
301	92-1	0-18	.02	.04	8.9	6.0	27.5			1.15			
302	2	18-40	--	--	9.2	6.2	18.0			.963			
303	3	40-48	.01	.02	8.7	6.4	38.5			1.53			
304	4	48-60	--	--	9.9	6.5	22.0			.491			
305	93	Master Sample	.56	.44	9.1	6.3	14.5			.055			

Lab Number	Saturation Extract ecx10[3] @ 25 c	Saturation Extract Na Me/L	Saturation Extract Ca+Mg Me/L	Saturation Extract SAR	Saturation Extract Sat %	Saturation Extract Ca+Mg Me 100g	Gyp Me 100g	Na Me/100g Total Na	Na Me/100g Exch. Na	Cation Exchange Capacity	ESP %	% of Moisture	% of Moisture 15 Bars
181	.350	1.9	1.4	2.3	25.2	.04				9.6			4.1
182	1.45	11.0	1.2	14.2	28.5	.03				9.6			5.2
183	3.50	28.0	8.8	13.3	28.2	.25				9.2			3.7
184	1.20	7.5	2.0	7.5	31.1	.06				13.0			6.5
185	3.80	24.5	21.2	7.5	29.7	.63				7.0			4.1
186	2.20	16.5	3.9	11.8	33.3	.13				14.4			4.8
187	7.50	65.0	21.2	20.0	12.8	.27				24.8			15.5
188	6.70	55.0	12.2	22.3	40.2	.49				18.8			8.0
189	7.50	60.0	16.9	20.6	34.6	.58				12.4			5.0
190	1.20	10.0	1.2	12.9	46.8	.06				24.4			13.7
191	4.60	30.0	19.6	9.6	50.1	.98				26.0			15.7
192	2.70	22.0	7.3	11.5	32.0	.23				14.6			5.9
193	3.40	28.0	14.5	10.4	41.6	.60				22.0			10.8
194	.700	5.0	1.0	7.1	33.6	.03				13.0			5.9
195	3.60	27.0	11.6	11.2	35.1	.41				10.0			6.6
196	2.50	23.5	2.5	21.0	33.4	.08				12.0			7.5
197	1.25	10.0	1.0	14.1	40.5	.04				19.0			11.7
198	5.50	38.0	19.8	12.1	38.3	.76				20.0			10.3
199	6.00	40.0	19.2	12.9	42.5	.82				21.0			12.7
200	.800	7.5	.82	11.7	31.4	.03				15.0			8.8
201	2.20	19.0	.61	10.9	38.4	.02				12.0			6.9
202	13.50	130	22.6	38.7	59.7	1.3				33.0			19.1
203	13.2	150	16.3	52.5	56.7	.92				35.0			20.2
204	15.5	100	21.0	30.9	32.6	.68				14.0			9.9
292	.399	3.6	1.4	4.3	29.7	.04				12.5			6.6
293	2.47	21.0	5.2	13.0	45.5	.24				24.6			17.8
294	2.81	22.5	5.0	14.2	53.1	.27				22.2			14.5
295	1.49	14.0	1.8	14.8	38.6	.07				13.8			6.4
296	.169	.39	2.0	.39	25.5	.05				12.2			2.4
297	.428	1.7	3.0	1.4	29.2	.09				13.0			7.0
298	.624	3.7	3.2	2.9	32.4	.10				9.0			5.2
299	3.37	18.0	34.0	4.4	27.6	.94				8.0			4.5
300	.785	4.8	3.0	3.9	61.0	.18				6.8			2.5
301	8.33	56.0	19.3	18.0	42.9	.83				17.8			12.4
302	6.28	62.0	16.9	21.0	43.5	.74				11.4			5.6
303	6.74	63.0	18.3	21.0	62.5	1.1				23.6			18.0
304	1.34	19.2	1.6	22.0	40.2	.06				14.6			5.8
305	.133	.50	1.6	.56	23.1	.04				6.6			3.0

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Table N-8 (con.)

Results of Laboratory Tests on Auger Hole/Drill Hole Samples

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Regional Laboratory
Soils and Water

GPO 838-360/29

Lab Number	Site Number *	Depth Feet	Hydraulic Conductivity Ins./hr. 24th ~~6th~~ Hr.	48th ~~24th~~ Hr.	pH 1:5	pH $CaCl_2$ .01M	Settling Volume ML	Lime Qual.	Gyp. Qual.	1:5 Extract ecx10^3 @ 25 c	Ca+Mg Me/L	SAR Est.	Ca+Mg Me/100g
205	OH 1A-1	0-10	1.3	0.42		6.0	16			.254			
206	2	13.0-38.4	0.10	0.10		6.3	20			.198			
207	3	38.4-47.9				6.8	55			.495			
208	4	61.6-73.8				7.4	140			.487			
209	5	73.8-101.0				7.5	225			.476			
210	6	117.1-122.7	0.64	0.36		5.2	17			.507			
211	7	132.0-145.0				5.6	35			.198			
212	8	145.0-154.1				6.4	175			.507			
213	9	154.1-163.5				8.5	370			.254			
214	10	163.5-174.2				9.0	280			.735			
215	11	174.2-200.9				5.5	80			.518			
216	OH 2-1	0-2.0	0.71	0.57		5.8	23			1.906			
217	2	2.0-4.0				6.1	45			.476			
218	3	4.0-5.0				6.3	60			.522			
219	4	5.0-6.0				6.3	76			.396			
220	5	6.0-7.0				6.4	43			.479			
221	6	7.0-8.0				6.5	51			.515			
222	7	8.0-10.0				6.7	80			.380			
223	8	10.0-12.0				6.8	70			.620			
224	9	12.0-13.5	0.02	0.01		6.4	43			.634			
225	10	37.6-47.3	1.4	0.68		4.6	17			.195			
226	11	47.3-56.5	0.88	0.45		4.4	16			.481			
227	12	66.5-84.3				5.8	24			.327			
228	13	86.4-91.2				6.3	115			.423			
229	14	91.2-99.8				7.3	120			.347			
230	15	101.1-106.5				7.5	86			.259			
231	16	106.5-125.5				7.3	60			.167			
232	OH 3-1	0-2.0				7.3	21			.838			
233	2	2.0-3.0				7.6	22			.349			
234	3	3.0-4.0	0.07	0.07		7.4	20			1.023			
235	4	4.0-5.0				5.8	60			.610			
236	5	5.0-6.0				6.4	90			.887			
237	6	6.0-7.0				6.4	60			.688			
238	7	7.0-7.5				6.5	76			.903			
239	8	12.5-19.7				6.3	62			.552			
240	9	23.0-31.5				6.8	56			.591			
241	10	31.5-40.7				6.9	42			.619			
242	11	40.7-49.9				7.0	70			.564			
243	12	49.9-59.9				7.1	44			.468			
244	13	59.9-65.3				7.4	46			.634			
245	14	65.3-71.7				6.3	65			.253			
246	15	72.8-77.2				6.9	70			.427			
247	16	95.2-103.1	0.00	0.08		6.5	19			.158			
248	17	103.1-122.9				6.5	57			.350			
249	18	124.3-154.9				6.6	43			.445			
250	19	154.9-170.2	0.06	0.04		4.6	20			1.091			
251	20	170.2-189.0				4.4	30			.543			
252	21	189.0-201.0				5.3	66			.220			
253	22	201.0-220.0				6.0	150			.251			
254	23	220.0-230.0				7.6	76			.442			
255	24	230.0-250.0				5.8	125			.332			

Lab Number	Saturation Extract ecx10^3 @ 25 c	Na Me/L	Ca+Mg Me/L	SAR	Sat %	Ca+Mg Me 100g	Gyp Me 100g	Na Me/100g Total Na	Exch. Na	Cation Exchange Capacity	ESP %	% of Moisture	15 Bars
205										11.8			7.4
206										10.0			7.7
207	1.26	11.9	0.2	37.6	91.3	.018				34.2			39.2
208	1.16	10.1	0.2	31.9	135.7	.027				30.5			46.3
209	.955	8.4	0.2	26.6	180.7	.036				20.4			23.9
210	4.23	36.0	11.0	15.4	33.5	.368				12.6			6.0
211										13.8			7.4
212	1.18	10.1	0.4	22.6	156.8	.063				21.0			18.0
213	.948	10.5	0.2	33.2	296.4	.059				46.2			64.1
214	1.14	12.8	0.2	40.5	230.5	.046				38.4			61.3
215	1.99	22.5	0.2	71.1	88.9	.018				19.2			17.1
216	6.31	60.0	19.2	19.4	49.7	.954				24.0			31.6
217	7.93	86.0	18.4	28.4	59.0	1.08				22.6			19.4
218	3.82	39.0	2.0	39.0	75.0	.150				26.0			25.5
219	2.89	32.5	1.0	45.9	71.1	.071				27.2			25.7
220	4.15	39.0	2.8	32.9	58.6	.164				12.0			11.7
221	4.90	47.0	4.0	33.2	64.7	.258				23.0			18.2
222	7.52	73.0	13.6	27.9	75.7	1.03				24.6			23.1
223	6.92	71.0	11.2	30.0	89.8	1.00				27.0			24.1
224	10.6	120.0	21.4	36.7	60.0	1.28				28.0			23.4
225										6.1			3.3
226										6.2			3.5
227										8.0			6.9
228	1.21	15	0.2	47.4	128.4	.026				29.4			29.8
229										37.8			34.2
230										28.1			30.1
231										7.4			7.1
232	5.59	62.0	11.3	26.1	53.8	.608				17.4			11.5
233	2.79	29.5	1.8	31.1	59.5	.107				13.4			9.5
234	7.32	76.0	22.8	22.5	42.2	.962				11.2			6.2
235	8.19	92.0	21.8	27.9	92.0	2.00				21.8			15.4
236	6.69	76.0	6.2	43.2	107.3	.665				41.2			30.4
237	9.80	112.0	23.0	33.0	78.1	1.79				35.0			26.3
238	9.15	96.0	19.0	31.1	100.4	1.90				43.0			30.6
239	4.99	50.0	3.8	36.2	94.1	.358				22.0			16.4
240	2.21	36.0	0.4	80.5	87.0	.035				34.0			36.0
241	3.49	22.0	0.9	32.8	67.1	.060				29.6			28.1
242	2.06	21.0	0.4	46.9	116.3	.046				20.4			20.5
243	1.54	17.0	0.4	38.0	77.4	.031				30.6			24.8
244	1.53	20.0	0.4	44.7	85.3	.034				32.0			30.9
245										24.2			23.5
246	1.87	16.8	0.5	33.6	94.3	.047				27.8			25.7
247										10.4			9.2
248										9.4			12.5
249	3.57	36.0	0.7	60.8	58.8	.041				7.8			8.8
250	9.92	102.0	19.4	32.7	39.9	.774				9.0			8.2
251	5.88	58.0	6.6	31.9	46.6	.307				18.0			7.9
252										20.1			12.8
253										15.5			12.6
254	1.49	17.1	0.2	54.1	110.1	.022				21.8			20.1
255	.963	9.8	0.2	31.0	197.1	.039				16.8			20.5

* DH 1A-1 = Drill Hole (Core) 1A-Sample 1.

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Table N-8 (con.)
Results of Laboratory Tests on Auger Hole/Drill Hole Samples

Lower Missouri
Regional Laboratory
Soils and Water

Lab Number	Site Number	Depth Feet	Hydraulic Conductivity Ins./hr. 24th Hr.	48th Hr.	pH 1:5	pH $CaCl_2$ .01M	Settling Volume ML	Lime Qual.	Gyp. Qual.	1:5 Extract ecx10[3] @ 25 c	Ca+Mg Me/L	SAR Est.	Ca+Mg Me/100g	Saturation Extract ecx10[3] @ 25 c	Na Me/L	Ca+Mg Me/L	SAR	Sat %	Ca+Mg Me 100g	Gyp Me 100g	Na Me/100g Total Na	Exch. Na	Cation Exchange Capacity	ESP %	% of Moisture	15 Bars
256	OH 4-1	0-1.0				6.1	20			.191													14.8			11.0
256	2	1.0-5.0	0.76	0.62		6.2	19			.673				5.15	39.0	27.9	10.4	42.8	1.19				18.5			10.3
258	3	5.0-10.0				6.4	20			.603				5.13	38.0	26.1	10.5	44.8	1.17				20.0			10.9
259	4	10.0-15.0				6.6	26			.436				2.71	23.0	3.2	18.2	55.6	.178				26.2			19.3
260	5	15.0-19.0				6.6	29			.318													26.6			20.5
261	6	28.5-32.5	0.30	0.30		6.7	21			.242													19.4			11.8
262	7	33.3-46.6				7.3	61			.312													19.2			21.1
263	8	63.4-77.2				7.5	73			.301													9.9			4.7
264	9	77.2-93.3				7.4	100			.435				3.46	34.5	0.7	58.3	102.5	.072				17.4			12.1
265	10	93.6-117.4				5.0	90			.297													7.8			4.5
266	11	117.4-128.0	0.30	0.08		4.3	21			.769				7.93	76.0	19.5	24.3	43.7	.852				3.8			5.0
267	12	136.4-155.0				5.0	60			.346													7.3			11.2
268	13	155.0-173.8				5.5	48			.457				3.01	29.5	0.6	53.9	64.2	.038				6.4			6.1
269	14	173.8-195.0				5.8	70			.616				2.17	21.0	0.6	38.3	89.2	.054				12.5			6.0
270	15	195.9-201.9				7.4	86			.752				1.82	20.9	0.2	66.1	133.4	.027				37.0			20.9
271	16	201.9-205.1				7.7	170			.632				1.20	13.4	0.2	42.4	180.8	.036				20.5			22.1
272	17	205.1-220.0				7.1	195			.215													13.6			10.2
273	18	220.0-250.0				7.6	86			.611				1.89	19.9	0.2	62.9	113.5	.023				18.3			12.0
274	OH 5-1	0-1.0	2.0	1.3		6.9	19			.105													17.3			12.6
275	2	1.0-5.0				5.1	19			.196													15.4			11.4
276	3	5.0-10.0				5.6	19			.351													14.0			9.9
277	4	10.0-15.0				5.8	22			1.221				8.09	74.0	23.2	21.7	42.8	.993				19.0			13.2
278	5	15.0-20.0	0.04	0.08		5.9	24			1.443				9.52	96.0	23.0	28.3	39.0	.897				14.0			9.6
279	6	20.0-27.5				6.1	64			1.203				12.3	134.0	24.6	38.2	68.5	1.68				40.0			28.7
280	7	32.5-51.0				6.7	46			.781				8.48	89.0	11.2	37.6	100.3	1.12				43.0			35.5
281	8	51.0-59.4				7.5	85			.772				1.43	16.0	0.2	50.6	169.0	.034				45.0			31.5
282	9	61.1-81.0				7.6	45			.595				2.09	19.0	0.6	34.7	85.8	.051				25.0			26.6
283	10	81.0-91.0				7.4	57			.398				1.46	15.2	0.4	33.9	92.6	.037				31.0			35.0
284	11	91.0-110.0				7.7	68			.412				1.48	15.0	0.4	33.5	116.2	.046				36.0			39.0
285	12	110.0-120.0				6.0	75			.554				1.56	16.3	0.2	51.5	97.5	.019				28.5			35.2
286	13	120.0-130.0				6.6	80			.638				2.14	19.5	0.4	43.6	110.5	.044				40.0			40.2
287	14	130.0-140.0				6.9	75			.534				1.47	14.9	0.5	29.8	107.9	.054				33.0			38.4
288	15	140.0-150.0				7.0	64			.431				1.17	12.5	0.2	39.5	114.3	.023				25.0			30.6
289	16	190.0-207.0	0.58	0.46		6.5	18			.490				5.58	46.0	18.6	15.1	32.8	.610				12.5			4.5
290	17	207.0-218.0				6.5	33			.269													8.0			11.8
291	18	225.0-240.0				6.4	21			.238													8.8			7.6

REGIONAL SOILS LABORATORY
Lower Missouri Region

Table N-9
Mechanical Analysis of Soil and Core Samples

PROJECT: Ojo Encino

DATE:

Lab Number	Profile Number	Sample Number	Depth in Inches	Percent Sand	Percent Silt	Percent Clay	Lab. Texture	Field Texture
1	P1	S1	0-30	80.0	11.2	8.8	LS	LS
2		S2	30-48	68.6	16.6	14.8	SL	SL
3		S3	48-60	72.0	11.2	16.8	SL	SL
4		S4	60-96	72.0	7.4	10.6	LS	SL
5	P2	S1	0-36	70.8	16.4	12.8	SL	LS
6		S2	36-42	75.6	8.8	15.6	SL	LS
7	P3	S1	0-48	23.0	31.8	45.2	C	CL
8		S2	48-85	80.0	9.4	10.6	SL	LS
9		S3	84-96	61.6	18.8	19.6	SL	SL
10		S4	96-120	62.6	18.8	18.6	SL	L
11	P4	S1	0-12	84.6	8.8	6.6	LS	S
12		S2	12-36	76.2	7.2	16.6	SL	SL
13		S3	36-78	71.8	15.8	12.4	SL	SL
14		S4	78-108	74.8	11.8	13.4	SL	LS/SL
15	P5	S1	0-48	40.6	25.0	34.4	CL	CL
16		S2	48-84	70.2	13.2	16.6	SL	SL
17		S3	84-108	69.6	8.0	22.4	SCL	LS/SL
18	P6	S1	0-36	79.6	15.6	4.8	LS	FS
19		S2	36-60	74.6	14.0	11.4	SL	LFS
20		S3	66-96	61.6	26.6	11.8	SL	FSL
21		S4	96-120	67.2	21.6	11.2	SL	L
22	P7	S1	0-6	27.8	37.2	35.0	CL	CL

REGIONAL SOILS LABORATORY
Lower Missouri Region

PROJECT:

DATE:

Table N-9 (con.)
Mechanical Analysis of Soil and Core Samples

Lab Number	Profile Number	Sample Number	Depth in Inches	Percent Sand	Percent Silt	Percent Clay	Lab. Texture	Field Texture
23	P8	S1	0-48	80.2	14.8	5.0	LS	LFS
24		S2	48-72	60.2	28.8	11.0	SL	FSL
25		S3	72-120	51.0	33.8	15.2	L	L
26	P9	S1	0-48	32.8	24.0	43.2	C	CL
27		S2	48-72	64.8	24.2	11.0	SL	LFS
28		S3	72-120	43.8	45.2	11.0	L	L
29	P10	S1	0-6	79.2	11.8	9.0	LS	LFS
30	P11	S1	0-12	66.8	22.2	11.0	SL	SL
31		S2	12-30	35.4	27.6	37.0	CL	L
32	P12	S1	0-60	30.0	29.0	41.0	C	CL
33		S2	60-72	34.6	26.4	39.0	CL	Weathered Shale
34		S3	72-84	66.6	13.4	20.0	SCL/SL	Weathered Sandstone
35	P13	S1	0-48	82.4	9.6	8.0	LS	FS
36		S4	60-66	34.0	31.0	35.0	CL	Weathered Shale
37	P14	S1	0-48	54.0	22.0	24.0	SCL	CL
38		S2	48-72	79.4	9.4	11.2	SL	GrS
39		S3	72-108	38.4	42.6	19.0	L	SiL
40		S4	108-120	18.2	49.6	32.2	SiCL	SiCL
41	P16	S1	0-60	55.4	34.8	9.8	SL	SL
42	P17	S1	0-48	49.2	33.0	17.8	L	L
43		S2	48-72	57.6	23.6	18.8	SL	CL
44		S4	84-96	62.0	22.2	15.8	SL	SL

REGIONAL SOILS LABORATORY
Lower Missouri Region

Table N-9 (con.)
Mechanical Analysis of Soil and Core Samples

PROJECT:

DATE:

Lab Number	Profile Number	Sample Number	Depth in Inches	Percent Sand	Percent Silt	Percent Clay	Lab. Texture	Field Texture
45	P18	S1	0-24	45.6	24.4	30.0	SCL	Weathered Shale
46	P19	S1	0-24	86.2	7.8	6.0	LS	SL
47		S2	24-48	72.6	12.6	14.8	SL	FS
48	P21	S1	0-26	86.2	10.0	3.8	LS	FS
49	P22	S1	0-66	85.2	10.2	4.6	LS	FS
50		S2	66-84	63.2	16.5	20.3	SCL	SL
51		S3	84-120	54.0	32.4	13.6	SL	SL
52		S4	120-132	53.8	7.6	38.6	SC	Shale
53	P23	S1	0-36	33.6	34.8	31.6	CL	Weathered Shale
54	P24	S1	0-60	18.2	29.2	52.6	C	CL
55		S2	60-78	64.2	16.2	19.6	SL	SS
56	P25	S1	0-24	28.0	32.2	39.8	CL	CL
57		S2	24-48	37.0	33.2	29.8	CL	L
58	P26	S1	0-24	34.0	35.0	31.0	CL	CL
59		S2	24-36	13.0	46.0	42.0	SiC	CL
60	P28	S1	0-12	43.4	22.6	34.0	CL	CL
61		S2	12-48	27.6	31.8	40.6	C	Weathered Shale
62	P29	S1	0-24	60.8	21.6	17.6	SL	SL
63		S2	24-84	73.2	15.2	11.6	SL	LS
64		S3	84-120	75.0	9.4	15.6	SL	FS
65	P30	S1	0-12	44.8	27.4	27.8	SCL	CL
66		S2	12-36	20.0	31.4	48.6	C	C

REGIONAL SOILS LABORATORY
Lower Missouri Region

Table N-9 (con.)

Mechanical Analysis of Soil and Core Samples

PROJECT:

DATE:

Lab Number	Profile Number	Sample Number	Depth in Inches	Percent Sand	Percent Silt	Percent Clay	Lab. Texture	Field Texture
67	P30	S4	48-120	9.6	36.8	53.6	C	C
68	P31	S1	0-12	58.0	25.4	16.6	SL	SCL
69		S2	12-60	75.4	16.0	8.6	SL	LS
70		S3	60-72	52.6	29.8	17.6	SL	SL
71		S4	72-120	64.4	22.0	13.6	SL	LS
72	P32	S1	0-12	61.8	18.6	19.6	SL	SCL
73		S2	12-72	34.8	36.0	29.2		C
74	P33	S2	6-24	66.2	14.2	19.6	SL	SL
75		S4	34-72	60.0	22.4	17.6	SL	SL
76		S5	72-108	49.0	32.4	18.6	L	L
77	P34	S1	0-24	82.2	14.2	3.6	LS	FS
78		S2	24-60	83.2	10.2	6.6	LS	LCOS
79		S3	60-120	54.0	26.4	19.6	SL	L
80	P35	S1	0-36	49.0	29.0	22.0	L	L
81		S2	36-66	57.0	27.4	15.6	SL	SL
82		S3	66-96	76.2	12.2	11.6	SL	COS
83		S4	96-120	20.4	44.0	35.6	CL	Clay Shale
84	P36	S1	0-30	20.6	63.8	15.6	SiL	CL
85		S2	30-60	57.0	27.4	15.6	SL	L/LS
86		S3	60-96	26.2	33.0	40.8	C	C
87		S4	96-120	41.6	36.8	21.6	L	L
88	P37	S1	0-24	27.6	30.8	41.6	C	CL

REGIONAL SOILS LABORATORY
Lower Missouri Region

Table N-9 (con.)

Mechanical Analysis of Soil and Core Samples

PROJECT:

DATE:

Lab Number	Profile Number	Sample Number	Depth in Inches	Percent Sand	Percent Silt	Percent Clay	Lab. Texture	Field Texture
89	P37	S2	24-60	52.2	31.2	16.6	SL	L
90		S3	60-78	66.0	20.2	13.8	SL	S/LS
91		S4	78-96	68.4	13.0	18.6	SL	FS/SS
92	P38	S1	0-18	88.0	6.4	5.6	S/LS	FS
93		S2	18-30	62.8	12.6	24.6	SL	LFS
94		S3	30-72	76.8	12.6	10.6	SL	Weathered Sandstone
95	P39	S1	0-12	72.8	11.6	15.6	LS	LFS
96		S2	12-24	75.2	13.2	11.6	SL	LFS
97		S3	24-36	73.2	14.2	12.6	SL	FS
98	P41	SL	0-12	59.6	24.8	15.6	SL	FS
99		S2	12-48	39.8	29.6	30.6	CL	CL
100		S3	48-120	60.4	26.8	12.8	SL	Shale,Coal mixture
101	P43	S1	0-36	18.2	39.2	42.6	C	CL
102		S2	36-84	16.0	33.4	50.6	C	CL
103		S4	96-120	71.8	22.6	5.6	SL	Carboneous Shale
104	P44	S1	0-36	20.6	29.8	49.6	C	CL
105		S2	36-72	28.2	31.2	40.6	C	CL
106		S3	72-96	53.2	24.2	22.6	SCL	L
107		S4	96-120	80.4	17.0	2.6	LS	Carboneous Shale
108	P45	S1	0-36	36.6	29.8	33.6	CL	CL
109		S2	36-84	28.4	34.0	37.6	CL	CL
110	P46	S1	0-48	24.0	37.4	38.6	CL	CL

REGIONAL SOILS LABORATORY
Lower Missouri Region

Table N-9 (con.)

Mechanical Analysis of Soil and Core Samples

PROJECT:

DATE:

Lab Number	Profile Number	Sample Number	Depth in Inches	Percent Sand	Percent Silt	Percent Clay	Lab. Texture	Field Texture
111	P46	S2	48-72	58.4	24.0	17.6	SL	FSL
112		S3	72-84	70.8	17.6	11.6	SL	SiL
113		S4	84-108	50.2	36.2	13.6	L	LFS
114	P47	S1	0-36	66.4	16.2	17.4	SL	LFS
115		S2	36-84	61.8	22.8	15.4	SL	LFS
116		S3	84-108	72.8	13.6	13.6	LS	LFS
117		S4	108-120	21.8	38.6	39.6	CL	C
118	P48	S2	6-54	53.0	24.4	22.6	SCL	SCL
119		S3	54-102	34.8	25.6	39.6	CL	C
120		S4	102-120	30.6	38.4	31.0	CL	CL
121	P49	S1	0-30	51.6	18.6	29.8	SL	CL
122		S2	30-54	75.4	11.8	12.8	SL	LS
123		S3	54-84	65.8	20.0	14.2	SL	SL
124		S5	96-120	38.8	26.4	34.8	CL	C
125	P50	S1	0-60	63.6	20.6	15.8	SL	SL
126		S2	60-84	65.2	18.0	16.8	SL	LS
127	P51	SL	0-12	34.8	29.6	35.6	CL	C
128		S2	12-72	20.6	30.6	48.8	C	Clay & Shale
129	P52	S1	0-24	56.4	22.4	21.2	SCL	SCL
130		S2	24-48	57.8	23.4	18.8	SL	SL
132		S3	48-72	82.6	6.6	10.8	LS	FS
131		S4	72-108	26.8	28.0	45.2	C	C

REGIONAL SOILS LABORATORY
Lower Missouri Region

Table N-9 (con.)

Mechanical Analysis of Soil and Core Samples

PROJECT:

DATE:

Lab Number	Profile Number	Sample Number	Depth in Inches	Percent Sand	Percent Silt	Percent Clay	Lab. Texture	Field Texture
133	P53	S2	6-48	55.2	25.2	19.6	SL	L
134		S4	60-120	81.2	6.0	12.8	SL	FS
135	P55	S1	0-36	49.6	21.6	28.8	SCL	CL
136		S2	36-60	55.0	25.2	19.8	SL	VFSL
137		S3	60-78	78.8	10.4	10.8	SL	SL
138		S5	102-120	62.8	22.4	14.8	SL	VFSL
139	P57	S2	36-60	76.8	13.4	9.8	SL	LFS
140		S3	60-84	56.6	26.6	16.8	SL	SiL
141		S4	84-108	71.0	15.6	13.4	SL	FSL
142	P58	S1	0-24	70.4	15.2	14.4	SL	LFS
143	P59	S1	0-60	58.0	19.8	22.2	SCL	SCL
144		S2	60-120	73.2	10.6	16.2	SL	LFS
145	P60	S1	0-48	44.8	34.0	21.2	L	CL
146	P61	S1	0-12	38.2	26.6	35.2	CL	SiL
147		S2	12-24	51.8	28.0	20.2	SCL	CL
148		S5	72-120	51.2	25.6	23.2	SCL	SC
149	P62	S1	0-48	69.6	15.4	15.0	SL	SL
150		S2	48-90	77.6	12.4	10.0	SL	S
151	P63	S3	12-48	85.4	7.6	7.0	LS	LS
152		S4	48-78	88.0	5.2	6.8	LS	S
153	P65	S1	0-24	58.4	16.8	24.8	SCL	CL
154		S2	24-48	44.2	25.0	30.8	CL	C

REGIONAL SOILS LABORATORY
Lower Missouri Region

Table N-9 (con.)

Mechanical Analysis of Soil and Core Samples

PROJECT:

DATE:

Lab Number	Profile Number	Sample Number	Depth in Inches	Percent Sand	Percent Silt	Percent Clay	Lab. Texture	Field Texture
155	P65	S5	78-96	50.8	38.4	10.8	L	SL
156	P66	S1	0-12	38.6	52.6	8.8		SCL
157		S2	12-36	59.2	24.0	16.8	SL	SL
158		S3	36-72	52.8	24.4	22.8	SCL	L
159		S4	72-120	68.0	17.2	14.8	SL	LFS
160	P68	S1	0-24	37.6	25.2	37.2	CL	CL
161	P69	S3	24-60	34.8	17.2	48.0	C	C
162		S5	78-108	39.8	40.6	19.6	L	Weathered Shale
163	P70	S2	12-48	62.2	22.2	15.6	SL	SL
164		S3	48-78	61.2	21.0	17.8	SL	SCL
165		S4	78-120	41.0	38.4	20.6	L	CL
166	P72	S1	0-30	85.0	7.2	7.8	LS	S
167		S2	30-60	78.8	9.6	11.6	SL	S
168		S3	60-102	22.2	33.2	44.6	C	Weathered Shale
169		S4	102-120	36.8	37.8	25.4	L	Weathered Shale
170	P74	S1	0-48	26.8	34.8	38.4	CL	C
171		S2	48-84	49.0	24.4	26.6	SCL	SC
172		S3	84-120	81.8	7.6	10.6	LS	S
173	P76	S1	0-12	47.2	30.2	22.6	L	L
174		S2	12-48	57.8	25.6	16.6	SL	CL
175		S3	48-60	61.8	22.6	15.6	SL	L
176	P77	S1	0-42	76.2	13.2	10.6	SL	LS

REGIONAL SOILS LABORATORY
Lower Missouri Region

Table N-9 (con.)
Mechanical Analysis of Soil and Core Samples

PROJECT:

DATE:

Lab Number	Profile Number	Sample Number	Depth in Inches	Percent Sand	Percent Silt	Percent Clay	Lab. Texture	Field Texture
177	P77	S2	42-84	90.2	3.2	6.6	S	LS
178	P78	S1	0-12	42.2	25.4	32.4	CL	C
179		S2	12-40	22.0	33.6	44.4	C	Weathered Shale
180		S4	50-84	32.2	23.0	44.8	C	Weathered Shale
181	P79	S1	0-36	81.0	10.0	9.0	LS	FS
182		S2	36-72	71.6	14.8	13.6	SL	FS
183		S3	72-120	70.0	12.4	17.6	SL	FS
184	P80	S1	0-24	63.0	19.0	18.0	SL	SL
185		S2	24-60	87.8	3.2	9.0	LS	FS
186		S5	96-120	72.8	15.2	12.0	SL	LS
187	P82	S1	0-24	55.0	23.4	21.6	SCL	SC
188		S2	24-60	60.4	22.6	17.0	SL	SL
189		S3	60-120	73.6	15.4	11.0	SL	FS
190	P83	S1	0-24	63.0	15.0	22.0	SCL	SCL
191		S2	24-60	56.2	16.8	27.0	SCL	SCL
192		S3	60-84	76.8	13.2	10.0	SL	SL
193		S4	84-120	58.2	22.8	19.0	SL	L
194	P84	S1	0-36	72.2	14.8	13.0	SL	LS
195		S2	36-72	80.2	9.8	10.0	LS	LS
196		S3	72-96	71.2	17.2	11.6	SL	FS
197	P85	S1	0-24	64.2	19.8	16.0	SL	SCL
198		S2	24-48	58.2	21.8	20.0	SCL/SL	SCL

REGIONAL SOILS LABORATORY
Lower Missouri Region

Table N-9 (con.)

Mechanical Analysis of Soil and Core Samples

PROJECT:

DATE:

Lab Number	Profile Number	Sample Number	Depth in Inches	Percent Sand	Percent Silt	Percent Clay	Lab. Texture	Field Texture
199	P85	S3	48-84	46.2	31.8	22.0	L	CL
200	P87	S1	0-24	61.6	23.8	14.6	SL	SL
201		S2	24-36	76.8	18.6	4.6	LS	FS
202	P88	S1	0-24	28.2	35.2	36.6	CL	CL
203		S2	29-60	38.2	26.8	35.0	CL	C
204		S5	96-120	59.8	21.2	19.0	SL	SL
292	P89	S1	0-18	68.0	16.8	15.2	SL	SL
293		S2	18-42	47.0	22.8	30.2	SCL	C
294		S3	42-58	50.0	22.8	27.2	SCL	CL
295		S4	58-72	55.8	30.0	14.2	SL	fSL
296	P90	S1	0-12	80.0	12.8	7.2	LS	LfS
297		S2	12-24	81.4	6.2	12.4	LS	LfS
298		S3	24-42	80.0	8.6	11.4	SL	LfS
299		S4	42-72	86.4	4.4	9.2	LS	fS
300	P91	S1	0-12	84.8	10.6	4.6	LS	SH
301	P92	S1	0-18	46.8	30.8	22.4	L	CL
302		S2	18-40	66.6	23.0	10.4	SL	fSL
303		S3	40-48	38.0	30.6	31.4	CL	CL
304		S4	48-60	67.8	21.0	11.2	SL	fSL
305	P93	S1	0-18 MASTER SAMPLE	73.2	22.4	4.4	SL	fSL

REGIONAL SOILS LABORATORY
Lower Missouri Region

Table N-9 (con.)
Mechanical Analysis of Soil and Core Samples

ROJ. -: OJO ENCINO (CORE)

ATE: 7/12/79

Lab Number	Profile Number	Sample Number	Depth in ~~Inches~~ FEET	Percent Sand	Percent Silt	Percent Clay	Lab. Texture	Field Texture
205	DH OE 1A-1	1	0-10	67.8	17.0	15.2	SL	
206	1A-2	2	13 - 38.4	70.8	16.4	12.8	SL	
207	1A-3	3	38.4 - 47.9	7.4	48.8	43.8	SiC	
208	1A-4	4	61.6 - 73.8	23.4	36.6	40.0	C/CL	
209	1A-5	5	73.8- 101.0	.58.6	14.4	27.0	SCL	
210	1A-6	6	117.1 - 122.7	87.8	0.4	11.8	LS	
211	1A-7	7	132 - 145	76.6	12.6	10.8	SL	
212	1A-8	1	145 - 154.1	59.4	15.2	25.4	SCL	
213	1A-9	9	154.1-163.5	30.4	26.4	43.2	C	
214	1A-10	10	163.5-174.2	21.0	34.2	44.8	C	
215	1A-11	1	174.2-200.9	61.2	22.6	16.2	SL	
216	DH-OE2-1	2	0-2	18.2	38.4	43.4	C	
217	2-2	3	2-4	14.6	52.8	32.6	SiCL	
218	2-3	4	4-5	22.8	45.8	31.4	CL	
219	2-4	5	5-6	32.4	37.0	30.6	CL	
220	2-5	6	6-7	46.0	31.8	22.2	L	
221	2-6	7	7-8	34.4	32.2	33.4	CL	
222	2-7	8	8-10	13.4	42.2	44.4	SiC	
223	2-8	9	10-12	16.2	42.6	41.2	SiC	
224	2-9	10	12-13.5	46.2	25.6	28.2	SCL	
225	2-10	1	37.6-47.3	72.4	19.2	8.4	SL	
226	2-11	2	47.3-56.5	43.8	33.4	22.8	L	

REGIONAL SOILS LABORATORY
Lower Missouri Region

Table N-9 (con.)

Mechanical Analysis of Soil and Core Samples

PROJECT: OJO ENCINO (CORE)

DATE:

Lab Number	Profile Number	Sample Number	Depth in FEET ~~Inches~~	Percent Sand	Percent Silt	Percent Clay	Lab. Texture	Field Texture
227	DH OE 2-12	3	66.5 - 84.3	35.4	25.8	38.8	CL	
228	2-13	4	86.4 - 91.2	31.8	42.2	26.0	L	
229	2-14	5	91.2 - 99.8	77.4	15.8	6.8	LS	
230	2-15	6	101.1 - 106.5	57.8	20.4	21.8	SCL	
231	2-16	7	106.5 - 125.5	70.0	17.4	12.6	SL	
232	DH OE 3-1	8	0 - 2	74.4	16.8	8.8	SL	
233	3-2	9	2 - 3	36.2	41.0	22.8	L	
234	3-3	10	3 - 4	7.2	41.0	51.8	SiC	
235	3-4	11	4 - 5	11.6	48.8	39.6	SiCL	
236	3-5	12	5 - 6	4.4	42.2	53.4	SiC	
237	3-6	13	6 - 7	19.0	61.4	19.6	SiL	
238	3-7	14	7 - 7.5	22.2	51.4	26.4	SiL	
239	3-8	15	12.5 - 19.7	16.4	54.0	29.6	SiCL	
240	3-9	16	23.0 - 31.5	14.2	43.2	42.6	SiC	
241	3-10	17	31.5 - 40.7	22.8	51.6	25.6	SiL	
242	3-11	18	40.7 - 49.9	17.8	54.6	27.6	SiCL	
243	3-12	19	49.9 - 59.9	30.8	38.6	30.6	CL	
244	3-13	20	59.9 - 65.3	16.2	41.2	42.6	SiC	
245	3-14	1	65.3 - 71.7	76.0	10.8	13.2	SL	
246	3-15	2	72.8 - 77.2	69.8	15.0	15.2	SL	
247	3-16	3	95.2 - 103.1	75.6	16.2	8.2	SL	
248	3-17	4	103.1 - 122.9	75.6	17.2	7.2	SL	

REGIONAL SOILS LABORATORY
Lower Missouri Region

Table N-9 (con.)
Mechanical Analysis of Soil and Core Samples

ROJ...: OJO ENCINO (CORE)

ATE:

Lab Number	Profile Number	Sample Number	Depth in Feet	Percent Sand	Percent Silt	Percent Clay	Lab. Texture	Field Texture
249	DHOE 318	5	124.3-154.9	42.8	48.0	9.2	L	
250	3-19	6	154.9-170.2	42.4	51.4	6.2	SiL	
251	3-20	7	170.2-189.0	69.2	8.6	22.2	SCL	
252	3-21	8	189.0-201.0	21.0	57.8	21.2	SiL	
253	3-22	9	201-220	63.0	19.8	17.2	SL	
254	3-23	10	220-230	59.2	21.6	19.2	SL	
255	3-24	11	230-250	56.2	22.4	21.4	SCL	
256	DHOE 4-1	12	0-1	52.2	28.4	19.4	SL	
257	4-2	13	1-5	17.0	55.6	27.4	SiCL	
258	4-3	14	5-10	20.0	52.6	27.4	Cl/SiCL	
259	4-4	15	10-15	43.6	38.0	18.4	L	
260	4-5	16	15-19	29.2	41.4	29.4	CL	
261	4-6	17	28.5-32.5	65.6	15.8	18.6	SL	
262	4-7	18	33.3-46.6	64.0	20.4	15.6	SL	
263	4-8	19	63.4-77.2	76.0	14.4	9.6	SL	
264	4-9	20	77.2-93.3	80.0	12.6	7.4	LS	
265	4-10	1	93.6-117.4	76.0	15.4	8.6	SL	
266	4-11	2	117.4-128	79.8	15.8	4.4	LS	
267	4-12	3	136.4-155	82.0	12.6	5.4	LS	
268	4-13	4	155-173.8	78.8	14.6	6.6	LS	
269	4-14	5	173.8-195	67.2	21.2	11.6	SL	
270	4-15	6	195.9-201.9	12.4	49.0	38.6	SiCL	

REGIONAL SOILS LABORATORY
Lower Missouri Region

Table N-9 (con.)
Mechanical Analysis of Soil and Core Samples

PROJECT: OJO ENCINO (CORE)

DATE:

Lab Number	Profile Number	Sample Number	Depth in Feet	Percent Sand	Percent Silt	Percent Clay	Lab. Texture	Field Texture
271	DHOE 4-16	7	201.9-205.1	28.8	41.8	29.4	CL	
272	4-17	8	205.1-220	77.2	10.6	12.2	SL	
273	4-18	9	220-250	59.2	22.4	18.4	SL	
274	DHOE 5-1	10	0-1	58.8	21.0	20.2	SCL	
275	5-2	1	1-5	62.2	21.8	16.0	SL	
276	5-3	2	5-10	67.6	18.4	14.0	SL	
277	5-4	3	10-15	60.6	21.4	18.0	SL	
278	5-5	4	15-20	75.0	13.0	12.0	SL	
279	5-6	5	20-27.5	41.6	32.2	26.2	L	
280	5-7	6	32.5-51	16.6	50.4	33.0	SiCL	
281	5-8	7	51-59.4	25.6	38.4	36.0	CL	
282	5-9	8	61.1-81	27.6	38.4	34.0	CL	
283	5-10	9	81-91	12.2	47.8	40.0	SiC/SiCL	
284	5-11	10	91-110	17.2	39.8	43.0	C	
285	5-12	1	110-120	27.2	33.4	39.4	CL	
286	5-13	2	120-130	7.2	36.4	56.4	C	
287	5-14	3	130-140	5.2	41.4	53.4	SiC	
288	5-15	4	140-150	17.2	42.4	40.4	SiC	
289	5-16	5	190-207	79.2	13.4	7.4	LS	
290	5-17	6	207-218	69.6	20.0	10.4	SL	
291	5-18	7	225-240	76.6	12.0	11.4	SL	

Detailed Soil Inventory Tables

UT0665 SOIL INTERPRETATIONS RECORD

SOILS SECTION
OFFICIAL FILE

BEEBE
BEEBE SERIES
FLOODED

MLRA(S): 37
REV. JER. 1-78
TYPIC TORRIFLUVENTS, SANDY, MIXED, MESIC

THE BEEBE SERIES CONSISTS OF DEEP, WELL DRAINED TO EXCESSIVELY DRAINED SOILS. THEY FORMED ON NEARLY LEVEL FLOODPLAINS AND LOW RIVER TERRACES IN COARSE TEXTURED ALLUVIUM OF MIXED ORIGIN. ELEVATIONS RANGE 4500 TO 6000 FEET. AVERAGE ANNUAL PRECIPITATION RANGES 6 TO 10 INCHES. AVERAGE ANNUAL AIR TEMPERATURE RANGES 51 TO 55 F. AVERAGE FROST FREE SEASON RANGES 140 TO 160 DAYS. TYPICALLY, THE SURFACE IS 6 INCHES OF LIGHT BROWNISH GRAY LOAMY SAND. THE UNDERLYING LAYER IS A BROWN LOAMY SAND AND SAND TO 67 INCHES AND MULTICOLORED GRAVELLY SAND TO 80 INCHES. SLOPES RANGE FROM 0 TO 1 PERCENT.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-6	LS	SM	A-2	0	100	100	50-75	15-30	-	NP
0-6	L, SL	SM-SC, CL-ML	A-2, A-4	0	100	100	65-90	30-60	20-30	5-10
6-80	S, LS, GR-S	SP-SM, SM	A-1	0	65-75	50-70	25-35	5-20	-	NP

DEPTH (IN.)	CLAY (PCT <2MM)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-6	5-10	-	6.0-20	0.06-0.08	7.4-8.4	2-4	LOW	.20	5	2		HIGH	LOW
0-6	10-15	-	0.6-5.0	0.08-0.17	7.4-8.4	2-4	LOW	.28	5	3			
6-80	<10	-	>20	0.03-0.08	7.4-8.4	2-4	LOW	.17					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
COMMON	V. BRIEF	JUN-SEP	>6.0			-		>60		-		A	LOW

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	PROTECTED: SLIGHT COMMON: SEVERE-FLOODS
SEWAGE LAGOON AREAS	PROTECTED: SEVERE-SEEPAGE COMMON: SEVERE-FLOODS, SEEPAGE
SANITARY LANDFILL (TRENCH)	PROTECTED: SEVERE-SEEPAGE, TOO SANDY COMMON: SEVERE-FLOODS, SEEPAGE, TOO SANDY
SANITARY LANDFILL (AREA)	PROTECTED: SEVERE-SEEPAGE COMMON: SEVERE-FLOODS, SEEPAGE
DAILY COVER FOR LANDFILL	POOR-TOO SANDY, SEEPAGE

CONSTRUCTION MATERIAL

ROADFILL	GOOD
SAND	FAIR-EXCESS FINES
GRAVEL	UNSUITED-EXCESS FINES
TOPSOIL	POOR-TOO SANDY

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	PROTECTED: SEVERE-CUTBANKS CAVE COMMON: SEVERE-FLOODS, CUTBANKS CAVE
DWELLINGS WITHOUT BASEMENTS	PROTECTED: SLIGHT COMMON: SEVERE-FLOODS
DWELLINGS WITH BASEMENTS	PROTECTED: SLIGHT COMMON: SEVERE-FLOODS
SMALL COMMERCIAL BUILDINGS	PROTECTED: SLIGHT COMMON: SEVERE-FLOODS
LOCAL ROADS AND STREETS	PROTECTED: SLIGHT COMMON: SEVERE-FLOODS
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	

WATER MANAGEMENT

POND RESERVOIR AREA	SEEPAGE
EMBANKMENTS DIKES AND LEVEES	SEEPAGE
EXCAVATED PONDS AQUIFER FED	NO WATER
DRAINAGE	COMMON: FLOODS, CUTBANKS CAVE, POOR OUTLETS PROTECTED: CUTBANKS CAVE, POOR OUTLETS
IRRIGATION	COMMON: FLOODS, SEEPAGE, SOIL BLOWING PROTECTED: SEEPAGE, SOIL BLOWING, DROUGHTY
TERRACES AND DIVERSIONS	SOIL BLOWING
GRASSED WATERWAYS	DROUGHTY

REGIONAL INTERPRETATIONS

Table N-10 (con.)

