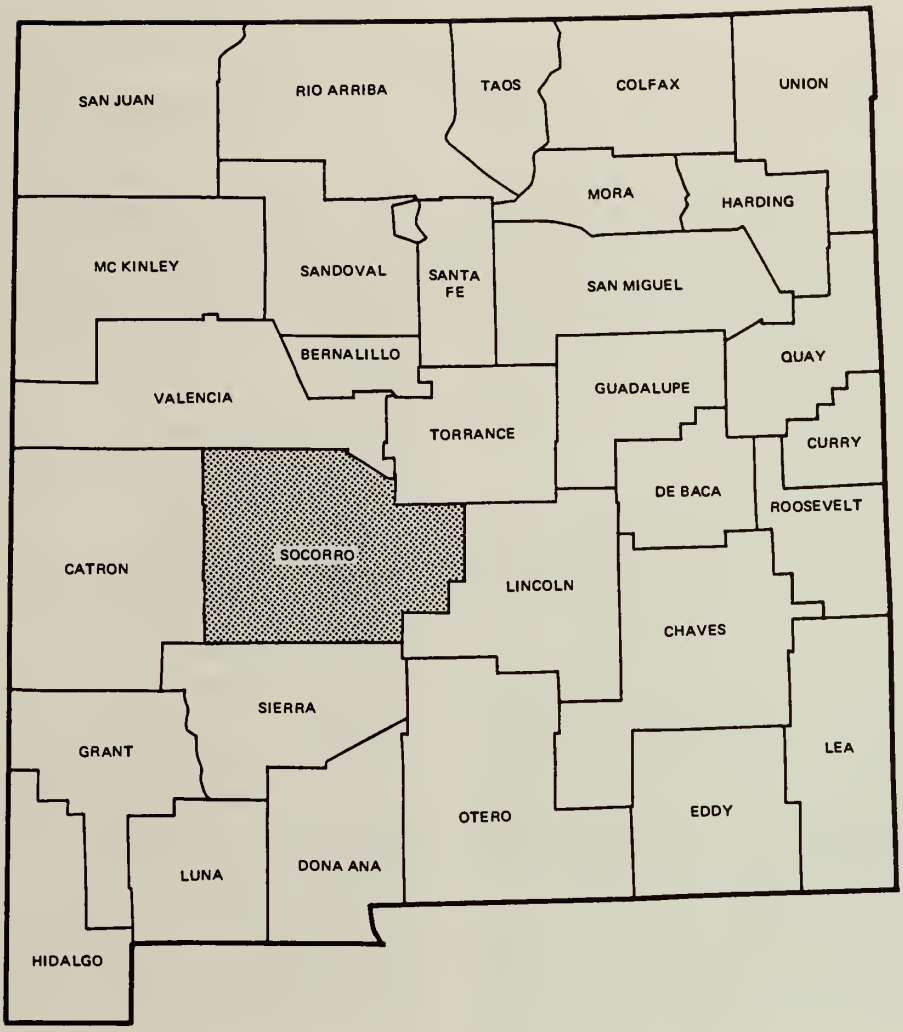
Soil Associations and Land Classification for Irrigation, Socorro County

Agricultural Experiment Station
in cooperation with
Water Resources Research Institute
and
Soil Conservation Service

AGRICULTURAL EXPERIMENT STATION RESEARCH REPORT 234



Acknowledgments

The work upon which this publication is based was supported by funds provided by the U.S. Department of the Interior as authorized under the Water Resources Research Act of 1964, Public Law 88-379; the United States Water Resources Planning Act of 1965; New Mexico State University's Water Resources Research Institute and Agricultural Experiment Station; and the New Mexico Property Appraisal Office. Credit is due Henry D. Galt, Range Conservationist, Soil Conservation Service, for information furnished on vegetation.

Summary

Socorro County has a total land area of about 4,240,600 acres. Approximately 40 percent, or about 1,703,739 acres, is considered suitable for irrigation. Of this estimated acreage of irrigable land, about 18,300 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 21,454 acres are in irrigation land class 1; 435,897 acres are in class 2; 792,764 acres are in class 3; and 453,624 acres are in class 4. The remaining 2,536,861 acres in the county are in land class 6, which is not suitable for irrigation.

The data are presented on the basis of the 22 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 Socorro 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 Rock Land-Lehmans-Lozier (No. 19) is generally restricted to recreation, habitat for wildlife, and very limited grazing for livestock. In contrast, the Gila-Vinton-Glendale association (No. 1) is suitable for many uses, including irrigated farming, range, urban and industrial sites, recreation, and habitat for many species of wildlife. The high mountainous land included in soil association 21 includes the principal timber-producing soils in the county. In addition to forestry, it is suitable for range use, provides a good habitat for many species of wildlife, and offers a number of recreational opportunities.

Engineering classification of these soils is also 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.

Contents

Soil Associations and Land Classification for Irrigation, Socorro County

H. J. Maker,[1] J. M. Downs,[2] and J. U. Anderson[1]

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 Socorro 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 Socorro County are presented in the map showing land classification for irrigation (see figure 2). The general soil map (figure 1) based on a reconnaissance soil 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 that 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 Socorro 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.

---

[1]Soil Scientist and Professor, respectively, Department of Agronomy, New Mexico State University.

[2]Soil Scientist, Soil Conservation Service, U. S. Department of Agriculture.

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 maps are often made by generalizing from large-scale detailed soil maps, this was possible only to a limited extent in Socorro County. Detailed soil surveys were available only for the irrigated lands and small areas of rangeland where special studies had been 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 22 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 Socorro County consist of two or more kinds of soil. Land types and a number of less extensive soils are also 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 their 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,[3] 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 has 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

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

level of management. Class 6 land is not suitable for irrigation.

The land in Socorro 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 the 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; alkali; permeability; erosion; surface smoothness; slope; internal soil drainage; and surface drainage. For example, the Deama, Travessilla, Pinon, and Holloman 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. The Bluepoint soils in soil associations 2 and 3 were placed in class 4 because of their sandy textures, low moisture-retention capacity, roughness of the land surface, and high erosion hazard. In the mountainous and hilly parts of the county, steep slopes, rough broken topography, 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. In contrast, land in the Adelino-Tome-Largo association is dominantly in classes 2, 3, and 1 because of more favorable soil properties and related land factors. Slope, erosion, and susceptibility to overflow were the principal reasons for placing slightly more than half of these soils in classes 2 and 3 instead of class 1.

Description of Area

Location and Topography

Socorro County, with 6,626 square miles, or approximately 4,240,600 acres, ranks third in size among the state's counties and is located just to the west and south of the geographic center. It is bounded on the west by Catron County, which has as its western boundary the Arizona-New Mexico state line.

The Rio Grande, the major stream in the area, flows generally south through the central part of the county. Except for a small area in the west-central part of the county that drains into playas on the San Augustin Plains, essentially all surface runoff from the western part of the county enters the Rio Grande. The lands immediately adjacent to the Rio Grande Valley on the east also drain into it, but all other drainage in the eastern part of the county is into closed basins or playas. The two principal basin areas in the eastern part of the county are Jornado del Muerto and Tularosa. The Jornado del Muerto Basin comprises an extensive area east of the Rio Grande Valley between the Los Pinos Mountains on the west and the Chupadera Mesa and the Sierra Oscura mountain range on the east. The extreme eastern and southeastern parts of the county drain into the Tularosa Basin. The Tularosa Basin comprises extensive areas in western Otero County and the eastern parts of Dona Ana and Sierra counties. Socorro County lies within the Mexican Highland section of the Basin and Range Province and has within its borders varied landscapes and a wide range in topographic relief.[4]

The immediate valley, or flood plain of the Rio Grande, which varies in width from about one mile to slightly more than three miles, is nearly level to very gently sloping. Narrow areas of gently to strongly sloping and rolling alluvial fans and terraces generally parallel the Rio Grande flood plain on

[4]Charles B. Hunt, Physiography of the United States, W. H. Freeman and Company, 1967.

Table 1. Land classification specifications for Pacific Southwest Basin irrigation land classes[1]

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 ($EC_e \times 10^3$ - equil.)	< 4	4 - 8	8 - 12	12 - 16	
Sodic Conditions[5]					
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	

[1]Specifications 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.

[2]Finer 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.

[3]In 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.

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

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

[6]Severity 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.

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

[8]Special 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.

[9]Air 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

both sides along its entire length through the county. They are commonly dissected by numerous intermittent drainages that slope towards the Rio Grande. Elevations range from about 4500 feet on the south county boundary to nearly 4700 feet where the Rio Grande enters the county.

The area west of the Rio Grande Valley is dominated by gently rolling to steep uplands, hills, and mountains interspersed with gently to strongly sloping plains, valleys, terraces, and alluvial fans. Mountain ranges, which comprise extensive areas, include the San Mateo, Magdalena, Ladron, Bear, Gallinas, and Lemitar mountains. Elevations in these mountain areas range from about 6000 feet in the foothill areas to 10,116 feet on Mt. Withington and 10,141 feet on San Mateo Peak. The elevations in much of this mountainous area, however, range between 7000 and 8500 feet. Although the topography varies considerably, much of the mountain area is characterized by a rough and broken terrain, including steep and very steep mountain slopes and canyons. Intermingled with the steep to very steep mountains and hills are nearly level to strongly sloping and rolling plains, alluvial fans, and valleys. Elevations in these non-mountainous areas generally range between 5000 and 7000 feet.

The area east of the Rio Grande Valley also has variable topography, but does not contain extensive areas of high mountainous land. Elevations are generally between 5000 and 7000 feet, with extremes ranging from about 4600 to 8700 feet. It is characterized by gently sloping plains and valleys intermingled with gently rolling to moderately steep hills, steep mountain ranges, and isolated mountain peaks. A relatively large valley and alluvial plains area dominated by gently sloping and undulating landscapes extends northeast from the southern boundary just east of the Rio Grande almost to the southwest corner of Torrance County. Gently rolling to steep hills and steep desert mountain ranges are more common northwest and southeast of this plains area.

Climate[5]

The climate of Socorro County is continental and ranges from arid in the narrow centrally located Rio Grande Valley to semi-arid on the uplands and mountains which rise both to the east and west from this valley.

Average annual precipitation ranges from 8 inches in the valley to 14 inches on the mesas and uplands and to 18 inches or more on the mountain peaks. July through September are the rainiest months and have nearly half the annual average, and the warmest six months get more than 70 percent of the annual average precipitation. The main source of moisture during this rainy season is air from over the Gulf of Mexico, flowing from the southeast in the general circulation about the Bermuda high pressure area which shifts westward in summer. Most of the warm-season precipitation falls from thunderstorms, which are usually brief but sometimes heavy and occasionally accompanied by hail. Tornadoes are rare and have caused only minor damage. During winter, the main source of moisture is eastward-moving Pacific Ocean storms, which lose much of their moisture in passing over the mountains west of New Mexico. The average precipitation in winter is less than one-half inch. The annual average number of days having 0.10 inch or more of precipitation ranges from 19 in the valley to 36 in the mountains and eastern localities. Precipitation varies greatly from year to year and month to month; San Marcial records show that 24.58 inches fell in 1859 and only 1.08 inches in 1901; 11.87 inches fell in August 1859 and only 0.03 inch in August 1919; and the greatest one-day rainfall was 5.10 inches, July 25, 1915.

Average annual snowfall ranges from 5 inches in the valley to 25 inches or more in

[5]This section prepared by Frank E. Houghton, Climatologist for New Mexico, National Oceanic and Atmospheric Administration, U. S. Department of Commerce, Las Cruces, New Mexico.

the mountains. Precipitation may fall as snow in the valley during November through March, and in the mountains, during October through April. Although there are few occurrences of snow and amounts are generally light, as much as 16 inches has fallen in a single storm. Snow seldom remains long on the ground in the valley.

Mean annual temperature ranges from 59 degrees in the Rio Grande Valley to 48 degrees in the higher elevations of the west, and even cooler on mountain peaks. Extremes of temperature have been 113 degrees at San Marcial, June 25, 1902, and -31 degrees at Augustine, January 6, 1971. The average annual number of days with temperatures of 90 degrees or more ranges from 111 days at Bosque del Apache, in the valley, to 21 days in mountain areas. Most summer days in the valley reach 90 degrees, but few days reach 100 degrees. Above 6500 feet, less than 30 days a year reach 90 degrees, and few days reach 100 degrees. From mid-November to mid-March most nights in the valley reach freezing, and at Augustine most nights from mid-October to mid-May reach freezing. Few days in the valley have zero or lower temperatures.

The average freeze-free period in the valley is from mid-April to late October, about six and one-half months. At Augustine, the freeze-free period is from the end of May to the end of September, four months.

The annual patterns of temperature and precipitation at Socorro are shown in table 2. These patterns are generally representative of other county locations when elevation effects are considered. Selected climatological data for other county locations are listed in table 3 for comparison.

Sunshine occurs an average of near 3400 hours a year, 75 percent of the possible hours. Monthly sunshine ranges from 70 percent of possible in January to more than 75 percent of possible in June. Average annual relative humidity is 45 percent, with monthly averages ranging from 60 percent in winter to 30 percent in June. Annual average relative humidity ranges from 60 percent in the early morning hours to 30 percent in the warm afternoon hours. Winds in the valley are predominantly northerly in winter and southerly in summer. Northerly winds are also more common in the morning hours, and southerly winds in the afternoon hours. On the mesas and in the mountains, the prevailing winds are more westerly. Annual average wind speed, estimated from nearby stations, is 9 miles per hour. Winds are strongest in spring, about 12 miles per hour, and lightest in fall and winter, about 8 miles per hour. Strongest winds are likely from the southwesterly quadrant. Average annual evaporation from a Class A pan is estimated to range from 105 inches in the southern river valley to 95 inches in the higher elevations, with two-thirds of the years being within 6 inches of the averages. During May through October, the warmest six months, 70 percent of the annual evaporation occurs.

Land Use

Much of the early history on the use and settlement of land in Socorro County centers around Indian Pueblos, the City of Socorro, and early mining in the Magdalena, Water Canyon, and Socorro mountain areas. The early Spanish explorers reported that the Pueblo Indians were cultivating irrigated fields of corn and beans when they first visited the area in 1540. Although Spanish missionaries and a few Spanish settlers located along the Rio Grande in the early 1600's, little progress was made in establishing permanent settlements in Socorro County until 1815 to 1817, when Governor Maynez granted land in the vicinity of Socorro to twenty-one families. Grapes were an important crop following this early settlement. They were made into wine and became valuable for trade with settlements to the north of Socorro.[6]

[6] Area Plans, Socorro County, New Mexico, New Mexico State Planning Office, 1970.

Table 2. Monthly temperatures and precipitation at Socorro, New Mexico, for period ending 1960*

Item	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Temperatures (F°)												
Average daily maximum	52	59	66	75	84	93	93	92	86	75	62	52
Average daily minimum	23	27	33	41	48	51	63	61	53	41	29	23
Mean daily	38	43	49	58	66	75	78	76	69	58	46	37
Extreme maximum	76	80	91	94	102	108	108	106	102	95	86	81
Extreme minimum	-13	- 2	9	15	27	35	42	45	27	16	5	-16
Precipitation												
Average (inches)	.41	.40	.50	.56	.60	.57	1.64	1.55	1.34	1.03	.37	.59
Average days 0.10 inch or more (no.)	1	1	1	1	1	2	3	4	3	2	1	1
Average snowfall (inches)	1.6	1.3	0.9	0.2	0	0	0	0	T**	0.2	0.5	2.2

*Period of record: Temperatures, 63 years; average precipitation, 74 years, average snowfall, 70 years; average days 0.10 inch or more, 30 years.

**T - trace, less than 0.05 inch.

Irrigated agriculture, therefore, is an old industry in Socorro County. Although no reliable estimates are available, the acreage of irrigated land in Socorro County undoubtedly fluctuated considerably during the period following these early Spanish settlements to 1925 when the Irrigation District serving this county was organized. Following the organization of the Irrigation District and rehabilitation of irrigation systems and flood control structures, the irrigated acreage increased some and has fluctuated less in recent years. In 1967 approximately 18,300 acres of land in this county were irrigated.[7] The principal irrigated crops are alfalfa, cotton, small grains, corn, sorghum, vegetables, and pastures. A number of wells have been developed since 1945 supplementing the surface water sources from the Rio Grande.

Livestock grazing is another important agricultural land use, as much of the land in Socorro County is used as range for beef cattle production. In 1969 there were approxi-

[7] New Mexico Soil and Water Conservation Needs Inventory, Statistical Report. Soil Conservation Service and other Federal and State Agencies, 1970.

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

Station	Elevation	Temperatures: Mean maximum	Temperatures: Mean minimum	Temperatures: Yrs. of record	Precipitation: Mean annual	Precipitation: Yrs. of record	Last 32° F or Lower in Spring	First 32° F or Lower in Fall	Time Between Dates
	feet	Fo	Fo	number	inches	number	-----average date----		days
Augustine	7025	67	29	22	10.63	32	May 28	Sept. 28	123
Bingham	5453	72	40	19	9.07	21	April 29	Oct. 23	177
Bosque del Apache	4520	76	41	61	8.73	102	April 15	Oct. 24	192
Gran Quivira National Monument	6620	68	38	21	13.48	28	May 7	Oct. 14	160
Magdalena	6556	67	37	43	11.86	56	May 1	Oct. 15	167
Socorro	4617	74	41	63	9.56	74	April 10	Oct. 24	197
Claunch*	6400				12.45	9			
Hardin Ranch*	6000				12.87	9			
Hill Ranch*	5800				9.10	6			
Kelly Ranch	6700				13.88	15			
Rienhardt Ranch	5450				8.05	9			
Woofter Ranch*	6000				13.78	44			
Mount Withington (Storage gage)*	10290				17.40	9			

*Period of record: Claunch, through 1950; Hardin Ranch, through 1951; Hill Ranch, through 1948; Woofter Ranch, through 1950; Mt. Withington, through 1965.

mately 55,000 head of cattle on the ranches and farms in this county.[8]

Dryland farming, which once was rather extensive in the extreme northeastern part of the county in the vicinity of Claunch, has declined so that little land is used for that purpose now. In the 1967 Conservation Needs Inventory Report, slightly more than 20,000 acres were classified as dry cropland in Socorro County. Most of this dry cropland, however, was in conservation use or had been reseeded to grass.

The use of land for wildlife and recreation is also important in Socorro County. The mountainous and hilly areas of the county, in particular, provide suitable habitat for many species of wildlife. The high mountain areas, most of which are in the Cibola National Forest, provide many opportunities for outdoor recreation including camping, hunting, hiking, and other recreational activities.

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

Soil Map Symbol and Soil Association	Present Land Use
1 Gila-Vinton-Glendale	Irrigated farming; range
2 Bluepoint-Caliza-Rough Broken Land	Range
3 Berino-Bluepoint-Onite	Range
4 Nickel-Canutio-Rough Broken Land	Range
5 Madurez-Wink	Range
6 Adelino-Tome-Largo	Range
7 Yesum-Marcial-Holloman	Range
8 Travessilla-Encierro-Rock Land	Range
9 Penistaja-Pinon-Palma	Range
10 Harvey-Witt-Pinon	Range
11 Deama-Harvey-Rock Land	Range
12 Millett-Sedillo	Range
13 Penistaja-Palma	Range
14 Lonti-Poley-Rough Broken Land	Range
15 La Fonda-Travessilla-Rock Land	Range
16 Chilton-Rough Broken Land	Range
17 Luzena-Rock Land-Millett	Range
18 Deama-Limestone Rock Land	Range
19 Rock Land-Lehmans-Lozier	Range
20 Rock Land-Chimayo-Luzena	Forestry; range
21 Mirabal-Supervisor-Rock Land	Forestry; range
22 Lava Rock Land-Graham	Range; wildlife

[8]New Mexico Agricultural Statistics, Vol. VI. Supplement III, New Mexico Department of Agriculture, Las Cruces, New Mexico, 1970.

Description of Soils

Twenty-two soil associations are shown in figure 1. Each of these 22 general soil areas, or soil associations, includes soils that are geographically associated and comprise recognizable landscapes. The soil associations are named for 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. Gila-Vinton-Glendale association

Included in this association are nearly level to gently sloping soils occurring on the flood plain and alluvial fans adjacent to the Rio Grande. It consists of an area of about 82,340 acres, or slightly less than two percent of the county. The soils, which are dominantly deep and highly stratified, are forming in alluvium of mixed origin. The texture of the surface layers varies from sand to clay, but the commoner textures are moderately coarse, medium, and moderately fine. Although the soils in general are adequately to moderately well drained, some are poorly drained and saline. The poorly drained soils occur throughout the association, but they are more common in the southern part of the county below the village of San Antonio. They commonly occupy low positions on the landscape or are near the river channel, where they are subject to seepage from the Rio Grande. It is extremely difficult to keep the water tables below the root zone in many of these poorly drained soils during the growing season because of their low position and inadequate drainage outlets.

The soils in this association are used for irrigated cropland, irrigated pasture, urban and community developments, wildlife, and unimproved native pasture. Nearly all of the 18,300 acres of irrigated land in Socorro County is in this association. The principal irrigated crops are alfalfa, cotton, small grains, corn, sorghum, vegetables, and pastures. The lands not under irrigation support a fair cover of vegetation, including cottonwood, willow, tamarisk, Russian olive trees, and tornillo, with an understory of saltgrass, alkali sacaton, and annuals. In addition to the irrigated land and pasture areas, a considerable acreage of land in this unit is occupied by roads, highways, urban, and other built-up areas. Although many soils have properties suitable for engineering installations in this association, it includes areas of wet and saline-alkali soils as well as soils with moderate to high shrink-swell potential and low bearing capacities that will need to be considered in construction. Localized areas of these soils also need protection from flooding by runoff from adjacent higher lying lands.

Soil Characteristics. Gila soils, the most extensive in the association, usually have a surface layer of calcareous, light brownish-gray or pale brown loam or fine sandy loam. This is underlain to a depth of five feet or more by stratified loams and sandy loams. Also in close association with the Gila soils and commonly included in the same mapping unit are soils which differ from the Gila soils in containing more strata of heavy loam, sandy clay loam, light clay loam, and very fine sandy loam.

Vinton soils usually have a pale brown fine sandy loam or loamy fine sand surface layer. The subsurface layers consist of stratified loamy sand, loamy fine sand, and sandy loam with an occasional thin strata of loam, silt loam, or very fine sandy loam. The substratum is similar, except that it is slightly coarser-textured with loamy fine sands and sands being dominant.

Glendale soils have a surface layer of calcareous, light brownish-gray to pale brown loam or clay loam over stratified subsurface layers of silt loam, silty clay loam, and clay loam. Thin strata of silt and clay that are very slowly permeable commonly occur in these subsurface layers. The substratum is typically stratified and moderately coarse to moderately fine-textured.

Other soils of importance in this association include those of the Armijo, Brazito, Belen, Agua, and Anapra series. Armijo soils are deep, fine-textured, and slowly permeable. Brazito soils are underlain by clean sand at depths of 6 to 18 inches. Belen soils, like Armijo soils, are clayey but differ in that they are underlain at depths of 20 to 30 inches by permeable sandy loams and loams. Agua soils are similar to those of the Gila series but differ in that they are underlain by clean sand at depths of 20 to 36 inches. The Anapra soils consist of light-colored, calcareous, medium and moderately fine-textured soils underlain by clean sand at depths of 18 to 36 inches. The Rio Grande, lakes, ponds, and miscellaneous land types, including Riverwash and Alluvial Land in arroyo bottoms, comprise about five percent of this association.

Irrigation Potential. The well drained soils in this association, which are dominantly in land classes 1 and 2, are well suited for use as cropland under irrigation. The majority of these soils, however, are already under irrigation or in built-up areas, so the opportunity for expansion of irrigation is limited. About 19 percent is in class 1; 23 percent in class 2; 19 percent in class 3; 21 percent in class 4; and the remaining 18 percent is in class 6. Inadequate drainage, high water table, salinity, and alkali were the principal factors contributing to the placement of soils in land classes 3 and 4. The class 3 and 4 lands have moderate to severe limitations and generally will require drainage and leaching of salts before they can be used successfully for irrigation. The Alluvial

Land in arroyo bottoms, very poorly drained and saline-alkali soils, and the channel of the Rio Grande and its immediate flood plain constitute most of the class 6 land.

