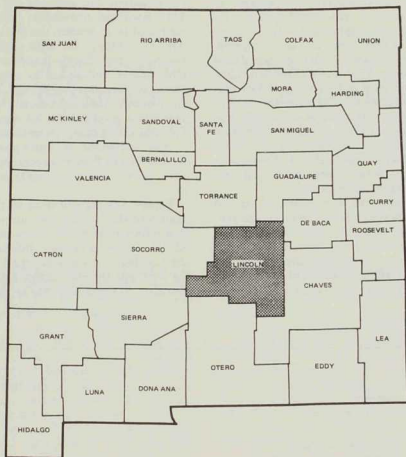


SOIL ASSOCIATIONS AND
LAND CLASSIFICATION FOR IRRIGATION
LINCOLN COUNTY



AGRICULTURAL EXPERIMENT STATION RESEARCH REPORT 212



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Summary

Lincoln County has a total land area of about 3,109,800 acres. Approximately 21 percent, or about 651,605 acres, is considered suitable for irrigation. Of this total estimated acreage of irrigable land, about 3,880 acres are now irrigated. Therefore, a large acreage of land remains that is suitable for irrigation. The potential for expanding irrigation is limited by a lack of water and by economic restrictions rather than by a shortage of suitable soils. Of the land classified as suitable for irrigation, approximately 13,935 acres are in irrigation land class 1; 245,685 acres in class 2; 314,571 acres in class 3; and 77,414 acres in class 4. The remaining 2,458,195 acres in the county are in land class 6, which is not suitable for irrigation.

The data are organized and presented on the basis of the 21 soil associations shown on the general soil map, (see figure 1). The irrigation land classification map (figure 2) shows the approximate distribution of irrigation land classes in Lincoln County. Only the dominant land classes are shown in each of the areas outlined.

The soil associations differ significantly in suitability for other uses just as they do in suitability for irrigation. For example, the use of land in the Lava Rockland association (No. 21) is generally restricted to recreation use and as habitat for wildlife. In contrast, the high mountainous land included in the Caballo-Peso-Supervisor association (No. 18) is well suited to many uses, including forestry, recreation, range, and wildlife. It includes the principal timber-producing soils in the county, provides a good habitat for many species of wildlife, and offers many recreational opportunities. It is also important as water-producing land. The Reakor-Toyah-Reeves association (No. 1) by contrast, is well suited to irrigation, range, and urban uses.

Engineering classification of these soils has also been provided to facilitate use of the soil association information by engineers and others acquainted with these groupings. Information relative to the suitability of the soils for a variety of engineering uses and specific factors limiting their use are also given in the engineering section.

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SOIL ASSOCIATIONS AND LAND CLASSIFICATION FOR IRRIGATION LINCOLN COUNTY

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An essential for planning the best possible use of land and water resources is information on the capability of soils for many uses, present and potential. One such land use is irrigated agriculture, and the many soils occurring within New Mexico should be evaluated for this land use, especially since there is interest in the expansion of irrigation in the state. The water required for the new irrigated land, if expansion should occur, would be developed locally, transferred from other sections of the state, or brought in from distant sources.

The primary purpose of this report is to present information on the suitability of soils in Lincoln County for irrigation. The acreage, general location, and relative capability of the soils for such use are given. This information can be used in appraising the value or suitability of large tracts of land for irrigation. Only soils capable of high productivity under sustained irrigation can be expected to provide a satisfactory income for farm operators. Obviously, limited or expensive irrigation water should be used on soils that are the most productive and have the fewest limitations. The extent, location, and relative suitability of land for irrigation in Lincoln County are presented in the map showing land classification for irrigation (figure 2). The general soils map (figure 1), based on a reconnaissance soils survey, provided the information needed for the classification for irrigation.

The general soil map is also useful in community or broad-area planning. It provides information on soil resources of large tracts. This information can

be used for preliminary planning for irrigated agriculture, forestry, range, urban, engineering, recreation, and wildlife uses, and it shows the general location of soils that will present problems in the construction of roads or building foundations.

The general soil map of Lincoln County does not replace the need for detailed soil maps for operational planning on individual farms and ranches or the planning of specific locations for houses, roads, parks, and other items of this nature. General soil maps are suitable *only* for *general* or *broad area planning*. They can, however, serve a very useful purpose in the planning process.

Procedures

In this county, the irrigation land classes were assigned primarily on the basis of the soil data available from the general soil map (figure 1). Although such general soil maps are often made by generalizing from large-scale detailed soil maps, this was possible only to a limited extent in Lincoln

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County. Detailed soil surveys were limited to the irrigated lands and small areas of rangeland where special studies were conducted. The general soil map of this county, therefore, was prepared largely on the basis of a field reconnaissance together with interpretation of airphotos, topographic maps, geological maps, and other available information.

When detailed soil surveys are completed for the entire area, some of the soil names that are used to identify the soil associations may be changed. This will not affect the usefulness of the map, however, because the names only identify the mapping units. The soil properties and qualities of the soils comprising the mapping units will not change.

The general soil map (figure 1) was prepared by grouping geographically associated soils into 21 general soil areas. These units, referred to as "soil associations," are landscapes, or geographic areas, that have distinctive proportional patterns of soils. Each kind of soil normally occurs in a comparatively small area, so the units on the general soil map of Lincoln County consist of two or more kinds of soil. In addition, land types and a number of less extensive soils are commonly components of the map units of this county. The kinds of soil included in each soil association are not necessarily similar. In fact, they often have contrasting characteristics that influence use and management.

In the classification of soils for irrigation, the major soils and miscellaneous land types within each soil association were placed into one of five classes of land, depending upon their suitability for irrigated agriculture (table 5). The criteria used in the placement of soils in the irrigation land classes are those proposed at the 1967 conference organized by the Federal Water Resources Council,⁴ as modified by a committee of this conference on January 12, 1968. These criteria were agreed upon by authorities from several organizations concerned with land classification and appear to have a particularly high reliability. For uniform and consistent application of these criteria and standards, the New Mexico Soils Work Group have issued guidelines and clarifications as needed and appropriate.

The classification system establishes four classes of irrigable land and one class of non-irrigable land. The limitations for use under irrigation increase from class 1 through 4. For example, class 1 has few or no limitations for use as cropland under irrigation. It is productive and well adapted to irrigation. High yields of most climatically adapted crops can be obtained on this land with good

management. Class 2 land, although well suited to irrigation, has slight to moderate limitations for sustained use under irrigation. This is moderately productive land, or land that requires more than average management to obtain high yields of climatically adapted crops. Class 3 land, which has moderate to severe limitations for sustained use under irrigation, is generally not as suitable for the production of as wide a range of the climatically adapted crops as land in classes 1 and 2. This land also has a more limited productivity for many of the climatically adapted crops, or requires a very high level of management to obtain moderate to high yields. Class 4 land has a very severe limitation for sustained use under irrigation. The land included in this class is usually suited only to a relatively few of the climatically adapted crops. Some of this land may be adapted or used for the production of specialized crops under a very high level of management. Class 6 land is not suitable for irrigation.

The land in Lincoln County was placed in the various irrigation land classes on the basis of soil properties and qualities that affect their suitability for continued use under irrigation. Neither the availability of irrigation water nor the cost of pumping and conveying it enters into the classification, nor was the shape, size, or location of lands with respect to other lands to be developed for irrigation considered in this classification. The detailed criteria used in the placement of land in various irrigation land classes are listed in table 1.

The factors that affected the placement of land in the various irrigation land classes were: soil texture including gravel and stone content, effective soil depth, available water-holding capacity, salinity, permeability, erosion, surface smoothness, slope, internal soil drainage, and surface drainage. For example, the Deama, Ector, Pastura, and Nickel soils are classified as non-irrigable because of the limited effective soil depth and very low moisture retention capacity. The Marcial soils, which are deep and have high water-holding capacity, were placed in irrigation land classes 4 and 6 primarily because of salinity and inadequate drainage. In the mountainous parts of the county, steep slopes and rough broken topography, together with stone and gravel content and limited water-holding capacity were the principal factors contributing to the placement of much of the land in class 6. This is in contrast to the land in the Reakor-Toyah-Reeves association which is dominated by land in class 2 because of favorable soil properties and related land factors. Slope and unevenness of the land surface were the principal reasons for placing the majority of these soils in class 2 instead of class 1.

⁴Proceedings Water Resources Council, Irrigation Land Classification Seminar, Salt Lake City, Utah, July 1967.

Table 1. Land classification specifications for Pacific Southwest Basin irrigation land classes¹

Land Characteristics	Class 1	Class 2	Class 3	Class 4	Non-irrigable Class 6
Soils					
Texture (Surface 12") ²	LVFS-CL	LS-C Peat, Muck	MS-C	MS-C	All other lands not meeting criteria for arability
Moisture Retention (AWHC-48") ³	> 6.0"	4.5" 6.0"	3.0" 4.5"	2.5" 3.0"	
Effective Depth (inches)	> 40" ⁴	30-40	20-30	10-20	
Salinity (EC _e × 10 ³ - equil.)	< 4	4-8	8-12	12-16	
Sodic Conditions⁵					
Percent area affected	< 5	5-15	15-25	25-35	
Severity of problem ⁶	Slight	Moderate	Moderate	Moderate	
Permeability (in place - in/hr)	0.2-5.0	0.05-5.0	0.05-10.0	Any	
Permissible coarse fragments (% by vol.)					
Gravel	15	35	55	70	
Cobbles	5	10	15 ⁷	35 ⁷	
Rock Outcrops (distance apart in feet)	200	100	50	30	
Soil Erosion (for all classes)	Severely eroded soils will be downgraded one class. Less severely eroded soils may be downgraded one class, depending on other conditions.				
Topography (or land development items)⁸					
Stone for Removal (cubic yards per acre)	10	25	50	70	
Slope (percent)					
Moderately to severely erodible	< 2	2-5	5-10	10-20	
Slightly erodible	< 4	4-10	10-20	20-25	
Surface Leveling or Tree Removal (amount of cover)					
	Light	Medium	Medium heavy	Medium heavy	
Irrigation Method	Lands unsuited to gravity irrigation where land grading would permanently reduce soil fertility below arable limits or exceed permissible costs, or field pattern too complex, may be considered for sprinkler. Land must meet other requirements for arability. Designate by "S" - example, 3-S.				
Drainage					
Soil Wetness (depth to water table during growing season with or without drainage)					
Loam or finer	> 60"	40" - 60"	20" - 40"	10" - 20"	
Sandy	> 50"	30" - 50"	20" - 30"	10" - 20"	
Surface Drainage	Good	Good	Restricted	Restricted	
Depth to Drainage Barrier (in feet)	> 7	6-7	5-6	1.5-5	
Air Drainage ⁹	No Problem	Minor	Restricted	Restricted	

¹Specifications are representative of conditions after land is developed for irrigation. Each individual factor represents a minimum requirement, and unless all other factors are near optimum two or more interacting deficiencies may result in land being placed in lower class or designated class 6 -- non-irrigable.

²Finer textures may be required than those indicated for each class in areas subject to critical hot spells or wind; coarser textures may sometimes be permissible.

³In areas of very warm growing season 3" may be required for class 4 and in cold areas as little as 5" may be permitted for class 1.

⁴Depth of 60" or more is required for class 1 where deep-rooted crops are important.

⁵More extensive and severe sodic problems may be tolerated in areas of wide crop adaptability.

⁶Severity of problem: **slight** - ESP less than 15% or less than 25% if dominated by nonswelling clays; **moderate** - ESP less than 20% or less than 30% if clay minerals favorable; **severe** - ESP less than 30%; with certain soil minerals may range above 50% as measured by usual techniques.

⁷May range above 50% in subsoil for certain crops if surface soil is favorable.

⁸Special crop and management practices may justify exceeding the limits for stone removal or slope in class 4; irregularity of slope may necessitate downgrading of class unless deficiency is compensated for by possibility of sprinkler irrigation.

⁹Air drainage is a consideration mainly in areas adapted to fruit or to early or late vegetables.

Abbreviations:

LVFS - loamy very fine sand
LS - loamy sand
MS - medium sand

CL - clay loam
C - clay
AWHC - available water holding capacity
ESP - exchangeable sodium percentage

Description of the Area

Location and Topography

Lincoln County comprises an area of 3,109,800 acres in the south-central part of New Mexico. It is bounded on the south by Otero County, which has as its south boundary the New Mexico-Texas state line. The county lies within the Mexican highland and Sacramento section of the Basin and Range Province, and has within its borders varied landscapes and a wide range in topographic relief.⁵ The western edge of a series of steep and rugged mountains and mountain ranges that are generally aligned in a north-south direction separates the Mexican highlands on the west from the Sacramento section that includes the central and eastern parts of this county.

The mountain upland areas include the northern extension of the Sierra Blanca range, and the Tucson, Carrizo, Patos, Jicarilla, and Gallinas mountains. The exception to this general north-south alignment involves Capitan Mountain that is located east of the other mountains. It is dominated by igneous rocks and is located just south of the central part of the county. The mountain upland areas are commonly steep to extremely steep. Elevations in the mountain areas range from about 7,000 feet to 10,023 on Capitan Peak and to nearly 12,000 feet in the Sierra Blanca range.

The area east of the mountains, in the central and eastern parts of the county, slopes generally to the east and southeast into the Pecos Valley. Surface runoff from this part of the county enters the Pecos River drainage system. The altitude ranges from nearly 4400 feet along the eastern boundary where the Rio Hondo leaves the county to about 7000 feet.

A number of varied and different types of topography occur throughout this area, but it is generally characterized by rolling to very steeply sloping limestone hills and mountain footslopes, steep canyon walls, breaks, and escarpments in the southeastern part. The remainder of the area, particularly in the northeastern part of the county, is not as steep or as rough and broken. Here the landscapes are generally gently to strongly sloping and undulating interspersed with an occasional moderately steep to steep and hilly area. One of the largest areas of steep and hilly landscapes occurs just southeast of Corona.

The area to the west of the mountain uplands in the extreme western and southwestern parts of the county also has variable topography. The northern part is dominated by gently to strongly sloping uplands interspersed with moderately steep and rolling upland ridges and hills. A small area of steep to very steep desert mountain ranges and hills also extends into the southwestern part from Socorro County. In addition, there are interspersed throughout the area nearly level to gently sloping valley bottoms and a few steep hills and breaks. A relatively large area of valleys and alluvial plains dominated by gently to strongly sloping and undulating landscapes occurs in the Carrizozo vicinity. Another characteristic feature of this part of the county is the Carrizozo lava flow, or malpais. It is a long narrow lava flow consisting of basalt rock that ranges in width from less than one mile to slightly more than four miles. Elevations in this part of the county range from about 4,200 in the extreme southwestern part to nearly 7,000 feet at the base of mountain uplands. Surface drainage is into the closed Tularosa Basin.

Climate⁶

Temperatures and precipitation in Lincoln County vary greatly because of topography and elevation. The closed Tularosa Basin, which extends southwest from Carrizozo, is separated from the eastern plains by foothills and mountains. The main source of moisture is the Gulf of Mexico, and this moist air enters New Mexico in the general southeasterly circulation about the Bermuda high pressure area which is most pronounced in summer. Precipitation generally increases with elevation as this moist air is heated by solar radiation and flows upslope in the foothills and mountains.

Half the annual precipitation falls in summer from brief but often heavy thunderstorms, occasionally accompanied by hail. Annual precipitation averages 11 to 13 inches in the eastern plains, increases to near 20 inches at elevations of 7000 feet, and becomes 25 to 30 inches or more in the mountains. Precipitation is less in the Tularosa Basin, which is partially shielded from the Gulf moisture by the mountains. Precipitation is comparatively light in winter, as mountains to the west remove much of the moisture from Pacific Ocean storms before they reach New Mexico. Much of the winter precipitation falls as snow in the upper elevations,

⁵C.H. Dane and Bachman, *Topography and Geology, N. Mex. Mineral and Water Resources of New Mexico*, State Bureau of Mines and Mineral Resources, Socorro, N. Mex.

⁶This section was prepared by Frank E. Houghton, ESSA, Weather Bureau State Climatologist.

where average annual snowfall ranges to more than four feet in the higher mountains.

Mean annual temperature ranges from 58 degrees in the lower elevations to less than 48 degrees in the higher mountains. At lower elevations of the county about two-thirds of the summer days have 90-degree temperatures, and a few days have 100-degree temperatures. In the mountains, few days reach 90 degrees. With the possible exception of the higher mountains, there are few dates that the temperature drops to zero or below, or fails to go above freezing. Most nights in winter have freezing temperatures throughout the county, and in the mountains most nights during the coldest half of the year have freezing temperatures.

The growing season, or freeze-free season, at lower elevations is about 190 days. At mid-elevation grazing areas it is about 155 days, and in mountain areas it is less than 100 days.

Table 2 shows the annual patterns of tempera-

ture and precipitation at Corona. These patterns generally apply to other county localities, when adjusted for increasing precipitation and lower temperatures with increased elevation.

Table 3 shows selected climatological data for various county localities which may be used for comparison with Corona.

Semi-arid, continental climate is typical of the county except in the mountains, and is characterized by wide ranges in diurnal and seasonal temperatures, variable precipitation, and plentiful sunshine. The average diurnal temperature range is more than 30 degrees. Variability of precipitation from year to year and month to month is illustrated by the annual total near Arabela of 43.74 inches in 1941 and only 9.97 inches in 1933, and by September totals of 13.54 inches in 1919 and only 0.21 inch in 1934. Greatest one-day precipitation in Lincoln County was 7.71 inches at Meek, September 16, 1919. Sunshine averages about 75 percent of the

Table 2. Monthly temperatures and precipitation, Corona, Lincoln County, New Mexico

Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperatures (F°)												
Average daily maximum	46	50	56	64	73	83	84	82	77	68	56	47
Average daily minimum	22	25	29	36	44	52	55	54	49	39	28	23
Daily mean	34	38	42	50	59	67	70	68	63	54	42	35
Extreme maximum	75	77	78	88	95	102	110	100	96	85	80	72
Extreme minimum	-17	-12	-12	9	20	32	38	36	22	17	-11	-12
Precipitation												
Average (inches)	.84	.80	.82	1.04	1.37	1.27	2.59	2.78	2.01	1.09	.56	.70
Average days 0.10 inch or more (no.)	2	2	2	3	4	4	7	7	3	4	1	1
Average snowfall (inches)	8.1	7.9	6.4	3.5	0.9	T	0	0	0.6	0.9	3.7	7.0

T = Trace, less than 0.5 inch

Period of record: temperatures, 1914-1960; average precipitation, 1931-1960; average days 0.10 inch or more, 1954-1960; average snowfall, 1969-1960

Table 3. Annual averages of selected climatological data, Lincoln County, New Mexico, for the period of record through 1960, except as indicated

Station	Elevation feet	Temperatures		Yrs. of record no.	Precipitation		Last 32°F or Lower in Spring	First 32°F or Lower in Fall	Time Between Dates days
		Mean maximum F°	Mean minimum F°		Mean annual in.	Yrs. of record no.			
Carrizozo	5438	71	42	49	12.72	52	Apr. 18	Oct. 25	190
Corona	6664	66	38	46	14.93	52	May 3	Oct. 16	166
Fort Stanton	6230	68	36	57	15.61	85	May 7	Oct. 8	154
Picacho	4965	75	42	8	11.93	16	Apr. 24	Oct. 25	184
Ruidoso	6755	67	30	17	20.96	18	June 7	Sept. 17	102
Ancho	6112				13.26	52			
Bonita Dam	7280				21.48	10			
Capitan	6350				15.94	49			
Farnsworth Ranch	5400				10.76	19			
Hondo	5230				10.88	10			
Cedar Creek Ski Course*	7830				24.26	17			
Monjeau Lookout*	8900				24.94	15			

*Storage-gage data: Cedar Creek Ski Course, 1942-1961; Monjeau Lookout, 1942-1963

possible hours, or near 3400 hours annually. Spring is the windiest season, and with dry soil and sparse vegetation, strong winds may occasionally cause blowing dust and sand.

In the winter and rainy seasons, the relative humidity in most of the county averages in the upper 60s in the early morning and about 50 percent in the afternoon. In other seasons the average is from near 50 percent in the early morning to the lower 20s in the afternoon. Mean annual relative humidity is about 50 percent. In the higher mountains, because of lower temperatures, the relative humidities are higher, and because of increased condensation, cloudiness is greater, allowing about 60 percent of the possible sunshine.

Land Use

Lincoln County is principally agricultural, and a large part of the income is derived from livestock enterprises. A high percentage of land in this county is, therefore, used for livestock grazing. Of the 3,109,800 acres in the county, slightly more than 1,900,000 acres are presently in ranches. In 1969 there were approximately 33,000 head of cattle and 128,100 sheep on the ranches and farms in this county.⁷ The sheep are raised on ranches located mostly in the eastern part of the county.

Although there are only about 3,880 acres of irrigated land in the county, the production of crops under irrigation is an important agricultural enterprise.⁸ Most of this irrigated land is in orchards, pastures, and small gardens, or is used for the production of alfalfa, corn, or small grains. Apples, which are the major fruit crop, contribute significantly to the economy of the area. The irrigated farms, which are small and intensively farmed, are located in the Hondo, Bonita, and Ruidoso valleys.

The use of land for forestry, wildlife, and recreational purposes is also important in this county. The Caballo-Peso-Supervisor (No. 18) and Pinata-Stroupe-Fortwingate (No. 19) associations support fair to good stands of timber. A few lumber mills operate from timber supplies obtained in these soil associations which are principally in the Lincoln and Cibola National Forests. This high mountainous land, as well as the adjacent foothill areas (association 20), provide a good habitat for many species of wildlife. It also offers many opportun-

⁷New Mexico Agricultural Statistics Vol. VI, Supplement III, 1970.