RECREATIONAL DEVELOPMENT

CAMP AREAS	PROTECTED.SL.L: SLIGHT LS.PROTECTED: MODERATE-TOO SANDY COMMON: SEVERE-FLOODS	PLAYGROUNDS	PROTECTED.SL.L: SLIGHT LS.PROTECTED: MODERATE-TOO SANDY L.SL.COMMON: MODERATE-FLOODS LS.COMMON: MODERATE-TOO SANDY.FLOODS
PICNIC AREAS	PROTECTED.SL.L: SLIGHT L.SL.COMMON: MODERATE-FLOODS LS.PROTECTED: MODERATE-TOO SANDY LS.COMMON: MODERATE-FLOODS.TOO SANDY	PATHS AND TRAILS	PROTECTED.SL.L: SLIGHT LS.PROTECTED: MODERATE-TOO SANDY L.SL.COMMON: MODERATE-FLOODS LS.COMMON: MODERATE-TOO SANDY.FLOODS

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		ALFALFA HAY (TONS)		CORN SILAGE (TONS)		PASTURE (AUM)		APPLES (BU)		POTATOES, IRISH (CWT)		GRAIN SORGHUM (BU)			
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
ALL	7E	4E	-	4.5	-	15	-	9.0	-	250	-	200	-	75		

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	COMMON TREES	SITE INDX	TREES TO PLANT
ALL									

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
IRR.	RUSSIAN-OLIVE	20	LOMBARDY POPLAR	60	ARIZONA CYPRESS	25	AUTUMN-OLIVE	10

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
IRR.	FAIR	GOOD	FAIR	-	-	FAIR	V. POOR	V. POOR	FAIR	-	V. POOR	FAIR
NIRR.	V. POOR	V. POOR	POOR	-	-	POOR	V. POOR	V. POOR	V. POOR	-	V. POOR	POOR

(Potential for habitat elements: GRAIN & SEED through SHALLOW WATER; Potential as habitat for: OPENLD WILDLF through RANGELD WILDLF)

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: LS				
INLAND SALTGRASS	DIST	6				
WESTERN WHEATGRASS	AGSM	12				
RUBBER RABBITBRUSH	CHNA2	5				
FOURWING SALTBUSH	ATCA2	5				
CLOVER	TRIFO	5				
ALKALI SACATON	SPAI	10				
BOTTLEBRUSH SQUIRRELTAIL	SIHY	10				
RED MUHLY	MURE	5				
SEDGE	CAREX	5				
SAND DROPSEED	SPCR	10				
OTHER PERENNIAL FORBS	PPFF	10				
OTHER ANNUAL FORBS	AAFF	15				
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		1400				
NORMAL YEARS		1100				
UNFAVORABLE YEARS		800				

FOOTNOTES

1 AFTER REMOVAL OF OVERBURDEN, REQUIRES REMOVAL OF GRAVELS.

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL INTERPRETATIONS RECORD

MLRA(S) 37 | KIND OF UNIT SERIES | UNIT NAME BLANCOT
STATE NEW MEXICO | RECORD NO. | AUTHOR(S) JER | DATE 1/79 | REVISED | UNIT MODIFIER SANDY SUBSTRATUM

CLASSIFICATION AND BRIEF SOIL DESCRIPTION

THE BLANCOT SERIES CONSISTS OF DEEP, WELL DRAINED SOILS FORMED IN ALLUVIUM DERIVED FROM SANDSTONE AND SHALE ON ALLUVIAL FANS. ELEVATIONS RANGE 6600 TO 7000 FEET. M.A.P. IS 6 TO 10 INCHES. M.A.A.T. IS 51 TO 55° F., AND THE FROST FREE SEASON IS 140 TO 160 DAYS. TYPICALLY, THE SURFACE IS LIGHT YELLOWISH BROWN FINE SANDY LOAM 2 INCHES THICK. THE SUBSOIL IS PALE BROWN AND BROWN SANDY CLAY LOAM AND CLAY LOAM 19 INCHES THICK. THE SUBSTRATUM IS YELLOWISH BROWN, LIGHT YELLOWISH BROWN AND PALE BROWN SANDY LOAM TO A DEPTH OF 60 INCHES. SLOPES RANGE FROM 2 TO 8 PERCENT.

ESTIMATED SOIL PROPERTIES

DEPTH (IN)	USDA TEXTURE	UNIFIED	AASHO	FRACT. >3 IN. (PCT)	PASSING SIEVE 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-2	SL	SM, SM-SC	A-2, A-4	0	100	100	60-70	30-40	20-25	NP-10
0-2	FSL	SM, SM-SC, ML, CL-ML	A-4	↓	↓	↓	70-85	40-55	↓	↓
0-2	L	ML, CL-ML	A-4	↓	↓	↓	85-95	60-75	25-35	5-10
2-21	SCL, CL, L	SC, CL	A-6, A-7	↓	↓	↓	85-95	45-75	30-45	10-20
21-60	SL, FSL	SM, SM-SC	A-2, A-4	↓	↓	↓	65-80	30-50	20-25	NP-10

DEPTH (IN)	CLAY (PCT OF <2MM)	MOIST BULK DENSITY (G/CM³)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (pH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
SAME DEPTH AS ABOVE	8-17		2.0-6.0	0.11-0.13	7.9-8.4	2-4	LOW	.20	5	3	.2-.5	HIGH	LOW
	10-17		↓	0.13-0.15	↓	↓	↓	.24	↓	↓	↓		
	18-27		0.6-2.0	0.16-0.18	↓	↓	↓	.28	↓	5	↓		
	18-35		0.2-2.0	0.14-0.21	7.9-8.4	↓	MODERATE	↓					
	8-17		2.0-6.0	0.11-0.15	7.9-9.0	↓	LOW	.24					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INITIAL (IN)	TOTAL (IN)	HYD GRP	POTENTIAL FROST ACTION
NONE			>6.0			—		>60		—		B	LOW

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SLIGHT
SEWAGE LAGOONS	2-7%: SEVERE-SEEPAGE 7+%: SEVERE-SEEPAGE, SLOPE
SANITARY LANDFILL (TRENCH)	SLIGHT
SANITARY LANDFILL (AREA)	SLIGHT
DAILY COVER FOR LANDFILL	GOOD

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	SLIGHT
DWELLINGS WITHOUT BASEMENTS	MODERATE-SHRINK-SWELL
DWELLINGS WITH BASEMENTS	MODERATE-SHRINK-SWELL
SMALL COMMERCIAL BUILDINGS	2-4%: MODERATE-SHRINK-SWELL 4-8%: MODERATE-SHRINK-SWELL, SLOPE
LOCAL ROADS AND STREETS	MODERATE-SHRINK-SWELL
LAWNS, LANDSCAPING, AND GOLF FAIRWAYS	

CONSTRUCTION MATERIAL

ROADFILL	GOOD
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	MODERATE-TOO CLAYEY

WATER MANAGEMENT

POND RESERVOIR AREA	SEVERE-SEEPAGE
EMBANKMENTS DIKES AND LEVEES	SLIGHT
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	2-3% SL, FSL: SOIL BLOWING 3+% SL, FSL: SOIL BLOWING, SLOPE 2-3% L: FAVORABLE 3+% L: SLOPE
TERRACES AND DIVERSIONS	SL, FSL: SOIL BLOWING L: FAVORABLE
GRASSED WATERWAYS	FAVORABLE

REGIONAL INTERPRETATIONS

Table N-10 (con.)

UNIT NAME: Blancot
UNIT MODIFIER: SANDY SUBSTRATUM

RECREATIONAL DEVELOPMENT

CAMP AREAS	SLIGHT	PLAYGROUNDS	2-6 %: MODERATE- SLOPE 6+ %: SEVERE - SLOPE
PICNIC AREAS	SLIGHT	PATHS AND TRAILS	SLIGHT

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY NIRR	CAPABILITY IRR.
ALL	7E	

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	COMMON TREES	SITE INDEX	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLAND WILDLIFE	WOODLAND WILDLIFE	WETLAND WILDLIFE	RANGELAND WILDLIFE
ALL	V. POOR	V. POOR	POOR	-	-	POOR	POOR	V. POOR	V. POOR	-	POOR	POOR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS-DETERMINING PHASE: L, FSL, SL
INDIAN RICEGRASS	ORHY	
GALLETA	HIJA	
BLUE GRAMA	BOGR2	
BIG SAGEBRUSH	ARTR2	
ANNUAL NATIVE FORBS	AAFF	
OTHER PERENNIAL GRASSES	PPGG	
OTHER SHRUBS	SSSS	

POTENTIAL PRODUCTION (LBS./AC. DRY WT):

FAVORABLE YEARS	800
NORMAL YEARS	600
UNFAVORABLE YEARS	300

FOOTNOTES

1 THE SOIL MATERIAL BELOW 21 INCHES HAS A "GOOD" RATING.
2 LOAMY RANGE SITE NO. 1 MLRA 37

Table N-10 (con.)

NM0388 SOIL INTERPRETATIONS RECORD

MLRA(S): 37
REV. JER-CWK, 1-78
TYPIC HAPLARGIDS, FINE-LOAMY, MIXED, MESIC

OOAK SERIES
MODERATELY ALKALI

THE OOAK SERIES, MODERATELY ALKALI PHASE, CONSISTS OF DEEP, WELL DRAINED SOILS. THEY FORMED IN ALLUVIAL AND AEOLIAN DEPOSITS DERIVED FROM SANDSTONE AND SHALE ON MESAS AND PLATEAUS. ELEVATIONS RANGE 5500 TO 6400 FEET. A.A.P. IS 6 TO 10 INCHES. A.A.T. IS ABOUT 52 F. FROST FREE SEASON IS 140 TO 160 DAYS. TYPICALLY THE SURFACE LAYER IS 5 INCHES OF BROWN VERY FINE SANDY LOAM. THE SUBSOIL IS 14 INCHES OF YELLOWISH RED SANDY CLAY LOAM. THE SUBSTRATUM IS A SODIUM AFFECTED, REDDISH BROWN LOAM TO 60 INCHES OR MORE. SLOPES RANGE FROM 0 TO 8 PERCENT.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-5	L, VFSL	CL, CL-ML	A-4	0	100	100	85-95	50-75	20-30	5-10
5-19	L, SCL, CL	CL, SM-SC, SC, CL-ML	A-4, A-6	0	100	100	90-100	40-60	25-40	5-20
19-60	L, SCL, CL	CL, SM-SC, SC, CL-ML	A-4, A-6	0	100	100	60-100	40-60	25-40	5-20

DEPTH (IN.)	CLAY (PCT <2MM)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-5	18-27		0.6-2.0	0.13-0.17	7.4-8.4	<2	LOW	.37	5	3	.5-.6	HIGH	LOW
5-19	18-35		0.2-0.6	0.13-0.19	7.4-9.0	<2	MODERATE	.32					
19-60	18-35		0.2-0.6	0.13-0.19	7.9-9.0	2-4	MODERATE	.37					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			>6.0			-		>60		-		B	LOW

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SEVERE-PERCS SLOWLY
SEWAGE LAGOON AREAS	0-2%: SLIGHT 2-7%: MODERATE-SLOPE 7+%: SEVERE-SLOPE
SANITARY LANDFILL (TRENCH)	SLIGHT
SANITARY LANDFILL (AREA)	SLIGHT
DAILY COVER FOR LANDFILL	GOOD

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	SLIGHT
DWELLINGS WITHOUT BASEMENTS	MODERATE-SHRINK-SWELL,LOW STRENGTH
DWELLINGS WITH BASEMENTS	MODERATE-SHRINK-SWELL,LOW STRENGTH
SMALL COMMERCIAL BUILDINGS	0-4%: MODERATE-SHRINK-SWELL,LOW STRENGTH 4+%: MODERATE-SHRINK-SWELL,LOW STRENGTH, SLOPE
LOCAL ROADS AND STREETS	SEVERE-LOW STRENGTH
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	

CONSTRUCTION MATERIAL

ROADFILL	POOR-LOW STRENGTH
SAND	UNSUITED
GRAVEL	UNSUITED
TOPSOIL	FAIR-TOO CLAYEY

WATER MANAGEMENT

POND RESERVOIR AREA	0-6%: FAVORABLE 6+%: SLOPE
EMBANKMENTS DIKES AND LEVEES	PIPING
EXCAVATED PONDS AQUIFER FED	NO WATER
DRAINAGE	0-2%: FAVORABLE 2+%: SLOPE
IRRIGATION	0-2%: SOIL BLOWING 2+%: SOIL BLOWING,SLOPE
TERRACES AND DIVERSIONS	SOIL BLOWING
GRASSED WATERWAYS	

REGIONAL INTERPRETATIONS

Table N-10 (con.)

RECREATIONAL DEVELOPMENT

CAMP AREAS	MODERATE-DUSTY	PLAYGROUNDS	0-2%: MODERATE-DUSTY 2-7%: MODERATE-SLOPE,DUSTY 7+%: SEVERE-SLOPE
PICNIC AREAS	MODERATE-DUSTY	PATHS AND TRAILS	MODERATE-DUSTY

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY															
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
ALL	7S															

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: COMMON TREES	SITE INDX	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
IRR.	RUSSIAN-OLIVE	20	LOMBARDY POPLAR	60	ARIZONA CYPRESS	25	AUTUMN-OLIVE	10

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	POTENTIAL AS HABITAT FOR: OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
NIRR	V. POOR	V. POOR	POOR	-	-	POOR	POOR	V. POOR	V. POOR	-	V. POOR	POOR
IRR	FAIR	GOOD	POOR	-	-	POOR	POOR	FAIR	GOOD	-	POOR	POOR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: LOAM				
GALLETA	HIJA	15				
FOURWING SALTBUSH	ATCA2	5				
BLUE GRAMA	BOGR2	5				
INDIAN RICEGRASS	ORHY	15				
ALKALI SACATON	SPAI	15				
NEEDLEANDTHREAD	STCO4	5				
BOTTLEBRUSH SQUIRRELTAIL	SIHY	10				
SAND DROPSEED	SPCR	5				
BIG SAGEBRUSH	ARTR2	10				
THREEAWN	ARIST	5				
BLACK GREASEWOOD	SAVE4	2				
SHADSCALE	ATCO	2				
OTHER PERENNIAL FORBS	PPFF	6				
POTENTIAL PRODUCTION (LBS./AC. DRY WT): FAVORABLE YEARS		650				
NORMAL YEARS		450				
UNFAVORABLE YEARS		300				

FOOTNOTES

MLRA(S): 35, 36, 37 FRUITLAND SERIES
REV. MEB,TLF. 4-79
TYPIC TORRIORTHENTS, COARSE-LOAMY, MIXED (CALCAREOUS), MESIC

THE FRUITLAND SERIES CONSISTS OF DEEP, WELL DRAINED SOILS FORMED IN MIXED ALLUVIUM ON VALLEY SIDES, ALLUVIAL FANS, AND MESAS. ELEVATION RANGE 4800 TO 6500 FEET. MEAN ANNUAL PRECIPITATION IS 6 TO 10 INCHES. MEAN ANNUAL AIR TEMPERATURE IS 51 TO 55 F., AND THE FROST-FREE SEASON IS 140 TO 165 DAYS. TYPICALLY THE SURFACE LAYER IS A BROWN CALCAREOUS SANDY LOAM 7 INCHES THICK. THE SUBSTRATUM IS A PALE BROWN AND LIGHT YELLOWISH BROWN CALCAREOUS SANDY LOAM TO 60 INCHES OR MORE. SLOPES RANGE FROM 0 TO 30 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-7	SL, FSL	SM	A-2, A-4	0	100	100	60-75	30-45	15-25	NP-5
0-7	SCL, L	SM-SC, SC, CL, CL-ML	A-6, A-4	0	100	100	80-90	40-60	20-30	5-15
0-7	LFS	SM	A-2	0	100	100	50-75	15-30	-	NP
7-60	FSL, SL	SM	A-4, A-2	0	100	100	60-75	30-45	15-25	NP-5

DEPTH (IN.)	CLAY (PCT <2MM)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-7	5-10		2.0-6.0	0.11-0.13	7.4-8.4	<4	LOW	.24	5	3	.6-.8	HIGH	LOW
0-7	10-25		0.6-2.0	0.15-0.17	7.4-8.4	<4	LOW	.28	5	5	.6-.8		
0-7	5-12		6.0-20	0.08-0.11	7.4-8.4	<4	LOW	.24	5	1	.6-.8		
7-60	5-18		2.0-6.0	0.11-0.13	7.4-8.4	<4	LOW	.28					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			26.0			-		260		-		B	LOW

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
SEWAGE LAGOON AREAS	0-7%: SEVERE-SEEPAGE 7+%: SEVERE-SEEPAGE,SLOPE
SANITARY LANDFILL (TRENCH) 1	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
SANITARY LANDFILL (AREA) 1	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DAILY COVER FOR LANDFILL	0-8%: GOOD 8-15%: FAIR-SLOPE 15+%: POOR-SLOPE

CONSTRUCTION MATERIAL

ROADFILL	0-15%: GOOD 15-25%: FAIR-SLOPE 25+%: POOR-SLOPE
SAND 2	IMPROBABLE-EXCESS FINES
GRAVEL 2	IMPROBABLE-EXCESS FINES
TOPSOIL	0-8% SL,FSL,SCL,L: GOOD 8-15% SL,FSL,SCL,L: FAIR-SLOPE 0-8% LFS: FAIR-TOO SANDY 8-15% LFS: FAIR-TOO SANDY,SLOPE 15+%: POOR-SLOPE

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITHOUT BASEMENTS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
DWELLINGS WITH BASEMENTS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
SMALL COMMERCIAL BUILDINGS	0-4%: SLIGHT 4-8%: MODERATE-SLOPE 8+%: SEVERE-SLOPE
LOCAL ROADS AND STREETS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	0-8%: SLIGHT 8-15%: MODERATE-SLOPE 15+%: SEVERE-SLOPE

WATER MANAGEMENT

POND RESERVOIR AREA	0-8%: SEVERE-SEEPAGE 8+%: SEVERE-SEEPAGE,SLOPE
EMBANKMENTS DIKES AND LEVEES	SEVERE-PIPING
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	0-3% SL,FSL,SCL,L: FAVORABLE 3+% SL,FSL,SCL,L: SLOPE 0-3% LFS: FAST INTAKE 3+% LFS: FAST INTAKE,SLOPE
TERRACES AND DIVERSIONS	0-8% SCL,L: FAVORABLE 8+% SCL,L: SLOPE 0-8% SL,FSL,LFS: SOIL BLOWING 8+% SL,FSL,LFS: SLOPE,SOIL BLOWING
GRASSED WATERWAYS	0-8%: FAVORABLE 8+%: SLOPE

REGIONAL INTERPRETATIONS

Table N-10 (con.)

RECREATIONAL DEVELOPMENT

CAMP AREAS	0-8% SL,FSL,SCL,LFS: SLIGHT 8-15% SL,FSL,SCL,LFS: MODERATE-SLOPE 0-8% L: MODERATE-DUSTY 8-15% L: MODERATE-SLOPE,DUSTY 15+%: SEVERE-SLOPE	PLAYGROUNDS	0-2% SL,FSL,SCL,LFS: SLIGHT 2-6% SL,FSL,SCL,LFS: MODERATE-SLOPE 0-2% L: MODERATE-DUSTY 2-6% L: MODERATE-SLOPE,DUSTY 6+%: SEVERE-SLOPE
PICNIC AREAS	0-8% SL,FSL,SCL,LFS: SLIGHT 8-15% SL,FSL,SCL,LFS: MODERATE-SLOPE 0-8% L: MODERATE-DUSTY 8-15% L: MODERATE-SLOPE,DUSTY 15+%: SEVERE-SLOPE	PATHS AND TRAILS	0-15% SL,FSL,SCL,LFS: SLIGHT 15-25% SL,FSL,SCL,LFS: MODERATE-SLOPE 0-15% L: MODERATE-DUSTY 15-25% L: MODERATE-SLOPE,DUSTY 25+%: SEVERE-SLOPE

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY		ALFALFA HAY (TONS)		PASTURE (AUM)		CORN (BU)		CORN SILAGE (TONS)		GRASS HAY (TONS)					
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
0-2%	7E	2E		7		25		125		25		5				
2-5%	7E	3E		6		20		110		20		4.5				
5+%	7E	4E		5		18		-		-		4				

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: COMMON TREES	SITE INDX	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
ALL,IRR	RUSSIAN-OLIVE	20	EASTERN REDCEDAR	20	ROCKY MT. JUNIPER	23		

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	POTENTIAL AS HABITAT FOR: OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
NIRR	V. POOR	V. POOR	POOR	-	-	POOR	POOR	V. POOR	V. POOR	-	V. POOR	POOR
0-2% IRR	GOOD	GOOD	POOR	-	-	POOR	GOOD	POOR	FAIR	-	FAIR	FAIR
2-5% IRR	FAIR	GOOD	POOR	-	-	POOR	POOR	V. POOR	FAIR	-	V. POOR	POOR
5+% IRR	FAIR	GOOD	POOR	-	-	POOR	POOR	V. POOR	FAIR	-	V. POOR	POOR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: WARM	COOL			
FOURWING SALTBUSH	ATCA2	10	5			
BLUE GRAMA	BOGR2	20	25			
GIANT DROPSEED	SPGI	10	-			
INDIAN RICEGRASS	ORHY	25	10			
GALLETA	HIJA	5	10			
NEW MEXICO FEATHERGRASS	STNE2	5	-			
NEVADA MORMON-TEA	EPNE	5	-			
SAND DROPSEED	SPCR	5	5			
WINTERFAT	EULA5	5	-			
BIG SAGEBRUSH 3/	ARTR2	10	5			
OTHER PERENNIAL FORBS	PPFF	-	5			
WESTERN WHEATGRASS	AGSM	-	15			
NEEDLEANDTHREAD	STCO4	-	10			
SIDEOATS GRAMA	BOCU	-	5			
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		900	800			
NORMAL YEARS		700	600			
UNFAVORABLE YEARS		300	400			

FOOTNOTES

2 STRATIFIED SAND, GRAVEL MAY OCCUR BELOW 40 INCHES.
A ESTIMATES OF ENGINEERING PROPERTIES ARE BASED ON TEST DATA OF 1 PEDON FROM SAN JUAN COUNTY, NEW MEXICO.
1 SEEPAGE OF LEACHATE IS NOT A LIMITATION.
3 NOT USUALLY UTILIZED BY CATTLE. UTILIZED BY SHEEP IN THE SPRING AND FALL.

HM0362 SOIL INTERPRETATIONS RECORD HUERFANO SERIES

MLRA(S): 37
REV. TLP, 5-78
TYPIC NATRARGIDS, LOAMY, MIXED, MESIC, SHALLOW

THE HUERFANO SERIES CONSISTS OF SHALLOW, WELL DRAINED SODIUM AFFECTED SOILS FORMED IN ALLUVIUM ON MESAS, PLATEAUS, AND UPLAND VALLEYS. ELEVATIONS RANGE FROM 5600 TO 6400 FEET. A.A.P. IS ABOUT 8 INCHES. A.A.A.T. IS ABOUT 53 F. FROST-FREE SEASON IS ABOUT 150 DAYS. TYPICALLY, THE SURFACE LAYER IS LIGHT YELLOWISH BROWN SANDY CLAY LOAM 2 INCHES THICK. THE SUBSOIL IS DARK YELLOWISH BROWN AND YELLOWISH BROWN SANDY CLAY LOAM 13 INCHES THICK. SHALE IS AT 15 INCHES. SLOPE RANGES FROM 0 TO 3 PERCENT.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-2	SCL, L	CL, SC	A-6	0	100	100	85-95	40-70	25-35	10-15
0-2	SL	SM, SM-SC	A-2, A-4	0	100	100	60-70	30-40	20-30	NP-10
2-15	CL, SCL, SC	CL, SC	A-7, A-6	0	100	100	85-95	45-60	35-45	15-20
15	WB									

DEPTH (IN.)	CLAY (PCT) (<2MM)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-2	15-25	-	0.6-2.0	0.15-0.17	7.9-9.0	>4	MODERATE	.32	1	4L	-	HIGH	LOW
0-2	10-20	-	2.0-6.0	0.11-0.13	7.9-9.0	>4	LOW	.24	1	3	-		
2-15	28-35	-	0.2-0.6	0.15-0.19	7.9-9.0	>4	MODERATE	.32					
15													

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			>6.0			-		10-20	RIPPABLE	-		D	LOW

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SEVERE-PERCS SLOWLY,DEPTH TO ROCK
SEWAGE LAGOON AREAS	SEVERE-DEPTH TO ROCK
SANITARY LANDFILL (TRENCH)	SEVERE-DEPTH TO ROCK,EXCESS SODIUM
SANITARY LANDFILL (AREA)	SLIGHT
DAILY COVER FOR LANDFILL	POOR-AREA RECLAIM,THIN LAYER,EXCESS SODIUM

CONSTRUCTION MATERIAL

ROADFILL	POOR-AREA RECLAIM,LOW STRENGTH,THIN LAYER
SAND	UNSUITED
GRAVEL	UNSUITED
TOPSOIL	POOR-EXCESS SODIUM,THIN LAYER

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	SEVERE-DEPTH TO ROCK
DWELLINGS WITHOUT BASEMENTS	MODERATE-SHRINK-SWELL,LOW STRENGTH, DEPTH TO ROCK
DWELLINGS WITH BASEMENTS	SEVERE-DEPTH TO ROCK
SMALL COMMERCIAL BUILDINGS	MODERATE-DEPTH TO ROCK,LOW STRENGTH, SHRINK-SWELL
LOCAL ROADS AND STREETS	SEVERE-LOW STRENGTH
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	

WATER MANAGEMENT

POND RESERVOIR AREA	DEPTH TO ROCK
EMBANKMENTS DIKES AND LEVEES	THIN LAYER,EXCESS SODIUM
EXCAVATED PONDS AQUIFER FED	NO WATER
DRAINAGE	0-2%: DEPTH TO ROCK,EXCESS SODIUM 2+%: DEPTH TO ROCK,EXCESS SODIUM,SLOPE
IRRIGATION	0-2%: EXCESS SODIUM,ROOTING DEPTH 2+%: EXCESS SODIUM,ROOTING DEPTH,SLOPE
TERRACES AND DIVERSIONS	DEPTH TO ROCK
GRASSED WATERWAYS	

REGIONAL INTERPRETATIONS

Table N-10 (con.)

RECREATIONAL DEVELOPMENT

CAMP AREAS	SEVERE-DEPTH TO ROCK	PLAYGROUNDS	SEVERE-DEPTH TO ROCK
PICNIC AREAS	SEVERE-DEPTH TO ROCK	PATHS AND TRAILS	SLIGHT

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY NIRR	CAPABILITY IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
ALL	7S	-														

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	COMMON TREES	SITE INDX	TREES TO PLANT
							NONE		

Management problems: EROSION HAZARD through PLANT COMPET.; Potential productivity: COMMON TREES, SITE INDX

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
NIRR	V. POOR	V. POOR	V. POOR	-	-	V. POOR	POOR	V. POOR	V. POOR	-	V. POOR	V. POOR

Potential for habitat elements: GRAIN & SEED through SHALLOW WATER; Potential as habitat for: OPENLD WILDLF through RANGELD WILDLF

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: ALL				
ALKALI SACATON	SPAI	30				
FOURWING SALTBUSH	ATCA2	15				
GALLETA	HIJA	15				
SAND DROPSEED	SPCR	5				
THREEAWN	ARIST	5				
SHADSCALE	ATCO	5				
BLACK GREASEWOOD 1/	SAVE4	10				
OTHER PERENNIAL FORBS	PPFF	10				
OTHER ANNUAL FORBS	AAFF	5				
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		525				
NORMAL YEARS		325				
UNFAVORABLE YEARS		200				

FOOTNOTES

1 UTILIZED BY CATTLE AND SHEEP IN WINTER AND SPRING. BLOAT AND PERHAPS POISONING MAY RESULT FROM EATING THIS FORAGE.

Table N-10 (con.)

MLRA(S): 37
REV. ACK,JER, 10-79
TYPIC CAMBORTHIDS, FINE, MIXED, MESIC

NOTAL SERIES

THE NOTAL SERIES CONSISTS OF DEEP WELL DRAINED SODIUM AFFECTED SOILS FORMED IN ALLUVIUM ON VALLEY BOTTOMS AND DRAINAGEWAYS. ELEVATIONS RANGE FROM 5600 TO 6400 FEET. A.A.P. IS ABOUT 8 INCHES. A.A.A.T. IS ABOUT 53 F. FROST-FREE SEASON IS ABOUT 150 DAYS. TYPICALLY THE SURFACE LAYER IS BROWN SILTY CLAY LOAM ABOUT 3 INCHES THICK. THE SUBSOIL IS GRAYISH BROWN CLAY ABOUT 20 INCHES THICK. THE SUBSTRATUM IS GRAYISH BROWN CLAY TO 60 INCHES OR MORE. SLOPES RANGE FROM 0 TO 2 PERCENT.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-3	CL, SICL	CL, ML	A-6, A-7	0	100	100	90-100	70-80	35-45	10-20
0-3	C, SIC	CL, CH	A-7	0	100	100	90-100	80-95	40-60	15-30
3-60	SIC, C	CL, CH	A-7	0	100	100	90-100	80-95	40-60	15-30

DEPTH (IN.)	CLAY (PCT <2MM)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-3	28-35	-	0.2-0.6	0.15-0.19	7.9-9.0	4-8	MODERATE	.32	5	4L	-	HIGH	HIGH
0-3	40-50	-	0.06-0.2	0.13-0.19	7.9-9.0	4-8	HIGH	.37	5	4L	-		
3-60	40-50	-	<0.06	0.12-0.19	7.9-9.0	4-8	HIGH	.43					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POT'NTL FROST ACTION
NONE-RARE			>6.0			-		>60		-		D	LOW

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SEVERE-PERCS SLOWLY
SEWAGE LAGOON AREAS	NONE: SLIGHT RARE: SEVERE-FLOODS
SANITARY LANDFILL (TRENCH)	NONE: SLIGHT RARE: MODERATE-FLOODS
SANITARY LANDFILL (AREA)	NONE: SLIGHT RARE: MODERATE-FLOODS
DAILY COVER FOR LANDFILL	POOR-HARD TO PACK

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	MODERATE-TOO CLAYEY
DWELLINGS WITHOUT BASEMENTS	NONE: SEVERE-SHRINK-SWELL RARE: SEVERE-FLOODS,SHRINK-SWELL
DWELLINGS WITH BASEMENTS	NONE: SEVERE-SHRINK-SWELL RARE: SEVERE-FLOODS,SHRINK-SWELL
SMALL COMMERCIAL BUILDINGS	NONE: SEVERE-SHRINK-SWELL RARE: SEVERE-FLOODS,SHRINK-SWELL
LOCAL ROADS AND STREETS	SEVERE-LOW STRENGTH,SHRINK-SWELL
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	CL,SICL: MODERATE-EXCESS SALT C,SIC: SEVERE-TOO CLAYEY

CONSTRUCTION MATERIAL

ROADFILL	POOR-LOW STRENGTH,SHRINK-SWELL
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	CL,SICL: FAIR-TOO CLAYEY,EXCESS SALT C,SIC: POOR-TOO CLAYEY

WATER MANAGEMENT

POND RESERVOIR AREA	SLIGHT
EMBANKMENTS DIKES AND LEVEES	MODERATE-HARD TO PACK
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	CL,SICL: PERCS SLOWLY C,SIC: SLOW INTAKE,PERCS SLOWLY, ERODES EASILY
TERRACES AND DIVERSIONS	ERODES EASILY,PERCS SLOWLY
GRASSED WATERWAYS	EXCESS SALT,ERODES EASILY,PERCS SLOWLY

REGIONAL INTERPRETATIONS

Table N-10 (con.)

RECREATIONAL DEVELOPMENT

CAMP AREAS	CL,SICL,NONE: MODERATE-PERCS SLOWLY C,SIC,NONE: MODERATE-PERCS SLOWLY,TOO CLAYEY RARE: SEVERE-FLOODS	PLAYGROUNDS	CL,SICL: MODERATE-PERCS SLOWLY,EXCESS SALT C,SIC: MODERATE-TOO CLAYEY,PERCS SLOWLY, EXCESS SALT
PICNIC AREAS	CL,SICL: MODERATE-EXCESS SALT,PERCS SLOWLY C,SIC: MODERATE-TOO CLAYEY,EXCESS SALT, PERCS SLOWLY	PATHS AND TRAILS	CL,SICL: SLIGHT C,SIC: SEVERE-ERODES EASILY

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY															
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
ALL	7S	-														

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: COMMON TREES	SITE INDX	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	POTENTIAL AS HABITAT FOR: OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
NIRR	V. POOR	V. POOR	POOR	-	-	POOR	POOR	POOR	V. POOR	-	POOR	POOR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: RARE	NONE			
ALKALI SACATON	SPAI	15	30			
WESTERN WHEATGRASS	AGSM	30	5			
GALLETA	HIJA	15	15			
BLACK GREASEWOOD 1/	SAVE4	10	10			
BIG SAGEBRUSH 2/	ARTR2	5	-			
SHADSCALE	ATCO	10	10			
OTHER PERENNIAL FORBS	PPFF	10	5			
OTHER ANNUAL FORBS	AAFF	5	-			
FOURWING SALTBUSH	ATCA2	-	15			
SAND DROPSEED	SPCR	-	5			
THREEAWN	ARIST	-	5			
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		1,250	300			
NORMAL YEARS		850	175			
UNFAVORABLE YEARS		375	75			

FOOTNOTES

1 UTILIZED BY CATTLE AND SHEEP IN WINTER AND SPRING. BLOAT AND PERHAPS POISONING MAY RESULT FROM EATING THIS FORAGE.

2 NOT USUALLY UTILIZED BY CATTLE. UTILIZED BY SHEEP IN THE FALL, WINTER AND SPRING.

SOILS SECTION
OFFICIAL FILE

Revd 2/80

Table N-10 (con.)

UT0225

SOIL INTERPRETATIONS RECORD

MLRA(S): 34, 35
REV. MEC, 9-79
TYPIC TORRIPSAMMENTS, MIXED, MESIC

SHEPPARD SERIES

THE SHEPPARD SERIES ARE VERY DEEP, SOMEWHAT EXCESSIVELY-DRAINED SOILS FORMED IN SANDY MATERIAL ON ROLLING UPLANDS UNDER GALLETA, SAND DROPSEED, AND SALTBUSH. MAST IS 54 TO 59 F. AAP IS 6 TO 12 INCHES. FFP IS 130 TO 150 DAYS. A TYPICAL PROFILE HAS A REDDISH-YELLOW FINE SAND SURFACE LAYER, 12 INCHES THICK. THE UNDERLYING LAYER IS REDDISH-YELLOW LOAMY FINE SAND TO 60 INCHES OR MORE. SLOPES ARE 1 TO 12 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-12	FS	SM	A-2	0	100	100	65-80	10-20	-	NP
12-60	LFS	SM	A-2	0	100	100	70-80	15-25	-	NP

DEPTH (IN.)	CLAY (PCT <2MM)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-12	2-5		6.0-20	0.05-0.07	7.4-8.4	<2	LOW	.10	5	1	<.5	HIGH	MODERATE
12-60	3-8		6.0-20	0.06-0.08	7.4-8.4	<2	LOW	.10					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			>6.0			-		>60		-		A	LOW

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SEVERE-POOR FILTER
SEWAGE LAGOON AREAS	1-7%: SEVERE-SEEPAGE 7+%: SEVERE-SEEPAGE,SLOPE
SANITARY LANDFILL (TRENCH)	1-8%: MODERATE-TOO SANDY 8-12%: MODERATE-SLOPE,TOO SANDY
SANITARY LANDFILL (AREA)	1-8%: SLIGHT 8-12%: MODERATE-SLOPE
DAILY COVER FOR LANDFILL	1-8%: FAIR-TOO SANDY 8-12%: FAIR-TOO SANDY,SLOPE

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	SEVERE-CUTBANKS CAVE
DWELLINGS WITHOUT BASEMENTS	1-8%: SLIGHT 8-12%: MODERATE-SLOPE
DWELLINGS WITH BASEMENTS	1-8%: SLIGHT 8-12%: MODERATE-SLOPE
SMALL COMMERCIAL BUILDINGS	1-4%: SLIGHT 4-8%: MODERATE-SLOPE 8+%: SEVERE-SLOPE
LOCAL ROADS AND STREETS	1-8%: SLIGHT 8-12%: MODERATE-SLOPE
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	1-8%: MODERATE-DROUGHTY 8-12%: MODERATE-DROUGHTY,SLOPE

CONSTRUCTION MATERIAL

ROADFILL	GOOD
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	POOR-TOO SANDY

WATER MANAGEMENT

POND RESERVOIR AREA	1-8%: SEVERE-SEEPAGE 8+%: SEVERE-SEEPAGE,SLOPE
EMBANKMENTS DIKES AND LEVEES	SEVERE-SEEPAGE,PIPING
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	DROUGHTY,FAST INTAKE,SOIL BLOWING
TERRACES AND DIVERSIONS	1-8%: SOIL BLOWING 8+%: SLOPE,SOIL BLOWING
GRASSED WATERWAYS	1-8%: DROUGHTY 8+%: SLOPE,DROUGHTY

REGIONAL INTERPRETATIONS

RECREATIONAL DEVELOPMENT

CAMP AREAS	SEVERE-TOO SANDY	PLAYGROUNDS	1-6%: SEVERE-TOO SANDY 6+%: SEVERE-SLOPE,TOO SANDY
PICNIC AREAS	SEVERE-TOO SANDY	PATHS AND TRAILS	SEVERE-TOO SANDY

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY NIRR	CAPABILITY IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
ALL	7S															

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: COMMON TREES	SITE INDX	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMINING PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	POTENTIAL AS HABITAT FOR: OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
ALL	V. POOR	V. POOR	POOR	-	V. POOR	POOR	V. POOR	V. POOR	V. POOR	V. POOR	V. POOR	POOR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: MAP 6-8	HUMMOCKY	MAP 6-12		
BLACK GRAMA	BOER4					
BLUE GRAMA	BOGR2					
DROPSEED	SPORO					
GALLETA	HIJA					
INDIAN RICEGRASS	ORHY					
FOURWING SALTBUSH	ATCA2					
MORMON-TEA	EPHED					
RABBITBRUSH	CHRYS5					
SAND SAGEBRUSH 1/	ARFI2					
WINTERFAT	EULA5					
POTENTIAL PRODUCTION (LBS./AC. DRY WT): FAVORABLE YEARS		650	575	750		
NORMAL YEARS						
UNFAVORABLE YEARS		325	275	375		

FOOTNOTES

A ESTIMATES BASED ON ENGINEERING TEST DATA ON ONE PEDON FOR SAN JUAN COUNTY, UTAH.