2. *Bluepoint-Caliza-Rough Broken Land association*

This association, which roughly parallels the Rio Grande on both sides in the north-central part of the county, consists of an area of approximately 134,775 acres. It is dominated by gently to strongly sloping and undulating alluvial fans and terraces interspersed with rolling to hilly gravelly ridges. The gently sloping and undulating landscapes in this association become more common as the unit approaches the Rio Grande flood plain. The soils, which are sandy and often gravelly, are forming in coarse-textured alluvial fan sediments of mixed origin. In localized areas, the sandy soils of this association have been modified by wind action, and hummocks and low dunes occur in and around shrubs. A few large dunes also occur adjacent to the Rio Salado.

This association, which supports a sparse to fair stand of native vegetation, is used mainly for grazing of livestock and wildlife. The more common grasses are black grama, giant dropseed, mesa dropseed, sand dropseed, sideoats grama, Indian ricegrass, galleta, and fluffgrass. Shrub species include mesquite, creosotebush, smokebush, and snakeweed. In addition to its use as rangeland, the Caliza and Rough Broken Land components of this association also have a potential as a local source of sand and gravel.

Fig. 3. Deep sandy soils of Bluepoint series in foreground and gravelly soils of Caliza series on rolling landscapes in background.

Soil Characteristics. Bluepoint soils in this association commonly occupy the gently to strongly sloping and undulating fans and terraces in the lower parts of this unit as it approaches the flood plain of the Rio Grande. These soils consist of weakly calcareous, light brown or light brownish-gray loamy sands and sands to a depth of five feet or more. They may contain a few pebbles and gravel, and these are usually lime-coated in the lower part of the profile. Low dunes and hummocks, forming in and around shrubs, are common in the wind-eroded areas.

Caliza soils usually occur on the gently sloping to rolling 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 has a high content of lime. The degree of carbonate cementation ranges from no cementation to a nearly continuous weak cementation. The lime content decreases with depth, and at an average depth of about 36 inches there is little or no visible segregated lime. The substratum at this depth usually consists of very gravelly sand with thin strata of very gravelly loamy sand or sandy loam.

The Rough Broken Land component of this

association occupies the steep and rough lands and terminal points of fans that are dissected by many intermittent stream channels. It consists of a complex of highly variable shallow soils and exposures of alluvial sediments. Exposures of subsurface layers of many different kinds of soil are common on some of the steep side slopes. These may consist of soft or hard caliche layers, as well as old subsurface layers of reddish-brown sandy clay loam or clay loam. A thin mantle of gravelly loam or gravelly sandy loam, however, generally occurs over much of the land surface. Erosion is active over much of this unit.

Yturbide, Onite, Madurez, and Arizo soils, together with Dune Land, Riverwash, Alluvial Land in arroyo bottoms, and other miscellaneous land types comprise the remaining parts of this association. The Yturbide soils resemble the Bluepoint but differ in that the subsurface layers consist of gravelly, loamy sand and gravelly sand. Onite soils typically have a thin surface layer of brown, noncalcareous loamy sand or sandy loam over moderately thick, reddish-brown, sandy loam subsoil. The substratum usually consists of loamy sand, sand, or sandy loam. Madurez soils, which are underlain at moderate depths by a strong lime zone, have light brown loamy sand surface layers overlying brown sandy clay loam subsoils. This is underlain at a depth of about 20 to 30 inches by a pinkish-white sandy loam and loam, which have a high content of lime. The Arizo soils consist dominantly of very gravelly sands and loamy sands. They are usually underlain at shallow depths by thick strata of gravel and sand.

Irrigation Potential. Approximately 41 percent of the land in this association was classified as suitable for irrigation. These irrigable lands, however, have a relatively low capability for such use as 33 percent is in irrigation land class 4 and 8 percent in class 3. The Bluepoint soils are dominantly in the class 4 lands. The extremely sandy textures, low water-holding capacity, very rapid permeability, and high erosion hazard contributed to this soil classification. The Madurez and Onite soils, which account for most of the land in class 3, were placed in this class primarily because of their sandy textures, slope, and low to moderate water-holding capacity. These soils, with the application of adequate erosion-control measures, land leveling, and other accepted good farming measures should, however, have sufficient productive capacity to support irrigation.

The remaining 59 percent of the land in this association was placed in class 6 because of unfavorable soil properties and topographic conditions. This high percentage of non-irrigable land, which is intermingled with the irrigable land, places severe restrictions on the size of the tracts that can be developed for irrigation.

3. *Berino-Bluepoint-Onite association*

This association, comprising an area of approximately 471,450 acres, occurs east of the Rio Grande in the south-central part of the county. It includes a major part of the Jornada del Muerto closed basin that lies within Socorro County. A few nearly level depressional areas are included in the association, but it characteristically occurs on gently sloping and undulating landscapes. Coppice dunes forming in and around mesquite and other shrubs are common in the wind-eroded areas. The soils in this association, which are generally moderately deep and deep, are developing in eolian and old valley-filling sediments derived from a wide variety of rocks.

It supports a fair cover of vegetation that is dominated by grass species including black grama, mesa dropseed, sand dropseed, giant dropseed, and fluffgrass. Shrub species, which occur less frequently, are sand sage, mesquite, yucca, and snakeweed. Tobosa grass also occurs to a limited extent in the

Fig. 4. Typical landscape of Berino-Bluepoint-Onite association (No. 3). Berino sandy loam in foreground and Lava Rock Land of soil association 22 in the background.

small swales and depressional areas. Gyp dropseed and alkali sacaton often occur on the soils underlain at shallow depths by gypsiferous earth or gypsum.

Soil Characteristics. Berino soils, one of the more extensive soils in this association, commonly occur on the gently sloping and undulating landscapes. A few low hummocks occasionally occur around shrubs where erosion has been active. These soils have a thin surface layer of light brown to light reddish-brown, noncalcareous sandy loam or loam or loamy sand, over thick, reddish-brown sandy clay loam subsoils. The lower part of the subsoil, which is normally calcareous, contains a few filaments and small soft masses of lime. This is underlain at depths of two to four feet by a pinkish-white sandy clay loam that is very high in lime.

The Bluepoint soils commonly occur on gently sloping ridges that are slightly higher than the surrounding 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 reddish-brown to light brown loamy sand or sandy loam. This is usually underlain by a light brown to light reddish-brown loamy sand or sand to depths of five feet or more. In local areas, gravelly sand may occur below depths of 30 to 48 inches. These soils are usually weakly calcareous throughout, but some are noncalcareous to depths of 30 or 48 inches.

The Onite soils, like the Berino soils, typically occur on the smooth, nearly level to gently sloping areas between the ridges occupied by the Bluepoint soils. They have a thin surface layer of noncalcareous, brown to light brown loamy sand over a moderately thick, reddish-brown sandy loam subsoil. The substratum usually consists of sand or

Fig. 5. Coppice dunes and undulating or hummocky topography is common in the wind-eroded areas of the Berino-Bluepoint-Onite association.

loamy sand; however, strata of gravelly sand may occur below a depth of three feet.

Soils of less extent in this association include those of Yesum, Holloman, Sotim, Dona Ana, Wink, and Pintura 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. It 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. The nearly level to gently sloping Sotim soils commonly occur in the swales and depressional areas in this association. They have thin surface layers of reddish-brown, calcareous loam or clay loam over a thick, reddish-brown, calcareous clay loam subsoil that commonly contains a few threads and small soft masses of lime. Dona Ana soils, which have calcareous sandy loam or loamy sand surface layers and sandy clay loam subsoils, are underlain by a pinkish-white loam high in lime at a depth of about 18 to 30 inches. This lime layer is occasionally weakly cemented in the upper part. The Wink soils, which are underlain by pinkish-white sandy loam layers high in lime at moderate depths, have brown fine sandy loam surface layers and light brown fine sandy loam subsoils. The Pintura soils in this association commonly occur in a complex pattern with soils of the Dona Ana and Berino series. They occupy the coppice dunes and have surface layers of loose, noncalcareous to weakly calcareous, brown or reddish-brown fine sand over thick deposits of fine sand.

Irrigation Potential. This association is dominated by soils classified as suitable for irrigation. Approximately 33 percent is in class 3; 27 percent in class 4; 25 percent in class 2, and the remaining 15 percent is nonirrigable, or in class 6. The Berino soils, which are well suited for irrigation, are dominantly in class 2. However, the severely eroded phases of the Berino soils that usually occur in association with coppice dunes were placed in class 3. The Bluepoint and Onite soils, because of their sandy textures and low to moderate water-holding capacities, were placed in irrigation land classes 4 and 3, respectively. The irrigable soils in this association have some limitations, but they should, with the application of adequate erosion-control measures, land leveling, and other accepted good farming practices, have sufficient productive capacity to support irrigation.

4. Nickel-Canutio-Rough Broken Land association

This association includes an area of approximately 340,045 acres adjacent to the flood plain of the Rio Grande in the central and south-central part of the county. It consists of gently sloping to steep alluvial fans, terraces, and valley-filling slopes that are dissected by numerous drainageways. Although much of this unit is dominated by rough broken landscapes, it includes some long ridges with relatively smooth and gently sloping surfaces. Ridge tops are gently sloping and vary from about 100 feet to one-half mile or more in width. The sides of the ridges are usually steep, but slopes may range from 5 percent to as much as 45 percent. Small areas of gently sloping fans and terraces also occur in the lower part of this association near the Rio Grande flood plain. The soils, which are often gravelly, are forming in coarse-textured alluvial fan sediments of mixed origin.

These soils support only sparse stands of vegetation that are dominated by creosotebush. Other vegetation includes black grama, bush muhly, mesa dropseed, tobosa, threeawns, fluffgrass, yucca, snakeweed, and a

Fig. 6. General view of gently to strongly sloping and rolling landscapes in the Nickel-Canutio-Rough Broken Land association (No. 4). Nickel gravelly sandy loam is shown in foreground.

number of annual forbs 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, gravelly or very gravelly loam. This grades at depths of 15 to 25 inches to white, very gravelly caliche which usually contains many hard caliche fragments and is occasionally weakly cemented in the upper part.

Canutio soils occupy the strongly sloping to steep sides of the gravelly ridges. These soils have a surface layer of light brown, calcareous, gravelly sandy loam. This is underlain to a depth of five feet or more by weakly stratified very gravelly sandy loam and gravelly sandy loam. The coarse fragments, which are mainly rounded, typically comprise 15 to 35 percent of the surface layer and 35 to 75 percent of the subsurface layers. The gravel and cobble in the subsurface layers are often lime-coated.

The Rough Broken Land component of this association occupies the moderately steep to steep and rough lands that are dissected by many intermittent stream channels. It consists of a complex of shallow soils with widely varying characteristics and exposures of alluvial sediments. In addition to these, exposure of subsurface layers of many different kinds of soil are common on some of the steep slopes. These may consist of soft or hard caliche layers or old subsurface layers of reddish-brown, sandy clay loam or clay loam. A thin mantle of gravelly loam or gravelly sandy loam, however, generally occurs over much of the land surface. Small areas of exposed bedrock may also occur in this unit where it joins mountainous and hilly areas. Erosion is active over much of this unit.

Also in this association are soils of Strauss, Chamberino, Caliza, Pinaleno, Arizo, Tencee, Upton, and Bluepoint series. The Strauss and Chamberino soils occupy the broad, nearly level to gently sloping tops of old alluvial fans and terraces of piedmont slopes. The Strauss soils are characterized by their brown, weakly calcareous to non-calcareous loam or fine sandy loam surface layers and reddish-brown to brown light clay loam or sandy clay loam subsoils. A few filaments and small soft masses of lime commonly occur in the lower part of the subsoil. This is underlain at a depth ranging from about 18 to 26 inches by a pinkish-white gravelly loam or gravelly sandy clay loam high in lime. The Chamberino soils, which occur in close association with soils of the Strauss series, typically occupy the outer edges of the alluvial fans or ridge tops. The Chamberino soils differ from the Strauss soils in that they are more calcareous and not as well developed. They usually have light brown, strongly calcareous, gravelly loam surface layers. This grades at a depth ranging from 15 to 20 inches to a pink or

pinkish-white, very gravelly loam or gravelly loam that contains a large amount of lime. This high lime layer often contains caliche fragments and is occasionally weakly cemented in the upper part. Caliza soils usually occur on the crests of narrow ridges. These soils typically have a surface layer of pinkish-gray, strongly calcareous, very gravelly sandy loam over a pinkish-white, very gravelly sandy loam that has a high content of lime. The degrees of carbonate cementation range from none to nearly continuous weak cementation. The lime content decreases with depth, and at an average depth of about 36 inches there is little or no visible segregated lime. The Pinaleno soils commonly occur on gently to strongly sloping alluvial fans that are adjacent to and extend outward from the mountain fronts. These soils have a thin surface layer of noncalcareous, very gravelly sandy loam and a moderately thick, red to reddish-brown, very gravelly sandy clay loam subsoil. The lower part of the subsoil, which is commonly coarse-textured and calcareous, usually contains a few filaments and specks of segregated lime. The coarse fragments are also typically lime-coated. Below the subsoil and at depths between about 30 and 60 inches is a very pale brown to light brown, very gravelly loamy sand or very gravelly sandy loam. Upton, Tencee, and Arizo soils are shallow. Those of the Upton and Tencee series are underlain by indurated caliche within a depth of 20 inches, while the Arizo soils are underlain at shallow depths by thick strata of gravel and sand. The Bluepoint soils in this association commonly occupy the gently to strongly sloping fans and terraces in the lower parts of this unit near the flood plain of the Rio Grande. Also occurring to a limited extent are such land types as Riverwash and Alluvial Land. These usually occur in association with drainages and arroyo bottoms.

Irrigation Potential. Because of unfavorable soil properties and topographic conditions, this association has a very limited potential for development of irrigated land. Approximately 79 percent is non-irrigable, or in class 6; 16 percent is in class 4; and 5 percent in class 3. The Bluepoint, Strauss, Pinaleno, and Canutio soils, when occurring on suitable slopes, were classified as irrigable. The sandy textures, gravel content, and low water-holding capacities constitute moderate to severe limitations and were the principal reasons for placing these soils in irrigation land classes 4 and 3. In addition, this irrigable land commonly occurs as small and irregularly shaped tracts intermingled with extensive areas of class 6 land.

5. *Madurez-Wink association*

This association, which consists of an area of about 115,815 acres, occurs dominantly on gently to strongly sloping and undulating uplands in the north-central part of the county. A few small areas of moderately steep side slopes of ridges and drainages are included. It is occasionally dissected by intermittent stream channels that drain from the higher lying uplands to the Rio Grande and Rio Puerco. The soils are forming generally in old alluvium that is dominantly coarse to moderately fine-textured. Sandy eolian sediments may also comprise a part of parent materials in localized areas. They usually have sandy surface layers and are highly susceptible to wind erosion.

This association is used dominantly for grazing of livestock and wildlife. Vegetation is mainly sand dropseed, mesa dropseed, Indian ricegrass, galleta, fluffgrass, blue grama, black grama, and annual forbs. A few scattered shrubs also commonly occur, including yucca, Mormon tea, smokebush, and sand sage. Wind erosion hazard is high when vegetation is disturbed or depleted.

Soil Characteristics. Madurez soils occupy the more level landscapes in this association that occur between the drainages. These landscapes are typically nearly level

to gently sloping. The Madurez soils typically have a surface layer of light brown, noncalcareous loamy fine sand over a brown sandy clay loam subsoil. This is underlain by pinkish-white loam high in lime at a depth ranging from about 20 to 36 inches.

Wink soils have pale brown to brown, calcareous fine sandy loam or loamy fine sand surface layers. The subsoil is a light brown sandy loam about 10 to 20 inches thick. This is underlain by a pinkish-white sandy loam high in lime at depths of 24 to 40 inches. They generally occupy the slightly convex areas that are gently to strongly sloping.

Also of importance in this association are soils of the Latene and Bluepoint series. The Latene soils commonly occur on gently sloping crests of upland ridges that are slightly higher than surrounding areas. They have light brown, calcareous loam or fine sandy loam surface layers. This grades to a pinkish-white or pink, gravelly loam high in lime at a depth of 10 to 15 inches. The coarse fragments consist of hard or indurated caliche and may comprise 15 to 30 percent of these layers. Below an average depth of three feet this soil becomes slightly coarser-textured, and contains less lime and caliche fragments. Bluepoint soils are also fairly extensive. They have a surface layer of light brown to light reddish-brown, weakly calcareous loamy sand. This is underlain by weakly stratified light brown to light reddish-brown loamy sand and sand to a depth of five feet or more.

Less extensive soils in this association include those of Caliza, Onite, and Armijo series. Caliza soils usually occur on the gently to strongly sloping gravelly knolls and ridges. They have a surface layer of very pale 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. Onite soils, which are deep, typically have a thin surface layer of noncalcareous, brown loamy sand over a moderately thick, yellowish-red to reddish-brown subsoil. The Armijo soils, which occur on nearly level to gently sloping flood plains and swales, are deep and fine-textured. The remaining parts of this association consist of small acreages of Rough Broken Land, Riverwash, and Alluvial Land.

Irrigation Potential. Approximately 85 percent of the land in this association has been classified as suitable for irrigation. These irrigable lands, however, are dominantly in irrigation land classes 3 and 4. The Madurez soils and small areas of the Onite soils account for most of the land in class 3. The sandy textures, moderate soil depths, and low to moderate water-holding capacities were the principal reasons for their placement in class 3. These soils, with the application of adequate erosion control measures, land leveling, and other accepted good farming measures, should have sufficient productive capacity to support irrigation. The Wink and Bluepoint soils are dominantly in class 4 and account for most of the land placed in this irrigation land class. The sandy textures, low water-holding capacities, rapid and very rapid permeabilities, and high erosion hazard contributed to their placement in class 4.

Although these class 3 and 4 lands have limitations for use as cropland under irrigation, this association offers a fair potential for expansion of irrigation.

6. *Adelino-Tome-Largo association*

Two areas in the north-central part of the county consisting of about 29,045 acres are included in this association. The larger of these two areas includes the valley lands adjacent to Arroyo Alamito near the Valencia County boundary, and the other delineation consists of the flood plain and valley slopes adjacent to the Rio Puerco. It is dominated by nearly level to gently sloping topography including flood plains and terraces contiguous to intermittent drainages as well as adjacent

alluvial fans and valley-filling slopes. The soils are dominantly deep and are forming generally in moderately coarse to fine-textured alluvium. Erosion, particularly gully erosion, can become a problem on these under misuse. The soils contiguous to the intermittent drainages are particularly susceptible to gully erosion if the vegetative cover is depleted or destroyed. Due to their low position, some areas in this association receive additional moisture as runoff from the surrounding higher lying lands.

These soils, which support sparse to fair stands of native vegetation, are used for grazing of livestock and wildlife. The more common species of native vegetation include black grama, sand dropseed, alkali sacaton, blue grama, galleta, burrograss, fluffgrass, bush muhly, three-awns, chamiza, yucca, and snakeweed.

Soil Characteristics. Adelino soils are mainly on gently sloping alluvial fans and valley-filling slopes. Slope gradients are usually less than three percent but may range up to five percent. These soils have a thin surface layer of pale brown to light brown fine sandy loam or loam that ranges from noncalcareous to weakly calcareous in reaction. The subsoil is a light brown, calcareous heavy loam about 10 to 12 inches thick. This is underlain to a depth of 60 inches or more by a pale brown loam or sandy clay loam. A few threads and small soft masses of lime are common in the substratum. These soils occasionally become coarser-textured, or consist of sandy loams below a depth of three to four feet.

Tome soils, which occur on gently sloping valley areas in association with Adelino soils, typically occupy the lower, or slightly concave parts of the landscape. They have a surface layer of pale brown to light yellowish-brown light clay loam and loam. Below a depth of three to four feet they are usually more stratified and slightly coarser textured. Texture of these layers may range from sandy loam to silt loam or light clay loam.

Largo soils occupy nearly level to gently sloping landscapes in swales, valley bottoms, and on alluvial slopes or fans. They are forming in silty alluvium, and usually have a thin surface layer of light brown to reddish-brown, calcareous loam or silt loam. Small areas of these soils also have fine sandy loam and silty clay loam surface layers. The subsurface layers to a depth of five feet or more consist of weakly stratified, reddish-brown, calcareous silt loams and loams. These soils are susceptible to water erosion where vegetative cover is depleted and there is a concentration of runoff. A few deep gullies, particularly in the drainageways, are common.

In addition to these three principal soils, other soils in this association include Armijo, Bluepoint, Wink, Madurez, and Caliza. The Armijo soils are deep, fine-textured, and slowly permeable. They usually occupy low lying and slightly concave areas, located principally on the flood plain adjacent to the Rio Puerco. In this association Armijo soils are generally saline- and alkali-affected. The Bluepoint soils are deep and sandy. The Wink soils, which are moderately deep and sandy, are underlain by soft caliche or soil layers which have a high lime content at depths of 20 to 40 inches. The Madurez soils have surface layers of light brown loamy fine sand and subsoils of brown sandy clay loam. They are underlain at a depth ranging from about 20 to 36 inches by a pinkish-white loam high in lime. The Caliza soils, which are shallow and gravelly, occupy the strongly sloping crests and side slopes of ridges. These soils have pale brown, gravelly sandy loam surface layers and very gravelly, sandy loam subsurface layers that contain a large amount of lime. Also in this association are small acreages of a number of miscellaneous land types such as Gullied Land, Alluvial Land, and Rough Broken Land.

Irrigation Potential. Although this is a relatively small association, it has a fair to good potential for irrigation. Approximately

20 percent of land in this unit is in class 1; 30 percent in class 2; 25 percent in class 3; 14 percent in class 4; and 11 percent in class 6. The major soils in this association are moderately well to well suited for irrigation and account for most of the land placed in irrigation land classes 1, 2, and 3. The susceptibility to overflow and development of unfavorable drainage conditions, together with erosion and slope, were the principal reasons for placing some of these soils in classes 2 and 3. The Bluepoint and Wink soils are in class 4 primarily because of their sandy texture, low water-holding capacity, and high erosion hazard. Small areas of saline- and alkali-affected soils were also included in class 4. In general, the only lands in this association not suitable for irrigation include the immediate flood plain of larger streams, arroyo bottoms, and small areas of Gullied Land, Rough Broken Land, and the gravelly soils of the Caliza series.

7. Yesum-Marcial-Holloman association

Included in this association are areas dominated by gypsiferous and saline soils that are forming generally in old valley-filling sediments from sedimentary formations. Nearly level to gently sloping and undulating basin floors and piedmont slopes are characteristic of this general soil area. Slope gradients dominantly range from less than one percent to three percent with extremes ranging from zero to five percent.

A major part of this association lies within the upper part of Jornado del Muerto closed basin in the south-central part of the county. The one exception is the small area of this association in the extreme southeastern part of the county that drains into the Tularosa Basin. Approximately 83,845 acres, or slightly less than two percent of the county, is included in this general soil area.

This association is used for grazing by wildlife and livestock. The density and production of native vegetation vary widely. There are included a few small bottomland areas that receive runoff water from higher lying lands and support relatively dense stands of vine mesquite, alkali sacaton, and tobosa. A high percentage of the soils in this association, however, are slightly to moderately saline, or highly gypsiferous, and support only sparse to fair stands of native vegetation. Alkali sacaton is a dominant grass, while tobosa, vine mesquite, and chamiza shrubs are less common. The strongly saline areas are either barren or support only scattered clumps of alkali sacaton, iodinebush, and chamiza. Gyp dropseed, gyp grama, and coldenis often occur on soils underlain at shallow depths by gypsiferous earth or gypsum.