⁸Soil Conservation Service and other Federal and State agencies, 1970.

ities for outdoor recreation including camping, hunting, fishing, and other activities of a similar nature. Undoubtedly there is a good potential for development of additional recreational facilities as well as improving existing facilities in this county.

The present use of the land in each soil association is shown in the following list. Only one or two of the more important land uses in each soil association are shown. Although much land is used for recreation, this is not included because of the difficulty of accurately determining its extent.

<i>Soil Map Symbol and Soil Association</i>	<i>Present Land Use</i>
1. Reakor-Toyah-Reeves association	Range
2. Dona Ana-Pajarito-Bluepoint association	Range
3. Marcial-Ubar-Sotim association	Range
4. Nickel-Tencee association	Range
5. Rock Land-Lozier-Gilland association	Range
6. Caliza-Latom-Holloman association	Range
7. Ector-Conger association	Range
8. Ector-Limestone Rock Land association	Range
9. Reagan-Eldrida-Conger association	Range
10. La Fonda-Alicia association	Range
11. Deama-Pastura-Manzano association	Range
12. Limestone Outcrop association	Range
13. Harvey-Pastura association	Range
14. Harvey-Pastura-Witt association	Range
15. Pinon-Rednun-Harvey association	Range
16. Penistaja-Pinon-Chupadera association	Range
17. San Mateo association	Irrigated farming; range
18. Caballo-Peso-Supervisor association	Forestry; range
19. Pinata-Stroupe-Fortwingate association	Forestry; range
20. Deama-Limestone Rock Land association	Range
21. Lava Rock Land association	Wildlife; range

Description of Soils

Twenty-one soil associations are shown in figure 1. Each of these 21 general soil areas or soil associations includes soils that are geographically associated and comprise recognizable landscapes. The soil associations are named for the major soil series and land types that occur within them. In addition to the named soils, they often contain soils of

other series. Selected soil characteristics and qualities of major soils in each soil association are summarized in table 4. A description of each of the soil associations follows:

1. Reakor-Toyah-Reeves association

This association comprises an area of about 88,600 acres in the southwestern part of the county in the vicinity of Carrizozo. It includes valley areas and alluvial plains that are characterized by gently to strongly sloping and undulating landscapes. Interspersed through this area are nearly level to gently sloping valley bottoms which commonly contain a few deep gullies or arroyos. The soils are dominantly moderately deep to deep and are forming in alluvium of mixed origin. They support fair to moderate stands of native vegetation, and under good management moderate yields of forage are produced. The more common kinds of native vegetation are black grama, blue grama, alkali sacaton, sideotsa grama, tobosa, sand dropseed, burrgrass, fluffgrass, three-awns, chamiza, snakeweed, and yucca.

Soil Characteristics. Reakor soils, the most extensive in the association, occur on gently to strongly sloping valley side slopes and plains. They normally have a surface layer, 6 to 12 inches thick, of light brownish-gray to brown calcareous loam. A light brown strongly calcareous loam or light clay loam subsoil about 24 inches thick underlies the surface layer. The substratum to a depth of 60 inches or more is a light brown very strongly calcareous clay loam. A few to many small lime concretions and small soft masses of lime commonly occur below an average depth of 28 inches.

Toyah soils occur on gently sloping valley bottoms and flood plains of intermittent drainages. They typically have a moderately thick surface layer of dark brown to dark grayish-brown calcareous loam. This is underlain to a depth of 60 inches or more by light brownish-gray or light brown stratified soil layers consisting dominantly of loam, sandy clay loam, and clay loam.

Reeves soils, which are moderately deep, are underlain by gypsiferous earths at depths of 20 to 36 inches. Although widely scattered throughout this association on gently sloping and undulating valley slopes, they generally occur below sedimentary formations containing gypsum. These soils usually have pale brown to brown, strongly calcareous, loam surface layers. The subsoil is a pale brown to light gray, massive, strongly calcareous, light clay loam.

In addition to these three major soils, miscellaneous land types, including Gypsum Land, Gullied Land, and Rough Broken Land, comprise small acreages in this association. Also included are small areas of Upton soils and unclassified deep moderately fine and fine-textured soils. The Upton soils have gravelly or cobbly loam surface layers and are underlain by strongly cemented caliche within 20 inches.

The unclassified soils occur in nearly level to gently sloping drainage-ways, ponded areas, and on the lower parts of alluvial fans. These soils typically have a surface layer of reddish-brown to brown strongly calcareous silty clay loam. This is underlain to a depth of five feet or more by a reddish-brown clay or heavy silty clay loam with increasing amounts of carbonates and salts in the lower part.

Irrigation Potential. The major soils in this association have characteristics and properties favorable for their use as irrigated cropland. Approximately 60 percent of the land in this general soil area has been placed in irrigation land class 2; 11 percent in class 3; 11 percent in class 4; and the remaining 18 percent is non-irrigable (class 6).

The Reakor soils in this county were placed in class 2 because of slope and unevenness of the land surface. The Toyah soils, like those of Reakor series, are dominantly in class 2. The low position together with drainage, overflow, and erosion hazards were the principal factors contributing to this classification. The Reeves soils, although suitable for irrigation, are not as well adapted to such use because of moderate soil depth and available water-holding capacity and salinity hazard. These soils are dominantly in classes 3 and 4.

2. Dona Ana-Pajarito-Bluepoint association

This association, one of the smallest in the county, includes an area of about 19,990 acres. It occurs on nearly level to gently sloping and undulating landscapes in the southwestern part of the area where it joins a like soil association in Otero County. The soils, which are dominantly sandy and moderately deep to deep, are developing in sandy sediments of alluvial and eolian origin. They are susceptible to wind erosion, and as a result, hummocky or wind eroded soils are quite common. There are included small areas where coppice dunes have formed around the shrubs.

It supports fair stands of semi-desert grasses and shrubs including mesa dropseed, spike dropseed, black grama, bush muhly, sandsage, snakeweed, and some mesquite, creosotebush, yucca, and chamiza.

Soil Characteristics. Dona Ana soils typically occur on nearly level to gently sloping areas between ridges occupied by the Bluepoint soils. They have a surface layer of light brown calcareous fine sandy loam or loamy fine sand that ranges from about 6 to 10 inches in thickness. This is underlain by a moderately thick reddish-brown calcareous sandy clay loam subsoil in which small soft masses and fine threads are common. A pinkish-white soft caliche or sandy clay loam with a high lime content occurs below the subsoil at depths between 20 and 36 inches. It is occasionally weakly cemented in the upper part. The lime content gradually decreases with depth.

Pajarito soils, which are also extensive in this association, occupy nearly level to gently sloping and hummocky landscapes. These soils typically have a thin surface layer of light reddish-brown, weakly calcareous loamy fine sand or fine sandy loam. The subsoil and substratum are usually light reddish-brown calcareous fine sandy loam extending to over 60 inches. The substratum, however, is occasionally stratified with thin or loamy fine sand. Pajarito soils are susceptible to wind erosion where vegetative cover is seriously depleted.

Bluepoint soils commonly occur on gently sloping and undulating ridges that are slightly higher than the surrounding or contiguous areas. Slopes are short and usually range between one and three percent, but may range up to five percent. They have a thin surface layer of light brown to reddish-brown fine sand or loamy fine sand. This is underlain by weakly stratified loamy fine sand and fine sand to a depth of five feet or more. In local areas, gravelly loamy sand may occur below a depth of three or four feet. These soils are usually weakly calcareous throughout, but may range from noncalcareous to moderately calcareous.

Also included in this association are soils of Wink, Onite, Mimbres, Pintura, and Caliza series. The Wink soils, the most extensive of the inclusions, have light brown calcareous loamy fine sand surface layers over strongly calcareous sandy loam subsoils. This is underlain by pinkish-white sandy loam high in lime or soft caliche at depths between 20 and 36 inches. Onite soils, like those of the Dona Ana series, typically occur on the smooth, nearly level to gently sloping areas. They have a surface layer of brown noncalcareous loamy fine sand over a moderately thick reddish-brown calcareous loamy fine sand that usually contains a few small soft masses and threads of lime. Mimbres soils, which occur in the swales and drainageways, are deep and moderately fine-textured. The Pintura soils, which commonly occur as dune areas, consist of sands and fine sands of a depth of five feet or

more. Caliza soils usually occur on the gently sloping crests of narrow ridges. These soils typically have a surface layer of pinkish-gray strongly calcareous very gravelly sandy loam. This is underlain within a depth of 20 inches by a pinkish-white very gravelly sandy loam that contains a high content of lime. The degree of carbonate cementation ranges from none to weak and nearly continuous.

Miscellaneous land types such as Riverwash, arroyo bottoms, very shallow soils over gypsum and caliche, and unclassified deep alluvial soils also occur to a very limited extent in this association. The deep alluvial soils, which occur in swales and depressional areas, usually have surface layers of loam, or silt loam and subsurface layers of silty clay loam, silt loam, or clay loam. They are strongly calcareous with lime content ranging between 15 and 30 percent.

Irrigation Potential. Although the lands in this association will require more than the normal amount of soil modification and conditioning for irrigation, there is some potential for development of irrigated land. The Bluepoint, Dona Ana, Pajarito, Onite, and Mimbres soils are suitable for irrigation. The Bluepoint soils, which comprise approximately 20 percent of this association, were placed in land class 4. The sandy textures and limited moisture-retention capacity were the principal factors involved in this classification. The Dona Ana and Pajarito soils, the other major components of this association, are placed in irrigation land class 3 because of their slightly higher water-holding capacities and finer textures. Wind erosion, however, is a hazard on all of these soils, and careful management will be needed to minimize damage by wind. Approximately 60 percent of the land in this association is in class 3; 25 percent in class 4; 2 percent is in class 2; and the remaining 13 percent is non-irrigable, or in class 6.

3. Marcial-Ubar-Sotim association

This association, which is located in the extreme southwestern part of the county, comprises an area of about 74,200 acres. The nearly level to gently sloping and occasionally undulating basin floors and the lower parts of the piedmont slopes are included in this general soil area. Slope gradients dominantly range from less than one percent to three percent with extremes ranging from zero to five percent. These nearly level to gently sloping soils are forming in old valley-filling sediments dominated by materials from sedimentary formations with lesser amounts from igneous rocks.

This association is used for grazing by wildlife and livestock. The density and production of native vegetation varies widely. There are included a few small bottomland areas that receive runoff water from higher lying lands that support dense stands of vine mesquite, alkali sacaton, and tobosa. A high percentage of the soils in this association, however, are slightly to moderately saline and support only sparse to fair stands of native vegetation. Alkali sacaton is dominant, while tobosa, vine mesquite, and chamiza comprise lesser amounts. The strongly saline areas are either barren or support only scattered clumps of alkali sacaton, iodinebush, and chamiza.

Soil Characteristics. Marcial soils occur on nearly level to very gently sloping landscapes with slope gradients that usually average less than one percent. They have a surface layer of reddish-brown strongly calcareous silty clay loam over a reddish-brown strongly calcareous silty clay or heavy silty clay loam subsoil. This grades through soil of similar color and texture to the underlying gypsiferous lacustrine materials at depths ranging from 40 to 60 inches. The subsurface layers commonly contain fine threads and specks of lime as well as crystals of gypsum and other salts. Although salinity generally varies from slight to moderate, about 20 percent of the Marcial soils are strongly saline. Also included in this unit are phases of these soils that have gypsum strata at depths of 20 to 40 inches.

Ubar soils are similar to the Marcial soils but differ primarily in that they are not as red and have a higher shrink-swell or are subject to more cracking on drying. These soils have a thin light yellowish-brown strongly calcareous silt loam surface layer over a thick light brown strongly calcareous silty clay or heavy silty clay loam subsoil. The substratum to a depth of 60 inches or more is similar in color and texture to the overlying subsoil. A few small soft masses of lime and gypsum crystals commonly occur in these soil layers.

Sotim soils usually occupy the piedmont slopes on the outer fringes of this association. Slope gradients average between one and five percent. They have a thin surface layer of reddish-brown calcareous loam or clay loam. This is underlain by a thick reddish-brown calcareous clay loam subsoil that commonly contains a few small soft masses of lime in the lower part. Below an average depth of 50 inches these soils typically become coarser-textured with textures ranging from gravelly sandy loam to gravelly loam or loam.

Soils of lesser extent in this association include those of Yesum, Holloman, Russler, Mead, and

Mimbres series. The Yesum and Holloman soils, which are developing over thick beds of gypsum or gypsiferous earths, commonly occur on ridges or on the more undulating landscapes in this association. The Yesum soils consist of light brown gypsiferous very fine sandy loam or fine sandy loam to a depth of 60 inches or more. The gypsum content of the surface soil is about 50 percent, increases to about 80 percent within 10 to 20 inches, and then decreases gradually with depth. The Holloman soils are underlain within a depth of 20 inches by thick beds of gypsum. Russler soils occupy the same general positions on the landscape as those of the Sotim series. They differ from the Sotim soils in that they contain an abundance of gypsum crystals within 40 inches of the surface. The Mead soils are deep, poorly drained, and saline. They usually have light-colored silt loam surface layers and stratified subsurface layers that are dominantly moderately fine- to fine-textured. They are either barren of vegetation or support only isolated clumps of alkali sacaton and iodinebush or traces of chamiza.

The Mimbres soils in this association occupy the gently sloping swales and narrow valley bottoms on the piedmont slopes. They are deep and typically have silt loam surface layers over silty clay loam or clay loam subsurface layers.

Irrigation Potential. There is only limited potential for expansion of irrigated cropland in this association. The soils classified as suitable for irrigation generally have a low capability for such use. For example, the Marcial and Ubar soils due to their low position, salt content, slow permeability, and fine textures will require very intensive management to prevent further accumulation of salts and development of unfavorable drainage conditions. The slightly to moderately saline phases of these soils have been placed in irrigation land class 4 and the strongly saline phases in class 6. The Sotim and Mimbres soils, which are in irrigation classes 2 and 3, are suitable for irrigation. However, in addition to their limited acreage, these soils commonly occur as small and irregular tracts, which will tend to place restriction on their use for irrigation. Approximately 45 percent of the land in this association has been placed in class 6; 30 percent in class 4; 16 percent in class 3; and 9 percent in class 2.

4. Nickel-Tencee association

This association includes the soils on the gently to strongly sloping piedmont slopes at the base of desert mountains and hills. It comprises an area of

about 34,920 acres in the southwestern part of the county. It is common for this soil association to form a contiguous area along the fronts of these steeply sloping mountainous areas. It is generally dissected by numerous ephemeral streams and arroyos originating in the adjacent mountain areas. Slopes along the ridge crests, fans, and terraces between the arroyos usually average about 2 to 5 percent, but may range up to nearly 10 percent in the upper part where it joins the mountainous areas. Slopes on the ridge sides adjacent to arroyo bottoms commonly exceed 10 percent. The soils, which are usually gravelly or cobbly, are forming in coarse-textured alluvial fan sediments of mixed origin.

This association is used for grazing and supports a sparse to fair cover of vegetation. The more common grasses include fluffgrass, black grama, mesa dropseed, and traces of bush muhly, tobosa, and three-awns. Blue grama and sideoats grama occur occasionally in the upper part of this unit adjacent to the mountain fronts. In general, this association is dominated by shrubs, mainly creosotebush with lesser amounts of snakeweed, yucca, tarbush, and various species of cacti.

Soil Characteristics. Nickel soils, one of the more extensive components of this association, typically have a thin surface layer of light brown or light brownish-gray calcareous gravelly sandy loam over a subsoil of light brown strongly calcareous very gravelly loam. This grades to a pinkish-white caliche or very gravelly loam with a very high lime content at a depth of 15 to 25 inches that is commonly weakly cemented in the upper part. The lime content and cementation decrease with depth, but the coarse fragments usually increase in size and amount with depth.

The Tencee soils occur on landscapes and slopes that are similar to those occupied by the Nickel soils. They normally have a thin surface layer of light brown strongly calcareous gravelly loam. This layer grades through a very gravelly loam containing many hard caliche fragments to strongly cemented or indurated caliche at depths of 6 to 20 inches. The cementation decreases with depth, and normally below a depth of two to three feet there is little cementation.

Less extensive soils in this association include an unclassified deep gravelly sandy loam soil, as well as those of the Delnorte, Caliza, Sonoita, and Upton series. The deep gravelly sandy loam soils, which typically occur on the lower parts of the alluvial fans, occupy slightly lower positions than those of Nickel and Tencee series. They consist of weakly stratified gravelly sandy loams and gravelly

loams with the gravel content ranging from about 15 to 30 percent. The Delnorte and Upton soils, like those of the Tencee series, are underlain by indurated caliche within a depth of 20 inches. The Delnorte soils do not contain the high lime content above the indurated caliche that is characteristic of the Tencee soils. The Upton soils differ from the Tencee soils in that they are not as gravelly. The Caliza soils have very gravelly sandy loam surface layers over a very gravelly sandy loam horizon with a high lime content. The prominent horizon of lime accumulation or soft caliche occurs within a depth of less than 20 inches. The Sonoita soils occur on the gently sloping landscapes in this association. They usually have a thin surface layer of brown noncalcareous gravelly sandy loam. This is underlain by a reddish-brown gravelly sandy loam subsoil. The substratum is gravelly sandy loam which typically becomes very gravelly at depths of 30 to 40 inches. A zone of moderate lime accumulation occurs at a depth of 24 to 48 inches.

Also in this association are small areas of shallow soils over sandstone, Rough Broken and Stony Land, arroyo bottoms, Gypsum Land, and other miscellaneous land types.

Irrigation Potential. This association is dominated by class 6 land, consequently there is little or no potential for development of irrigation. Approximately 91 percent of the land in this association has been placed in class 6; 4 percent in class 3; and 5 percent in class 4.

The Sonoita soils and the unclassified deep gravelly sandy loam account for most of the land in this unit classified as suitable for irrigation. The suitability of these soils for irrigation is further limited by the occurrence of the irrigable soils as small tracts intermingled with extensive areas of class 6 land. This will tend to preclude its consideration for irrigation.

5. Rock Land-Lozier-Gilland association

The mountain ranges, hills and upland ridges in the low rainfall areas of the southwestern part of the county are included in this association. Characteristic features of this unit are the steep slopes and shallow rocky soils with numerous exposures of bedrock. Although the soils in this association are developing from a wide variety of bedrock types, those forming in materials of limestone and sandstone origin are the most extensive. In many places other sedimentary rocks as well as igneous rocks have also contributed significantly to the parent materials in which these soils are forming. Approxi-

mately 47,420 acres, or about two percent of the county, is included in this association.

It is used principally for grazing by livestock and wildlife. The grazing of livestock, however, in many parts of this general soil area is somewhat restricted by the steep slopes and the rocky or stony nature of the land surface. Although these factors tend to limit the density of vegetation, it does support a wide variety of grasses and shrubs and a few trees. The vegetative cover, together with the rough topography, provide a good habitat for many species of wildlife. Black grama, blue grama, sideoats grama, bush muhly, Indian ricegrass, galleta, sand dropseed, and three-awns are the principal grasses. The more common shrubs include Apache plume, yucca, creosotebush, and various species of cacti.

Soil Characteristics. Rock Land, a miscellaneous land type, is a major component of this association. It is a complex of very shallow soils and rock outcrops. The bedrock usually occurs as vertical or nearly vertical exposures and ledges. In many parts of this unit a large amount of loose rock occurs on the surface. A thin mantle of cobbly or stony soil material commonly occurs between the outcrops of bedrock.

Lozier soils in the association are extensive on the moderately steep and rolling limestone hills and upland ridges. They have a thin surface layer of light brownish-gray calcareous stony loam. This is underlain by a light yellowish-brown to light brown very strongly calcareous stony loam. A thin layer of calcium carbonate accumulation in the form of soft masses and modules occurs immediately above the limestone bedrock which is usually encountered at a depth ranging from about 6 to 20 inches.

Gilland soils occur on the moderately steep and rolling hills and upland ridges dominated by sandstone. These soils have a thin surface layer of reddish-brown calcareous stony loam or stony sandy loam. Their subsoil is a reddish-brown or light reddish-brown stony loam containing numerous angular fragments of sandstone. The sandstone fragments are commonly lime-coated on the underside. This grades through soil material of similar color and texture to the underlying interbedded sandstone and shale that occurs at a depth ranging from 20 to about 40 inches.

Also included in the association are shallow soils of the Latom, Nickel, and Tencee series, Rough Broken and Stony Land, gravelly Alluvial Land, and isolated pockets or extremely small areas of moderately deep and deep unclassified soils. These inclusions, none of which is extensive, comprise

about 15 percent of the association. The Latom soils occur in close association with the soils of the Gilland series in areas dominated by sandstone. They are stony loams or stony sandy loams and are underlain by sandstone at a depth of less than 20 inches. The Nickel and Tencee are shallow gravelly soils underlain by weakly cemented caliche and indurated caliche, respectively.

Irrigation Potential. There is no potential for expansion of irrigation in this association because of the shallow soils, together with rock outcrops, steep slopes, and rough broken topography.

6. Caliza-Latom-Holloman association

This association consists of an area of approximately 128,750 acres in the southwestern part of the county. It includes the valley slopes and low ridges that occur generally at the base of steep mountainous uplands. The topography, which is varied, includes gently sloping and undulating valley slopes, gently to strongly sloping fans, and rolling to moderately steep ridges and low hills. Although geographically associated, the soils included in this unit have highly contrasting characteristics and often occur in rather complex patterns. They range from shallow soils developing over gypsum, sandstone, or other sedimentary rocks to deep, gravelly and moderately coarse or medium-textured soils forming in alluvium.

The lands in this association are used for the production of native vegetation. Blue grama, black grama, sand dropseed, galleta, bush muhly, three-awns, snakeweed, chamiza, and yucca are the more common plant species. In addition, gyp grama and alkali sacaton usually occur on the gypsiferous soils. It also supports thin and scattered stands of pinyon and juniper trees adjacent to the mountain fronts at the higher elevations.