1 NOT USUALLY UTILIZED BY SHEEP AND CATTLE.

NM0189 SOIL INTERPRETATIONS RECORD

MLRA(S): 37 SHIPROCK SERIES
REV. TLP,CWK, 1-78
TYPIC HAPLARGIDS, COARSE-LOAMY, MIXED, MESIC

THE SHIPROCK SERIES CONSISTS OF DEEP, WELL DRAINED SOILS. THEY FORMED IN ALLUVIAL DEPOSITS ON MESAS AND PLATEAUS. ELEVATIONS RANGE FROM 5600 TO 6400 FEET. MEAN ANNUAL PRECIPITATION RANGES FROM 6 TO 10 INCHES. MEAN ANNUAL AR TEMPERATURES RANGE FROM 50 TO 54 DEGREES F, AND THE FROST-FREE SEASON IS 140 TO 160 DAYS. TYPICALLY, THE SURFACE LAYER IS PALE BROWN FINE SANDY LOAM 2 INCHES THICK. THE SUBSOIL IS A BROWN FINE SANDY LOAM 12 INCHES THICK. THE SUBSTRATUM IS A BROWN AND LIGHT YELLOWISH BROWN FINE SANDY LOAM TO 60 INCHES. SLOPES ARE 0 TO 15 PERCENT.

ESTIMATED SOIL PROPERTIES (A)

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLASTICITY INDEX
0-2	SL, FSL	SM, SM-SC	A-2, A-4	0	100	100	75-90	30-50	20-30	NP-10
0-2	LS, LFS	SM, SP-SM	A-2, A-3	0	100	100	65-85	5-30	15-25	NP-5
2-60	SL, FSL	SM, SM-SC	A-2, A-4	0	100	100	75-90	30-50	20-30	NP-10

DEPTH (IN.)	CLAY (PCT <2MM)	MOIST BULK DENSITY (G/CM3)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-2	10-20		2.0-6.0	0.09-0.12	7.4-8.4	<2	LOW	.24	5	3	.5-.6	HIGH	LOW
0-2	10-15		6.0-20	0.06-0.09	7.4-8.4	<2	LOW	.15	5	2	.5-.6		
2-60	10-20		2.0-6.0	0.09-0.12	7.4-9.0	<4	LOW	.24					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			>6.0			-		>60		-		B	LOW

SANITARY FACILITIES		CONSTRUCTION MATERIAL	
SEPTIC TANK ABSORPTION FIELDS	0-8%: SLIGHT 8+%: MODERATE-SLOPE	ROADFILL	FAIR-LOW STRENGTH
SEWAGE LAGOON AREAS	0-7%: SEVERE-SEEPAGE 7+%: SEVERE-SLOPE,SEEPAGE	SAND	POOR-EXCESS FINES
SANITARY LANDFILL (TRENCH)	SLIGHT	GRAVEL	UNSUITED
SANITARY LANDFILL (AREA)	0-8%: SLIGHT 8+%: MODERATE-SLOPE	TOPSOIL	0-8%: GOOD 8+%: FAIR-SLOPE
DAILY COVER FOR LANDFILL	0-8%: GOOD 8+%: FAIR-SLOPE	**WATER MANAGEMENT**	
		POND RESERVOIR AREA	0-6%: SEEPAGE 6+%: SLOPE,SEEPAGE
BUILDING SITE DEVELOPMENT			
SHALLOW EXCAVATIONS	0-8%: SLIGHT 8+%: MODERATE-SLOPE	EMBANKMENTS DIKES AND LEVEES	FAVORABLE
DWELLINGS WITHOUT BASEMENTS	0-8%: SLIGHT 8+%: MODERATE-SLOPE	EXCAVATED PONDS AQUIFER FED	NO WATER
DWELLINGS WITH BASEMENTS	0-8%: SLIGHT 8+%: MODERATE-SLOPE	DRAINAGE	0-2%: FAVORABLE 2+%: SLOPE
SMALL COMMERCIAL BUILDINGS	0-4%: SLIGHT 4-8%: MODERATE-SLOPE 8+%: SEVERE-SLOPE	IRRIGATION	0-2%: DROUGHTY,SOIL BLOWING 2+%: SLOPE,DROUGHTY,SOIL BLOWING
LOCAL ROADS AND STREETS	0-8%: SLIGHT 8+%: MODERATE-SLOPE	TERRACES AND DIVERSIONS	0-8%: SOIL BLOWING 8+%: SLOPE,SOIL BLOWING
LAWNS, LANDSCAPING AND GOLF FAIRWAYS		GRASSED WATERWAYS	

REGIONAL INTERPRETATIONS

Table N-10 (con.)

RECREATIONAL DEVELOPMENT

CAMP AREAS	0-8%: SLIGHT 8+%: MODERATE-SLOPE	PLAYGROUNDS	0-2%: SLIGHT 2-6%: MODERATE-SLOPE 6+%: SEVERE-SLOPE
PICNIC AREAS	0-8%: SLIGHT 8+%: MODERATE-SLOPE	PATHS AND TRAILS	SLIGHT

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT) (B)

CLASS-DETERMINING PHASE	CAPABILITY		ALFALFA HAY (TONS)		CORN SILAGE (TONS)		GRAIN SORGHUM (BU)		PASTURE (AUM)		CORN (BU)		APPLES (BU)			
	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
0-2% SL.FSL	7E	2E	-	7.0	-	21	-	107	-	14	-	119	-	700		
2-5% SL.FSL	7E	3E	-	7.0	-	21	-	107	-	14	-	119	-	700		
5-8% SL.FSL	7E	4E	-	6.4	-	19	-	102	-	12	-	111	-	700		
8+%	7E	-	-	-	-	-	-	-	-		-	-	-	-		
0-2% LS.LFS	7E	3E	-	6.6	-	18	-	94	-	13	-	105	-	630		
2-5% LS.LFS	7E	4E	-	6.6	-	18	-	94	-	13	-	105	-	630		

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	MANAGEMENT PROBLEMS: EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	POTENTIAL PRODUCTIVITY: COMMON TREES.	SITE INDX	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMIN'G PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
IRR	ORIENTAL ARBORVITAE	10	SIBERIAN ELM	45	RUSSIAN-OLIVE	20	COMMON HACKBERRY	45
	MULTIFLORA ROSE	4	HONEYLOCUST	45	ROCKY MT. JUNIPER	23	EASTERN REDCEDAR	20

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	POTENTIAL AS HABITAT FOR: OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
NIRR	V. POOR	V. POOR	POOR	-	-	POOR	POOR	V. POOR	V. POOR	-	V. POOR	POOR
0-2% LS.IRR	FAIR	GOOD	POOR	-	-	POOR	FAIR	POOR	FAIR	-	POOR	POOR
2-5% LS.IRR	FAIR	GOOD	POOR	-	-	POOR	POOR	V. POOR	FAIR	-	V. POOR	POOR
0-2% SL.FSL.IRR	GOOD	GOOD	POOR	-	-	POOR	GOOD	POOR	FAIR	-	FAIR	POOR
2-5% SL.FSL.IRR	FAIR	GOOD	POOR	-	-	POOR	FAIR	V. POOR	FAIR	-	V. POOR	POOR
5-8% SL.FSL.IRR	FAIR	GOOD	POOR	-	-	POOR	POOR	V. POOR	FAIR	-	V. POOR	POOR

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE: SL.FSL	LS.LFS			
WINTERFAT	EULA5	5	-			
GIANT DROPSEED	SPGI	10	10			
SAND DROPSEED	SPCR	5	5			
INDIAN RICEGRASS	ORHY	25	15			
OTHER PERENNIAL FORBS	PPFF	5	5			
BLUE GRAMA	BOGR2	20	5			
NEW MEXICO FEATHERGRASS	STNE2	5	5			
BIG SAGEBRUSH	ARTR2	5	-			
GALLETA	HIJA	5	-			
LONGLEAF EPHEDRA	EPTR	5	5			
FOURWING SALTBUSH	ATCA2	10	5			
SAND BLUESTEM	ANHA	-	15			
LITTLE BLUESTEM	ANSC2	-	15			
SAND SAGEBRUSH	ARFI2	-	5			
SIDEOATS GRAMA	BOCU	-	10			
POTENTIAL PRODUCTION (LBS./AC. DRY WT):						
FAVORABLE YEARS		900	1200			
NORMAL YEARS		600	800			
UNFAVORABLE YEARS		300	400			

FOOTNOTES

A ESTIMATES OF ENGINEERING PROPERTIES BASED ON ANALYTICAL DATA OF 8 PEDONS FROM SAN JUAN COUNTY, NEW MEXICO.

B PREDICTED YIELDS BASED ON SPRINKLE METHOD OF IRRIGATION ONLY.

Rec'd 2/80

UT0668 — SOIL INTERPRETATIONS RECORD

MLRA(S): 37
REV. AJE.JER. 7-79
TYPIC NATRARGIDS, FINE-LOAMY, MIXED, MESIC

UFFENS SERIES

THE UFFENS SERIES CONSISTS OF DEEP, WELL DRAINED SODIUM AFFECTED SOILS FORMED IN ALLUVIUM FROM WEATHERED SHALE ON UPLAND VALLEY BOTTOMS, SIDE SLOPES, ALLUVIAL FANS AND SWALES. ELEVATIONS RANGE 5600 TO 6400 FEET. A.A.P. RANGES 6 TO 10 INCHES. A.A.A.T. RANGES 51 TO 55 F. A.F.F.S. RANGES 140 TO 160 DAYS. TYPICALLY, THE SURFACE IS A PALE BROWN AND LIGHT YELLOWISH BROWN VERY FINE SANDY LOAM 9 INCHES THICK. THE SUBSOIL IS BROWN AND LIGHT BROWN CLAY LOAM 11 INCHES THICK. THE SUBSTRATUM IS PALE BROWN SANDY CLAY LOAM TO 60 INCHES. SLOPES RANGE FROM 0 TO 8 PERCENT.

ESTIMATED SOIL PROPERTIES

DEPTH (IN.)	USDA TEXTURE	UNIFIED	AASHTO	FRACT >3 IN (PCT)	PERCENT OF MATERIAL LESS THAN 3" PASSING SIEVE NO. 4	10	40	200	LIQUID LIMIT	PLAS-TICITY INDEX
0-9	FSL, VFSL	SM, ML, CL-ML, SM-SC	A-4	0	100	100	80-90	45-55	20-30	NP-10
0-9	SCL, L, SIL	CL, CL-ML	A-6, A-4	0	100	100	85-95	55-75	25-35	5-15
9-20	SCL, CL, SICL	CL	A-6	0	100	100	85-95	65-85	30-40	10-20
20-60	SCL, L, CL	CL	A-6	0	100	100	85-95	55-75	30-40	10-15

DEPTH (IN.)	CLAY (PCT <2MM)	MOIST BULK DENSITY (G/CM3)	PERMEA-BILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (PH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS K	T	WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY STEEL	CONCRETE
0-9	10-20		2.0-6.0	0.08-0.14	7.4-8.4	4-8	LOW	.20	1	3	.5-1	HIGH	HIGH
0-9	15-25		0.6-2.0	0.13-0.16	>7.3	4-8	LOW	.28	1	6	.5-1		
9-20	25-35		0.2-0.6	0.05-0.10	>8.4	>16	MODERATE	.32					
20-60	20-30		0.2-0.6	0.05-0.10	>8.4	>16	MODERATE	.28					

FLOODING FREQUENCY	DURATION	MONTHS	HIGH WATER TABLE DEPTH (FT)	KIND	MONTHS	CEMENTED PAN DEPTH (IN)	HARDNESS	BEDROCK DEPTH (IN)	HARDNESS	SUBSIDENCE INIT. (IN)	TOTAL (IN)	HYD GRP	POTENT'L FROST ACTION
NONE			>6.0			-		>60		-		B	LOW

SANITARY FACILITIES

SEPTIC TANK ABSORPTION FIELDS	SEVERE-PERCS SLOWLY
SEWAGE LAGOON AREAS	0-2%: SLIGHT 2-7%: MODERATE-SLOPE 7+%: SEVERE-SLOPE
SANITARY LANDFILL (TRENCH)	SEVERE-EXCESS SALT
SANITARY LANDFILL (AREA)	SLIGHT
DAILY COVER FOR LANDFILL	GOOD

BUILDING SITE DEVELOPMENT

SHALLOW EXCAVATIONS	SLIGHT
DWELLINGS WITHOUT BASEMENTS	MODERATE-SHRINK-SWELL
DWELLINGS WITH BASEMENTS	MODERATE-SHRINK-SWELL
SMALL COMMERCIAL BUILDINGS	0-4%: MODERATE-SHRINK-SWELL 4-8%: MODERATE-SHRINK-SWELL,SLOPE
LOCAL ROADS AND STREETS	MODERATE-LOW STRENGTH,SHRINK-SWELL
LAWNS, LANDSCAPING AND GOLF FAIRWAYS	MODERATE-EXCESS SALT,DROUGHTY

CONSTRUCTION MATERIAL

ROADFILL	FAIR-LOW STRENGTH,SHRINK-SWELL
SAND	IMPROBABLE-EXCESS FINES
GRAVEL	IMPROBABLE-EXCESS FINES
TOPSOIL	POOR-THIN LAYER

WATER MANAGEMENT

POND RESERVOIR AREA	0-3%: SLIGHT 3-8%: MODERATE-SLOPE
EMBANKMENTS DIKES AND LEVEES	SEVERE-EXCESS SALT
EXCAVATED PONDS AQUIFER FED	SEVERE-NO WATER
DRAINAGE	DEEP TO WATER
IRRIGATION	0-3% SCL,L,SIL: DROUGHTY 3+% SCL,L,SIL: DROUGHTY,SLOPE 0-3% FSL,VFSL: DROUGHTY,SOIL BLOWING 3+% FSL,VFSL: DROUGHTY,SOIL BLOWING,SLOPE
TERRACES AND DIVERSIONS	SCL,L,SIL: FAVORABLE FSL,VFSL: SOIL BLOWING
GRASSED WATERWAYS	EXCESS SALT,DROUGHTY

REGIONAL INTERPRETATIONS

RECREATIONAL DEVELOPMENT

CAMP AREAS	FSL,SCL: MODERATE-EXCESS SALT VFSL,L,SIL: MODERATE-DUSTY,EXCESS SALT	PLAYGROUNDS	0-2%: MODERATE-EXCESS SALT 2-6%: MODERATE-EXCESS SALT,SLOPE 6+%: SEVERE-SLOPE
PICNIC AREAS	FSL,SCL: MODERATE-EXCESS SALT VFSL,L,SIL: MODERATE-EXCESS SALT,DUSTY	PATHS AND TRAILS	FSL,SCL: SLIGHT VFSL,L,SIL: MODERATE-DUSTY

CAPABILITY AND YIELDS PER ACRE OF CROPS AND PASTURE (HIGH LEVEL MANAGEMENT)

CLASS-DETERMINING PHASE	CAPABILITY NIRR	CAPABILITY IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.	NIRR	IRR.
ALL	7S															

WOODLAND SUITABILITY

CLASS-DETERMINING PHASE	ORD SYM	EROSION HAZARD	EQUIP. LIMIT	SEEDLING MORT'Y.	WINDTH. HAZARD	PLANT COMPET.	COMMON TREES	SITE INDX	TREES TO PLANT
							NONE		

WINDBREAKS

CLASS-DETERMIN'G PHASE	SPECIES	HT	SPECIES	HT	SPECIES	HT	SPECIES	HT
	NONE							

WILDLIFE HABITAT SUITABILITY

CLASS-DETERMINING PHASE	GRAIN & SEED	GRASS & LEGUME	WILD HERB.	HARDWD TREES	CONIFER PLANTS	SHRUBS	WETLAND PLANTS	SHALLOW WATER	OPENLD WILDLF	WOODLD WILDLF	WETLAND WILDLF	RANGELD WILDLF
ALL	V. POOR	V. POOR	V. POOR	-	-	V. POOR	POOR	V. POOR	V. POOR	-	V. POOR	V. POOR

(POTENTIAL FOR HABITAT ELEMENTS: GRAIN & SEED through SHALLOW WATER; POTENTIAL AS HABITAT FOR: OPENLD WILDLF through RANGELD WILDLF)

POTENTIAL NATIVE PLANT COMMUNITY (RANGELAND OR FOREST UNDERSTORY VEGETATION)

COMMON PLANT NAME	PLANT SYMBOL (NLSPN)	FSL,VFSL				
ALKALI SACATON	SPAI	20				
WESTERN WHEATGRASS	AGSM	10				
GALLETA	HIJA	15				
BLACK GREASEWOOD	SAVE4	15				
BIG SAGEBRUSH	ARTR2	5				
SHADSCALE	ATCO	5				
FOURWING SALTBUSH	ATCA2	10				
NEEDLEANDTHREAD	STCO4	5				
BLUE GRAMA	BOGR2	5				
WINTERFAT	EULA5	5				
BLACK SAGEBRUSH	ARARN	5				
POTENTIAL PRODUCTION (LBS./AC. DRY WT): FAVORABLE YEARS		900				
NORMAL YEARS		650				
UNFAVORABLE YEARS		400				

(PERCENTAGE COMPOSITION (DRY WEIGHT) BY CLASS DETERMINING PHASE)

FOOTNOTES

7-2006A (6-76)
Bureau of Reclamation

Table N-11

U S BUREAU OF RECLAMATION

POINT SITE LAND CHARACTERIZATION

(WITH DETERMINATIONS)

S Area: O20 ENCINO	Relief VERY GENTLY SLOPING	Stoniness NONE	Parent Material ALLUVIUM
L on. Sec 7 Twp 19N Range 5W	Elevation 6640		Soil Series NOTAL
PROFILE 5, 2620'W, 2227'S, NE COR	Slope Aspect SOUTH	Drainage GOOD SURFACE	Soil Classification 6s p, a s, pa 64 63 62
Climate SEMI-ARID	Vegetation POOR	Ground Water NONE	
Land Use RANGELAND	Erosion MODERATE	Land Form VALLEY	Profile Description By RG MOORE Date 8-78

LAB NO.	DEPTH (~~Cm~~) INCHES	PROFILE DESCRIPTION
5	0-48	CLAY LOAM, DRY, 10YR 2/1, A BLOCK, FIRM, PLS, STI
6	48-84	SANDY LOAM, 10YR 3/1, GRAN, FRI, NON PLS, SI STI
7	84-108	SANDY CLAY LOAM, DRY, 10YR 8/4, GRAN, FRI, NON PLS, SI STI

LABORATORY DESCRIPTION

DETERMINATION		DATA		
LABORATORY NUMBER —		5	6	7
DEPTH —	(cm)	0-48	48-84	84-108
PARTICLE SIZE ANALYSIS	(percent)			
Very Coarse Sand	(2.0-1.0 mm)			
Coarse Sand	(1.0-0.5 mm)			
Medium Sand	(0.5-0.25 mm)			
Fine Sand	(0.25-0.10 mm)			
Very Fine Sand	(0.10-0.05 mm)			
Total Sand —	(2.0-0.05 mm)	40.6	70.2	69.6
Silt —	(0.05-0.002 mm)	25.0	13.2	5.0
Clay —	(<0.002 mm)	34.4	16.6	22.4
TEXTURAL CLASS (LAB) —		cl	sl	scl
BULK DENSITY	(g/cm^3)			
HYDRAULIC CONDUCTIVITY	(cm/hr)			
6th hr —		—	.40	—
24th hr —		—	.30	—
SETTLING VOLUME —	(ml)	25	18	26
MOISTURE RETENTION	(percent)			
1/10 bar				
1/3 bar				
15 bar —		17.9	7.8	7.4
SOIL REACTION-pH				
Paste				
1:5 H_2O —		8.6	7.9	8.1
1:2 0.01 M $CaCl_2$ —		7.3	7.1	6.7
ORGANIC CARBON	(percent)			
AVAILABLE PHOSPHORUS	(ppm)			
$CaCO_3$ EQUIVALENT	(percent)			
GYPSUM REQUIREMENT	(me/100g)			
SATURATION EXTRACT				
Saturation Percentage —		56.6	27.4	32.0
EC_e @ 25°C —	(mmhos/cm)	3.2	14.0	5.2
Ca^{++} + Mg^{++} —	(me/l)	16.8	29.6	16.2
Mg^{++}	(me/l)			
Na^{+} —	(me/l)	37.0	145.0	65.0
K^{+}	(me/l)			
CO_3^-	(me/l)			
HCO_3^-	(me/l)			
Cl^-	(me/l)			
SO_4^-	(me/l)			
NO_3^-	(me/l)			
SAR —		12.8	37.7	22.8
Na	(me/100g)			
Ca+Mg	(me/100g)			
1:5 EXTRACT				
EC_5 @ 25°C —	(mmhos/cm)	.77	1.4	.62
Ca+Mg	(me/l)			
EXCHANGEABLE SODIUM	(percent)			
ACIDITY				
IN KCl exchange acidity				
Total	(me/100g)			
Al^{+++}	(me/100g)			
CATION EXCHANGE CAPACITY	(me/100g) —	51.0	18.0	22.0
NaOAc @ pH 8.2				
BORON	(mg/l)			

7-2006A (6-76)
Bureau of Reclamation

Table N-11 (con.)

U S BUREAU OF RECLAMATION

POINT SITE LAND CHARACTERIZATION

(WITH DETERMINATIONS)

Study Area: OJO ENCINO
Location. Sec. 4 Twp 19N Range 5W
PROFILE-31,990'E, 593'S, NW COR
Climate SEMI-ARID
Land Use. RANGELAND

Relief GENTLY SLOPING
Elevation 6640
Slope Aspect SOUTH
Vegetation POOR
Erosion SEVERE

Stoniness NONE
Drainage GOOD SURFACE
Ground Water NONE
Land Form VALLEY SIDESLOPES

Parent Material ALLUVIUM
Soil Series BLANCOT
Soil Classification 6s pa, a / 6₆6₄
Profile Description By RGMOORE Date 8-78

LAB NO.	DEPTH (INCHES)	PROFILE DESCRIPTION
68	0-12	SANDYLOAM, DRY, 10YR 5/3, A BLOCK, FRI, sli pls, sti, Na slicks on surf.
69	12-60	SANDY LOAM, DRY, 10YR 5/4, GRAN, LOOSE, NON PLS, NON STI,
70	60-72	SANDY LOAM, DRY, 10YR 4/3, GRAN, FRI, NON pls, NON STI
71	72-120	SANDYLOAM, DRY, 10YR 4/3, GRAN, loose, NON Pls, NON sti

LABORATORY DESCRIPTION

DETERMINATION		DATA			
LABORATORY NUMBER		68	69	70	71
DEPTH	(cm)	0-12	12-60	60-72	72-120
PARTICLE SIZE ANALYSIS	(percent)				
Very Coarse Sand	(2.0-1.0 mm)				
Coarse Sand	(1.0-0.5 mm)				
Medium Sand	(0.5-0.25 mm)				
Fine Sand	(0.25-0.10 mm)				
Very Fine Sand	(0.10-0.05 mm)				
Total Sand	(2.0-0.05 mm)	58.0	75.4	52.6	64.4
Silt	(0.05-0.002 mm)	25.4	16.0	29.8	22.0
Clay	(<0.002 mm)	16.6	8.6	17.6	13.6
TEXTURAL CLASS (LAB)		sl	sl	sl	sl
BULK DENSITY	(g/cm³)				
HYDRAULIC CONDUCTIVITY	(cm/hr)				
6th hr		—	—	—	.42
24th hr		—	—	—	.36
SETTLING VOLUME	(ml)	19	17	21	18
MOISTURE RETENTION	(percent)				
1/10 bar					
1/3 bar					
15 bar		8.9	4.6	9.6	8.2
SOIL REACTION-pH					
Paste					
1:5 H_2O		9.1	9.1	8.7	8.1
1:2 0.01 M $CaCl_2$		7.8	7.4	7.7	7.5
ORGANIC CARBON	(percent)				
AVAILABLE PHOSPHORUS	(ppm)				
$CaCO_3$ EQUIVALENT	(percent)				
GYPSUM REQUIREMENT	(me/100g)				
SATURATION EXTRACT					
Saturation Percentage		34.2	30.9	38.9	36.1
EC_e @ 25°C	(mmhos/cm)	3.1	4.3	6.2	7.0
$Ca^{++} + Mg^{++}$	(me/l)	7.8	9.4	17.8	19.6
Mg^{++}	(me/l)				
Na^+	(me/l)	25.0	34.0	55.0	55.0
K^+	(me/l)				
CO_3^-	(me/l)				
HCO_3^-	(me/l)				
Cl^-	(me/l)				
SO_4^-	(me/l)				
NO_3^-	(me/l)				
SAR		12.7	15.7	18.4	17.6
Na	(me/100g)				
Ca+Mg	(me/100g)				
1:5 EXTRACT					
EC_5 @ 25°C	(mmhos/cm)	.32	.35	.74	.88
Ca+Mg	(me/l)				
EXCHANGEABLE SODIUM	(percent)				
ACIDITY					
IN KCl exchange acidity					
Total	(me/100g)				
Al^{+++}	(me/100g)				
CATION EXCHANGE CAPACITY NaOAc@pH 8.2	(me/100g)	17.0	10.0	18.0	18.0
BORON	(mg/l)				

GPO 835-799

7-2006A (6-76)
Bureau of Reclamation

Table N-11 (con.)

U S BUREAU OF RECLAMATION

POINT SITE LAND CHARACTERIZATION

(WITH DETERMINATIONS)

Study Area: OJO ENCINO
Location. Sec. 33 Twp 20N Range 5W
PROFILE 52, 1300'W, 1732'N, SE COR
Climate SEMI-ARID
Land Use RANGELAND

Relief GENTLY SLOPING, COMPLEX
Elevation 6680
Slope Aspect SOUTH
Vegetation POOR
Erosion SEVERE

Staniness NONE
Drainage GOOD SURFACE
Ground Water NONE
Land Form VALLEY SIDESLOPES

Parent Material ALLUVIUM
Soil Series FRUITLAND
Soil Classification 6S pa, a, pha 6 2 6 + 6 3
Profile Description By RG MOORE Date 8-78

LAB NO.	DEPTH (INCHES)	PROFILE DESCRIPTION
129	0-24	SANDY CLAYLOAM, DRY, 10YR 6/3, A BLOCK, FIRM, sli pls, v sli sti
130	24-48	SANDYLOAM, DRY, 10YR 6/3, GRAN, FRI, NON PLS, NON STI
131	48-72	LOAMY FINE SAND, DRY, 10YR 7/4, SINGLE GRAIN, LOOSE, NON PLS, NON STI, MOD CEM
132	72-108	CLAY, DRY, 10YR 3/2, A BLOCK, FIR, PLS, NON STI
	108-120	SANDYLOAM, DRY, 10YR 5/4, SINGLE GRAIN, LOOSE, NON PLS, NON STI, NO SAMPLE

LABORATORY DESCRIPTION

DETERMINATION		DATA			
LABORATORY NUMBER		129	130	131	132
DEPTH	(cm)	0-24	24-48	48-72	72-108
PARTICLE SIZE ANALYSIS	(percent)				
Very Coarse Sand	(2.0-1.0 mm)				
Coarse Sand	(1.0-0.5 mm)				
Medium Sand	(0.5-0.25 mm)				
Fine Sand	(0.25-0.10 mm)				
Very Fine Sand	(0.10-0.05 mm)				
Total Sand	(2.0-0.05 mm)	56.4	57.8	82.6	26.8
Silt	(0.05-0.002 mm)	22.4	23.4	6.6	28.0
Clay	(<0.002 mm)	21.2	18.8	10.8	45.2
TEXTURAL CLASS (LAB)		scl	sl	lfs	c
BULK DENSITY	(g/cm³)				
HYDRAULIC CONDUCTIVITY	(cm/hr)				
6th hr		—	.15	.15	—
24th hr		—	.26	.16	—
SETTLING VOLUME	(ml)	24	23	19	100
MOISTURE RETENTION	(percent)				
1/10 bar					
1/3 bar					
15 bar		9.2	9.1	4.9	20.3
SOIL REACTION-pH					
Paste					
1:5 H_2O		8.4	8.1	9.3	7.5
1:2 0.01 M $CaCl_2$		7.3	7.5	7.5	7.3
ORGANIC CARBON	(percent)				
AVAILABLE PHOSPHORUS	(ppm)				
$CaCO_3$ EQUIVALENT	(percent)				
GYPSUM REQUIREMENT	(me/100g)				
SATURATION EXTRACT					
Saturation Percentage		45.5	48.6	38.5	105.7
EC_e @ 25°C	(mmhos/cm)	8.5	9.3	8.5	9.5
Ca^{++} + Mg^{++}	(me/l)	19.2	20.0	16.2	16.8
Mg^{++}	(me/l)				
Na^{+}	(me/l)	75.0	90.0	75.0	85.0
K^{+}	(me/l)				
CO_3^{-}	(me/l)				
HCO_3^{-}	(me/l)				
Cl^{-}	(me/l)				
SO_4^{-}	(me/l)				
NO_3^{-}	(me/l)				
SAR		24.2	28.5	26.4	29.3
Na	(me/100g)				
Ca+Mg	(me/100g)				
1:5 EXTRACT					
EC_5 @ 25°C	(mmhos/cm)	.78	.91	.68	1.10
Ca+Mg	(me/l)				
EXCHANGEABLE SODIUM	(percent)				
ACIDITY					
IN KCl exchange acidity					
Total	(me/100g)				
Al^{+++}	(me/100g)				
CATION EXCHANGE CAPACITY	(me/100g)	18.0	15.0	10.0	33.0
NaOAc@pH 8.2					
BORON	(mg/l)				

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Bureau of Reclamation

Table N-11 (con.)

U S BUREAU OF RECLAMATION

POINT SITE LAND CHARACTERIZATION

(WITH DETERMINATIONS)

Study Area: OJO ENCINO
Location: Sec. 33 Twp 20N Range 5W
PROFILE 53,2145W,1980N, SE COR
Climate: SEMI-ARID
Land Use: RANGELAND

Relief: VERY GENTLY SLOPING
Elevation: 6700
Slope Aspect: SOUTHEAST
Vegetation: GOOD
Erosion: SLIGHT

Stoniness: NONE
Drainage: GOOD SURFACE
Ground Water: NONE
Land Form: UPLAND

Parent Material: EOLIAN
Soil Series: DOAK
Soil Classification: $\frac{1}{10}$
Profile Description By: RG MOORE Date: 8-78

LAB NO	DEPTH (INCHES)	PROFILE DESCRIPTION
	0-6	FINE SAND, DRY, 10YR 6/3, SINGLE GRAIN, LOOSE NON PlS, NON STI, NO SAMPLE
133	6-48	SANDY LOAM, DRY, 10YR 5/3, CRUMB, FRI, NON PLS, NON STI
	48-60	CLAY LOAM, DRY, 10YR 5/4, A BLOCK, FRI, Sl PLS, V Sl STI, NO SAMPLE
134	60-120	SANDY LOAM, DRY, 10YR 6/4, SINGLE GRAIN, LOOSE, NON pls, NON STI, WK CEM

LABORATORY DESCRIPTION

DETERMINATION		DATA	
LABORATORY NUMBER —		133	134
DEPTH —	(cm)	6-48	60-120
PARTICLE SIZE ANALYSIS	(percent)		
Very Coarse Sand	(2.0-1.0 mm)		
Coarse Sand	(1.0-0.5 mm)		
Medium Sand	(0.5-0.25 mm)		
Fine Sand	(0.25-0.10 mm)		
Very Fine Sand	(0.10-0.05 mm)		
Total Sand —	(2.0-0.05 mm)	55.2	81.2
Silt —	(0.05-0.002 mm)	25.2	6.0
Clay —	(<0.002 mm)	19.6	12.8
TEXTURAL CLASS (LAB) —		sl	sl
BULK DENSITY	(g/cm^3)		
HYDRAULIC CONDUCTIVITY	(cm/hr)		
6th hr —		1.3	1.0
24th hr —		.99	.74
SETTLING VOLUME —	(ml)	19	18
MOISTURE RETENTION	(percent)		
1/10 bar			
1/3 bar			
15 bar —		10.5	5.8
SOIL REACTION-pH			
Paste			
1:5 H_2O —		7.9	8.3
1:2 0.01 M $CaCl_2$ —		7.3	7.8
ORGANIC CARBON	(percent)		
AVAILABLE PHOSPHORUS	(ppm)		
$CaCO_3$ EQUIVALENT	(percent)		
GYPSUM REQUIREMENT	(me/100g)		
SATURATION EXTRACT			
Saturation Percentage —		39.2	34.2
EC_e @ 25°C —	(mmhos/cm)	.80	4.3
$Ca^{++} + Mg^{++}$ —	(me/l)	1.4	22.4
Mg^{++}	(me/l)		
Na^+ —	(me/l)	4.5	28.0
K^+	(me/l)		
CO_3^-	(me/l)		
HCO_3^-	(me/l)		
Cl^-	(me/l)		
SO_4^-	(me/l)		
NO_3^-	(me/l)		
SAR —		5.4	8.4
Na	(me/100g)		
Ca+Mg	(me/100g)		
1:5 EXTRACT			
EC_5 @ 25°C —	(mmhos/cm)	.12	.54
Ca+Mg	(me/l)		
EXCHANGEABLE SODIUM	(percent)		
ACIDITY			
IN KCl exchange acidity			
Total	(me/100g)		
Al^{+++}	(me/100g)		
CATION EXCHANGE CAPACITY	(me/100g) —	19.0	10.0
NaOAc @ pH 8.2			
BORON	(mg/l)		

GPO 835-791

7-2006A (6-76)
Bureau of Reclamation

Table N-11 (con.)

U S BUREAU OF RECLAMATION

POINT SITE LAND CHARACTERIZATION

(WITH DETERMINATIONS)

Study Area: OJO ENCINO	Relief GENTLY SLOPING	Staniness NONE	Parent Material ALLUVIUM
Location. Sec. 35 Twp 20N Range 5W	Elevation 6600		Soil Series DOAK
PROFILE 83, 600'W, 400'N, SE COR	Slope Aspect SOUTHEAST	Drainage GOOD SURFACE	Soil Classification 6S pa,p,a,p 02632263
Climate SEMI-ARID	Vegetation POOR	Ground Water NONE	
Land Use RANGELAND	Erosion CRITICAL	Land Form UPLAND	Profile Description By RGMOORE Date 8-78

LAB NO.	DEPTH (INCHES)	PROFILE DESCRIPTION
190	0-24	SANDY CLAY LOAM, DRY, 10YR 5/4, A BLOCK FRI, PLS, STI, MOD CEM
191	24-60	SANDY CLAY LOAM, DRY, 10YR 4/4, A BLOCK FRI, PLS, STI, MOD CEM
192	60-84	SANDY LOAM, DRY, 10YR 5/4, GRAN, FRI, NON PLS, NON STI, WK CEM
193	84-120	SANDY LOAM, DRY, 10YR 4/4, CRUMB FRI, NON PLS, NON STI, WK CEM

LABORATORY DESCRIPTION

DETERMINATION	Unit	190	191	192	193
LABORATORY NUMBER		190	191	192	193
DEPTH	(cm)	0-24	24-60	60-84	84-120
PARTICLE SIZE ANALYSIS	(percent)				
Very Coarse Sand	(2.0-1.0 mm)				
Coarse Sand	(1.0-0.5 mm)				
Medium Sand	(0.5-0.25 mm)				
Fine Sand	(0.25-0.10 mm)				
Very Fine Sand	(0.10-0.05 mm)				
Total Sand	(2.0-0.05 mm)	63.0	56.2	76.8	58.2
Silt	(0.05-0.002 mm)	15.0	16.8	13.2	22.8
Clay	(<0.002 mm)	22.0	27.0	10.0	19.0
TEXTURAL CLASS (LAB)		SCL	SCL	SL	SL
BULK DENSITY	(g/cm^3)				
HYDRAULIC CONDUCTIVITY	(cm/hr)				
6th hr		—	.05	.12	.02
24th hr		—	.04	.11	.01
SETTLING VOLUME	(ml)	22	22	19	19
MOISTURE RETENTION	(percent)				
1/10 bar					
1/3 bar					
15 bar		13.7	15.7	5.9	10.8
SOIL REACTION-pH					
Paste					
1:5 H_2O		8.5	8.6	7.7	7.7
1:2 0.01 M $CaCl_2$		7.5	7.5	7.3	7.3
ORGANIC CARBON	(percent)				
AVAILABLE PHOSPHORUS	(ppm)				
$CaCO_3$ EQUIVALENT	(percent)				
GYPSUM REQUIREMENT	(me/100g)				
SATURATION EXTRACT					
Saturation Percentage		46.8	50.1	32.0	41.6
EC_e @ 25°C	(mmhos/cm)	1.2	4.6	2.7	3.4
$Ca^{++} + Mg^{++}$	(me/l)	1.2	19.6	7.3	14.5
Mg^{++}	(me/l)				
Na^{+}	(me/l)	10.0	30.0	22.0	28.0
K^{+}	(me/l)				
CO_3^-	(me/l)				
HCO_3^-	(me/l)				
Cl^-	(me/l)				
SO_4^-	(me/l)				
NO_3^-	(me/l)				
SAR		12.9	9.6	11.5	10.4
Na	(me/100g)				
Ca+Mg	(me/100g)				
1:5 EXTRACT					
EC_5 @ 25°C	(mmhos/cm)	.22	.81	.28	.35
Ca+Mg	(me/l)				
EXCHANGEABLE SODIUM	(percent)				
ACIDITY					
IN KCl exchange acidity					
Total	(me/100g)				
Al^{+++}	(me/100g)				
CATION EXCHANGE CAPACITY NaOAc@pH 8.2	(me/100g)	24.4	26.0	14.6	22.0
BORON	(mg/l)				

7-2006A (6-76)
Bureau of Reclamation

Table N-11 (con.)