Soil Characteristics. The Yesum soils, although occurring on nearly level to gently undulating landscapes, typically occupy the more undulating parts of this general soil area. These soils have a surface layer of light brown, gypsiferous very fine sandy loam, about three to five inches thick. This is underlain to a depth of 60 inches or more by a light brown to pink, highly gypsiferous very fine sandy loam or fine sandy loam. The gypsum content of the surface layer is about 50 percent. It increases to approximately 80 percent within 10 to 20 inches, and then decreases gradually with depth.

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.

Holloman soils commonly occur on the low ridges or the more undulating landscapes in this association. They are thin, light-colored, gypsiferous and calcareous soils underlain by beds of gypsum. The surface layers are pale brown to light brown loam or very fine sandy loam. These are underlain by gypsum or gypsiferous earth at depths of 4 to 20 inches.

Soils of lesser extent in this association include those of Ubar, Sotim, Russler, and Mimbres series. Ubar soils are similar to the Marcial soils but differ primarily in that they are not as red and have a higher shrink-swell potential and thus 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. 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. 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 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. This association has an extremely limited potential for expansion of irrigated cropland. 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, these soils commonly occur as small irregular tracts, which will tend to place restrictions on their use for irrigation. Approximately 62 percent of the land in this association has been placed in class 6; 17 percent in class 4; 15 percent in class 3; and 6 percent in class 2.

8. *Travessilla-Encierro-Rock Land association*

Included in this association is an area of approximately 254,420 acres in the northwestern part of the county. It is dominated by rough and broken topography and consists of gently to strongly sloping mesa tops and steep to very steep mesa side slopes and escarpments. Also interspersed with these upland ridges and mesas are gently to strongly sloping alluvial fans and narrow valley bottoms. The more extensive soils in this association are developing residually in materials weathered from sedimentary rocks dominated by sandstone or interbedded sandstone and shale. In addition to being shallow, the soils in this general soil area are often gravelly and stony. Rock outcrops are common along the rims of the mesas. Elevation in the area comprising this association generally ranges between 5000 and 7500 feet.

Although the density of vegetation is quite variable, this association in general supports a fair to good cover of native vegetation. The overstory vegetation consists of thin and scattered stands of pinyon and juniper trees. The more common shrubs are mountain mahog-

any, turbinella oak, chamiza, cholla, rabbitbrush, and yucca. Grass species include blue grama, sideoats grama, sand dropseed bluestem spp., galleta, needle grass, muhly spp., and three-awns.

Soil Characteristics. Travessilla soils, which are underlain by sandstone at shallow depths, occur on gently sloping to moderately steep and rolling upland areas and mesa tops. They have a thin layer of light brownish-gray or light brown sandy loam or stony sandy loam. This grades through soil of similar color and texture to the underlying sandstone bedrock at depths ranging from about 8 to 20 inches. Small angular fragments of sandstone are common in the soil layers immediately above the bedrock.

Encierro soils occur on strongly sloping to moderately steep and rolling ridge crests and side slopes in this general soil area. The surface layer consists of about six inches of light brown to brown, gravelly fine sandy loam or brown, stony, gravelly loam over a thin reddish-brown heavy clay or clay subsoil. This grades through a gravelly or cobbly clay to the underlying interbedded sandstone and shale within a depth of 20 inches. The coarse fragments comprise about 10 to 15 percent of the subsoil and the layer immediately above the underlying sandstone and shale. These soils are weakly calcareous to noncalcareous.

Rock Land, which is also an important component of this association, consists of a complex of shallow soils and outcrops of sandstone and other types of sedimentary rocks. A few localized areas of basalt outcrops are also included. It characteristically occupies the steep and very steep mesa side slopes, escarpments, and breaks in which ledges and stairstep topography are common. Outcrops of bedrock commonly occur as vertical or nearly vertical exposures or ledges. A thin mantle of rocky or stony soil generally occurs between the ledges or outcrops of bedrock. Although shallow soils and rock outcrops are dominant, small isolated pockets of moderately deep to deep stony soils occur on the escarpments where benches or areas with a lesser slope gradient have formed.

Bernal soils, although not included in the association name, are also moderately extensive. These soils, which are shallow and neutral in reaction, are developing in materials weathered from sandstone on gently sloping mesa tops and rolling bedrock controlled ridges. They have a thin surface layer of brown noncalcareous loam over a brown sandy clay loam subsoil. This is underlain at a depth ranging from about 10 to 20 inches by sandstone bedrock which is usually fractured and weathered in the upper part. A few fragments of sandstone often occur on the surface and in the soil layers immediately above the bedrock.

Other soils of importance in this association include those of the Hagerman, Las Lucas, Silver, Penistaja, Lohmiller, Moriarty, and Persayo series. The Hagerman soils, which have surface layers of brown fine sandy loam or loam and subsoils of light brown to reddish-brown sandy clay loam, are underlain by sandstone bedrock at a depth of 20 to 40 inches. The Las Lucas soils are forming dominantly in materials of shale origin. They usually have a surface layer of pale brown loam or clay loam and silty clay subsoils. Shale is typically encountered at depths of three to five feet. Silver soils, which are deep, occur on nearly level to gently sloping broad swales or slightly depressed areas on mesa tops and other upland areas. They have a surface layer of brown noncalcareous loam over a thick clay subsoil. This is underlain by a pinkish-gray loam or gravelly loam substratum. The deep and well drained Penistaja soils occupy the crests and side slopes of upland ridges and alluvial fans. They have a brown noncalcareous fine sandy loam surface layer over a light brown or reddish-brown sandy clay loam subsoil and substratum. The Manzano, Lohmiller, and Moriarty soils are in gently sloping swales and valley bottoms. The Manzano soils are deep and medium to moderately fine-textured. The Lohmiller soils are also

deep, but differ in being fine-textured. The Moriarty soils are characterized by their reddish-brown silty clay loam surface layers and dense silty clay or clay subsoils that often contain some salt crystals. In addition to these named soils there are also included small areas of shallow soils over shale and basalt. Alluvial Land, which occurs in the immediate flood plain and bottoms of arroyos and intermittent drainages, also comprises a small acreage in this general soil area.

Irrigation Potential. This association is dominated by class 6 land, and offers little or no potential for expansion of irrigation. Approximately 80 percent of the land comprising this unit is in class 6; 7 percent is in class 3; 8 percent is in class 2; and the remaining 5 percent is in class 4. As would be expected with this high percentage of non-irrigable land, the lands suitable for irrigation commonly occur interspersed with extensive areas of class 6 land. For example, the Penistaja, Silver, Lohmiller, and Manzano soils, which are moderately well to well suited to irrigation and account for most of the class 2 and 3 land, occur as small and irregular tracts. The Hagerman and Las Lucas soils, because of their moderate depths over sandstone and shale, respectively, were placed in irrigation land class 4. Although suitable for irrigation, these class 4 lands have moderate to severe limitations for such use. The Travessilla, Encierro, and Bernal soils, due to their limited soil depth, low moisture-retention capacity, steep slopes, and other characteristics, are not suitable for irrigation.

9. *Penistaja-Pinon-Palma association*

This association, comprising an area of approximately 85,750 acres, is located in the northeastern part of the county. The topography is quite varied as it ranges from nearly level to strongly sloping and undulating in the valley areas and plains, to rolling and very steep on the low hills, ridges, and mesa escarpments. The soils in the valley areas and on the plains, which are forming in eolian and alluvial sediments of mixed origin, are dominantly deep. Miscellaneous land types and shallow soils developing over limestone and sandstone 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, giant dropseed, little bluestem, Indian ricegrass, black grama, sideoats grama, galleta, and tobosa. The more common shrubs include sand sagebrush, chamiza, winterfat, and yucca. In addition to these shrubs and grasses, light to heavy stands of pinyon and juniper trees are common on the shallow soils and miscellaneous land types occupying the low hills, ridges, and escarpments.

Soil Characteristics. Penistaja soils, the most extensive in the association, commonly occur on gently to strongly sloping uplands and valley 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 masses and thin threads. A prominent lime zone occasionally occurs in these soils below a depth of 40 inches.

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 sur-

face 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.

Palma soils, like those of Penistaja series, occupy gently to strongly sloping and undulating plains and slopes at the base of hills and escarpments. These soils are typically leached of lime in the surface layer and the upper part of the subsoil. They have a thin surface layer of brown or reddish-brown loamy fine sand or fine sandy loam over a subsoil of reddish-brown heavy fine sandy loam. This is underlain to a depth of 60 inches or more by a light reddish-brown fine sandy loam. Thin seams and small soft masses of segregated lime are common in the lower part of the subsoil and upper part of the substratum.

Other soils of importance in this association include those of Witt, Otero, Manzano, Chupadera, and Rance series. Witt soils 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. This is underlain by a pinkish-white very limy loam at depths of 40 to 50 inches. Otero soils have light brown to very pale brown, calcareous, fine sandy loam subsurface layers. The Manzano soils, which occur mainly in swales and depressional areas have a thick surface layer of grayish-brown to brown loam over a thick subsoil of grayish-brown heavy loam or clay loam. This is underlain to a depth of 60 inches or more by a pale brown to brown clay substratum. 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 or fine sandy loam. This grades through a light brownish-gray, strongly calcareous fine sandy loam that contains from 10 to 30 percent coarse angular fragments of limestone, to limestone bedrock at a depth ranging from about 20 to 36 inches. Rance soils consist of shallow to moderately deep, light colored, calcareous loams underlain by gypsiferous earth or rock. They usually have a thin light brownish-gray, calcareous, loam or silt loam surface layer. This grades through a pale brown, calcareous loam or clay loam to the underlying gypsiferous material at a depth of about 15 to 35 inches. Miscellaneous land types, such as Gypsum Land, Rock Land, and Alluvial Land comprise the remaining parts of this association. Rock Land consists of a complex of shallow soils and outcrops of bedrock dominated by limestone and sandstone. Gypsum Land is also a complex of shallow soils and outcrops but differs in that the outcrops consist generally of gypsiferous earth or rock.

Irrigation Potential. Although 36 percent of the land in this association has been classified as non-irrigable, it includes some relatively extensive tracts of land well suited to irrigation. There is, therefore, some opportunity for expansion of irrigation in the area occupied by this association. In addition to the non-irrigable land, approximately 40 percent is in class 2, and the remaining 24 percent is in class 3. Penistaja and Palma fine sandy loams, which have been classified as suitable for irrigation, are in irrigation land class 2 where they occur on gently sloping landscapes. The strongly sloping Penistaja soils and Palma loamy fine sand are in class 3. Small acreages of Witt, Manzano, and Otero, which were placed in irrigation land classes 2 and 3, also occur in this association. The Pinon and Chupadera soils are not suitable for irrigation because of their limited soil depth, low moisture-retention capacity, and other characteristics. These class 6 lands, which occur interspersed with the irrigable land, place some restrictions on the size of the tracts that can be developed for irrigation.

10. Harvey-Witt-Pinon association

This association includes a number of widely separated areas in both the eastern

and northwestern parts of the county. Approximately 391,435 acres, or nine percent of the county, is included in this general soil area. It occurs mainly on gently to strongly sloping upland plains and valleys interspersed with moderately steep and rolling upland ridges and hills. There are also included a few steep escarpments or breaks and nearly level to gently sloping valley bottoms. The moderately steep and rolling uplands and breaks areas are more extensive in the eastern part of this association near Lincoln County. 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. More common grasses include blue grama, western wheatgrass, Indian ricegrass, black grama, galleta, needle-and-thread grass, little bluestem, sideoats grama, and spike muhly. A few shrubs, including chamiza, rabbitbrush, winterfat, sagebrush, and cholla cactus, also occur in this association.

Soil Characteristics. The Harvey soils are mainly on the gently to strongly sloping valley side slopes. 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 to 36 inches.

Witt soils commonly occupy the broad gently sloping plains and valley slopes between the drainageways. They have a thin surface layer of light brown, noncalcareous loam over a thick subsoil of brown to 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.

Pinon soils are located on the moderately steep and rolling ridges and low hills that occur throughout this association and are particularly extensive in the units in the eastern part of the county. 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 10 to 20 inches.

Also in this association are soils of the Penistaja, La Fonda, Manzano, Rance, Pastura, Dean, and Poley series. The Penistaja soils are similar to those of the Witt series but differ primarily in that they are coarser-textured and lack the strong lime layer. They typically have light brown, noncalcareous, fine sandy loam surface layers and sandy clay loam subsoils. The deep and gently to strongly sloping La Fonda soils commonly occur on the crests and side slopes of low ridges. They have a reddish-brown, calcareous, loam surface layer and a heavy loam subsoil. This is underlain by a light reddish-brown, strongly calcareous loam that usually contains many small soft masses and fine streaks of lime. The Manzano soils, which occur in swales and depressional areas adjacent to drainages, are deep, dark colored, and medium to moderately fine-textured. The Rance soils in this association commonly occur as a complex with Gypsum Land that consists of outcrops of gypsiferous earth or rock. These soils, which have light brownish-gray, calcareous, loam surface layers and pale brown, loam or clay loam subsurface layers, are underlain by gypsiferous earth or rock at a depth ranging from about 15 to 35 inches. The Pastura and Dean

Fig. 7. Harvey-Witt-Pinon association (No. 10). The deep and gently sloping Witt soils in foreground are well suited to irrigation.

soils, which are shallow, are underlain by caliche and soft caliche, respectively, within a depth of less than 20 inches. The moderately deep soils of the Poley series occur to a limited extent in the units in the western part of the county. These soils have a thin surface layer of reddish-brown, noncalcareous, gravelly loam over a reddish-brown, gravelly clay or clay loam subsoil. This is underlain by a soft to weakly cemented gravelly and cobbly caliche. In addition to these soils, approximately 10 percent of this association consists of miscellaneous land types including steep Rock Land, Gypsum Land, and Alluvial Land. Steep Rock Land occurs generally on mesa breaks, escarpments, or side slopes of ridges. It consists of a complex of shallow soils and outcrops of bedrock with sandstone and limestone rock types being the most extensive. Gypsum Land differs in being less steep, and it consists of a complex of outcrops of gypsiferous earth or rocks and shallow soils. Alluvial Land occupies arroyo and drainage bottoms or floodplains and consists of very highly stratified soil materials with extremely variable textures.

Irrigation Potential. Although this association contains a relatively high percentage of non-irrigable land, it has some potential for expansion of irrigation. This is particularly true where the Witt, Harvey, Penistaja, and other soils classified as suitable for irrigation occur in tracts which are large enough to be economically developed for irrigation. The Witt and Penistaja soils are in irrigation land class 2 when occurring 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 La Fonda soils, which were placed in irrigation land class 2 and 3, respectively, also occur in this association. Approximately 40 percent of the land in this association has been classified as non-irrigable primarily because of shallow soils, rock outcrops, and steep slopes. Steep Rock Land, Gypsum Land, Alluvial Land, and soils of the Pinon, Pastura, and Rance series are dominant in the class 6 lands. These class 6 lands often tend to restrict the size of tracts that can be developed for irrigation.

11. Deama-Harvey-Rock Land association

This association includes an area of approximately 153,895 acres in the eastern part of the county. It occupies gently to strongly sloping and rolling uplands that generally range between about 5200 and 6700 feet in elevation. Also intermingled with these rolling uplands are moderately steep limestone hills, steep escarpments and breaks areas, and some nearly level to gently sloping valley bottoms. The soils, which range from shal-

Fig. 8. Typical landscape of Deama-Harvey-Rock Land association (No. 11).

low to deep, are developing residually in materials of limestone origin, or are forming in valley-filling sediments from limestone and other sedimentary rocks.

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, Metcalf muhly, galleta, sideoats grama, sand dropseed, three-awns, and some New Mexico feathergrass, spike muhly, and needle-and-thread grass. Shrubs and woody species include skunkbush, sumac, beargrass, yucca, and pinyon and juniper trees.

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 intermingled with limestone Rock Land. 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 of the subsurface layer immediately above the limestone bedrock.

Harvey soils, which are also moderately extensive in this general soil area, usually occupy gently to strongly sloping valley side slopes below ridges occupied by the Deama soils. 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.

Rock Land, which typically occurs on steep slopes, escarpments, and breaks, is also an important component of this association. It consists of a complex of shallow soils and outcrops of limestone bedrock. Characteristic features of this unit, therefore, are 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 and exposures of bedrock. Although dominated by shallow soils, the association has small areas of moderately deep and deep soils interspersed with the shallow soils and rock outcrops.

Gypsum Land consists of a complex of outcrops of gypsiferous earth or rocks and very shallow soils. The gypsiferous materials vary from white to light gray, gypsiferous earths to hard, light-colored, crystalline gypsum rocks. A thin mantle of loamy soil material commonly occurs between the outcrops of gypsiferous earth or rock.

Also in this association are small areas of Rance, Rednun, Manzano, Pastura, and Dean soils. The Rance soils, which occur in association with Gypsum Land, consist of pale brown or light brownish-gray, shallow to moderately deep, medium-textured soils. They are underlain by gypsiferous material at depths ranging from about 15 to 35 inches. Rednun soils occupy the relatively broad, nearly level to gently sloping alluvial fans and

valley slopes. These soils are deep and have reddish-brown, noncalcareous loam to clay loam surface layers and heavy clay loam to clay subsoils. 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. They are deep, dark-colored, and medium to moderately fine-textured. Pastura soils, which are shallow, 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. The Dean soils are light-colored and shallow to soft caliche or soil layers with a high content of lime. In addition to these soils, there are small acreages of unclassified alluvial soils and miscellaneous land types, including Alluvial Land, in this association.

Irrigation Potential. The potential for development of irrigated land in this association is extremely limited. Approximately 65 percent of this general soil area is non-irrigable, or in class 6; 27 percent is in class 3, and the remaining 8 percent is in class 2. Two of the major components of this unit, Deama and Limestone Rock Land, are not suitable for use as cropland under irrigation. They account for a high percentage of the land included in class 6. The Harvey, Manzano, and Rednun soils, which are suitable for irrigation, commonly occur as small areas interspersed with large tracts of non-irrigable land. These irrigable lands, therefore, will undoubtedly merit little consideration for such use, except where they can be developed with lands in adjoining associations.

12. *Millett-Sedillo association*

This association comprising an area of about 264,520 acres is dominated by gently to strongly sloping and undulating alluvial fans and valley-filling slopes that are located generally at the base of mountain ranges. Slope gradients are usually less than five percent, but they may range up to 15 percent near the base of mountains in areas occupied by the Millett soils. Small areas of strongly sloping to moderately steep soils also occur adjacent to drainageways. The soils, which are characterized by their gravelly textures or gravel content, are developing in old valley-fill sediments of mixed origin.

This general soil area supports fair to moderate stands of grasses and shrubs. The more common grasses are black grama, blue grama, galleta, ring muhly, sideoats grama, sand dropseed, alkali sacaton, and bush muhly. Shrub species include snakeweed and traces of little-leaf sumac, Apache plume, shrub live oak and juniper trees. The latter four species usually occur in the alluvial valley bottoms.

Soil Characteristics. Millett soils, the most extensive in the association, occur on gently to strongly sloping piedmont slopes near the base of mountain ranges. They usually have a thin surface layer of reddish-brown, noncalcareous, gravelly sandy loam. Their subsoil to a depth of about 18 to 20 inches consists of a reddish-brown to brown, gravelly sandy clay loam or gravelly light clay loam. This is underlain by a substratum that generally ranges in texture from a gravelly sandy loam to gravelly clay loam or very gravelly clay loam. It is strongly calcareous and typically contains many pinkish-white mottles and soft masses of lime. Thin strata of gravelly sand or very gravelly sand may occur below a depth of 24 inches.

Sedillo soils, like the Millett soils, occur on gently to strongly sloping landscapes, but differ in having a higher content of coarse fragments, and typically occur farther away from the mountain fronts. These soils have a thin surface layer of brown, noncalcareous, gravelly sandy loam or very gravelly loam. The subsoil is a reddish-brown to brown,

very gravelly clay loam or very gravelly sandy clay loam about 20 inches thick. This is underlain by a pinkish-gray, very gravelly sandy loam with a high content of lime that occurs dominantly as large soft masses and thick coatings on the coarse fragments. A few discontinuous lenses of cemented caliche are also commonly present in these high-lime layers. This grades to a brown, calcareous, gravelly sandy loam below a depth of about 50 inches.

Other soils of lesser extent in this association include those of the Leo, Chilton, and Witt series. The Leo soils occupy gently sloping valley bottoms and flood plains contiguous to intermittent drainages. They have a surface layer of light brownish-gray gravelly sandy loam. This is underlain to a depth of 60 inches or more by stratified gravelly and sandy soil layers that average a gravelly loamy sand in texture. The Chilton soils, which occur on the strongly sloping to moderately steep and rolling side slopes of drainages, have brown, gravelly, loam surface layers over light brown, very gravelly, loam subsurface layers. The non-gravelly soils in this association are represented by soils of the Witt series. These soils have a thin surface 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. A small acreage of miscellaneous land types, such as Rock Land, Riverwash, and Alluvial Land comprise the remaining parts of this association. Rock Land, which commonly occurs in the upper part of this unit near the mountain fronts and as isolated hills, consists of a complex of shallow soils and rock outcrops. A large amount of loose rock and stones usually occurs on the surface of soils between the rock outcrops. Riverwash and Alluvial Land, which usually occur in arroyos and drainage bottoms, consist of recent alluvium that is highly variable in texture.

Irrigation Potential. This association, which is dominated by land in classes 3, 4, and 6, offers some potential for expansion of irrigation. Approximately 39 percent of the land in this association is in class 3; 30 percent is in class 4; 27 percent is in class 6; and the remaining 4 percent is in class 2. The Millett and Sedillo soils, which are the most extensive soils in this general soil area, are in irrigation land classes 3 and 4, respectively. The coarse and gravelly textures, together with limited water-holding capacity and slope, are the principal reasons for placing these soils in classes 3 and 4. Although these lands are suitable for irrigation, they will require a high level of management for moderate to high yields of climatically adapted crops.

13. Penistaja-Palma association

This association, consisting of about 87,070 acres, is located in the west-central part of the county at an elevation ranging from about 6900 to 7000 feet. Included in this general soil area is the eastern extension of the San Augustin Plains, which are located principally in Catron County. The soils, which occur dominantly on nearly level to gently sloping and undulating landscapes, are forming in moderately coarse to moderately fine-textured alluvial sediments of mixed origin. Although it is dominated by nearly level to gently sloping and undulating topography, there are some strongly sloping and rolling areas, particularly on the outer fringes of this general soil area. The soils are dominantly deep and well drained, but a few small areas of somewhat poorly drained and saline-alkali soils occur adjacent to playas or in the basin areas.

The soils of this association support a good cover of native vegetation including such grass species as blue grama, sand dropseed, western wheatgrass, spike muhly, ring muhly, galleta, and three-awns. Sand sagebrush, rabbitbrush, Mormon tea, and yucca are the more common shrubs.

Soil Characteristics. Penistaja soils, the most extensive, are mainly on the broad gently sloping plains between the more sloping and undulating landscapes occupied by the Palma and Pinavetes soils. The Penistaja soils 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 or 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.

The Palma soils occupy the gently to strongly sloping and undulating landscapes in this association. These soils, which differ from those of the Penistaja series in being coarser-textured, have a surface layer of brown or reddish-brown, noncalcareous loamy fine sand. Their subsoil is a reddish-brown heavy fine sandy loam that is usually noncalcareous in the upper part. This is underlain to a depth of more than 60 inches by a light reddish-brown fine sandy loam or sandy loam. Thin seams and small soft masses of segregated lime are common in the lower part of the subsoil and upper part of the substratum.