Soil Characteristics. The Caliza soils in this unit commonly occur on gently sloping and undulating to moderately steep narrow ridges and alluvial fans. They have a surface layer of very pale brown or light brown strongly calcareous gravelly sandy loam. This grades through a light gray very gravelly sandy loam to a prominent zone of lime accumulation at a depth ranging from 10 to 20 inches. The lime content typically decreases with depth, and at an average depth of about 36 inches there is little visible lime. The substratum consists of light brown very gravelly sand, very gravelly loamy sand, or very gravelly sandy loam.

The Latom soils occur on the gently to strongly

sloping and rolling upland ridges and low hills dominated by sandstone. These soils have a thin surface layer of brown to light reddish-brown calcareous stony loam or stony sandy loam. This grades through soil material of similar color and texture until sandstone bedrock is encountered at depths of 6 to 20 inches. The coarse material consists dominantly of angular fragments of sandstone. A few small soft masses and streaks of lime are usually present in the soil layer immediately above the sandstone bedrock.

The Holloman soils are on the crests and sideslopes of upland ridges dominated by gypsiferous materials. They commonly occur as relatively small and widely distributed areas on gently sloping and undulating landscapes. They are thin light-colored strongly calcareous soils underlain by gypsiferous earth or gypsum at depths of 4 to 20 inches. The surface layers are a pale brown to light brownish-gray loam.

Also in this association are small acreages of deep alluvial soils and a number of miscellaneous land types such as Rough Broken and Stony Land, Gypsum Land, and Alluvial Land. The deep alluvial soils, which commonly occur as small areas on fans and flood plains of intermittent drainages are dominantly moderately coarse to medium-textured.

Irrigation Potential. The dominance of shallow soils, together with the dissected and undulating to rolling topography will generally preclude the use of the land in this association for irrigation. The deep alluvial soils comprise the only land classified as suitable for irrigation. This irrigable land, however, will undoubtedly merit little or no consideration for irrigation because of its common occurrence as small and widely distributed tracts. Approximately 95 percent of the land in this association has been classified as non-irrigable.

7. Ector-Conger association

This association occurs in the southeastern part of the area adjacent to the county boundary where it joins extensive areas of a similar soil association in Chaves County. It is not extensive, however, in Lincoln County, as it comprises an area of about 60,920 acres. The soils, which occupy strongly sloping to rolling and hilly landscapes, are dominantly shallow and are forming in material of limestone origin.

It is used for livestock grazing, and under good management fair to moderate yields of forage are obtained. Native vegetation includes blue grama, black grama, sideoats grama, tobosa, three-awns,

yucca, and various cacti. Creosotebush and a few mesquite also grow in the southeastern part of this association.

Soil Characteristics. Ector soils, the most extensive in the association, have a thin surface layer of grayish-brown stony loam. They have a subsoil of dark brown very stony loam. The content of angular limestone fragments ranges from 35 to 75 percent. Below this, at depths ranging from about 4 to 15 inches, is limestone bedrock which has numerous vertical and horizontal cracks. Thin coatings of calcium carbonate commonly occur on the upper part and in the fractures of the underlying limestone bedrock.

Conger soils, the other major soil in this association, generally occur on moderately sloping and rolling landscapes in the lower part and outer fringes of this mapping unit. They have grayish-brown calcareous gravelly loam surface layers. These are underlain by fractured, platy, strongly cemented to indurated caliche at depths of 6 to 20 inches. Angular caliche fragments are common in the soil layers above the underlying cemented caliche. In this association, limestone bedrock commonly occurs at varying depths below the caliche.

Included in this association are small acreages of Santo Tomas, Elfrida, and Reagan soils. The Santo Tomas and Elfrida soils occupy the flood plains and valley bottoms of intermittent streams that traverse the area. The deep Reagan soils occur in small areas with nearly level to gently sloping landscapes. Limestone Rock Land, Alluvial Land, and other miscellaneous land types also occur to a very limited extent. These inclusions comprise 20 percent of this association.

Irrigation Potential. There is essentially no potential for the development of irrigated land in this association. The shallow stony and gravelly soils which normally occur on rolling and hilly landscapes are best used as native range. The limited acreage of soils with properties suitable for irrigation commonly occurs in small tracts in valley bottoms and flood plains of intermittent drainages. Approximately 88 percent of the land in this association has been placed in class 6. The remaining 12 percent, which is irrigable, is nearly equally divided among classes 1, 2, and 4.

8. Ector-Limestone Rock Land association

Included in this association are limestone hills and mountain footslopes in the southeastern part

of the county. The unit, which comprises an area of about 83,620 acres, is characterized by its very steep hills, canyon walls, breaks, and escarpments. The soils are dominantly shallow, stony, and rocky, and are generally underlain by limestone bedrock at shallow depths.

The very shallow and steep soils of this association under prevailing climatic conditions support only a fair to moderate cover of vegetation. Range for livestock and wildlife is the principal use. Short and mid grasses along with sotol, agave, ocotillo, snakeweed, sacahuista, and yucca comprise most of the vegetation. Blue grama, sideoats grama, bush muhly, little bluestem, tridens, and three-awns represent the more common grasses. A few juniper trees, mountain mahogany, and other brush species characteristic of higher elevations also occur along the western edge of the areas in this association.

Soil Characteristics. Ector soils represent the major component of this association. Although slopes on the landscapes occupied by the Ector soils are not as steep as those of Limestone Rock Land, they do range from strongly sloping to rolling and hilly. These soils have thin grayish-brown stony loam or rock loam surface layers and dark brown very stony subsoils. Below this and at depths ranging from about 4 to 15 inches is limestone bedrock. Numerous vertical and horizontal cracks are common in the underlying bedrock.

Limestone Rock Land, a miscellaneous land type, is also an extensive component of this association. It consists mainly of a complex of very shallow soils and outcrops of bedrock. Although very shallow soils are the most extensive, small areas of moderately deep to deep soils occur interspersed with the shallow soils, rock outcrops, and rock ledges. The rock outcrops commonly occur as vertical or nearly vertical exposures and ledges. The interspersed very shallow soils are commonly stony and moderately coarse to medium-textured. Numerous stones and angular fragments of limestone are common on the surface.

Also in this association are small areas of Elfrida, Santo Tomas, Atoka, and Reagan soils. The deep medium to moderately fine-textured Elfrida soils and the gravelly Santo Tomas soils occur in the narrow valley bottoms adjacent to drainages. The Reagan and Atoka soils occupy nearly level to gently sloping upland terraces. The Reagan soils are deep, medium to moderately fine-textured, and strongly calcareous. The Atoka soils are similar in texture and reaction, but differ in being underlain at moderate depths by strongly cemented caliche. Alluvial Land, Riverwash, arroyos, and other miscellaneous land types comprise the remaining parts

of this general area. These minor soils and land types comprise about 15 percent of the association.

Irrigation Potential. There is essentially no potential for the development of irrigated land in this association because of the rough broken topography, steep slopes, and shallow soils. This association is best used as range for livestock and wildlife. The lands classified as irrigable commonly occur as small tracts interspersed with extensive areas of class 6 land.

9. Reagan-Elfrida-Conger association

Included in this association are a number of small and widely separated areas adjacent to the Chaves County boundary in the southeastern part of the county. They consist of nearly level to gently sloping valley bottoms and the adjacent gently sloping to rolling terraces and plains. The soils, which are calcareous, are forming primarily in calcareous alluvium from geologic formations dominated by limestone with minor amounts from other sedimentary rocks. Approximately 13,530 acres, or less than one percent of the county, is included in this association.

They are moderately productive grassland soils and are used for the grazing of livestock and wildlife. The more common native vegetation includes blue grama, hairy grama, tobosa, sideoats grama, black grama, sand dropseed, three-awns, and some broom snakeweed, cholla cactus, and mesquite.

Soil Characteristics. Reagan soils, the most extensive in this association, occupy the nearly level to gently sloping plains and terraces intermediate in elevation between the Conger and Elfrida soils. They typically have a moderately thick surface layer of light brownish-gray to brown calcareous loam. A light brown strongly calcareous loam subsoil about 24 inches thick underlies the surface layer. The substratum to a depth of 60 inches or more is a light brown very strongly calcareous clay loam. A few fine threads and small soft masses of lime commonly occur below an average depth of 30 inches.

Elfrida soils, which are also moderately extensive in this association, occupy nearly level to gently sloping swales and slightly lower lying positions than those of the Reagan series. They have a surface layer of grayish-brown silt loam or loam over a thick subsoil of brown silty clay loam. The underlying material to a depth of 60 inches or more consists of a light brown to brown clay loam or silty clay loam. This is strongly calcareous and

usually has filaments and small soft masses of lime in the lower part of the subsoil and in the substratum.

The Conger soils in this association commonly occur on strongly sloping and undulating ridges and uplands just above the position occupied by Reagan soils. They normally consist of less than 10 inches of grayish-brown calcareous gravelly loam over layered and fractured indurated caliche. Angular caliche fragments often occur on the surface, and in the soft layers above the indurated caliche where they may comprise as much as 35 percent of the soil mass. The depths to the underlying caliche may range from 6 to 20 inches.

Also in this association are the moderately deep Atoka soils, the gravelly Santo Tomas soils, the shallow Ector soils, and small acreages of Alluvial Land, Riverwash, and arroyo bottoms. These soils and miscellaneous land types comprise about 15 percent of the association.

Irrigation Potential. Although this is a relatively small association, about 83 percent of the land in this unit is suitable for irrigation. Therefore, it offers some opportunity for development of irrigated land, particularly if based on the capability of the soils for such use. Approximately 51 percent of the land in this general soil area is in irrigation land class 1; 29 percent is in class 2; 3 percent in class 4; and the remaining 17 percent is non-irrigable (class 6). The delineations comprising this association, however, generally occur as small and irregularly shaped units in the Ector-Conger association (No. 7) that is dominated by non-irrigable land. The cost and difficulty of transporting irrigation water to these isolated tracts of irrigable land will undoubtedly restrict their use for irrigation.

10. La Fonda-Alicia association

This association, comprising an area of about 92,240 acres, occurs in the west-central part of the county. The topography is quite varied ranging from gently to strongly sloping and undulating on the valley slopes and plains to steep, rough, and broken on the escarpment and breaks areas. The soils are forming dominantly in alluvium from sedimentary rocks including shale, siltstone, and sandstone, although there are small areas of soils developing residually in materials from these sedimentary rocks. In general, the soils of this association are moderately susceptible to erosion, and as a result, only a few areas are not at least slightly eroded. Gullies are common in many of the valley bottoms.

This general soil area is used for grazing by livestock, and under good management moderate yields of forage are obtained. Because of the gully erosion hazard, a high level of management is required to prevent depletion of vegetation and loss of soil. Short and mid grasses, chamiza, yucca, broom snakeweed, cactus, and a few scattered scrub trees are the main vegetation. The more common grasses include blue grama, black grama, tobosa grass, sand dropseed, bush muhly, three-awns, and burgrass. Tobosa grass often comprises a very high percentage of the grass species in the swales and valley bottoms.

Soil Characteristics. La Fonda soils, the most extensive in the association, occur on gently to strongly sloping and undulating piedmont surfaces or fans. They commonly occupy the crests and side slopes of low ridges that are slightly higher than landscapes on which the associated Alicia soils occur. The surface layer, about five inches thick, is a reddish-brown calcareous friable loam. This layer grades to a subsoil, about 18 to 20 inches thick of light reddish-brown heavy loam. The lower part of the subsoil is usually more limy and coarser-textured than the upper part. This is underlain by a light reddish-brown strongly calcareous loam that commonly contains many small soft masses and fine threads of lime.

Alicia soils are in the swales and the lower parts of the piedmont slopes. These gently sloping soils have a surface layer of light reddish-brown weakly calcareous loam. It rests on a moderately thick subsoil of reddish-brown clay loam or silty clay loam. This grades to light reddish-brown silty clay loam that contains a few small soft masses and threads of lime.

In addition to the two major soils, Gullied Land, Rock Land, and other miscellaneous land types and unclassified soils and soils of the Manzano, Moriarty, Newkirk, and San Jon series comprise about 35 percent of this association. Rock Land, the most extensive of the inclusions, occurs on moderately steep to steep side slopes of hills and escarpments. It consists of a complex of very shallow soils and outcrops of thinly bedded shale, siltstone, limestone, sandstone, and gypsiferous rocks. A thin mantle of soil commonly occurs between the exposures of bedrock. Manzano and Moriarty soils occur in swales and on flood plains. The Manzano soils have thick dark colored loam or clay loam surface layers over clay loam subsoils and substrata. The Moriarty soils differ in that they are deep fine-textured soils. The Newkirk and San Jon soils are shallow to moderately deep and are developing over interbedded shale and sandstone.

Irrigation Potential. This association, which is dominated by classes 3 and 2 land, offers a fair potential for expansion of irrigation. Slope and unevenness of the land surface, together with moderate overflow and erosion hazard were the principal factors contributing to the placement of the soils in these land classes. They will require considerable land leveling and soil conditioning for irrigation. Gullied Land, Rock Land, and the shallow to moderately deep soils of the Newkirk and San Jon series were placed in class 6. These interspersed non-irrigable lands will often tend to restrict the size of the tracts that can be developed for irrigation. Approximately 45 percent of the land in this association was placed in class 3; 25 percent in class 2; 3 percent in class 4; and the remaining 27 percent in non-irrigable, or in class 6.

11. Deama-Pastura-Manzano association

This association, which is widely distributed in the northern part of the county, includes an area of approximately 698,680 acres. It is particularly extensive in northeastern and north-central sections, where it occupies gently to strongly sloping and rolling uplands that generally range between 4700 and 6500 feet in elevation. Some moderately steep and steep breaks, or escarpments, and nearly level to gently sloping valley bottoms are also included. It is dominated by shallow soils forming from limestone. It is used for grazing of livestock, and under good management moderate yields of forage are obtained. Native vegetation includes blue grama, hairy grama, galleta, sideoats grama, sand dropseed, three-awns, and some New Mexico feathergrass, spike muhly, and needle-and-thread grass. Shrubs and woody species include snake-weed, cholla cactus, and mesquite.

Soil Characteristics. Soils of the Deama series are dominant in this association. They usually occur on nearly level to strongly sloping and gently rolling landscapes. These soils have a surface layer of grayish-brown to brown calcareous stony loam. This grades through a dark grayish-brown very stony loam to the underlying limestone bedrock at a depth of 6 to 20 inches. Coarse angular fragments comprise about 25 to 40 percent of the surface layer and as much as 70 percent in the subsurface layers immediately above the limestone bedrock.

Pastura soils are also shallow, but are developing on indurated caliche. These soils have a surface layer of grayish-brown calcareous gravelly loam. This grades through a pale brown calcareous loam to the underlying caliche, which usually occurs

within 12 inches of the surface but may range in depth from 6 to 20 inches. Coarse fragments of very hard caliche are common in the subsurface layers. The degree of cementation of the caliche layer usually decreases gradually with depth and becomes soft and weakly cemented 1 to 3 feet below its upper surface. Limestone bedrock may occur below the indurated caliche layer at variable depths.

Manzano soils, the least extensive of the major soils in this association, occur on nearly level to very gently sloping swales and flood plains of intermittent drainages. The surface layer, about nine inches thick, is a grayish-brown to dark brown non-calcareous loam. The subsoil is a dark grayish-brown clay loam that has a moderate blocky structure. This is underlain by a substratum of brown light clay loam that usually contains a few pinkish-white specks and threads of segregated lime.

Soils of lesser extent in this association include those of the Harvey, Tapia, Dean, and Laporte series. The Harvey soils are limy and occur on gently to strongly sloping valley side slopes. The grayish-brown calcareous loam surface layers of these soils are underlain by a pinkish-white very limy loam at a depth of about 16 to 20 inches. The Tapia soils have thin brown noncalcareous loam surface layers and light brown clay loam subsoils. They are underlain at moderate depths by a caliche layer consisting of indurated caliche gravels and cobbles that are weakly cemented together in the upper part. The Dean soils are light-colored and shallow to soft caliche or soil layers with a high content of lime. The Laporte soils, which are also shallow, are similar to those of the Deama series, but differ in containing less coarse fragments. In addition to these soils, the association includes small areas of unclassified alluvial soils and miscellaneous land types, such as Rock Land.

Irrigation Potential. The potential for development of irrigated land in this association is extremely limited. The two most extensive soils, Deama and Pastura, are not suitable for use as cropland under irrigation. The Manzano, Harvey, and Tapia soils are suitable for such use, but commonly occur as small areas interspersed with large tracts of non-irrigable land. About 86 percent of the land in this general soil area is non-irrigable.

12. Limestone Outcrop association

This association includes soils and land types on rolling to steep limestone hills, escarpments, and breaks areas located principally in the east-central

part of the county. It consists of a number of areas that are widely separated and that occur generally at elevations of about 5000 to 5500 feet. The soils, which are dominantly shallow, stony, and rocky, are generally underlain by limestone bedrock within a depth of 20 inches. A few small areas of moderately deep and deep soils, however, are included. Approximately 88,570 acres, or about three percent of the county, is included in this association. These soils are used as range for livestock and wildlife. Although the density and amount of forage produced is somewhat restricted on the Limestone Rock Land component of this association, moderate yields of forage are obtained on the Laporte and associated soils. Principal native vegetation includes glue grama, sideoats grama, galleta, sand dropseed, tridens, three-awns, snake-weed, cholla cactus, and a few juniper trees.

Soil Characteristics. Limestone Rock Land, an extensive component of this association, consists dominantly of a complex of very shallow soils and outcrops of limestone. It is characterized by numerous rock outcrops, bare ledges, and a large amount of loose rock and stones on the surface. A thin mantle of stony or gravelly loam soil is common between the outcrops of bedrock. Although it is dominated by shallow soils, small areas of moderately deep and deep soils do occur interspersed with the shallow soils and rock outcrops. It commonly occurs on steep slopes, escarpments, and breaks.

Laporte soils, which occur with the Limestone outcrops, are extensive in this association. They are usually located on the less sloping areas with slope gradients usually averaging less than 15 percent. Slopes, however, may range from gently sloping to moderately steep and rolling. These soils have a surface layer of dark grayish-brown calcareous stony loam. This grades through a pale brown to grayish-brown stony loam to the underlying limestone bedrock at a depth of 6 to 20 inches. Angular coarse fragments usually comprise about 15 to 35 percent of the soil layers above the limestone bedrock.

Also included in this association are soils of the Deama, Harvey, and Manzano series. The Deama soils, which are dark-colored, stony, and shallow, are similar to those of the Laporte series, but differ principally in that they contain a much higher content of coarse fragments. These coarse fragments comprise from 35 to 70 percent of the soil layers immediately above the underlying limestone bedrock. Harvey soils are limy and occur on gently to strongly sloping valley side slopes. The grayish-brown calcareous loam surface layers of these soils

are underlain by a pinkish-white very limy loam at a depth of about 16 to 20 inches. The Manzano soils are deep and occur in the nearly level to gently sloping valley bottoms. They have a thick surface layer of grayish-brown loam or clay loam over a thick subsoil of dark grayish-brown clay loam. In addition to these soils, small acreages of unclassified alluvial soils, drainageways, and other miscellaneous land types comprise the remaining parts of this association.

Irrigation Potential. There is essentially no potential for development of irrigated land in this association because of the prevalence of shallow soils, rock outcrops, steep slopes, and rough broken topography. The lands classified as suitable for irrigation are widely distributed and usually occur as very small tracts.

13. Harvey-Pastura association

This association, which comprises an area of about 142,610 acres, is intermingled with the Deama-Pastura-Manzano association (No. 11) in the northeastern part of the county. In general, it occupies weakly defined valley areas or landscape positions that are slightly lower than those of the Deama-Pastura-Manzano association. The topography is somewhat varied and usually ranges from nearly level to gently sloping and undulating. Some of the valley side slopes are strongly sloping. The soils, which are usually calcareous and of variable depth, are developing dominantly in materials of limestone origin with other sedimentary materials contributing lesser amounts.

It is used for grazing, and under good management moderate yields of forage are obtained in years of average or above precipitation. Native vegetation includes blue grama, sand dropseed, spike dropseed, sideoats grama, ring muhly, poverty three-awns, and some New Mexico feathergrass, needle-and-thread, black grama, Indian ricegrass, snakeweed, and yucca.

Soil Characteristics. The Harvey soils occur dominantly on gently to strongly sloping valley side slopes. They typically have light brown or grayish-brown calcareous loam surface layers. The subsoil is similar except that it contains more lime and is slightly lighter colored. This layer grades to a pinkish-white very limy loam that begins at a depth of about 15 to 20 inches. The lime content decreases slightly below a depth of 30 or 36 inches.

The Pastura soils occur mainly on the crests of upland ridges and on the upper part of the valley

side slopes. These soils typically have thin light brownish-gray calcareous loam surface layers and pale brown calcareous loam or gravelly loam subsoils. They are underlain by indurated caliche at depths ranging from 6 to 20 inches. The strong cementation of the caliche layer is usually confined to the upper 6 to 18 inches with a gradual decrease in cementation below this depth. In this association limestone bedrock may occur in the Pastura soils below the caliche layer.