U S BUREAU OF RECLAMATION

POINT SITE LAND CHARACTERIZATION

(WITH DETERMINATIONS)

Study Area: OJO ENCINO
Location. Sec. 2 Twp. 19N Range 5W
PROFILE 89, 850'W, 1250'S, NE COR
Climate. SEMI-ARID
Land Use. RANGELAND

Relief: GENTLY SLOPING
Elevation: 6600
Slope Aspect: EAST
Vegetation: POOR
Erosion: CRITICAL

Staniness: NONE
Drainage: GOOD SURFACE
Ground Water: NONE
Land Form: UPLAND

Parent Material: ALLUVIUM
Soil Series: FRUITLAND
Soil Classification: 2s d, pa 2, 65
Profile Description By: RGMOORE Date: 8-78

LAB NO	DEPTH (INCHES)	PROFILE DESCRIPTION
292	0-14	SANDY LOAM, DRY, 10YR 6/4, GRAN FIRM, NONPLS, SI, STI
293	14-42	SANDY CLAY LOAM, DRY, 10YR 5/3, S BLOCK, FIRM, PLS, STI
294	42-58	SANDY CLAY LOAM, DRY, 10YR 5/3, S BLOCK, FIRM, PLS, STI
295	58-72	SANDY LOAM, DRY, 10YR 6/4, MASS, FRI, NON PLS, NON STI

LABORATORY DESCRIPTION

DETERMINATION		DATA			
LABORATORY NUMBER		292	293	294	295
DEPTH	(cm)	0-14	14-42	42-58	58-72
PARTICLE SIZE ANALYSIS	(percent)				
Very Coarse Sand	(2.0-1.0 mm)				
Coarse Sand	(1.0-0.5 mm)				
Medium Sand	(0.5-0.25 mm)				
Fine Sand	(0.25-0.10 mm)				
Very Fine Sand	(0.10-0.05 mm)				
Total Sand	(2.0-0.05 mm)	68.0	47.0	50.0	55.8
Silt	(0.05-0.002 mm)	16.8	22.8	22.8	30.0
Clay	(< 0.002 mm)	15.2	30.2	27.2	14.2
TEXTURAL CLASS (LAB)		Sl	Scl	Scl	Sl
BULK DENSITY	(g/cm^3)				
HYDRAULIC CONDUCTIVITY	(cm/hr)				
6th hr		.76	—	—	—
24th hr		.40	—	—	—
SETTLING VOLUME	(ml)	16.5	20.5	20.0	17.5
MOISTURE RETENTION	(percent)				
1/10 bar					
1/3 bar					
15 bar		6.6	17.8	14.5	6.4
SOIL REACTION-pH					
Paste					
1:5 H_2O		9.6	9.6	9.5	9.8
1:2 0.01 M $CaCl_2$		6.4	6.9	6.9	7.0
ORGANIC CARBON	(percent)				
AVAILABLE PHOSPHORUS	(ppm)				
$CaCO_3$ EQUIVALENT	(percent)				
GYPSUM REQUIREMENT	(me/100g)				
SATURATION EXTRACT					
Saturation Percentage		29.7	45.5	53.1	38.6
EC_e @ 25°C	(mmhos/cm)	.39	2.4	2.8	1.4
$Ca^{++}+Mg^{++}$	(me/l)	1.4	5.2	5.0	1.8
Mg^{++}	(me/l)				
Na^+	(me/l)	3.6	21.0	22.5	14.0
K^+	(me/l)				
CO_3^-	(me/l)				
HCO_3^-	(me/l)				
Cl^-	(me/l)				
SO_4^-	(me/l)				
NO_3^-	(me/l)				
SAR		4.3	13.0	14.2	14.8
Na	(me/100g)				
Ca+Mg	(me/100g)				
1:5 EXTRACT					
EC_5 @ 25°C	(mmhos/cm)	.14	.45	.47	.34
Ca+Mg	(me/l)				
EXCHANGEABLE SODIUM	(percent)				
ACIDITY					
IN KCl exchange acidity					
Total	(me/100g)				
Al^{+++}	(me/100g)				
CATION EXCHANGE CAPACITY NaOAc@pH 8.2	(me/100g)	12.5	24.6	22.2	13.8
BORON	(mg/l)				

GPO 835-198

Form 7310-12
(May 1973)

Table N-12

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

By: ? . Moore — Date: 8-?-78

Location: 2800'W, 250'N, SE COR. SEC. 3 – T19N, R 5W
MU-7317-PROFILE 5

Treatment affecting the SSF

DETERMINATION OF EROSION CONDITION CLASS
SOIL SURFACE FACTORS (SSF)

SOIL MOVEMENT •	No visual evidence of movement 0 1 2 3	Some movement of soil particles 4 5	Moderate movement of soil is visible and recent. Slight terracing generally less than 1" in height. (6) 7 8	Occurs with each event. Soil and debris deposited against minor obstructions. 9 10 11	Subsoil exposed over much of area, may have embryonic dunes and wind scoured depressions 12 13 14
SURFACE LITTER •	Accumulating in place 0 1 2 3	May show slight movement 4 5 (6)	Moderate movement is apparent, deposited against obstacles 7 8	Extreme movement apparent, large and numerous deposits against obstacles 9 10 11	Very little remaining *(use care on low productive sites)* 12 13 14
SURFACE ROCK •	If present, the distribution of fragments show no movement caused by wind or water 0 1 2	If present, coarse fragments have a truncated appearance or spotty distribution caused by wind or water 3 4 5	If present, fragments have a poorly developed distribution pattern caused by wind or water 6 7 8	If present, surface rock or fragments exhibit same movement and accumulation of smaller fragments behind obstacles 9 10 11	If present, surface rock or fragments are dissected by rills and gullies or are already washed away 12 13 14
PEDESTALLING •	No visual evidence of pedestalling 0 1 2 3	Slight pedestalling, in flow patterns 4 5 6	Small rock and plant pedestals occurring in flow patterns (7) 8 9	Rocks and plants on pedestals generally evident, plant roots exposed 10 11	Most rocks and plants pedestalled and roots exposed 12 13 14
FLOW PATTERNS •	No visual evidence of flow patterns 0 1 2 3	Deposition of particles may be in evidence 4 5 6	Well defined, small, and few with intermittent deposits 7 (8) 9	Flow patterns contain silt and sand deposits and alluvial fans 10 11 12	Flow patterns are numerous and readily noticeable. May have large barren fan deposits. 13 14 15
RILLS	No visual evidence of rills 0 1 2 3	Some rills in evidence at infrequent intervals over 10' 4 5 6	Rills ½" to 6" deep occur in exposed places at approximately 10' intervals (7) 8 9	Rills ½" to 6" deep occur in exposed area at intervals of 5 to 10' 10 11 12	May be present at 3" to 6" deep at intervals less than 5' 13 14
GULLIES	May be present in stable condition. Vegetation on channel bed and side slopes 0 1 2 3	A few gullies in evidence which show little bed or slope erosion. Some vegetation is present on slopes. 4 5 6	Gullies are well developed with active erosion along less than 10% of their length. Some vegetation may be present. 7 8 9	Gullies are numerous and well developed with active erosion along 10 to 50% of their lengths or a few well developed gullies with active erosion along more than 50% of their length 10 11 12	Sharply incised gullies cover most of the area and over 50% are actively eroding 13 14 15

SITUATION	TOTAL				
		PRESENT SSF =	34 ÷ 64 × 100 = 53	(Moderate)	

Erosion Condition Classes: Stable 0–20; Slight 21–40; Moderate 41–60; Critical 61–80; Severe 81–100

(Instructions on reverse)

Table N-12 (con.)
EXAMPLES

ITEM	EXAMPLE ONE			EXAMPLE TWO**			EXAMPLE THREE***		
	POTENTIALLY PRESENT	IDENTIFIED FACTORS	POSSIBLE FACTOR	POTENTIALLY PRESENT	IDENTIFIED FACTORS	POSSIBLE FACTOR	POTENTIALLY PRESENT	IDENTIFIED FACTORS	POSSIBLE FACTOR
Soil Movement	Yes	8	14	Yes	8	14	Yes	8	14
Surface Litter	Yes	9	14	Yes	9	14	Yes	9	14
Surface Rock	Yes	7	14	No	–	– –	No	–	– –
Pedestalling	Yes	10	14	Yes	10	14	Yes	10	14
Rills	Yes	8	14	Yes	8	14	No	–	– –
Flow Patterns	Yes	10	15	Yes	10	15	Yes	10	15
Gullies	Yes	6	15	No	–	– –	No	–	– –
TOTAL		58	100		45	71		37	57
Total SSF	$\frac{58}{100} \times 100 = 58$			$\frac{45}{71} \times 100 = 63$			$\frac{37}{57} \times 100 = 65$		

GENERAL INSTRUCTIONS

District prepares one (1) copy and files in district with particular study under consideration.

Do *not* include items in computations which are not potentially present.

Identify numerical factor that most nearly describes the conditions observed by circling the factor given for each logical item.

**Wind and water are considered eroding agents when evaluating item*
***A soil with no rocks in its profile and no probability of gullying*
****A pumice soil area where no water erosion occurs*

SPECIFIC INSTRUCTIONS

Total all factors at bottom of page. Divide total identified factors by total possible factors for items considered and multiply by 100 in order to compute the SSF.

Situation – Describe situations being evaluated such as present, geologic, with mechanical treatment in effect for 10 years, under a 5 pasture livestock management system for last 8 years, etc.

Total – Total computed SSF.

☆ U. S. GOVERNMENT PRINTING OFFICE 1972--780-678/117 REGION NO. 8

Form 7310-12
(May 1973)

Table N-12 (con.)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

DETERMINATION OF EROSION CONDITION CLASS
SOIL SURFACE FACTORS (SSF)

By: P. G. MOORE | Date: 8-78

Location: 990'E, 593'S, NW COR SEC. 4, T19N, R5W
MU-7020-PROFILE 31

Treatment affecting the SSF

SOIL MOVEMENT •	No visual evidence of movement 0 1 2 3	Some movement of soil particles 4 5	Moderate movement of soil is visible and recent. Slight terracing generally less than 1" in height. 6 7 8	Occurs with each event. Soil and debris deposited against minor obstructions. 9 10 11	Subsoil exposed over much of area, may have embryonic dunes and wind scoured depressions (12) 13 14
SURFACE LITTER •	Accumulating in place 0 1 2 3	May show slight movement 4 5 6	Moderate movement is apparent, deposited against obstacles 7 8	Extreme movement apparent, large and numerous deposits against obstacles 9 (10) 11	Very little remaining *(use care on low productive sites)* 12 13 14
SURFACE ROCK •	If present, the distribution of fragments show no movement caused by wind or water 0 1 2	If present, coarse fragments have a truncated appearance or spotty distribution caused by wind or water 3 4 5	If present, fragments have a poorly developed distribution pattern caused by wind or water 6 7 8	If present, surface rock or fragments exhibit same movement and accumulation of smaller fragments behind obstacles 9 10 11	If present, surface rock or fragments are dissected by rills and gullies or are already washed away 12 13 14
PEDESTALLING •	No visual evidence of pedestalling 0 1 2 3	Slight pedestalling, in flow patterns 4 5 6	Small rock and plant pedestals occurring in flow patterns 7 8 9	Rocks and plants on pedestals generally evident, plant roots exposed 10 (11)	Most rocks and plants pedestalled and roots exposed 12 13 14
FLOW PATTERNS •	No visual evidence of flow patterns 0 1 2 3	Deposition of particles may be in evidence 4 5 6	Well defined, small, and few with intermittent deposits 7 8 9	Flow patterns contain silt and sand deposits and alluvial fans 10 11 (12)	Flow patterns are numerous and readily noticeable. May have large barren fan deposits. 13 14 15
RILLS	No visual evidence of rills 0 1 2 3	Some rills in evidence at infrequent intervals over 10' 4 5 6	Rills 1/2" to 6" deep occur in exposed places at approximately 10' intervals 7 8 9	Rills 1/2" to 6" deep occur in exposed area at intervals of 5 to 10' 10 11 12	May be present at 3" to 6" deep at intervals less than 5' (13) 14
GULLIES	May be present in stable condition. Vegetation on channel bed and side slopes 0 1 2 3	A few gullies in evidence which show little bed or slope erosion. Some vegetation is present on slopes. 4 5 6	Gullies are well developed with active erosion along less than 10% of their length. Some vegetation may be present. 7 8 9	Gullies are numerous and well developed with active erosion along 10 to 50% of their lengths or a few well developed gullies with active erosion along more than 50% of their length 10 11 12	Sharply incised gullies cover most of the area and over 50% are actively eroding 13 14 15
SITUATION	TOTAL	PRESENT SSF =	58 ÷ 71 X 100 =	82 (SEVERE)	

Erosion Condition Classes: Stable 0–20; Slight 21–40; Moderate 41–60; Critical 61–80; Severe 81–100

(Instructions on reverse)

Form 7310-12
(May 1973)

Table N-12 (con.)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

DETERMINATION OF EROSION CONDITION CLASS
SOIL SURFACE FACTORS (SSF)

By: RG MOORE | Date: 8-78

Location: 1300'W, 1732'N, SE COR SEC. 33, T20N, R5W
MU-7020-PROFILE 52

Treatment affecting the SSF

SOIL MOVEMENT *	No visual evidence of movement 0 1 2 3	Some movement of soil particles 4 5	Moderate movement of soil is visible and recent. Slight terracing generally less than 1" in height. 6 7 8	Occurs with each event. Soil and debris deposited against minor obstructions. 9 10 11	Subsoil exposed over much of area, may have embryonic dunes and wind scoured depressions (12) 13 14
SURFACE LITTER *	Accumulating in place 0 1 2 3	May show slight movement 4 5 6	Moderate movement is apparent, deposited against obstacles 7 8	Extreme movement apparent, large and numerous deposits against obstacles 9 (10) 11	Very little remaining *(use care on low productive sites)* 12 13 14
SURFACE ROCK *	If present, the distribution of fragments show no movement caused by wind or water 0 1 2	If present, coarse fragments have a truncated appearance or spotty distribution caused by wind or water 3 4 5	If present, fragments have a poorly developed distribution pattern caused by wind or water 6 7 8	If present, surface rock or fragments exhibit same movement and accumulation of smaller fragments behind obstacles 9 10 11	If present, surface rock or fragments are dissected by rills and gullies or are already washed away 12 13 14
PEDESTALLING *	No visual evidence of pedestalling 0 1 2 3	Slight pedestalling, in flow patterns 4 5 6	Small rock and plant pedestals occurring in flow patterns 7 8 9	Rocks and plants on pedestals generally evident, plant roots exposed 10 (11)	Most rocks and plants pedestalled and roots exposed 12 13 14
FLOW PATTERNS *	No visual evidence of flow patterns 0 1 2 3	Deposition of particles may be in evidence 4 5 6	Well defined, small, and few with intermittent deposits 7 8 9	Flow patterns contain silt and sand deposits and alluvial fans 10 11 (12)	Flow patterns are numerous and readily noticeable. May have large barren fan deposits. 13 14 15
RILLS	No visual evidence of rills 0 1 2 3	Some rills in evidence at infrequent intervals over 10' 4 5 6	Rills ½" to 6" deep occur in exposed places at approximately 10' intervals 7 8 9	Rills ½" to 6" deep occur in exposed area at intervals of 5 to 10' 10 11 12	May be present at 3" to 6" deep at intervals less than 5' (13) 14
GULLIES	May be present in stable condition. Vegetation on channel bed and side slopes 0 1 2 3	A few gullies in evidence which show little bed or slope erosion. Some vegetation is present on slopes. 4 5 6	Gullies are well developed with active erosion along less than 10% of their length. Some vegetation may be present. 7 8 9	Gullies are numerous and well developed with active erosion along 10 to 50% of their lengths or a few well developed gullies with active erosion along more than 50% of their length 10 11 12	Sharply incised gullies cover most of the area and over 50% are actively eroding 13 14 15

SITUATION	TOTAL				
		PRESENT SSF =	58 ÷ 71 X 100 =	82 (SEVERE)	

Erosion Condition Classes: Stable 0–20; Slight 21–40; Moderate 41–60; Critical 61–80; Severe 81–100

(Instructions on reverse)

Table N-12 (con.)

Form 7310-12
(May 1973)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

By F.G. MOORE | Date 8-3-78

Location 2145'W, 1980'N, SE COR SEC. 33, T20N, R5W
MU-7018 PROFILE-53

Treatment affecting the SSF

DETERMINATION OF EROSION CONDITION CLASS
SOIL SURFACE FACTORS (SSF)

SOIL MOVEMENT •	No visual evidence of movement 0 1 2 3	Some movement of soil particles 4 (5)	Moderate movement of soil is visible and recent. Slight terracing generally less than 1" in height. 6 7 8	Occurs with each event. Soil and debris deposited against minor obstructions. 9 10 11	Subsoil exposed over much of area, may have embryonic dunes and wind scoured depressions 12 13 14
SURFACE LITTER •	Accumulating in place 0 1 2 3	May show slight movement 4 (5) 6	Moderate movement is apparent, deposited against obstacles 7 8	Extreme movement apparent, large and numerous deposits against obstacles 9 10 11	Very little remaining *(use care on low productive sites)* 12 13 14
SURFACE ROCK •	If present, the distribution of fragments show no movement caused by wind or water 0 1 2	If present, coarse fragments have a truncated appearance or spotty distribution caused by wind or water 3 4 5	If present, fragments have a poorly developed distribution pattern caused by wind or water 6 7 8	If present, surface rock or fragments exhibit same movement and accumulation of smaller fragments behind obstacles 9 10 11	If present, surface rock or fragments are dissected by rills and gullies or are already washed away 12 13 14
PEDESTALLING •	No visual evidence of pedestalling 0 1 2 3	Slight pedestalling, in flow patterns (4) 5 6	Small rock and plant pedestals occurring in flow patterns 7 8 9	Rocks and plants on pedestals generally evident, plant roots exposed 10 11	Most rocks and plants pedestalled and roots exposed 12 13 14
FLOW PATTERNS •	No visual evidence of flow patterns 0 1 2 (3)	Deposition of particles may be in evidence 4 5 6	Well defined, small, and few with intermittent deposits 7 8 9	Flow patterns contain silt and sand deposits and alluvial fans 10 11 12	Flow patterns are numerous and readily noticeable. May have large barren fan deposits. 13 14 15
RILLS	No visual evidence of rills 0 1 (2) 3	Some rills in evidence at infrequent intervals over 10' 4 5 6	Rills ½" to 6" deep occur in exposed places at approximately 10' intervals 7 8 9	Rills ½" to 6" deep occur in exposed area at intervals of 5 to 10' 10 11 12	May be present at 3" to 6" deep at intervals less than 5' 13 14
GULLIES	May be present in stable condition. Vegetation on channel bed and side slopes 0 1 2 3	A few gullies in evidence which show little bed or slope erosion. Some vegetation is present on slopes. 4 5 6	Gullies are well developed with active erosion along less than 10% of their length. Some vegetation may be present. 7 8 9	Gullies are numerous and well developed with active erosion along 10 to 50% of their lengths or a few well developed gullies with active erosion along more than 50% of their length 10 11 12	Sharply incised gullies cover most of the area and over 50% are actively eroding 13 14 15
SITUATION	TOTAL	PRESENT SSF =	19 ÷ 71 x 100 =	27 (SLIGHT)	

Erosion Condition Classes: Stable 0–20; Slight 21–40; Moderate 41–60; Critical 61–80; Severe 81–100

(Instructions on reverse)

Form 7310-12
(May 1973)

Table N-12 (con.)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

DETERMINATION OF EROSION CONDITION CLASS
SOIL SURFACE FACTORS (SSF)

By: R G MOORE | Date: 8-78

Location: 600' W, 400' N, SE COR. SEC 35, T 20N, R5W
MU-7019-PROFILE 83

Treatment affecting the SSF

SOIL MOVEMENT •	No visual evidence of movement 0 1 2 3	Some movement of soil particles 4 5	Moderate movement of soil is visible and recent. Slight terracing generally less than 1" in height. 6 7 (8)	Occurs with each event. Soil and debris deposited against minor obstructions. 9 10 11	Subsoil exposed over much of area, may have embryonic dunes and wind scoured depressions 12 13 14
SURFACE LITTER •	Accumulating in place 0 1 2 3	May show slight movement 4 5 6	Moderate movement is apparent, deposited against obstacles (7) 8	Extreme movement apparent, large and numerous deposits against obstacles 9 10 11	Very little remaining *(use care on low productive sites)* 12 13 14
SURFACE ROCK •	If present, the distribution of fragments show no movement caused by wind or water 0 1 2	If present, coarse fragments have a truncated appearance or spotty distribution caused by wind or water 3 4 5	If present, fragments have a poorly developed distribution pattern caused by wind or water 6 7 8	If present, surface rock or fragments exhibit same movement and accumulation of smaller fragments behind obstacles 9 10 11	If present, surface rock or fragments are dissected by rills and gullies or are already washed away 12 13 14
PEDESTALLING •	No visual evidence of pedestalling 0 1 2 3	Slight pedestalling, in flow patterns 4 5 6	Small rock and plant pedestals occurring in flow patterns 7 (8) 9	Rocks and plants on pedestals generally evident, plant roots exposed 10 11	Most rocks and plants pedestalled and roots exposed 12 13 14
FLOW PATTERNS •	No visual evidence of flow patterns 0 1 2 3	Deposition of particles may be in evidence 4 5 6	Well defined, small, and few with intermittent deposits 7 8 9	Flow patterns contain silt and sand deposits and alluvial fans 10 (11) 12	Flow patterns are numerous and readily noticeable. May have large barren fan deposits. 13 14 15
RILLS	No visual evidence of rills 0 1 2 3	Some rills in evidence at infrequent intervals over 10' 4 5 6	Rills ½" to 6" deep occur in exposed places at approximately 10' intervals 7 8 9	Rills ½" to 6" deep occur in exposed area at intervals of 5 to 10' (10) 11 12	May be present at 3" to 6" deep at intervals less than 5' 13 14
GULLIES	May be present in stable condition. Vegetation on channel bed and side slopes 0 1 2 3	A few gullies in evidence which show little bed or slope erosion. Some vegetation is present on slopes. 4 5 6	Gullies are well developed with active erosion along less than 10% of their length. Some vegetation may be present. 7 8 9	Gullies are numerous and well developed with active erosion along 10 to 50% of their lengths or a few well developed gullies with active erosion along more than 50% of their length 10 11 12	Sharply incised gullies cover most of the area and over 50% are actively eroding 13 14 15

SITUATION	TOTAL				
		PRESENT SSF =	44 ÷ 71 X 100 =	62 (CRITICAL)	

Erosion Condition Classes: Stable 0–20; Slight 21–40; Moderate 41–60; Critical 61–80; Severe 81–100

(Instructions on reverse)

Form 7310-12
(May 1973)

Table N-12 (con.)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

DETERMINATION OF EROSION CONDITION CLASS

SOIL SURFACE FACTORS (SSF)

By: R G MOORE | Date: 8-78

Location: 850'W, 1250'S, NE COR SEC. 2, T19N, R5W
MU-7019-PROFILE 89

Treatment affecting the SSF

SOIL MOVEMENT*	No visual evidence of movement 0 1 2 3	Some movement of soil particles 4 5	Moderate movement of soil is visible and recent. Slight terracing generally less than 1" in height. 6 7 (8)	Occurs with each event. Soil and debris deposited against minor obstructions. 9 10 11	Subsoil exposed over much of area, may have embryonic dunes and wind scoured depressions 12 13 14
SURFACE LITTER*	Accumulating in place 0 1 2 3	May show slight movement 4 5 6	Moderate movement is apparent, deposited against obstacles 7 (8)	Extreme movement apparent, large and numerous deposits against obstacles 9 10 11	Very little remaining *(use care on low productive sites)* 12 13 14
SURFACE ROCK*	If present, the distribution of fragments show no movement caused by wind or water 0 1 2	If present, coarse fragments have a truncated appearance or spotty distribution caused by wind or water 3 4 5	If present, fragments have a poorly developed distribution pattern caused by wind or water 6 7 8	If present, surface rock or fragments exhibit same movement and accumulation of smaller fragments behind obstacles 9 10 11	If present, surface rock or fragments are dissected by rills and gullies or are already washed away 12 13 14
PEDESTALLING*	No visual evidence of pedestalling 0 1 2 3	Slight pedestalling, in flow patterns 4 5 6	Small rock and plant pedestals occurring in flow patterns 7 8 (9)	Rocks and plants on pedestals generally evident, plant roots exposed 10 11	Most rocks and plants pedestalled and roots exposed 12 13 14
FLOW PATTERNS*	No visual evidence of flow patterns 0 1 2 3	Deposition of particles may be in evidence 4 5 6	Well defined, small, and few with intermittent deposits 7 8 9	Flow patterns contain silt and sand deposits and alluvial fans 10 (11) 12	Flow patterns are numerous and readily noticeable. May have large barren fan deposits. 13 14 15
RILLS	No visual evidence of rills 0 1 2 3	Some rills in evidence at infrequent intervals over 10' 4 5 6	Rills 1/2" to 6" deep occur in exposed places at approximately 10' intervals 7 8 9	Rills 1/2" to 6" deep occur in exposed area at intervals of 5 to 10' 10 11 (12)	May be present at 3" to 6" deep at intervals less than 5' 13 14
GULLIES	May be present in stable condition. Vegetation on channel bed and side slopes 0 1 2 3	A few gullies in evidence which show little bed or slope erosion. Some vegetation is present on slopes. 4 5 6	Gullies are well developed with active erosion along less than 10% of their length. Some vegetation may be present. 7 8 9	Gullies are numerous and well developed with active erosion along 10 to 50% of their lengths or a few well developed gullies with active erosion along more than 50% of their length 10 11 12	Sharply incised gullies cover most of the area and over 50% are actively eroding 13 14 15
SITUATION	TOTAL				
		PRESENT SSF =	48÷71X100 =	68 (CRITICAL)	

Erosion Condition Classes: Stable 0–20; Slight 21–40; Moderate 41–60; Critical 61–80; Severe 81–100

(Instructions on reverse)

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Table N-13

VEGETATION–SOIL DESCRIPTION

1. State: NM
2. District: FARM.
3. Planning Unit: --
4. Vegetation Soil Unit: --
5. Soil Map Symbol: 7017
6. Surname: R G MOORE
7. Date: 8 mo 78 yr

8. Area: --
9. County: McKIN.
10. Location: Sec. 7, T. 19N, R. 5W
11. Photo No.: --
12. Writeup No.: --
13. File No.: --
14. Parent Rock: Alluvium

15. Formation Name: QUATERNARY Alluvium
16. Surface Conditions (percent): NONE (Stone -- Rock --)
17. Land Conditions: YES; YES; Water tabl NONE
18. Landform: VALLEY

19. Slope (percent): ≤3; X Single ☐ Complex
20. Aspect: S
21. Elevation: 6640
22. Present Erosion: Type SHEET, FILL; SSF --- Class: MODERATE
23. Hydrologic Group: -

24. Precipitation (in): 12 TOTAL (1st, 2nd, 3rd, 4th)
25. Temperature: -- Air -- Soil
26. Frost-free: 138 Days ---> 28°
27. Drainage Class: SURFACE WELL DRAINED
28. Infiltration: V.V. slow
29. Percolation: NONE
30. ERD: -- in
31. AWC: --.-- in

32. HORIZON	33. THICKNESS	34. COLOR (DRY/MOIST) MATRIX	MOTTLING	35. TEXTURE	36. STRUCTURE	37. CONSISTENCY DRY MOIST	38. CLAY FILMS	39. ROOTS	40. STONES % VOL.	41. REACTION (pH)	42. BOUNDARY
A1	0-48	10YR 2/1 dry		CL	A BLOCK	firm pls sti				7.3	
C1	48-84	10YR 3/1 dry		SL	GRAN	fri non pls sli sti				7.1	
C2	84-108	10YR 8/4 dry		SCL	GRAN	fri non pls sli sti				6.7	

PROFILE-5, MASTER SITE FOR MAPPING UNIT 7017 – NOTAL ASSOCIATION

(Instructions inside back cover)

Form 7310-9a (December 1970)

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Table N-13 (con.)

VEGETATION-SOIL DESCRIPTION

1. State NM
2. District FARM
3. Planning Unit
4. Vegetation-Soil Unit
5. Soil Map Symbol 7020
6. Surname
7. Date 8 mo 78 yr

8. Area
9. County McKIN.
10. Location Sec. 4, T. 19N, R 5W
11. Photo No
12. Writeup No.
13. File No
14. Parent Rock ALLUVIUM

15. Formation Name CRETACEOUS KIRTLAND
16. Surface Conditions (percent) Stone — Rock
17. Land Conditions Alkaline YES Saline YES Water table NONE
18. Landform

19. Slope (percent) <3 X Single Complex
20. Aspect S
21. Elevation 6640
22. Present Erosion RILL, WATER Type SEVERE SSF Class
23. Hydrologic Group

24. Precipitation (in) 12 TOTAL 1st, 2nd, 3rd, 4th
25. Temperature — Air — Soil
26. Frost-free 138 Days —> 28°
27. Drainage Class SURFACE WELL DRAINED
28. Infiltration V. POOR
29. Percolation V. POOR
30. ERD — in
31. AWC — in

32. HORIZON	33. THICKNESS	34. COLOR DRY/MOIST MATRIX	MOTTLING	35. TEXTURE	36. STRUCTURE	37. CONSISTENCY DRY MOIST	38. CLAY FILMS	39. ROOTS	40. STONES % VOL	41. REACTION (pH)	42. BOUNDARY
A	0-12	10YR 5/3 dry		SL	A BLOCK	fri, sl pls STI				7.8	
	12-60	10YR 5/4 dry		SL	GRAN	loose NON pls NON STI				7.4	
	60-72	10YR 4/3 dry		SL	GRAN	fri NON pls NON STI				7.7	
	72-120	10YR 4/3 dry		SL	GRAN	loose NON pls NON STI				7.5	

PROFILE-31 MASTER SITE FOR MAPPING UNIT 7020 — BLANCOT-FRUITLAND COMPLEX

(Instructions inside back cover)

Form 7310-9a (December 1970)

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Table N-13 (con.)

VEGETATION–SOIL DESCRIPTION

1. State NM	2. District FARM	3. Planning Unit – –	4. Vegetation–Soil Unit – – – – – – – – – – / – – – – – – –	5. Soil Map Symbol 7020	6. Surname RG MOORE	7. Date 8 mo 78 yr
8. Area – –	9. County Mc KIN.	10. Location Sec. 33, T. 20N, R 5W	11. Photo No. – – – – – – – – – – –	12. Writeup No. – – – –	13. File No. – – – – – –	14. Parent Rock ALLUVIUM

15. Formation Name CRETACEOUS KIRTLAND	16. Surface Conditions (percent) Stone – – Rock	17. Land Conditions Alkaline YES Saline YES Water table NONE	18. Landform
19. Slope (percent) <3 ☐ Single ☒ Complex	20. Aspect S / 21. Elevation 6680	22. Present Erosion Type RILL, water SSF – – – Class SEVERE	23. Hydrologic Group –

24. Precipitation (in) 12 TOTAL 1st, 2nd, 3rd, 4th	25. Temperature – – Air – – Soil	26. Frost-free 138 Days – – – > 28°	27. Drainage Class SURFACE well drained	28. Infiltration V. POOR	29. Percolation V. POOR	30. ERD – – in	31. AWC – – . – in

32. HORIZON	33. THICKNESS	34. COLOR DRY MOIST – MATRIX	34. COLOR – MOTTLING	35. TEXTURE	36. STRUCTURE	37. CONSISTENCY DRY MOIST	38. CLAY FILMS	39. ROOTS	40. STONES % VOL	41. REACTION (pH)	42. BOUNDARY
A	0-24	10YR 6/3 dry		SCL	A Block	FIRM sli. pls V. sli. STI				7.3	
C1	24-48	10YR 6/3 dry		SL	GRAN	fri. NON pls NON STI				7.5	
C2	48-72	10YR 7/4 dry		LFS	SG	loose NON pls NON sti				7.5	
[illegible]	72-108	10YR 3/2 dry		C	A Block	FIRM pls NON STI				7.3	
[illegible]	108-120	10YR 5/4 dry		SL	SG	loose NON pls NON sti					

PROFILE-52-MASTER SITE FOR MAPPING UNIT 7020—BLANCOT-FRUITLAND COMPLEX

(Instructions inside back cover)

Form 7310-9a (December 1970)

Table N-13 (con.)

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VEGETATION–SOIL DESCRIPTION

1. State	2. District	3. Planning Unit	4. Vegetation–Soil Unit	5. Soil Map Symbol	6. Surname	7. Date
NM	FARM	— —	— — — — —	7018	RG MOORE	8 mo 78 yr

8. Area	9. County	10. Location	11. Photo No.	12. Writeup No.	13. File No.	14. Parent Rock
— —	McKIN.	Sec. 33 T. 20N R 5W	— — — —	— — — —	— — — —	EOLIAN

15. Formation Name	16. Surface Conditions (percent)	17. Land Conditions	18. Landform
CRETACEOUS KIRTLAND	Stone — — Rock	Alkaline NO; Saline NO; Water table NONE	UPLAND

19. Slope (percent)	20. Aspect	21. Elevation	22. Present Erosion	23. Hydrologic Group
≤ 3; [X] Single [ ] Complex	SE	6700	Type WIND; SSF — — — Cl. SLIGHT	–

24. Precipitation (in)	25. Temperature	26. Frost-free	27. Drainage Class	28. Infiltration	29. Percolation	30. ERD	31. AWC
12 TOTAL; 1st, 2nd, 3rd, 4th	— — Air — Soil	138 Days — — —> 28°	SURFACE Well drained	good	good	— — in	— —. — in

32. HORIZON	33. THICKNESS	34. COLOR DRY MOIST: MATRIX	MOTTLING	35. TEXTURE	36. STRUCTURE	37. CONSISTENCY DRY MOIST	38. CLAY FILMS	39. ROOTS	40. STONES % VOL	41. REACTION (pH)	42. BOUNDARY
A1	0–6	10YR 6/3 dry		fs	SG	Sl. loose NON P/S NON STI					
C	6–48	10YR 5/3 dry		SL	CRUMB	fri., NON P/S NON sti				7.3	
C	48–60	10YR 5/4 dry		cl	A BLOCK	fri., sli. p/s v. sli. sti.					
C1	60-120	10YR 6/4 dry		sl	SG	loose NON P/S NON sti				7.8	

PROFILE-53, MASTER SITE FOR MAPPING UNIT 7018 — DOAK–SHIPROCK LOAM

(Instructions inside back cover)

Form 7310–9a (December 1970)

Table N-13 (con.)

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VEGETATION–SOIL DESCRIPTION

1. State NM	2. District FARM	3. Planning Unit --	4. Vegetation–Soil Unit ---------- --------	5. Soil Map Symbol 7019	6. Surname R.G. MOORE	7. Date 8 mo 78 yr
8. Area --	9. County McKIN.	10. Location Sec. 35, T. 20N, R 5W	11. Photo No. ----- ----	12. Writeup No. ----	13. File No. ------	14. Parent Rock Alluvium

15. Formation Name QUATERNARY ALLUVIUM	16. Surface Conditions (percent) Stone -- Rock	17. Land Conditions Alkaline YES Saline NO Water table NONE	18. Landform

19. Slope (percent) <3 ☒ Single ☐ Complex	20. Aspect SE	21. Elevation 6600	22. Present Erosion RILL, WIND Type; SSF --- Class CRITICAL	23. Hydrologic Group -

24. Precipitation (in) 12 TOTAL 1st, 2nd, 3rd, 4th	25. Temperature -- Air -- Soil	26. Frost-free 138 Days ---> 28°	27. Drainage Class SURFACE well drained	28. Infiltration V. POOR	29. Percolation POOR	30. ERD -- in	31. AWC --.- in

32. HORIZON	33. THICKNESS	34. COLOR DRY/MOIST MATRIX	MOTTLING	35. TEXTURE	36. STRUCTURE	37. CONSISTENCY DRY MOIST	38. CLAY FILMS	39. ROOTS	40. STONES % VOL.	41. REACTION (pH)	42. BOUNDARY
1	0-24	10YR 5/4 dry		SCL	A Block	fri. pls STI				7.5	
C1	24-60	10YR 4/4 dry		SCL	A Block	fri pls STI				7.5	
C2	60-84	10YR 5/4 dry		SL	GRAN	fri, NON pls NON STI				7.3	
C3	84-120	10YR 4/4 dry		SL	CRUMB	fri, NON pls NON STI				7.3	

PROFILE-83 MASTER SITE FOR MAPPING UNIT 7019 — FRUITLAND-DOAK COMPLEX

(Instructions inside back cover)

Form 7310–9a (December 1970)

Table N-13 (con.)

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

VEGETATION-SOIL DESCRIPTION

1. State	2. District	3. Planning Unit	4. Vegetation-Soil Unit	5. Soil Map Symbol	6. Surname	7. Date
NM	FARM	__		7019	R. G MOORE	8 mo 78 yr

8. Area	9. County	10. Location	11. Photo No	12. Writeup No.	13. File No	14. Parent Rock
--	McKIN.	Sec. 2, T. 19N, R 5W				Alluvium

15. Formation Name	16. Surface Conditions (percent)	17. Land Conditions	18. Landform
QUATERNARY ALLUVIUM	Stone -- Rock	Alkaline YES; Saline NO; Water table NONE	

19. Slope (percent)	20. Aspect	21. Elevation	22. Present Erosion	23. Hydrologic Group
≤ 3; [X] Single [ ] Complex	E	6600	Type RILL, WATER; SSF --- Class CRITICAL	-

24. Precipitation (in.)	25. Temperature	26. Frost-free	27. Drainage Class	28. Infiltration	29. Percolation	30. ERD	31. AWC
12 TOTAL; 1st, 2nd, 3rd, 4th	-- Air -- Soil	138 Days ---> 28°	SURFACE well drained	FAIR	V. POOR	-- in	--.- in

32. HORIZON	33. THICKNESS	34. COLOR (DRY / MOIST) MATRIX	MOTTLING	35. TEXTURE	36. STRUCTURE	37. CONSISTENCY DRY MOIST	38. CLAY FILMS	39. ROOTS	40. STONES % VOL.	41. REACTION (pH)	42. BOUNDARY
[illegible]	0-14	10YR 6/4 dry		SL	GRAN	Firm NON p/s sl st				6.4	
[illegible]	14-42	10YR 5/3 dry		SCL	S Block	FIRM P/S st				6.9	
[illegible]	42-58	10YR 5/3 dry		SCL	S Block	FIRM P/S st				6.9	
[illegible]	58-72	10YR 6/4 dry		SL	MASS	FRI NON p/s st				7.0	

PROFILE - 89 MASTER SITE FOR MAPPING UNIT 7019 - FRUITLAND - DOAK COMPLEX

(Instructions inside back cover)

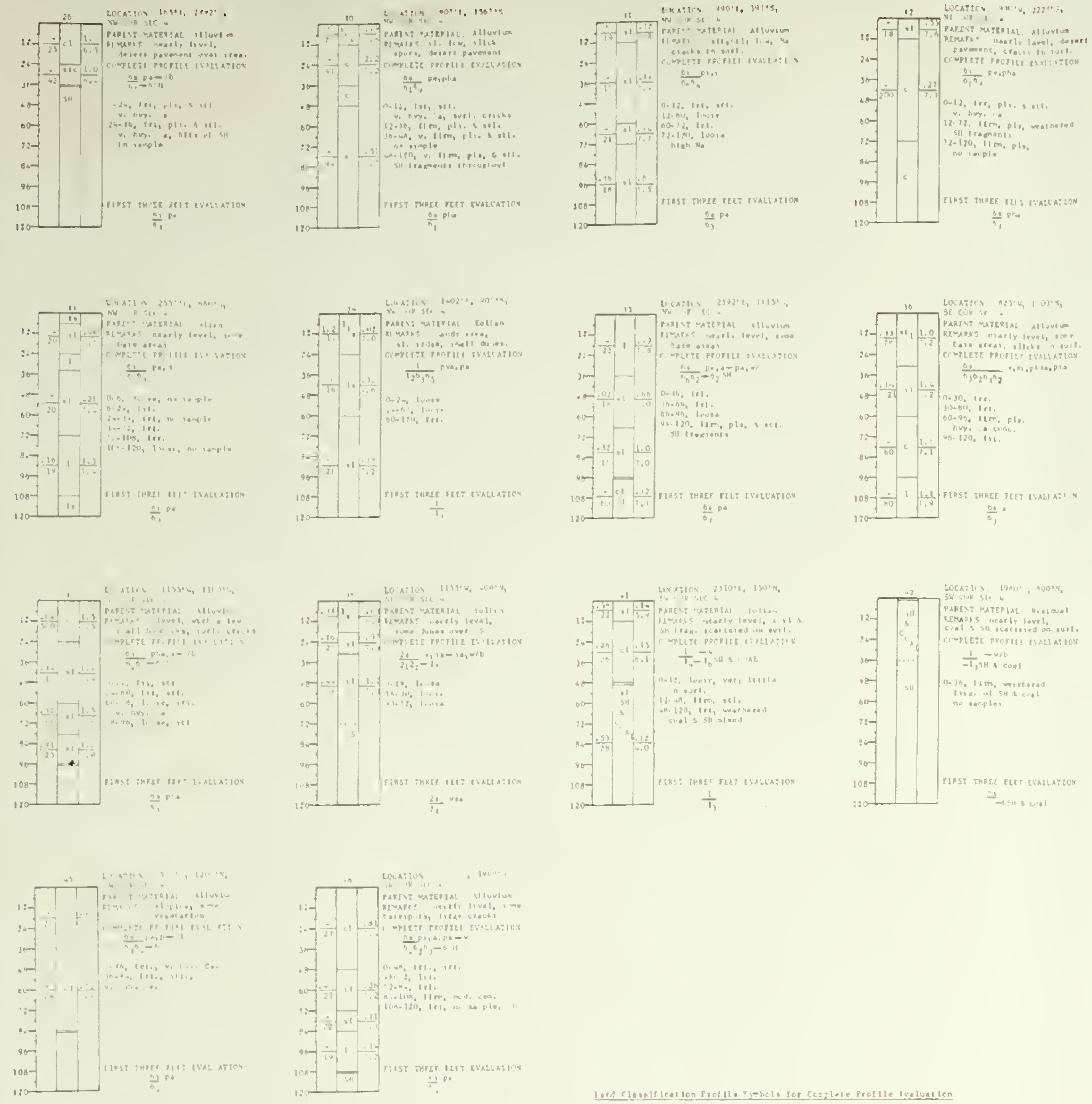
Form 7310-9a (December 1970)

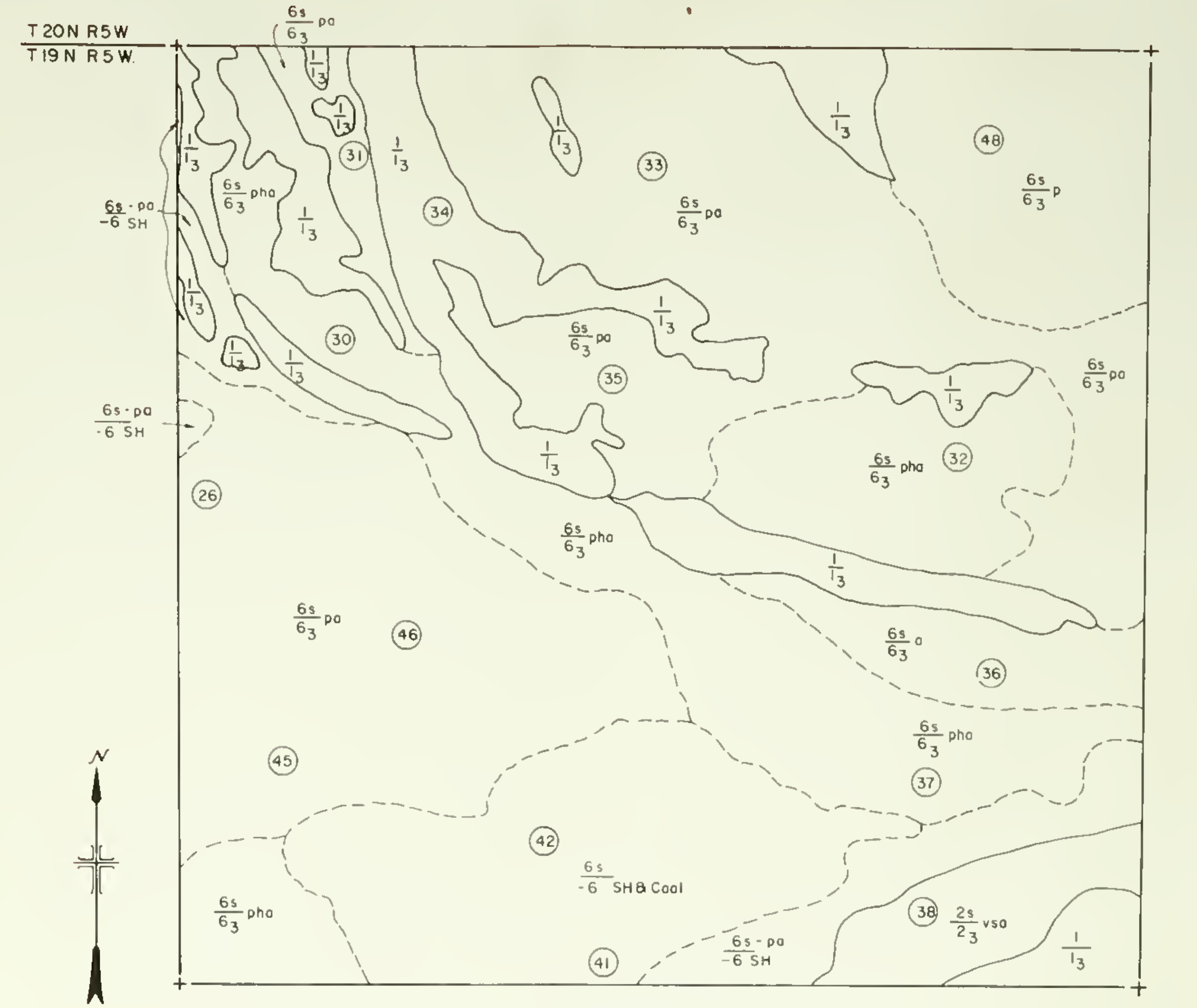
Land Classification

Table N-14
Land Class/Subclass Acreages

*Land class/ subclass	Section: T. 19 N., R. 5 W. (acres)						T. 20 N., R. 5 W. (acres)				Study area total/percent (acres/percent)
	2	3	4	5	7	9	33	34	35	36	
$\frac{1}{1_3}$	47	4	88	197	97	35	128	75	190		861/21
Total class 1	47	4	88	197	97	35	128	75	190		861/21
$\frac{2s}{2_3}$ v	201	2			47						250/6
$\frac{2s}{2_3}$ a		67						72			139/3
$\frac{2s}{2_3}$ vs		6						130	21		157/4
$\frac{2s}{2_3}$ va	58	52									110/3
$\frac{2s}{2_3}$ sa		115		8							123/3
$\frac{2s}{2_3}$ vsa		7	18			49					74/2
Total class 2	259	249	18	8	47	49		202	21		853/21
$\frac{6s}{6_3}$ a		28	19					27			74/2
$\frac{6s}{6_3}$ p		20	48		69		18	2	7	45	208/5
$\frac{6s}{6_3}$ ph					14	60					74/2
$\frac{6s}{6_3}$ pa	177	111	251	55	80		94	87	76	18	950/23
$\frac{6s}{6_3}$ pva	6	26		30							62/2
$\frac{6s}{6_3}$ pha		6	117	140	13	16					292/7
$\frac{6s}{6_3}$ psa	60									17	77/2
$\frac{6s}{-6SH}$ -pa	91	196	26	210		29		7	26		585/14
$\frac{6s}{-6SH}$ & coal			73			11					84/2
Total class 6	334	387	534	435	176	116	112	123	109	80	2,406/58
Total all classes	640	640	640	640	320	200	240	400	320	80	4,120/100.