Also in this association are soils of Manzano, Valent, Dwyer, Otero, and Millett series. The Manzano soils, which occupy the lower lying and nearly level to gently sloping landscapes in this association, have a thick surface layer of grayish-brown to brown loam over a thick subsoil of grayish-brown heavy loam or clay loam. This is underlain to a depth of 60 inches or more by a pale brown to brown clay loam substratum. Valent soils usually occur on the gently undulating and slightly higher parts of the landscape in this general soil area. These soils have a surface layer of light brown, noncalcareous loamy fine sand over subsurface layers of pale brown to light brown fine sand and loamy fine sand to a depth of five feet or more. The Dwyer soils occupy similar positions on the landscape and have textures similar to the Valent soils, but differ in being moderately to strongly calcareous. The Otero soils, like the Valent and Dwyer soils, occupy undulating to gently rolling landscapes, but are slightly finer-textured and contain more lime. They normally have a moderately thick surface layer of grayish-brown loamy fine sand or fine sandy loam over a similar, but more calcareous subsoil. The substratum is a pale brown loamy sand. It typically contains a few small masses and threads of segregated lime. The Millett soils typically occupy the gently to strongly sloping gravelly ridges that are located on the outer fringes of this association near the base of hills and mountain ranges. These soils have reddish-brown, noncalcareous, gravelly sandy loam surface layers over gravelly sandy clay loam subsoils. In addition to these named soils, small areas of saline- and alkali-affected soils, Alluvial Land in drainage bottoms, and playas are included in this association. The saline and alkali soils usually occupy low or depressional areas with restricted drainage. They are deep and range from medium to fine in texture.

Irrigation Potential. The major soils of this association are suitable for use as cropland under irrigation. The Palma, Otero, Valent, and Dwyer soils, which have been placed in irrigation land classes 3 and 4, have moderate to severe limitations for use under irrigation due to their low water-holding capacity, sandy texture, undulating topography, and wind-erosion hazard. The Penistaja and Manzano soils, which are well suited to irrigation, account for most of the land placed in land class 2. The dominant limitation of the Penistaja soils is a slight to moderate wind-erosion hazard and unevenness of the land surface. The Manzano soils, because of their low position, are susceptible to overflow and development of inadequate drainage conditions. Approximately 43 percent of the land in this association has been placed in irrigation land class 3; 37 percent in class 2; 12 percent in class 4; and the re-

maining 8 percent is non-irrigable, or in class 6. Soil temperature and length of growing season were not criteria in the irrigation land classification, but they restrict the choice of crops that could be grown on the irrigable lands in this association as it occurs at an elevation of about 7000 feet, where the frost-free season is much shorter than at lower elevations.

14. Lonti-Poley-Rough Broken Land association

This association, comprising an area of approximately 93,865 acres, includes two widely separated areas in the western part of the county. The largest area is in the extreme southwestern part of the county, and the much smaller area lies north of the Gallinas Mountains in the northwestern part. The topography is quite variable, ranging from gently to strongly sloping and undulating on the alluvial fan and terrace tops to moderately steep or steep on the sides of the upland ridges and terraces. It is dissected by numerous intermittent drainages and arroyos, and steep and rough and broken landscapes are common adjacent to these drainageways and arroyos. The rough and broken lands typically become more extensive in the upper part of the association near the base of the adjoining mountain ranges. A few narrow valley bottoms and flood plains on nearly level to gently sloping landscapes are also included.

The soils in this association are forming generally in old alluvial sediments of mixed origin. These soils, which are typically neutral to mildly alkaline in reaction, are deep and generally gravelly. The amount of gravel and cobble in the substratum often increases with depth.

The dominant use made of the land in this association is grazing, and under good management moderate yields of herbage are obtained. It supports a wide variety of grasses including black grama, sideoats grama, blue grama, bush muhly, little bluestem, Arizona cottontop, sand dropseed, fluffgrass, and three-awns. The more common shrubs and woody species are juniper trees, oakbrush, catclaw, Apache plume, chamiza, and broom snakeweed.

Soil Characteristics. Lonti soils, which occupy the more stable landscapes in this association, occur on the gently to strongly sloping and rolling ridge crests and side slopes. They have a thin surface layer of brown, noncalcareous, gravelly loam or gravelly sandy loam over a thick, reddish-brown, gravelly clay loam or gravelly clay subsoil. This is underlain by a light reddish-brown, slightly calcareous, gravelly or very gravelly loam and sandy loam to a depth of more than 60 inches.

Poley soils differ from the Lonti soils in that they are moderately deep over a strong lime zone. They have a thin surface layer of reddish-brown, noncalcareous, gravelly loam over a reddish-brown, gravelly clay or gravelly heavy clay loam subsoil that is free of lime in the upper part. This is underlain by gravelly and cobbly caliche or soil layers containing a high content of lime at depths of 20 to 36 inches.

Rough Broken Land includes the steep to very steep and severely dissected lands in this association. It consists of a complex of shallow, gravelly soils and exposures of unconsolidated to weakly consolidated sedimentary deposits dominated by gravelly and loamy or sandy sediments. Erosional remnants capped by moderately erosion-resistant conglomerates occur frequently through this unit. Erosion is active, and as a result, the Rough Broken Land component of this association contributes considerable sediments to the drainage system.

Also in this association are small acreages of a number of other miscellaneous land types such as Rock Land, Alluvial Land, Gullied Land, and Riverwash. Rock Land, which consists of a complex of shallow soils and rock outcrops, including igneous dikes and sills, occasionally occurs in the upper

part of this unit where it joins the mountainous areas. Gullied Land, Alluvial Land, and Riverwash commonly occur in the narrow valley bottoms. In addition to the miscellaneous land types, small areas of Silver soils and unclassified alluvial soils are also included. Silver soils have a thin, brown loam or fine sandy loam, noncalcareous surface layer that is underlain by a thick, light brown silty clay or clay subsoil that becomes progressively more calcareous with depth. The substratum is strongly calcareous, pinkish-gray, gravelly sandy loam. The unclassified alluvial soils, which occur adjacent to drainageways, are usually calcareous and moderately coarse to medium-textured.

Irrigation Potential. This association, which is dominated by class 6 land, offers only a limited potential for expansion of irrigation. Approximately 49 percent of the land comprising this unit is in class 6; 17 percent is in class 4; 25 percent in class 3; and 9 percent in class 2. The Lonti, Poley, and Silver soils account for most of the land classified as suitable for irrigation. The gravel and cobble content, unevenness of the land surface, slope, and erosion hazard, together with a moderate water-holding capacity, were the principal reasons for placing the Lonti and Poley soils in land classes 2 and 4. The Silver soils were placed in irrigation land classes 2 and 3 primarily because of slope and unevenness of the land surface. The irrigable lands are widely distributed and usually occur in small and irregularly shaped tracts. This will undoubtedly tend to further restrict their use for irrigation.

15. La Fonda-Travessilla-Rock Land association

This association, comprising an area of about 171,795 acres, includes three widely separated areas in the eastern part of the county. The topography is varied, ranging from gently to strongly sloping and undulating on the valley slopes and plains to steep, rough and broken on the escarpments, breaks, and rock outcrop areas. Although geographically associated, the soils included in this general soil area have highly contrasting characteristics. They range from shallow soils developing over sandstone, limestone, or interbedded sandstones and shales to deep medium and moderately fine-textured soils forming in alluvium. In general the soils of this association are moderately susceptible to erosion. Gullies often occur in many of the valley bottoms.

This association is used mainly as range land and supports a moderately good stand of native vegetation. Thin to moderately dense stands of pinyon and juniper trees are common on the shallow soils, steep breaks, and rough broken areas. The principal grasses are blue grama, sideoats grama, alkali sacaton, galleta, bush muhly, three-awns, black grama, and sand dropseed. The more common shrubs include rabbitbrush, chamiza, winterfat, and Apache plume. In the southeastern part of the county, tobosa grass often comprises a 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 the 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.

Travessilla are shallow, light-colored, gently to strongly sloping soils developing on sandstone mesas and breaks. They have thin

surface layers of light brownish-gray to light brown sandy loam or gravelly sandy loam. This grades through a pale brown to light yellowish-brown, calcareous, gravelly sandy loam or sandy loam to the underlying sandstone bedrock which occurs at depths ranging from 8 to 20 inches. The coarse fragments in the soil layers above the bedrock consist dominantly of small angular fragments of sandstone.

Rock Land, a miscellaneous land type, is also an extensive component of this association. It commonly occupies the steep breaks and escarpments on the sides of mesas, hills, and upland ridges, and consists of a complex of shallow stony soils, and outcrops of sandstone and other types of sedimentary rocks. A thin mantle of the soil generally occurs between the ledges or outcrops of bedrock. Although dominated by shallow stony soils with highly variable characteristics, this association has pockets of moderately deep and deep soils intermingled with the outcrops of bedrock. Boulders and stones often occur on the surface.

Other soils and land types in this association include Alluvial Land, Gullied Land, and soils of the Alicia, Harvey, Penistaja, Rednun, Manzano, Encierro, Newkirk, and Pinon series. The Alicia soils, which occur in close association with the La Fonda soils, occupy nearly level to gently sloping swales and the lower parts of the valley slopes. They have a surface layer of light reddish-brown loam over a thick reddish-brown clay loam or silty clay loam subsoil. The Harvey soils, which are underlain at shallow depths by soil layers high in lime, occur on gently to strongly sloping alluvial fans and side slopes of drainageways. They typically have a light brown or grayish-brown, calcareous loam surface layer. 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 16 to 20 inches. The Penistaja and Rednun soils are on gently to strongly sloping alluvial fans and valley slopes. The Penistaja soils, which are deep, have light brown, noncalcareous, fine sandy loam surface layers and sandy clay loam subsoils. The Rednun soils are also deep but have brown to dark brown, noncalcareous, loam or clay loam surface soils and heavy clay loam or clay subsoils. The Manzano soils occur mainly in swales and depressional areas adjacent to intermittent drainages. They have a surface layer of grayish-brown to dark brown, noncalcareous loam over a thick, grayish-brown, clay loam subsoil. This is underlain to a depth of five feet or more by a brown calcareous loam or clay loam. The Newkirk and Encierro soils are shallow and are developing over interbedded sandstone and shale. The Pinon soils are also shallow but are forming over limestone bedrock and contain numerous angular limestone fragments.

Irrigation Potential. Approximately 53 percent of the land in this association is nonirrigable, or in class 6; 25 percent is in class 2, and the remaining 22 percent is in class 3. Slope and unevenness of the land surface, together with moderate overflow and erosion hazard, were principal factors contributing to the placement of the soils in this association in land classes 2 and 3. Although these irrigable lands will require considerable land leveling and conditioning, they are moderately well to well suited for irrigation and offer some potential for its expansion. The intermingled class 6 land will often restrict the size of the tracts that can be developed. Rock Land, Gullied Land, Alluvial Land, and the shallow soils of the Travessilla, Newkirk, Encierro, and Pinon series account for most of this class 6 land.

16. Chilton-Rough Broken Land association

Included in this association is an area of approximately 84,345 acres that roughly surrounds the Ladron Mountains in the north-central part of the county. It is dominated by

highly dissected and moderately steep to rolling and hilly landscapes. It also contains small areas of alluvial fans, ridge tops, and valley bottoms that are gently to strongly sloping. The soils, which are generally gravelly and light-colored, range from shallow to deep. They are forming generally in old, coarse to medium-textured, gravelly alluvium. However, small areas of shallow soils are developing residually in materials weathered from underlying bedrock.

Although the density of the native vegetation is quite variable, the cover is generally fair to good and is dominated by short and mid grasses with a scattered and thin canopy of shrubs and juniper trees. The trees and shrubs are more prevalent on the breaks, escarpments, and the areas adjacent to the mountain uplands. Grasses which are more common include blue grama, black grama, sideoats grama, galleta, Texas timothy, Indian ricegrass, sand dropseed, threeawns, and ring muhly.

Soil Characteristics. Chilton soils occur on the gently to strongly sloping and rolling ridge crests and steep side slopes bordering drainageways. These soils, which are deep, light-colored, and gravelly, are forming in old alluvial sediments of mixed origin. They have a surface layer of brown, noncalcareous to weakly calcareous, gravelly loam. This is underlain to a depth of 60 inches or more by a light brown, calcareous, very gravelly loam that usually contains some segregated lime in the form of small concretions and coatings on the coarse fragments or gravel. The content of gravel in the subsurface layers ranges from 35 to 85 percent, but is typically between 50 and 75 percent.

Rough Broken Land, a miscellaneous land type, is also relatively extensive in this association. It includes the moderately steep to steep severely dissected lands that consist of a complex of shallow soils and exposures of unconsolidated to weakly consolidated sedimentary deposits. This alluvial material, which is quite variable, is dominated by gravelly and moderately coarse to medium-textured sediments. Erosion is active in those areas not protected by a good cover of vegetation or a surface mantle of gravel. These lands are commonly dissected by numerous intermittent drainage channels, and runoff in this part of the association is generally rapid.

Other soils of lesser extent in this association include those of Lonti, Poley, La Fonda, and Leo series. The Lonti and Poley soils occur on the gently sloping to moderately steep areas near the base of mountain ranges and hills. The Lonti soils have brown, noncalcareous, gravelly sandy loam or gravelly loam surface layers and reddish-brown to brown, gravelly clay loam or gravelly clay subsoils. These are underlain by a substratum ranging in texture from a gravelly loam or sandy loam to a very gravelly loam and sandy loam containing many pinkish-white mottles and soft masses of lime. The Poley soils resemble the soils of the Lonti series but differ in being moderately deep over a strong lime zone. These soils have a thin surface of reddish-brown, noncalcareous, gravelly loam over a gravelly clay or gravelly clay loam subsoil. This is underlain by gravelly and cobbly soil layers containing large amounts of lime at depths of 20 to 36 inches. 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 a 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. Leo soils, which occur in the gently sloping valley bottoms and flood plains, have light brownish-gray, gravelly, sandy loam surface layers. These are underlain by stratified subsurface layers that average a gravelly loamy sand in texture. In addition to these soils, the association also includes small areas of unclassified alluvial soils, Rock Land, and Alluvial Land. The

unclassified alluvial soils occupy gently sloping flood plains adjacent to intermittent drainages. They are deep and usually moderately coarse to medium-textured. Rock Land occurs on steep to very steep landscapes like the Rough Broken Land component of this association. It consists of a complex of shallow soils and outcrops of bedrock, instead of exposures of unconsolidated alluvium which characterize the Rough Broken Land. Alluvial Land includes the stratified and highly variable recent alluvial sediments in arroyo and drainage bottoms.

Irrigation Potential. The potential for development of irrigated land in this association is extremely limited. Approximately 77 percent of the land in this association is in class 6; 15 percent in class 3; 6 percent in class 4; and 2 percent in class 2. A small acreage of La Fonda soils, which are in class 2, is well suited to irrigation, but occurs as small and widely distributed tracts intermingled with extensive areas of non-irrigable land. The Lonti and Poley soils were placed in classes 3 and 4 primarily because of their steep slopes, unevenness of the land surface, and high gravel content. Although suitable for irrigation, these class 3 and 4 lands have moderate to severe limitations for such use, and like the class 2 land, consist of small and widely distributed tracts intermingled with the non-irrigable land.

17. Luzena-Rock Land-Millett association

This association is relatively extensive and comprises an area of about 199,815 acres in the northwestern and west-central parts of the county. The topography is dominated by gently rolling to very steep and hilly landscapes interspersed with gently to strongly sloping valley bottoms, alluvial fans, and plains. A few steep to very steep canyon walls and breaks are also included. The soils are developing in a wide variety of parent materials which have weathered from rhyolite, latite, andesite, basalt conglomerates, and old alluvial sediments. They are generally shallow and stony in those areas dominated by steep and hilly landscapes. Those soils forming in materials from conglomerates and old alluvial sediments on gently rolling to moderately steep landscapes generally range from moderately deep to deep. Deep soils are common on the alluvial fans and in the valley areas between the upland hills and ridges. Gravel and a few cobbles and stones are common over much of the land surface in this general soil area.

This association supports a fair to good cover of vegetation which is dominated by short and mid grasses and scattered to moderate stands of pinyon and juniper trees. Grasses common to the association are blue grama, sideoats grama, western wheatgrass,

Fig. 9. The topography of the Luzena-Rock Land-Millett association (No. 17) is dominated by gently rolling and hilly landscapes interspersed with gently to strongly sloping valley bottoms and alluvial fans.

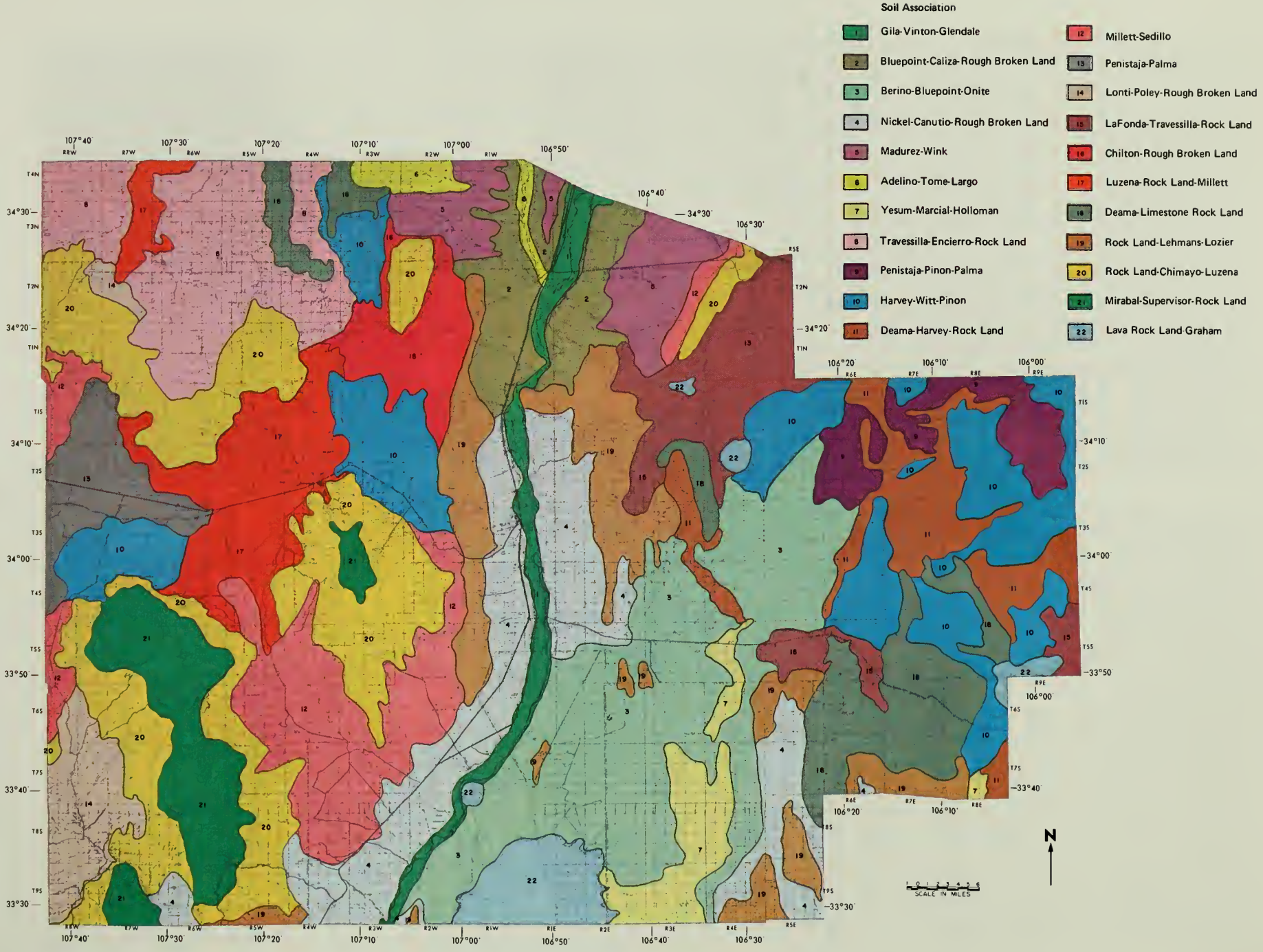


Figure 1. General Soil Map of Socorro County, New Mexico

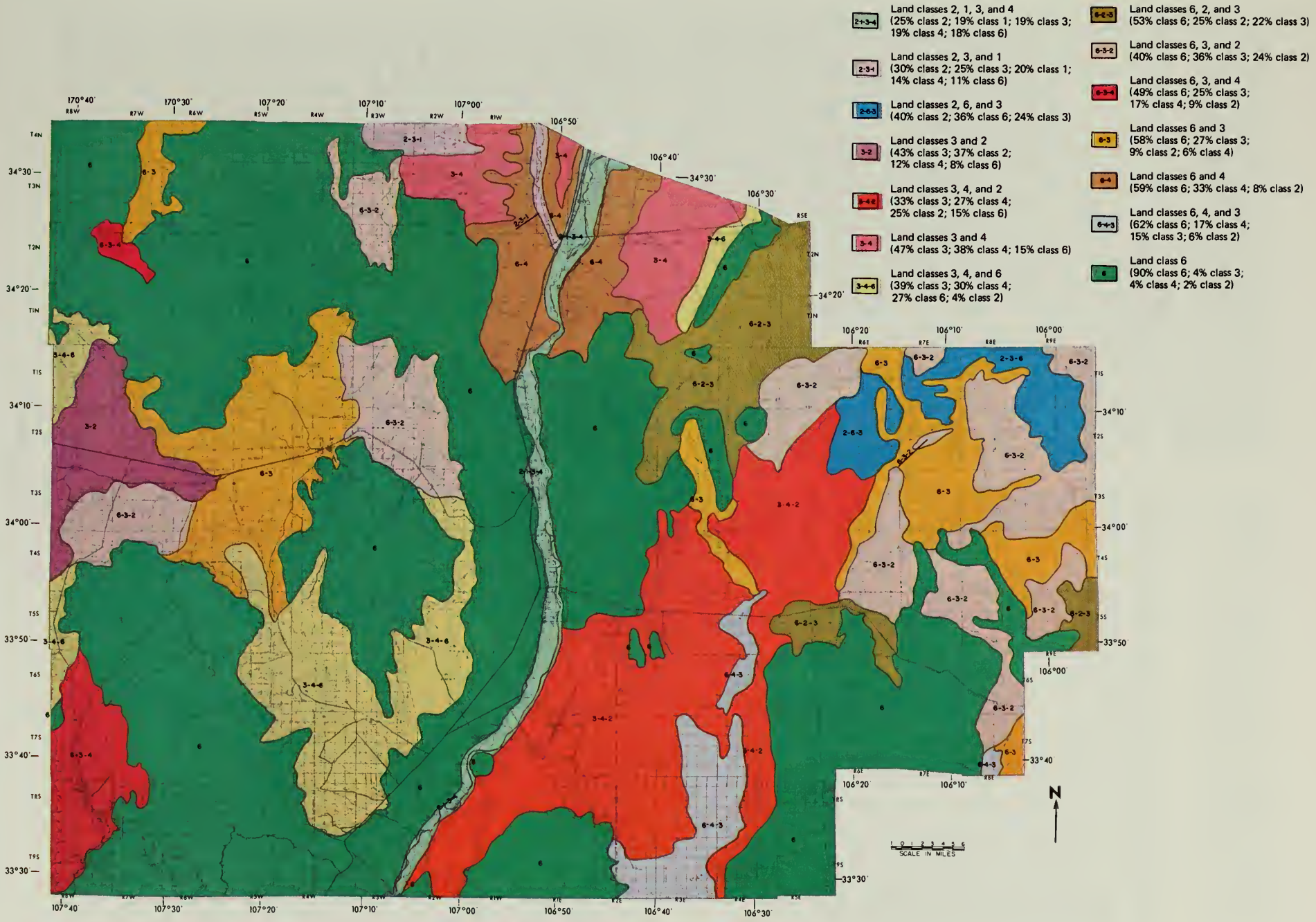


Figure 2. Classification of Land for Irrigation in Socorro County, New Mexico

wolftail, galleta, and three-awns. Rabbitbrush, winterfat, chamiza, shrub live oak, and yucca are the principal shrubs.