Less extensive soils in this association include those of La Fonda, Dean, Deama, Tapia, and Manzano series. The La Fonda soils, which are deep, well-drained, and medium-textured, occupy the crests, and side slopes of upland ridges and alluvial fans. They have a reddish-brown calcareous loam surface layer over a loam or sandy clay loam subsoil and substratum. A weak but distinct lime zone in the form of fine soft masses and coatings on pebbles typically occurs at depths of 18 to 40 inches. The Dean and Deama soils are shallow and are underlain by soft or weakly cemented caliche and limestone bedrock, respectively. The moderately deep Tapia soils occur on nearly level to gently sloping uplands. They usually have a brown noncalcareous loam or fine sandy surface layer over a sandy clay loam or light clay loam subsoil. This is underlain at depths of 20 to 40 inches by white fractured caliche. The Manzano soils, which occur mainly in swales and depressional areas, have grayish-brown loam surface layers over thick grayish-brown to dark brown clay loam subsoils. A small acreage of Rock Land and arroyo bottoms comprise the remaining parts of this association.

Irrigation Potential. Although class 6 land is relatively extensive (50 percent), approximately 12 percent of the land in this association is in class 2, and 38 percent is in class 3. This acreage of classes 2 and 3 land, where it occurs in tracts of sufficient size, offers some opportunity for development of irrigated land. The La Fonda and Manzano soils are dominantly in irrigation land class 2 and are well suited for use as cropland under irrigation. The Harvey and Tapia soils account for most of the land in irrigation class 3. These soils, although suitable for irrigation, have a lower capability for such use than those included in class 2. The Harvey soils have moderate to severe limitations for use as cropland under irrigation because of their shallow depth to a prominent lime zone, moderately low water-holding capacity, and slope. The Tapia soils have similar limitations because of slope, moderate depth, and water-holding capacity. These class 3 lands will require above-average management practices to insure satisfactory yields of adapted crops

under irrigation. The shallow soils of the Dean, Deama, and Pastura series were placed in land class 6.

14. Harvey-Pastura-Witt association

Included in this association are three widely separated areas comprising an acreage of about 143,980 acres. One of these areas is located in the north-central part adjacent to the north county boundary. The other two areas are east and north of the Jicarilla and Capitan mountains in the central part of the county. The soils, which range from shallow to deep, are forming generally in old valley-filling sediments of mixed origin. They occupy gently to strongly sloping and undulating valley slopes and plains with slope gradients seldom exceeding 10 percent. In addition to this dominant and prevailing topography, there are also included nearly level to very gently sloping valley bottoms and a few small areas of steep escarpments and breaks.

It is used mainly as native range and under good management moderate forage yields are obtained. Blue grama, hairy grama, galleta, sand dropseed, western wheatgrass, Indian ricegrass, sideoats grama, ring muhly, New Mexico feathergrass, needle-and-thread grass, and three-awns are the principal grasses. A few scattered pinyon and juniper trees and traces of broom snakeweed, chamiza, yucca, and cactus also occur.

Soil Characteristics. Harvey soils, the most extensive, occupy gently to strongly sloping landscapes that occur adjacent to, and slope toward drainageways. These soils have a surface layer of light brown or grayish-brown calcareous loam. The subsoil is similar, except that it contains more lime and is slightly lighter colored. This layer grades to a pinkish-white very limy loam that begins at a depth of about 15 to 20 inches. The lime content decreases slightly below a depth of 30 to 36 inches.

The shallow Pastura soils occur mainly on the crests of upland ridges and plains in close association with the Harvey soils. These soils have thin light brownish-gray calcareous loam surface layers and pale brown calcareous loam or gravelly loam subsoils. They are underlain by indurated caliche at depths ranging from 6 to 20 inches. The strong cementation of the caliche layer is usually confined to the upper 6 to 18 inches with a gradual decrease in cementation below this depth. Although not typical for the series, limestone bedrock may occur below the caliche layer in the Pastura soils in this association.

Witt soils are mainly on the broad gently sloping plains or valley slopes between the drainageways. They have a thin surface layer of light brown noncalcareous loam over a thick subsoil of reddish-brown clay loam that is noncalcareous in the upper part. A few threads and small soft masses of lime are common in the lower part of the subsoil. This is underlain by a pinkish-white very limy loam at depths of 40 to 50 inches.

In addition to these principal soils, other soils in this association include those of the Tapia, Penistaja, Manzano, and Deama series. Tapia soils occur on the broad smooth and gently sloping areas between the drainageways and depressions. These moderately deep soils have a thin surface layer of brown noncalcareous loam. Their subsoil is a light brown to brown clay loam that usually contains a few indurated caliche pebbles. This is underlain at a depth ranging from 20 to 35 inches by pinkish-white caliche, that commonly consists of about 35 percent of indurated caliche fragments or gravel. The caliche fragments are usually weakly cemented together in the upper few inches. The Penistaja soils, which are deep, have sandy loam surface layers and sandy clay loam subsoils. The Manzano soils, which occur mainly in swales and depression areas, have grayish-brown loam or clay loam surface layers over thick grayish-brown to dark brown clay loam subsoils. The Deama soils, which are shallow, have a surface layer of grayish-brown to brown stony loam. This grades through a dark grayish-brown very stony loam to the underlying limestone bedrock at a depth of 6 to 20 inches. Limestone Rock Land, arroyo bottoms, and other miscellaneous land types comprise the remaining parts of this association. The Limestone Rock Land comprises the small steep breaks or escarpment areas on the side of the upland areas occupied by the Deama soils.

Irrigation Potential. Although class 6 land is relatively extensive (46 percent), approximately 16 percent of the land in this association is in class 2; 31 percent in class 3; and 7 percent in class 4. There is, therefore, some opportunity for expansion of irrigation in the areas occupied by this association. The Witt, Penistaja, and Manzano soils are dominantly in irrigation land class 2, which is well-suited for use as cropland under irrigation. The Harvey and Tapia soils account for most of the land in irrigation land class 3. These soils, although suitable for irrigation, have a lower capability for such use than those included in land class 2. They have a moderately severe limitation for irrigation because of their limited depth to a prominent lime zone, moderate water-holding capacity, and slope.

15. Pinon-Rednun-Harvey association

This association includes an area of about 148,060 acres in the northwestern part of the county. It occurs mainly on gently to strongly sloping and undulating uplands interspersed with moderately steep and rolling upland ridges and hills. A few steep escarpments or breaks and nearly level to gently sloping valley bottoms are also included. The soils range in depth from shallow on the upland ridges and low hills to moderately deep and deep on the less sloping areas.

The moderately steep and rolling upland ridges and low hills support moderate to heavy stands of pinyon and juniper trees, which provide not only good habitat for wildlife but also fence posts and firewood. Although there are some thin and scattered stands of pinyon and juniper in the remaining areas of this unit, short and mid grasses are dominant. The more common grasses are blue grama, western wheatgrass, Indian ricegrass, black grama, galleta, needle-and-thread grass, little bluestem, Junegrass, sideoats grama, and spike muhly.

Soil Characteristics. Pinon soils are located on the moderately steep and rolling ridges and low hills that occur throughout this association. They are characterized by their brown or grayish-brown calcareous channery loam surface layer. This grades through soil of similar texture that becomes lighter colored and more limy with depth. The light brown to pinkish-white channery loam subsurface layer rests abruptly on partly weathered, fractured limestone bedrock at a depth of 6 to 20 inches.

The Rednun soils are also extensive in this association. They commonly occur on gently sloping piedmont surfaces or valley side slopes. The surface layer, about 10 inches thick, normally consists of a brown to dark brown noncalcareous loam. This grades through about 8 to 12 inches of brown clay loam that has a strong blocky structure to the underlying subsoil. The subsoil consists of a reddish-brown heavy clay loam or clay with strong blocky structure. A limy reddish-brown clay loam occurs at an average depth of 42 inches.

The Harvey soils are mainly on the gently to strongly sloping side slopes of piedmont surfaces and fans. They typically have a moderately thick surface layer of light brown or grayish-brown calcareous loam. The subsoil is similar, except that it contains more lime and is slightly lighter colored. This layer grades to pinkish-white very limy loam at a depth of about 15 to 20 inches. The lime content decreases slightly below a depth of 30 or 36 inches.

Other soils of importance in this association

include those of the Carnero, Witt, Pinata, Stroupe, and Manzano series. The Carnero soils occur on the gently to strongly sloping uplands adjacent to the Gallinas Mountains. These soils, which are typically underlain by sandstone bedrock at depths of 20 to 40 inches, have a thin surface layer of brown noncalcareous loam over a reddish-brown clay loam subsoil. The Witt soils, which are a major component of the adjoining soil association in Torrance County, are not as extensive in Lincoln County. They have a thin surface layer of light brown noncalcareous loam over a thick subsoil of reddish-brown clay loam. This is underlain by a pinkish-white very limy loam at depths of 40 to 50 inches. Manzano soils occur on nearly level to very gently sloping areas in swales, depressions, and drainageways. The surface layer, about 6 to 10 inches thick, is a grayish-brown to dark brown noncalcareous loam. This is underlain by a thick grayish-brown clay loam subsoil. The substratum is a brown calcareous loam or light clay loam that commonly contains a few small specks and fine threads of lime. The Pinata and Stroupe stony loams, which usually occur in a complex pattern in this general soil area, also occupy the wooded ridges and low hills as do the Pinon soils. The Pinata stony loam occurs on the steeper, less stony, and more heavily wooded parts of this complex. They have a brown or dark brown noncalcareous stony loam surface layer over a gravelly or stony clay loam subsoil. The subsoil grades to felsite bedrock at an average depth of about 20 inches. The Stroupe soils occupy the less sloping and more open parts of this complex. They have a surface layer of dark grayish-brown noncalcareous stony loam over a reddish-brown stony clay loam subsoil. The substratum consists of a very limy, pink stony loam. The stone content ranges from about 20 percent in the surface layer to 50 percent in the subsoil. In addition to these soils, Rock Land, Gullied Land, and other miscellaneous land types comprise small acreages in this association.

Irrigation Potential. Although this association contains a relatively high percentage of non-irrigable land, there is some potential for expansion of irrigation in the areas comprising this unit. This is particularly true in those cases where the Rednun soils and associated soils classified as suitable for irrigation occur in large enough tracts for economical development. The Rednun soils are in irrigation land class 2 on gently sloping landscapes, and in class 3 on the strongly sloping areas. The Harvey soils, because of their shallow depth to a prominent lime zone, moderately low water-holding capacity, and slope, were included in class

3. Small acreages of Manzano and Carnero soils, which were placed in irrigation land classes 2 and 4, respectively, also occur in this association. Approximately 62 percent of the land in this association has been classified as non-irrigable, primarily because of stony and shallow soils and steep slopes. Pinon, Pinata, and Stroupe soils are dominant on the class 6 lands. These class 6 lands often tend to restrict the size of tracts that can be developed for irrigation.

16. Penistaja-Pinon-Chupadera association

This association is in the north-central part of the county near the boundary between Lincoln and Torrance counties. It comprises a total land area of about 84,340 acres, or slightly more than three percent of the county. The topography is quite varied as it ranges from nearly level to strongly sloping and undulating in the valley areas to rolling and very steep on low hills, ridges, and mesa escarpments. The soils on the valley side slopes and in the valley bottoms, which are forming in eolian and alluvial sediments of mixed origin, are dominantly deep. Miscellaneous land types and shallow soils developing over sandstone and limestone are dominant on the low hills, ridges, mesa escarpments, and breaks.

Nearly all of this association is used for grazing of livestock and wildlife. The deep soils produce moderate yields of forage, and under a good level of management support a mixture of tall, mid and short grasses. The principal grass species include blue grama, sand dropseed, mesa dropseed, lovegrass, sand bluestem, little bluestem, Indiangrass, black grama, sideoats grama, needle-and-thread grass, and New Mexico feathergrass. In addition, light to heavy stands of pinyon and juniper occur throughout much of this association. Although it is typical for the shallow soils and miscellaneous land types occupying the low hills, ridges, and escarpments to have an overstory of pinyon and juniper, these tree species have also invaded many parts of the deep soil areas in this association represented by the Penistaja series.

Soil Characteristics. Penistaja soils, the most extensive in the association, commonly occur on gently to strongly sloping uplands and piedmont slopes at the base of hills and ridges. They have a thin surface layer of brown noncalcareous fine sandy loam over a subsoil of light brown or reddish-brown sandy clay loam. Below this is a light brown fine sandy loam that commonly contains some segregated lime in the form of small soft

masses and thin threads. A prominent lime zone occasionally occurs in these soils below a depth of 40 inches or more.

Pinon soils, which occur on strongly sloping and rolling ridges and low hills throughout this association, are also relatively extensive. They are characterized by a brown or grayish-brown calcareous channery loam surface layer. This is underlain by soil of similar texture that becomes lighter colored and more limy with depth. The content of coarse angular limestone fragments varies from about 25 to 40 percent in the surface to as much as 70 percent in the underlying material above the limestone bedrock that usually occurs at a depth ranging from 10 to 20 inches.

Chupadera soils commonly occur on crests and side slopes of upland ridges. Typically these soils have a moderately thick surface layer of brown weakly calcareous loamy fine sand. This grades into a grayish-brown strongly calcareous fine sandy loam that contains from 10 to 30 percent coarse angular fragments of limestone. This in turn is underlain by limestone bedrock at a depth ranging from about 24 to 36 inches.

Other soils of lesser extent in this association include deep alluvial soils, shallow soils of the Travessilla, Bernal, and Dean series, and moderately deep soils of the Hagerman series. The deep alluvial soils occupy the narrow flood plain areas contiguous to intermittent streams. Although quite variable they are usually moderately coarse to medium-textured.

Rock Land, a miscellaneous land type, is also an important inclusion of this association. It is a complex of shallow soils and outcrops of sandstone and other sedimentary rocks. It consists of steep and very steep escarpments and breaks in which ledges and stairstep topography are common. A thin mantle of soil, which usually occurs between the outcrops of bedrock, support most of the plant life.

Irrigation Potential. There is only a limited opportunity to develop or expand irrigation in this association. Approximately 61 percent of this general soil area is non-irrigable or in class 6; 19 percent is in class 2; 10 percent is in class 3; and the remaining 10 percent is in class 4. As would be expected with this high percentage of non-irrigable land, the lands suitable for irrigation commonly occur as small tracts interspersed with extensive areas of class 6 land. For example, the Penistaja soils which are well suited to irrigation and account for most of the land in class 2, usually occur as relatively narrow and irregular shaped tracts in valley bottoms and adjacent side slopes. The Pinon

and Chupadera soils, due to their limited soil depth, low moisture-retention capacity, and other characteristics, are not suitable for irrigation.

17. San Mateo association

Included in this association are the nearly level to gently sloping flood plains, terraces, and valley areas adjacent to the Rio Hondo, Rio Ruidoso, Salado, Bonita, and Carrizo creeks. Although nearly level to gently sloping landscapes are dominant, some of the valley side slopes and fans are undulating and strongly sloping. The soils, which are usually deep and have dark-colored surface layers, are forming in alluvium of mixed origin. Fine sandy loam, loam, and clay loam are the dominant surface soil textures. The subsurface layers are usually highly variable and range from moderately coarse to fine-textured. Approximately 56,750 acres, slightly less than two percent of the county, are included in this association.

The 3,880 acres of irrigated land in Lincoln County is in this association. Most of it is in orchards, pastures, and small gardens or is used for the production of alfalfa, corn, and some small grains. Apples, which are the major fruit crop, contribute considerably to the economy of the area. In addition to the irrigated land, a considerable amount of the land in this unit is used by roads, highways, buildings, and other built-up areas.

The land not under irrigation or in built-up areas provides grazing for livestock and wildlife. Production of forage varies considerably depending on the amount of additional moisture received as runoff from adjacent areas. Vegetation is dominated by mid and short grasses, shrubs, and scattered pinyon and juniper trees. Some cottonwood trees are common on the flood plain contiguous to the major drainages.

Soil Characteristics. San Mateo soils, the most extensive in the association, commonly occur on nearly level to gently sloping alluvial fans and flood plains adjacent to drainages. These soils are typically stratified, moderately dark-colored to dark-colored, and deep. They usually have a surface layer of calcareous grayish-brown loam. This is underlain to a depth of five feet or more by stratified soil material consisting dominantly of loam, sandy clay loam, light clay loam, and sandy loam.

Also of moderate extent in this association are soils of the Glenberg-like series. They differ from the San Mateo soils in that they are coarser-textured and contain more strata of sandy loam,

loamy sand, and light loams. These soils have a surface layer of brown to grayish-brown calcareous fine sandy loam or loam. This is underlain to depths of four feet or more by stratified soil material consisting dominantly of sandy loam and loam with some thin strata of loamy sand. The Glenberg-like soils in this association include a medium and moderately coarse-textured soil underlain by sand and gravel at moderate depths. These soils have a surface layer of grayish-brown calcareous loam or fine sandy loam. The subsurface layers above the gravel, cobble, and sand which occur at depths ranging from 24 to 40 inches, consist dominantly of stratified sandy loams and light loams.

Shanta soils, which occur on the nearly level to gently sloping valley areas and terraces, are also of importance in this association. These soils have a thick surface layer of brown or grayish-brown calcareous loam. This is underlain to depths of 60 inches or more by loam or light clay loam. A few pebbles and cobbles may occur in subsurface layers.

The remaining parts of this association consist of a number of other unnamed soils and miscellaneous types. These inclusions comprise about 25 percent of the association. One of the more extensive of these included soils occurs in the vicinity of Capitán. These soils have a light brown to brown calcareous loam surface layer over a moderately thick dark brown calcareous heavy clay loam or clay subsoil. This is underlain at a depth of 30 to 40 inches by interbedded sandstone and shale.

Other soils of importance include deep fine-textured or clayey soils in the valley bottoms and deep gravelly loam and gravelly sandy loam soils on the strongly sloping valley side slopes and fans. Small acreages of Riverwash, Rock Land, Gullied Land, arroyo bottoms, and river bottoms comprise the remaining parts of this association.

Irrigation Potential. Approximately 91 percent of the land in this association has been classified as irrigable. In general, the only lands not irrigable include miscellaneous land types and the immediate flood plains and bottoms of the larger streams. The soils are well suited for use as cropland under irrigation, and as a result about 85 percent of the land in this unit has been placed in irrigation land classes 1, 2, and 3. In addition to good farming practices, these lands often need protection from overflow or runoff from higher lying lands. This is a small association, hence the amount of land available for expansion of irrigation is limited. In addition, the present irrigated land (about 3880 acres), roads, and a few built-up areas further restrict the acreage of land available for future development of irrigated land.

18. Caballo-Peso-Supervisor association

This association includes about 204,720 acres in the south-central part of the county. Although the altitude ranges from slightly less than 7,000 feet to near 12,000 feet on some of the mountain peaks, it is dominantly between 7,500 and 10,500 feet. It is characterized by mountainous topography that ranges from gently sloping to moderately steep on the ridge tops and valley areas to steep on the mountain side slopes. A wide variety of igneous, metamorphic, and sedimentary rocks have contributed to the parent materials in which the soils of this association are forming. This includes the soils developing residually in materials weathered from the underlying bedrock as well as those forming in colluvial and alluvial sediments. The soils are typically dark-colored with a moderate to high content of organic matter, and are mildly alkaline to neutral and slightly acid in reaction. The surface layers commonly contain a few gravel and stones.

This association is used principally for timber production, range, and recreation. It is also an important watershed area and most of the perennial streams in Lincoln County originate in this general soil area. With the exception of the small rock outcrop areas, it supports, in general, a good cover of native vegetation that is dominated by tree species. The more common species are ponderosa pine, Douglas fir, white fir, Engelmann spruce, Mexican white pine, and some aspen, Gambel oak, pinyon, and juniper. The more common and representative grasses are Arizona fescue, Thurbers fescue, mountain brome, Junegrass, bluegrass, stipa species, blue grama, sideoats grama, and little and big bluestem. It also supports a number of desirable browse plants that are suitable for grazing by wildlife.

Soil Characteristics. Caballo soils occur on strongly sloping and rolling to very steep mountain slopes at elevations of about 7,000 to 10,000 feet. These soils typically have thick surface layers of very dark grayish-brown clay loam. They are neutral in reaction and usually have thin organic layers of decaying forest litter on the surface. It is also common for these surface layers to contain a few cobbles and stones. The subsoil is a brown cobbly and very cobbly clay loam that ranges in reaction from neutral in the upper 12 to 18 inches to mildly alkaline and calcareous in the lower part. This is underlain at depths of about 4 to 6 feet by boulders, flagstone, and fractured bedrock. A small amount of soil material commonly occurs in the fractures and between the coarse fragments.