*/ Based on top 36 inches of material.

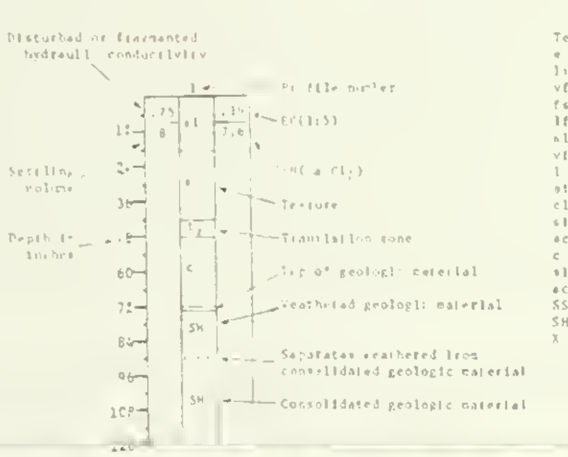




SECTION 4

500 0 500 1000 1500
SCALE OF FEET

Land Classification Profile Symbols for Complete Profile Evaluation



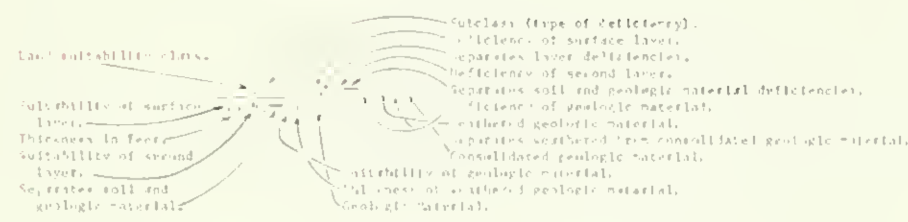
Textures

s	sand
ls	loamy sand
vfs	very fine sand
fs	fine sand
lfs	loamy fine sand
sl	sandy loam
vfsl	very fine sandy loam
l	loam
sil	silty loam
cl	clay loam
sicl	silty clay loam
scl	sandy clay loam
c	clay
sic	silty clay
sc	sandy clay
SS	sandstone
SH	shale
X	terminated augering

Complete Profile Evaluation

First Three Feet Evaluation*

*Only the first three feet was evaluated and classified for suitability as a source of planting media.



Land suitability class
1 - good
2 - fair
6 - unsuitable

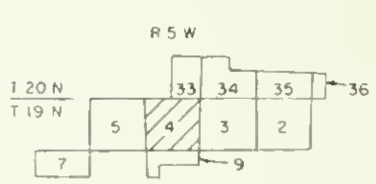
Subclass (type of deficiency)
s - soils

Subclass deficiencies (soil & geologic material)
s - salinity
h - very fine textures
p - restricted permeability
d - shallow depth of suitable material
w - weathered geologic material
h - consolidated geologic material

Profiles
separates classes
separates subclasses

LAND CLASS	ACRES**
1	[illegible]
2	[illegible]
TOTAL	[illegible]
6	[illegible]
GRAND TOTAL	[illegible]

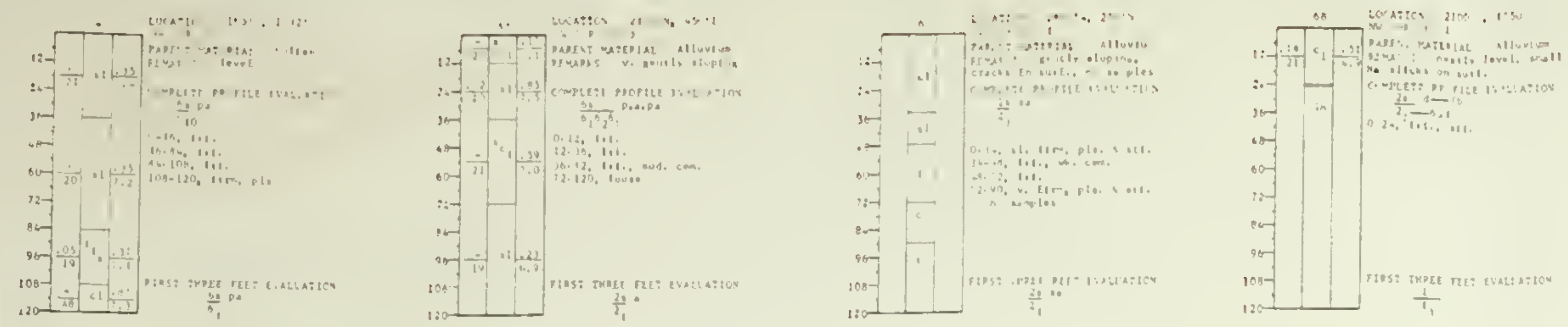
** for complete acreages of each individual land classification, see table [illegible]

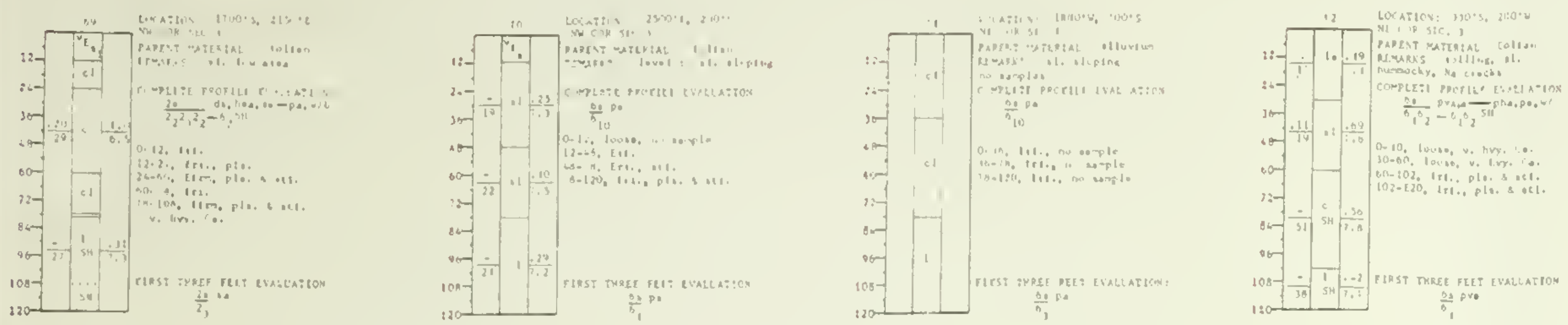


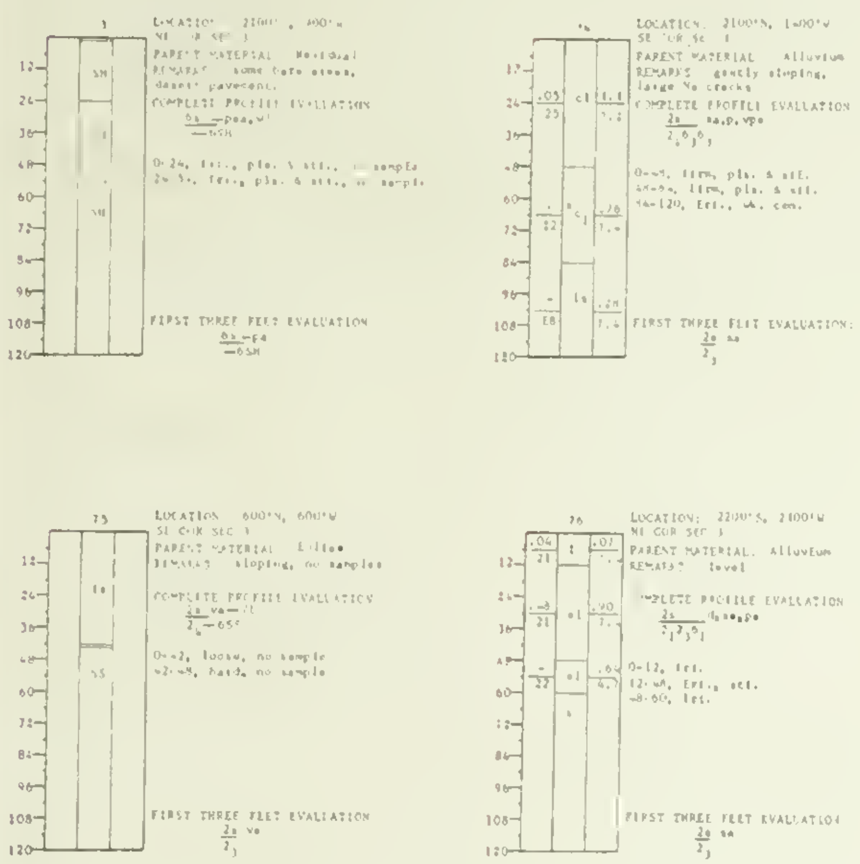
OJO ENCINO STUDY AREA, NEW MEXICO

PROFILE DESCRIPTION AND LAND CLASSIFICATION

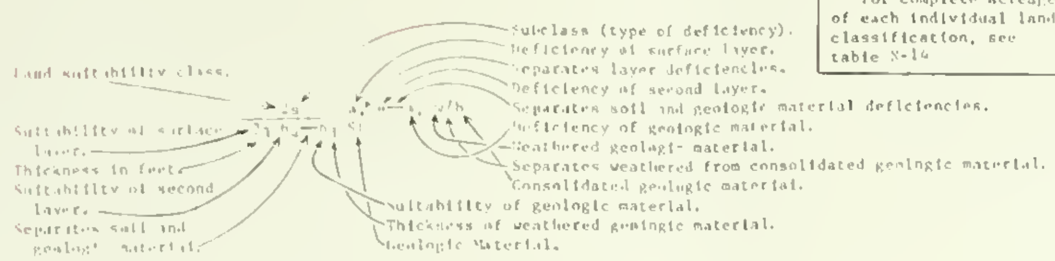
EMRIA REPORT NO 19-78







Land Classification Mapping Symbols for Complete Profile Evaluation



LAND CLASS	ACRES**
1	--
2	249
TOTAL	253
6	387
GRAND TOTAL	640

** for complete acreages of each individual land classification, see table N-14

Land suitability class
- 1 good
- 2 fair
- 6 unsuitable

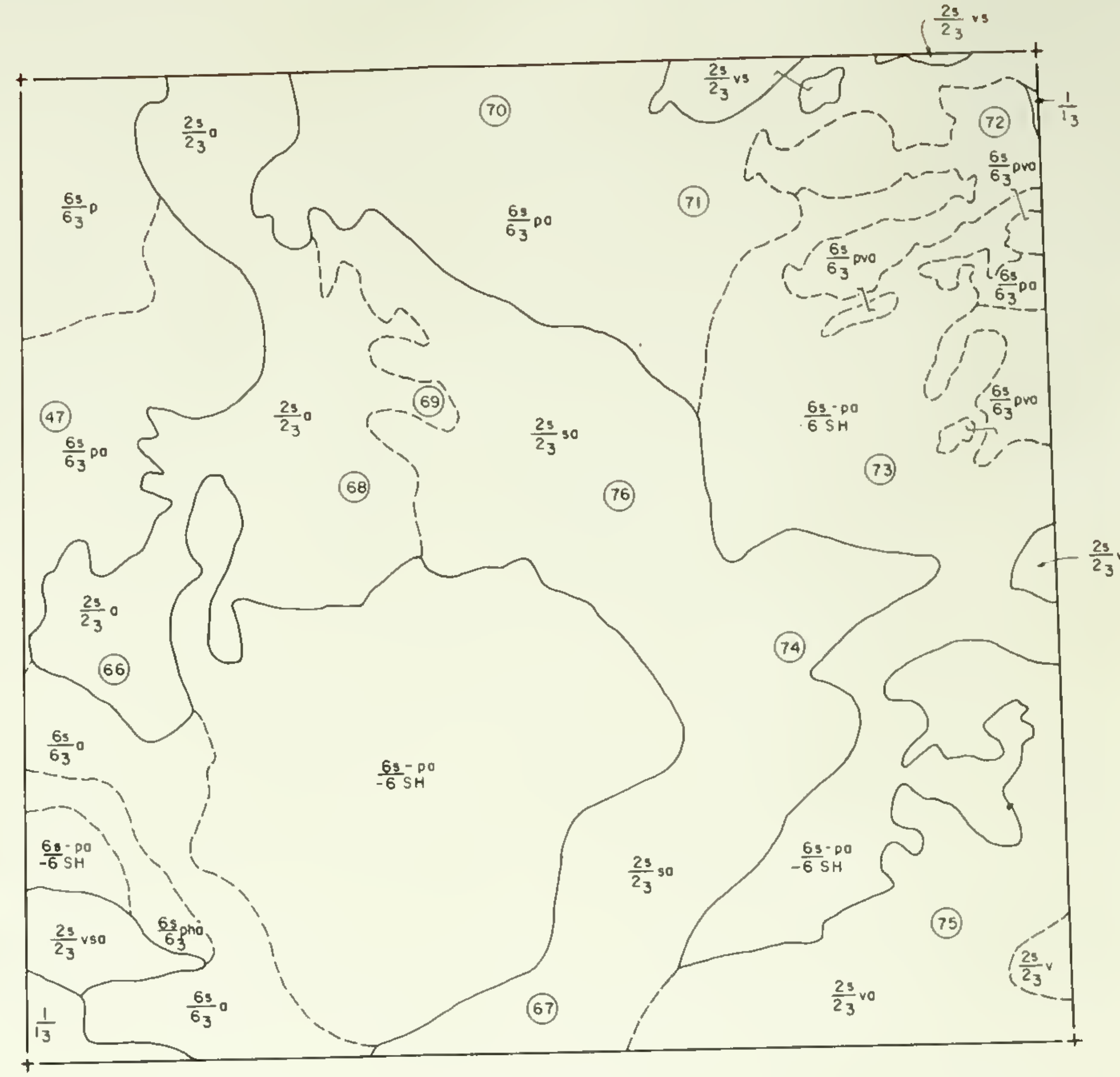
Subclass (type of deficiency)
- s - soils

Subclass deficiencies (soil & geologic material)
- s - salinity
- a - sodicity
- h - very fine textures
- v - coarse textures
- p - restricted permeability
- d - shallow depth of suitable material
- w - weathered geologic material
- b - consolidated geologic material

(4) Profiles

——— separates classes

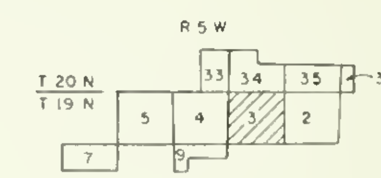
- - - - separates subclasses



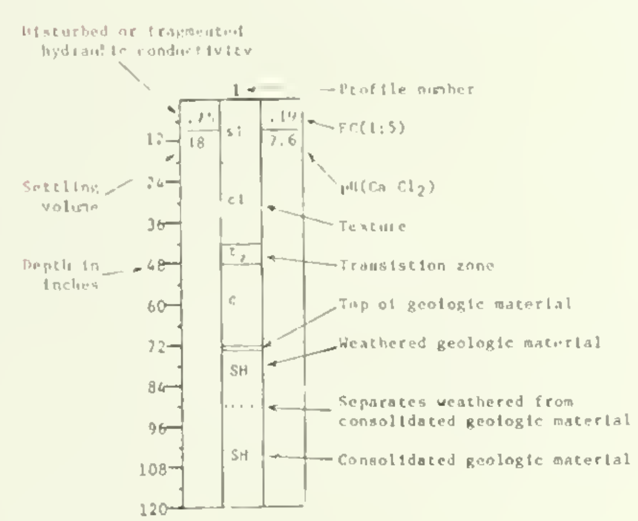
SECTION 3

500 0 500 1000 1500

SCALE OF FEET



Land Classification Profile Symbols for Complete Profile Evaluation



Textures

s	sand
ls	loamy sand
vfs	very fine sand
fs	fine sand
lfs	loamy fine sand
sl	sandy loam
vfsl	very fine sandy loam
l	loam
sil	silty loam
cl	clay loam
sicl	silty clay loam
scl	sandy clay loam
c	clay
sic	silty clay
sc	sandy clay
SS	sandstone
SH	shale
X	terminated augering

Complete Profile Evaluation

$\frac{2s}{2_1 2_2 - 2_3 SS}$ v, sa—sa, w/b

First Three Feet Evaluation*

$\frac{2s}{2_3}$ vsa

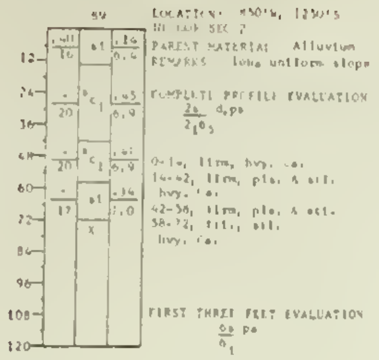
*Only the first three feet was evaluated and classified for suitability as a source of planting media.

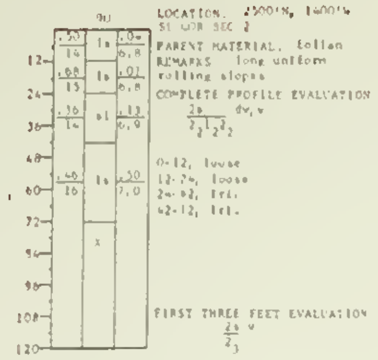
OJO ENCINO STUDY AREA, NEW MEXICO

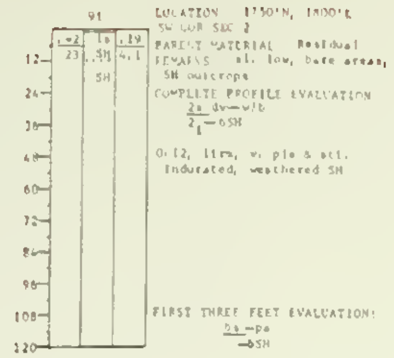
PROFILE DESCRIPTION AND LAND CLASSIFICATION

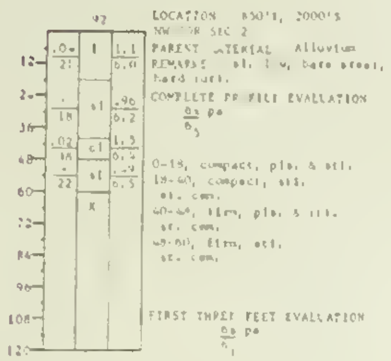
EMRIA REPORT NO 19-78

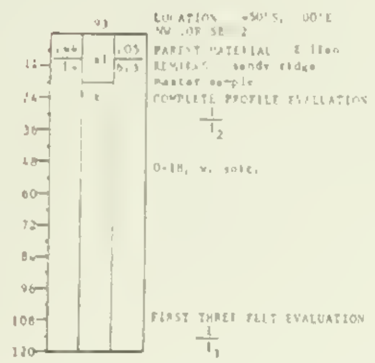
FIGURE N-10

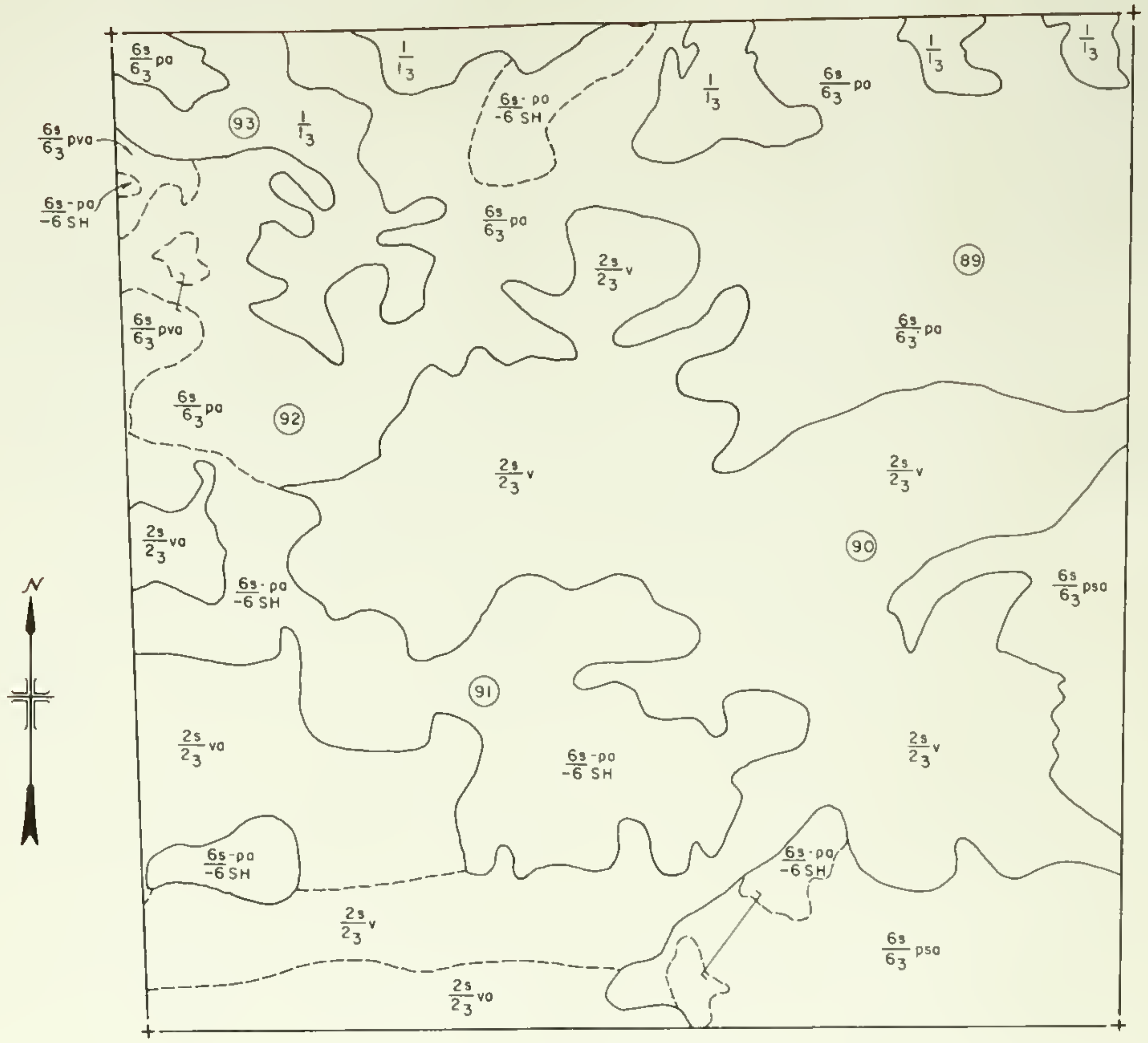






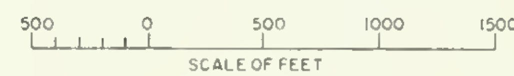




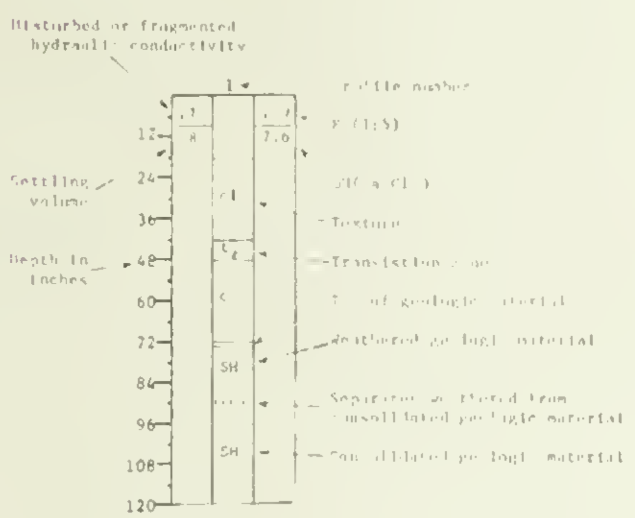


LAND CLASS	ACRES**
1	47
2	259
TOTAL	306
6	334
GRAND TOTAL	640

** for complete acreages of each individual land classification, see table N-14



Land Classification Profile Symbols for Complete Profile Evaluation



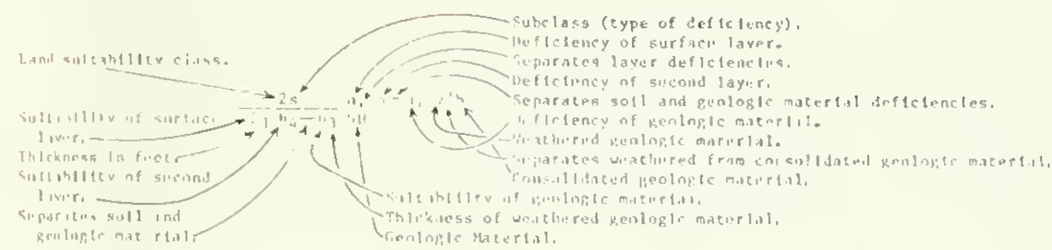
Textures
s sand
ls loamy sand
vfs very fine sand
fs fine sand
lfs loamy fine sand
sl sandy loam
vfsl very fine sandy loam
l loam
sil silty loam
cl clay loam
sicl silty clay loam
scl sandy clay loam
c clay
sic silty clay
sc sandy clay
SS sandstone
SH shale
X terminated augering

Complete Profile Evaluation

First Three Feet Evaluation*

*Only the first three feet was evaluated and classified for suitability as a source of plating media.

Land Classification Mapping Symbols for Complete Profile Evaluation

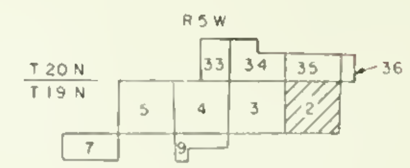


Land suitability class
1 good
2 fair
6 unsuitable

Subclass (type of deficiency)
s - soils

Subclass deficiencies (soil & geologic material)
s - salinity
a - sodicity
b - very fine textures
v - coarse textures
p - restricted permeability
d - shallow depth of suitable material
w - weathered geologic material
h - consolidated geologic material

(4) Profiles
——— separates classes
- - - - separates subclasses



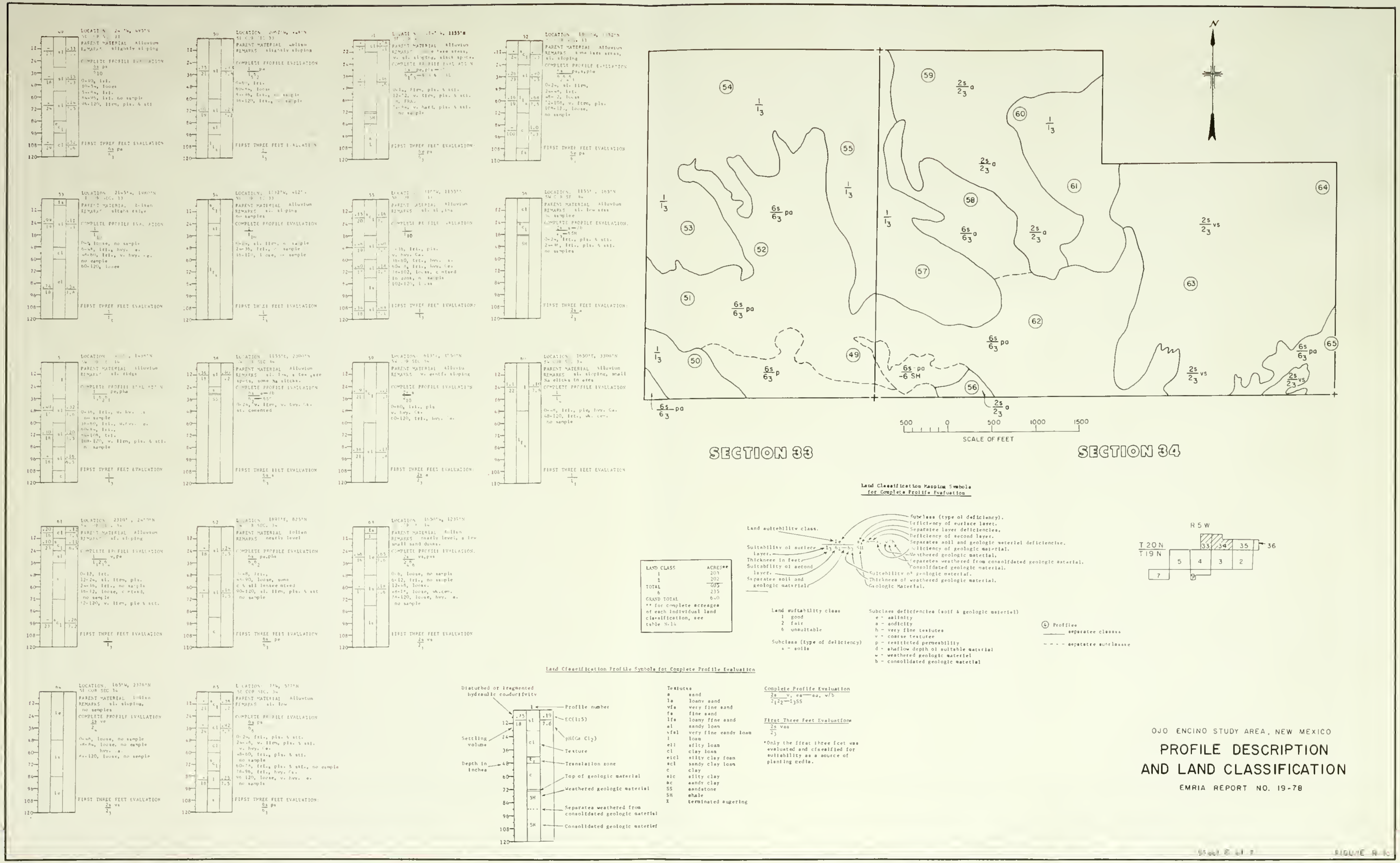
OJO ENCINO STUDY AREA, NEW MEXICO

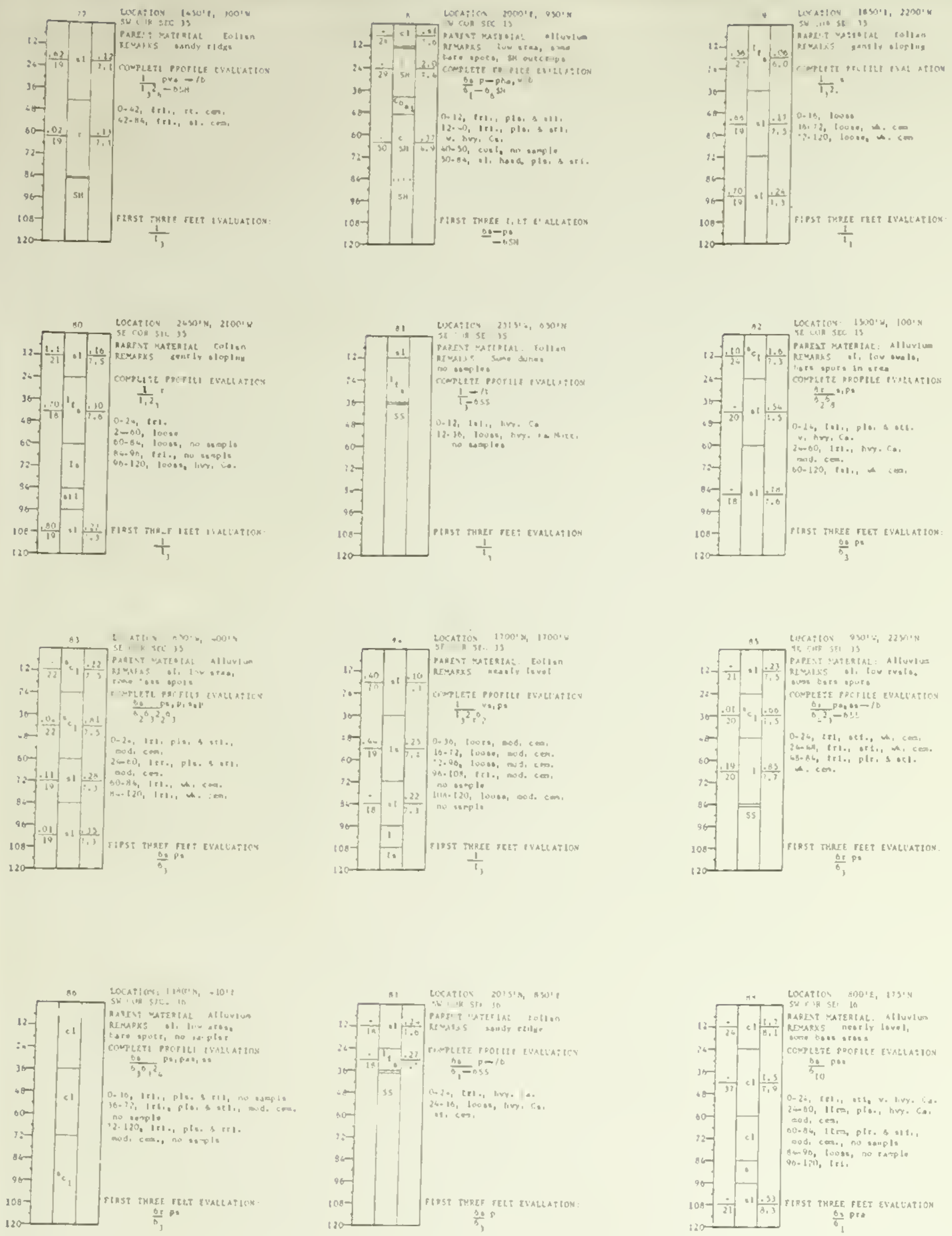
PROFILE DESCRIPTION AND LAND CLASSIFICATION

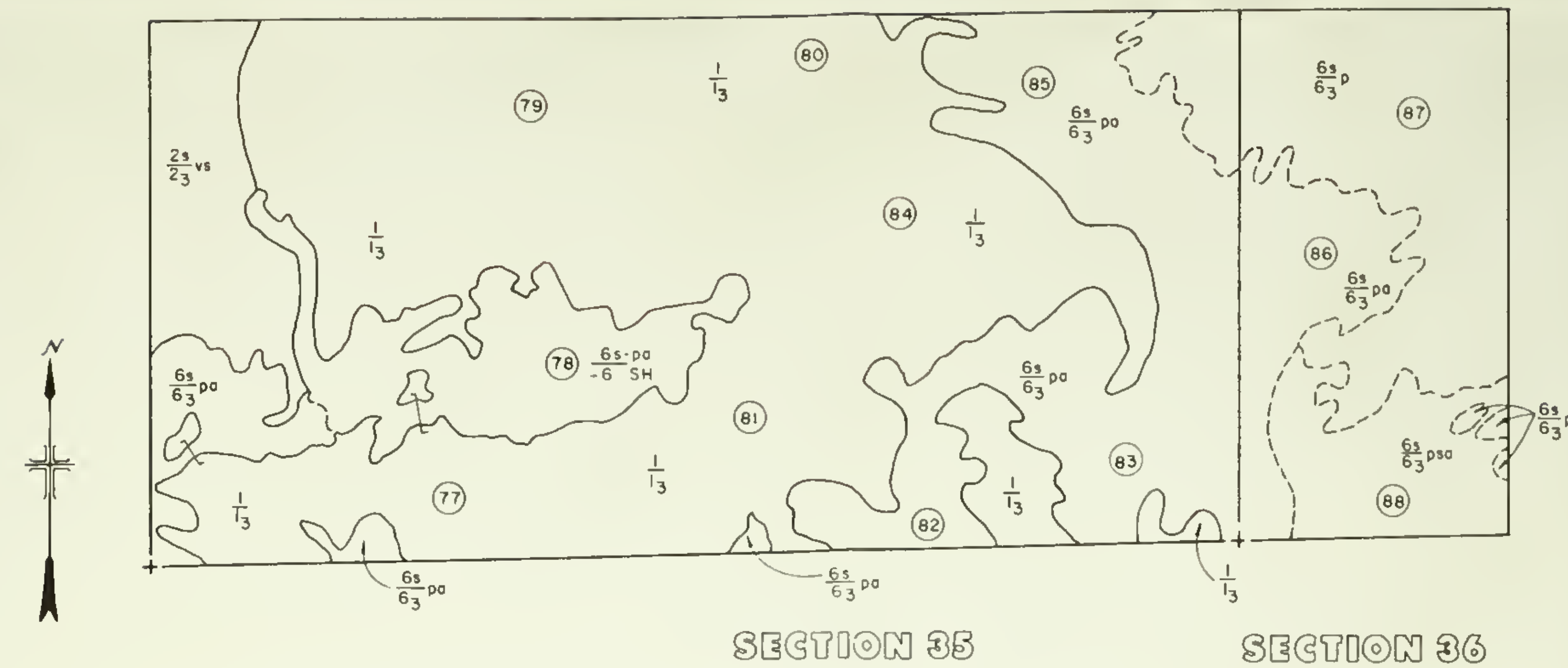
EMRIA REPORT NO 19-78

Sheet 5 of 7

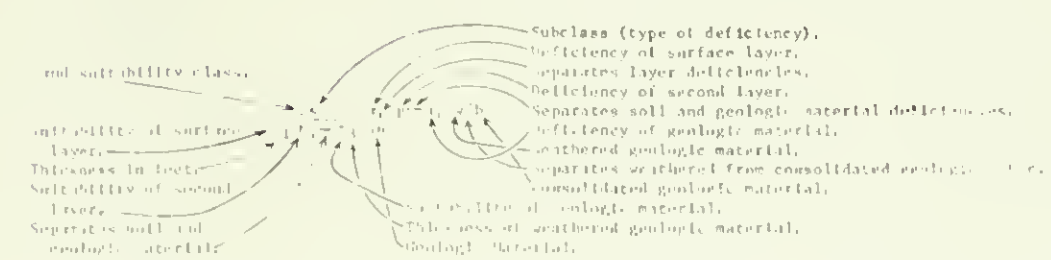
FIGURE N-10


SECTION 33
SECTION 34
N
SCALE OF FEET
500 0 500 1000 1500
R 5 W
T 20 N
T 19 N
33 34 35 36
5 4 3 2
7 9
Land Classification Mapping Symbols for Complete Profile Evaluation
Land suitability class.
Suitability of surface layer.
Thickness in feet.
Suitability of second layer.
Separates soil and geologic material.
Subclass (type of deficiency).
Deficiency of surface layer.
Separates layer deficiencies.
Deficiency of second layer.
Separates soil and geologic material deficiencies.
Deficiency of geologic material.
Weathered geologic material.
Separates weathered from consolidated geologic material.
Consolidated geologic material.
Suitability of geologic material.
Thickness of weathered geologic material.
Geologic Material.
LAND CLASS ACRES**
1 203
2 202
TOTAL 405
6 235
GRAND TOTAL 640
** for complete acreages of each individual land classification, see table N-14
Land suitability class
1 good
2 fair
6 unsuitable
Subclass (type of deficiency)
s - soils
Subclass deficiencies (soil & geologic material)
e - salinity
a - sodicity
h - very fine textures
v - coarse textures
p - restricted permeability
d - shallow depth of suitable material
w - weathered geologic material
b - consolidated geologic material
Profiles
separates classes
separates subclasses
Land Classification Profile Symbols for Complete Profile Evaluation
Disturbed or fragmented hydraulic conductivity
Profile number
EC(1:5)
pH(Ca Cl2)
Settling volume
Texture
Translation zone
Depth in inches
Top of geologic material
Weathered geologic material
Separates weathered from consolidated geologic material
Consolidated geologic material
Textures
s sand
ls loamy sand
vfs very fine sand
fs fine sand
lfs loamy fine sand
sl sandy loam
vfsl very fine sandy loam
l loam
sil silty loam
cl clay loam
sicl silty clay loam
scl sandy clay loam
c clay
sic silty clay
sc sandy clay
SS sandstone
SH shale
X terminated augering
Complete Profile Evaluation
First Three Feet Evaluation*
*Only the first three feet was evaluated and classified for suitability as a source of planting media.
FIRST THREE FEET EVALUATION
COMPLETE PROFILE EVALUATION
LOCATION
PARENT MATERIAL
REMARKS
OJO ENCINO STUDY AREA, NEW MEXICO
PROFILE DESCRIPTION AND LAND CLASSIFICATION
EMRIA REPORT NO. 19-78





Land Classification Mapping Symbols for Complete Profile Evaluation



LAND CLASS	ACRES**
1	190
2	21
TOTAL	211
6	189
GRAND TOTAL	400

** for complete acreages of each individual land classification, see table a-14

Land suitability class
- 1 good
- 2 fair
- 6 unsuitable

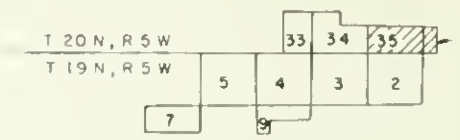
Subclass (type of deficiency)
- s - soils

Subclass deficiencies (soil & geologic material)
- s - salinity
- a - sodicity
- k - very fine textures
- v - coarse textures
- p - restricted permeability
- d - shallow depth of suitable material
- w - weathered geologic material
- h - consolidated geologic material

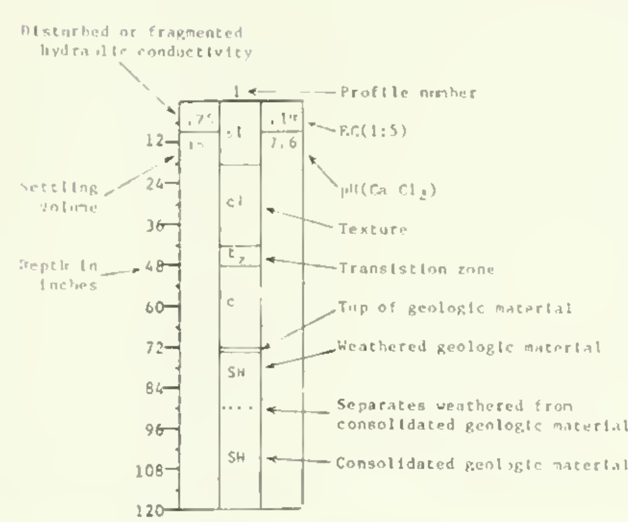
(4) Profiles

______ separates classes

- - - - separates subclasses



Land Classification Profile Symbols for Complete Profile Evaluation



Textures

s	sand
ls	loamy sand
vfs	very fine sand
fs	fine sand
lfs	loamy fine sand
sl	sandy loam
vfsl	very fine sandy loam
l	loam
sil	silty loam
cl	clay loam
sicl	silty clay loam
scl	sandy clay loam
c	clay
sic	silty clay
sc	sandy clay
SS	sandstone
SH	shale
X	terminated augering

Complete Profile Evaluation

$\frac{2s\ \ v,\ sa — sa,\ v/h}{2_1 2_2 — 2_3 SS}$

First Three Feet Evaluation*

$\frac{2s\ vsa}{2_3}$

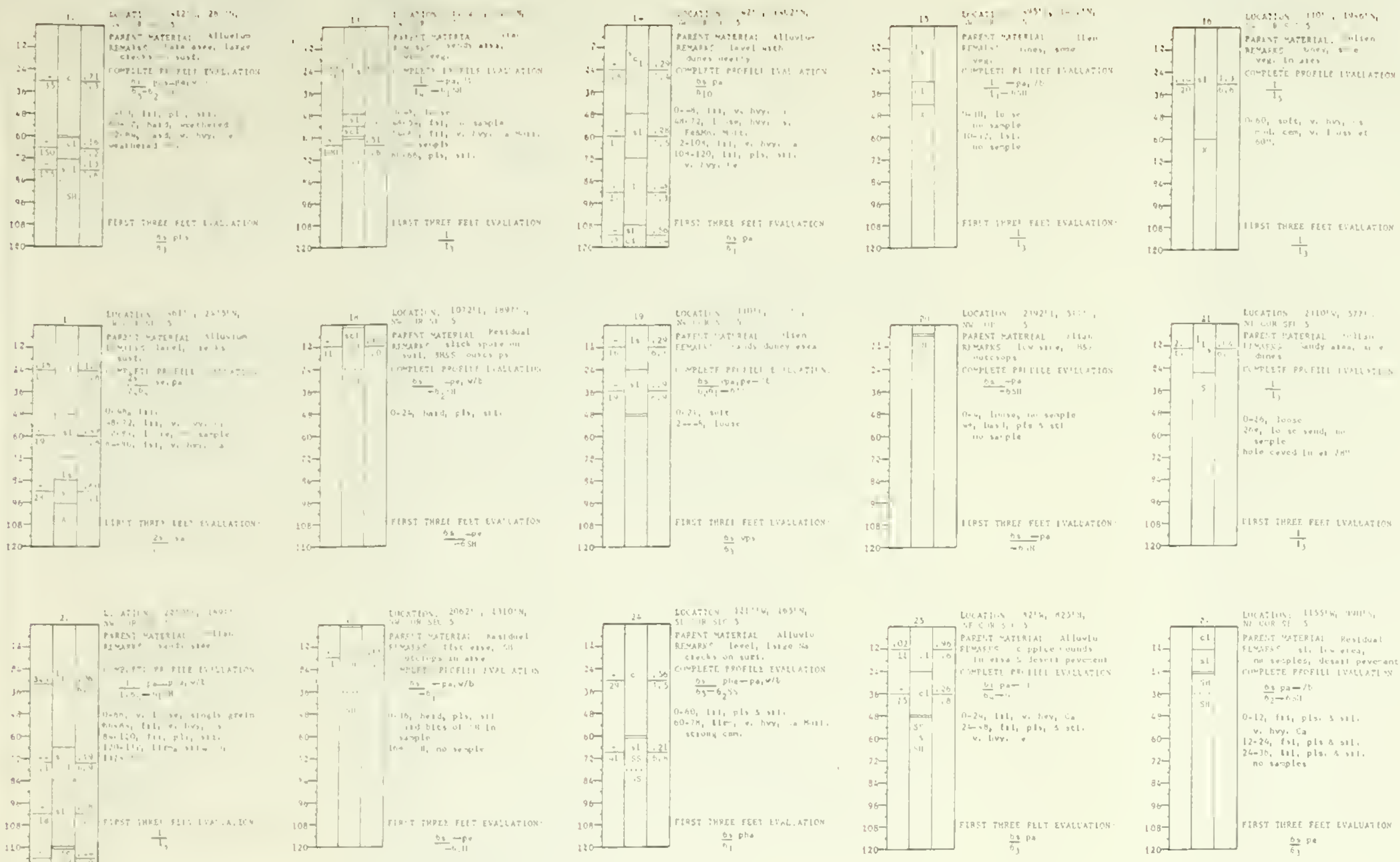
*Only the first three feet was evaluated and classified for suitability as a source of planting media.