Soil Characteristics. Luzena soils, one of the more extensive soils in this association, occur on moderately steep and hilly landscapes. They are moderately dark-colored, noncalcareous or neutral in reaction, and shallow. The surface layer is usually a thin, brown, gravelly or cobbly loam. This is underlain by a brown to dark reddish-brown, noncalcareous, heavy clay loam, stony clay, or gravelly clay. Igneous bedrock or conglomerate commonly occurs within 20 inches of the surface. The underlying bedrock is generally fractured and weathered in the upper part.

Approximately 20 percent of this association consists of Rock Land. It includes those parts of the association that are characterized by numerous outcrops of bedrock and that usually occur on steep to very steep slopes. It consists of a complex of rock outcrops and shallow soils with variable characteristics. The shallow soils that are intermingled with rock outcrops, however, are generally gravelly or stony and moderately coarse to medium-textured. Stones and boulders occur on much of the soil surface. Although the soils are usually shallow, small areas of moderately deep soils occur interspersed with the shallow soils, rock outcrops, and rock ledges.

Millett soils in this association occupy the gently to strongly sloping and undulating alluvial fans and valley slopes that extend from the base of hills and upland ridges. They usually have a thin surface layer of reddish-brown, noncalcareous, gravelly sandy loam. Their subsoil to a depth of about 18 to 20 inches consists of a reddish-brown to brown, gravelly sandy clay loam or gravelly light clay loam. This is underlain by a substratum that generally ranges in texture from a gravelly sandy loam to gravelly clay loam or very gravelly clay loam. It is strongly calcareous and typically contains many pinkish-white mottles and soft masses of lime. Thin strata of gravelly sand or very gravelly sand may occur below a depth of 24 inches.

The remaining parts of this association consist of miscellaneous land types including Rough Broken Land and Alluvial Land, and soils of the Lonti, Penistaja, Silver, Sedillo, Cabezon, Palma, and Manzano series, as well as small acreages of deep unclassified soils. The Lonti soils, like the Millett, occur on the gently to strongly sloping alluvial fans that extend from the base of hills and ridges. They differ primarily from the Millett soils in having finer-textured subsoils. They typically have a thin surface layer of brown, noncalcareous, gravelly loam over a thick, reddish-brown, noncalcareous, gravelly clay or gravelly heavy clay loam subsoil. The Penistaja soils, which are deep and well drained, occupy the crests and side slopes of upland ridges and alluvial fans. They have a brown, noncalcareous, fine sandy loam surface layer over a light brown or reddish-brown sandy clay loam subsoil and substratum. The Silver soils are deep like the Penistaja soils, but differ in having a finer textured subsoil and a strong lime zone. They typically have a thin surface layer of brown, noncalcareous loam over a thick subsoil of light brown silty clay or heavy clay loam that becomes progressively more calcareous with depth. This is underlain by a pinkish-white very limy loam or gravelly loam at depths of 40 to 50 inches. The Sedillo soils resemble those of the Millett series, which is one of the major components of this association, but differ in containing much more gravel or coarse fragments and lime. These soils have very gravelly clay loam subsoils that are underlain by pinkish-gray, very gravelly sandy loam with a high content of lime. The Cabezon soils occur in those parts of this association where the soils are forming dominantly in materials of volcanic or basalt origin. These soils have a thin, dark grayish-brown, stony loam or stony clay loam surface layer that contains variable

amounts of angular and semi-rounded fragments of basalt. Their subsoils are brown, strongly calcareous, cobbly or stony clay. Basalt fragments typically increase with depth, and unweathered basalt bedrock is usually encountered within a depth of 10 to 20 inches. In addition to the lime coatings on the basalt fragments, there are slight to moderate amounts of segregated lime just above the bedrock. The Palma soils, which are deep, usually have loamy fine sand surface layers over sandy loam subsoils. The Manzano soils are deep and have a moderately thick surface layer of grayish-brown loam over a thick subsoil of dark grayish-brown clay loam. These soils usually occur in swales and narrow valley bottoms. The majority of the unclassified soils are similar to those of the Manzano series, but differ in that the subsurface layers consist dominantly of sandy loams or light loams. They occur as a complex in the form of small areas or pockets with extensive areas of other soils in this association.

Irrigation Potential. This association is dominated by class 6 land, and offers little potential for expansion of irrigation. Approximately 52 percent of the land comprising this unit is in class 6; 27 percent is in class 3; 11 percent is in class 4; and the remaining 10 percent is in class 2. Lands suitable for irrigation commonly occur interspersed with extensive areas of class 6 land. For example, the Penistaja, Silver, Lonti, and Manzano soils, which are well suited to irrigation and account for most of the class 2 land and a part of the class 3 land, occur as small and irregular tracts on alluvial fans and in valley bottoms and adjacent side slopes. The Millett and Sedillo soils, because of the gravel and cobble content, unevenness of the land surface, slope, erosion hazard, and moderate water-holding capacity, were placed in irrigation land classes 3 and 4. Although suitable for irrigation these class 3 and 4 lands have moderate to severe limitations for such use. Luzena and Cabezon soils, due to limited soil depth, low moisture-retention capacity, steep slopes, and other characteristics are not suitable for irrigation.

18. Deama-Limestone Rock Land association

This association, comprising an area of about 197,570 acres, occurs mainly in the southeastern part of the county. However, it is not limited to this part of the county as there are a number of small areas distributed throughout the northern part of the county. It includes soils and land types on gently rolling to very steep limestone hills and mountain foot slopes that occur generally at elevations ranging from about 6000 to 7000 feet. The soils, which are dominantly shallow, stony, and rocky, are generally underlain by limestone bedrock and lesser amounts of gypsiferous and other types of sedimentary rocks. Moderately deep and deep soils, however, occur to a limited extent in the swales, valley areas, and flood plains contiguous to the intermittent drainages.

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. The steep upland ridges and hills support moderate to heavy stands of pinyon and juniper trees. These decrease to thin and scattered stands on the rolling areas at the lower elevations. Shrubs of importance are beargrass, yucca, and shrub live oak. The more common grasses are blue grama, black grama, sideoats grama, galleta, sand dropseed, muhly species, tridens, three-awns, and wolftail.

Soil Characteristics. Deama soils, the most extensive in the association, commonly occur on rolling uplands. Slopes 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 of 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 and exposure of bedrock. Although it is dominated by shallow soils, small areas of moderately deep and deep soils occur interspersed with the shallow soils and rock outcrops. It commonly occurs on steep slopes, escarpments, and breaks.

Gypsum Land, an important miscellaneous land type in this association, occurs in those areas dominated by gypsiferous rock and earth. It consists of a complex of shallow soils and outcrops of gypsiferous earth. It consists of a complex of shallow soils and outcrops of gypsiferous earth and rocks. The gypsiferous materials range from a white or light gray, gypsiferous earth to hard, light colored, crystalline gypsum rocks. A thin mantle of loamy soil material commonly occurs between the outcrops.

Also included in this association are soils of Rance, Harvey, Manzano, and Penistaja soils. The Rance soils, which occur in association with Gypsum Land, consist of pale brown or light brownish-gray, shallow to moderately deep, medium-textured soils. They are underlain by gypsiferous material at a depth ranging from about 15 to 35 inches. 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 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. Penistaja soils occupy the relatively broad, gently sloping alluvial fans and valley slopes. These soils have a thin surface layer of brown, noncalcareous, fine sandy loam over a light brown or reddish, sandy clay loam subsoil. This is underlain by light reddish-brown fine sandy loam that commonly contains thin seams and small soft masses of lime in the upper part. 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. Approximately 82 percent of the land in this general soil area has been placed in class 6; 15 percent in class 3; and the remaining 3 percent in class 2. The lands classified as suitable for irrigation are widely distributed and usually occur as small tracts.

19. Rock Land-Lehmans-Lozier association

Included in this association are desert mountain ranges, isolated mountain peaks, and hills that are widely distributed throughout the central and southeastern parts of the county. It comprises approximately 241,510 acres, or about 6 percent of the county. Characteristic features of this unit are the steep to very steep slopes and shallow and rocky soils with numerous exposures of bedrock. A wide variety of bedrock types is included, with andesite, rhyolite, limestone, and sandstone being dominant.

Although it is used primarily for grazing, access for livestock to many parts of this as-

sociation is limited by steep slopes and roughness of land surface. These features also tend to restrict the density of vegetation; however, it does support a wide variety of grasses and shrubs and a few trees. Black grama, sideoats grama, blue grama, hairy grama, bush muhly, little bluestem, galleta, sand dropseed, and three-awns are the more dominant grasses. The more common shrubs and woody species include juniper, shrub live oak, wolfberry, Apache plume, yucca, and various species of cacti. A few pine and pinyon trees occasionally occur on the north and east sides of the mountains at the high elevations.

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.

The Lehmans soils are also relatively extensive in this general soil area. They occur on the moderately steep and rolling to hilly landscapes in this association. These soils usually have a thin surface layer of brown, stony loam over a reddish-brown, gravelly or stony clay subsoil. They are typically underlain by igneous bedrock within 20 inches of the surface.

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 brown or light brownish-gray, calcareous, stony loam. This is underlain by a light yellowish-brown to light brownish-gray, very strongly calcareous, stony loam. A thin layer of calcium carbonate accumulation in the form of soft masses and nodules occurs immediately above the limestone bedrock, which is usually encountered at depths ranging from about 6 to 15 inches.

Fig. 10. Rock Land-Lehmans-Lozier association (No. 19). Steep Rock Land is extensive in this association.

Also included in this association are soils of Gilland, Latom, Nickel, Luxor, and Akela 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 25 percent of the association. 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. 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. The Latom soils occur in close association with the soils of the Gilland series in the 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 soils, which

are shallow and gravelly, are underlain by gravelly caliche. The soils of Luxor and Akela series, which are also shallow, are underlain by rhyolite and basalt bedrock respectively within a depth of 10 to 20 inches.

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

20. Rock Land-Chimayo-Luzena association

This association includes the extensive areas of hilly to very steep mountain foothills and intermediate mountain areas in the western part of the county. It is widely distributed and comprises an area of approximately 502,740 acres, or about 12 percent of the county. Although there is a relatively wide range in altitude, most of this association ranges between 6000 and 7500 feet in elevation. The topography is variable and ranges from gently to strongly sloping and rolling ridge tops to steep and extremely steep mountain side slopes. Small and narrow floors below the steep mountain side slopes and canyon walls are gently to strongly sloping.

The soils, which are generally stony or gravelly and shallow, are forming dominantly in materials weathered from a wide variety of igneous rocks. Rock outcrops and some rock slides are common on the steep side slopes below upland ridges. This is suitable for a number of uses, including recreation, livestock and wildlife grazing, and watershed. These steep hilly and mountain lands support a wide variety of native vegetation including pinyon pine, juniper, tree oaks, oakbrush, and mountain mahogany. There are also a few scattered ponderosa pines, particularly on the north slopes at the higher elevations. Some of the more common grasses are blue grama, sideoats grama, squirreltail, plains lovegrass, bullgrass, mountain muhly, little bluestem, dropseed spp., Arizona cottontop, New Mexico feathergrass, and three-awns. The steep slopes, rock ledges, and escarpments tend to restrict grazing by livestock in parts of this association.

Soil Characteristics. Approximately 30 percent of this association has been included in a land type identified as Rock Land. It is characterized by numerous outcrops of bedrock and rock slides that usually occur on steep to very steep slopes. It consists of a complex of rock outcrops and shallow soils with variable characteristics. The shallow soils that are intermingled with rock outcrops, however, are generally gravelly or stony and moderately coarse- to medium-textured. Stones and boulders occur on much of the soil surface. Although the soils are usually shallow, small areas of moderately deep soils occur interspersed with the shallow soils, rock outcrops, and rock ledges. Rock slides included in this unit consist of an accumulation of rock fragments of various sizes and shapes.

Chimayo soils occur on steep mountain side slopes that range in gradient from about 30 to 75 percent. These soils typically have a thin surface layer of brown to grayish-brown, cobbly loam that is neutral in reaction. The subsurface layers are a light grayish-brown or light brown, very cobbly or very gravelly loam. This is underlain by igneous bedrock within a depth of 20 inches.

Luzena soils are shallow and moderately dark colored and are forming dominantly on acid igneous bedrock or conglomerate. They have a thin brown, noncalcareous, cobbly loam surface layer over a brown to dark reddish-brown, clay or gravelly clay subsoil. Igneous bedrock or conglomerate typically occurs within 20 inches of the surface.

Soils of the Faraway series are also relatively extensive in this association. They differ principally from the Luzena soils in lacking the clayey or fine-textured subsoil. Typically, the Faraway soils have a dark brown, neutral, very gravelly and cobbly

loam surface layer. This grades through a brown, very cobbly or very gravelly loam to the underlying, fine-grained, igneous bedrock which is usually encountered within a depth of 20 inches.

Also in this association are soils of the Santana, Apache, Cabezon, Thunderbird, and Santa Fe series. The Santana soils, which are underlain by igneous bedrock within 20 inches of the surface, have a grayish-brown, neutral to slightly acid, stony surface layer and cobbly or stony loam subsurface layers. The Apache soils have a dark grayish-brown, calcareous, stony loam surface and grayish-brown, strongly calcareous, stony loam underlying layers. Basalt bedrock typically occurs at a depth of less than 20 inches. The Cabezon soils have a surface layer of dark grayish-brown, noncalcareous, stony loam over a cobbly clay subsoil. This is underlain by basalt bedrock at depths ranging from 10 to 20 inches. The Thunderbird soils are like the Cabezon soils except they are 20 to 40 inches deep over basalt bedrock. The Santa Fe soils, which are also shallow, have dark brown, calcareous, gravelly loam or clay loam surface layers and dark reddish-brown, very gravelly, clay loam subsoils.

Fig. 11. Rock Land-Chimayo-Luzena association (No. 20) in background and Harvey-Witt-Pinon association (No. 10) in foreground.

Other soils and miscellaneous land types included in this association are unclassified deep alluvial soils, moderately deep and deep gravelly and stony soils, Rough Broken Land, and Alluvial Land. These inclusions, none of which is extensive, comprise less than five percent of the association.

Irrigation Potential. Although this is a large association, it is dominated by shallow soils and steep mountainous topography and offers little or no opportunity for development of irrigated land. Only one percent of the land in this association has been classified as suitable for irrigation. In addition to the small acreage of land involved, these irrigable lands commonly occur as small and irregular-shaped tracts.

21. Mirabal-Supervisor-Rock Land association

This association comprises the timberland in the San Mateo and Magdalena mountains at elevations ranging from about 7,500 to 11,000 feet. The topography is steep and extremely steep mountains, canyon side slopes, and strongly sloping broad ridge tops. Slope gradients range from 25 to over 100 percent. The soils are forming dominantly in parent materials weathered from rhyolite, andesite, granite, and other igneous rocks. Rock outcrops and rock slides are common. The soils are generally shallow and moderately deep and have gravelly, cobbly, and stony surface layers.

These steep and rugged mountainous lands support a wide variety of grasses, shrubs, and trees. Vegetation on the north and east aspects is dominated by a dense stand of mixed conifer and ponderosa pine; south and east aspects support an open stand of ponderosa pine, pinyon-pine, and Gambel oak, with a shrub understory. Shrubs include mountain mahogany, turbinella oak, and Fendlerbush. Forbs are asters, yarrow, pussytoes, and many others. The chief grasses are June grass, pine dropseed,

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

Soil Map Symbol and Soil Association	Dominant Slope Range (percent)	Approximate Percent of Association	Pedologic Classification		
			Subgroup	Family	Texture1
1 Gila-Vinton-Glendale					
Gila soils	0- 1	35	Typic Torrifluvent	Coarse-loamy, mixed, calcareous, thermic	loam;cl;fsl
Vinton soils	0- 1	20	Typic Torrifluvent	Sandy, mixed, thermic	fsl;lfs;loam;scl
Glendale soils	0- 1	20	Typic Torrifluvent	Fine-silty, mixed, calcareous, thermic	cl;sicl;loam;c
Armijo soils	0- 1	4	Typic Torrert	Fine, montmorillonitic, thermic	cl;clay;loam
Brazito soils	0- 1	5	Typic Torripsamment	Mixed, thermic	loam;fsl
Anapra soils	0- 1	4	Typic Torrifluvent	Fine-silty over sandy or sandy skeletal, mixed, (calcareous), thermic	cl;sicl;loam
Other soils and land types		12			
2 Bluepoint-Caliza-Rough Broken Land					
Bluepoint loamy sand	0- 5	30	Typic Torripsamment	Mixed, thermic	ls;fs;lfs
Caliza very gravelly sandy loam	0-10	30	Typic Calciorthid	Sandy-skeletal, mixed, thermic	vgsl;gsl
Rough Broken Land	15-65+	18	(A miscellaneous land type)		
Other soils and land types		22			
3 Berino-Bluepoint-Onite					
Berino soils	0- 3	33	Typic Haplargid	Fine-loamy, mixed, thermic	sl;ls
Bluepoint loamy sand	0- 5	15	Typic Torripsamment	Mixed, thermic	ls;fs;lfs
Onite loamy sand	0- 3	15	Typic Haplargid	Coarse-loamy, mixed, thermic	ls
Other soils and land types		37			
4 Nickel-Canutio-Rough Broken Land					
Nickel gravelly sandy loam	0-10	25	Typic Calciorthid	Loamy-skeletal, mixed, thermic	gsl;gl
Canutio gravelly sandy loam	5-45	20	Typic Torriorthent	Loamy-skeletal, mixed, (calcareous), thermic	gsl;gl
Rough Broken Land	15-50	20	(A miscellaneous land type)		
Other soils and land types		35			
5 Madurez-Wink					
Madurez loamy sand	0- 3	40	Typic Haplargid	Fine-loamy, mixed, thermic	lfs;fsl
Wink loamy fine sand	0- 3	30	Typic Calciorthid	Coarse-loamy, mixed, thermic	fsl;lfs
Latene loam	0- 5	7	Typic Calciorthid	Coarse-loamy, mixed, thermic	loam;fsl
Bluepoint loamy sand	0- 5	8	Typic Torripsamment	Mixed, thermic	ls;fs
Other soils and land types		15			
6 Adelino-Tome-Largo					
Adelino fine sandy loam	0- 3	25	Typic Camborthid	Fine-loamy, mixed, thermic	fsl;loam
Tome loam	0- 3	25	Typic Torriorthent	Fine-silty, mixed, (calcareous), thermic	loam;cl
Largo loam	0- 3	15	Typic Torriorthent	Fine-silty, mixed (calcareous), thermic	loam;sil
Other soils and land types		35			
7 Yesum-Marcial-Holloman					
Yesum very fine sandy loam	0- 3	30	Typic Gypsiorthid	Coarse-loamy, gypsic, thermic	vfsl
Marcial silty clay loam	0- 1	20	Typic Camborthid	Fine, illitic, thermic	sicl
Holloman loam	0- 3	20	Typic Torriorthent	Fine-loamy, gypsic, thermic, shallow	loam;vfsl
Other soils and land types		30	(Cemented caliche layers may restrict permeability)		
8 Travessilla-Encierro-Rock Land					
Travesilla stony sandy loam	5-30	20	Lithic Ustic Torriorthent	Loamy, mixed, calc., mesic	st. sl;sl
Encierro gravely fine sandy loam	15-30	20	Lithic Argiustoll	Clayey, mixed, mesic	gfsl;gl;st. l
Rock Land	20-75+	20	(a miscellaneous land type)		
Bernal loam	1-10	10	Lithic Argiustoll	Loamy, mixed, mesic	l;fsl
Other soils and land types		30			

Surface Soil Features		Subsoil Features				Soil Depth	AWHC[5]
Color[2]	Reaction	Texture[1]	Color[2]	Permeability[3]	Substratum	(inches)	(inches)
Light brownish-gray	Calcareous	loam;scl;lvfs; fsl	Pale brown and light brownish gray	Moderate	Loamy alluvium	48 to 60 or more	6 to 7
Pale brown	Calcareous	ls;lfs;sl	Pale brown and light brown	Rapid	Sandy alluvium	48 to 60 or more	3
Light brownish-gray	Calcareous	sil;sicl;cl	Pale brown and light brownish gray	Slow; some very slow	Loamy alluvium	48 to 60 or more	7 to 8
Light brownish-gray	Calcareous	clay	Light brown or pinkish-gray	Very slow	Clayey alluvium	48 to 60 or more	7 to 8
Light brownish-gray	Calcareous	sand	Light brown or pinkish-gray	Very rapid	Sandy alluvium	10 to 12 to clean sand	3
Light brownish-gray	Calcareous	sil;sicl;cl	Pale brown and light brownish gray	Slow	Sandy alluvium	20 to 40 to clean sand	4 to 6
Light brown	Weakly calc.	fs;ls	Light brown	Rapid	Sandy alluvial and eolian sediments	60 or more	2.5 to 4
Pinkish-gray	Strongly calc.	vgsl	Pinkish-white to light gray	Rapid	Gravelly alluvium	10 to 20	2
Brown to light reddish-brown	Nonoalcareous	scl	Reddish-brown	Moderate	Soft caliche and calcareous alluvium	36 to 50	5 to 6
Light brown	Weakly calc.	fs;ls	Light brown	Very rapid	Sandy alluvial and eolian sediments	60 or more	2.5 to 4
Brown to light brown	Noncalcareous	sl	Reddish-brown	Rapid	Sandy alluvium	60 or more	4
Light brownish-gray	Strongly calc.	gl;vgl	Light brown	Moderate to slow	Caliche; upper part weakly cemented	15 to 25	2
Light brown	Calcareous	vgsl;gsl	Light brown to pale brown	Rapid	Gravelly alluvium	60 or more	2.5 to 3
Light brown	Noncalcareous	scl;loam	Brown	Moderate	Limy alluvium; or soft caliche	20 to 36	3 to 5
Pale brown to brown	Strongly calc.	sl;fsl	Light brown	Moderate	Limy alluvium or soft caliche	24 to 36	2.5 to 3
Light brown	Calcareous	loam;fsl	Pinkish-white	Moderate	Limy alluvium or soft caliche	10 to 15	2 to 3
Light brown	Weakly calc.	fs;ls	Light brown	Very rapid	Sandy alluvial and eolian sediments	60 or more	2.5 to 4
Pale brown to light brown	Noncalcareous	loam	Light brown	Moderate	Loamy alluvium	60 or more	6 to 7
Pale brown	Calcareous	loam;cl	Light yellowish-brown	Moderate to slow	Loamy alluvium	60 or more	7
Light brown to reddish-brown	Calcareous	sil;loam	Reddish-brown	Moderate to slow	Loamy alluvium	60 or more	7
Light brown	Calcareous	vfsl;fsl	Light brown to pink	Moderate	Gypsiferous earth	10 to 20	1 to 3
Reddish-brown	Strongly calc.	sic;sicl	Reddish brown	Very slow	Gypsiferous sediments	40 to 60 or more	6 to 7
Pale brown	Calcareous	loam;vfsl	Light brownish-gray	Rapid	Gypsiferous earth	4 to 20	1 to 3
Light brownish-gray	Weakly calc.	st. sl;sl	Light brown	Rapid	Sandstone bedrock	8 to 20	1 to 2
Brown	Noncalcareous	cl;clay	Reddish-brown	Very slow to slow	Sandstone	10 to 20	2 to 3
Brown	Noncalcareous	scl	Brown	Moderate	Sandstone	10 to 20	2 to 3