The Peso soils occupy landscapes similar to

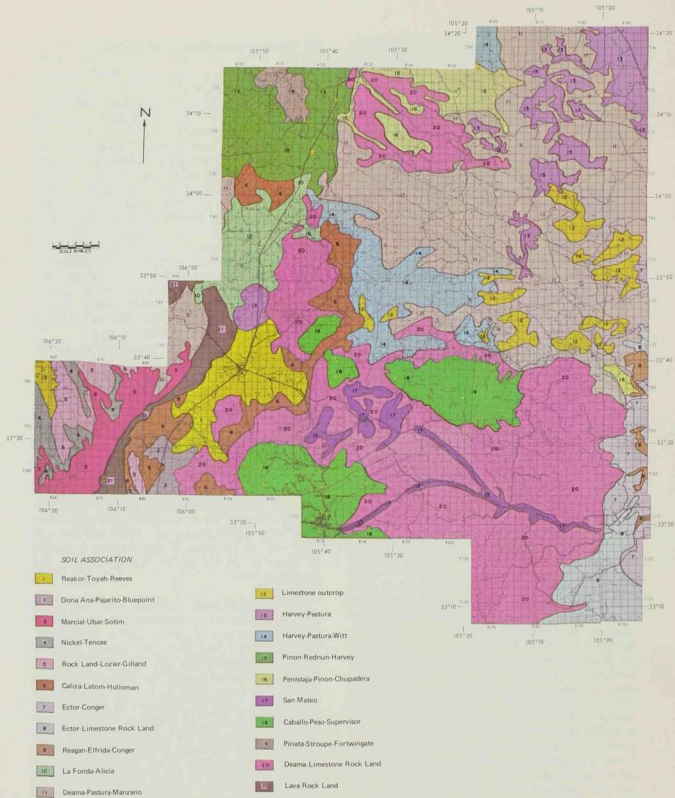


Fig. 1. General soil map of Lincoln County, New Mexico

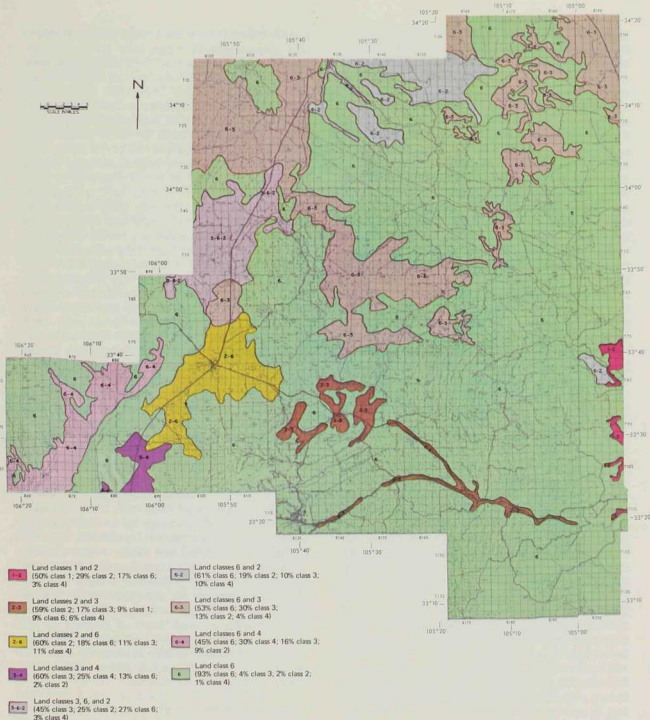


Fig. 2. Classification of land for irrigation in Lincoln County, New Mexico

those of the Caballo series, but differ in having thinner dark-colored surface layers, and in having bedrock at moderate depths. They usually have a thin surface layer of very dark grayish-brown cobbly clay loam that is mildly alkaline in reaction. A one- to three-inch layer of partially decomposed and undecomposed needles, leaves, and twigs commonly lies on the surface. The subsoil is a dark grayish-brown, mildly alkaline, very cobbly clay loam about 7 to 10 inches thick. This grades through a brown moderately alkaline very cobbly clay loam to the underlying bedrock that commonly occurs at a depth of about 30 inches, but may range from 20 to as much as 40 inches below the surface. A weak accumulation of lime occurs in the substratum in the form of small soft masses and coatings on the underside of the coarse fragments.

Supervisor soils, the other major component of this association, have a surface layer of dark gray, gravelly sandy loam that is leached free of lime. A two- to three-inch layer of litter consisting of partially decomposed and undecomposed needles, leaves, and twigs commonly occurs on the surface. The subsurface layer consists of a dark grayish-brown slightly acid gravelly sandy loam. This grades through a very gravelly loamy sand, about one foot thick, to the underlying acid igneous bedrock that occurs at a depth of about 20 to 36 inches.

Rock Land, which is also of importance in this association, commonly occurs near the mountain crests and on the steep canyon walls and escarpments. It consists of a complex of shallow soils and outcrops of bedrock. The outcrops occur as vertical or nearly vertical exposures and ledges. The interspersed soils are usually shallow, and moderately coarse to moderately fine-textured. Numerous stones and boulders are common on the surface of the included soils. Although these soils are dominantly shallow, small areas and pockets of moderately deep to deep soils do occur interspersed with the shallow soils, rock outcrops, and rock ledges.

Also in this association are soils of the Blanca, Firo, Irock, Tularosa, and Mescalero series. The Blanca soils occur at elevations of nearly 10,000 feet in association with the Supervisor soils. These soils, which are deep, have thick dark grayish-brown slightly acid sandy loam surface layers and light yellowish-brown to brown very cobbly sandy loam and very cobbly loamy sand subsurface layers. The Firo soils are shallow and occur on moderately steep to steep mountain side slopes and ridge crests. They have a thin surface layer of very dark grayish-brown very stony loam over a dark

grayish-brown cobbly heavy loam subsoil. Depth to acid igneous bedrock ranges from 10 to 20 inches from the surface. The Irock soils are forming dominantly in old alluvial sediments of mixed igneous and sedimentary origin. These soils are characterized by their brown noncalcareous cobbly sandy loam surface layers and yellowish-brown cobbly heavy sandy loam subsoils. Depth to consolidated bedrock ranges from about 40 to 72 inches. The Mescalero soils are on gently to strongly sloping ridge tops and crests in areas dominated by limestone formations. These soils have a very dark grayish-brown stony silty clay loam surface layer over a subsoil of similar color and texture in the upper part and that grades to a brown very cobbly clay loam in the lower part. They are underlain by limestone bedrock at a depth ranging from 20 to 40 inches from the surface. The Tularosa soils, which are forming in alluvial sediments of mixed origin weathered from igneous and sedimentary rocks, occupy nearly level to moderately steep landscapes in valley areas. These deep soils have dark gray silty clay loam and clay loam surface layers and subsoils. The surface layers contain a large amount of organic matter and are neutral in reaction. Below an average depth of 30 inches, the substratum consists of dark colored and weakly stratified clays and clay loams.

In addition to these soils, there are included drainage bottoms and miscellaneous land types such as Alluvial Land and Rock Land. The Alluvial Land commonly occurs as small areas in valley bottoms on narrow flood plains adjacent to drainages. They consist of soils with highly variable characteristics that may range from coarse-textured to moderately fine-textured. In addition, they are usually very stratified and often contain gravelly and stony layers. Rock Land, however, is the most extensive land type. It generally is steep and very steep and consists of a complex of very shallow and shallow soils and outcrops of bedrock. The soils occurring as small areas or pockets of soil between the outcrops of bedrock are variable. They are, however, usually moderately coarse to medium-textured with varying amounts of cobble, stones, and rocks on the surface.

Irrigation Potential. This association is dominated by steep and mountainous topography and there is little or no opportunity for development of irrigated land. The only land suitable for irrigation consists of the small areas of deep and gently to strongly sloping alluvial soils located in the valley areas. The small size, location, and isolation of these irrigable lands will generally preclude their use for this purpose.

19. Pinata-Stroupe-Fortwingate association

Included in this association is the Gallinas Mountain area in the northwestern part of the county. It comprises an area of about 21,830 acres, or less than one percent of the county. Steep to very steep mountainous landscapes with slope gradients of 15 to 60 percent are characteristic of this general soil area. Although the slope gradients are generally within this range, small areas with slopes of five percent or less do occur in some of the narrow valleys and foothill areas. Elevations in the area range from slightly less than 7,000 feet to about 8,800 feet on Gallinas Peak.

This association is used dominantly for timber production, recreation, grazing by wildlife, and some livestock grazing in the more accessible areas. Ponderosa pine, Douglas fir, alligator juniper, Gambel oak, gray oak, and an understory of cool-season grasses comprise the main part of the vegetation at the higher elevations and on the north and northeast slopes. Moderate to heavy stands of pinyon and juniper, with an understory of scrub oak, mountain mahogany, blue grama, galleta, side-oats grama, little bluestem, and western wheatgrass, are the principal plants at lower elevations.

Soil Characteristics. Pinata soils usually occur on steep to very steep mountain slopes with gradients ranging from about 20 to 60 percent. A layer of decomposing forest litter about two inches thick usually covers the surface. These soils have a moderately thick surface layer of stony loam or stony fine sandy loam that is neutral to slightly acid in reaction. The color is very dark grayish-brown in the upper part and pinkish-gray in the lower part. The subsoil is a reddish-brown noncalcareous stony clay. It is about 35 inches thick and grades to partly weathered feldspar bedrock. Stones or coarse fragments comprise from 15 to 40 percent of the surface layers and from 35 to 80 percent of the subsoil.

The Stroupe soils in this association usually occur in a complex pattern with soils of the Pinata series. Stroupe soils are less stony, less sloping, and occupy the more open parts of this complex. These soils have a thin dark brown noncalcareous stony loam surface layer over a dark reddish-brown stony clay subsoil. The subsoil has been leached free of lime in the upper part, but contains a few threads and specks of lime in the lower part. This grades through a very limy massive stony loam or clay loam at a depth of 24 to 40 inches. The content of coarse fragments or stones ranges from about 30 percent in the surface layer to 50 percent in the subsoil.

Fortwingate soils occur on rolling to strongly sloping crests and steep side slopes of ridges in this general soil area. They have a surface layer of light gray to brown noncalcareous stony loam over a reddish-brown heavy clay loam subsoil that is typically calcareous in the lower part. These soils are underlain by sandstone bedrock at an average depth of about 30 inches, but may range from 20 to 40 inches.

Other soils of importance in this association include those of the Erramouspe and Tecolote series. The moderately deep Erramouspe soils commonly occupy steep to very steep south and west facing slopes. They are characterized by a thin very dark gray friable stony loam surface layer and a dark brown to reddish-brown clay loam subsoil. This rests abruptly on partly weathered feldspar bedrock at a depth of about 30 to 40 inches. These soils are noncalcareous or neutral in reaction. The Tecolote soils, which are deep and well drained, occur on strongly sloping to steep mountain slopes. They have a thick gray stony loam surface layer and a reddish-brown stony clay loam subsoil. They are neutral to mildly alkaline in reaction and generally bedrock is not encountered within 40 inches of the surface. Rock Outcrops, Rock Slides, and Stony Alluvial Land, which are the more common land types, also comprise small acreages in this association. The Rock Outcrops include those areas dominated by steep and nearly vertical outcrops of bedrock. The Rock Slides, consisting of loose rock fragments of variable size, usually occur immediately below the steep or nearly vertical outcrops. The Stony Alluvial Land occurs in the narrow valley bottoms and drainageways in this mountainous area. The surface is covered by numerous stones, cobbles, pebbles, and sand. In places, loamy and clayey sediments are intermingled with the coarse fragments or have accumulated in small pockets and areas.

Irrigation Potential. This association is dominated by steep and mountainous topography and offers little or no opportunity for development of irrigated land. In addition to the steep slopes, the soils are generally stony and rocky. All the land in this association has been included in class 6.

20. Deama-Limestone Rock Land association

This association, the largest in the county, consists of an area of about 820,680 acres. It occurs widely distributed throughout the central and southern parts on gently rolling to very steep limestone hills and mountain footslopes. The altitude

Table 4. Soil characteristics and qualities of major soils in each association, Lincoln County, New Mexico

Soil Map Symbol and Soil Association	Dominant Slope Range (percent)	Approximate Percent of Association	Pedologic Classification		Texture ¹
			Subgroup	Family	
1 Reakor-Toyah-Reeves					
Reakor loam	0-5	45	Typic Calciorthid	Fine-loamy, mixed, thermic	Loam
Toyah loam	0-2	15	Fluventic Haplustoll	Fine-loamy, mixed, thermic	cl;loam
Reeves loam	0-5	15	Typic Calciorthid	Fine-loamy, gypsic, thermic	Loam
Other soils and land types		25			
2 Dona Ana-Pajarito-Bluepoint					
Dona Ana fine sandy loam	0-3	30	Typic Haplargid	Fine-loamy, mixed, thermic	fs;lfs
Pajarito fine sandy loam	1-4	25	Typic Camborthisd	Coarse-loamy, mixed, thermic	fs;lfs
Bluepoint loamy fine sand	1-5	20	Typic Torripsamment	Mixed, thermic	lfs;fs
Other soils and land types		25			
3 Marcial-Ubar-Sotim					
Marcial silty clay loam	0-1	30	Typic Camborthisd	Fine, illitic, thermic	scl
Ubar silt loam	0-1	25	Typic Camborthisd	Fine, mixed, thermic	stl;stcl
Sotim clay loam	1-5	15	Typic Calciorthid	Fine-loamy, mixed, thermic	cl;loam
Other soils and land types		30			
4 Nickel-Tenecce					
Nickel gravely sandy loam	0-10	50	Typic Calciorthid	Loamy-skeletal, mixed, thermic	gsl;gl
Tenecce very gravely loam	0-10	20	Typic Paleorthisd	Loamy-skeletal, mixed, thermic, shallow	vg;l;vgs;l
Other soils and land types		30			
5 Rock Land-Lozler-Gilland					
Rock Land	15-75	35	(A miscellaneous land type)		
Lozier stony loam	5-35	35	Lithic Torriorthent	Loamy-skeletal, carbonatic, thermic	stl
Gilland stony loam	5-35	15	Ustochreptic Calciorthid	Loamy-skeletal, mixed, thermic	stl;stsl
Other soils and land types		15			
6 Caliza-Latom-Holloman					
Caliza very gravely sandy loam	5-35	35	Typic Calciorthid	Sandy-skeletal, mixed, thermic	vg;l;gsl
Latom stony sandy loam	0-20	20	Lithic Ustic Torriorthent	Loamy, mixed (calcareous), thermic	stsl;stl
Holloman loam	0-10	20	Typic Torriorthent	Fine-loamy, gypsic, thermic, shallow	Loam
Other soils and land types		25			
7 Ector-Conger					
Ector stony and rocky loams	0-30	60	Aridic Lithic Calciclustoll	Loamy-skeletal, carbonatic, thermic	stl;rl
Conger gravely loam	0-15	20	Ustollic Paleorthisd	Loamy, mixed, thermic, shallow	gl;loam
Other soils and land types		20			
8 Ector-Limestone Rock Land					
Ector stony and rocky loams	10-35	45	Aridic Lithic Calciclustoll	Loamy-skeletal, carbonatic, thermic	stl;rl
Limestone Rock Land	25-65+	40	(A miscellaneous land type)		
Other soils and land types		15			
9 Reagan-Elfrida-Conger					
Reagan loam	0-5	55	Ustollic Calciorthid	Fine-silty, mixed, thermic	Loam
Elfrida silt loam	0-2	15	Pachic Calciclustoll	Fine-loamy, mixed, thermic	Loam;stl
Conger gravely loam	0-10	15	Ustollic Paleorthisd	Loamy, mixed, thermic, shallow	gl;loam
Other soils and land types		15			
10 La Fonda-Alicia					
La Fonda loam	1-9	40	Ustollic Camborthisd	Fine-loamy, mixed, mesic	Loam
Alicia loam	0-5	25	Ustollic Camborthisd	Fine-silty, mixed, mesic	Loam;stl
Other soils and land types		35			
11 Deama-Pastura-Manzano					
Deama stony loam	0-25	65	Aridic Lithic Calciclustoll	Loamy-skeletal, carbonatic, mesic	stl;col
Pastura gravely loam or loam	0-10	15	Ustollic Paleorthisd	Loamy, mixed, mesic, shallow	gl;loam
Manzano loam	0-3	5	Cumullic Haplustoll	Fine-loamy, mixed, mesic	Loam;cl
Other soils and land types		15			
12 Limestone Outcrop					
Limestone Rock Land	35-70+	40	(A miscellaneous land type)		
Laporte stony loam	0-25	30	Aridic Lithic Haplustoll	Loamy, mixed, mesic	stl;col
Deama stony loam	0-35	20	(See association 11)		
Other soils and land types		10			

¹Abbreviations used for textural classes:

fs - fine sand	vg;l - very gravely sandy loam	vgl - very gravely loam	cl - clay loam
ls - loamy sand	vg;fal - very gravely fine sandy loam	stl - stony loam	stcl - silty clay loam
lfs - loamy fine sand	stsl - stony sandy loam	stl - silt loam	gcl - gravely clay loam
sl - sandy loam	gl - gravely loam	scl - sandy clay loam	stc - silty clay
fs;l - fine sandy loam	rl - rocky loam	col - cobbly loam	

Surface Soil Features		Subsoil Features			Substratum	Soil Depth ⁴ (Inches)	AWHC ⁵ (Inches)
Color ²	Reaction	Texture ¹	Color ²	Permeability ³			
brown	Strongly calc.	cl;loam	Light brown	Moderate	Calcareous alluvium	60 or more	7 to 8
dark grayish-brown	Strongly calc.	sol;cl;loam	Light brownish-gray	Moderate	Loamy alluvium	60 or more	7 to 8
pale brown to brown	Strongly calc.	Loam;cl	Pale brown to light gray	Moderate	Gypsiferous earth	20 to 36	4 to 6
light brown	Calcareous	sol;cl	Reddish-brown	Moderate	Soft caliche or limy alluvium	20 to 36	3 to 5
light reddish-brown	Calcareous	fs;l;sl	Light reddish-brown	Rapid	Sandy alluvium	60 or more	4 to 5
light brown	Weakly calc.	fs;lfs;ls	Light brown	Very rapid	Sandy alluvial and eolian sediments	60 or more	2.5 to 4
reddish-brown	Strongly calc.	sl;c;stcl	Reddish-brown	Very slow	Gypsiferous sediments	40 to 60	6 to 7
light yellowish-brown	Strongly calc.	sl;c;stcl	Light brown	Very slow	Clayey alluvium	60 or more	7 to 8
reddish-brown	Strongly calc.	cl	Reddish-brown	Slow	Gravelly alluvium	60 or more	8
light brownish-gray	Strongly calc.	gl;vgl	Light brown	Rapid	Caliche; upper part weakly cemented	15 to 25	2
light brown	Strongly calc.	vg;l;vgl	Pale brown	Rapid	Caliche; platy and indurated in upper part	6 to 20	1 to 2
light brown	Calcareous	st;l;stcl	Light yellowish-brown	Moderate	Limestone bedrock	6 to 20	1 to 3
reddish-brown	Calcareous	stl	Reddish-brown	Moderate	Interbedded sandstone and shale	20 to 40	2 to 4
pale brown	Strongly calc.	vgl	Light gray	Rapid	Gravelly alluvium	10 to 20	2
brown	Calcareous	st;l;stcl	Light reddish-brown	Moderate	Sandstone	6 to 20	1 to 2
pale brown	Calcareous	Loam;cl	Light brownish-gray	Moderate	Gypsiferous earth	4 to 20	1 to 3
grayish-brown	Calcareous	stl	Dark brown	Moderate	Limestone bedrock	4 to 15	1 to 2
grayish-brown	Calcareous	gl;gl	Pale brown	Moderate	Caliche; indurated in upper part	6 to 20	1 to 3
grayish-brown	Calcareous	stl	Dark brown	Moderate	Limestone bedrock	4 to 15	1 to 2
light brownish-gray	Strongly calc.	Loam;cl	Light brown	Moderate	Calcareous alluvium	60 or more	7
grayish-brown to brown	Strongly calc.	st;cl;cl	Brown	Slow	Calcareous alluvium	60 or more	7
grayish-brown	Calcareous	gl;gl	Pale brown	Moderate	Caliche; indurated in upper part	6 to 20	1 to 3
reddish-brown	Weakly calc.	Loam	Light reddish-brown	Moderate	Calcareous alluvium	60 or more	5 to 7
light reddish-brown	Weakly calc.	cl;st;cl	Reddish-brown	Slow	Loamy alluvium	60 or more	7 to 8
grayish-brown to brown	Calcareous	stl	Dark grayish-brown	Moderate	Limestone bedrock	6 to 20	1 to 3
grayish-brown	Calcareous	gl;loam	Pale brown	Moderate	Caliche; indurated in upper part	6 to 20	1 to 3
grayish-brown to dark brown	Non-calc.	cl;loam	Dark grayish-brown	Slow	Loamy alluvium	60 or more	8
dark grayish-brown	Calcareous	stl	Grayish-brown	Moderate	Limestone bedrock	6 to 20	1 to 3

²Colors are for dry soil.