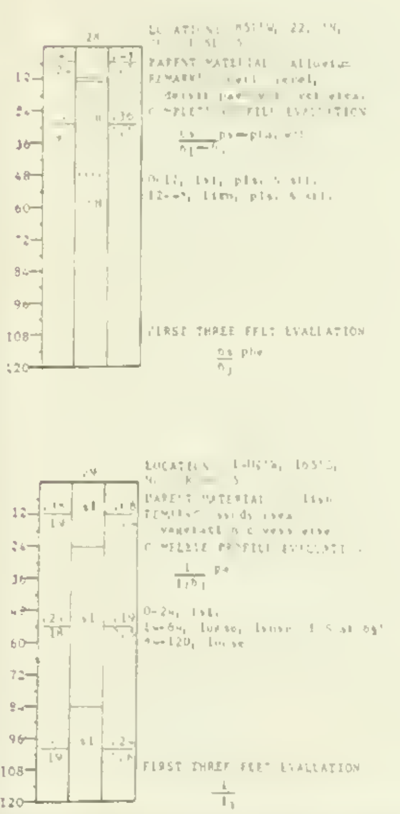
OJO ENCINO STUDY AREA, NEW MEXICO

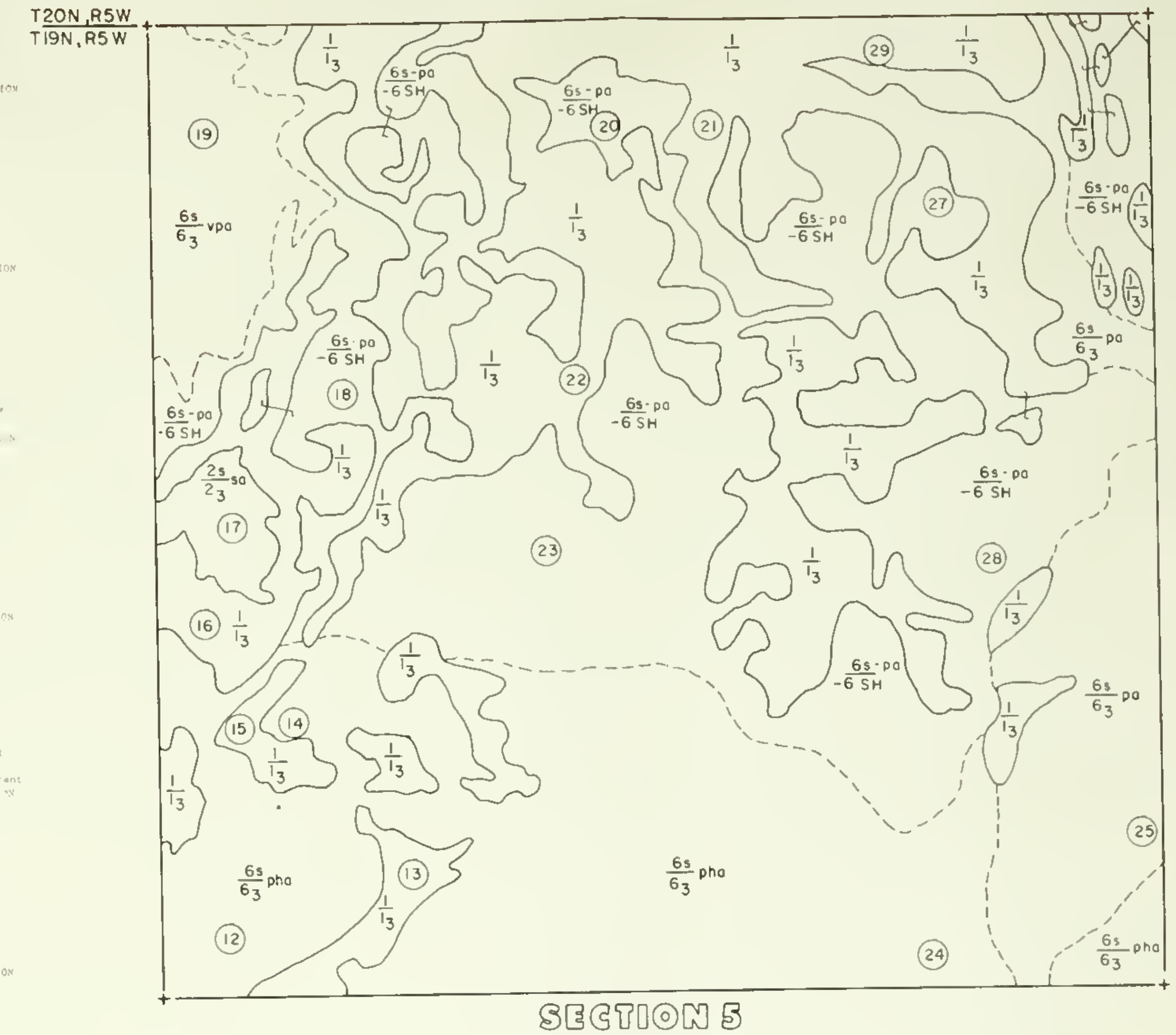
PROFILE DESCRIPTION AND LAND CLASSIFICATION

EMRIA REPORT NO 19-78

FIGURE N-10

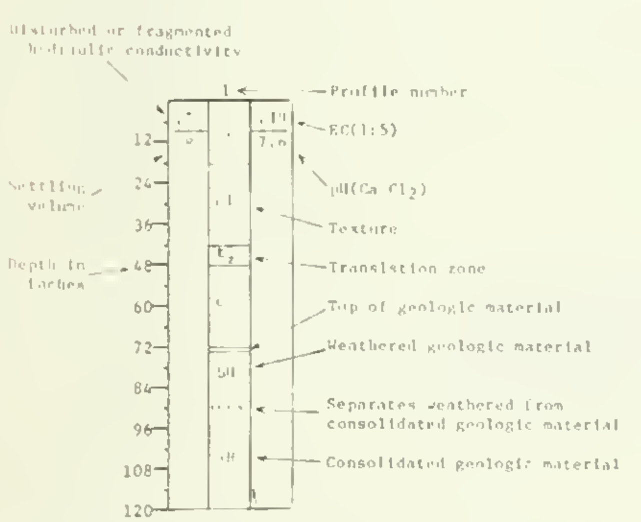






500 0 500 1000 1500
SCALE OF FEET

Land Classification Profile Symbols for Complete Profile Evaluation



Textures
- s sand
- ls loamy sand
- vfs very fine sand
- fs fine sand
- lfs loamy fine sand
- sl sandy loam
- vfsl very fine sandy loam
- l loam
- sil silty loam
- cl clay loam
- sicl silty clay loam
- scl sandy clay loam
- c clay
- sic silty clay
- sc sandy clay
- SS sandstone
- SH shale
- X terminated augering

Complete Profile Evaluation

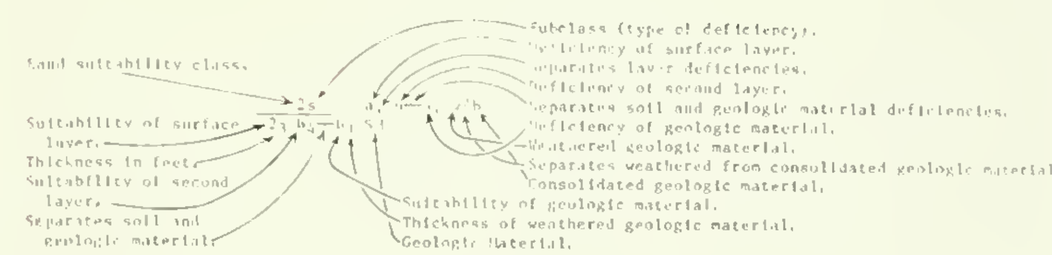
$\frac{2s}{2_1 2_2 - 2_3 SS}$ v, sa—sa, w/b

First Three Feet Evaluation

$\frac{2s}{2_3}$ vsa

*Only the first three feet was evaluated and classified for suitability as a source of planting media.

Land Classification Mapping Symbols for Complete Profile Evaluation



Land suitability class
- 1 good
- 2 fair
- 6 unsuitable

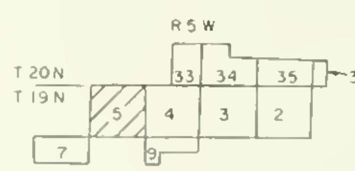
Subclass (type of deficiency)
- s - soils

Subclass deficiencies (soil & geologic material)
- s - salinity
- a - sodicity
- h - very fine textures
- v - coarse textures
- p - restricted permeability
- d - shallow depth of suitable material
- w - weathered geologic material
- b - consolidated geologic material

(4) Profiles
——— separates classes
- - - - separates subclasses

LAND CLASS	ACRES**
1	197
2	8
TOTAL	205
6	435
GRAND TOTAL	640

** for complete acreages of each individual land classification, see table N-14



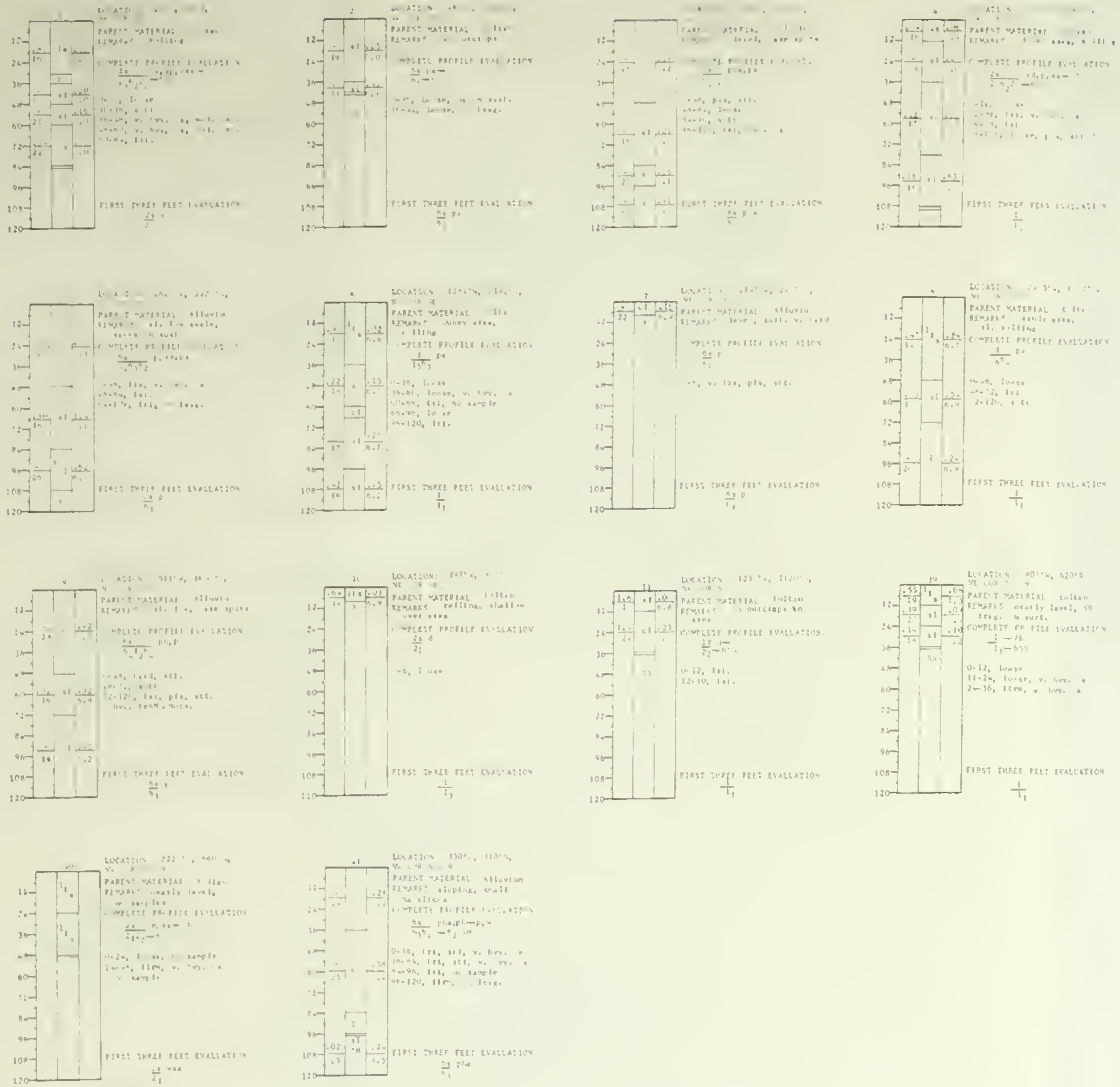
OJO ENCINO STUDY AREA, NEW MEXICO

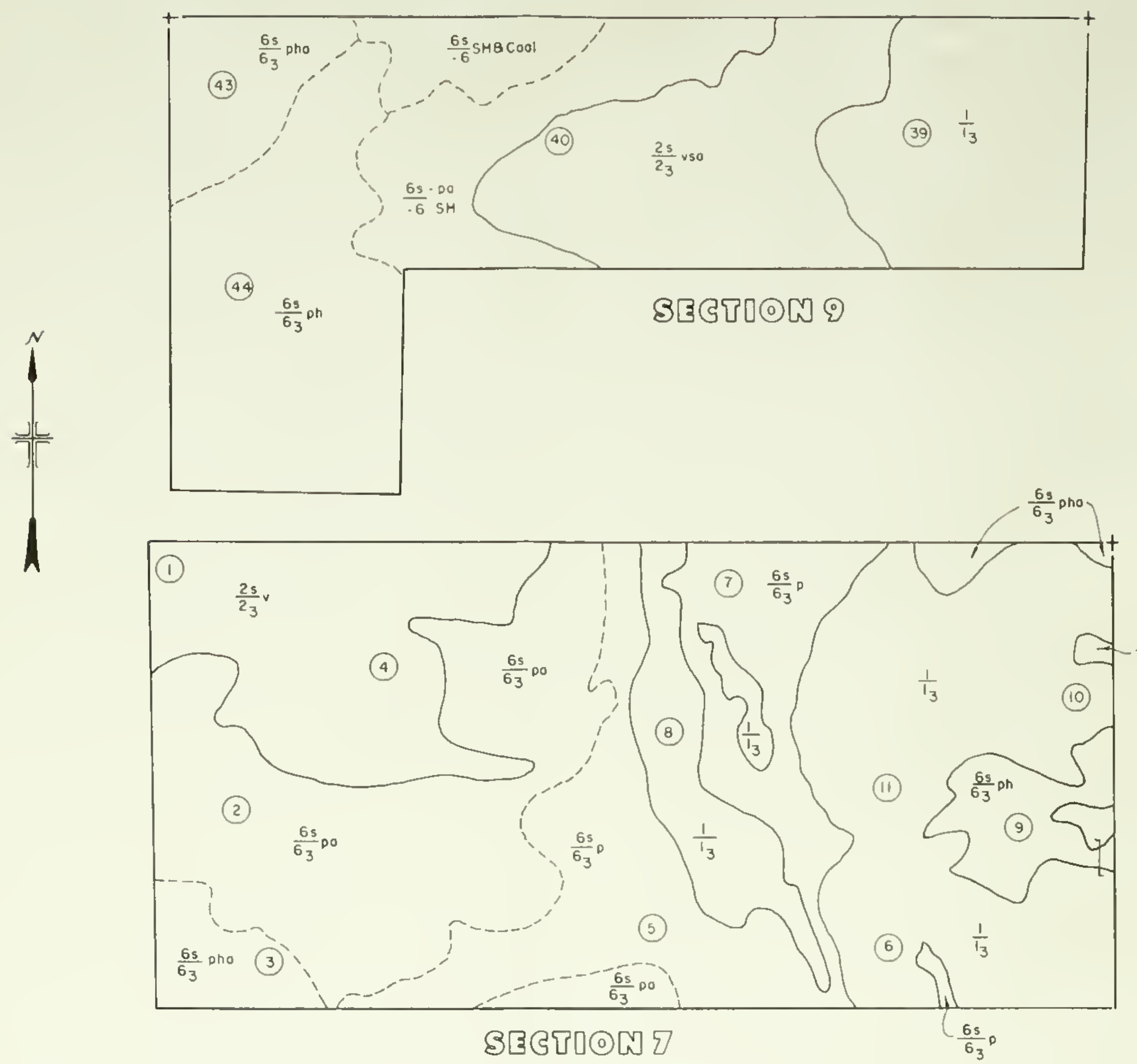
PROFILE DESCRIPTION AND LAND CLASSIFICATION

EMRIA REPORT NO 19-78

Sheet 2 of 7

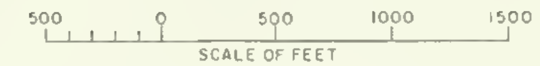
FIGURE N-10



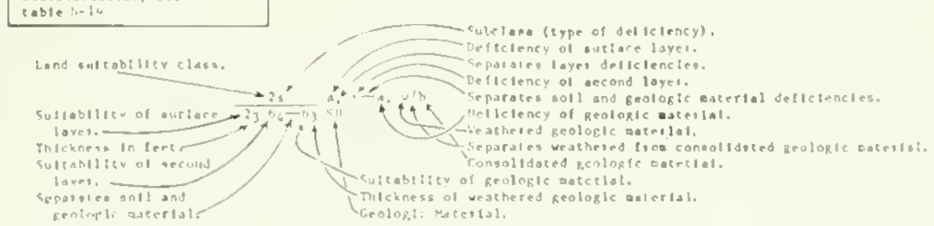


LAND CLASS	ACRES**
1	132
2	96
TOTAL	228
6	292
GRAND TOTAL	520

** for complete acreages of each individual land classification, see table N-14



Land Classification Mapping Symbols for Complete Profile Evaluation

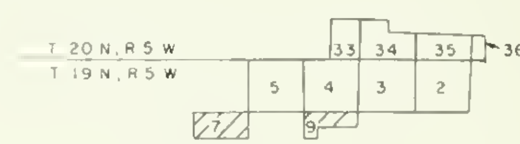


Land suitability class
- 1 good
- 2 fair
- 6 unsuitable

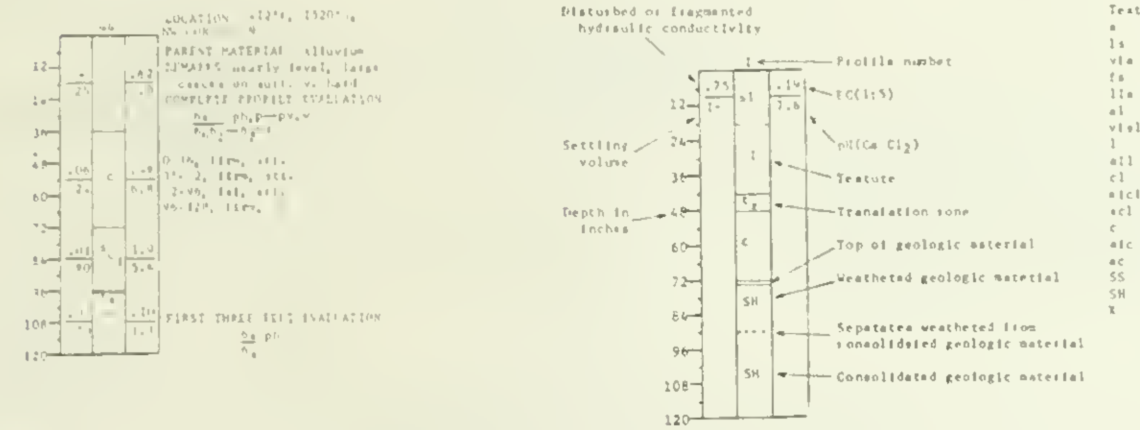
Subclass (type of deficiency)
- s - soils

Subclass deficiencies (soil & geologic material)
- s - salinity
- a - sodicity
- h - very fine textures
- v - coarse textures
- p - restricted permeability
- d - shallow depth of suitable material
- w - weathered geologic material
- b - consolidated geologic material

(i) Profiles
——— separates classes
- - - - separates subclasses



Land Classification Profile Symbols for Complete Profile Evaluation



Textures

s	sand
ls	loamy sand
vfs	very fine sand
fs	fine sand
lfs	loamy fine sand
sl	sandy loam
vfsl	very fine sandy loam
l	loam
sil	silty loam
cl	clay loam
sicl	silty clay loam
scl	sandy clay loam
c	clay
sic	silty clay
sc	sandy clay
SS	sandstone
SH	shale
x	terminated augering

Complete Profile Evaluation

$\frac{2s \quad v, ss—sa, w/b}{2_1 2_2—2_3 SS}$

First Three Feet Evaluation*

$\frac{2s \; vsa}{2_3}$

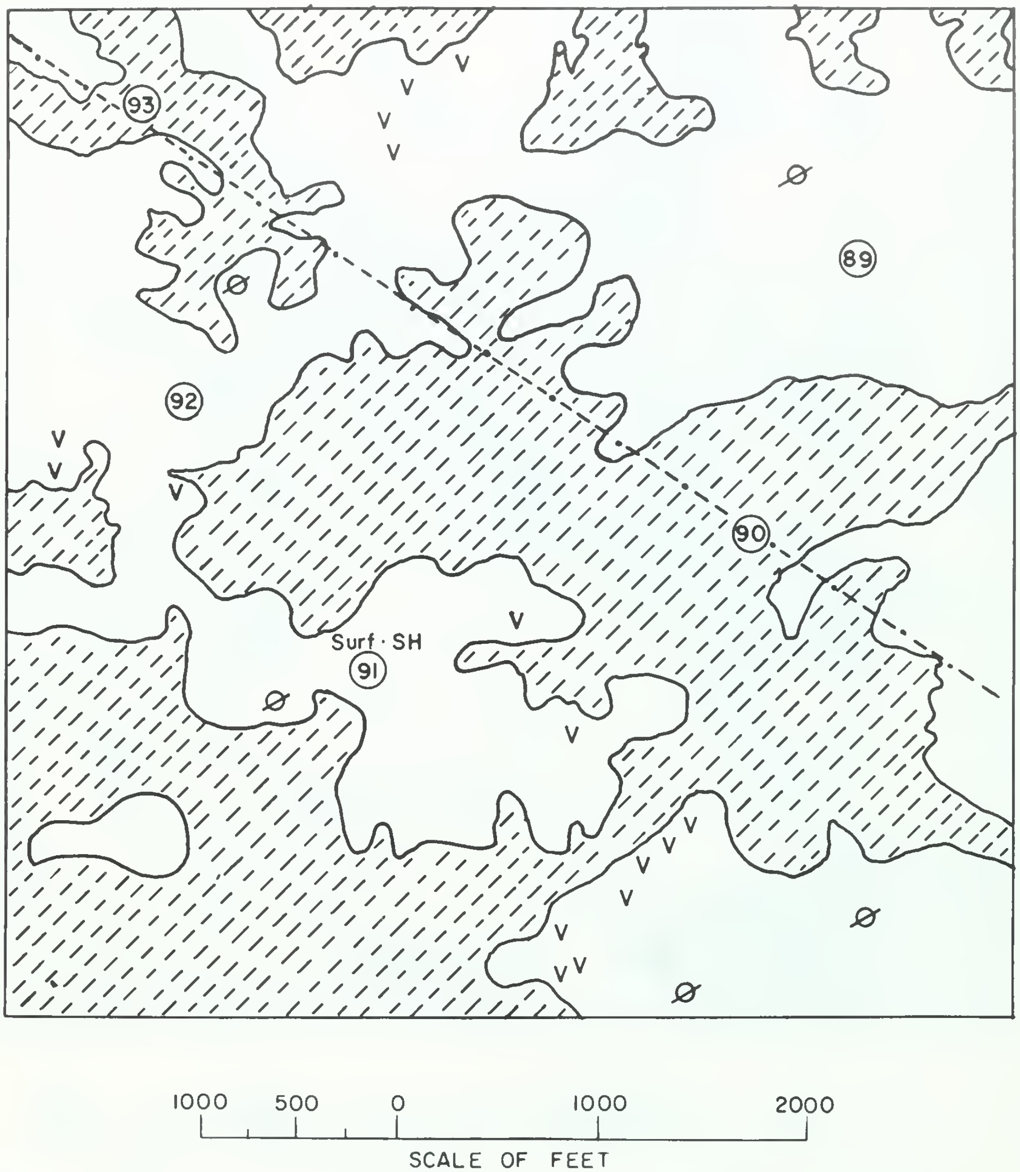
*Only the first three feet was evaluated and classified for suitability as a source of planting media.

OJO ENCINO STUDY AREA, NEW MEXICO

PROFILE DESCRIPTION AND LAND CLASSIFICATION

EMRIA REPORT NO 19-78

FIGURE N-10



Mapping Symbols

- Windmill
- Blowout
- Clay spot
H - House
- Gumbo, Slick or scaby spot (sodic)
V - Rock Outcrop (includes Shale and sandstone)
.V. - Baked rock (scoria)
- Intermittent pond
(4) - Profiles
(CK) - Check holes
- Power - Transmission Line
4SS - Depth to Bedrock in feet SS - Sandstone, SH - Shale

SOIL SUITABILITY FOR PLANTING MEDIA

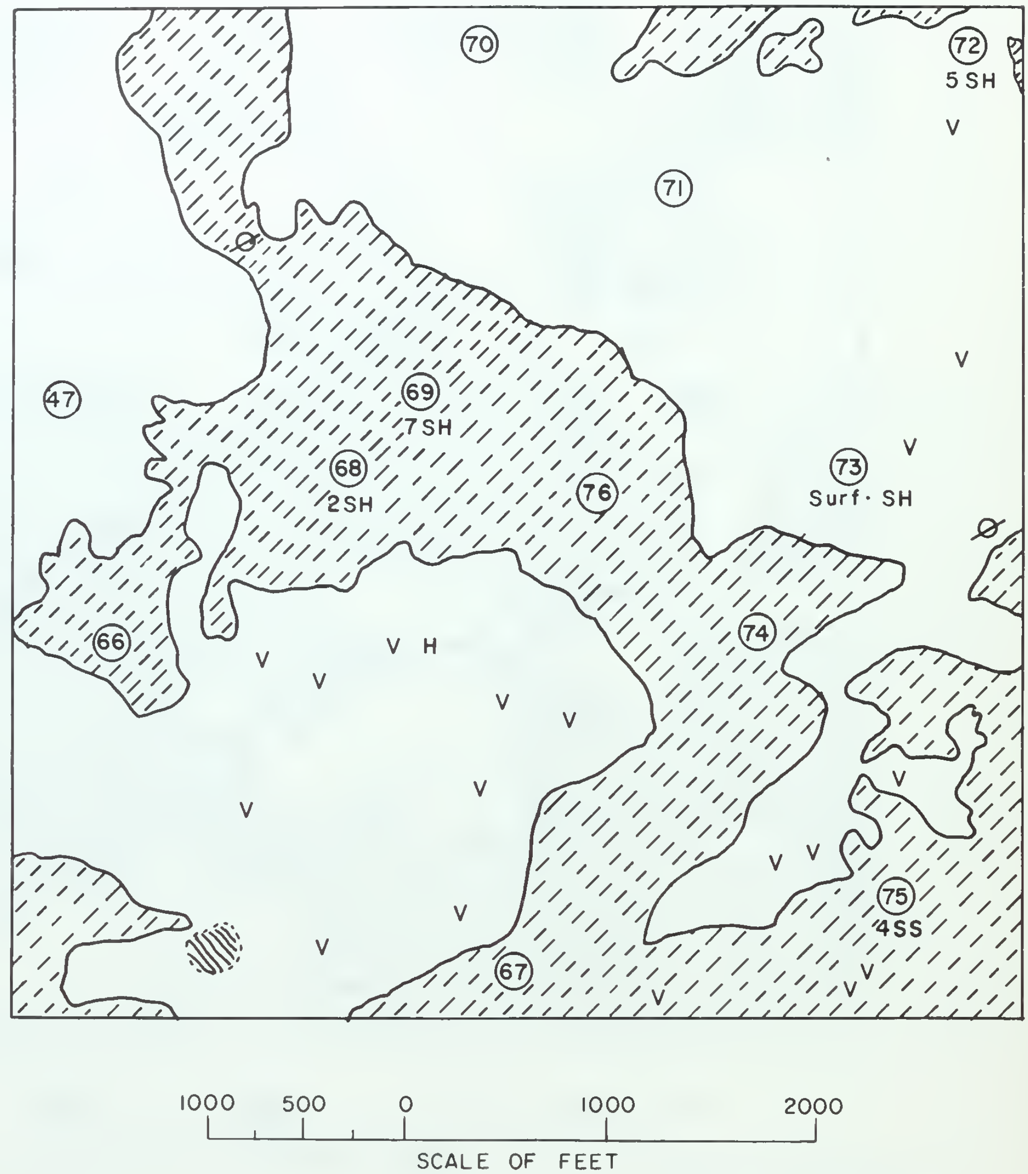
	ACRES
- Suitable	306
- Unsuitable	334
TOTAL	640

SECTION 2

EMRIA REPORT NO. 19-78

SHEET 1 of 10

FIGURE N-11



Mapping Symbols

- Windmill
- Blowout
- Clay spot
H - House
- Gumbo, Slick or scaby spot (sodic)
V - Rock Outcrop (includes Shale and sandstone)
.V. - Baked rock (scoria)
- Intermittent pond
(4) - Profiles
(CK) - Check holes
- Power-Transmission Line
4SS - Depth to Bedrock in feet
SS - Sandstone, SH - Shale

SOIL SUITABILITY FOR PLANTING MEDIA

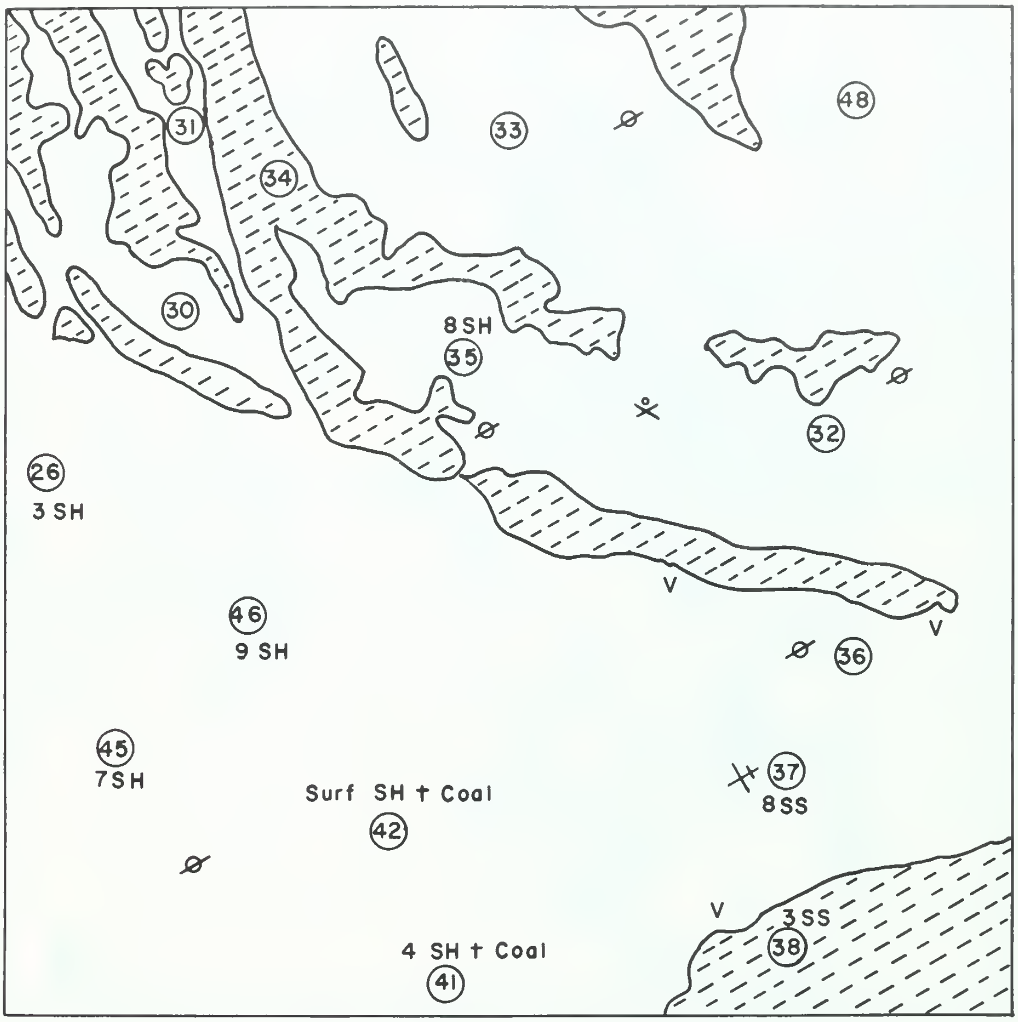
	ACRES
Suitable	253
Unsuitable	387
TOTAL	640

SECTION 3

EMRIA REPORT NO. 19-78

SHEET 2 of 10

FIGURE N-11



1000 500 0 1000 2000

SCALE OF FEET

Mapping Symbols

- Windmill
- Blowout
- Clay spot
- H - House
- Gumbo, Slick or scaby spot (sodic)
- V - Rock Outcrop (includes Shale and sandstone)
- .V. - Baked rock (scoria)
- Intermittent pond
- (4) - Profiles
- (CK) - Check holes
- ·---·---· - Power-Transmission Line
- 4SS - Depth to Bedrock in feet SS-Sandstone, SH-Shale

SOIL SUITABILITY FOR PLANTING MEDIA

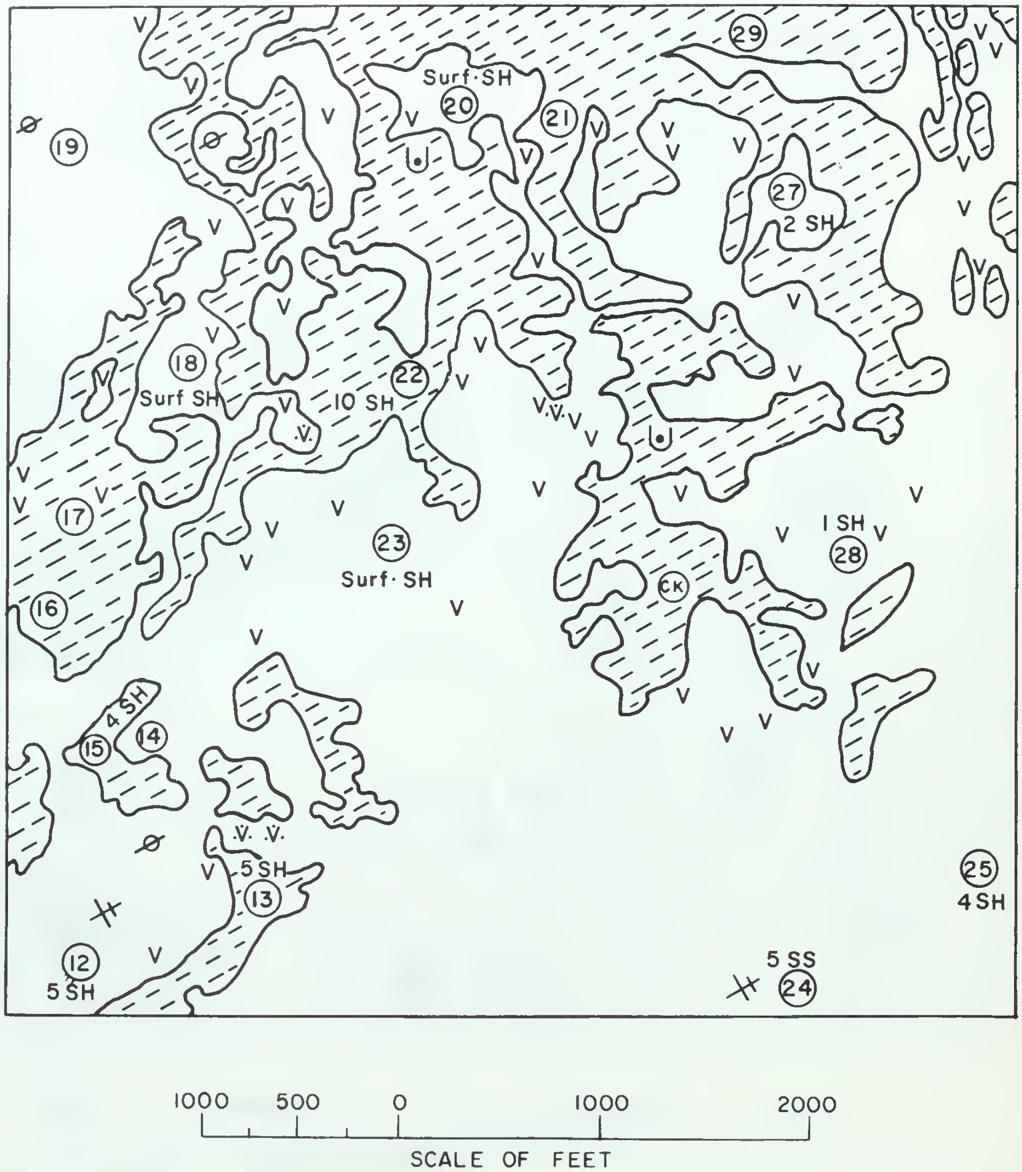
	ACRES
- Suitable	106
- Unsuitable	534
TOTAL	640