Table 4. Continued

Soil Map Symbol and Soil Association	Dominant Slope Range (percent)	Approximate Percent of Association	Pedologic Classification		
			Subgroup	Family	Texture[1]
9 Penistaja-Pinon-Palma					
Penistaja fine sandy loam	1- 9	20	Ustollic Haplargid	Fine-loamy, mixed, mesic	fsl;vfsl
Pinon channery loam	3-25	20	Lithic Ustollic Calciorthid	Loamy, mixed, mesic	ch. l
Palma soils	0- 9	20	Ustollic Haplargid	Coarse-loamy, mixed, mesic	fsl;lfs
Other soils and land types		40			
10 Harvey-Witt-Pinon					
Harvey loam	0-10	25	Ustollic Calciorthid	Fine-loamy, mixed, mesic	loam;fsl
Witt loam	0- 8	20	Ustollic Haplargid	Fine-silty, mixed, mesic	loam
Pinon channery loam	3-25	15	Lithic Ustollic Calciorthid	Loamy, mixed, mesic	ch. l
Penistaja fine sandy loam	0- 9	10	Ustollic Haplargid	Fine-loamy, mixed, mesic	fsl;vfsl
Other soils and land types		30			
11 Deama-Harvey-Rock Land					
Deama stony loam	0-25	25	Lithic Calciustoll	Loamy-skeletal, carbonatic, mesic	st. l;co. l
Harvey loam	0-10	20	Ustollic Calciorthid	Fine-loamy, mixed, mesic	loam;fsl
Limestone Rock Land	25-65+	20	(a miscellaneous land type)		
Other soils and land types					
12 Millett-Sedillo					
Millett gravelly sandy loam	1- 5	35	Ustollic Haplargid	Fine-loamy, mixed, mesic	gsl
Sedillo very gravelly loam	1- 5	30	Ustollic Haplargid	Loamy-skeletal, mixed, mesic	vgl;gsl;gl
Leo gravelly sandy loam	0- 3	10	Typic Torriorthent	Sandy-skeletal, mixed, mesic	gsl
Other soils and land types					
13 Penistaja-Palma					
Penistaja fine sandy loam	0- 8	40	Ustollic Haplargid	Fine-loamy, mixed, mesic	fsl;vfsl
Palma loamy fine sand	0- 8	20	Ustollic Haplargid	Coarse-loamy, mixed, mesic	lfs;fsl
Valent loamy sand	0- 8	10	Ustollic Torripsamment	Mixed, mesic	ls;sand
Manzano loam	0- 2	5	Cumulic Haplustoll	Fine-loamy, mixed, mesic	loam;cl
Other soils and land types		25			
14 Lonti-Poley-Rough Broken Land					
Lonti gravelly loam	5-20	25	Ustollic Haplargid	Fine, mixed, mesic	gl;gscl;gsl
Poley gravelly loam	5-20	15	Ustollic Haplargid	Fine, mixed, mesic	gl;gscl;gsl
Rough Broken Land	10-30	25	(a miscellaneous land type)		
Silver loam	2-10	15	Ustollic Haplargid	Fine, mixed, mesic	loam
Other soils and land types		20			
15 La Fonda-Travessilla-Rock Land					
La Fonda loam	0- 9	25	Ustollic Camborthid	Fine-loamy, mixed, mesic	loam
Travessilla sandy loam	3-15	20	Lithic Ustic Torriorthent	Loamy, mixed, calcareous, mesic	sl;st. sl
Rock Land	15-65+	20	(a miscellaneous land type)		
Other soils and land types		35			
16 Chilton-Rough Broken Land					
Chilton gravelly loam	5-35	30	Ustic Torriorthent	Loamy-skeletal, mixed, (calc), mesic	gl;gsl
Rough Broken Land	20-65	30	(a miscellaneous land type)		
Lonti gravelly sandy loam	3-15	10	Ustollic Haplargid	Fine, mixed, mesic	gsl;gl;gscl
Other soils and land types		30			

Surface Soil Features		Subsoil Features				Soil Depth	AWHC[5]
Color[2]	Reaction	Texture[1]	Color[2]	Permeability[3]	Substratum	(inches)	(inches)
Brown	Noncalcareous	scl	Light brown to reddish-brown	Moderate	Eolian and alluvial sediments	60 or more	6
Brown to grayish-brown	Calcareous	ch.l	Light brown to pinkish-white	Moderate	Limestone bedrock	10 to 20	1 to 3
Brown to reddish-brown	Noncalcareous	fsl	Reddish-brown	Rapid	Sandy loam and loamy sand	60 or more	4 to 5
Light brown to grayish-brown	Calcareous	loam;scl;cl	Light brown	Moderate	Very limy loam or soft caliche	15 to 20	3 to 4
Light brown to brown	Noncalcareous	cl	Brown to reddish-brown	Slow	Calcareous alluvium	60 or more	7 to 8
Brown to grayish-brown	Calcareous	ch.l	Light brown to pinkish-white	Moderate	Limestone bedrock	10 to 20	1 to 3
Brown	Noncalcareous	scl	Light brown to reddish-brown	Moderate	Eolian and alluvial sediments	60 or more	6
Grayish-brown to brown	Calcareous	st.l	Dark grayish-brown	Moderate	Limestone bedrock	6 to 20	1 to 3
Light brown to grayish-brown	Calcareous	loam;scl;cl	Light brown	Moderate	Very limy loam or soft caliche	15 to 20	3 to 4
Reddish-brown	Noncalcareous	gscl;gcl	Reddish-brown to brown	Moderate	Very gravelly alluvium	60 or more	3 to 4
Brown	Noncalcareous	vgscl;vgcl	Reddish-brown to brown	Moderate to rapid	Very gravelly alluvium	60 or more	3
Light brownish-gray	Weakly calc.	gls;gravel	Light brown to light brownish-gray	Very rapid	Very gravelly alluvium	60 or more	2 to 3
Brown	Noncalcareous	scl	Light brown to reddish-brown	Moderate	Eolian and alluvial sediments	60 or more	6
Brown or reddish-brown	Noncalcareous	fsl	Reddish-brown	Rapid	Sandy loam and loamy sand	60 or more	4 to 5
Grayish-brown	Calcareous	fs	Pale brown	Very rapid	Calcareous sand	60 or more	2.5 to 4.0
Grayish-brown to dark brown	Noncalcareous	cl;loam	Grayish brown	Slow	Loamy alluvium	60 or more	8
Brown	Noncalcareous	gc;gcl	Reddish-brown	Very slow to slow	Calcareous gravelly alluvium	60 or more	5 to 6
Reddish-brown	Noncalcareous	gc;gcl	Reddish-brown	Slow	Weakly cemented gravelly caliche	20 to 36	4 to 4.5
Brown	Noncalcareous	clay	Light brown to brown	Slow	Loamy and gravelly sediments	60	7 to 8
Reddish-brown	Weakly calc.	loam	Light reddish-brown	Moderate	Calcareous alluvium	60 or more	5 to 7
Light brownish-gray	Weakly calc.	sl;st.sl	Light brown	Rapid	Sandstone	8 to 20	1 to 2
Brown	Noncalcareous	vgl	Light brown	Rapid	Calcareous gravelly alluvium	60 or more	2.5 to 4
Brown	Noncalcareous	gscl;gcl	Reddish brown to brown	Very slow to slow	Very gravelly, alluvium	60 or more	3 to 4

Table 4. Continued

Soil Map Symbol and Soil Association	Dominant Slope Range (percent)	Approximate Percent of Association	Pedologic Classification: Subgroup	Pedologic Classification: Family	Texture[1]
17 Luzena-Rock Land-Millet					
Luzena cobbly loam	5-35	25	Aridic, Lithic Argiustoll	Clayey, montmorillonitic, mesic	co.l;gl
Rock Land	15-75	20	(a miscellaneous land type)		
Millett gravelly sandy loam	0- 5	15	Ustollic Haplargid	Fine-loamy, mixed, mesic	gsl
Lonti gravelly loam	3-15	10	Ustollic Haplargid	Fine, mixed, mesic	gl;gscl;gsl
Other soils and land types		30			
18 Deama-Limestone Rock Land					
Deama stony loam	0-35	30	Lithic Calciustoll	Loamy-skeletal, carbonatic, mesic	st.l;co.l
Limestone Rock Land	25-65+	30	(a miscellaneous land type)		
Other soils and land types		40			
19 Rock Land-Lehmans-Lozier					
Rock Land	15-75	35	(a miscellaneous land type)		
Lehmans stony loam	10-35	20	Lithic Haplargid	Clayey, montmorillonitic, thermic	st.l
Lozier stony loam	3-35	20	Lithic Torriorthent	Loamy-skeletal, carbonatic, thermic	st.l
Other soils and land types		25			
20 Rock Land-Chimayo-Luzena					
Rock Land	30-75+	30	(a miscellaneous land type)		
Chimayo cobbly loam	30-75+	30	Lithic Ustorthent	Loamy-skeletal, mixed, non-acid, mesic	stl;col
Luzena cobbly loam	20-50	15	Lithic Argiustoll	Clayey, montmorillonitic, mesic	col;gl
Faraway very gravelly loam	25-65	10	Lithic Haplustoll	Loamy-skeletal, mixed, mesic	vgl;vcol
Other soils and land types		15			
21 Mirabal-Supervisor-Rock Land					
Mirabal cobbly loam	30-65	40	Typic Ustorthent	Loamy-skeletal, mixed, non-acid; frigid	col;gl;stl
Supervisor cobbly loam	15-60	25	Typic Cryoboroll	Loamy-skeletal, mixed	col;gsl
Rock Land	30-75+	30	(a miscellaneous land type)		
Other soils and land types		5			
22 Lava Rock Land-Graham					
Lava Rock Land	3-65+	50	(a miscellaneous land type)		
Graham stony loam	0- 9	35	Lithic Argiustoll	Clayey, montmorillonitic; thermic	st.l;st.cl
Other soils and land types		15			

[1]Abbreviations used for textural classes:

fs - fine sand	fsl - fine sandy loam	ch.l - channery loam	scl - sandy clay loam
ls - loamy sand	gsl - gravelly sandy loam	vgl - very gravelly loam	gscl - gravelly sandy clay loam
gls - gravelly loamy sand	vfsl - very fine sandy loam	st.l - stony loam	vgscl - very gravelly sandy clay loam
lfs - loamy fine sand	vgsl - very gravelly sandy loam	vst.l - very stony loam	sicl - silty clay loam
lvfs - loamy very fine sand	stsl - stony sandy loam	co.l - cobbly loam	cl - clay loam
sl - sandy loam	gl - gravelly loam	si - silt loam	st.cl - stony clay loam

Surface Soil Features		Subsoil Features				Soil Depth	AWHC[5]
Color[2]	Reaction	Texture[1]	Color[2]	Permeability[3]	Substratum	(inches)	(inches)
Brown	Neutral	st.c;gc	Dark reddish-brown	Slow	Acid igneous bedrock	10 to 20	1 to 3
Reddish-brown	Noncalcareous	gscl;gcl	Reddish-brown to brown	Moderate	Very gravelly alluvium	60 or more	3 to 4
Brown	Noncalcareous	gc;gcl	Reddish-brown	Slow	Calc. gravelly alluvium	60 or more	5 to 6
Grayish-brown to brown	Calcareous	vst.l	Dark grayish-brown	Moderate	Limestone bedrock	6 to 20	1 to 3
Brown	Noncalcareous	stc;gc	Reddish-brown	Slow	Igneous bedrock	10 to 20	2 to 3
Light brown	Calcareous	st.l;stcl	Light yellowish-brown	Moderate	Limestone bedrock	6 to 20	1 to 3
Brown to grayish brown	Neutral	col;stl	Light brownish-gray	Moderate to rapid	Acid igneous rock	15 to 20	2 to 3
Brown	Neutral	st.c;gc	Dark reddish-brown	Slow	Acid igneous bedrock	10 to 20	1 to 3
Dark brown	Neutral	vgl;vcol	Brown to dark brown	Moderate	Igneous bedrock	8 to 20	1 to 2
Grayish-brown	Neutral to slightly acid	vcol;vgl	Pale brown and brown	Rapid	Acid igneous rock and conglomerate	15 to 20	2 to 3
Dark brown	Neutral to medium acid	vcol;vgl	Pale brown to brown	Moderate	Acid igneous rock	20 to 40	4
Brown	Weakly calc.	clay;stc	Reddish-brown	Very slow	Basalt bedrock	12 to 20	3

gcl - gravelly clay loam
si.c - silty clay
vgcl - very gravelly clay loam
gc - gravelly clay
st.c - stony clay

[2]Colors are for dry soil

[3]Permeability classes and approximate rates per hour:
Very slow - less than 0.20 inches
Slow - 0.20 to 0.63 inches
Moderate - 0.63 to 2.00 inches
Rapid - 2.00 to 6.30 inches
Very rapid - more than 6.30 inches

[4]Depth in inches from surface of effective soil.

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

mountain muhly, Arizona fescue, winter bent, Kentucky bluegrass, and blue grama.

Soil Characteristics. Mirabal soils are shallow, gravelly, and cobbly forming from highly fractured igneous rocks. They have a loose mat of litter over a thick, grayish-brown, slightly acid, cobbly and gravelly loam surface layer. This grades through a pale brown to brown, very cobbly and gravelly loam to the underlying fractured igneous bedrock at a depth of about 15 to 20 inches. The soil layer immediately above the bedrock commonly contains numerous angular fragments of rock, and often contains very little soil material.

Supervisor soils, the other major component of this association, are moderately deep, dark colored, and gravelly and cobbly. These soils typically have a thick, dark brown, cobbly and gravelly loam, medium acid surface layer. A two- to three-inch layer of litter consisting of partially decomposed and undecomposed needles, leaves, and twigs commonly lies on the surface. The subsurface layers consist of a slightly acid, pale brown, very cobbly or very gravelly loam. Bedrock is usually encountered at about 30 inches, but may range in depth from 20 to 40 inches.

Rock Land, a miscellaneous land type, is also an important component of this association. It generally is steep and very steep and consists of a complex of very shallow or shallow soils, outcrops of bedrock, and rock slides. The soils occurring as small areas or pockets of soil between the outcrops of bedrock are variable. They are, however, usually stony and gravelly with varying amounts of cobble, stones, and rocks on the surface. The rock slides included in this unit usually occur on slopes that have gradients of more than 60 percent. These areas consist of an accumulation of igneous rock of various sizes and shapes that have broken loose from the exposed rock ledges and cliffs located above these rock slides.

Other soils and miscellaneous land types included in this association are deep alluvial soils, moderately deep and deep stony soils, Rough Broken Land, and Alluvial Land. These inclusions, none of which is extensive, comprise about five percent of the association.

Irrigation Potential. The lands in this association are best used for forestry, watershed, recreation, and range. They provide excellent habitat for many species of wildlife.

This association has very little or no potential for the development of irrigated land. The short growing season, rough mountainous topography, and stoniness of the soils all are adverse factors.

22. Lava Rock Land-Graham association

This association, which comprises an area of about 87,590 acres, is widely distributed throughout the eastern part of the county. Included are soils forming in materials of volcanic or basic igneous origin on lava flows. A distinctive feature is the stony soils and associated outcrops of basalt rock. These outcrops of basalt rock and associated stoniness provide a rock mantle over much of the land surface. Although there are included small areas or pockets of moderately deep and deep soils, the soils of this association are dominantly shallow and stony. The land surface on the mesa tops and lava flows is usually gently to strongly sloping, but may range from nearly level to moderately steep. The sides and fronts of the lava flows are steep to very steep.

The land types and soils of this association are used as rangeland. Runoff from exposures of basalt bedrock, boulders, and stones tends to concentrate water on adjoining soils, resulting in a complex and variable pattern of forage production. The more common native vegetation includes black grama, blue grama, tobosa, sand dropseed, spike dropseed, bush muhly, vine mesquite, and various species of shrubs.

Soil Characteristics. Lava Rock Land, a miscellaneous land type, occurs on the steep sides and fronts of lava flows, isolated basalt hills, and those areas dominated by rock outcrops. It consists of a complex of shallow stony soils and outcrops of basalt bedrock. Much of the surface between the outcrops is covered with boulders and stones. It is only slightly susceptible to erosion because the surface is protected by rocks.

Graham soils, which usually occur on the nearly level to gently sloping tops of mesas and lava flows, have a thin surface layer of brown stony loam. The subsoil is a reddish-brown clay or heavy clay loam with 10 to 25 percent basalt stones and gravel. This grades through a very stony clay loam to the underlying basalt bedrock which typically occurs within 20 inches of the surface. The basalt stones and gravels in the layers immediately above the bedrock are commonly lime-coated.

In addition to the Lava Rock Land and Graham soils, the association includes small and isolated areas of moderately deep and deep soils. They are similar to the soils of the Graham series, but differ primarily in being deeper to the underlying bedrock.

Irrigation Potential. There is essentially no potential for development of irrigated land in the areas included in this association. The small and isolated areas and pockets of moderately deep and deep soils are intermingled with large tracts of class 6 land, which will tend to preclude their use for irrigated agriculture.

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 acreages of irrigable and non-irrigable land in each of the 22 soil associations are 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.

The approximate distribution of the various land classes in Socorro County is shown on the irrigation land class map (figure 2). This map is 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. Only land classes comprising at least 15 percent or more of the area are shown 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 soil associations contain a high percentage of suitable land for irrigation:

1. Gila-Vinton-Glendale association
3. Berino-Bluepoint-Onite association
5. Madurez-Wink association
6. Adelino-Tome-Largo association
9. Penistaja-Pinon-Palma association
10. Harvey-Witt-Pinon association
12. Millett-Sedillo association
13. Penistaja-Palma association
15. La Fonda-Travessilla-Rock Land association

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

Soil Map Symbol and Soil Association	Class 1		Class 2		Class 3		Class 4		Classes 1 to 4 Total		Class 6		Grand Total[1]		Principal Limiting Factors
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	
1 Gila-Vinton-Glendale															
Gila soils	9,881		5,764		4,940		6,587		27,172		1,647		28,819		Drainage;salinity
Vinton soils					7,410		4,940		12,350		4,117		16,467		AWHC;*drainage
Glendale soils	5,764		3,294		3,294		1,647		13,999		2,470		16,469		Drainage;salinity
Armijo soils			3,294						3,294				3,294		Texture;permeability
Brazito soils							2,470		2,470				2,470		AWHC
Anapra soils			4,940						4,940				4,940		AWHC
Other soils and land types			3,294						3,294		6,587		9,881		
Total	15,645	19	20,586	25	15,644	19	15,644	19	67,519	82	14,821	18	82,340	2	
2 Bluepoint-Caliza-Rough Broken Land															
Bluepoint loamy sand							40,433		40,433				40,433		AWHC;texture
Caliza very gravelly sandy loam											40,433		40,433		AWHC;texture
Rough Broken Land											24,259		24,259		Topography and soil
Other soils and land types					10,782		4,043		14,825		14,825		29,650		
Total					10,782	8	44,476	33	55,258	41	79,517	59	134,775	3	
3 Berino-Bluepoint-Onite															
Berino soils			117,862		37,716				155,578				155,578		Topography;AWHC;erosion
Bluepoint loamy sand							70,718		70,718				70,718		AWHC;texture
Onite loamy sand					70,718				70,718				70,718		AWHC;texture
Other soils and land types					47,145		56,574		103,719		70,717		174,436		
Total			117,862	25	155,579	33	127,292	27	400,733	85	70,717	15	471,450	11	
4 Nickel-Canutio-Rough Broken Land															
Nickel gravelly sandy loam											85,011		85,011		AWHC;soil depth
Canutio gravelly sandy loam							27,204		27,204		40,805		68,009		Slope;AWHC
Rough Broken Land											68,009		68,009		Topography and soil
Other soils and land types					17,002		27,204		44,206		74,810		119,016		
Total					17,002	5	54,408	16	71,410	21	268,635	79	340,045	8	
5 Madurez-Wink															AWHC;slope
Madurez loamy sand					46,326				46,326				46,326		AWHC;slope
Wink loamy fine sand							34,745		34,745				34,745		AWHC;slope
Latene loam											8,107		8,107		AWHC;soil depth
Bluepoint loamy sand							9,265		9,265				9,265		AWHC;texture
Other soils and land types					8,107				8,107		9,265		17,372		
Total					54,433	47	44,010	38	98,443	85	17,372	15	115,815	3	
6 Adelino-Tome-Largo															
Adelino fine sandy loam			3,050		1,307				4,357				4,357		Slope
Tome loam			4,357		2,905				7,262				7,262		Erosion;overflow
Largo loam	5,809		1,452						7,261				7,261		Erosion;overflow
Other soils and land types					2,905		4,066		6,971		3,194		10,165		
Total	5,809	20	8,859	30	7,117	25	4,066	14	25,851	89	3,194	11	29,045	1	
7 Yesum-Marcial-Holloman															
Yesum very fine sandy loam											25,153		25,153		Salinity-AWHC
Marcial silty clay loam							10,061		10,061		6,708		16,769		Salinity;drainage
Holloman loam											16,769		16,769		Soil depth;salinity
Other soils and land types			5,031		12,577		3,773		21,381		3,773		25,154		
Total			5,031	6	12,577	15	13,834	17	31,442	38	52,403	62	83,845	2	

8 Travessilla-Encierro-Rock Land														
Travessilla stony sandy loam									50,884		50,884		Soil depth;AWHC	
Encierro gravelly fine sandy loam									50,884		50,884		Soil depth;AWHC	
Rock Land									50,884		50,884		Topography and soil	
Bernal loam									25,442		25,442		Soil depth;AWHC	
Other soils and land types	19,081		17,810		13,993		50,884		25,442		76,326			
Total	19,081	8	17,810	7	13,993	5	50,884	20	203,536	80	254,420	6		
9 Penistaja-Pinon-Palma														
Penistaja fine sandy loam	12,862		4,288				17,150				17,150		Slope	
Pinon channery loam									17,150		17,150		Soil depth;slope	
Palma fine sandy loam	10,290						10,290				10,290		AWHC;slope	
Palma loamy fine sand			6,860				6,860				6,860		AWHC;slope	
Other soils and land types	10,719		9,860				20,579		13,721		34,300			
Total	33,871	40	21,008	24			54,879	64	30,871	36	85,750	2		
10 Harvey-Witt-Pinon														
Harvey loam			97,859				97,859				97,859		Slope;AWHC	
Witt loam	58,715		19,572				78,287				78,287		Slope	
Pinon channery loam									58,715		58,715		Soil depth;AWHC	
Penistaja fine sandy loam	29,357		9,786				39,143				39,143		Slope	
Other soils and land types	7,829		11,743				19,572		97,859		117,431			
Total	95,901	24	138,960	36			234,861	60	156,574	40	391,435	9		
11 Deama-Harvey-Rock Land														
Deama stony loam									38,474		38,474		Soil depth;AWHC	
Harvey loam			30,779				30,779				30,779		Slope;AWHC	
Limestone Rock Land									30,779		30,779		Topography and soil	
Other soils and land types	13,080		10,004				23,084		30,779		53,863			
Total	13,080	8	40,783	27			53,863	35	100,032	65	153,895	3		
12 Millett-Sedillo														
Millett gravelly sandy loam			92,582				92,582				92,582		AWHC;texture	
Sedillo very gravelly loam					79,356		79,356				79,356		AWHC;texture	
Leo gravelly sandy loam									26,452		26,452		AWHC;gravel	
Other soils and land types	10,581		10,581				21,162		44,968		66,130			
Total	10,581	4	103,163	39	78,356	30	193,100	73	71,420	27	264,520	6		
13 Penistaja-Palma														
Penistaja fine sandy loam	27,862		6,966				34,828				34,828		Slope	
Palma loamy fine sand			17,414				17,414				17,414		AWHC;texture;slope	
Valent loamy sand					8,707		8,707				8,707		AWHC;texture;slope	
Manzano loam	4,353						4,353				4,353		Overflow;drainage	
Other soils and land types			13,061		1,741		14,802		6,966		21,768			
Total	32,215	37	37,441	43	10,448	12	80,104	92	6,966	8	87,070	2		
14 Lonti-Poley-Rough Broken Land														
Lonti gravelly loam			11,733		9,386		21,119		2,347		23,466		Slope;AWHC	
Poley gravelly loam			5,632		7,040		12,672		1,408		14,080		AWHC;soil depth	
Rough Broken Land									23,466		23,466		Topography and soil	
Silver loam	8,448		5,632				14,080				14,080		Slope	
Other soils and land types									18,773		18,773			
Total	8,448	9	22,997	25	16,426	17	47,871	51	45,994	49	93,865	2		
15 La Fonda-Travessilla-Rock Land														
La Fonda loam	25,769		17,179				42,948				42,948		Slope;erosion	
Travessilla sandy loam									34,359		34,359		Soil depth;AWHC	
Rock Land									34,359		34,359		Topography and soil	
Other soils and land types	17,180		20,616				37,796		22,333		60,129			
Total	42,949	25	37,795	22			80,744	47	91,051	53	171,795	4		
16 Chilton-Rough Broken Land														
Chilton gravelly loam									25,303		25,303		Slope;AWHC	
Rough Broken Land									25,303		25,303		Topography and soil	
Lonti gravelly sandy loam			6,326		2,109		8,435				8,435		Slope;AWHC	
Other soils and land types	1,518		6,748		2,699		10,965		14,339		25,304			
Total	1,518	2	13,074	15	4,808	6	19,400	23	64,945	77	84,345	2		

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[1]		Principal Limiting Factors
	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent	
17 Luzena-Rock Land-Millett															
Luzena cobbly loam											49,954		49,954		Soil depth-AWHC
Rock Land											39,963		39,963		Topography and soil
Millett gravelly sandy loam					22,479		7,493		29,972				29,972		AWHC;texture;slope
Lonti gravelly loam			4,996		9,991		4,995		19,982				19,982		Slope;AWHC
Other soils and land types			13,987		12,979		9,991		45,957		13,987		59,944		
Total			18,983	10	54,449	27	22,479	11	95,911	48	103,904	52	199,815	5	
18 Deama-Limestone Rock Land															
Deama stony loam											59,271		59,271		Soil depth;AWHC
Limestone Rock Land											59,271		59,271		Topography and soil
Other soils and land types			5,927		29,636				35,563		43,465		79,028		
Total			5,927	3	29,636	15			35,563	18	162,007	82	197,570	5	
19 Rock Land-Lehmans-Lozier															
Rock Land											84,529		84,529		Topography and soil
Lehmans stony loam											48,302		48,302		Soil depth;AWHC
Lozier stony loam											48,302		48,302		Soil depth;AWHC
Other soils and land types											60,377		60,377		
Total											241,510	100	241,510	6	
20 Rock Land-Chimayo-Luzena															
Rock Land											150,822		150,822		Topography and soil
Chimayo cobbly loam											150,822		150,822		Soil depth;slope
Luzena cobbly loam											75,411		75,411		Soil depth;slope
Faraway very gravelly loam											50,274		50,274		Soil depth;slope
Other soils and land types			1,005		2,514		1,508		5,027		70,384		75,411		
Total			1,005	**	2,514	**	1,508	**	5,027	1	497,713	99	502,740	12	
21 Mirabal-Supervisor-Rock Land															
Mirabal cobbly loam											66,786		66,786		Soil depth;slope
Supervisor cobbly loam											41,741		41,741		Soil depth;slope
Rock Land											50,090		50,090		Topography and soil
Other soils and land types											8,348		8,348		
Total											166,965	100	166,965	4	
22 Lava Rock Land-Graham															
Lava Rock Land											43,795		43,795		Topography and soil
Graham stony loam											30,656		30,656		Soil depth;AWHC
Other soils and land types							876		876		12,263		13,139		
Total							876	1	876	1	86,714	99	87,590	2	
Grand Total	21,454 **		435,897	10	792,764	19	453,624	11	1,703,739	40	2,536,861	60	4,240,600	100	

[1]Percent is of association except Grand Total which is percent of county.