³Permeability classes and approximate rates per hour:

Very slow - less than 0.20 inches

Rapid - 2.00 to 6.30 inches

Slow - 0.20 to 0.63 inches

Very rapid - more than 6.30 inches

Moderate - 0.63 to 2.00 inches

⁴Depth in inches from surface of effective soil

⁵AWHC - Available water-holding capacity (estimated to a depth of 4 feet or for effective soil material if less than 4 feet)

Table 4. Continued

Soil Map Symbol and Soil Association	Dominant Slope Range (percent)	Approximate Percent of Association	Pedologic Classification		Texture ¹
			Subgroup	Family	
13 Harvey-Pastura					
Harvey loam	2-10	30	Ustollic Calciorthid	Fine-loamy, mixed, mesic	Loam;fsl
Pastura gravelly loam or loam	0-10	30	Ustollic Paleorthis	Loamy, mixed, mesic, shallow	gl;loam
Dean loam	0-10	10	Ustollic Calciorthid	Fine-loamy, carbonatic, mesic	Loam
La Fonda loam	0-5	10	Ustollic Camborthis	Fine-loamy, mixed, mesic	Loam;fsl
Other soils and land types		20			
14 Harvey-Pastura-Witt					
Harvey loam	1-15	30	Ustollic Calciorthid	Fine-loamy, mixed, mesic	Loam;fsl
Pastura gravelly loam or loam	0-10	30	Ustollic Paleorthis	Loamy, mixed, mesic, shallow	gl;loam
Witt loam	1-8	15	Ustollic Haplargid	Fine-silty, mixed, mesic	Loam
Other soils and land types		25			
15 Pinon-Redmun-Harvey					
Pinon channery loam	3-25	30	Lithic Ustollic Calciorthid	Loamy, mixed, mesic	chl;
Redmun loam	1-8	15	Aridic Argustoll	Fine, montmorillonitic, mesic	Loam
Harvey loam	0-10	15	Ustollic Calciorthid	Fine-loamy, mixed, mesic	Loam;fsl
Other soils and land types		40			
16 Penistaja-Pinon-Chupadera					
Penistaja fine sandy loam	0-9	25	Ustollic Haplargid	Fine-loamy, mixed, mesic	fsl;lfs
Pinon channery loam	3-25	25	Lithic Ustollic Calciorthid	Loamy, mixed, mesic	chl
Chupadera loamy fine sand	5-15	20	Ustollic Calciorthid	Coarse-loamy, mixed, mesic	lfs
Other soils and land types		30			
17 San Mateo-Glenburg					
San Mateo loam	0-5	35	Ustic Torrifluent	Fine-loamy, mixed, mesic	Loam;cl
Glenburg-like loam	0-5	25	Ustic Torrifluent	Coarse-loamy, mixed, mesic	Loam;fsl
Shanta loam	0-5	15	Cumultic Haplustoll	Fine-loamy, mixed, mesic	Loam;stl;cl
Other soils and land types		25			
18 Caballo-Peso-Supervisor					
Caballo clay loam	10-65+	25	Pachic Cryoboroll	Loamy-skeletal, mixed	cl;cocl
Peso cobbly clay loam	10-65+	20	Typic Haploboroll	Loamy-skeletal	cocl
Supervisor gravelly sandy loam	15-65+	25	Typic Cryoboroll	Loamy-skeletal, mixed	gl
Other soils and land types		30			
19 Pinata-Stroupe-Fortwingate					
Pinata stony loam	20-60	55	Typic Eutroborsf	Clayey-skeletal, mixed	stl;stfsl
Stroupe stony loam	5-50	13	Aridic Argustoll	Clayey-skeletal, mixed, mesic	stl
Fortwingate stony loam	5-40	13	Typic Eutroborsf	Fine, montmorillonitic	stl;stfsl
Other soils and land types		19			
20 Deama-Limestone Rock Land					
Deama stony loam	0-35	50	Aridic Lithic Calcustoll	Loamy-skeletal, carbonatic, mesic	stl;col
Limestone Rock Land	25-85+	30	(A miscellaneous land type)		
Other soils		20			
21 Lava Rock Land					
Rock Land		98	(A miscellaneous land type)		
Other soils		2			

¹Abbreviations used for textural classes:

fs - fine sand	vgsl - very gravelly sandy loam	vgl - very gravelly loam	cl - clay loam
ls - loamy sand	vgfsl - very gravelly fine sandy loam	stl - stony loam	sicl - silty clay loam
lfs - loamy fine sand	stsl - stony sandy loam	sll - silt loam	gel - gravelly clay loam
sf - sandy loam	gl - gravelly loam	scl - sandy clay loam	sic - silty clay
fsl - fine sandy loam	rl - rocky loam	col - cobbly loam	

Surface Soil Features		Subsoil Features				Soil Depth ⁴ (inches)	AWHC ⁵ (inches)
Color ²	Reaction	Texture ¹	Color ²	Permeability ³	Substratum		
Light brown to brown	Calcareous	Loam;sl;cl	Light brown	Moderate	Soft caliche or very limy loam	15 to 20	3 to 4
Light brownish-gray	Calcareous	g;loam	Pale brown	Moderate	Caliche; indurated in upper part	6 to 20	1 to 3
Light brownish-gray	Calcareous	g;loam	Light brownish-gray	Moderate	Soft caliche; may be weakly cemented in upper part	6 to 15	1 to 3
Reddish-brown	Weakly calc.	Loam	Reddish-brown	Moderate	Calcareous alluvium	60 or more	5 to 7
Light brown to brown	Calcareous	Loam;sl;cl	Light brown	Moderate	Soft caliche or very limy loam	15 to 20	3 to 4
Grayish-brown	Calcareous	g;loam	Pale brown	Moderate	Caliche; indurated in upper part	6 to 20	1 to 3
Light brown to brown	Non-calc.	cl	Brown to reddish-brown	Slow	Calcareous alluvium	60 or more	7 to 8
Brown to grayish-brown	Calcareous	chl	Light brown to pinkish-white	Moderate	Limestone bedrock	6 to 20	1 to 3
Brown to dark brown	Non-calc.	Clay	Reddish-brown	Slow	Calcareous alluvium	60 or more	7 to 8
Light brown to brown	Calcareous	Loam;sl;cl	Light brown	Moderate	Soft caliche or very limy loam	15 to 20	3 to 4
Brown	Non-calc.	scl	Light brown to reddish-brown	Moderate	Eolian and alluvial sediments	60 or more	6
Brown to grayish-brown	Calcareous	chl	Light brown to pinkish-white	Moderate	Limestone bedrock	10 to 20	1 to 3
Brown	Weakly calc.	gsl;sl	Grayish-brown	Rapid	Limestone bedrock	24 to 36	2 to 4
Grayish-brown	Calcareous	Loam;sl;cl	Grayish-brown and brown	Moderate	Loamy alluvium	48 to 60 inches or more	7 to 8
Brown to grayish-brown	Calcareous	sl;loam;ifs	Light brownish-gray	Moderate	Loamy and sandy alluvium	48 to 60 inches or more	4 to 7
Brown or grayish-brown	Calcareous	Loam;cl	Brown	Moderate	Loamy alluvium	60 or more	7 to 8
Very dark grayish-brown	Neutral	oco;voco	Brown	Moderate	Limestone bedrock	48 or more	4 to 6
Very dark grayish-brown	Neutral	voco	Dark grayish-brown	Moderate to slow	Limestone bedrock	20 to 40	3 to 5
Dark gray	Neutral	gsl;vsl;vgs	Dark grayish-brown and pale brown	Rapid	Acid igneous rock	20 to 36	4
Dark grayish-brown and pinkish-gray	Neutral	ste	Reddish-brown	Slow	Felsite and sandstone bedrock	36 to 50	4 to 6
Dark brown	Non-calc.	ste	Dark reddish-brown	Slow	Felsite bedrock	24 to 40	3 to 6
Light gray and brown	Neutral	cl;stcl	Reddish-brown	Slow	Sandstone bedrock	20 to 40	3 to 6
Grayish-brown to brown	Calcareous	stl	Dark grayish-brown	Moderate	Limestone bedrock	6 to 20	1 to 3

²Colors are for dry soil.

³Permeability classes and approximate rates per hour:

Very slow - less than 0.20 inches Rapid - 2.00 to 6.30 inches
 Slow - 0.20 to 0.63 inches Very rapid - more than 6.30 inches
 Moderate - 0.63 to 2.00 inches

⁴Depth in inches from surface of effective soil

⁵AWHC - Available water-holding capacity (estimated to a depth of 4 feet or for effective soil material if less than 4 feet)

ranges from about 5000 to 8000 feet, but is most commonly between 5000 and 7000 feet. The soils, which are dominantly shallow, stony, and rocky are generally underlain by limestone bedrock and less commonly by other sedimentary rocks. Moderately deep and deep soils occur to a limited extent in the swales, valley areas, and flood plains contiguous to drainageways.

These soils are used as range for livestock and wildlife. Although the density and amount of forage produced is somewhat restricted on the Limestone Rock Land component of this association, moderate yields of forage are obtained on the Deama and associated soils. Principal native vegetation includes blue grama, sideoats grama, galleta, sand dropseed, muhly species, tridens, three-awns, wolftail, Carruth sagewort, chamiza, and scattered stands of pinyon and juniper trees. A few scattered ponderosa pine also occur at the higher elevations.

Soil Characteristics. Deama soils, the most extensive in the association, commonly occur on rolling uplands. Slopes, however, may range from gently sloping to steep and hilly. These soils have a surface layer of grayish-brown to brown calcareous stony loam. This grades through a dark grayish-brown very stony loam to the underlying limestone bedrock at a depth of 6 to 20 inches. Angular coarse fragments comprise about 25 to 40 percent of the surface layer and as much as 70 percent in the underlying material above the limestone bedrock.

Limestone Rock Land is also an extensive component of this association. It consists dominantly of a complex of very shallow soils and outcrops of limestone. Other types of sedimentary rocks may occur to a very limited extent. It is characterized by numerous rock outcrops, bare ledges, and a large amount of loose rock and stones on the surface. A thin mantle of stony or gravelly materials is common between the outcrops of bedrock. Although it is dominated by shallow soils, small areas of moderately deep and deep soils do occur interspersed with the shallow soils and rock outcrops. It commonly occurs on steep slopes, escarpments, and breaks.

Other soils of importance in this association include those of the Remunda, Ruidoso, Jarita, Pinkel, Pena, Shanta, and Travessilla series. The Remunda and Ruidoso soils occur on nearly level to strongly sloping valley slopes and alluvial fans. They have dark colored clay loam or silty clay loam surface layers and clayey subsoils. They differ in that the Ruidoso soils have thicker dark colored surface layers. The Jarita soils usually occur as small areas on gently sloping to moderately steep

ridge tops, crests, and saddles of low rolling limestone hills. These soils, which have dark colored silt loam surface layers and silty clay loam subsoils, are underlain by limestone bedrock at depths of 20 to 40 inches. The Pinkel soils are forming residually in materials of sandstone and shale origin. These soils, which occur on strongly to steeply sloping and rolling upland ridges and hills have a thin brown noncalcareous cobbly loam surface layer over a very cobbly sandy clay loam subsoil. Depth to bedrock ranges from 10 to 40 inches with the dominant depth ranging from 20 to 40 inches. The Pena soils, like those of the Pinkel series, are cobbly and stony, but differ in that they are forming in alluvium and are not underlain by bedrock within a depth of 60 inches. These soils have dark grayish-brown gravelly and cobbly loam surface layers and light gray cobbly to very cobbly loam subsurface layers which are high in lime. The high lime layers commonly occur within 10 to 30 inches of the surface. Shanta soils, which occur on terminal points of alluvial fans, valley bottoms, and depression areas, also occur to a limited extent in this association. These soils have a thick surface layer of brown or grayish-brown calcareous loam. This is underlain to a depth of five feet or more by loam or light clay loam. A few gravel and cobbles commonly occur in the subsurface layers. The Travessilla soils are shallow gently to moderately steep soils developing on upland ridges and mesas dominated by sandstone. They have a surface layer of brown stony fine sandy loam or stony loam. This is underlain by sandstone bedrock at depths ranging from 4 to 15 inches. In addition to these soils, small acreages of unclassified soils, drainageways, and other miscellaneous land types comprise the remaining parts of this association.

Irrigation Potential. There is essentially no potential for development of irrigated land in this association because of the prevalence of shallow soils, rock outcrops, steep slopes, and rough broken topography. The lands classified as suitable for irrigation are widely distributed and usually occur as small tracts. Approximately 97 percent of the land in this association has been classified as non-irrigable.

21. Lava Rock Land association

This association, which comprises an area of about 55,390 acres, occurs in the southwestern part of the county. In addition to recent lava flows, it includes stony and rocky soils developing in materials of volcanic or basic igneous origin. A

major part of this unit, however, consists of the relatively recent basalt or lava flow, locally known as the Malpais, and located just west of the town of Carrizozo. It consists of a long narrow area ranging in width from less than one mile to slightly more than four miles. The distinctive feature is its extreme rocky and rough broken surface. The basalt rock covering this area is slow to weather, so, the entire area is practically devoid of soil. The small pockets of soil that do occur scattered throughout the area are generally inaccessible to livestock. These small isolated pockets of soil, however, do support a cover of grasses and shrubs which are grazed by wildlife, particularly deer. The Valley of the Fires State Park is located a few miles west of Carrizozo in the area comprising this association.

In addition to the more recent lava flow, a small area adjacent to the Socorro County boundary has also been included in this association. The lava flows in this area are older, and soils have had an opportunity to develop.

The soils, which are variable in depth, generally have a stone or rock mantle over much of the surface. They usually have thin surface layers of brown stony loam over light brown to reddish-brown clay loam subsoils that typically contain numerous coarse fragments of basalt. Basalt bedrock usually occurs within 40 inches of the surface. This part of the association supports a fair cover of native vegetation including such species as blue grama, sideoats grama, sand dropseed, three-awns, ring muhly, and snakeweed.

Irrigation Potential. There is no potential for development of irrigated land in this association. The use of this land is limited to grazing, recreation, and as habitat for wildlife.

Suitability of Soils for Irrigation

In this section the extent, location, and suitability of soils for irrigation, as well as their placement in the various irrigation land classes are discussed. The acreage of irrigable and non-irrigable land in each of the 21 soil associations is shown in table 5. These estimates and percentages of land in each of the five land classes were determined on the basis of the kinds of soils occurring in the soil associations.

In addition to the data given in table 5, the approximate distribution of the various land classes in Lincoln County is shown on the irrigation land class map (figure 2). This map was based on the soil association map (figure 1) and the acreages of land classes in each of the soil associations (table

5). The land class or classes shown comprise more than 75 percent of the delineated area. No land class was shown that did not comprise at least 15 percent or more of the area identified on the map. Where more than one land class is shown, the most extensive class is indicated first, followed in order by those of lesser extent. The small scale of the irrigation land class map precludes the possibility of showing small areas of land with different capabilities for irrigation. For example, the large and extensive areas of class 6 land may contain small tracts of land suitable for irrigation. Because of the limitation of map scale, these small tracts that differ in capability for irrigation are not shown.

The irrigation land classes provide a relative rating of the suitability of land for irrigation. Class 1 land has few or no limitations for irrigation. The limitations for use of land under irrigation increase from 1 through 4 with class 4 having severe limitations for such use. Class 6 land is non-irrigable. An analysis of the irrigation land classification data, as shown in table 5 and figure 2, indicates that the following five soil associations contain a high percentage of land suitable for irrigation:

1. Reakor-Toyah-Reeves association
2. Dona Ana-Pajarito-Bluepoint association
9. Reagan-Elfrida-Conger association
10. La Fonda-Alicia association
17. San Mateo association

These soil associations (figure 1) contain slightly more than 220,200 acres of irrigable land, or about 34 percent of the 651,605 acres of Lincoln County land classified as irrigable. They also contain about 125,750 acres out of the 259,620 acres that were placed in irrigation land classes 1 and 2.

Although each of these five associations contains a high percentage of land classified as suitable for irrigation, they differ significantly in potential for expansion of irrigation. In comparison with the other soil associations, the Reakor-Toyah-Reeves association (No. 1) undoubtedly offers the best possibilities for expansion of irrigated land in Lincoln County. It occurs as a relatively large continuous tract of land that contains only a small percentage of non-irrigable land. It is dominated by class 2 land, which is well-suited for use as irrigated cropland. Approximately 60 percent of this general soil area is in irrigation land class 2; 18 percent in class 6; 11 percent in class 3; and 11 percent in class 4. Slope and unevenness, or undulating nature of the land surface, were the principal features contributing to the placement of the Reakor soils in irrigation land class 2. The Toyah soils, like those of the Reakor series, were also included in

Table 5. Estimated acreage and approximate percentage of land in each irrigation land class by soil association, Lincoln County, New Mexico¹

Soil Map Symbol and Soil Association	Class 1		Class 2		Class 3		Class 4		Classes 1 to 4		Grand Total		Principal Limiting Factor(s)
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Total Acres	Total Percent	Acres	Percent	
1 Breaker-Torah-Reeves Breaker loam Torah loam Reeves loam Other soils and land types Total	39,870		9,968	11	9,968	11	9,324	11	72,632	82	39,870	39	Slope Overflow/drainage Salinity/soil depth
	13,290						3,322		13,290		13,290	13	
			400	2	1,000	—	999	—	2,399	—	4,998	4	
			400	2	11,994	60	4,997	25	17,391	87	2,599	13	
									15,944	18	58,600	58	
2 Dona Ana-Pajarito-Bluepoint Dona Ana fine sandy loam Pajarito fine sandy loam Bluepoint loamy fine sand Other soils and land types Total	5,997		4,997		4,997		3,998		4,997		5,997	5	AWHC*soil depth AWHC*erosion AWHC:slope
							999	—	2,399	—	3,998	3	
			400	2	11,994	60	4,997	25	17,391	87	2,599	13	
									15,944	18	58,600	58	
									15,944	18	58,600	58	
3 Maricel-Ubar-Sottim Maricel silty clay loam Ubar silt loam Sottim clay loam Other soils and land types Total	6,678		6,678	9	11,872	16	22,631	30	41,181	55	17,460	17	Salinity/drainage Salinity/drainage Slope/erosion
									33,019	45	74,200	74	
									33,019	45	74,200	74	
									33,019	45	74,200	74	
									33,019	45	74,200	74	
4 Nickel-Tencoe Nickel gravelly sandy loam Tencoe very gravelly loam Other soils and land types Total	1,400		1,400	4	1,740	5	3,140	9	31,780	91	17,460	17	Soil depth:AWHC Soil depth:AWHC
									31,780	91	34,920	34	
									31,780	91	34,920	34	
									31,780	91	34,920	34	
									31,780	91	34,920	34	
5 Rock Land-Lorier-Gilland Rock Land Lorier stony loam Gilland stony loam Other soils and land types Total	16,597		16,597		16,597		7,113		7,113		16,597	16	Soil and topography Soil depth:AWHC Soil depth:AWHC
									7,113		7,113	7	
									7,113		7,113	7	
									7,113		7,113	7	
									7,113		7,113	7	
6 Caliza-Latom-Holloman Caliza very gravelly sandy loam Latom stony sandy loam Holloman loam Other soils and land types Total	2,575		2,575	2	3,860	3	6,435	5	6,435	5	47,420	47	Soil depth:AWHC Soil depth:AWHC Soil depth:AWHC Soil depth:AWHC
									6,435	5	128,750	128	
									6,435	5	128,750	128	
									6,435	5	128,750	128	
									6,435	5	128,750	128	
7 Ector-Conger Ector stony and rocky loams Conger gravelly loam Other soils and land types Total	2,100		2,495	4	2,797	4	2,797	4	7,392	12	36,550	36	Soil depth:slope Soil depth:AWHC
									7,392	12	12,185	12	
									7,392	12	12,185	12	
									7,392	12	12,185	12	
									7,392	12	12,185	12	
8 Ector-Limestone Rock Land Ector stony and rocky loams Limestone Rock Land Other soils and land types Total	1,672		1,672	2	1,671	2	2,510	3	5,853	7	37,629	37	Soil depth:slope Soil and topography
									5,853	7	33,448	33	
									5,853	7	33,448	33	
									5,853	7	33,448	33	
									5,853	7	33,448	33	

¹Percentages are of association except grand total, which is percent of county

*AWHC is abbreviation for available water-holding capacity

Table 5. Continued

Soil Map Symbol and Soil Association	Class 1		Class 2		Class 3		Class 4		Classes 1 to 4		Class 6		Grand Total		Principal Limiting Factor(s)
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Total	Acres	Percent	Acres	Percent	Acres	
9 Roazan-Elfrida-Conger															
Isagan loam	4,840		2,605						7,445					7,445	Slope
Elfrida silt loam	2,030							2,030						2,030	
Conger gravelly loam			1,350				405		1,755		2,030			2,030	Soil depth;AWHC
Other soils and land types	6,870	51	3,855	29			405	3	11,230	83	2,300	17		13,530	**
Total															
10 La Fonda-Allecia															
La Fonda loam	9,224		27,672						36,896					36,896	Slope;erosion
Allecia loam	9,224		13,836				2,767		23,060		24,905			32,264	Overflow;erosion
Other soils and land types	4,512				41,508	45	2,767	3	7,379		24,905	27		92,240	3
Total	23,660	25	41,508	45			2,767	3	67,335	73	24,905	27		92,240	
11 Desama-Pastura-Manzano															
Desama stony loam									34,935					104,800	Soil depth;AWHC
Pastura gravelly loam or loam									34,935					104,800	Soil depth;AWHC
Manzano loam	34,935								34,935					34,935	Overflow;erosion
Harvey loam									27,950		41,920			69,870	AWHC;slope
Other soils and land types									27,950					69,870	
Total	34,935	5	62,885	9					97,820	14	600,860	86		698,680	22
12 Limestone Outcrop															
Limestone Rock Land									35,430					35,430	Soil and topography
Laporte stony loam									26,570					26,570	Soil depth;AWHC
Desama stony loam							1,770		17,715					17,715	Soil depth;AWHC
Other soils and land types	885	1							2,655		6,200			8,855	
Total	885	1	1,770	2					2,655	3	85,915	97		89,570	3
13 Harvey-Pastura															
Harvey loam									42,785					42,785	AWHC;slope
Pastura gravelly loam or loam									42,785					42,785	Soil depth;AWHC
Dean loam	9,880		4,280						14,260		14,260			14,260	Soil depth;AWHC
La Fonda loam	7,130								14,260					14,260	Slope
Other soils and land types	17,110	12	54,195	38					71,305	50	15,260	10		29,520	
Total	17,110	12	54,195	38					71,305	50	71,305	50		142,610	5
14 Harvey-Pastura-Whit															
Harvey loam									43,194					43,194	Slope;AWHC
Pastura									43,194					43,194	Soil depth;AWHC
Whit loam	16,357		3,240						21,597		23,035			35,995	Slope
Other soils and land types	4,320		8,640						12,960		86,229	46		143,980	5
Total	22,677	16	44,275	31					77,751	54	86,229	46		143,980	5
15 Pinon-Redum-Harvey															
Pinon channery loam									44,418					44,418	Soil depth;slope
Redum loam	13,330		8,888						22,218					22,218	Slope
Harvey loam									22,200					22,200	AWHC;slope
Other soils and land types	4,440								11,845		47,379			59,224	
Total	17,770	12	31,088	21					7,405	5	56,263	38		91,797	62
									91,797	62				148,060	5

**Less than .05 percent

Table 5. Continued

Soil Map Symbol and Soil Association	Class 1		Class 2		Class 3		Class 4		Classes 1 to 4 Total		Class 6		Grand Total*		Principal Limiting Factor(s)
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	
16 Pininfaja-Pinac-Chapudera															
Pentafaja fine sandy loam	15,815		5,270						21,085				21,085		Slope
Pinac clayey loam					3,370		9,434		11,804		21,085		21,085		Soil depth;slope
Chapudera toony fine sand					5,640		5,434		11,074		16,868		16,868		AWHC;slope;depth
Other soils and land types									37,859		25,302		25,302		
Total	15,815	19	5,270	10	3,370	10	9,434	10	37,859	39	51,451	61	84,340	3	
17 San Mateo-Glenburg															
San Mateo loam	4,965								19,862				19,862		Slope;overflow
Glenburg-like loam	14,188								14,188				14,188		Slope;AWHC
Suanta loam	4,256				4,266				8,522				8,522		Slope
Other soils and land types					5,673		3,405		9,078		5,108		14,188		
Total	4,965	9	33,341	59	3,931	17	3,405	6	51,642	91	5,108	9	56,750	2	
18 Chuallo-Peño-Supervisor															
Chuallo clay loam															
Peño cobbly clay loam															
Supervisor gravelly sandy loam	950		3,100						4,050				4,050		Slope
Other soils and land types															Slope;stones;AWHC
Total	950	**	3,100	2					4,050	2	200,670	98	204,720	7	
19 Pinata-Stroupe-FortWingate															
Pinata stony loam															
Stroupe stony loam															
FortWingate loam															
Other soils and land types															
Total															
20 Deama-Limestone Rock Land															
Deama stony loam															
Limestone Rock Land															
Other soils and land types	8,207		16,414						24,621				24,621		Soil depth;AWHC
Total	8,207	1	16,414	2					24,621	3	796,059	97	829,680	26	
21 Lava Rock Land															
Rock Land															
Other soils															
Total															
Grand Total	13,935	**	245,685	8	314,571	10	77,414	3	651,605	21	2,458,195	79	3,109,800	2	

class 2. These soils, which occupy low positions, were so classified primarily because of drainage, overflow, and erosion hazards.