SECTION 4

EMRIA REPORT NO. 19-78

SHEET 3 of 10

FIGURE N-11



Mapping Symbols

- Windmill
- Blowout
- Clay spot
- H - House
- Gumbo, Slick or scaby spot (sodic)
- V - Rock Outcrop (includes Shale and sandstone)
- .V. - Baked rock (scoria)
- Intermittent pond
- (4) - Profiles
- (CK) - Check holes
- Power - Transmission Line
- 4SS - Depth to Bedrock in feet
  SS - Sandstone, SH - Shale

SOIL SUITABILITY FOR PLANTING MEDIA

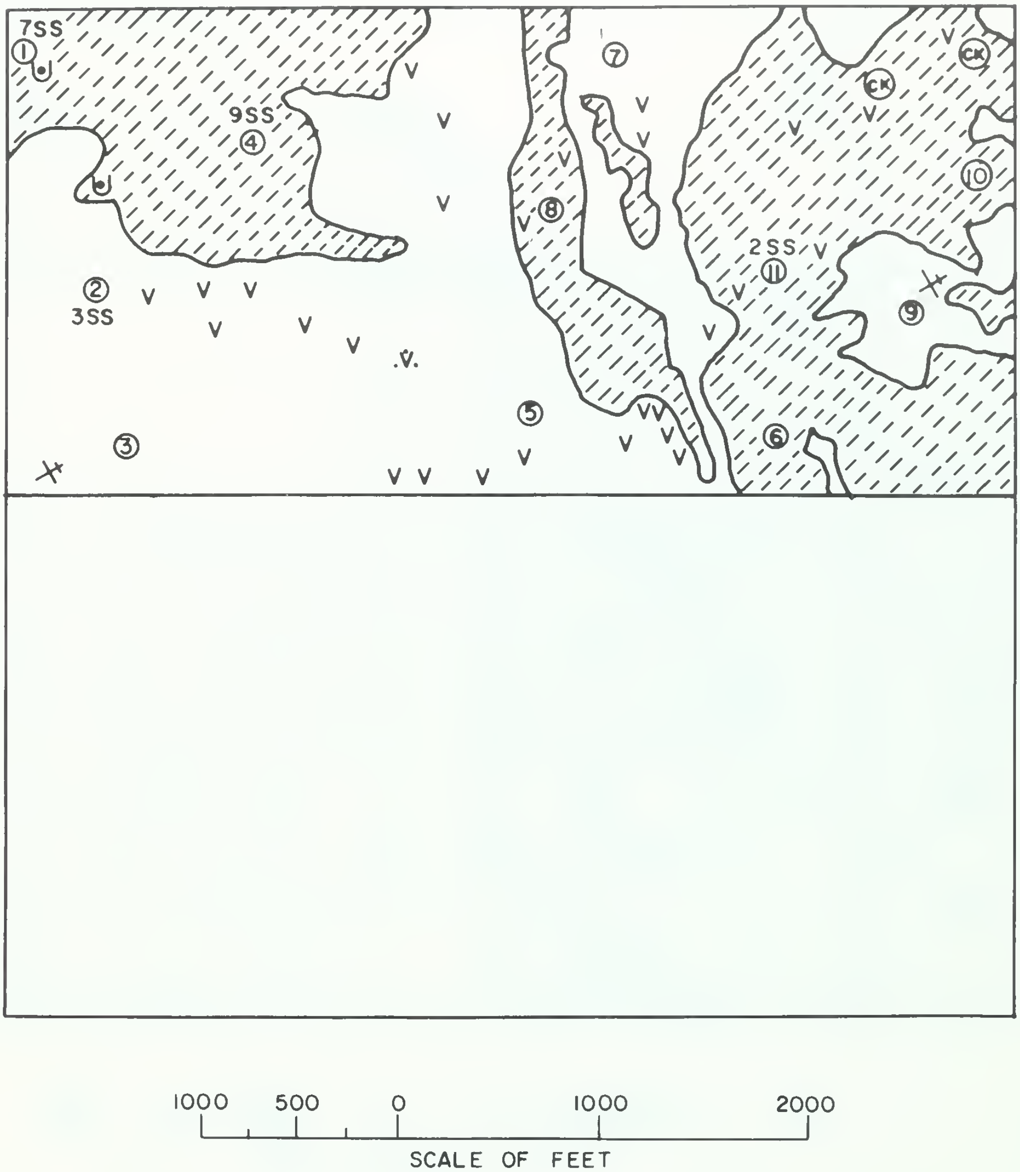
	ACRES
- Suitable	205
- Unsuitable	435
TOTAL	640

SECTION 5

EMRIA REPORT NO. 19-78

SHEET 4 of 10

FIGURE N-11



Mapping Symbols

- Windmill
- Blowout
- Clay spot
H - House
- Gumbo, Slick or scaby spot (sodic)
V - Rock Outcrop (includes Shale and sandstone)
.V. - Baked rock (scoria)
- Intermittent pond
(4) - Profiles
(CK) - Check holes
- Power-Transmission Line
4SS - Depth to Bedrock in feet SS-Sandstone, SH-Shale

SOIL SUITABILITY FOR PLANTING MEDIA

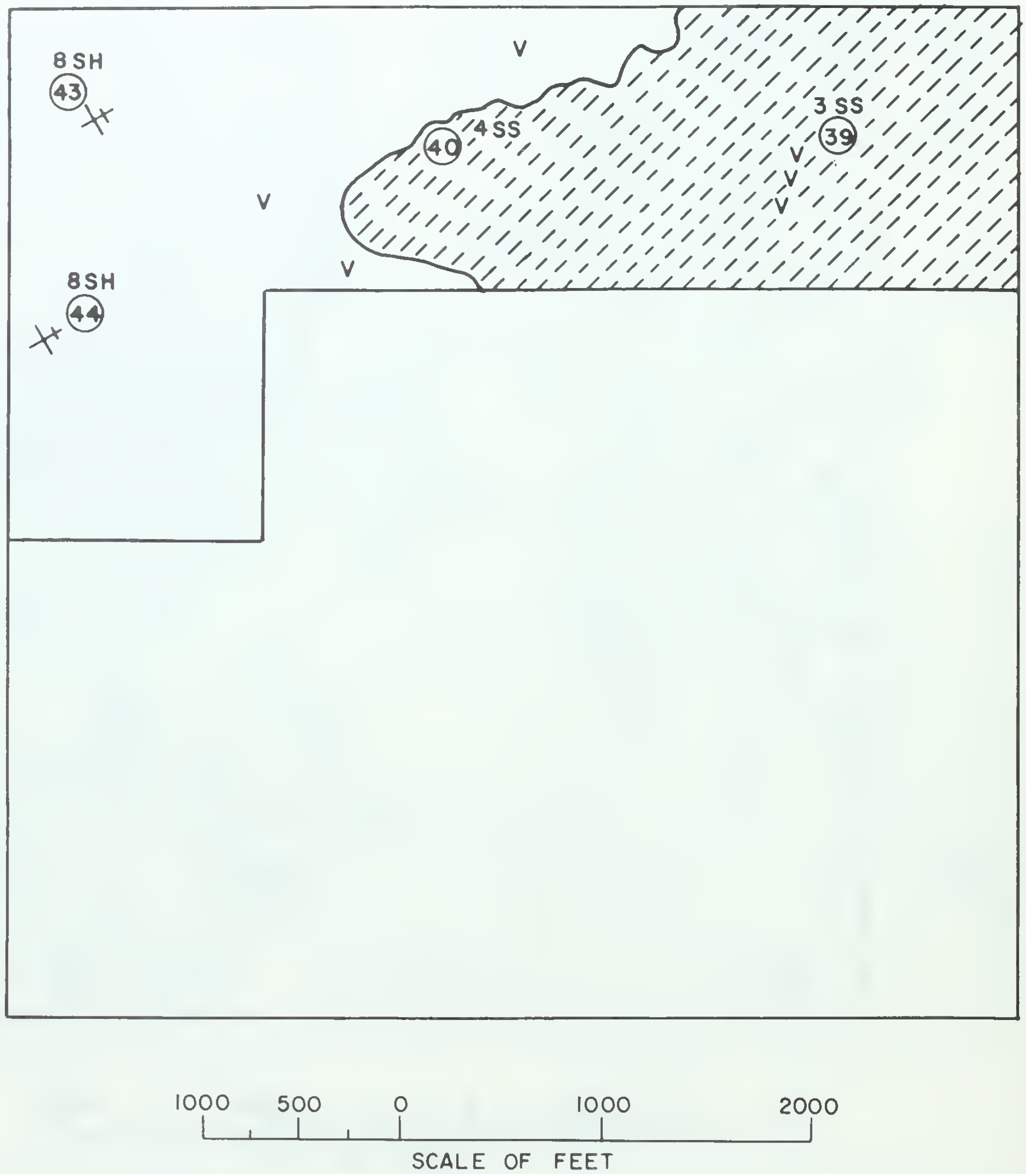
	ACRES
- Suitable	144
- Unsuitable	176
TOTAL	320

SECTION 7

EMRIA REPORT NO. 19-78

SHEET 5 of 10

FIGURE N-11



Mapping Symbols

- Windmill
- Blowout
- Clay spot
H - House
- Gumbo, Slick or scaby spot (sodic)
V - Rock Outcrop (includes Shale and sandstone)
.V. - Baked rock (scoria)
- Intermittent pond
(4) - Profiles
(CK) - Check holes
- Power - Transmission Line
4SS - Depth to Bedrock in feet SS - Sandstone, SH - Shale

SOIL SUITABILITY FOR PLANTING MEDIA

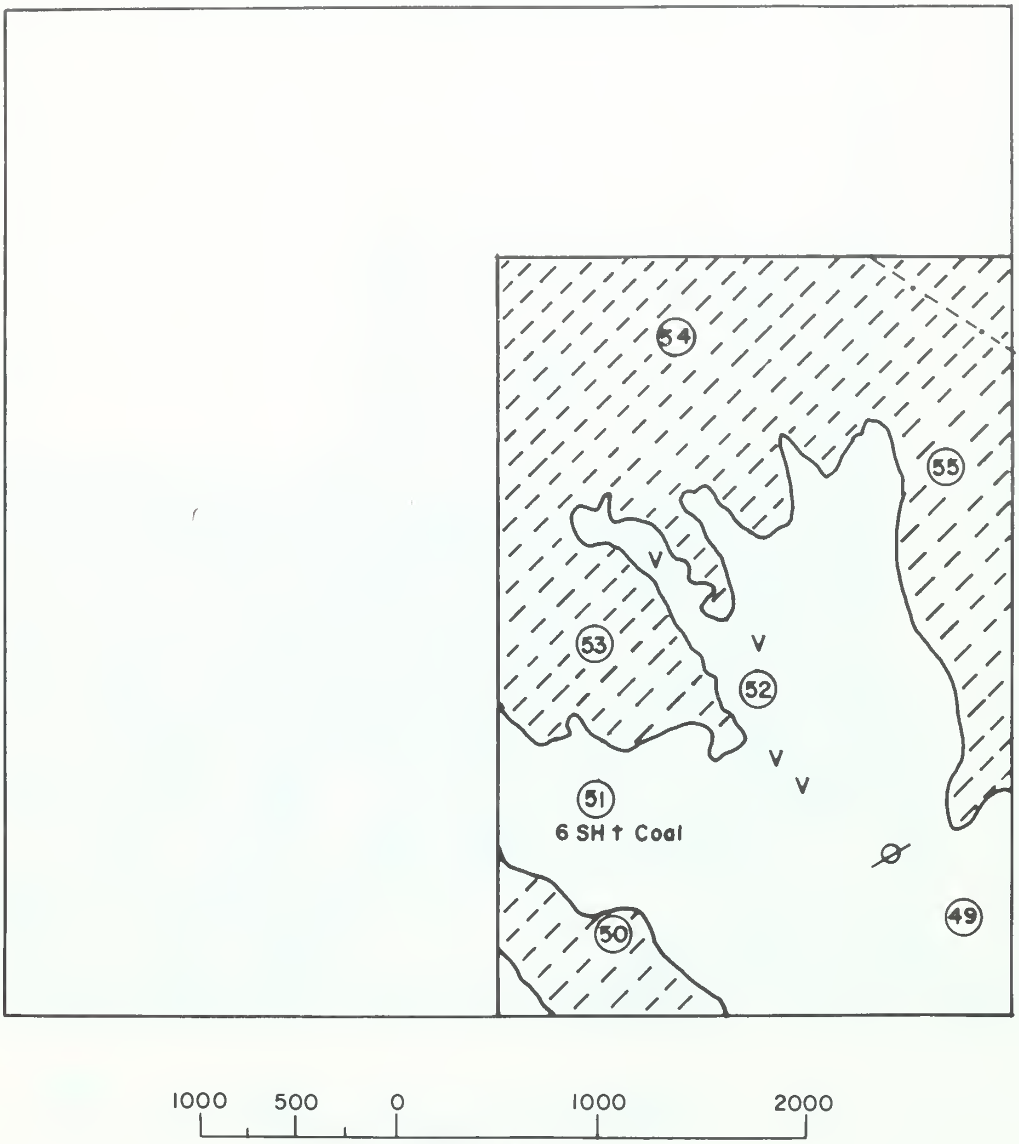
	ACRES
Suitable	84
Unsuitable	116
TOTAL	200

SECTION 9

EMRIA REPORT NO. 19-78

SHEET 6 of 10

FIGURE N-11



Mapping Symbols

- Windmill
- Blowout
- Clay spot
H - House
- Gumbo, Slick or scaby spot (sodic)
V - Rock Outcrop (includes Shale and sandstone)
.V. - Baked rock (scoria)
- Intermittent pond
(4) - Profiles
(CK) - Check holes
- Power - Transmission Line
4SS - Depth to Bedrock in feet
SS - Sandstone, SH - Shale

SOIL SUITABILITY FOR PLANTING MEDIA

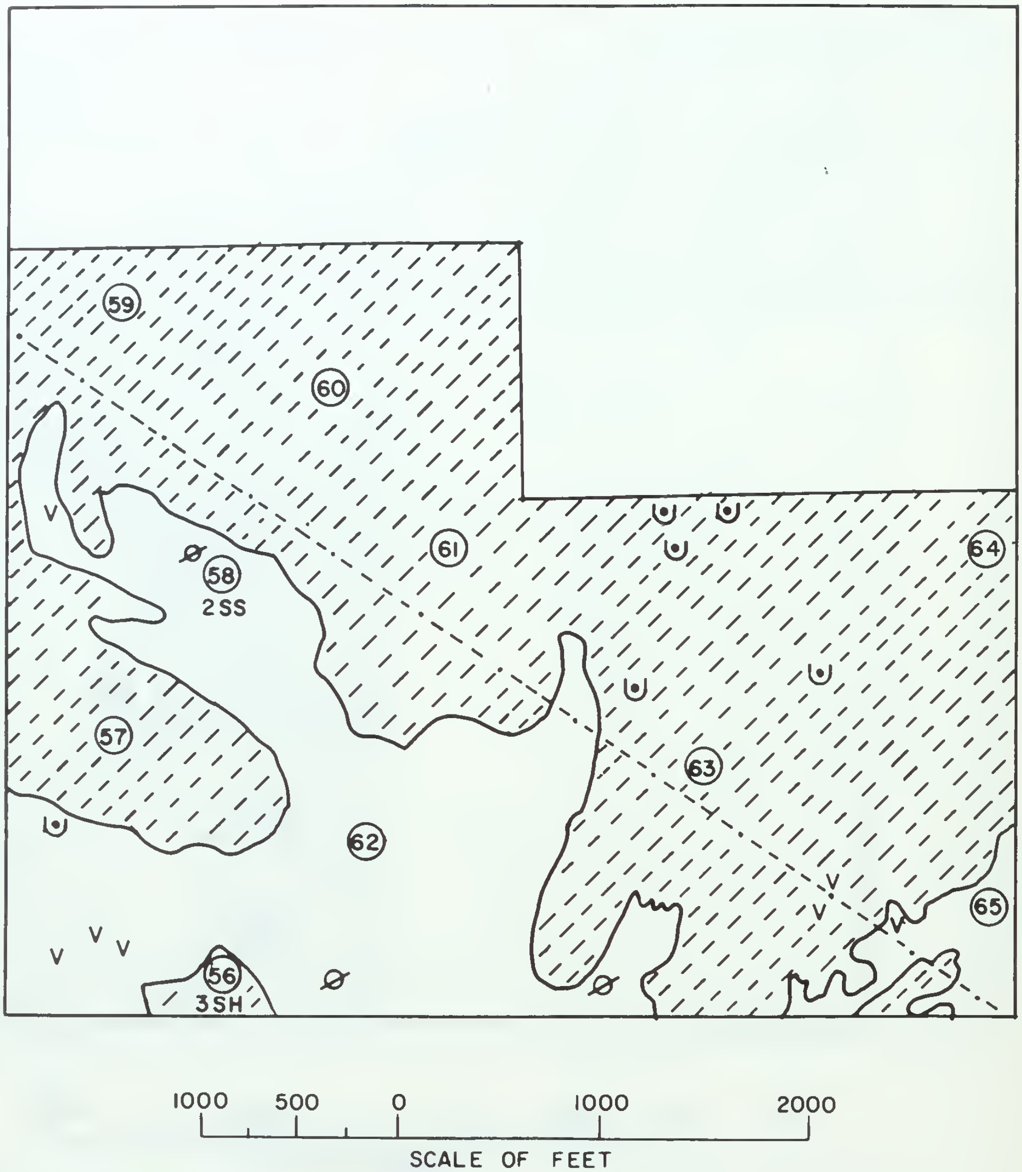
	ACRES
- Suitable	128
- Unsuitable	112
TOTAL	240

SECTION 33

EMRIA REPORT NO. 19-78

SHEET 7 of 10

FIGURE N-11



Mapping Symbols

- Windmill
- Blowout
- Clay spot
H - House
- Gumbo, Slick or scaby spot (sodic)
V - Rock Outcrop (includes Shale and sandstone)
.V. - Baked rock (scoria)
- Intermittent pond
④ - Profiles
(CK) - Check holes
- Power-Transmission Line
4SS - Depth to Bedrock in feet SS-Sandstone, SH-Shale

SOIL SUITABILITY FOR PLANTING MEDIA

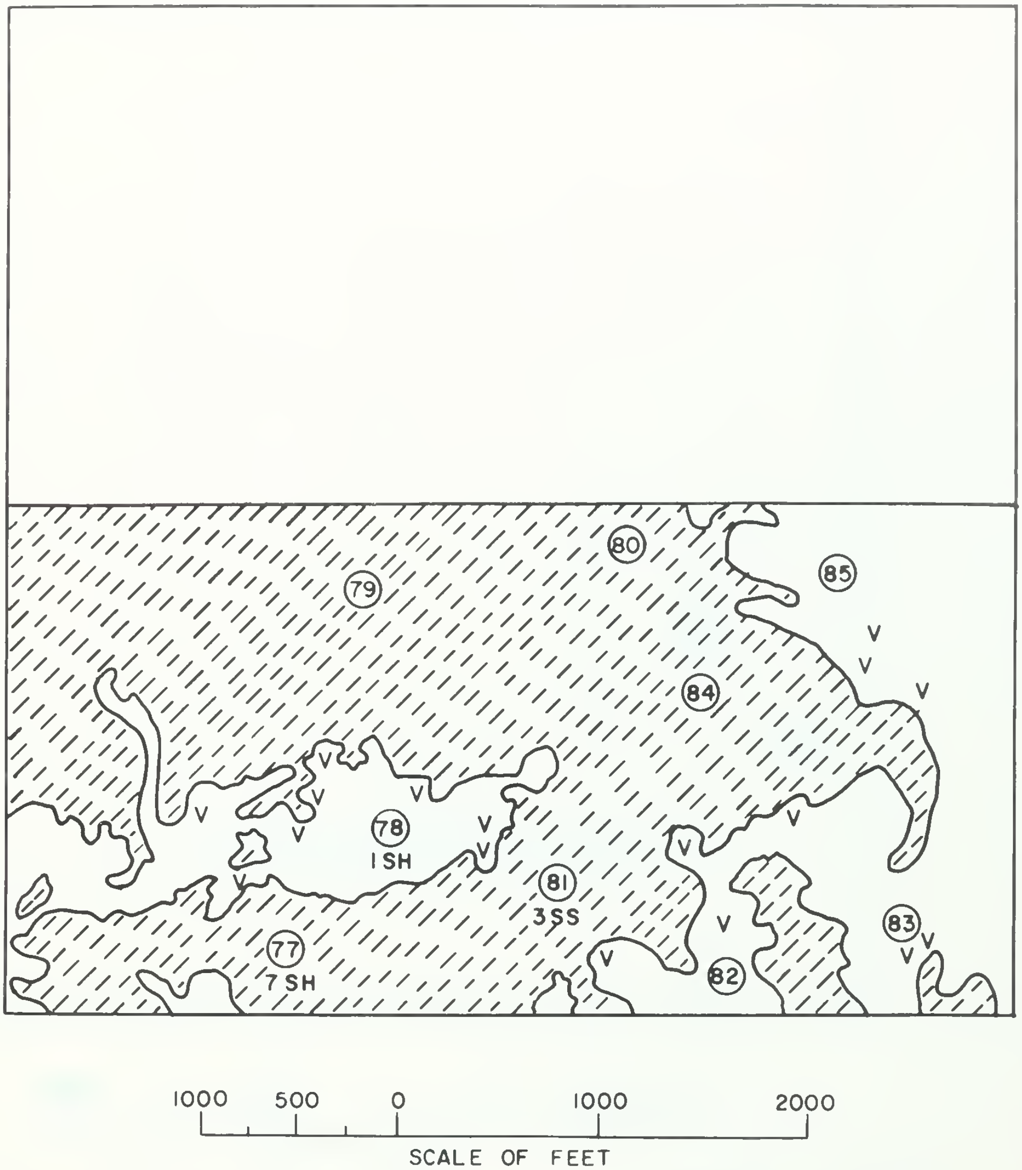
	ACRES
Suitable	277
Unsuitable	123
TOTAL	400

SECTION 34

EMRIA REPORT NO. 19-78

SHEET 8 of 10

FIGURE N-11



Mapping Symbols

- Windmill
- Blowout
- Clay spot
H - House
- Gumbo, Slick or scaby spot (sodic)
V - Rock Outcrop (includes Shale and sandstone)
.V. - Baked rock (scoria)
- Intermittent pond
(4) - Profiles
(CK) - Check holes
- Power - Transmission Line
4SS - Depth to Bedrock in feet SS - Sandstone, SH - Shale

SOIL SUITABILITY FOR PLANTING MEDIA

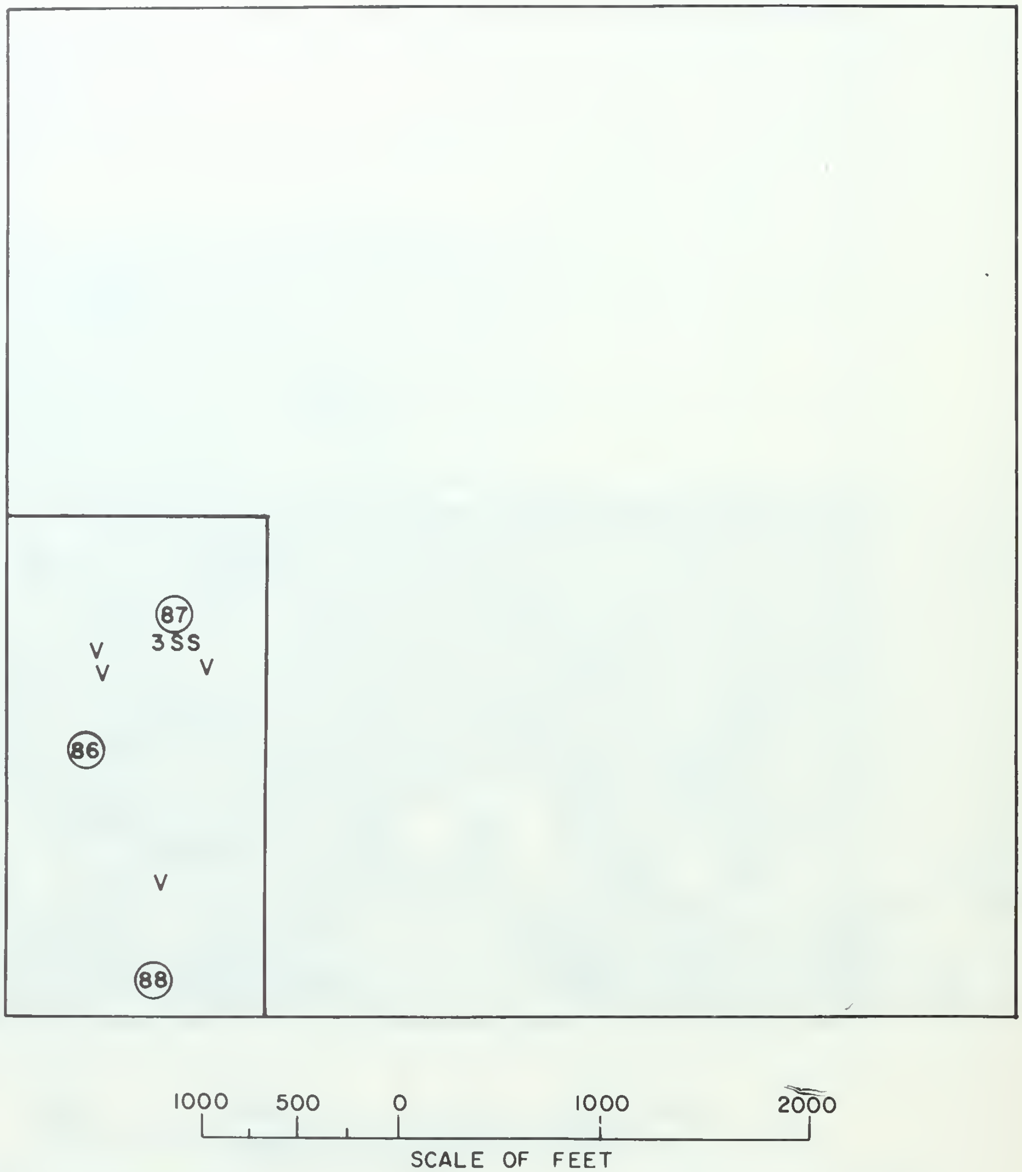
	ACRES
- Suitable	211
- Unsuitable	109
TOTAL	320

SECTION 35

EMRIA REPORT NO. 19-78

SHEET 9 of 10

FIGURE N-11



Mapping Symbols

- Windmill
- Blowout
- Clay spot
H - House
- Gumbo, Slick or scaby spot (sodic)
V - Rock Outcrop (includes Shale and sandstone)
.V. - Baked rock (scoria)
- Intermittent pond
(4) - Profiles
(CK) - Check holes
- Power-Transmission Line
4SS - Depth to Bedrock in feet SS-Sandstone, SH-Shale

SOIL SUITABILITY FOR PLANTING MEDIA

	ACRES
- Suitable	0
- Unsuitable	80
TOTAL	80

SECTION 36

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FIGURE N-11

SECTION O

SELECTED GOVERNMENTAL COAL MINING REGULATIONS APPENDIX

SECTION O

SELECTED GOVERNMENTAL COAL MINING REGULATIONS APPENDIX

Federal Regulations

TITLE 43--PUBLIC LANDS, INTERIOR

CHAPTER II--BUREAU OF LAND MANAGEMENT, DEPARTMENT OF THE INTERIOR

PART 3040--ENVIRONMENT AND SAFETY

SUBPART 3041--SURFACE MANAGEMENT

FEDERAL COAL RESOURCES

Section 3041.0-1 - Purpose

(a) The purpose of this subpart is to establish rules and regulations to be followed in the management of the federally owned coal estate consistent with the policies, goals, and objective established by the acts cited in section 3041.0-3 of this subpart, regardless of surface ownership, to assure effective and reasonable regulation of surface coal mining operations in accordance with the requirements hereof, as an appropriate and necessary means to minimize so far as practicable the adverse social, economic, and environmental effects of such operations.

(b) It is the policy of the Department to encourage the development of federally owned coal, where such development is authorized, through a program that will provide for the protection, orderly development, and conservation of Federal mineral and nonmineral resources in a manner that will avoid, minimize, or correct adverse impacts on society and the environment resulting from coal development, without undue duplication or administrative delay by Federal officers. It is also the policy of the Department to issue leases, permits, and licenses for coal only where reclamation of the affected lands to the standards set forth herein is attainable and assured and a reclamation program will be undertaken as contemporaneously as practicable with operations.

Section 3041.1-2 - Preliminary Data

(a) Any application for coal lease, permit, or license filed pursuant to the regulations in this chapter shall contain preliminary data (in lieu requirements also described).

(b) Such preliminary data shall include (1) maps of the topography of the land applied for; its physical features, roads, and utilities; and proposed exploration and mining operations and (2) a narrative statement covering proposed exploration operations and mining method; existing land use; known geologic, visual, cultural, or archeological features; known habitat of fish and wildlife that may be affected by the proposed operations; and proposed measures to prevent environmental damage and public hazard and to reclaim the surface.

Section 3041.2-2 - Obligations and Standards of Performance

(a) Any operator who accepts a coal base, permit, or license shall comply with, and be bound by, the general obligations and standards of performance set forth in this section and such additional and more stringent specific requirements as may be contained in the terms and conditions of such lease, permit, or license.

(d) The operator shall take visual resources into account in the planning, design, location, and construction of facilities and shall take action to minimize, control, or prevent damage to the recreational, cultural, scientific, historical, and known or suspected archeological and paleontological values of the land.

(f) (1) The operator shall reclaim affected lands pursuant to his approved plan, as contemporaneously as practicable with operations, to a condition capable of supporting all practicable uses which such lands were capable of supporting immediately prior to any exploration or mining, or equal or better uses that have been approved in accordance with this subpart.

(2) The operator shall replace overburden and waste materials in the mined area by backfilling, grading, or other means, so as to cover all toxic materials and eliminate high walls and spoil piles and restore the approximate original contour. The operator shall use all available overburden or spoil material to obtain the lowest practicable grade, which shall in any event be less than the angle of repose. Excess overburden or other spoil material shall be fully reclaimed.

(3) The operator shall stabilize and protect all surface areas, including spoil piles, affected by the coal mining and reclamation operation, to effectively control slides, erosion, subsidence, and attendant air and water pollution.

(4) The operator shall remove topsoil separately, for replacement on the backfill area, and if not so utilized immediately, segregate it in a separate pile from other spoil. When topsoil is not to be replaced on a backfill area within a time short enough to avoid deterioration, the operator shall establish and maintain an approved quick growing vegetative cover or employ other approved measures so that the topsoil is protected from wind and water erosion and establishment of noxious plant species, and is in a condition for sustaining vegetation when used during reclamation. If topsoil is of insufficient quantity or of poor quality for sustaining vegetation, and if other excavated materials can be shown to be more suitable for revegetation, then the operator may be authorized in the approved plan to remove, segregate, protect, and utilize in a like manner such other materials.

(5) The operator shall assure that water impoundments, water retention facilities, dams, or settling ponds have been set forth in an approved plan, and are properly implemented.

(7) The operator shall utilize the best practicable commercially available technology to minimize, control, or prevent disturbances of the prevailing quality, quantity, and flow of water in surface and ground water systems, and of the prevailing erosion and deposition conditions at the mine site and in affected offsite areas, both during and after coal mining operations and reclamation.

(8) The operator shall properly treat or dispose of all rubbish and noxious substances and all waste resulting from the mining and preparation of coal in a manner designed to minimize, control, or prevent air and water pollution and the hazards of ignition and combustion.

(11) The operator shall design to applicable standards, construct, maintain, and, when no longer necessary and unless otherwise authorized in an approved plan, remove all roads, pipelines, powerlines, and similar utility access facilities and associated bridges, culverts, and ditches, into and across the site of operations, in a manner that will minimize, control, or prevent erosion and siltation, fugitive dust, pollution of water, damage to fish or wildlife or their habitat and public or private property.

(13) (i) The operator shall, except where other reclamation, based upon post-mining land use and not requiring revegetation pursuant to the requirements of this section, is expressly provided for in an approved plan, establish on regraded areas and all other affected lands a diverse vegetative cover native to the area and capable of regeneration and plant succession at least equal in density and permanence to the natural vegetation, provided, however, that the Mining Supervisor, with the concurrence of the appropriate authorized officer may allow the use of approved mixtures of introduced or native species where preferable to achieve quick cover or assure successful revegetation. In approving such mixture, preference will be given to nonnoxious species.

(ii) The operator's responsibility and liability under his performance bond for revegetation of each planting area shall extend until such time as the appropriate authorized officer, in consultation with the Mining Supervisor and the surface owner, if other than the United States, determines that successful revegetation in compliance with paragraph (i) of this subsection has occurred, provided, however, that this period shall extend for a minimum of 5 full years after the first planting, and for a total period of liability not to exceed 10 years from the original planting. (In certain instances this period of responsibility may not apply.)

(14) (ii) The operator shall regulate public access, vehicular traffic, and wildlife or livestock grazing in all areas of active operations, including lands undergoing reclamation, in order to protect the public, wildlife, and livestock

from hazards associated with such operations, and to protect revegetated areas from unplanned and uncontrolled grazing. For this purpose, the operator shall provide warning signs, fencing, flagmen, barricades, and other safety and protective measures as may be necessary.

Section 3041.5 - Completion of Operations and Abandonment

(a) Grading and backfilling. Upon completion of backfilling and grading as required by the approved plan and prior to replacing topsoil and revegetation, the operator shall submit a report thereon, in duplicate, to the Mining Supervisor and request inspection for approval. Whenever it is determined by such inspection that the backfilling and grading has met the requirements of the approved plan, the Mining Supervisor shall recommend to the appropriate authorized officer release of an appropriate amount of the compliance bond for the area satisfactorily backfilled and graded.

(c) Permanent abandonment. Methods of abandonment shall be approved in advance by the Mining Supervisor. Areas affected by access roads will be graded, drained, and revegetated in accordance with the approved Mining Plan and therein approved postmining land use prior to bond release. In the event that access or haul roads are intended to remain after abandonment of the operation, pursuant to section 3041.2-2(f)(11) of this subpart, they must be designed and constructed so as to be permanently stabilized using adequate drains, water barriers, and other practices.

TITLE 30--MINERAL RESOURCES

CHAPTER II--GEOLOGICAL SURVEY
DEPARTMENT OF THE INTERIOR

PART 211--COAL MINING OPERATING REGULATIONS

Section 211.75 - Applicability of State Law

(a) On the effective date of this part, and from time to time thereafter, the Secretary shall direct a prompt review of State laws and regulations in effect or adopted and due to come into effect, relating to reclamation of lands disturbed by surface mining of coal in each State in which Federal coal has been leased, permitted, or licensed. If, after such review, the Secretary determines that the requirements of the laws and regulations of any such State afford general protection of environmental quality and values at least as stringent as would occur under exclusive application of this Part, he shall, by rulemaking, direct that the requirements of such State laws and regulations thereafter be applied as conditions upon the approval of any proposed exploration or mining plan, unless (i) the Secretary determines that such application of the requirements of such laws and regulations would unreasonably and substantially prevent the mining of Federal coal in such State, and (ii) the Secretary determines that it is in the overriding national interest that such coal be produced without such application of such requirements. In any such determination of overriding national interest, the Secretary will consult in advance of such determinations with the Governor of the State involved.

CHAPTER VII--OFFICE OF SURFACE MINING RECLAMATION, AND ENFORCEMENT

DEPARTMENT OF THE INTERIOR

PART 700-GENERAL

Section 700.1--Scope

(a) This chapter sets forth the rules and procedures through which the Secretary of the Interior will implement the Surface Mining Control and Reclamation Act of 1977 (Pub. L. 95-87). The Act requires the Secretary to establish procedures for development and approval of programs for the regulation of surface coal mining and surface effects of underground coal mining in each State. The Act also requires the Secretary to establish an initial regulatory program which applies limited environmental performance standards to State, Federal, Indian and private lands until the implementation of a permanent regulatory program.

(b) Regulations authorized under Act and contained in this chapter include but are not limited to . . . .

(1) Environmental performance standards for surface coal mining and reclamation operations during the initial and permanent regulatory programs, including the assessment of civil penalties;

(2) Inspection and enforcement procedures during initial and permanent regulatory programs, including the assessment of civil penalties;

(3) Assistance to small operators meeting permit application requirements of the permanent regulatory program;

(4) Requirements and approval procedures for State programs;

(5) Requirements for surface coal mining and reclamation operations on Federal lands;

(6) Procedures for State and Federal designation of areas unsuitable for surface coal mining operations and lands unsuitable for non-coal mining;

(7) Conflict of interest standards for State and Federal employees;

(8) Requirements and procedures for approval of State mining permits during the permanent regulatory program;

(9) Requirements for posting, release and forfeiture of performance bonds;

(10) Standards prohibiting discrimination against employees for reporting violations of the Act and regulations;

(11) Procudures for administering the Abandoned Mine Reclamation Fund, including approval of State plans and programs, procedures for implementing Federal programs; and

(12) Procedures for grants for State mining and mineral research institutes.

State Regulations

Section 1 - Permit Application - Fees

A permit application accompanied by a written mining plan and signed by the operator shall be filed with the Director of the State Bureau of Mines and Mineral Resources along with the application and initial acreage fees required by Subparagraphs 1 and 2, Subsection A, Section 7, of the New Mexico Coal Surfacemining Act, Chapter 68, Laws 1972, hereinafter referred to as "the Act." Duplicates of the application and mining plan shall be filed with the Director of the Environmental Improvement Agency.

Section 2 - Mining Plan

The mining plan prepared by the operator for approval by the Commission shall set forth the following information:

F. Topographical maps showing drainage before, during, and after mining.

G. Physiography before and after mining.

H. Present and future land use of study site and pertinent surrounding land.

I. Summay of climatological, topographical, soil, water, agricultural, wildlife, and other data pertinent to current and future land use of study site.

J. Water to be stored, diverted, or used and resulting pollutants.

K. Description and analyses of soils in the area to be mined.

O. Existing depth of topsoil in affected area.

P. Proposed efforts to remove and preserve topsoil during mining.

R. Description of existing and postmining vegetation, planting times, and times for growth to maturity.

S. Detailed proposal and time schedule for revegetation.

V. Plans for disposal of waste materials.

Section 5 - Grading

A. Grading shall proceed as set out in the operator's mining plan. Grading shall be an integral part of the mining operation and shall be completed within a reasonable and prescribed time limit.

B. Grading shall be carried out so as to produce a greatly undulating topography or such other topography as is consistent with the proposed end use of the area stated in the approved mining plan.

C. Grading shall be done in such a manner as to control erosion and siltation of the affected area, surrounding property, and water courses.

D. Mining and grading shall not affect the drainage or streamflow in a manner that would impair or be detrimental to existing water rights or the availability of water for beneficial use in the State.

E. The operator shall grade the affected area, construct earth dams in final cuts of all operations, or take whatever measures are necessary to control water which is sufficiently toxic to be dangerous or harmful to or destructive of plant, animal, or human life; provided that a dam may be constructed in a final cut only if such construction and impoundment would not be contrary to the water laws of this State.

F. Where waste material is to be deposited within the affected area, such deposits shall be in such designated areas and within such schedules as are set forth in the approved mining plan and shall be covered to a minimum depth as set forth in the approved mining plan. The operator shall commence grading and reclamation of that portion of the affected area to be used to deposit waste material immediately after cessation of the depositing of waste material.

G. Grading of access, haul or support roads, and final cuts as shown in the mining plan may be excepted of deferred, with the approval of the Commission. Final cuts whose grading is to be excepted or deferred, must be graded, to the extent necessary, upon the order of the Commission if the Commission determines that the ungraded final cut is (1) interfering with drainage or forming pools detrimentally affecting existing water rights or the availability of water for beneficial use in the State, or (2) leaving a condition which may cause a loss of coal resource by fire or excessive oxidation.

Section 6 - Revegetation

A. Revegetation shall proceed as set out in the operator's approved mining plan. Revegetation shall be an integral part of the mining operation, shall be carried out to the extent practicable in consultation with the local soil and water conservation district, and shall be completed within a reasonable and prescribed time limit.

B. The operator shall revegetate the affected area in the following manner for the appropriate end use stated in the operator's mining plan:

(1) Forest planting - The type of trees to be planted shall be as set forth in the approved mining plan. In passing upon the type of trees to be planted, the Commission shall consider the character and nature of the soil, the altitude, the temperature, and the precipitation at the site. Planting methods and care of planting stock shall be governed by professionally accepted reforestation practices.

(2) Range - The vegetative species to be planted or seeded shall be as set forth in the approved mining plan. The character and nature of the soil, the natural rainfall and the intended capacity of the area for grazing by livestock following the stripmining activity shall be considered by the commission in passing on the operator's selection.

(3) Agricultural or Horicultural Crops - Seeding plans and planting rates shall be set forth in the approved mining plan.

(4) Special Projects - Affected areas to be developed for selected purposes such as recreational, residential, industrial, or other special uses shall have a reclamation program suitable for the specific use set forth in the approved mining plan.

C. The operator, with the consent of the Commission, may delay planting or seeding the affected area during any period in which the operator is conducting research on more productive methods of revegetation.