*Abbreviation for readily available water-holding capacity.

**0.5 percent or less.

These nine soil associations (figure 1) contain slightly more than 1,236,200 acres of irrigable land, more than 72 percent of the 1,703,739 acres of Socorro County classified as irrigable. They also contain about 384,000 acres, or 84 percent, of the class 1 and 2 land.

Although each of these nine soil associations contains a high percentage of land classified as suitable for irrigation, they differ significantly in potential for expansion of irrigation. The three soils associations that offer the best possibility are the Berino-Bluepoint-Onite association, Penistaja-Pinon-Palma association, and the Penistaja-Palma association.

The Berino-Bluepoint-Onite association (No. 3), which comprises an extensive area of about 471,450 acres, is dominated by soils classified as suitable for irrigation. Approximately 33 percent of the land in this association is in class 3; 27 percent in class 4; 25 percent in class 2; and the remaining 15 percent is non-irrigable, or in class 6. These percentages indicate a possibility of developing relatively large tracts for irrigation, with little or no interspersed non-irrigable land. The association contains slightly more than 117,800 acres of class 2 land, which is well suited for use as cropland under irrigation. The class 3 and 4 land in this association has moderate to severe limitations and would need good management practices to insure moderate to high yields of adapted crops under irrigation.

There is also considerable opportunity for expansion of irrigated land in Penistaja-Pinon-Palma association. It differs, however, from the Berino-Bluepoint-Onite association in that approximately 36 percent is non-irrigable, or in class 6. The strongly sloping to rolling ridges and hills occupied by the Pinon and Chupadera soils comprise the majority of the land in class 6. Although the lands suitable for irrigation are intermingled with this class 6 land, they are generally of sufficient size to merit consideration for irrigation. In addition to the class 6 land, about 40 percent of the land in this unit is in class 2 and 24 percent is in class 3. These class 2 and 3 lands are moderately well to well suited for irrigation and generally occur in relatively large tracts that will permit their development for irrigation without including the non-irrigable land.

The Penistaja-Palma association, which occurs at an elevation of about 7000 feet, is dominated by class 3 and 2 land that is moderately well to well suited for use as cropland under irrigation. Although soil temperature and length of growing season will place some restrictions on the choice of crops that can be grown on these soils, this association has a good potential for expansion of irrigation. Approximately 43 percent of the land in this association is in class 3; 37 percent in class 2; 12 percent in class 4; and the remaining 8 percent is non-irrigable. With the application of good management practices the irrigable lands in this association should be able to support sustained irrigation.

The land in the Gila-Vinton-Glendale association (No. 1) occurs as a long relatively narrow area on the flood plain of the Rio Grande. Approximately 82 percent of the land in this association is about equally divided among irrigation land classes 1 through 4. These irrigable lands commonly occur as relatively large tracts with little interspersed non-irrigable land. The Rio Grande channel, and its immediate flood plain, together with low-lying wet lands that are located dominantly in the southern part of the unit, comprise the majority of the land classified as non-irrigable. Although a high percentage of land in this association is suitable for irrigation, there is little potential for its expansion as much of it is either already irrigated or in other uses such as urban areas, roads, and built-up areas.

The Adelino-Tome-Largo association, which comprises an area of only 29,045 acres, offers some opportunity for expansion of irrigation in this county, particularly if the irrigable land in this unit is developed in conjunction with that of adjacent Madurez-Wink

association. The major soils in this association are moderately well suited to irrigation; 30 percent of the land in the unit is in class 2; 25 percent in class 3; 20 percent in class 1; 14 percent in class 4; and the remaining 11 percent is non-irrigable, or class 6.

The Madurez-Wink association also contains a high percentage of land classified as suitable for irrigation. However, unlike the previously discussed associations, it contains a much higher percentage of class 4 land, which has a relatively low capability for irrigation. In addition to the class 4 land, which amounts to about 38 percent, 47 percent is in class 3 and 15 percent is in class 6. The irrigable land in this association, therefore, presents moderate to severe limitations for use under irrigation. The low to moderate moisture-retention capacity, unevenness of the land surface or hummocky topography, and moderate to severe wind erosion hazard were the principal reasons for placing the irrigable lands in classes 3 and 4.

The Millett-Sedillo association, like the Madurez-Wink association, is dominated by class 3 and 4 land. Approximately 39 percent is in class 3; 30 percent in class 4; 4 percent in class 2; and the remaining 27 percent is non-irrigable, or in class 6. The sandy and gravelly textures, limited moisture-retention capacity, and slope were the principal factors involved in the placement of the soils in irrigation land classes 3 and 4. Although an estimated 73 percent of the land in this association is suitable for irrigation, the potential for irrigation is not as favorable as in the previously discussed associations that have a higher percentage of classes 1 and 2 land.

The La Fonda-Travessilla-Rock Land (No. 15) and Harvey-Witt-Pinon (No. 10) also contain appreciable acreages of land classified as suitable for irrigation. These two associations, although dominated by class 6 land, contain approximately 176,755 acres of class 3 land and 138,850 acres of class 2 land. This class 3 and 2 land is moderately well to well suited for use as cropland under irrigation, but its potential for such use is restricted because of its wide distribution and the extensive areas of intermingled class 6 land. The difficulty and expense of transporting irrigation water to these scattered tracts of irrigable lands will undoubtedly tend to preclude the use of much of it for irrigation. In spite of these limitations, these two soil associations have some potential for irrigation. This is particularly true where the class 2 and 3 lands occur in relatively large tracts or adjacent to irrigable land in adjoining soil associations so that they can be economically developed for irrigation.

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 small tracts intermingled with extensive areas of non-irrigable lands. Furthermore, much of this irrigable land is in classes 3 and 4, or has a relatively low capability for irrigation.

Of the 1,703,739 acres of land in Socorro County classified as suitable for irrigation, about one percent is in class 1; 26 percent in class 2; 46 percent in class 3, and 27 percent in 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 a 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 percentages of soil material passing sieves No. 4, No. 10, and No. 200 are in the columns headed by these sieve numbers. These percentages reflect 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. Estimates are based on the texture, structure, and porosity of the soil.

Shrink-swell potential indicates the change in soil material volume to be expected 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 high-

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

[10] Waterways 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, Socorro County, New Mexico

Soil Map Symbol and Soil Association	Depth from Surface	Classification			Coarse Fraction Greater than 3 Inches	Percentage Passing Sieve-- No. 4 (4.7mm)	No. 10 (2.0mm)	No. 200 (0.074mm)	Range in Permeability	Shrink-swell Potential
		USDA texture	Unified	AASHO						
	inches				percent				in/hr	
1 Gila-Vinton-Glendale										
Gila	0-60	Loam (stratified)	ML or SM	A-4		100	100	45-75	0.63-2.00	Low
Vinton	0-10	Fine sandy loam	SM	A-2 or A-4		100	95-100	10-45	2.00-6.30	Low
	10-60	Loamy fine sand	SM	A-2		100	95-100	10-30	2.00-6.30	Low
Glendale	0-40	Clay loam	CL	A-6		100	100	80-95	0.20-0.63	Moderate
	40-60	Sandy loam to clay loam	ML or CL	A-4 or A-6		100	100	50-80	0.20-2.00	Moderate to low
Armijo	0-60	Clay	CH or MH	A-7		100	100	90-100	< 0.20	High
Brazito	0- 8	Loam	ML or SM	A-4		100	100	40-60	2.00-6.30	Low
	8-60	Sand	SP	A-3		100	100	0-5	> 6.30	Low
Anapra	0-26	Clay loam	CL	A-6		100	100	75-95	0.20-0.63	Moderate
	26-60	Fine sand	SP	A-3		100	100	0- 5	> 6.30	Low
2 Bluepoint-Caliza-Rough Broken Land										
Bluepoint	0-60	Loamy sand	SM	A-2		95-100	95-100	10-25	> 6.30	Low
Caliza	0-36	Gravelly sandy loam	GM	A-1		35-50	30-45	15-25	2.00-6.30	Low
	36-60	Very gravelly sand	GM	A-1		35-50	25-45	5-15	> 6.30	Low
Rough Broken Land	(no estimates made)									
3 Berino-Bluepoint-Onite										
Berino	0- 8	Sandy loam	SM	A-2		100	100	25-35	2.00-6.30	Low
	8-35	Sandy clay loam	SC	A-6		100	100	35-45	0.63-2.00	Low to moderate
Bluepoint	0-60	Loamy sand	SM	A-2		95-100	95-100	10-25	> 6.30	Low
Onite	0- 8	Loamy sand	SM	A-2		95-100	95-100	15-25	> 6.30	Low
	8-50	Sandy loam	SM	A-2		95-100	95-100	20-35	2.00-6.30	Low
4 Nickel-Canutio-Rough Broken Land										
Nickel	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 or A-2		35-50	30-45	15-25	0.20-2.00	Low
Canutio	0-50	Very gravelly sandy loam	GM	A-1		35-50	30-45	15-25	2.00-6.30	Low
Rough Broken Land	(no estimates made)									
5 Madurez-Wink										
Madurez	0-10	Loamy sand	SM	A-2		95-100	95-100	10-25	2.00-6.30	Low
	10-16	Sandy clay loam	SC or CL	A-6		95-100	95-100	40-60	0.63-2.00	Moderate
	16-60	Sandy loam (high lime)	SM	A-2		95-100	95-100	20-35	2.00-6.30	Low
Wink	0- 8	Loamy fine sand	SM	A-2		95-100	95-100	10-25	2.00-6.30	Low
	8-32	Fine sandy loam	SM	A-4 or A-2		95-100	95-100	25-45	0.63-2.00	Low
	32-60	Loam (high lime)	ML or SM	A-4		100	95-100	40-60	0.63-2.00	Low
Latene	0-11	Loam or fine sandy loam	ML or SM	A-4 or A-2		100	100	30-60	0.63-6.30	Low
	11-50	Gravelly loam or gravelly sandy loam	CL or SC	A-6		95-100	90-100	40-65	0.63-2.00	Low
Bluepoint	0-60	Loamy sand	SM	A-2		95-100	95-100	10-25	> 6.30	Low
6 Adelino-Tome-Largo										
Adelino	0- 4	Fine sandy loam	SM	A-2 or A-4		100	100	30-45	0.63-2.00	Low
	4-38	Loam	CL or ML	A-6 or A-4		100	100	55-75	0.63-2.00	Moderate
Tome	0-10	Fine sandy loam	ML	A-4		100	100	50-60	0.63-2.00	Low
	10-48	Very fine sandy loam	ML or CL	A-4		100	100	50-75	0.20-0.63	Low
Largo	0-60	Loam and silt loam	ML or CL	A-4 or A-6		100	95-100	65-95	0.63-2.00	Low to moderate

Table 6. Continued

Soil Map Symbol and Soil Association	Depth from Surface	Classification			Coarse Fraction Greater than 3 Inches	Percentage Passing Sieve-- No. 4 (4.7mm)	No. 10 (2.0mm)	No. 200 (0.074mm)	Range in Permeability	Shrink-swell Potential
		USDA texture	Unified	AASHO						
	inches				percent				in/hr	
7 Yesum-Marcial-Holloman										
Yesum	0-60	Very fine sandy loam; high gypsum	ML	A-4		100	95-100	30-60	0.63-2.00	Low
Marcial	0-52	Silty clay or silty clay loam gypsiferous sediments	CL or MH	A-6 or A-7		100	100	50-65	0.63-2.00	Low
Holloman	0- 9	Loam	ML or CL	A-4		100	100	60-75	0.63-2.00	Low
	9+	Gypsiferous earth								
8 Travessilla-Encierro-Rock Land										
Travessilla	0-14	Stony sandy loam	SM	A-4 or A-2	5-20	90-95	80-90	25-50	2.00-6.30	Low
	14+	Sandstone								
Encierro	0- 5	Gravelly fine sandy loam	ML	A-4	0- 5	70-85	65-85	55-75	0.63-2.00	Low
	5-15	Light clay	CL or CH	A-6	5-15	90-100	85-100	60-85	< 0.20	Moderate to high
	15+	Sandstone and shale								
Rock Land	(no estimates made)									
Bernal	0- 7	Fine sandy loam	SM or ML	A-4	0- 5	100	100	45-70	0.63-2.00	Low
	7-18	Clay loam	CL	A-6	5-10	100	100	75-90	0.63-2.00	Low
	18+	Sandstone								
9 Penistaja-Pinon-Palma										
Penistaja	0- 5	Fine sandy loam	ML or SM	A-4		100	100	45-60	2.00-6.30	Low
	5-30	Sandy clay loam	CL	A-6		100	100	50-75	0.63-2.00	Low to moderate
	30-60	Fine sandy loam	ML	A-4		100	100	50-65	0.63-2.00	Low
Pinon	0-15	Channery loam	ML or CL	A-4 or A-6	0-10	55-85	50-80	50-60	0.63-2.00	Low
	15+	Limestone bedrock								
Palma	0- 9	Loamy fine sand	SM	A-2		100	100	20-35	2.00-6.30	Low
	9-20	Fine sandy loam	SM	A-4		100	100	35-50	2.00-6.30	Low
	20-60	Sandy loam and loamy fine sand	SM	A-2 or A-4		100	100	20-50	2.00-6.30	Low
10 Harvey-Witt-Pinon										
Harvey	3-12	Loam	ML or CL	A-4 or A-6		100	100	50-60	0.63-2.00	Low
	12-27	Clay loam	CL	A-6		100	100	70-80	0.63-2.00	Moderate
	27-60	Sandy clay loam	CL	A-6		100	100	50-60	0.63-2.00	Low to moderate
Witt	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	CL	A-6		100	100	60-75	0.63-2.00	Moderate
Pinon	0-15	Channery loam	ML or CL	A-4 or A-6	0-10	55-85	50-80	50-60	0.63-2.00	Low
	15+	Limestone bedrock								
Penistaja	0- 5	Fine sandy loam	ML or SM	A-4		100	100	45-60	2.00-6.30	Low
	5-30	Sandy clay loam	CL	A-6		100	100	50-75	0.63-2.00	Low to moderate
	30-60	Fine sandy loam	ML	A-4		100	100	50-65	0.63-2.00	Low
11 Deama-Harvey-Rock Land										
Deama	0- 9	Stony loam	SM or GM	A-4 or A-2		50-70	45-65	35-50	0.63-2.00	Low
	9+	Limestone bedrock								
Harvey	3-12	Loam	ML or CL	A-4 or A-6		100	100	50-60	0.63-2.00	Low
	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
Limestone Rock Land	(no estimates made)									

Table 6. Continued

Soil Map Symbol and Soil Association	Depth from Surface	Classification: USDA texture	Unified	AASHO	Coarse Fraction Greater than 3 Inches	Percentage Passing Sieve-- No. 4 (4.7mm)	No. 10 (2.0mm)	No. 200 (0.074mm)	Range in Permeability	Shrink-swell Potential
	inches				percent				in/hr	
12 Millett-Sedillo										
Millett	0-18	Gravelly sandy clay loam	SM or SC	A-4	0- 5	85-95	70-85	35-45	0.63-2.00	Low
	18-40	Very gravelly sandy clay loam	GM	A-2	0- 5	35-50	35-50	25-35	0.63-2.00	Low
Sedillo	0-23	Very gravelly loam	GM or GC	A-2	0- 5	35-50	30-50	15-25	0.63-2.00	Low
	23-60	Very gravelly sandy loam	GW or GM	A-1	0- 5	35-45	20-35	5-15	2.00-6.30	Low
Leo	0-15	Gravelly sandy loam	SM	A-2	5-10	85-100	70-85	20-30	2.00-6.30	Low
	15-60	Very gravelly loamy sand	GM	A-1	5-15	35-50	25-50	5-15	> 6.30	Low
13 Penistaja-Palma										
Penistaja	0- 5	Fine sandy loam	ML or SM	A-4		100	100	45-60	2.00-6.30	Low
	5-30	Sandy clay loam	CL	A-6		100	100	50-75	0.63-2.00	Low to moderate
	30-60	Fine sandy loam	ML	A-4		100	100	50-65	0.63-2.00	Low
Palma	0- 9	Loamy fine sand	SM	A-2		100	100	20-35	2.00-6.30	Low
	9-20	Fine sandy loam	SM	A-4		100	100	35-50	2.00-6.30	Low
	20-60	Sandy loam and loamy fine sand	SM	A-2 or A-4		100	100	20-50	2.00-6.30	Low
Valent	0-10	Loamy sand	SM	A-2		100	100	15-30	> 6.30	Low
	10-60	Fine sand and loamy sand	SM or SP-SM	A-2 or A-3		100	100	5-30	> 6.30	Low
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
14 Lonti-Poley-Rough Broken Land										
Lonti	0- 6	Gravelly loam	ML or SM	A-2 or A-4		85-95	75-85	45-60	0.63-2.00	Low
	6-40	Gravelly clay	CL	A-7		85-95	70-85	55-65	< 0.20	Moderate
	40-60	Gravelly sandy clay loam	SC	A-4 or A-2		75-85	65-85	20-45	0.63-2.00	Low
Poley	0- 5	Gravelly loam	ML	A-4		85-95	75-85	45-60	0.20-0.63	Low
	5-28	Gravelly clay	CL	A-7		85-95	70-85	55-65	0.20-0.63	Moderate
	28+	Cobbly caliche; weakly cemented in upper part								
Rough Broken Land	(no estimates made)									
Silver	0- 3	Loam	ML	A-4		100	100	60-75	0.63-2.00	Low to moderate
	3-14	Clay	CL or CH	A-6 or A-7		100	100	85-95	< 0.20	High
	14-45	Silty clay loam	CL	A-6 or A-7		100	100	85-95	0.20-0.63	Moderate
	45-60	Loam	ML	A-6		100	100	80-90	0.63-2.00	Low to moderate
15 La Fonda-Travessilla-Rock Land										
La Fonda	0- 9	Loam	ML	A-4		100	100	60-85	0.63-2.00	Low
	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
Travessilla	0-14	Sandy loam	SM	A-4 or A-2	5-20	90-95	80-90	25-50	2.00-6.30	Low
	14+	Sandstone								
Rock Land	(A miscellaneous land type - no estimates made)									
16 Chilton-Rough Broken Land										
Chilton	0- 9	Gravelly loam	SM	A-4	0- 5	65-75	60-75	35-50	2.00-6.30	Low
	9-60	Very gravelly loam	GM	A-2		35-50	30-45	20-35	2.00-6.30	Low
Rough Broken Land	(no estimates made)									
Lonti	0- 6	Gravelly loam	ML or SM	A-4		85-95	75-85	45-60	0.63-2.00	Low
	6-40	Gravelly clay	CL	A-7		85-95	70-85	55-65	< 0.20	Moderate
	40-60	Gravelly sandy clay loam	SC	A-4 or A-2		75-85	65-85	20-45	0.63-2.00	Low