The Dona Ana-Pajarito-Bluepoint association (No. 2), which includes a small area in the southwestern part of the county, also offers some opportunity for expansion of irrigation. This is particularly true if the irrigable land in this association is developed for irrigation in conjunction with that of the adjacent Reakor-Toyah-Reeves association. It is, however, dominated by classes 3 and 4 lands that have moderate to severe limitations for such use. Sixty percent of these lands were placed in irrigation land class 3; 25 percent is in class 4; 2 percent is in class 2; and 13 percent is non-irrigable, or in class 6. The irrigable lands in this association were placed dominantly in classes 3 and 4 because of the sandy soil texture, limited moisture retention capacity, and unevenness of the land surface. Wind erosion is a hazard, and careful management will be needed to minimize damage by wind.

The Reagan-Elfrida-Conger association (No. 9), which is another of the small associations, also contains a high percentage of land classified as irrigable. Approximately 51 percent of the land in this unit is in class 1; 29 percent is class 2; 3 percent is class 4; and the remaining 17 percent is non-irrigable, or in class 6. Therefore on the basis of soils and suitability of land for irrigation these lands have a potential for irrigation. However, in contrast to the two previously discussed associations, a considerable part of the land in this general soil area occurs as relatively small irregular tracts interspersed with non-irrigable lands. The cost and difficulty of transporting irrigation water to these small and isolated tracts will undoubtedly restrict their use for this purpose.

Approximately 73 percent of the land in the La Fonda-Alicia association (No. 10) has been classified as suitable for irrigation. About 45 percent is in class 3; 25 percent is in class 2; and the remaining 3 percent is in class 4. Although the irrigable land in this association, in general, has moderate limitations for use under irrigation, it offers a fair potential for expansion of irrigation in Lincoln County. The land surface, which is usually undulating and sloping, will require considerable leveling and land preparation before it can be profitably used for irrigation. The interspersed non-irrigable land (27 percent), will place some restrictions on the size of tracts that can be developed for irrigation.

Although most of the soils in the San Mateo association (No. 17) are well suited to irrigation, there is only limited opportunity for expansion of irrigated land in this association, because of its

small size and because much of the irrigable land is already irrigated or in built-up areas. Approximately 59 percent is in class 2; 17 percent in class 3; 9 percent in class 1; 6 percent in class 4; and the remaining 9 percent in non-irrigable, or in class 6.

In addition to these five associations, the Harvey-Pastura (No. 13), Harvey-Pastura-Witt (No. 14), Pinon-Rednun-Harvey (No. 15), and the Penistaja-Pinon-Chupadera (No. 16) associations also contain moderate acreages of land classified as suitable for irrigation. The percentage of irrigable land ranges from about 38 percent in the Pinon-Rednun-Harvey association to 54 percent in the Harvey-Pastura-Witt association. Although these four soil associations contain about 73,300 acres of class 2 land and 138,200 acres of class 3 land, there is only limited opportunity for development of irrigated land. This limited potential is due primarily to the small size and wide distribution of these irrigable lands with extensive areas of class 6 lands. The difficulty and expense of transporting irrigation water to these irrigable lands will undoubtedly tend to preclude their use for this purpose.

In the remainder of the soil associations, the characteristics of the soils and related land features are such that there is little or no opportunity for development of irrigated land. The small acreage of soils classified as suitable for irrigation commonly occurs in very small tracts intermingled with extensive areas of non-irrigable lands.

The Marcial-Ubar-Sotim (No. 3) association is the only one of these 12 remaining soil associations that contains an appreciable acreage of land classified as irrigable. The soils classified as irrigable, however, generally have a low capability for such use. They are fine-textured and usually occupy low positions where they are susceptible to accumulation of salts and development of poor drainage. Because of these problems, or those inherent in the irrigation of these soils, the opportunity for any significant increase of irrigated land in this association is limited.

Of the 651,605 acres of land in Lincoln County classified as suitable for irrigation, about 2 percent is class 1; 38 percent is class 2; 48 percent is class 3; and 12 percent is class 4.

Suitability of Soils for Engineering and Related Uses

In this section information is provided on engineering properties and uses of soils as construction material and as support for various kinds of structures. The information provided is in tabular form and in accordance with soil associations shown on

the small-scale soil map (figure 1). Selected engineering properties, engineering classifications, and estimates on the suitability of soils for specified engineering uses are indicated for the major soils in each soil association. This correlation of engineering data and soil properties according to soil associations or general soil areas can be useful in estimating the suitability of certain areas for engineering purposes. The information on general soil problems, limitations, and hazards can also be helpful in the selection of areas for various engineering structures or practices.

The data presented here will not eliminate the need for on-site sampling and testing of sites for design and construction of specific engineering works and uses. This is particularly true at those sites of specific engineering works involving heavy loads or where excavations are deeper than the soil depths reported here. In addition, the general soil map does not delineate or specifically show the location of the individual kinds of soil.

The general soil map is useful, however, for planning more detailed investigations and for suggesting the kinds of problems that may be expected in each of the soil associations.

Engineering Soil Groups and Estimated Soil Properties

Estimates of selected soil properties and engineering groups of importance in engineering are given in table 6. Information taken from the detailed soil surveys, knowledge of the soil types of the county, and a limited amount of laboratory test data were used as a basis for making these estimates.

A brief explanation of some of the terms used in table 6 follows:

The "USDA texture" is determined by the relative proportions of sand, silt, and clay in the soil mass. It is the standard procedure used by the U.S. Department of Agriculture to classify soils according to texture.

Highway engineers generally classify soil material in accordance with the system approved by the American Association of State Highway Officials.⁹ In this system (AASHO), classification is based on the gradation, liquid limit, and plasticity index of the soil. Highway performance has been related to this system of classification. All soil materials are classified in seven principal groups. The groups range from A-1 (gravelly soils of high bearing

capacity, the best soils for subgrades) to A-7 (clay soils having low strength when wet, and the poorest soils for subgrades).

Many engineers prefer to use the Unified soil classification system established by the Waterways Experiment Station, Corps of Engineers.¹⁰ This system is based on identification of soils according to their texture and plasticity and their performance as engineering construction materials. Soil materials are identified as coarse grained (8 classes), fine grained (6 classes), or highly organic.

The estimated percentage of soil material passing sieves No. 4, No. 10, and No. 200 is in the columns headed by these sieve numbers. The percentage of material as given reflects the normal range for the soil series, and most soils within a series will fall within the range indicated.

Permeability as indicated in table 7 relates to the rate water moves through undisturbed and uncompacted soil. The estimates are based on the texture, structure, and porosity of the soil.

Shrink-swell potential is an indication of the volume change to be expected of the soil material with changes in moisture content. Shrinking and swelling of soils cause much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates hazards to the maintenance of structures constructed in, on, or with such materials.

Engineering Interpretations

Table 7 indicates the relative suitability of soils to support various structures, to serve as construction materials for highways, farm facilities, and other engineering structures, to absorb sewage effluent, and to serve for other engineering purposes. Also listed are soil features or properties that might present difficulties or affect such uses. Although soil features restricting the use of soils for various engineering structures are emphasized, favorable soil features may also be listed. The ratings and other interpretations in this table are based on the estimated soil properties for engineering uses as listed in table 7, on available test data, and field experience.

Topsoil is a term used to designate a fertile soil or soil material of favorable texture, structure, and organic matter content used as a topdressing for lawns, roadbanks, and various other engineering structures. The ratings of poor, fair, or good

⁹American Association of State Highway Officials, 1955 Standard Specifications for Highway Materials and Methods of Sampling and Testing, Ed. 7, part 1, 257 pp., illus.

¹⁰Waterways Experiment Station, Corps of Engineers, 1953 The Unified Soil Classification System, Tech. Memo. 3-357, 2 V. and appendix.

Table 6. Engineering soil groups and estimated soil properties, Lincoln County, New Mexico

Soil Map Symbol and Soil Association	Depth from surface in.	USDA texture	Classification	Unified	AASHTO	Percentage Passing Sieve--			Shrink-swell potential	
						No. 4 (4.75mm)	No. 10 (2.0mm)	No. 200 (0.075mm)		
						Permeability in/hr	in			
1 Reaker-Toyrah-Reeves Reaker Toyrah Reeves	0-28	Loam		ML	A-4	100	95-100	60-75	0.63-2.00	Low
	28-60	Clay loam		CL	A-6	100	100	65-80	0.63-2.00	Moderate
	0-8	Loam		ML	A-4	100	100	55-75	0.63-2.00	Low
	8-20	Sandy clay loam		SC or CL	A-6	100	100	40-60	0.63-2.00	Low to moderate
	20-60	Clay loam		CL or ML	A-6	100	100	60-80	0.63-2.00	Moderate
	0-8	Loam		ML or CL	A-4	100	100	55-70	0.63-2.00	Low
	8-32	Clay loam		CL	A-6	100	100	60-75	0.63-2.00	Moderate
	0-6	Fine sandy loam		SM	A-2	95-100	95-100	25-35	2.00-6.30	Low
	6-25	Sandy clay loam		SC	A-6	95-100	95-100	35-50	0.63-2.00	Low to moderate
	25+	Soft caliche								
2 Dona Ana-Pajarito-Bluepoint Pajarito Bluepoint Marcial-Ubar-Sotim	0-10	Fine sandy loam		SM	A-2	95-100	95-100	20-35	2.00-6.30	Low
	10-60	Fine sandy loam		SM	A-4	95-100	95-100	35-50	2.00-6.30	Low
	0-60	Loamy fine sand		SM	A-2	95-100	95-100	10-25	> 6.30	Low
	0-52	Silty clay or silty clay loam; K/psiferous sediments		CL or MH	A-6 or A-7	100	100	75-95	< 0.20	Moderate to high
	3-60	Silty clay or silty clay loam		CL or MH	A-6 or A-7	100	100	75-95	< 0.20	Moderate to high
4 Nickel-Tencece Nickel Tencece	0-50	Clay loam		CL	A-6	100	100	65-90	0.20-0.63	Moderate
	50-60	Gravelly sandy loam		SM	A-2	75-85	70-85	20-30	0.63-2.00	Low
	0-15	Gravelly sandy loam		SM	A-2 or A-4	75-85	70-85	20-45	2.00-6.30	Low
	15-40	Very gravelly loam		GM	A-1	35-50	35-50	15-25	> 6.30**	Low
	0-8	Very gravelly loam		GM	A-1	35-50	35-50	15-25	2.00-6.30	Low
	8+	Gravelly caliche; upper part strongly cemented								
	(No estimates made)									
	0-14	Stony loam		SM	A-4	65-85	60-80	35-45	0.63-2.00	Low
	14+	Limestone bedrock								
	0-28	Stony loam		GM or CL	A-1	35-50	30-45	15-25	0.63-2.00	Low
5 Rock Land-Iozier-Gilland Rock Land Lozier Gilland	28+	Interbedded sandstone and shale								
	0-36	Very gravelly sandy loam		GM	A-1 or A-2	35-50	20-35	10-20	> 6.30	Low
	36-60	Very gravelly sand		GM-GW	A-1	35-50	15-35	5-15	> 6.30	Low
	0-5	Stony sandy loam		SM	A-4	80-90	75-85	35-50	0.63-2.00	Low
	5-9	Stony sandy clay loam		SM	A-2	75-85	65-80	30-45	0.63-2.00	Low
	9+	Sandstone bedrock								
	0-9	Loam		ML or CL	A-4	100	100	60-75	0.63-2.00	Low
	9+	Oypsisiferous earth								
	0-6	Stony loam		SM or ML	A-4	55-85*	50-80*	35-60*	0.63-2.00	Low
	6+	Limestone bedrock								
6 Calira-Latom-Holloman Calira Latom Holloman	0-9	Gravelly loam		SM	A-4 or A-2	75-85*	60-85*	25-45*	0.63-2.00	Low
	9+	Indurated caliche								
	9+									
7 Ector-Conger Ector Conger	0-6	Stony loam		SM or ML	A-4	55-85*	50-80*	35-60*	0.63-2.00	Low
	6+	Limestone bedrock								
	0-9	Gravelly loam		SM	A-4 or A-2	75-85*	60-85*	25-45*	0.63-2.00	Low

*Fragments larger than 3 inches included in estimates

**May occasionally be moderately slow because of lime cementation

Table 6. Continued

Soil Mfg Symbol and Soil Association	Depth from Surface in.	USDA texture	Classification	Unified	AASHC	Percentage Passing Sieve--			Shrink-swell Potential
						No. 4 (4.7mm)	No. 10 (2.0mm)	No. 200 (0.075mm)	
8 Estor-Limestone Rock Land	0-6	Sandy loam	SM or ML	A-4	55-85*	50-80*	35-60*	0.63-2.00	Low
Estor	6+	Limestone bedrock							
		(A miscellaneous land type - no estimates made)							
9 Reagan-Elfrida-Conger	0-26	Loam	ML	A-4	100	100	60-75	0.63-2.00	Low
Reagan	26-60	Clay loam	CL	A-6	100	100	65-85	0.63-2.00	Moderate
Elfrida	0-12	Silt loam	ML or CL	A-4	100	100	65-85	0.63-2.00	Low
	12-60	Silty clay loam	CL	A-6	100	100	70-95	0.20-0.63	Moderate
Conger	0-9	Gravelly loam	SM	A-4	75-85*	60-85*	35-50*	0.63-2.00	Low
	9+	Inhorted caliche							
10 La Fonda-Alicia	0-9	Loam	ML	A-4	100	100	60-85	0.63-2.00	Low
La Fonda	9-22	Heavy loam	CL	A-6	100	100	85-95	0.63-2.00	Low to moderate
	22-60	Loam	ML or CL	A-4 or A-6	95-100	95-100	60-95	0.63-2.00	Low
Alicia	0-6	Silt loam	ML	A-4	100	100	70-90	0.63-2.00	Low
	6-28	Silty clay loam	CL	A-6	100	100	80-95	0.20-0.63	Moderate
	28-60	Silt loam	ML or CL	A-4 or A-6	100	100	60-80	0.20-0.63	Low
11 Deama-Pastura-Manzano	0-9	Sandy loam	SM or SC	A-4	50-70*	45-65*	35-50*	0.63-2.00	Low
Deama	9+	Limestone bedrock							
Pastura	0-9	Gravelly loam	ML or CL	A-4 or A-6	65-80*	60-75*	50-65*	0.63-2.00	Low
	9+	Inhorted caliche							
Manzano	0-12	Loam	ML	A-4	100	100	60-80	0.63-2.00	Low
	12-50	Light clay loam	CL	A-6	100	100	70-95	0.20-0.63	Moderate
12 Limestone Outcrop	0-9	Sandy loam	SM or ML	A-4	50-70*	45-65*	35-50*	0.63-2.00	Low
Laporis	9+	Limestone bedrock							
		(A miscellaneous land type - no estimates made)							
13 Harvey-Pastura	0-12	Loam	ML or CL	A-4 or A-6	100	100	50-60	0.63-2.00	Low
Harvey	12-27	Clay loam	CL	A-6	100	100	70-80	0.63-2.00	Moderate
	27-60	Sandy clay loam	ML or CL	A-4 or A-6	100	100	50-60	0.63-2.00	Low to moderate
Pastura	0-9	Gravelly loam	ML or CL	A-4 or A-6	65-80*	60-75*	50-65*	0.63-2.00	Low
	9+	Inhorted caliche							
14 Harvey-Pastura-Whit	0-12	Loam	ML or CL	A-4 or A-6	100	100	50-60	0.63-2.00	Low
Harvey	12-27	Clay loam	CL	A-6	100	100	70-80	0.63-2.00	Moderate
	27-60	Sandy clay loam (limy)	ML or CL	A-4 or A-6	100	100	50-60	0.63-2.00	Low to moderate
Pastura	0-9	Gravelly loam	ML or CL	A-4 or A-6	65-80*	60-75*	50-65*	0.63-2.00	Low
	9+	Inhorted caliche							
Whit	0-8	Loam	ML	A-4	100	100	60-75	0.63-2.00	Low
	8-23	Clay loam	CL	A-6	100	100	70-80	0.20-0.63	Moderate
	23-37	Sandy clay loam	ML or CL	A-4	100	100	60-75	0.63-2.00	Moderate
	37-60	Loam	ML or CL	A-4	100	100	60-75	0.63-2.00	Low to moderate

Table 6. Continued

Soil Map Symbol and Soil Association	Depth from Surface	USDA texture	Classification	AASHTO	Percentage Passing Sieve—			Range in Permeability in/hr	Shrink-swell Potential
					No. 4 (4.75mm)	No. 10 (2.0mm)	No. 200 (0.075mm)		
15 Pihon-Hedum-Harvey									
Pihon	0-15	Chansery loam	ML or CL	A-4 or A-6	55-85*	50-80*	0.63-2.00	Low	
.	15+	Limestone bedrock	ML	A-4	100	60-75	0.63-2.00	Low	
.	0-10	Loam	CL	A-6	100	70-80	0.20-0.63	Moderate	
.	10-21	Clay loam	CL or CH	A-6 or A-7	100	75-85	0.20-0.63	High	
.	21-42	Clay	ML or CL	A-4 or A-6	100	90-90	0.63-2.00	Moderate	
.	3-12	Clay loam	CL	A-6	100	70-80	0.63-2.00	Moderate	
.	12-27	Sandy clay loam	CL	A-6	100	90-90	0.63-2.00	Low to moderate	
.	27-60								
16 Penitajala-Pihon-Chupadera									
Penitajala	0-5	Fine sandy loam	SM or ML	A-4	100	45-60	2.00-4.30	Low	
.	5-30	Sandy clay loam	CL	A-6	100	50-75	0.63-2.00	Low to moderate	
.	30-60	Fine sandy loam	ML or CL	A-4 or A-6	100	50-65	0.63-2.00	Low	
.	0-15	Chansery loam	ML or CL	A-4 or A-6	55-85*	50-80*	0.63-2.00	Low	
.	15+	Limestone bedrock	SM	A-4	100	95-100	2.00-4.30	Low	
.	0-18	Loamy fine sand	SM	A-4	100	75-85*	2.00-4.30	Low	
.	16-24	Fine sandy loam	SM	A-4	75-85*	70-85*	2.00-4.30	Low	
.	24+	Fractured limestone bedrock							
18 Cahallo-Pase-Supervisor									
Cahallo	0-10	Clay loam	CL	A-6	85-95	80-90	0.63-2.00	Moderate	
.	10-36	Cobbly clay loam	CL	A-6	75-85	70-80	0.63-2.00	Moderate	
.	36-64	Very cobbly clay loam	CL	A-6	80-90	75-85	0.63-2.00	Low	
.	64+	Bedrock							
.	0-16	Very cobbly clay loam	CL	A-6	80-90	75-85	0.20-0.63	Low to moderate	
.	16-32	Very cobbly clay loam	CL	A-6	80-90	75-85	0.20-0.63	Low to moderate	
.	32+	Bedrock							
.	0-10	Gravelly sandy loam	SM	A-2	60-75	50-65	2.00-4.30	Low	
.	10-23	Very gravelly sandy loam	SM	A-2	60-75	50-65	2.00-4.30	Low	
19 Pihata-Sroupe-Portwingate									
Pihata	0-12	Loam	ML	A-4	100	100	0.63-2.00	Low	
.	12-60	Stratified loam, scl, sl and cl	SM	A-2 or A-4	100	100	0.63-2.00	Low to moderate	
.	0-10	Fine sandy loam	SM	A-2 or A-4	100	100	2.00-4.30	Low	
.	10-60	Stratified sandy loams and loams	ML or SM	A-4	100	100	0.63-2.00	Low	
.	0-10	Sony loam	GC or SC	A-6	40-45*	35-50*	0.63-2.00	Moderate to high	
.	10-45	Sony loam	ML	A-4	55-75*	45-55*	0.20-0.63	Moderate to high	
.	45+	Bedrock							
.	0-7	Sony loam	GM or SM	A-4	45-65*	40-55*	0.63-2.00	Low	
.	7-25	Sony clay	SC or CL	A-6 or A-4	50-70*	45-65*	0.20-0.63	Moderate to high	
.	25+	Bedrock							
.	0-10	Sony loam	SM or ML	A-4	55-70*	55-65*	0.63-2.00	Low	
.	10-30	Sony clay loam	CL or CH	A-6 or A-7	70-80*	65-75*	0.20-0.63	Moderate to high	
.	30+	Sandstone bedrock							
20 Deama-Limestone Rock Land									
Deama	0-9	Sony loam	SM	A-4	50-70*	45-65*	0.63-2.00	Low	
.		(No estimates made)							
.		Limestone Rock Land							
.		(No estimates made)							
21 Lava Rock Land									