D. Revegetation of haulage roads shall not be required where the road has been adequately surfaced and the operator or owner of the property has demonstrated to the satisfaction of the Commission that the roads will be required for a substantial use after stripmining operations have terminated.

E. Upon application by the operator concerning any portion of affected area, the Commission shall investigate whether the operator has completed the reclamation set forth in the approved mining plan or if, considering the natural condition and vegetation prior to stripmining, technical and economic practicability, future productivity for the end use stated in the approved mining plan, esthetic appearance and peculiar condition of the geographic area in which the stripmine is located, further revegetation efforts are justified. If the Commission shall determine that the reclamation set forth in the mining plan has been completed or that further revegetation efforts are not justified, it shall certify such decision to the operator and he shall thereupon be released from further reclamation duties with respect to the portion of affected area concerned, including any bond relating thereto.

SECTION P

VEGETATION APPENDIX

SECTION P

VEGETATION APPENDIX

Field notes Ojo Encino vegetation - Dick-Peddie

12/2/78

<u>1st stop</u> NW Sec. 3

Photos - 2 E & 2 W

Patches of Artemesia tridentata on elevated soil blocks. This is deeper more friable soil and less clay.

<u>On Flats</u>

Atriplex obovata Hilaria jamesii Bouteloua gracilis	Dominant perennials
Atriplex rosea Atriplex powelii Salsola kali	Annuals

<u>Drainages and Swales</u>

Sporobolus airoides
Sarcobatus vermiculatus
Chrysothamnus nauseosus
  var. bigelovii
Chrysothamnus greeni
Gut. saroth - occasional

<u>2nd stop</u> south edge of sec 3 east quarter. Photo

More Hilaria jamesii than first stop. Going north along section boundary occasional Indian rice grass, Lycium pal., Atriplex can., Yucca angust., Jun. osteo.

In Sec. 5 similar to Sec. 3 stop

Over most of the area the islands of Artemesia are elevated, sometimes on rocky benches.

It appears that most of the elevated areas have resulted from erosion between.

There are occasional clay mounds (miniature buttes) with virtually no vegetation. These are most numerous on Section 5.

12/2/78

<u>1st major stop</u> (Photo E & S, W)

Sec.

35	36
2	1

Field notes Ojo Encino Vegetation - Spellenberg

12/2/78 - Ojo Encino

Flat S of powerline. Atriplex saccaria, A. powellii, A. obovata, Art. tridentata, BG, HJ, Sal. paulsenii.

SECTION Q

HYDROLOGY AND WATER SUPPLY APPENDIX

SECTION Q

HYDROLOGY AND WATER SUPPLY APPENDIX

Tables

Table Q-1. Summary of average monthly and average annual runoff volumes during the period October 1, 1977, to September 30, 1980.

Streamflow gaging sites	Papers Wash (southwest corner of study area)	Chaco Wash (8 miles west of study area)
Drainage Area (mi2)	20.3	59.0
Monthly Average (runoff volume in acre-ft)		
October	3.2	18
November	5.3	21
December	.9	53
January	17	131
February	91	305
March	1.0	64
April	0	0
May	2.1	47
June	.9	.2
July	4.3	10
August	4.5	10
September	.2	17
Annual Average (acre-ft)	130	676
Unit Yield (acre-ft/mi2/yr)	6.4	11.5

TABLE Q-2. STATISTICAL SUMMARY OF WATER QUALITY OF STREAMFLOW NEAR THE OJO ENCINO STUDY AREA.

STATION NUMBER: 08334300 STATION NAME AND LOCATION: PAPERS WASH NR STARLAKE TRADING POST, NM

DRAINAGE AREA: SQUARE MILES

WATER QUALITY CONSTITUENT	DESCRIPTIVE STATISTICS: SAMPLE SIZE	MAXIMUM	MINIMUM	MEAN	STANDARD DEVIATION	PERCENT OF SAMPLES IN WHICH VALUES WERE LESS THAN OR EQUAL TO THOSE SHOWN: 95	75	MEDIAN 50	25	5
SUMMARY OF DATA COLLECTED AT PERIODIC INTERVALS										
TEMPERATURE, WATER (DEG C)	2	6.00	0.00							
TEMPERATURE, AIR (DEG C)	2	9.50	5.00							
AGENCY ANALYZING SAMPLE (CODE NUMBER)	17	80020.00	80020.00	80020.00	0.00	80020.00	80020.00	80020.00	80020.00	80020.00
STREAMFLOW, INSTANTANEOUS (CFS)	19	21.00	0.02	7.57	5.77	21.00	8.70	5.20	4.50	0.02
SPECIFIC CONDUCTANCE (MICROMHOS)	19	414.00	193.00	299.05	76.70	414.00	353.00	325.00	211.00	193.00
OXYGEN, DISSOLVED (MG/L)	2	11.10	9.30							
PH (UNITS)	19	8.90	7.20	7.82	0.51	8.90	8.30	7.80	7.30	7.20
CARBON DIOXIDE DISSOLVED (MG/L AS CO2)	2	0.90	0.80							
ALKALINITY (MG/L AS CACO3)	2	170.00	110.00							
BICARBONATE (MG/L AS HCO3)	2	200.00	130.00							
CARBONATE (MG/L AS CO3)	2	2.00	2.00							
NITROGEN, TOTAL (MG/L AS N)	2	6.20	2.40							
NITROGEN, ORGANIC TOTAL (MG/L AS N)	2	4.40	1.20							
NITROGEN, AMMONIA TOTAL (MG/L AS N)	2	0.54	0.53							
NITROGEN,AMMONIA + ORGANIC TOTAL (MG/L)		4.90	1.70							
NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	2	1.30	0.68							
PHOSPHORUS, TOTAL (MG/L AS P)	2	0.77	0.32							
PHOSPHORUS, DISSOLVED (MG/L AS P)	2	0.12	0.10							
CARBON, ORGANIC TOTAL (MG/L AS C)	17	240.00	8.60	66.83	62.56	240.00	103.50	40.00	25.50	8.60
CARBON, ORGANIC DISSOLVED (MG/L AS C)	2	13.00	5.40							
CARBON, ORGANIC SUSPENDED TOTAL (MG/L)	1	12.00	12.00							
HARDNESS (MG/L AS CACO3)	2	37.00	33.00							
HARDNESS, NONCARBONATE (MG/L CACO3)	2	0.00	0.00							
CALCIUM DISSOLVED (MG/L AS CA)	2	13.00	11.00							
MAGNESIUM, DISSOLVED (MG/L AS MG)	2	1.30	1.00							
SODIUM, DISSOLVED (MG/L AS NA)	2	75.00	39.00							
SODIUM ADSORPTION RATIO	2	5.70	2.80							
SODIUM PERCENT	2	81.00	68.00							
SODIUM+ POTASSIUM DISSOLVED (MG/L AS NA)	1	79.00	79.00							
POTASSIUM, DISSOLVED (MG/L AS K)	2	3.70	2.90							
CHLORIDE, DISSOLVED (MG/L AS CL)	2	12.00	4.30							
SULFATE DISSOLVED (MG/L AS SO4)	2	9.50	3.10							
FLUORIDE, DISSOLVED (MG/L AS F)	2	0.60	0.50							
SILICA, DISSOLVED (MG/L AS SIO2)	2	9.70	6.40							
ARSENIC TOTAL (UG/L AS AS)	17	38.00	1.00	13.53	12.24	38.00	22.50	9.00	2.50	1.00
BORON, DISSOLVED (UG/L AS B)	2	80.00	70.00							
IRON, DISSOLVED (UG/L AS FE)	2	160.00	60.00							
SELENIUM, TOTAL (UG/L AS SE)	17	3.00	1.00	2.06	0.90	3.00	3.00	2.00	1.00	1.00
COLIFORM, FECAL, 0.7 UM-MF (COLS./100 ML)	2	0.00	0.00							
STREPTOCOCCI FECAL, KF AGAR (COLS/100 ML)	2	13000.00	11000.00							
SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED	2	282.00	154.00							
SOLIDS, SUM OF CONSTITUENTS, DISS. (MG/L)	2	224.00	136.00							
SOLIDS, DISSOLVED (TONS PER DAY)	2	0.06	0.01							
SOLIDS, DISSOLVED (TONS PER AC-FT)	2	0.38	0.21							

TABLE Q-3. STATISTICAL SUMMARY OF WATER QUALITY OF STREAMFLOW NEAR THE OJO ENCINO STUDY AREA.

STATION NUMBER: 08334300 STATION NAME AND LOCATION: PAPERS WASH NR STARLAKE TRADING POST, NM

DRAINAGE AREA: SQUARE MILES

WATER QUALITY CONSTITUENT	DESCRIPTIVE STATISTICS: SAMPLE SIZE	MAXIMUM	MINIMUM	MEAN	STANDARD DEVIATION	PERCENT OF SAMPLES IN WHICH VALUES WERE LESS THAN OR EQUAL TO THOSE SHOWN: 95	75	MEDIAN 50	25	5
SUMMARY OF DATA COLLECTED AT PERIODIC INTERVALS										
NITROGEN, AMMONIA TOTAL (MG/L AS NH4)	1	0.65	0.65							
PHOSPHORUS TOTAL (MG/L AS PO4)	1	2.40	2.40							
NITROGEN, TOTAL (MG/L AS NO3)	2	27.00	11.00							
MERCURY TOTAL RECOVERABLE (UG/L AS HG)	17	0.70	0.10	0.26	0.19	0.70	0.45	0.20	0.10	0.10
SAMPLE SOURCE	18	40.00	40.00	40.00	0.00	40.00	40.00	40.00	40.00	40.00
SEDIMENT, SUSPENDED (MG/L)	19	19800.00	566.00	6354.37	5386.58	19799.90	10900.00	4830.00	1390.00	566.00
SEDIMENT DISCHARGE, SUSPENDED (T/DAY)	19	500.00	0.06	128.04	153.18	500.00	241.00	55.00	26.00	0.06
SUMMARY OF DATA COLLECTED AT ONCE-DAILY OR MORE FREQUENT INTERVALS										
STREAMFLOW (CFS)	1104	23.00	0.00	0.18	1.38	0.44	0.00	0.00	0.00	0.00

TABLE Q-4. STATISTICAL SUMMARY OF WATER QUALITY OF STREAMFLOW NEAR THE OJO ENCINO STUDY AREA.

STATION NUMBER: 09367660 STATION NAME AND LOCATION: CHACO WASH NR STARLAKE TRADING POST, NM

DRAINAGE AREA: SQUARE MILES

WATER QUALITY CONSTITUENT	DESCRIPTIVE STATISTICS: SAMPLE SIZE	MAXIMUM	MINIMUM	MEAN	STANDARD DEVIATION	PERCENT OF SAMPLES IN WHICH VALUES WERE LESS THAN OR EQUAL TO THOSE SHOWN: 95	75	MEDIAN 50	25	5
SUMMARY OF DATA COLLECTED AT PERIODIC INTERVALS										
TEMPERATURE, WATER (DEG C)	10	22.00	1.00	13.15	6.76	22.00	17.00	17.00	5.88	1.00
TEMPERATURE, AIR (DEG C)	6	22.00	4.00							
AGENCY ANALYZING SAMPLE (CODE NUMBER)	44	80020.00	80020.00	80020.00	0.00	80020.00	80020.00	80020.00	80020.00	80020.00
STREAMFLOW, INSTANTANEOUS (CFS)	57	113.00	0.12	9.24	17.15	34.20	8.10	4.40	1.20	0.12
SPECIFIC CONDUCTANCE (MICROMHOS)	53	6700.00	102.00	614.47	1088.20	3639.99	467.50	383.00	268.50	177.50
OXYGEN, DISSOLVED (MG/L)	6	10.80	6.30							
OXYGEN, DISSOLVED (PERCENT SATURATION)	1	99.00	99.00							
PH (UNITS)	53	8.80	7.00	7.61	0.40	8.39	7.90	7.50	7.30	7.07
CARBON DIOXIDE DISSOLVED (MG/L AS CO2)	10	14.00	0.30	4.27	5.23	14.00	7.90	1.40	0.62	0.30
ALKALINITY (MG/L AS CACO3)	10	180.00	71.00	101.30	32.53	180.00	115.00	90.00	79.25	71.00
BICARBONATE (MG/L AS HCO3)	10	220.00	86.00	121.60	40.24	220.00	130.00	110.00	97.00	86.00
CARBONATE (MG/L AS CO3)	10	4.00	0.00	0.80	1.69	4.00	1.00	0.00	0.00	0.00
NITROGEN, TOTAL (MG/L AS N)	5	9.40	2.90							
NITROGEN, DISSOLVED (MG/L AS N)	1	5.20	5.20							
NITROGEN, ORGANIC TOTAL (MG/L AS N)	6	7.40	0.80							
NITROGEN, AMMONIA TOTAL (MG/L AS N)	6	6.70	0.02							
NITROGEN,AMMONIA + ORGANIC DIS. (MG/L)	1	2.70	2.70							
NITROGEN,NH4 + ORG. SUSP. TOTAL (MG/L)	1	4.80	4.80							
NITROGEN,AMMONIA + ORGANIC TOTAL (MG/L)	6	7.90	1.40							
NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	5	1.50	0.93							
NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N)	1	2.50	2.50							
PHOSPHORUS, TOTAL (MG/L AS P)	6	1.70	0.12							
PHOSPHORUS, DISSOLVED (MG/L AS P)	6	0.12	0.03							
CARBON, ORGANIC TOTAL (MG/L AS C)	42	260.00	12.00	104.86	60.81	235.50	150.00	98.00	50.75	19.65
CARBON, ORGANIC DISSOLVED (MG/L AS C)	6	17.00	5.00							
CARBON, ORGANIC SUSPENDED TOTAL (MG/L)	6	39.00	8.00							
HARDNESS (MG/L AS CACO3)	6	21.00	11.00							
HARDNESS, NONCARBONATE (MG/L CACO3)	6	0.00	0.00							
CALCIUM DISSOLVED (MG/L AS CA)	6	7.80	4.20							
MAGNESIUM, DISSOLVED (MG/L AS MG)	6	0.70	0.10							
SODIUM, DISSOLVED (MG/L AS NA)	6	100.00	44.00							
SODIUM ADSORPTION RATIO	6	11.00	4.20							
SODIUM PERCENT	6	92.00	80.00							
SODIUM+ POTASSIUM DISSOLVED (MG/L AS NA)	2	66.00	65.00							
POTASSIUM, DISSOLVED (MG/L AS K)	6	2.60	1.50							
CHLORIDE, DISSOLVED (MG/L AS CL)	6	57.00	3.60							
SULFATE DISSOLVED (MG/L AS SO4)	6	130.00	4.70							
FLUORIDE, DISSOLVED (MG/L AS F)	6	0.60	0.30							
SILICA, DISSOLVED (MG/L AS SIO2)	6	16.00	4.70							
ARSENIC DISSOLVED (UG/L AS AS)	4	2.00	1.00							
ARSENIC SUSPENDED TOTAL (UG/L AS AS)	2	24.00	9.00							
ARSENIC TOTAL (UG/L AS AS)	46	69.00	1.00	25.33	17.74	65.95	37.00	21.00	12.75	3.00
ARSENIC TOTAL IN BOTTOM MATERIAL (UG/G)	2	3.00	3.00							

TABLE Q-5. STATISTICAL SUMMARY OF WATER QUALITY OF STREAMFLOW NEAR THE OJO ENCINO STUDY AREA.

STATION NUMBER: 09367660 STATION NAME AND LOCATION: CHACO WASH NR STARLAKE TRADING POST, NM

DRAINAGE AREA: SQUARE MILES

WATER QUALITY CONSTITUENT	SAMPLE SIZE	MAXIMUM	MINIMUM	MEAN	STANDARD DEVIATION	95	75	MEDIAN 50	25	5
	DESCRIPTIVE STATISTICS					PERCENT OF SAMPLES IN WHICH VALUES WERE LESS THAN OR EQUAL TO THOSE SHOWN				
SUMMARY OF DATA COLLECTED AT PERIODIC INTERVALS										
BARIUM, DISSOLVED (UG/L AS BA)	3	100.00	10.00							
BARIUM, SUSPENDED RECOVERABLE (UG/L)	1	1600.00	1600.00							
BARIUM, TOTAL RECOVERABLE (UG/L AS BA)	2	1600.00	1100.00							
BARIUM, RECOV. FM BOTTOM MATERIAL (UG/G)	2	110.00	100.00							
BERYLLIUM, DISSOLVED (UG/L AS BE)	4	5.00	0.00							
BERYLLIUM, SUSPENDED RECOV. (UG/L AS BE)	1	10.00	10.00							
BERYLLIUM, TOTAL RECOVERABLE (UG/L AS BE)	3	10.00	10.00							
BERYLLIUM, RECOV. FM BOT. MATERIAL (UG/G)	2	1.00	0.00							
BORON, DISSOLVED (UG/L AS B)	6	260.00	40.00							
CADMIUM DISSOLVED (UG/L AS CD)	4	2.00	0.00							
CADMIUM SUSPENDED RECOVERABLE (UG/L)	1	2.00	2.00							
CADMIUM TOTAL RECOVERABLE (UG/L AS CD)	3	2.00	1.00							
CADMIUM RECOV. FM BOTTOM MATERIAL (UG/G)	2	0.00	0.00							
CHROMIUM, RECOV. FM BOT. MATERIAL (UG/G)	2	2.00	1.00							
CHROMIUM, DISSOLVED (UG/L AS CR)	4	20.00	0.00							
CHROMIUM, SUSPENDED RECOV. (UG/L AS CR)	2	60.00	60.00							
CHROMIUM, TOTAL RECOVERABLE (UG/L AS CR)	3	60.00	60.00							
COBALT, DISSOLVED (UG/L AS CO)	3	3.00	2.00							
COBALT, TOTAL RECOVERABLE (UG/L AS CO)	2	100.00	89.00							
COBALT, RECOV. FM BOTTOM MATERIAL (UG/G)	2	4.00	0.00							
COPPER, DISSOLVED (UG/L AS CU)	4	40.00	11.00							
COPPER, SUSPENDED RECOVERABLE (UG/L)	2	290.00	240.00							
COPPER, TOTAL RECOVERABLE (UG/L AS CU)	3	320.00	240.00							
COPPER, RECOV. FM BOTTOM MATERIAL (UG/G)	2	6.00	5.00							
IRON, SUSPENDED RECOVERABLE (UG/L AS FE)	1	120000.00	120000.00							
IRON, TOTAL RECOVERABLE (UG/L AS FE)	5	220000.00	120000.00							
IRON, DISSOLVED (UG/L AS FE)	6	1000.00	120.00							
LEAD, DISSOLVED (UG/L AS PB)	3	38.00	0.00							
LEAD, SUSPENDED RECOVERABLE (UG/L AS PB)	2	160.00	140.00							
LEAD, TOTAL RECOVERABLE (UG/L AS PB)	3	180.00	95.00							
LEAD, RECOV. FM BOTTOM MATERIAL (UG/G)	2	0.00	0.00							
MANGANESE, RECOV. FM BOT. MATERIAL (UG/G)	2	270.00	200.00							
MANGANESE, SUSPENDED RECOV. (UG/L AS MN)	2	2000.00	1600.00							
MANGANESE, TOTAL RECOVERABLE (UG/L AS MN)	7	4000.00	1100.00							
MANGANESE, DISSOLVED (UG/L AS MN)	4	10.00	0.00							
MOLYBDENUM, DISSOLVED (UG/L AS MO)	3	10.00	0.00							
MOLYBDENUM, SUSPENDED RECOV. (UG/L AS MO)	1	0.00	0.00							
MOLYBDENUM, TOTAL RECOVERABLE (UG/L)	2	3.00	0.00							
MOLYBDENUM, RECOV. FM BOT.MATERIAL (UG/G)	2	1.00	0.00							
NICKEL, DISSOLVED (UG/L AS NI)	4	7.00	3.00							
NICKEL, SUSPENDED RECOVERABLE (UG/L)	2	83.00	59.00							
NICKEL, TOTAL RECOVERABLE (UG/L AS NI)	3	90.00	26.00							
NICKEL, RECOV. FM BOTTOM MATERIAL (UG/G)	2	10.00	10.00							
STRONTIUM, DISSOLVED (UG/L AS SR)	1	100.00	100.00							

TABLE Q-6. STATISTICAL SUMMARY OF WATER QUALITY OF STREAMFLOW NEAR THE OJO ENCINO STUDY AREA.

STATION NUMBER: 09367660 STATION NAME AND LOCATION: CHACO WASH NR STARLAKE TRADING POST, NM

DRAINAGE AREA: SQUARE MILES

WATER QUALITY CONSTITUENT	DESCRIPTIVE STATISTICS					PERCENT OF SAMPLES IN WHICH VALUES WERE LESS THAN OR EQUAL TO THOSE SHOWN				
	SAMPLE SIZE	MAXIMUM	MINIMUM	MEAN	STANDARD DEVIATION	95	75	MEDIAN 50	25	5
SUMMARY OF DATA COLLECTED AT PERIODIC INTERVALS										
VANADIUM, DISSOLVED (UC/L AS V)	3	6.00	3.00							
ZINC, DISSOLVED (UG/L AS ZN)	4	140.00	8.00							
ZINC, SUSPENDED RECOVERABLE (UG/L AS ZN)	2	730.00	610.00							
ZINC, TOTAL RECOVERABLE (UC/L AS ZN)	3	760.00	360.00							
ZINC, RECOV. FM BOTTOM MATERIAL (UG/G)	2	12.00	10.00							
ALUMINUM, DISSOLVED (UG/L AS AL)	3	520.00	140.00							
LITHIUM DISSOLVED (UG/L AS LI)	3	7.00	4.00							
LITHIUM SUSPENDED RECOVERABLE (UG/L)	1	80.00	80.00							
LITHIUM TOTAL RECOVERABLE (UG/L AS LI)	2	90.00	80.00							
SELENIUM, DISSOLVED (UC/L AS SE)	4	4.00	1.00							
SELENIUM, SUSPENDED TOTAL (UG/L AS SE)	2	0.00	0.00							
SELENIUM, TOTAL (UC/L AS SE)	46	12.00	1.00	3.28	2.58	9.30	4.25	3.00	1.00	1.00
SELENIUM, TOTAL IN BOTTOM MATERIAL (UG/G)	2	0.00	0.00							
GROSS ALPHA, DISSOLVED (PCI/L AS U-NAT)	2	5.60	1.00							
GROSS ALPHA, SUSP. TOTAL (PCI/L AS U-NAT)	2	210.00	68.00							
GROSS BETA, DISSOLVED (PCI/L AS CS-137)	2	8.50	4.80							
GROSS BETA, SUSP. TOTAL (PCI/L AS CS-137)	2	190.00	100.00							
COLIFORM, FECAL, 0.7 UM-MF (COLS./100 ML)	5	5100.00	0.00							
STREPTOCOCCI FECAL, KF AGAR (COLS/100 ML)	5	23000.00	870.00							
SOLIDS, RESIDUE AT 180 DEC. C DISSOLVED	6	366.00	165.00							
SOLIDS, SUM OF CONSTITUENTS, DISS. (MG/L)	6	315.00	152.00							
SOLIDS, DISSOLVED (TONS PER DAY)	6	4.89	0.17							
SOLIDS, DISSOLVED (TONS PER AC-FT)	6	0.50	0.22							
SED. SUSP. SIEVE DIAM. % FINER THAN .062	4	99.00	91.00							
SED. SUSP. SIEVE DIAM. % FINER THAN .125	1	100.00	100.00							
SED. SUSP. FALL DIAM. % FINER THAN .002	3	96.00	69.00							
SED. SUSP. FALL DIAM. % FINER THAN .004	3	99.00	72.00							
SED. SUSP. FALL DIAM. % FINER THAN .016	2	96.00	77.00							
SED. SUSP. FALL DIAM. % FINER THAN .062	2	100.00	81.00							
SED. SUSP. FALL DIAM. % FINER THAN .125	1	85.00	85.00							
SED. SUSP. FALL DIAM. % FINER THAN .250	1	98.00	98.00							
SED. SUSP. FALL DIAM. % FINER THAN .500	1	100.00	100.00							
NITROGEN, AMMONIA TOTAL (MG/L AS NH4)	3	2.30	0.67							
PHOSPHORUS TOTAL (MC/L AS PO4)	4	5.20	0.37							
NITROGEN, TOTAL (MC/L AS NO3)	5	42.00	13.00							
MERCURY DISSOLVED (UC/L AS HC)	4	0.10	0.00							
MERCURY SUSPENDED RECOVERABLE (UG/L)	2	0.40	0.40							
MERCURY TOTAL RECOVERABLE (UC/L AS HG)	46	1.50	0.10	0.60	0.34	1.29	0.90	0.60	0.40	0.10
MERCURY RECOV. FM BOTTOM MATERIAL (UG/L)	2	0.02	0.01							
SAMPLE SOURCE	45	40.00	40.00	40.00	0.00	40.00	40.00	40.00	40.00	40.00
GROSS ALPHA, DISSOLVED (UC/L AS U-NAT)	2	8.20	1.40							
GROSS ALPHA, SUSP. TOTAL (UG/L AS U-NAT)	2	310.00	100.00							
GROSS BETA, DISSOLVED (PCI/L AS SR/YT-90)	1	4.60	4.60							
GROSS BETA, SUSP TOT (PCI/L AS SR/YT-90)	1	180.00	180.00							

TABLE Q-7. STATISTICAL SUMMARY OF WATER QUALITY OF STREAMFLOW NEAR OJO ENCINO STUDY AREA.

STATION NUMBER: 09367660 STATION NAME AND LOCATION: CHACO WASH NR STARLAKE TRADING POST, NM

DRAINAGE AREA: SQUARE MILES

	DESCRIPTIVE STATISTICS					PERCENT OF SAMPLES IN WHICH VALUES WERE LESS THAN OR EQUAL TO THOSE SHOWN				
WATER QUALITY CONSTITUENT	SAMPLE SIZE	MAXIMUM	MINIMUM	MEAN	STANDARD DEVIATION	95	75	MEDIAN 50	25	5
SUMMARY OF DATA COLLECTED AT PERIODIC INTERVALS										
SEDIMENT, SUSPENDED (MG/L)	55	26100.00	706.00	13640.76	6981.68	23440.00	19200.00	14700.00	9350.00	1291.20
SEDIMENT DISCHARGE, SUSPENDED (T/DAY)	55	1760.00	0.23	266.94	375.34	1342.00	339.00	96.00	43.00	3.30
BED MAT. FALL DIAM. % FINER THAN .062 MM	3	25.00	7.00							
BED MAT. FALL DIAM. % FINER THAN .125 MM	3	48.00	11.00							
BED MAT. FALL DIAM. % FINER THAN .250 MM	3	87.00	72.00							
BED MAT. FALL DIAM. % FINER THAN .500 MM	3	99.00	91.00							
BED MAT. FALL DIAM. % FINER THAN 1.00 MM	3	100.00	95.00							
BED MAT. FALL DIAM. % FINER THAN 2.00 MM	1	100.00	100.00							
SUMMARY OF DATA COLLECTED AT ONCE-DAILY OR MORE FREQUENT INTERVALS										
STREAMFLOW (CFS)	971	61.00	0.00	1.16	4.91	4.70	0.16	0.00	0.00	0.00

TABLE Q-8. SUMMARY OF GROUND-WATER QUALITY OF PICTURED CLIFFS SANDSTONE, COAL SEAMS, AND OVERBURDEN IN THE OJO ENCINO STUDY AREA.

LOCAL IDENT-I-FIER	STATION NUMBER	COUNTY	SITE	DATE OF SAMPLE	TIME	GEO-LOGIC UNIT	DEPTH BELOW LAND SURFACE (WATER LEVEL) (FEET) (72019)	DEPTH TO BOT-TOM OF WATER-BEARING ZONE (FT) (72003)	DEPTH TO TOP OF WATER-BEARING ZONE (FT) (72002)
19N.05W.03.222 DHOE4 COA	355446107204801	031	GW	79-07-24	1430	211FRLD	47.60	54	25
		031	GW	80-08-19	1430	211FRLD	--	--	--
19N.05W.04.333 DHOE2 PCC	355400107224201	031	GW	79-07-25	1145	211PCCF	50.32	233	102
		031	GW	80-08-20	1145	211PCCF	--	--	--
19N.05W.05.221 DHOE5 OB	355447107224301	031	GW	79-07-25	1630	211FRLD	68.00	180	162
		031	GW	80-08-19	1615	211FRLD	--	--	--
19N.05W.07.112 DHOE1 COA	355353107244501	031	GW	79-07-24	1015	211FRLD	57.48	60	10

LOCAL IDENT-I-FIER	DATE OF SAMPLE	DEPTH OF WELL, TOTAL (FEET) (72008)	ELEV. OF LAND SURFACE DATUM (FT. NGVD) (72000)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS) (00095)	PH FIELD (UNITS) (00400)	TEMPER-ATURE, AIR (DEG C) (00020)	TEMPER-ATURE, WATER (DEG C) (00010)	OXYGEN DEMAND, CHEM-ICAL (HIGH LEVEL) (MG/L) (00340)	HARD-NESS (MG/L AS CACO3) (00900)	HARD-NESS, NONCAR-BONATE (MG/L CACO3) (00902)
19N.05W.03.222 DHOE4 COA	79-07-24	54	6621.00	6800	12.4	--	14.0	49	10	0
	80-08-19	54	6621.00	6100	12.1	--	12.0	43	--	--
19N.05W.04.333 DHOE2 PCC	79-07-25	233	6640.00	4000	8.8	--	16.0	120	28	0
	80-08-20	233	6640.00	5400	8.3	4.0	14.0	43	27	0
19N.05W.05.221 DHOE5 OB	79-07-25	182	6675.00	1900	9.0	--	16.0	30	7	0
	80-08-19	182	6675.00	2050	8.6	--	14.0	49	7	0
19N.05W.07.112 DHOE1 COA	79-07-24	60	6693.00	4600	8.1	--	15.5	--	86	0

LOCAL IDENT-I-FIER	DATE OF SAMPLE	CALCIUM DIS-SOLVED (MG/L AS CA) (00915)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG) (00925)	SODIUM, DIS-SOLVED (MG/L AS NA) (00930)	SODIUM AD-SORP-TION RATIO (00931)	SODIUM+ POTAS-SIUM DIS-SOLVED (MG/L AS NA) (00933)	POTAS-SIUM, DIS-SOLVED (MG/L AS K) (00935)	BICAR-BONATE (MG/L AS HCO3) (00440)	CAR-BONATE (MG/L AS CO3) (00445)	HY-DROXIDE ION (MG/L AS OH) (71830)
19N.05W.03.222 DHOE4 COA	79-07-24	3.2	.4	750	105	760	9.8	--	197	449
	80-08-19	6.2	--	620	--	--	6.0	--	134	349
19N.05W.04.333 DHOE2 PCC	79-07-25	8.4	1.5	930	78	940	6.2	840	--	--
	80-08-20	7.0	2.1	1200	102	--	6.1	1100	0	--
19N.05W.05.221 DHOE5 OB	79-07-25	2.5	.2	550	90	550	2.7	860	39	--
	80-08-19	2.3	.2	450	76	--	2.1	856	20	--
19N.05W.07.112 DHOE1 COA	79-07-24	26	4.8	1200	57	1200	8.8	1500	24	--

TABLE Q-9. SUMMARY OF GROUND-WATER QUALITY OF PICTURED CLIFFS SANDSTONE, COAL SEAMS, AND OVERBURDEN IN THE OJO ENCINO STUDY AREA.

LOCAL IDENT-I-FIER	STATION NUMBER	COUNTY	SITE	DATE OF SAMPLE	TIME	GEO-LOGIC UNIT	DEPTH BELOW LAND SURFACE (WATER LEVEL) (FEET) (72019)	DEPTH TO BOT-TOM OF WATER-BEARING ZONE (FT) (72003)	DEPTH TO TOP OF WATER-BEARING ZONE (FT) (72002)
19N.05W.03.222 DHOE4 COA	355446107204801	031	GW	79-07-24	1430	211FRLD	47.60	54	25
		031	GW	80-08-19	1430	211FRLD	--	--	--
19N.05W.04.333 DHOE2 PCC	355400107224201	031	GW	79-07-25	1145	211PCCF	50.32	233	102
		031	GW	80-08-20	1145	211PCCF	--	--	--
19N.05W.05.221 DHOE5 OB	355447107224301	031	GW	79-07-25	1630	211FRLD	68.00	180	162
		031	GW	80-08-19	1615	211FRLD	--	--	--
19N.05W.07.112 DHOE1 COA	355353107244501	031	GW	79-07-24	1015	211FRLD	57.48	60	10

LOCAL IDENT-I-FIER	DATE OF SAMPLE	ALKA-LINITY (MG/L AS CACO3) (00410)	SULFIDE TOTAL (MG/L AS S) (00745)	SULFATE DIS-SOLVED (MG/L AS SO4) (00945)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL) (00940)	FLUO-RIDE, DIS-SOLVED (MG/L AS F) (00950)	SILICA, DIS-SOLVED (MG/L AS SIO2) (00955)	SOLIDS, RESIDUE AT 180 DEG. C DIS-SOLVED (MG/L) (70300)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L) (70301)	NITRO-GEN, NITRATE DIS-SOLVED (MG/L AS N) (00618)
19N.05W.03.222 DHOE4 COA	79-07-24	1620	1.4	24	69	2.2	16	1800	2500	--
	80-08-19	1260	.8	300	81	3.4	24	1530	1370	.00
19N.05W.04.333 DHOE2 PCC	79-07-25	690	.7	380	700	3.5	8.2	2340	2450	--
	80-08-20	902	.2	86	1200	3.0	6.1	3040	3060	.00
19N.05W.05.221 DHOE5 OB	79-07-25	770	.4	290	31	2.7	7.5	1200	1350	--
	80-08-19	735	4.6	230	31	2.6	8.6	1090	1170	.00
19N.05W.07.112 DHOE1 COA	79-07-24	1270	--	--	--	--	--	--	--	--

LOCAL IDENT-I-FIER	DATE OF SAMPLE	NITRO-GEN, NITRITE DIS-SOLVED (MG/L AS N) (00613)	NITRO-GEN, NO2+NO3 DIS-SOLVED (MG/L AS N) (00631)	NITRO-GEN, AMMONIA DIS-SOLVED (MG/L AS N) (00608)	NITRO-GEN, ORGANIC DIS-SOLVED (MG/L AS N) (00607)	PHOS-PHORUS, ORTHOPH OSPHATE DISSOL. (MG/L AS P) (00671)	ALUM-INUM, DIS-SOLVED (UG/L AS AL) (01106)	ARSENIC DIS-SOLVED (UG/L AS AS) (01000)	BARIUM, DIS-SOLVED (UG/L AS BA) (01005)	BERYL-LIUM, DIS-SOLVED (UG/L AS BE) (01010)
19N.05W.03.222 DHOE4 COA	79-07-24	--	.05	7.000	.00	.010	4600	1	<100	10
	80-08-19	.030	.00	4.600	16	.010	--	2	--	--
19N.05W.04.333 DHOE2 PCC	79-07-25	--	.01	.650	.00	<.010	20	3	<100	10
	80-08-20	.010	.00	.900	.70	.000	--	2	--	--
19N.05W.05.221 DHOE5 OB	79-07-25	--	.05	.280	.00	.010	50	2	30	<1
	80-08-19	.000	.00	.210	.89	.020	--	1	--	--
19N.05W.07.112 DHOE1 COA	79-07-24	--	<.10	3.800	.90	.390	30	2	<100	<10

TABLE Q-10. SUMMARY OF GROUND-WATER QUALITY OF PICTURED CLIFFS SANDSTONE, COAL SEAMS, AND OVERBURDEN IN THE OJO ENCINO STUDY AREA.

LOCAL IDENT-I-FIER	STATION NUMBER	COUNTY	SITE	DATE OF SAMPLE	TIME	GEO-LOGIC UNIT	DEPTH BELOW LAND SURFACE (WATER LEVEL) (FEET) (72019)	DEPTH TO BOT-TOM OF WATER-BEARING ZONE (FT) (72003)	DEPTH TO TOP OF WATER-BEARING ZONE (FT) (72002)
19N.05W.03.222 DHOE4 COA	355446107204801	031	GW	79-07-24	1430	211FRLD	47.60	54	25
		031	GW	80-08-19	1430	211FRLD	--	--	--
19N.05W.04.333 DHOE2 PCC	355400107224201	031	GW	79-07-25	1145	211PCCF	50.32	233	1[illegible]
		031	GW	80-08-20	1145	211PCCF	--	--	--
19N.05W.05.221 DHOE5 OB	355447107224301	031	GW	79-07-25	1630	211FRLD	68.00	180	162
		031	GW	80-08-19	1615	211FRLD	--	--	--
19N.05W.07.112 DHOE1 COA	355353107244501	031	GW	79-07-24	1015	211FRLD	57.48	60	10

LOCAL IDENT-I-FIER	DATE OF SAMPLE	BORON, DIS-SOLVED (UG/L AS B) (01020)	CADMIUM DIS-SOLVED (UG/L AS CD) (01025)	CHRO-MIUM, DIS-SOLVED (UG/L AS CR) (01030)	COBALT, DIS-SOLVED (UG/L AS CO) (01035)	COPPER, DIS-SOLVED (UG/L AS CU) (01040)	IRON, DIS-SOLVED (UG/L AS FE) (01046)	LEAD, DIS-SOLVED (UG/L AS PB) (01049)	LITHIUM DIS-SOLVED (UG/L AS LI) (01130)	MANGA-NESE, DIS-SOLVED (UG/L AS MN) (01056)
19N.05W.03.222 DHOE4 COA	79-07-24	110	ND	3	ND	5	90	17	40	<10
	80-08-19	210	0	0	--	2	70	4	20	10
19N.05W.04.333 DHOE2 PCC	79-07-25	740	<2	<2	ND	2	20	17	100	<10
	80-08-20	590	0	0	--	1	60	4	130	10
19N.05W.05.221 DHOE5 OB	79-07-25	320	<2	ND	<3	2	<10	<2	30	1
	80-08-19	370	<1	0	--	0	50	4	10	5
19N.05W.07.112 DHOE1 COA	79-07-24	1100	ND	ND	<2	ND	110	ND	100	170

LOCAL IDENT-I-FIER	DATE OF SAMPLE	MERCURY DIS-SOLVED (UG/L AS HG) (71890)	MOLYB-DENUM, DIS-SOLVED (UG/L AS MO) (01060)	NICKEL, DIS-SOLVED (UG/L AS NI) (01065)	SELE-NIUM, DIS-SOLVED (UG/L AS SE) (01145)	SILVER, DIS-SOLVED (UG/L AS AG) (01075)	STRON-TIUM, DIS-SOLVED (UG/L AS SR) (01080)
19N.05W.03.222 DHOE4 COA	79-07-24	1.6	3	ND	1	ND	200
	80-08-19	.2	--	--	1	--	160
19N.05W.04.333 DHOE2 PCC	79-07-25	.6	21	<2	<1	ND	440
	80-08-20	.0	--	--	0	--	540
19N.05W.05.221 DHOE5 OB	79-07-25	.4	19	2	<1	ND	100
	80-08-19	.2	--	--	0	--	70
19N.05W.07.112 DHOE1 COA	79-07-24	1.1	1	<2	<1	ND	1100

TABLE Q-11. SUMMARY OF GROUND-WATER QUALITY OF PICTURED CLIFFS SANDSTONE, COAL SEAMS, AND OVERBURDEN IN THE OJO ENCINO STUDY AREA.

LOCAL IDENT-I-FIER	STATION NUMBER	COUNTY	SITE	DATE OF SAMPLE	TIME	GEO-LOGIC UNIT	DEPTH BELOW LAND SURFACE (WATER LEVEL) (FEET) (72019)	DEPTH TO BOT-TOM OF WATER-BEARING ZONE (FT) (72003)	DEPTH TO TOP OF WATER-BEARING ZONE (FT) (72002)
19N.05W.03.222 DHOE4 COA	355446107204801	031	GW	79-07-24	1430	211FRLD	47.60	54	25
		031	CW	80-08-19	1430	211FRLD	--	--	--
19N.05W.04.333 DHOE2 PCC	355400107224201	031	CW	79-07-25	1145	211PCCF	50.32	233	102
		031	GW	80-08-20	1145	211PCCF	--	--	--
19N.05W.05.221 DHOE5 OB	355447107224301	031	GW	79-07-25	1630	211FRLD	68.00	180	162
		031	GW	80-08-19	1615	211FRLD	--	--	--

LOCAL IDENT-I-FIER	STATION NUMBER	COUNTY	SITE	DATE OF SAMPLE	TIME	GROSS ALPHA, DIS-SOLVED (UG/L AS U-NAT) (80030)	GROSS BETA, DIS-SOLVED (PCI/L AS CS-137) (03515)	GROSS BETA, DIS-SOLVED (PCI/L AS SR/YT-90) (80050)	RA-226, DIS-SOLVED, PLAN-CHET COUNT (PCI/L) (09510)
19N.05W.03.222 DHOE4 COA	355446107204801	031	CW	79-07-24	1430	<31	<18	<17	<.1
		031	GW	80-08-19	1430	<42	<33	<31	--
19N.05W.04.333 DHOE2 PCC	355400107224201	031	GW	79-07-25	1145	<44	<17	<16	.3
		031	CW	80-08-20	1145	<58	<32	<31	--
19N.05W.05.221 DHOE5 OB	355447107224301	031	CW	79-07-25	1630	<26	<7.9	<7.3	.1
		031	GW	80-08-19	1615	<20	<10	<9.7	--

LOCAL IDENT-I-FIER	DATE OF SAMPLE	RADIUM 226, DIS-SOLVED, RADON METHOD (PCI/L) (09511)	URANIUM NATURAL DIS-SOLVED (UG/L AS U) (22703)	URANIUM DIS-SOLVED, EXTRAC-TION (UG/L) (80020)	STRON-TIUM 90 DIS-SOLVED (PCI/L) (13503)
19N.05W.03.222 DHOE4 COA	79-07-24	--	<.5	--	--
	80-08-19	.03	--	.03	134
19N.05W.04.333 DHOE2 PCC	79-07-25	--	<.5	--	--
	80-08-20	.35	--	.33	--
19N.05W.05.221 DHOE5 OB	79-07-25	--	<.5	--	--
	80-08-19	.14	--	.19	--

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