Table 6. Continued

Soil Map Symbol and Soil Association	Depth from Surface	Classification			Coarse Fraction Greater than 3 Inches	Percentage Passing Sieve-- No. 4 (4.7mm)	No. 10 (2.0mm)	No. 200 (0.074mm)	Range in Permeability	Shrink-swell Potential
		USDA texture	Unified	AASHO						
	inches				percent				in/hr	
17 Luzena-Rock Land-Millett										
Luzena	0- 5	Cobbly loam		A-4	5-15	80-95	65-85	40-50	0.63-2.00	Low
	5-15	Gravelly clay	CL	A-7	0- 5	80-95	70-90	55-65	< 0.20	Moderate
	15-20	Gravelly clay loam	SC or CL	A-6	0-10	75-90	65-85	45-55	0.63-2.00	Low
	20+	Bedrock								
Rock Land	(no estimates made)									
Millett	0-18	Gravelly sandy clay loam	SM or SC	A-4	0- 5	85-95	70-85	35-45	0.63-2.00	Low
	18-40	Very gravelly sandy clay loam	GM	A-2	0- 5	35-50	35-50	25-35	0.63-2.00	Low
18 Deama-Limestone Rock Land										
Deama	0- 9	Stony loam	SM or GM	A-4 or A-2	25-60	55-70	50-65	30-45	0.63-2.00	Low
	9+	Limestone bedrock								
Limestone Rock Land	(no estimates made)									
19 Rock Land-Lehmans-Lozier										
Rock Land	(no estimates made)									
Lehmans	0- 8	Stony loam	GM	A-2 or A-4	10-20	40-60	35-55	25-45	0.20-0.63	Moderate
	8-15	Stony clay	CL or CH	A-7	10-20	65-85	60-80	50-70	0.20-0.63	Moderate
	15+	Igneous bedrock								
Lozier	0-14	Stony loam	SM	A-4	5-20	65-85	60-80	35-45	0.63-2.00	Low
	14+	Limestone bedrock								
20 Rock Land-Chimayo-Luzena										
Rock Land	(no estimates made)									
Chimayo	0- 6	Stony loam	SM	A-4	15-25	90-100	75-85	35-45	0.63-2.00	Low
	6-18	Cobbly loam	SM	A-4 or A-2	25-35	85-95	60-85	30-45	2.00-6.30	
Luzena	0- 5	Cobbly loam	SM	A-4	20-30	80-95	65-85	40-50	0.63-2.00	Low
	5-15	Gravelly clay	CL or CH	A-7	10-20	80-95	70-90	55-65	0.20-0.63	Moderate
	15-20	Gravelly clay loam	SC or CL	A-6	15-25	75-90	65-85	50-60	0.20-2.00	
	20+	Acid igneous bedrock								
Faraway	0-20	Very gravelly loam	GM	A-2	10-20	35-50	30-45	15-25	0.63-2.00	Low
21 Mirabal-Supervisor-Rock Land										
Mirabal	0-18	Cobbly loam	SM or GM	A-2	15-35	55-75	50-70	20-35	0.63-2.00	Low
	18+	Igneous bedrock								
Supervisor	0-10	Cobbly loam	SM	A-2	5-15	90-100	75-85	25-35	2.00-6.30	Low
	10-23	Very gravelly loamy sand	GM	A-1	5-15	80-90	55-65	10-20	> 6.30	Low
	23+	Bedrock								
Rock Land	(no estimates made)									
22 Lava Rock Land-Graham										
Lava Rock Land	(no estimates made)									
Graham	0- 5	Stony loam	CL	A-4	25-50	70-85	70-85	50-65	0.63-2.00	Low
	5-16	Clay	CH	A-7	0-10	95-100	95-100	85-95	< 0.20	High
	16-20	Stony clay loam	CL	A-6	10-30	70-85	70-85	50-65	0.20-0.63	Moderate
	20+	Bedrock								

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

Soil Map Symbol and Soil Association	Suitability as a Source of -- Topsoil	Road fill	Degree of Limitation for Septic Tank Filter Fields	Corrosion Potential (untreated steel pipe)
1 Gila-Vinton-Glendale				
Gila soils	Surface 8 to 10 inches fair to good	Fair	Slight to moderate flooding may be problem	Moderate
Vinton soils	Fair; sandy and erodible; low fertility	Good	Slight	Low
Glendale soils	Poor to fair; clay loam	Poor; plastic	Severe; slow permeability	Moderate
Armijo soils	Poor; clayey	Poor; plastic	Severe; very slow permeability	High
Brazito soils	Surface 5 to 8 inches fair	Good; may need to add binder	Slight; may contaminate water supplies	Low
Anapra soils	Poor; clay loam	Poor to a depth of 20 to 36 inches; good below if soil binder added	Slight; occasional flooding; may contaminate water supplies	Low
2 Bluepoint-Caliza-Rough Broken Land				
Bluepoint loamy sand	Poor; sandy and erodible	Good	Slight	Low
Caliza very gravelly sandy loam	Poor; gravelly; low fertility	Good	Slight to moderate depending on slope	Low
Rough broken land	(interpretations not made)			
3 Berino-Bluepoint-Onite				
Berino soils	Poor;surface layers sandy loam and erodible	Fair material when mixed to a depth of about 3 feet	Moderate; moderately permeable	Moderate
Bluepoint loamy sand	Poor; sandy and erodible	Good	Slight	Low
Onite loamy sand	Poor; sandy; erodible and low fertility	Good	Slight	Low
4 Nickel-Canutio-Rough Broken Land				
Nickel gravelly sandy loam	Poor; high gravel content	Good	Slight	Low to moderate
Canutio gravelly sandy loam	Poor; gravelly and sandy	Good	Slight to severe depending on slope	Low to moderate
Rough broken land	(interpretations not made)			

Soil Features Affecting --				
		Farm ponds		
Foundation support	Highway location	Reservoir area	Embankments	Terraces, diversions, contour furrows, and pitting
Fair to good bearing capacity; stratified materials	Occasional overflow and flood hazard; other features favorable	Moderate permeability; exposed sandy strata may require sealing	Stable material when mixed and compacted	*
Good bearing capacity and low shrink-swell	Erodible when exposed on embankments	Rapidly permeable; subject to seepage	Erodible; fair stability if compacted	Erodible and permeable
Fair bearing capacity and shear strength; moderate shrink-swell	Plastic and low bearing capacity when wet	Soil features generally favorable; some sandy strsta in substratum	Clay loam material; fair stability when compacted	Clay loam material difficult to vegetate
Poor bearing capacity; high shrink-swell	Poor stability and bearing value; high shrink-swell	Good; very slowly permeable	Fair to poor stability and compaction characteristics	Subject to cracking on drying
Good bearing capacity below 10 to 12 inches if confined	Features generally favorable; some wet areas	Subject to seepage; very permeable below 10 to 12 inches	Sandy and very permeable material below 10 to 12 inches; poor stability	Sandy and very permeable below 10 to 12 inches
Good bearing capacity below 20 to 36 inches if confined	Upper 20 to 36 inches plastic	Subject to seepage; permeable below 20 to 36 inches	Upper 20 to 36 inches is clay loam; difficult to compact.	Sandy and very permeable below a depth of 20 to 36 inches; surface layers clay loam
Good bearing capacity; fair shear strength; low shrink-swell	Erodible when exposed on embankments	Very permeable; subject to seepage	Sandy, erodible and permeable material	**
Good bearing capacity; low shrink-swell	Very gravelly material; strongly sloping	Material too porous to hold water	Gravelly and very permeable	**
Good bearing capacity and shear strength; low to moderate shrink-swell	Erodible on exposed embankments; other features favorable	Moderately permeable; may require compaction	Erodible;fair stability when mixed and compacted	Surface layers sandy loam and erodible
Good bearing capacity; fair shear strength low shrink-swell	Erodible when exposed on embankments	Very permeable; subject to seepage	Sandy, erodible and permeable material	**
Good bearing capacity and shear strength; subject to wind erosion	Highly erosive when exposed on embankments; subject to wind erosion and drifting sand	Very permeable; subject to seepage	Erodible and porous	**
Good bearing capacity and shear strength; low shrink-swell	Moderately sloping; some cuts and fills	Subject to seepage; gravelly	Gravelly and cobbly material; fair stability if compacted	Moderate slopes; gravelly and cobbly material
Good bearing capacity	Rolling to moderately steep	Very permeable**	Fair stability; gravelly and permeable material	Gently rolling to steep slopes

Table 7. Continued

Soil Map Symbol and Soil Association	Suitability as a Source of -- Topsoil	Road fill	Degree of Limitation for Septic Tank Filter Fields	Corrosion Potential (untreated steel pipe)
5 Madurez-Wink				
Madurez loamy sand	Poor; sandy and erodible	Fair to good when mixed to a depth of 4 to 6 feet; subsoil layer 10-18" poor	Slight to moderate***	Moderate
Wink loamy fine sand	Poor; sandy and erodible	Upper 2 feet good; fair below	Slight to moderate***	Moderate
Latene loam	Poor	Poor to fair, unstable; high lime	Moderate; permeability	Moderate
Bluepoint loamy sand	Poor; sandy and erodible	Good	Slight	Low
6 Adelino-Tome-Largo				
Adelino fine sandy loam	Fair; moderately alkaline	Fair	Slight	Low
Tome loam	Poor to fair; low fertility	Fair	Severe; permeability	Moderate
Largo loam	Poor to fair; silty and erodible	Fair to poor	Severe; occasional overflow; moderately slow permeability	Moderate
7 Yesum-Marcial-Holloman				
Yesum very fine sandy loam	Poor; gypsiferous	Poor; high gypsum content	Severe	High
Marcial silty clay loam	Poor; clayey, saline	Poor	Severe; slow permeability	High
Holloman loam	Poor, saline and alkaline	Poor; unstable material	Severe; less than 20 inches to gypsum or gypsiferous earth	High
8 Travessilla-Encierro-Rock Land				
Travessilla stony sandy loam	Poor, stony	Fair to good; amount of material very limited	Severe; shallow to bedrock	Low
Encierro gravelly fine sandy loam	Poor; gravelly	Poor; clayey subsoil limited amount of material	Severe; sandstone and shale at 10 to 20 inches	Moderate
Rock Land	(no interpretations made)			
Bernal loam	Fair to a depth of 5 to 8 inches	Fair; limited amount of material	Severe; shallow to bedrock	Moderate

Soil Features Affecting --				
		Farm ponds		
Foundation support	Highway location	Reservoir area	Embankments	Terraces, diversions, contour furrows, and pitting
Subsoil from 4 to 24 inches has fair bearing capacity and moderate shrink-swell; good bearing capacity below 24 inches; fair to good shear strength	Sandy and erodible surface layers; limy substratum	Subject to seepage; permeable substratum	Good compaction characteristic	Limy materials in substratum; erodible and difficult to vegetate
Good bearing capacity; fair to good shear; may be necessary to confine surface layers	Erodible; some loose and drifting sand	Subject to seepage; moderate permeability	Erodible surface layers; permeable	**
Good bearing capacity	Limy and erodible material below 10 to 12 inches	Soft caliche at 10 to 12 inches; may require sealing	Exposed limy layers erodible and difficult to vegetate	Limy material erodible and difficult to vegetate when exposed
Good bearing capacity; fair shear strength; low shrink-swell	Erodible when exposed on embankments	Very permeable; subject to seepage	Sandy, erodible and permeable material	**
Fair bearing capacity and shear strength	Moderately plastic; fair stability	Sandy loam substratum layers subject to seepage if exposed	Fair stability and compaction characteristics	*
Fair bearing capacity and shear strength; moderate shrink-swell	Moderate shrink-swell	*	Fair compaction characteristics; low to moderate permeability	Slightly to moderately susceptible to erosion
Fair to poor bearing capacity and shear strength	Highly erosive when exposed on embankments; subject to occasional flooding	Moderately slow permeability; may require compaction	Erodible; unstable material; difficult to vegetate	Unstable embankments; channels subject to siltation; subject to piping
Poor to fair bearing capacity; high gypsum content	Erodible gypsiferous material	Subject to solution channels and crevices; subject to seepage	Unstable material; high gypsum content	Gypsiferous material; erodible and subject to siltation
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
Poor 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
Shallow to sandstone bedrock	Shallow to sandstone bedrock; moderate slopes; some rock outcrops	**	Amount of borrow material very limited; shallow to bedrock	**
Shallow to sandstone and shale; clayey strata have moderate to high shrink-swell	Shallow to interbedded sandstone and shale; some rock outcrops	Shallow to fractured bedrock	Limited amount of material	**
Bedrock at 1 to 2 feet	Shallow to bedrock	*	Limited amount of borrow material	*

Table 7. Continued

Soil Map Symbol and Soil Association	Suitability as a Source of -- Topsoil	Road fill	Degree of Limitation for Septic Tank Filter Fields	Corrosion Potential (untreated steel pipe)
9 Penistaja-Pinon-Palma				
Penistaja fine sandy loam	Fair; sandy loam and erodible	Fair; low to moderate shrink-swell	Slight to moderate	Moderate
Pinon channery loam	Poor; numerous coarse fragments	Fair; amount of material limited	Severe-shallow to limestone bedrock	Moderate
Palma soils	Poor; sandy and erodible	Fair	Slight to Moderate depending on slope	Low
10 Harvey-Witt-Pinon				
Harvey loam	Fair to a depth of 5 to 6 inches	Fair; low to moderate shrink-swell	Moderate***	Moderate
Witt loam	Good to a depth of 5 to 8 inches	Poor; moderate shrink-swell	Severe; moderately slow permeability	Moderate
Pinon channery loam	Poor; numerous coarse fragments	Fair; amount of material limited	Severe-shallow to limestone bedrock	Moderate
Penistaja fine sandy loam	Fair; sandy loam and erodible	Fair; low to moderate shrink-swell	Slight	Moderate
11 Deama-Harvey-Rock Land				
Deama stony loam	Poor; high content of stones	Fair; amount of material very limited; stony	Severe; shallow to limestone bedrock	Moderate
Harvey loam	Fair to a depth of 5 to 6 inches	Fair; low to moderate shrink-swell	Moderate***	Moderate
Limestone Rock Land	(interpretation not made)			
12 Millett-Sedillo				
Millett gravelly sandy loam	Poor; gravelly	Good	Slight	Low
Sedillo very gravelly loam	Poor; very gravelly	Good	Slight	Low
Leo gravelly sandy loam	Poor; gravelly	Good	Slight to moderate; some flooding hazards	Low

Soil Features Affecting --				
		Farm ponds		
Foundation support	Highway location	Reservoir area	Embankments	Terraces, diversions, contour furrows, and pitting
Fair bearing capacity and shear strength; low shrink-swell below 30 inches	Sandy loam surface layers; moderately erodible	Moderately permeable; may require compaction and sealing	Fair stability if material is mixed and compacted	Surface layers sandy and erodible
Limestone bedrock at 6 to 20 inches	Shallow to limestone bedrock; rolling to moderately steep topography	Bedrock at 6 to 20 inches**	Shallow soil; material very limited	**
Good bearing capacity; low shrink-swell	Sandy materials; subject to wind erosion	Subject to seepage; rapidly permeable	Sandy material; erodible; fair stability if mixed and compacted	Sandy and erodible surface layers**
Fair bearing capacity and shear strength; low to moderate shrink-swell	Limy material; erodible and difficult to vegetate if exposed on embankments	Exposed caliche layers may require sealing	Limy material; difficult to vegetate; fair stability if compacted	Exposed limy materials erodible
Fair bearing capacity and shear strength; moderate shrink-swell	Moderately plastic material at a depth of 8 to 36 inches; moderate shrink swell	Moderately permeable strata; may require sealing	Fair to good compaction characteristics; moderate to slow permeability	Features generally favorable; gently to strongly sloping
Limestone bedrock at 6 to 20 inches	Shallow to limestone bedrock; rolling to moderately steep topography	Bedrock at 6 to 20 inches**	Shallow soil; material very limited	**
Fair bearing capacity and shear strength; low to moderate shrink-swell	Sandy loam surface layers; moderately erodible	Moderately permeable; may require compaction and sealing	Fair stability if material is mixed and compacted	Surface layers sandy loam and erodible
Good; limestone bedrock at 6 to 20 inches	Shallow to limestone bedrock; gently sloping to moderately steep	**	**	**
Fair bearing capacity and shear strength; low to moderate shrink-swell	Limy material; erodible and difficult to vegetate if exposed on embankments	Exposed caliche layers may require sealing	Limy material; difficult to vegetate; fair stability if compacted	Exposed limy materials erodible
Good bearing capacity; low shrink-swell	Gravelly materials; some arroyos	Subject to seepage; very gravelly and permeable substratum	Gravelly material; fair stability	Gravelly materials; some arroyos
Good bearing capacity; low shrink-swell	Gravelly material; some arroyos and flooding hazard	Subject to seepage; very permeable below 2 feet	Gravelly material; fair stability	Gravelly material; some arroyos
Good bearing capacity; some overflow and flood hazards	Very gravelly material; some overflow and flood hazard	**	**	**

Table 7. Continued

Soil Map Symbol and Soil Association	Suitability as a Source of -- Topsoil	Road fill	Degree of Limitation for Septic Tank Filter Fields	Corrosion Potential (untreated steel pipe)
13 Penistaja-Palma				
Penistaja fine sandy loam	Fair; sandy and erodible	Fair; low to moderate shrink-swell	Slight	Moderate
Palma loamy fine sand	Poor; sandy and erodible	Fair	Slight to moderate depending on slope	Low
Manzano loam	Good to a depth of 8 to 12 inches	Fair to poor; moderately plastic	Severe; slow permeability; occasional flooding	Moderate
14 Lonti-Poley-Rough Broken Land				
Lonti gravelly loam	Fair to a depth of 6 to 8 inches; gravelly	Poor; clayey and plastic subsoil	Moderate; moderately permeable below 40 inches	Moderate
Poley gravelly loam	Fair to a depth of 5 to 8 inches; gravelly	Poor; clayey and plastic subsoil; fair below 30 inches	Severe; slowly permeable	Moderate
Rough Broken Land	(no interpretations made)			
Silver loam	Good to a depth of 3 to 9 inches	Poor; plastic; moderate to high shrink-swell	Severe; slow permeability	Moderate to high
15 La Fonda-Travessilla-Rock Land				
La Fonda loam	Fair; erodible	Fair	Slight to moderate; moderately permeable	Moderate
Travessilla sandy loam	Poor; some sandstone fragments	Fair to good; amount of material limited	Severe; shallow to bedrock	Low
Rock Land	(interpretation not made)			
16 Chilton-Rough Broken Land				
Chilton gravelly loam	Fair to depth of 8 to 10 inches; gravelly	Good	Moderate to severe depending on slope	Low
Rough Broken Land	(no interpretations made)			
Lonti gravelly sandy loam	Fair to a depth of 6 to 8 inches; gravelly	Poor; clayey and plastic subsoil	Moderate; moderately permeable below 40 inches	Moderate
17 Luzena-Rock Land-Millett				
Luzena cobbly loam	Poor; thin cobbly and stony surface layer	Poor; limited amount of material; plastic; cobbly	Severe; shallow to bedrock; steep	Low to moderate
Rock Land	(no interpretations made)			
Millett gravelly sandy loam	Poor; gravelly	Good	Slight to moderate depending on slope	Low

Soil Features Affecting --				
		Farm ponds		Terraces, diversions, contour furrows, and pitting
Foundation support	Highway location	Reservoir area	Embankments	
Fair bearing capacity and shear strength; low shrink-swell below 30 inches	Sandy loam surface layers; moderately erodible	Moderately permeable; may require compaction and sealing	Fair stability if material is mixed and compacted	Surface layers sandy loam and erodible
Good bearing capacity; low shrink-swell	Sandy materials; subject to wind erosion	Subject to seepage; rapidly permeable	Sandy material; erodible; fair stability if mixed and compacted	Sandy and erodible surface layers
Fair bearing capacity and shear strength; moderate shrink-swell	Moderate overflow hazard; moderately plastic	*	Fair to good stability if compacted	Features generally favorable; occasional arroyos
Fair bearing capacity and shear strength; moderate to high shrink-swell	Clayey and plastic subsoil	Subject to seepage if excavation extends below 40 inches	Clayey subsoil; poor compaction characteristics	Clayey subsoil; difficult to work and vegetate
Fair bearing capacity and shear strength; moderate shrink-swell	Cobbly caliche below 30 inches; difficult to vegetate if exposed	Subject to seepage if excavated below a depth of 30 inches	Clayey subsoil; cobbly caliche below a depth of of 30 inches	Clayey subsoil; difficult to work and vegetate
Fair to poor bearing capacity; moderate to high shrink-swell	Plastic subsoil layers	Moderately permeable below about 40 inches	Clayey material; high volume change; difficult to compact	Dense clayey subsoil; difficult to vegetate
Fair bearing capacity and shear strength	Gently to strongly sloping	Subject to seepage; some permeable layers in substratum	Fair stability; medium to high compressibility	Undulating and sloping topography; subject to channel siltation
Shallow to bedrock	Shallow to sandstone bedrock; moderate slopes; some outcrops	**	Amount of material limited; shallow to bedrock	**
Good bearing capacity	Steep slopes and rolling to hilly topography	Subject to seepage; gravelly and permeable; steep slopes	Gravelly and porous material; fair stability	Rolling to hilly topography; gravelly and permeable material
Fair bearing capacity and shear strength; moderate to high shrink-swell	Clayey and plastic subsoil	Subject to seepage if excavation extends below 40 inches	Clayey subsoil; poor compaction characteristics	Clayey subsoil; difficult to work and vegetate
Bedrock within 20 inches of surface	Rolling and hilly topography; some rock outcrops and steep breaks	**	Limited amount of material; clayey and stony	**
Good bearing capacity; low shrink-swell	Gravelly material; gently to strongly sloping; some arroyos	Subject to seepage; very gravelly and permeable substratum	Gravelly material; fair stability	Gravelly material; some arroyos; gently to strongly sloping

Table 7. Continued

Soil Map Symbol and Soil Association	Suitability as a Source of -- Topsoil	Road fill	Degree of Limitation for Septic Tank Filter Fields	Corrosion Potential (untreated steel pipe)
18 Deama-Limestone Rock Land				
Deama stony loam	Poor; high content of stones	Fair; amount of material very limited; stony	Severe; shallow to limestone bedrock	Moderate
Limestone Rock Land	(no interpretations made)			
19 Rock Land-Lehmans-Lozier				
Rock Land	(no interpretations made)			
Lehmans stony loam	Poor; stony and clayey	Poor; plastic; material very limited	Severe; shallow to bedrock	Moderate
Lozier stony loam	Poor; stony and rocky	Poor; stony and rocky; limited amount of material	Severe; shallow to limestone bedrock; steep slopes	Moderate
20 Rock Land-Chimayo-Luzena				
Rock Land	(no interpretations made)			
Chimayo cobbly loam	Poor; cobbly	Fair; moderate to high cobble content; limited material	Severe; steep slopes; shallow to bedrock	Low
Luzena cobbly loam	Poor; thin cobbly surface layer	Poor; limited amount of material; plastic; cobbly	Severe; shallow to bedrock	Low to moderate
Faraway very gravelly loam	Poor; gravelly	Fair to poor; amount of material very limited	Severe; shallow to bedrock; steep slopes	Low
21 Mirabal-Supervisor-Rock Land				
Mirabal cobbly loam	Poor; high cobble content	Fair; high content of cobble; limited amount of borrow material	Severe; steep slopes; shallow	Low
Supervisor cobbly loam	Poor; cobbly	Fair; limited amount of borrow material	Severe; steep slopes; moderately deep to bedrock	Low
Rock Land	(no interpretations made)			
22 Lava Rock Land-Graham				
Lava Rock Land	(no interpretations made)			
Graham stony loam	Poor; high stone content	Poor; plastic; high stone content; limited material	Severe; shallow to bedrock	Low

*Soil features favorable.
**Unsuitable or practice not applicable
***High lime layers may restrict the function of the filter fields over a period of time.

Soil Features Affecting --				
		Farm ponds		Terraces, diversions, contour furrows, and pitting
Foundation support	Highway location	Reservoir area	Embankments	
Good; limestone bedrock at 6 to 20 inches	Shallow to limestone bedrock; gently sloping to moderately steep	**	**	**
Shallow to bedrock	Steep slopes; rock outcrops; stony; limited borrow material	**	Limited borrow material; clayey and stony material	**
Shallow to bedrock	Steep slopes; shallow to limestone bedrock	**	Stony and rocky; limited amount of borrow material	**
Shallow to bedrock	Steep slopes and hilly topography; shallow to bedrock	**	**	**
Bedrock within 20 inches of surface	Rolling and hilly topography; some rock outcrops and steep breaks	**	Limited amount of material; clayey and stony	**
Fair bearing capacity and shear strength; bedrock within 20 inches	Steep and hilly topography; bedrock within 20 inches	Shallow to bedrock; steep slopes**	Cobbly and stony; amount of material very limited	Steep and hilly topography**
Shallow to bedrock	Steep slopes and hilly topography; shallow to bedrock	**	**	**
Moderately deep to bedrock	Steep slopes and hilly topography; moderately deep to bedrock	**	**	**
Bedrock at 12 to 20 inches; stony	High stone content and shallow to bedrock	**	**	**

ways, 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 6, on available test data, and on 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 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. These are based on the performance of the soil material when excavated and used as borrow for highway subgrade.

Septic tank filter 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.

New Mexico State University's Agricultural Experiment Station publishes many bulletins and research reports of interest to residents of New Mexico. You may obtain a copy of the latest list of such publications by contacting the County Extension Office in your county, or by writing to:

Bulletin Office
Department of Agricultural Information
New Mexico State University
Drawer 3AI
Las Cruces, New Mexico 88001