Table 7. Interpretation of soil properties for engineering uses, Lincoln County, New Mexico

Soil Map Symbol and Soil Association	Suitability as a Source of --		Degree of Limitation for Septic Tank Filter Fields	Corrosion Potential (untreated steel pipe)
	Topsoil	Roadfill		
1 Reakor-Toyah-Reeves Reakor loam	Fair; moderately alkaline	Fair	Moderate; moderately slow to moderate permeability	Moderate
Toyah loam	Fair to good to a depth of 12 to 15 inches	Fair	Moderate; overflow hazard; moderate permeability	Moderate
Reeves loam	Fair; moderately alkaline	Poor to fair	Moderate; gypsiferous materials at 20 to 36 inches	High
2 Dona Ana-Pajarito-Bluepoint Dona Ana fine sandy loam	Fair to poor; sandy and erodible	Fair material when mixed to a depth of about 30 inches	Moderate; moderately permeable	Moderate
Pajarito fine sandy loam	Fair to poor; sandy and erodible	Good to fair	Slight; rapidly permeable	Low
Bluepoint loamy fine sand	Poor; very sandy and erodible	Good	Slight	Low
3 Marcial-Ubar-Sotiza Marcial silty clay loam	Poor; clayey; saline	Poor	Severe; slow permeability	High
Ubar silt loam	Poor; clayey and silty; saline	Poor	Severe; slow permeability	High
Sotiza clay loam	Fair to poor	Poor	Severe; moderately slow permeability	Moderate
4 Nickel-Tencee Nickel gravelly sandy loam	Poor; high gravel content	Good	Slight to moderate; slope	Low to moderate
Tencee very gravelly loam	Poor; calcareous and high gravel content	Good; caliche layer may require crushing	Severe; shallow to strongly cemented caliche	Moderate
5 Rock Land-Lozier-Gilland Rock Land	(No interpretations made)			
Lozier stony loam	Poor; stony and rocky	Poor; stony and rocky; limited amount of material	Severe; shallow to limestone bedrock; steep slopes	Moderate
Gilland stony loam	Poor; stony	Fair; stony; amount of material limited	Severe; bedrock at 20 to 40 inches; strongly sloping to steep	Moderate
6 Caliza-Latom-Holloman Caliza very gravelly sandy loam	Poor; gravelly	Good	Slight to moderate; strongly sloping to steep	Low to moderate
Latom stony sandy loam	Poor; coarse fragments	Fair to good; limited amount of material; shallow to rock	Severe; shallow to bedrock	Low
Holloman loam	Poor; saline and alkaline	Poor; unstable material	Severe; less than 20 inches to gypsum or gypsiferous earth	High

*Unsuitable or practice not applicable

Foundation support	Highway location	Soil Features Affecting --			Terraces, diversions, contour furrows and pitting
		Farm ponds		Embankments	
		Reservoir area			
Low to moderate shrink-swell; fair bearing capacity and shear strength	Moderate stability at high moisture content	Moderately slow permeability below 30 inches; may need compaction	Calcareous material; difficult to vegetate	Difficult to vegetate; fairly stable if compacted	
Good bearing capacity; fair shear strength	Overflow hazard; some gullies	Overflow hazard; may require compaction	Fair stability if compacted	Flooding hazard; some gullies	
Poor to fair bearing capacity and shear strength; moderate shrink-swell	Gypsiferous materials at 20 to 36 inches	Poor; subject to seepage; solution holes in crevices	Limited material; gypsiferous material at 20 to 40 inches	Gypsiferous materials	
Good bearing capacity and shear strength; low to moderate shrink-swell	Limy material at 18 to 30 inches; erodible and difficult to vegetate if exposed	Limy material at 18 to 30 inches; may require compaction and sealing	Fair stability if compacted; limy material; difficult to vegetate	Surface layers sandy and erodible; limy material; difficult to vegetate if exposed	
Good if confined	Erodible when exposed on embankments; some drifting sand	Porous and permeable material	Sandy and porous material; highly erodible	*	
Good bearing capacity; low shrink-swell; fair shear strength	Erodible when exposed on embankments	Very permeable; subject to seepage	Sandy and erodible	*	
Fair to poor bearing capacity and shear strength; moderate to high shrink-swell	Unstable at high moisture content	Subject to seepage; solution of gypsum can cause leakage	Clayey material; poor compaction characteristics	Clayey material; subject to erosion and siltation	
Fair to poor bearing capacity and shear strength; moderate to high shrink-swell	Unstable at high moisture content	Solution of gypsum may cause some seepage	Clayey material; poor compaction characteristics	Clayey material; subject to erosion and siltation	
Fair bearing capacity and shear strength	Unstable at high moisture content	Features generally favorable; gravel strata below 50 inches	Moderately fine-textured material; fair to poor compaction characteristics	Subject to erosion and siltation unless protected by vegetation	
Good bearing capacity and shear strength; low shrink-swell	Moderately sloping; some cuts and fills	Subject to seepage; permeable and gravelly	Gravelly and cobbly material; fair stability if compacted	Moderate slopes; gravelly and cobbly material; difficult to vegetate	
Good bearing capacity; shallow to caliche; indurated in upper part	Moderately sloping; some cuts and fills; indurated caliche at 6 to 20 inches	*	Gravelly and porous material	*	
Shallow to bedrock	Shallow to limestone bedrock; steep slopes	*	Stony and rocky material; limited amount of material	*	
Good bearing capacity; fair shear strength; bedrock at 0 to 40 inches	Strongly sloping to steep; interbedded sandstone and shale at 20 to 40 inches	*	Stony material; interbedded sandstone and shale at 20 to 40 inches	*	
Good bearing capacity; low shrink-swell	Strongly sloping to steep; very gravelly material	Material too porous to hold water	Gravelly and very permeable	*	
Shallow to bedrock; good bearing capacity	Moderate slope; shallow to bedrock; some rock outcrops	*	*	*	
Good bearing capacity and shear strength; gypsiferous material within 20 inches of surface	Gypsum or gypsiferous earth at 4 to 20 inches; unstable material	Poor; subject to seepage, solution holes, and crevices	Gypsiferous material; poor stability	Gypsiferous material; erodible and subject to siltation	

Table 7. Continued

Soil Map Symbol and Soil Association	Suitability as a Source of --		Degree of Limitation for Septic Tank Filter Fields	Corrosion Potential (untreated steel pipe)
	Topsoil	Roadfill		
7 Ector-Conger Ector stony loam	Poor; high content of gravel and cobble	Fair; amount of material very limited; stony	Severe; shallow to limestone bedrock	Moderate
Conger gravelly loam	Poor; calcareous and gravelly	Fair; caliche within 20 inches; may require crushing	Severe; shallow to indurated caliche	Moderate
8 Ector-Limestone Rock Land Ector stony loam	Poor; high content of gravel and cobble	Fair; amount of material very limited; stony	Severe; shallow to limestone bedrock	Moderate
Limestone Rock Land	(A miscellaneous land type)			
9 Reagan-Elfrida-Conger Reagan loam	Fair; moderately alkaline	Fair	Moderate; permeability moderate	Moderate
Elfrida silt loam	Fair to good; moderately alkaline and silty	Poor; plastic materials	Moderate; subject to occasional flooding; slow permeability	Moderate
Conger gravelly loam	Poor; calcareous and gravelly	Fair; caliche within 20 inches; may require crushing	Severe; shallow to indurated caliche	Moderate
10 La Fonda-Alicia La Fonda loam	Fair; erodible	Fair	Slight to moderate; moderately permeable	Moderate
Alicia loam	Fair to a depth of 6 to 10 inches; silty and erodible	Poor	Severe; slow permeability	Moderate
11 Deama-Pastura-Manzano Deama stony loam	Poor; high content of cobble	Fair to poor; amount of material very limited; stony	Severe; shallow to limestone bedrock	Moderate
Pastura gravelly loam	Poor; thin surface layer with caliche fragments	Fair; limited material unless caliche is crushed	Severe; very shallow to cemented caliche	Moderate
Manzano loam	Good to a depth of 8 to 12 inches	Fair to poor; moderately plastic	Moderate; slow permeability; occasional flooding	Moderate
12 Limestone Outcrop Laporte stony loam	Poor; high content of cobble	Fair to poor; amount of material very limited	Severe; shallow to limestone bedrock	Moderate
Limestone Rock Land	(A miscellaneous land type)			
13 Harvey-Pastura Harvey loam	Fair to a depth of 5 to 6 inches	Fair; low to moderate shrink-swell	Moderate to severe; caliche layers may restrict permeability	Moderate
Pastura gravelly loam	Poor; thin surface layer with caliche fragments	Poor; limited material unless caliche is crushed	Severe; very shallow to cemented caliche	Moderate
Dean loam	Poor; limy; some caliche fragments	Good to fair; very high lime content	Moderate to severe; shallow to lime zone that restricts permeability	Moderate
La Fonda	Fair; erodible	Fair	Slight to moderate; moderately permeable	Moderate

**Soil features favorable

Foundation support	Highway location	Soil Features Affecting --			Terraces, diversions, contour furrows and pitting
		Reservoir area	Farm ponds		
			Embarkments		
Good; limestone bedrock at 6 to 20 inches	Shallow to limestone bedrock; steep slopes and hilly topography	*	*	*	
Good bearing capacity; low shrink-swell	Indurated caliche within a depth of 10 inches	*	*	*	
Good; limestone bedrock at 6 to 20 inches	Shallow to limestone bedrock; steep slopes and hilly topography	*	*	*	
Fair bearing capacity and shear strength	**	Moderately permeable; may need to be compacted	Calcareous material; difficult to vegetate	Difficult to vegetate; fairly stable if compacted	
Fair to poor bearing capacity and shear strength; moderate shrink-swell	Subject to occasional flooding; moderately plastic materials	**	Fair stability; subject to some cracking	Clayey material; difficult to vegetate	
Good bearing capacity; low shrink-swell	Indurated caliche within a depth of 20 inches	*	*	*	
Fair bearing capacity and shear strength	Gently to strongly sloping	Subject to seepage; moderately permeable	Fairly stable; medium to high compressibility	Undulating topography; channels subject to siltation	
Poor to fair bearing capacity and shear strength	Silty and erodible materials when exposed on embankments	**	Poor to fair compaction characteristics; erodible	Silty material; slow permeability; subject to channel erosion and siltation	
Good; limestone bedrock at 6 to 20 inches	Shallow to limestone bedrock; gently to strongly sloping	*	*	*	
Shallow to indurated caliche with good bearing capacity	Shallow to cemented caliche	Subject to seepage; shallow to caliche	Very limited amount of material	*	
Fair bearing capacity and shear strength; moderate shrink-swell	Occasional flooding; moderately plastic material	**	Fair to good compaction characteristics and stability	Features generally favorable; occasional deep gully	
Good; limestone bedrock at 6 to 20 inches	Shallow to limestone bedrock; gently to strongly sloping	*	*	*	
Fair bearing capacity and shear strength; low to moderate shrink-swell	Erodible when exposed on embankments	Soil features generally favorable; exposed caliche layers may require sealing	Limy material; difficult to vegetate; fairly stable when compacted	Strongly sloping and undulating topography	
Shallow to indurated caliche with good bearing capacity	Shallow to cemented caliche; some limestone bedrock	Subject to seepage; shallow to caliche	Very limited amount of material	*	
Low shrink-swell; good bearing capacity	Exposed caliche; erodible and difficult to vegetate	Shallow to a lime zone; subject to seepage	Limy material; erodible and difficult to vegetate	Shallow to a lime zone; exposed limy material erodible and difficult to vegetate	
Fair bearing capacity and shear strength	Gently to strongly sloping	Subject to seepage; moderately permeable	Fairly stable; medium to high compressibility	Undulating topography; channels subject to siltation	

Table 7. Continued

Soil Map Symbol and Soil Association	Suitability as a Source of --		Degree of Limitation for Septic Tank Filter Fields	Corrosion Potential (untreated steel pipe)
	Topsoil	Roadfill		
14 Harvey-Pastura-Witt Harvey loam	Fair to a depth of 5 to 6 inches	Fair; low to moderate shrink-swell	Moderate to severe; caliche layers may restrict permeability	Moderate
Pastura gravelly loam	Poor; thin surface layer with caliche fragments	Poor; limited material unless caliche is crushed	Severe; very shallow to indurated caliche	Moderate
Witt loam	Good to a depth of 5 to 8 inches	Poor; moderate shrink-swell	Severe; moderately slow permeability	Moderate
15 Pinon-Redmun-Harvey Pinon channery loam	Poor; numerous coarse fragments	Fair; amount of material limited	Severe; shallow to limestone bedrock	Moderate
Redmun loam	Good to a depth of 10 to 18 inches	Poor; plastic materials	Severe; slow permeability	Moderate
Harvey loam	Fair to a depth of 5 to 6 inches	Fair; low to moderate shrink-swell	Moderate to severe; caliche layers may restrict permeability	Moderate
16 Penistaja-Pinon-Chupadera Penistaja fine sandy loam	Fair; sandy and erodible	Fair; low to moderate shrink-swell	Slight	Moderate
Pinon channery loam	Poor; numerous coarse fragments	Fair; amount of material limited	Severe; shallow to limestone bedrock	Moderate
Chupadera loamy fine sand	Poor; sandy and erodible	Fair; amount of material limited	Severe; bedrock at 24 to 36 inches	Low to moderate
17 San Mateo-Glenberg San Mateo loam	Good	Fair to poor	Slight to moderate; flooding may be a problem	Moderate
Glenberg-like loam	Good to fair	Fair	Slight; possible contamination hazard	Moderate
18 Caballo-Peso-Supervisor Caballo clay loam	Poor to fair; stones and clayey	Poor	Severe; steep slopes	Moderate
Peso cobbly clay loam	Poor; cobbly and stony	Poor	Severe; bedrock at 20 to 40 inches; steep slopes	Moderate
Supervisor gravelly sandy loam	Poor; gravelly and stony	Fair; very limited amount of material	Severe; steep slopes; shallow to bedrock	Low

Foundation support	Highway location	Soil Features Affecting --			Terraces, diversions, contour furrows and pitting
		Reservoir area	Farm ponds	Embankments	
Fair bearing capacity and shear strength; low to moderate shrink-swell	Erodible when exposed on embankments	Soil features generally favorable; exposed caliche layers may require sealing	Limy material; difficult to vegetate; fairly stable when compacted	Susceptible to soil blowing and channel siltation	
Shallow to indurated caliche with good bearing capacity	Shallow to cemented caliche; some limestone bedrock	Subject to seepage; shallow to caliche	Very limited amount of material	*	
Fair bearing capacity and shear strength; low to moderate shrink-swell	Moderately plastic material at a depth of 8 to 36 inches	Moderately permeable substratum; may require sealing	Fair to good compaction characteristics; low to moderate permeability	**	
Good; limestone bedrock at 6 to 20 inches	Shallow to limestone bedrock; rolling to moderately steep topography	Subject to seepage; bedrock at 6 to 20 inches	Shallow soil; material very limited	*	
Fair bearing capacity and shear strength; moderate to high shrink-swell	Plastic material below a depth of 10 inches	**	Clayey material; poor compaction characteristics	Clayey subsoil; difficult to vegetate and construct	
Fair bearing capacity and shear strength; low to moderate shrink-swell	Erodible when exposed on embankments	Soil features generally favorable; exposed caliche layers may require sealing	Limy material; difficult to vegetate; fairly stable when compacted	Susceptible to soil blowing and channel siltation	
Fair bearing capacity and shear strength; low shrink-swell below 30 inches	Sandy surface layers; moderately erodible	Moderately permeable; may require compaction and sealing	Fair stability if compacted	Surface layers sandy and erodible	
Good; limestone bedrock at 1 to 20 inches	Shallow to limestone bedrock; rolling to moderately steep topography	Subject to seepage; bedrock at 6 to 20 inches	Shallow soil; material very limited	*	
Good bearing capacity and fair shear strength; bedrock at 24 to 36 inches	Sandy and erodible surface layers; bedrock at 24 to 36 inches	Sandy and permeable surface layers; bedrock at 24 to 36 inches; subject to seepage	Sandy and permeable materials; limited amount of material	Sandy and erodible*	
Fair to good bearing capacity and shear strength; stratified materials	Occasional overflow hazard; few wet areas	Soil features generally favorable; some sandy strata; may require sealing	Stable material when mixed and compacted	**	
Fair to good bearing capacity; stratified materials	Occasional overflow hazard; other features favorable	Subject to seepage; sandy strata; may require sealing	Erodible; fair stability when compacted	**	
Fair bearing capacity; steep slopes	Steep slopes; stony and cobbly substratum	Very cobbly and permeable substratum; steep slopes	Cobbly and stony material; fair stability when compacted	Steep slopes; very cobbly substratum	
Steep slopes; bedrock at 20 to 40 inches; fair bearing capacity	Steep slopes; bedrock at 20 to 40 inches; stony and cobbly material	Bedrock at 20 to 40 inches; steep slopes*	Cobbly and stony material; fair stability; bedrock at 20 to 40 inches	Steep slopes; cobbly and stony materials*	
Shallow to bedrock; steep slopes	Steep slopes and hilly topography; shallow to bedrock	*	*	*	

Table 7. Continued

Soil Map Symbol and Soil Association	Suitability as a Source of --		Degree of Limitation for Septic Tank Filter Fields	Corrosion Potential (untreated steel pipe)
	Topsoil	Roadfill		
19 Pinata-Stroupe-Fortwingate Pinata stony loam	Poor; stony	Poor	Severe; bedrock at 36 to 50 inches; steep slopes	Moderate
Stroupe stony loam	Poor; stony	Poor; plastic and stony	Severe; bedrock at 24 to 40 inches; steep slopes	Moderate
Fortwingate stony loam	Poor; stony	Poor; clayey subsoil layers	Severe; bedrock at 20 to 40 inches; steep slopes	Moderate
20 Deama-Limestone Rock Land Deama stony loam	Poor; high content of cobble	Fair to poor; amount of material very limited	Severe; shallow to lime- stone bedrock	Moderate
Limestone Rock Land	(No interpretations made)			
21 Lava Rock Land (No interpretations made; dominated by lava or basalt flows)				

*Unsuitable or practice not applicable

**Soil features favorable

indicate the general suitability of the surface soil layers for such use.

Suitability ratings of poor, fair, or good for road fill are given for the major soils in each soil association. The ratings are based on the performance of the soil material when excavated and used as borrow for highway subgrade.

Sewage fields are affected mainly by permeability, depth to water table, depth of bedrock or indurated caliche, and susceptibility to flooding. The degree of limitations and principal reasons for assigning moderate or severe limitations are given.

A corrosion potential of low, moderate, or high is indicated for the major soils in each soil association. Corrosivity, as used here, indicates the potential danger of uncoated steel pipe to corrode or become weakened through chemical action. Among the features considered in rating corrosion potential are soil drainage, presence of soluble salts, and frequency of wetting and drying. The texture, structure, and porosity of the soil are also important because of their effect on aeration, moisture-holding capacity, and movement of water.

In the remainder of the columns in table 7 are given the major soil features or properties that affect the use of a soil for specified purposes. For example, under the column headed "Foundation Support" are listed those features of the undisturbed soil that influence its capacity to support low buildings with normal foundation loads.

Although specific values of bearing capacity and shear strength are not assigned, general values are indicated.

Highway location is influenced by features of the undisturbed soil that affect construction and maintenance of highways. The soil features considered include the depth to bedrock and caliche, the content of stones and rocks, the suitability for embankments, susceptibility to overflow, erodibility, stability, ease of excavation and hauling, salinity, plasticity, and topography. The more common soil features affecting highway construction and maintenance are listed in the column headed "Highway Location."

The soil features that affect seepage or loss of water from excavated reservoir sites are those considered under farm pond reservoir areas. The permeability, depth to bedrock or caliche, and possibility of exposing porous strata are some of the items listed.

Farm pond embankments serve as dams. The major soil features, of both subsoil and substratum, that are of importance in the use of soils for constructing embankments are considered.

Terraces and diversions are low structures designed to retain or direct water. Pitting, chiseling, and contour furrowing serve to loosen the soil and retain water from rainfall and snow melt. The intake rate, permeability, stability of clods, and the use of the soil material for embankments are the soil features considered.

Soil Features Affecting --					
Foundation support	Highway location	Farm ponds		Terraces, diversions, contour furrows and pitting	
		Reservoir areas	Embankments		
Bedrock at 36 to 50 inches; fair to good bearing capacity; stony	Steep slopes; bedrock at 36 to 50 inches	*		Stony and clayey material; poor compaction characteristics	Steep slopes*
Bedrock at 24 to 40 inches; stony	Steep slopes; bedrock at 24 to 40 inches	*		Bedrock at 24 to 40 inches; stony and clayey material; poor compaction characteristics	Steep slopes*
Moderately deep to bedrock; fair bearing capacity above bedrock	Steep slopes; bedrock at moderate depths; some rock outcrops	Moderate depth to bedrock; subject to seepage		Clayey subsoil layers with fair compaction characteristics	Moderately steep slopes; bedrock at 20 to 40 inches
Good; limestone bedrock at 1 to 20 inches	Shallow to limestone bed- rock; gently to strongly sloping	*	*		*

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